Energy and Geostrategy 2020

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Introduction

*Claudio Aranzadi**

This seventh issue of Energy and Geostrategy presents the following articles: "Strategic Rivalry between China and the USA in the Energy Area", by Isidoro Tapia; "Geopolitics in the Eastern Mediterranean: more than just gas", by Felipe Sánchez Tapia; "Security of European Electrical Systems", by Alberto Carbajo; and "Energy and Sustainability in the Defence and Security Sector. A Global, European and NATO Context", by Manuel Francisco Arribas and David Martín Borreguero.

I. Tapia, in his article, to a large extent supplementary to the one the same author wrote in "Energy and Geostrategy 2017" devoted to the US energy policy, gives a detailed examination of the current profile of the energy sector in China, after more than four decades of sharp economic growth in the country. It analyses the geopolitical impact of some of the predominant characteristics (high volume of hydrocarbon import, foreign investment strategy, energy aspect of its *Belt and Road* initiative, unexploited shale gas potential, detention of the main capacity of global production of rare earth materials required in energy transition technologies, progress with the decarbonisation technology learning curve,

* This introduction was written before the COVID-19's outbreak.

such as nuclear electricity generation, solar panels, batteries, electric cars, etc.) and China's interrelation with the USA's new energy positioning (now a net exporter of hydrocarbons and a pivotal country in the crude oil market). All of this is examined in the context of unfinished bilateral trade negotiations and the growing importance of technological competition between the two countries. F. Sánchez Tapia, analyses in his work, the complex geostrategic interrelations between political, military and energy geostrategies in a geographical area that according to the author, fits the definition of "shatterbelt" perfectly (i.e., the geographical zone that includes Egypt, Israel, Lebanon, Syria, Turkey and Greece, plus the island of Cyprus and the bottlenecks of the Strait of Suez and the Turkish Straits). The discovery of major natural gas reserves in this area has added a new conflict-triggering factor (for example, in the acceptance of the respective Exclusive Economic Zones) and of partial-interest communities (favourable, for example, in the energy field, to a greater cooperation between Egypt, Israel, Cyprus and Greece). The article also examines in detail, the different involvement strategies adopted in the area by Russia, China and the USA and the repercussions in Europe of the new scenario in the region. A. Carbajo, in his article, explains the new challenges involved in developing a security strategy in the European electrical sector. He does this by analysing the specific characteristics that from an institutional and technological viewpoint characterise the electrical sector, in its attempt to reach a particular standard of "reliability for the system"; the article also analyses the requirements stemming from technological innovation and from the perspective of the need for an energy transition aiming to the total decarbonisation of the sector. As the article points out, the major progress made in digitalisation and in European electricity market integration (with progress in national market coupling and an increase in the number of inter-connections) are, on the one hand, an efficiency and security factor, but, on the other hand, they also generate new risks and threats, which the cybersecurity strategy (that the article analyses in detail) has to deal with. Finally, M.F. Arribas and D. Martín, explain the new outlook whereby the energy and climate policy goals are integrated into the security and defence policy, going beyond the traditional perception of energy as a commodity, albeit an input that is essential for military operations. From a European perspective, one particularly enlightening aspect of the article is the author's reference to the conclusions reached by the European Council in June 2019 regarding security

and defence within the context of the European Union's Global Strategy, in which recognition is given to the results obtained by the Consultation Forum for Sustainable Energy in the Defence and Security Sector, a European Commission initiative managed by the European Defence Agency.

Since the publication of the previous issue of "Energy and Geostrategy", the energy geopolitical panorama is still dominated by the effects of the USA Government's decisions. The trade war between the USA and China, the way the Iran conflict evolves after the USA abandoned the P5+1 nuclear deal and the confirmation of US withdrawal from the Paris Agreement, are still the most outstanding occurrences on the geostrategic agenda when it comes to decision making by the major State and business agents in the global energy space, and are decisive factors in shaping the geopolitical risk as it affects the energy area. It is somehow difficult, however, to make a clear distinction between the most erratic aspects of President Trump's strategy and those that respond to a more systematic behaviour pattern (i.e. those determined by political options already announced beforehand or by interests, for example electoral, which are easier to discern), both appearing, in any case, to be mixed in his initiatives. Moreover, it is surely not possible with Trump, to rule out a degree of impulsiveness in some of his decisions designed to make a distinction between his image and that of his predecessor (with regard to his attitude to the Paris Agreement, the Nuclear Deal with Iran and, probably, the attack on General Soleimani); Trump's idiosyncratic impulses not corrected sufficiently by his institutional environment will in the future, still have an explanatory value where the US President's decisions are concerned, but carrying a high element of randomness. Yet with Trump there are also systematic patterns associated with his anti-environmentalist and protectionist ideology, and his mistrust of multilateralism and cooperation procedures; logically, the existence of those systematic patterns would make it possible to anticipate the future with greater predictive potential.

The combination of the two factors and how they affect the behaviour of the US´s highest executive are relevant when it comes to predicting the outcome of the US/Iran conflict, a very important determinant of the way the geopolitical risk develops and of the effect that this will have on the energy markets. The "maximum pressure" strategy exerted by the USA, with a further intensification of the sanctions imposed on Iran after that country's

limited response to the attack on General Soleimani, aimed at achieving a broader nuclear agreement that includes a ballistic programme for Iran and the containment of its interventionist policy in the region, does not seem to have much likelihood of success in the short term. However, regardless of its collateral effect of political destabilisation in Iran, (which is unlikely to bring about a regime change, but could lead to the unwanted effect of a regime radicalisation), the imposition of even stricter sanctions that has already had a decisive effect on production and investment in Iran's oil industry, could make itself felt in Iraq (a very serious theatre of confrontation between Iran and the USA after the recent attacks in this country, which also included the leader of the main Shiite militia in Iraq). However, as the IEA points out in its "Oil Market Report. January 2020", Iraq is now the third largest exporter in the OPEC+ and the second in the OPEC, (with oil exports of around 4 M b.d., exports having doubled in the past decade), so the multiplying effect of the global crude oil supply could be sensitive and another factor to add to other disruptions associated with the geopolitical tensions such as those that affect Venezuela and, to a lesser extent, Libya. It is true to say that the IEA predicts that the first half of 2020 will be characterised by a surplus offer of crude oil, so in the short term this political risk would not affect oil prices and would even make it unnecessary to require further reductions in the offer from the OPEP+. However, in the medium term, with the markets much tenser, such a geopolitical risk could emerge if its progress is not kept in check. This is the sense in which Trump's systematic behavioural patterns may play a role. His isolationism, his reluctance to become involved in military conflicts (which would already appear to have become apparent in his attitude to Venezuela, and his containment in the face of a possible escalation with Iran), plus electoralist considerations (Presidential Elections are due in November 2020), could contribute –at least until the elections are held and perhaps beyond- to easing the situation and lowering the political risk associated with the US-Iran conflict, certainly where the US sourcing of that risk is concerned.

Nevertheless, the utilisation of this interpretative framework leads to ambiguous forecasting with respect to the future of the trade war between the USA and China. The signing of the first phase of the trade agreement between the two countries will probably have a positive effect on world growth, (it could even decelerate the global trend towards an economic slowdown), which would mean an upward revision of the oil demand forecasts, with uncertain effects on the market (depending on the reaction from OPEP+,

the response to the tight-oil offer from the USA, etc.). Whatever the case may be, the achievements at this first phase of the trade agreement can be interpreted as a victory for Trump and a possible deceleration of the global economic downturn would undoubtedly have a positive effect on his re-election prospects. All of this should lead to a favourable position making it advisable to complete the second phase of the negotiations as soon as possible. Although, it may also occur that Trump interprets the achievements reached in this first agreement as being a demonstration of the correctness of an energy negotiation strategy contaminated by political pressure and focused on bilateralism (something that his action in relation to the WTO is demonstrating) and make him try to increase the dose at the second phase. Should this be the correct conjecture, it would not only compound the deterioration of multilateralism in the international trade order, but it could also amount to a further step in the decline of such a basic institution as the WTO. Furthermore, it is difficult to image that at this second phase of the negotiations, China would give way with any of the basic claims pending from the USA (and other countries), for example, the one concerning the use of public aid (through direct and indirect mechanisms) to become more competitive on the global markets, since it considers its State Capitalism to be a fundamental component of its institutional identity. A failure affecting the final signing of the trade agreement would probably lead to an international economic crisis.

Other events in the recent year have helped to add uncertainty to the geopolitical scenario where energy is concerned, such as the crisis in Venezuela or Libya. In Libya, where the increased presence of Russia and Turkey in the opposing sides of the civil war would appear to be adding further disturbance to the conflict, the Berlin Conference in Germany (January 2020) could prove to be a new start for the stabilisation process in the country, as long as a permanent ceasefire is reached and an embargo is imposed on military aid for the combatants. However, in Venezuela, there is great uncertainty, and this is occurring in the context of the tense political situation that is affecting most countries in Latin America.

Furthermore, in the medium- and long-term, growing attention is starting to be attached to the risk associated with climate change, which the Bank of England[1] breaks down into three types

[1] Bank of England (2015) "The impact of climate change on the U.K. insurance sector". B. of E. /Prudential Regulation Authority

(respectively linked to the physical impacts of global warming, the effects of the energy transition necessary to minimise those impacts, and the liabilities associated with the foregoing risks), all of them increasingly containing geopolitical ingredients. The Paris Agreement of December 2015 was a milestone in multilateral diplomacy (by including 195 countries as parties) that created a suitable international cooperative framework to face a negative externality on a worldwide basis, such as global warming. However, a dynamic development is required to implement the Agreement that includes procedural aspects (in which the COP 24 in Katowice, with the agreements (incomplete) concerning the Rulebook, amounted to a major step forward) and an ongoing adaptation to the new factual and technical evidence provided by the scientists who specialise in climate change. In this sense, the publication of the IPCC Report (2018)[2] is encouraging more thought to be given to a stricter application of the goals that involve the reduction of the global emissions of greenhouse gases and is also bringing to light the fact that there is an enormous gap between the emission pathways that are consistent with the current fulfilling of their national commitments by the countries that participated in the Agreement, on the one hand, and the pathway needed to achieve the goal set in Paris (aimed at achieving a global temperature growth significantly below 2 ºC and continuing efforts to limit the temperature rise to 1.5 ºC above preindustrial levels) on the other hand; this gap would be even greater if a target to reduce emissions were to be established that was more in keeping with the IPCC Report (2018), which would mean strictly adhering to the temperature increase limit of 1.5 ºC and, therefore, achieving emission neutrality (zero net emissions) by 2050. As the IPCC Report points out, the current national commitments announced until 2030, are in keeping with a temperature increase of 3 ºC, which indicates the degree of correction required in their new versions if the aim is to retake an emission reduction pathway that is compatible with the climate policy targets.

The differences between the emission reduction pathway consistent with the target of limiting the temperature to considerably below 2 ºC and the pathway that is compatible with strictly adhering to a 1.5 ºC limit, are shown in the International Energy Agency's WEO 2019[3]. In the first case, which is consistent with the

[2] Intergovernmental Panel on Climate Change (Special Report) 2018. "Global warming of 1.5 ºC".

[3] International Energy Agency. "World Energy Outlook, 2019"

strictest scenario of the WEO 2019 (Sustainable Development Scenario) in environmental terms, the pathway is defined on the basis of a temperature increase of 1.8 ºC (with 66% probability) without relying on negative CO_2 emissions, or 1.65 ºC (with 50% probability), which would lead to zero CO_2 emissions associated with energy by 2070, although the IEA considers, however, that this scenario leaves open the possibility (under the hypothesis of a negative emissions pathway in the second half of the century) that the limit of 1.5 ºC might be achieved (with a 50% probability) in 2100. Yet according to the WEO 2019, adhering to the 1.5 ºC limit without resorting to negative emissions would require a zero emission level by 2050, which the Agency estimates would amount to an annual emission reduction, as from 2018, of 13 Gt., a figure that is roughly equivalent to the emissions prevented with the closure of 299 Gw of coal based electrical generation capacity (14% of the global installed capacity with coal plants) or by replacing 40% of the passenger vehicle fleet with electric cars. Although the International Energy Agency itself points out that the strictest scenario (1.5 ºC limit) has not been analysed in detail, the preceding data included in WEO 2019, indicate that what might appear to be only a slight difference in the temperature increase limits accepted leads to significant divergence in the CO_2 emission pathways involved and that the difficulties in reaching a zero emission level by 2050 (without negative emissions) are considerable.

Even without taking into account the strictest scenario (1.5 ºC), the huge deviation of the pathway defined by the climate policies associated with the participants in the Paris Agreement from the actual targets of the Agreement, can be shown by comparing, in the WEO 2019, the Stated Policies, which show the trajectory that is in keeping with the policies announced by the countries as a whole, and the Sustainable Development Scenario, consisting of the Paris Agreement's explicit goals (temperature considerably below 2 ºC), whose bases for the purpose of definition have been mentioned in the preceding pages. Two examples, taken from WEO 2019, one concerning the oil sector and the other concerning the coal sector, are sufficient to illustrate the differences. In the first case, the IEA estimates that in the Stated Policies Scenario, the "demand peak" for crude oil will not take place before 2040 and that the global demand for oil in that year will rise to 106 M/bd., whereas the same demand in the Sustainable Development Scenario would be 67 M/bd. (less than 40 M/bd in the scenario with a strict

temperature rise limit of 1.5 ºC)[4]. That is to say, in the coming decades new policies will have to be put into practice to correct a drift that by 2040 could amount to an oil demand excess of around 40 M/bd (more than 65 M/bd in the scenario for the 1.5 ºC limit) when compared to what is required according to the climate policy goals.

The figures regarding coal based electrical generation capacity cause a similar impression. It is planned to close 600 Gw of the 2,080 Gw of global capacity currently installed, according to the Stated Policies Scenario of WEO 2019, (i.e. plants with a working life of 50 years), whereas in the Sustainable Development Scenario, there would be additional closures amounting to around 500 Gw (power plants whose working life is less than 50 years), 240 Gw would undergo a retrofit to joint combustion with biomass or the installation of CO_2 capture and confinement technology, while some 720 Gw would reduce their operation by being offered only to act as service provider for reliability and flexibility of the electrical system. Hence, almost the entire currently existing capacity of coal plants would, in the Sustainable Development Scenario, be affected by some kind of restructuring or closure. It must also be pointed out that, on the basis of the data that appear in WEO 2019, given that the global coal based generation capacity is basically in Asia (particularly China) and that in the developing countries in Asia the average age of the plants that generate electricity with coal is 12 years, these countries would find themselves seriously affected, and China and India, whose contribution to global decarbonisation is crucial, would have to cope with considerable additional restructuring demands.

The upward revision of the physical impacts of climate change (as takes place in the IPCC Reports) and the rise in the costs of mitigation associated with the severe adjustment that would have to be made to the climate policies in order to achieve the Paris Agreement targets, means an increase in the three types of climate risk indicated by the Bank of England[1]. It also means a potential redistribution of the supplementary mitigation efforts among the parties to the Paris Agreement, which would lead to complex geopolitical bartering, where the reflection on a fair energy transition, hitherto mainly focused on a domestic area, would extend and spread to the international domain (Aranzadi

[4] International Energy Agency. WEO 2016.

2019)[5]. It is true to say that a large number of countries, led by Europe, have shown that they are prepared to take on the goal of emission neutrality by 2050, but the findings of the COP25 (Chile) in Madrid (where no specific commitments were recorded for correcting the orientation of the national commitments and no agreements were reached in the development of Article 6 of the Paris Agreement) show that the industrialised countries with a political will to boost an active climate policy, under the leadership of the European Union, will have to draw up a geopolitical agenda that favours an about-turn in the position of countries like the USA, China, India, Russia, etc., all of which are major emitters and all of which have the ability to stand in the way of achieving a new and more demanding cooperation framework where global climate policy is concerned. In view of the fact that an updating of the Nationally Determined Contributions is planned to take place at the COP 26 in Glasgow (2020), the period of time for a multilateral readjustment of further efforts to reduce emissions is rather limited.

The difficulty in reaching an agreement at the COP 25 in Madrid regarding the development of Article 6 of the Paris Agreement, thus closing the Rulebook, is another indicator of the complex geopolitical challenge when it comes to drawing up new cooperative balances to progress in the instrumentation of the global climate policy. In the previous issue of Energy and Geostrategy reference was made to the interaction models between heterogeneous climate policies aimed at attaining greater global efficiency by Mehling, Metcalf and Stavins (2017)[6], an analysis that was completed by the same authors[7] with greater emphasis on the development of Article 6.2 of the Paris Agreement. As these authors point out, given the difference in the marginal costs of reducing emissions between countries and geographical areas, the transfer of mitigation efforts between countries (conducive to a process of convergence) makes it easier to achieve a reduction in the total cost of mitigation. However, Mehling[8], shows the complexity involved in designing

[5] Aranzadi C. (2019). "Lessons in the industrial restructuring policy for a fair energy transition". Energy Papers (June 2019). (Funcas)

[6] Mehling, M.A., Metcalf G.E., Stavins R.N.. "Linking heterogeneous climate policies" (WP). MIT Center for Energy and Environmental Policy Research

[7] Mehling, M.A., Metcalf G.E., Stavins R.N.. "Linking Climate policies to advance global mitigation". Science 359

[8] Mehling, M.A.. "Governing cooperative approaches under the Paris Agreement" (WP). M.I.T. Center for Energy and Environmental Policy Research.

a governance framework that minimises the loss of effectiveness associated with an insufficient guarantee of environmental integrity, loss of ambition and regulatory failures. With a transaction system involving mitigation efforts (sale of emission rights by those who are more rigorous than their commitments, and purchase of those rights by those who would not comply with them) slackness can be encouraged when undertaking mitigation commitments, although Mehling does not consider this effect to be important. However, Mehling does insist on the importance of devising a balanced regulatory framework, which prevents a possible overregulation and the consequent increase in transaction costs and investment risks.

The discussions concerning the development of Article 6 of the Paris Agreement are still open to debate, as a matter of fact they were subject to review in previous issues of "Energy and Geostrategy", regarding the respective advantages of the three main mitigation mechanisms (taxation, cap & trade, and establishing technological or operational standards); they being mainly focused on the effectiveness of the governance framework to be agreed to. Yet as Linares (2019)[9] pointed out, the redistributive aspects of the established framework are of particular importance (which amounts to a further argument in favour of a *Pigouvian* tax, given that it would permit the creation of a "double dividend" feeding for example, the Adaptation Fund), just like the attention given to other pillars of the Paris Agreement (adaptation, technology transfer and reforestation) to which less importance would be attached owing to excessive focus being given to the mitigation aspect.

It is clear that climate risk is asymmetrical. Firstly, thanks to the decarbonisation policy, the avoided social cost of the global warming (future damage, updated) is clearly greater than the costs of mitigation; in a cost-benefit analysis, the net welfare obtained by the climate policy is clearly very positive (catastrophic damage is prevented). Yet costs, both the costs associated with the physical impact of warming and also the costs of mitigation, are unequally distributed. The physical damage caused by global warming is already having very different effects in geographical areas and on population groups. Where the costs of mitigation are concerned, the asymmetries between companies and production

[9] Linares P. (2019). "Regarding the COP (III); Will there be an agreement regarding Article 6?. Economics for Energy Blog (Dec. 2019)

sectors and their time profile (the costs of mitigation concentrate on the short- and medium-term, whereas the benefits of limiting the temperature increase concentrate on the medium- and long-term) have to be added to the social and geographical asymmetries. In the latter case, (minimising the physical damage caused by the warming) the main course of action will be the horizontal adaptation policies. In the former case (correcting the asymmetrical impacts between production sectors from the mitigation policies) the most appropriate course of action should be the industrial policy.

In the oil sector, ever-increasing importance will be attached to climate risk associated with the uncertainty and cost of energy transition. It has been pointed out in previous issues of "Energy and Geostrategy" that with the estimates made by the International Energy Agency, the volume of global oil resources, in the very long term, will by far exceed the crude oil requirements in a demand scenario compatible with the decarbonisation targets of the Paris Agreement. The most obvious long-term risk would thus consist of the uncertainty regarding the schedule and the amount by which those resources will depreciate. The main sign of change, (according to Dale and Fattouh[10]) from the traditional paradigm of oil shortage to a paradigm of abundance, would be the consolidation of the expectations of a "peak demand" in the global oil market historic series. These authors agree with most analysts when they consider that it will be necessary to wait for decades for this "peak demand" to materialise (in fact, the IEA itself, in its central scenario of WEO 2019 does not expect this to take place before 2040). However, as has already been pointed out in previous paragraphs, for the IEA in its scenario compatible with the Paris Agreement targets, the "peak demand" would take place in the next few years and the oil demand in 2040 should lie between 40 and 67 M/bd (as opposed to the 106 M/bd that the Agency itself estimates for 2040 in its central scenario). This gap means that, besides a considerable inflexion of the climate policy being required, tit also serves to illustrate the great uncertainty surrounding what the long-term effects of the energy transition will be on the oil market and, thus, of the amount of long-term climate risk hanging over it.

[10] Dale S. and Fattouh B. (2018 January). "Peak oil demand and long-run oil prices". The Oxford Institute for Energy Studies".

In any event, and as Dale and Fattouh state, it is likely that countries with large volumes of resources and low production cost will postpone putting into practice a "high volume, low price" strategy consistent with the more competitive long-term scenario, and this delay will last until their diversification strategies reduce their demands for a minimum crude oil price that enables them to cope with their "social costs", a trend being maintained therefore in oil prices, in the long term, that is distant from the marginal costs of "physical" production, in the case of countries with low costs, and that is more aligned with their "social costs" of production. Nevertheless, as Fattouh, Poudineh and West[11] indicate, anticipating a scenario of abundance in the oil market is being incorporated into the assessment by investors when analysing oil project risks. According to these authors, the discount rates considered are higher and the paybacks required are shorter, which tends to bring about a shift from the phases where the production cycle risk is highest (for example, exploration) towards the less risky operations, a short-term pressure on the investment horizon, an impact on the value of the companies and an increase in the risk of insufficient investment to cover the foreseen demand.

The danger of incurring stranded investments appears minimised in recent IEA publications, mentioned in preceding issues of "Energy and Geostrategy", in the short- and medium-terms, given the need to replace exhausted wells. It is clear that with the scenarios handled by the majority of analysts (or in WEO 2019´s central scenario), a careful investment strategy could minimise the risk of stranded reserves in the short- and medium-term, and that the way crude oil prices have evolved by those horizons will continue to show a trend that is more consistent, as pointed out in previous paragraphs, with the marginal cost of production in the long-term (social), than with anticipating the status of stranded assets that some of the existing crude oil resources would be defined as. With regard to short-term price forecasts for crude oil, the recent market development demonstrates the growing complexity of the factors that determine those prices. The performance of the "fundamentals" (excess demand and marginal costs of production) is subject not only to the strategic decisions of the OPEC+ (basically Russia and above all Saudi

[11] Fattouh B., Poudineh R. and West R. (2019 January). "Energy Transition, Uncertainty, and the Implications of Change in the Risk Preferences of Fossil Fuels Investors" The Oxford Institute for Energy Studies.

Arabia) hard to define in changing environments like the current situation, but also to the responses to the market signs of tight-oil supplies from the USA, the structural, operational and financial characteristics of which are subject to debate[12] as well as to the erratic evolution of the geopolitical risk. It would seem that with this short-term horizon the effect of climate risk on oil prices would be of very little importance, but if the medium-term crude oil demand development scenarios gradually adjust to the requirements that insist on compliance with the Paris Agreement goals, the risk associated with the effects of energy transition would tend to make themselves more obvious.

Even though gas is a fossil fuel, the characteristics of the climate risk in the gas sector are very different from the ones that characterise the risk in the oil sector. Firstly, replacing coal with natural gas to generate electricity could have a significant transitory effect on the decarbonisation process in countries such as China and India, where the adjustment in the use of coal will be more radical. On the one hand, natural gas emits 40% less CO_2 than coal (20% less than oil) per unit of energy produced and, on the other hand, electrical generation accounts for 40% of natural gas consumption and 60% of coal consumption (WEO 2019), which means that the potential for replacement in terms of emission reduction is considerable; apart from the reduction of CO_2 emissions, there would also be a reduction in particle emissions, SO_2 emissions and nitrogen oxide emissions, which is a major social demand in some countries. The use of natural gas to generate electricity as a transient option will also last longer because of the electrical system's need for better reliability and flexibility offers (arising from the growing replacement of conventional generation capacity with renewable generation capacity) while the new storage technologies (especially batteries) become firmly established in terms of cost and operability and their presence increases as bidders for the services of reliability and flexibility of demand and interconnections.

Uncertainty surrounding the future of low-carbon gas (essentially a new mix containing biomethane and especially hydrogen) can be regarded as a climate risk variant inherent to natural gas. The IEA (WEO 2019) considers that there is major potential in hydrogen through its use in building, transport, industry and

[12] Fattouh B. and Economou A. (2019 November). "The Dilemma Continues: OPEC choices amidst high uncertainty". The Oxford Institute for Energy Studies

electrical generation. However, technological uncertainties still revolve around the development of the major role allocated to hydrogen in the decarbonisation policy (at least with respect to the slope of its learning curve). Hydrogen production using methane depends on the maturing of a technology such as the capture and confinement of CO_2, which has still not reached the commercial operation stage. Moreover, the production of hydrogen by electrolysis to be used in fuel cells (as an alternative to the battery-powered electric vehicle) can only be competitive if the price of electricity is sufficiently low (utilising waste in electricity production from renewable sources, for example). The option of having a "decarbonised" gas is undoubtedly an extraordinary strategic opportunity that, as the IEA points out, would pave the way for a qualitative leap in the decarbonisation policy for areas of transport or industry where so far there have been almost insurmountable technological barriers. However, a significant climate risk hovers over this alternative in the form of a technological risk.

The potential intensification of the climate risk, as is the case with the geopolitical risk, tends to bring about a decrease in the value of the assets of the agents involved in energy geostrategy (whether they are business or State stakeholders). Furthermore, with both types of risk it is difficult to formally model the causality relationship (not only the intensity but also the time lags) between the magnitude of the risk and its economic effects (relationship between geopolitical risk and oil prices is a clear example), which generally leads to qualitative appraisals. However, the characteristics of the two risk types differ in other aspects. The geopolitical risk is generally inextricably linked to a context of rivalry between States (diplomatic or military tension), whereas the climate risk is compatible with the presence of an essentially cooperative framework (like the one formed by the Paris Agreement). In the case of climate risk there are natural and technological factors that do not directly affect the geopolitical risk, although reference has already been made to the challenges of a geopolitical nature currently faced by the signatories when it comes to developing and implementing the Paris Agreement (specifically, the inevitable geopolitical bartering that will take place between the countries that are the main emitters, in order to distribute their supplementary efforts in correcting their national commitments if the intention is to achieve the climate policy goals). The European Union has to play an important role in the strategy of minimising both risks;

in this sense, it is symptomatic that two of the top priorities of the new European Union Commission are its will to strengthen the geopolitical presence of the Union and the "European Green Deal" as a guideline for its environmental strategy (basically for its contribution to the global decarbonisation policy).

Questionnaire of the Senior Vice President, Global Energy and International Affairs at IHS Markit. Mr. Carlos Pascual

What has been the combined impact of COVID-19 on global energy demand and on the oil supply surge erupting from the price war between Saudi Arabia and Russia?

Perhaps for the first time we have seen the dual impact of a collapse in oil demand combined with a supply surge driven by the price war started between Saudi Arabia and Russia. Its intent may be to cause a collapse in US oil production and to permanently damage the prospects of shale producers. But in the short term all countries may suffer.

The events launching the oil war between Saudi Arabia and Russia now seem clear. Saudi Arabia sought a cut in production of 1.5 million barrels a day. Russia did not see this cut as serving the interests of producers seeking supply growth and new investment. Russia also seemed concerned that a supply cut during a period of intense demand compression would have little impact on stabilizing prices. Russia walked out of the negotiations. Saudi Arabia slashed its Official Sales Prices and pledged to increase production to 12 million barrels a day. One result: US production in 2020 is expected to drop at least 1 million barrels a day.

The combined impact of the demand collapse and supply surge may generate an oil surplus of between 4 and 7 million barrels a day in 2020. In 1Q 2020, oil demand fell 3.9 million barrels a day. Production may increase 1 to 2 million barrels per day. Oil prices, not surprisingly, have crumbled into the USD 30 range. The stock overhang in global markets could reach a level of 700 million to 1 billion barrels. For comparison, in 2016-17 the stock overhang was 400 million barrels, and that took 2 years to work off.

Under these scenarios it is inevitable that more companies will be pressured to cut costs. Some oil producers may have to starve expensive energy diversification strategies in the short-term. The corona virus has given energy transition a new meaning.

From what we have seen lately in the most recent international forums such as COP25 held in Madrid last year or the presentations at the Davos 2020 Forum… Do you think that international negotiations are the best possible way of slowing down temperature increase? What lessons can we learn from them? What impact do these negotiations have on international relations?

The global consensus that led to the Paris Accord in 2015 has been shattered. China and the United States were at the heart of this international alignment. Europe embraced their move toward a lower carbon economy. This consensus among major actors won the support of the G77.

Today the United States and other countries are in the process of leaving the Paris Accord. China, India and most countries in South East Asia are increasing their use of coal. Moving in the opposite direction, the European Union has pledged net-zero emissions by 2050. Emerging economies are perplexed at the future direction of global climate policies and what this collapse in consensus means for them.

At the same time the world has witnessed an explosion of a bottom-up activism among states and municipalities and by environmental groups throughout the world. The financial sector is making sustainability a central factor in its investment decisions. Still, bottom-up pressures at times lead to conflicting signals in regulations and standards across sub-federal jurisdictions that may be costly to implement. Given the existential nature of climate change one would ideally have greater coherence between government federal policies and measures taken at sub-federal levels.

The lesson learned from this process is that the world needs consistent actions across three levels. The first is clarity among national government policies to send consistent market symbols and incentives to investors and operators. The second is the importance of sustained local pressure to drive politics and policy, yet ideally coordinated to achieve greater efficiency and impact. Third is the need for strong and consistent signals on investments in new technologies.

The process of innovation can take years if not decades. Investors need a clear understanding of how to focus technology investments to have the maximum impact. The world needs technology to drive the race to reduce emissions.

It is clear that different countries run at different paces and have different goals. China, India and the United States were responsible for 85% of the emission increases in 2018. What scenario will future world negotiations on climate be facing when such factors are taken into account as US withdrawal from the Paris Agreement commitments, China's reluctance to stop using coal or the fact that India finds it impossible to embark on a decarbonisation process without foreign economic aid on a large scale? Could the international pressure exerted on those countries to lower their emissions levels have negative geopolitical repercussions?

Nations make decisions based on national interests first, not necessarily on the basis of global geopolitical pressures. On climate change, national perspectives vary greatly. Europe's strong political consensus on sustainability led to the development of the Green New Deal. In the United States there's been a political battle, often emotional and generational, between those who see climate change as an existential threat and those who diminish its short-term relevance. Asia and Africa are preoccupied with the price of energy and energy access – and, in some urban centres, with pollution. In Latin America climate change has a significant impact on rainfall and the erratic supply of hydro power, but it remains far from a central focus. Taken together, we are still a long way from external geopolitical pressures changing national behaviour on climate change.

Many measures are being promoted in the financial area associated with sustainable investment in world energy

production and consumption. What impact could all these measures have?

The financial sector has the potential to stimulate a massive shift in energy investment towards sustainability. We have seen over the past months institutional and private equity investors responding to stakeholder pressures to make sustainability a central factor in their investment decisions. Investors increasingly seek to find guidance from environmental, social and governance (ESG) indices to measure how companies comply with sustainability considerations.

Still, we are not at the cusp of a revolution. Returns on renewable energy and CleanTech investments remain relatively low – at about 8 to 10%, and investors are sceptical. Until the advent of COVID-19, capital was fleeing to information technology, pharmaceuticals and consumer goods, where returns were typically 10 to 20 times greater.

Geography also matters. Asia is the only part of the world where both energy demand and GHG emissions are growing, but investors still shy away. One issue is the limited competitiveness of renewables and gas relative to coal in Asia. Investors are still looking to governments to implement policy measures (e.g., credit subsidies) to strengthen demand for cleaner fuels and clean tech investments. Solving this conundrum in Asia will be fundamental to the impact the financial sector might have on reducing emissions at a global level.

What role do you think technologies like hydrogen or the capture, transport and utilisation of carbon could play, in complying with the climate targets?

Technology is increasingly important to address climate change because states show little capacity to build a consensus on climate action through politics and diplomacy.

Studies almost unanimously demonstrate that some form of carbon capture will be necessary in order to take carbon out of industry and power system emissions. Without such capacity for carbon extraction, climate studies indicate that global temperatures will rise far higher than the targets in the Paris accord. Reducing the cost of batteries and storage is critical both for electric vehicles as well as to mitigate the intermittency of wind and solar. For Europe, where gas is the main source of heating, hydrogen is critical to finding a heating alternative that eliminates

or reduces the use of fossil fuels. Electric vehicles are high on the global agenda to reduce the demand for oil in transport, but the effectiveness of electric vehicles obviously depends on whether the electrical systems that support them can be decarbonized as well. The world still has focused little attention on decarbonizing agricultural, which accounts for about 25% of emissions, yet we know that preventing deforestation and investing in reforestation can absorb carbon out of the atmosphere.

It is undoubtedly the case, nowadays, that technology has been playing an ever-increasing role in energy transition. This means that power will now be in the hands of those who are at the technological forefront. To what extent has this fact meant a loss of geostrategic importance for Europe and the Middle East?

Technological prowess is critical to a nation's productivity, competitiveness and economic strength. But strength in technology is usually derived from a range of other factors: good economic policy, education levels and diversification of the workforce. A strong endowment of natural resources always helps. Over time, demographic factors will certainly be critical. The youth bulge in Africa, for example, could radically change Africa's position as a manufacturing hub for the world, especially if it benefits from technology imports from other countries. One also must mention external factors in this era of coronavirus, which has had a massive impact on decimating consumer demand, economic growth and supply chains. Technology is key to any country's economic future; however, technology alone is not a guarantee to economic prosperity.

The role of the United States in the energy field has changed radically over the past 10 years. The shale revolution, the lifting of the ban on oil exports and the use of gas instead of coal, have all served to make the United States a net exporter of crude oil and petroleum products. What are the geopolitical consequences of this?

The shale revolution has been transformative for the United States and the world. Perhaps most importantly, it has allowed low-cost gas to substitute for coal, reducing US GHG emissions to the levels of the 1990s. At a global level, the development of US gas supplies has helped stimulate a global LNG market with global geopolitical and economic impacts. In Europe, for

example, LNG has contributed to a competitive gas market which has forced pipeline suppliers to maintain their prices at levels consistent with global international competition. Gas today is an international commodity, whereas once regional pipelines between seller and buyer created monopoly relationships that also could convey geopolitical influence.

The ability of the United States to export oil has also become a critical economic and geopolitical factor. Today the United States, Russia and Saudi Arabia are the three largest suppliers of oil in the world. The three have reshaped the dynamics of the global oil market. The US role in global oil markets departs significantly from Russia and Saudi Arabia. The US government is not making decisions on production. Rather, thousands of producers make decisions based on their economic incentives.

Even with the emergence of the United States as a net oil and gas exporter, it is important to remember that oil and gas are global commodities. No individual country dominates these markets. Changes in demand and supply conditions can affect all countries, even when they are net exporters. The corona virus crisis has been a painful reminder that the contraction of global economic demand can affect all countries, no matter how significant their resources or the strength of their internal fundamentals.

After the Trade Agreement between the Governments of China and the United States was reached on 15th January 2020… How has the reciprocal tariff system been established, given that this was a key tool used in the Trade War between the two largest economies in the world? How could this matter evolve? How will the geopolitical balances between Asia and America be affected by it?

The Phase One Agreement between the US and China was based on the near-term commercial interests of both countries. For the United States the trade war with China had destabilized domestic equity markets, affecting pensioners across the United States in an election year, and had begun to disrupt supply chains throughout the country. For China, the tariffs imposed by the United States had a major impact on its capacity to export to the world's major import market. For the United States, a major consideration was the potential impact of a trade war on the U.S elections. Certainly, President Trump had little interest in seeing import tariffs affect consumer pocketbooks just before the elections.

Ironically, and tragically, the advent of COVID-19 has had a much more destructive impact on China and the United States than the trade war. The current compression of economic demand has reached every country in the world, decimating the oil market, destroying equity values, and overtaxing the capacity of health systems to care for those infected. It is unlikely that either the United States or China will be able to meet the commitments that have been made under the Phase One Agreement given these conditions. Yet non-compliance is unlikely to set off another trade war. The issue today is recovery from the impact from COVID-19. The reality for tomorrow is that the tensions between the United States and China -- cyber warfare, intellectual property rights, the South China Sea, and the battle for global influence that is reflected in China's Belt and Road Initiative – will be postponed until after the U.S presidential elections.

Over the long run, both the United States and China need each other. China needs the United States as a market for its products. The Chinese economy is oriented towards international engagement and trade. It simply cannot live without access to the largest economy in the world. For the United States, China has proven itself as a critical (and hard to replace) element of the global supply chain. Both countries will continue to face incentives to reduce their dependence on one another. Still, both will have to contend with the interdependence to which they seem destined. Their futures will not be devoid of conflict, but they will seek some form of coexistence despite the tensions which underlie the relationship.

Approximately 70% of rare earth element extraction takes place in China (the country also possesses 37% of the world's reserves). In view of the importance of these metals to the technological sector… How important is this to the "Trade War" between China and the United States? How would an increase in the price of these chemical elements affect the final cost of the products that contain them (in small quantities) if the Asian giant were to take advantage of its position to block this market? To what extent might this affect the end consumer?

The issue of supply chains for rare earths and other precious minerals is a matter of global importance. China is at the centre of this equation because of its supply of 70% of the world's rare earths. Congo is another example of a critical country that

supplies 80% of the world's cobalt. Such concentration can create vulnerability in global supply chains. China could use its control over these resources to advance its competitive position as a manufacturer. A second factor plays into the wider human rights agenda if countries and companies feel that they cannot honestly address China's domestic political practices.

Despite all these points, there is one final consideration that is critical: China is an exporting nation. It needs access to the world's largest economies and in particular, access to the American economy. That will always be a constraining factor on how it behaves internationally. That does not mean that China, the United States, and other countries will necessarily agree on key issues related to trade, security, and human rights, but it does suggest that they have a mutual incentive to coexist and find a way to work with each other within a global environment rather than be in a constant state of conflict.

The two leading energy superpowers, China and the United States, are still opting for coal as one of the key primary energy sources in their energy mixes. Is this due to supply security reasons, competitiveness or both?

A common factor in the continuing use of coal by China and the United States is employment. Significant population concentrations in both countries have few economic alternatives and, hence, federal governments maintain an incentive to use coal in order to protect jobs in those regions.

There are, however, potentially larger factors. In China, a key consideration has been the cost of producing energy and its impact on China's competitiveness as an international manufacturer. For China, energy security is also a factor. Coal is readily abundant nationally; China's imports of oil and gas expose it to international risks.

Coal in the United States has been propped up by political considerations. There are important political constituencies in support of coal in states like West Virginia, Kentucky, Pennsylvania, and Ohio which can play an important role in American politics, particularly presidential elections.

A differentiating factor for the United States has been shale gas. Natural gas in the United States is cheaper than coal and has become the dominant fuel used in power generation. In the end, national economic considerations may be the most important

driver of the fuel sources used in any country. In the United States, natural gas has been, relative to coal, cheaper and cleaner. That has made it the leading source of power generation in the country.

Europe is trying to become the first continent to neutralise its emissions for 2050. It recently presented its European Green Deal, not only as a climate strategy but also as the EU´s Economic Strategy. How compatible is economic development with decarbonising the economy? What factors must not be forgotten if Europe is to succeed? Do you think that any other region may follow Europe down the same path?

Europe's Green New Deal provides an aspirational opportunity to transform its energy, industrial, and agricultural sectors to advance sustainability. No other continent has taken on this challenge on such a global scale. Inevitably, this ambition is going to create challenges.

To achieve net-zero emissions by 2050, many of Europe's challenges will not be unique, but they may be unprecedented in scale and urgency to achieve its goals: balancing intermittency in the generation of solar and wind energy power, limited competitiveness of storage solutions to reduce intermittency, replacing gas with a carbon-free fuel for heating, creating a carbon market that incentivizes sustainability but does not reduce national competitiveness.

On a system-wide basis, a net-zero target could increase the overall cost of supplying energy throughout Europe, at least in a transition phase, with a negative impact on industry, workers and consumers. In some cases, industries may move to seek a more competitive economic climate. All of these factors can have an impact on national employment. Europe must also be sensitive to supply chains for the inputs required to produce critical CleanTech products.

These challenges do not diminish the importance of pursuing Europe's commitment to net zero emissions. However, it will be important to approach these issues through a strong partnership between government and industry to ensure that solutions are effective, competitive, and can achieve the intended results.

What is your opinion about the interest shown by some countries, such as the United States or Russia, in exploiting

the natural resources underlying the Arctic permafrost? How do you think world´s governance will evolve in this matter, bearing in mind the positions adopted by the different superpowers?

The exploitation of the Arctic poses a major challenge on climate change and international security. Many parts of the Arctic are navigable today that could not be transited ten years ago. There are widespread concerns that this exploitation will accelerate climate change. There are also competitive issues related to the Artic. It continues to remain one of the highest cost areas for the extraction of natural resources. Exploitation of Artic resources may require national subsidies; to the extent non-market economies can hide these subsidies, unfair competitive advantages could appear.

For decades, access to Arctic territory has posed questions of sustainability and security that have drawn the attention of the world's major powers. Governance over these challenges has been the responsibility of the Arctic Council. The Artic Council is an autonomous, high-level intergovernmental forum that provides a means to address common concerns across Arctic States. This cooperation includes the eight Arctic States: Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States, along with six Indigenous peoples' organizations and around 40 non-Artic States and international organizations holding Observer status. Its mandate focuses on protection of the Arctic Environment and sustainable development. No organization is specifically responsible for Arctic security issues, such as the transit of nuclear submarines.

A key challenge for an organization such as the Arctic Council will be whether it can maintain honesty, transparency, and enforceability on its policies, especially at a time of significant tensions between the United States and Russia and between the United States and China. These tensions have caused a collapse of US-Russia arms control agreements, and China has refused to consider Strategic Arms Reduction Talks, which could lead the US and Russia to allow the current START Treaty to expire. Without an effective global framework on nuclear arms control, that will only complicate potential issues on Arctic security.

It is positive for the world that the Arctic Council exists and provides mechanisms for dialogue on critical issues that need to be resolved on a global basis. However, at a time when international

organizations are under stress it would be unrealistic to believe that the Arctic Council, or any other multilateral mechanism, will be able to effectively control conflicting national interests in the Arctic if nations decide to put their individual security or commercial interests above international norms.

Little is said about Africa, but... What role will this continent play in the world´s energy scenario?

Demographics will begin to change the world's perception of Africa. In 2050, Africa will have the world's largest number of young people, making up nearly twice the young population of South Asia, Southeast Asia, East Asia and Oceania. Such demographics will make sustainable development in Africa critical to global economic growth. Africa could potentially become the world's future manufacturing hub and would require significant changes in global trade patterns and supply chains. Climate change risks will also increase. Desertification will have an impact on health and migration out of Africa. That migration will directly have an impact on Europe.

Given Africa's growing population there will be international pressure to help Africa grow without putting greater pressure on global emissions. Yet within Africa, the focus will be on energy access and the cost of energy in order to stimulate Africa's economic development. In some parts of the world gas is seen negatively because of its GHG emissions, even if they are far less than coal. Within Africa, many countries see gas as an alternative to desertification that is accelerated by the use of wood and biomass for cooking. Natural gas can also be a substitute for diesel fuel, which is far more expensive than gas and with far higher emissions. The future of oil in Africa will inevitably be determined by global markets. Eventually the world will face peak demand for oil. At that point the world's most competitive suppliers will continue to capture consumer markets. As painful as it may be for some African countries to lose market share, competitive economics will determine new market realities.

Africa's future is potentially bright. Many countries have shown that they can introduce new policies which advance economic prosperity, educational access and quality, and access to energy. Africa faces a huge education problem in order to ensure that its burgeoning work force will be able to supply international supply chains. Energy is a key factor in this equation for success. To be sure, Africa would ideally meet a significant share of its

energy demand through renewable or low carbon sources. Gas should not be dismissed as an important fuel within Africa that would help address significant sustainability challenges such as desertification and the excessive consumption of diesel fuel.

Chapter one

Strategic rivalry between China and the U.S. in the area of energy

Isidoro Tapia Ramírez

Abstract

A growth in demand has made China the world's largest energy consumer, and this is having major geopolitical consequences. China now occupies a key place in regions such as West Africa, Central & South America and the Middle East, where the country is now taking over the role traditionally played by the USA, as Chinese growth is combining with the USA´s withdrawal from those regions, after having become self-sufficient in petroleum by-products.

The geopolitical transition is also coinciding with developments in the energy sector, which is moving towards systems where technology is playing a greater part, to the detriment of primary resources, a move towards renewable energies and away from fossil fuels, and a greater weight of electricity in the energy mix. Risk analyses examining these changes are often too optimistic. Apart from the transitional effects, shifts in the energy paradigm will have major geopolitical effects, which will make the risks different rather than lower.

Relations between China and the USA are analysed within this new paradigm, not only in the energy sector but also in its

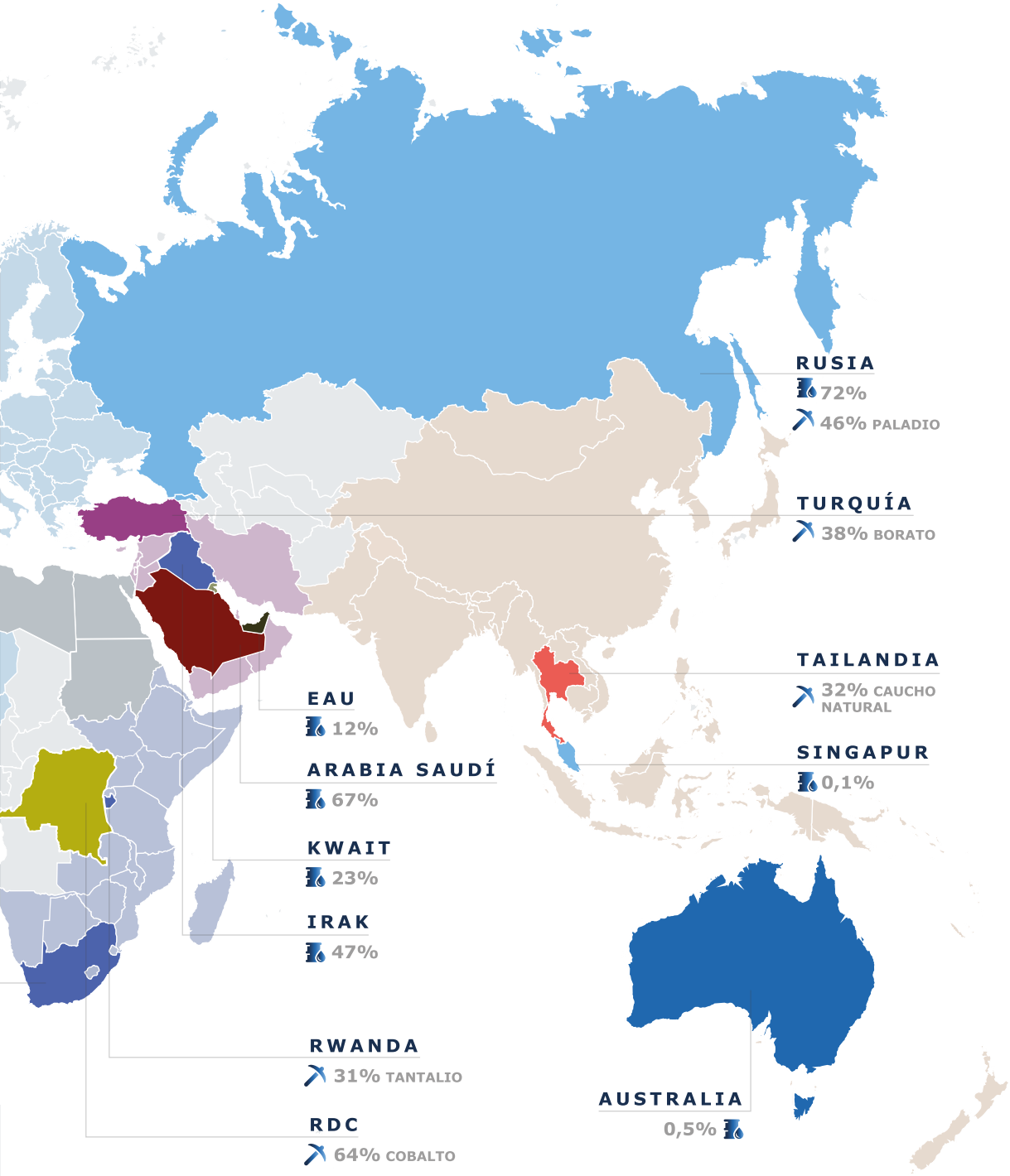
numerous subsectors (oil, natural gas, renewable energies or interconnection infrastructures, in the context of the «Belt and Road Initiative»). The crises induced by the Covid-19 outbreak could accelerate some of these geopolitical shifts and slowdown others.

The fact that energy systems are evolving at the same time as the most far-reaching geopolitical transition in the past century occurs, means that the coming decades will be a period of major historical importance. Despite what the prophets of doom might say, the crossroads we are now standing at constitute a challenge that is more formidable than ever before.

Keywords

Geopolitics, energy security, unconventional hydrocarbons, China, the United States, renewable energy, the Middle East, Donald Trump, Xi Jinping.

IMPORTANCIA DE CHINA EN LOS MERCADOS DEL PETRÓLEO Y MINERALES DE TIERRA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AUSTRALIA
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First part - China: a map of energy resources

Introduction

It hardly seems necessary to dwell on China's importance on the world geopolitical map. The country's 1,400 million inhabitants and over 140 cities with a population of more than one million, make it the second largest economy in the world[1]. Since its economy opened up towards the end of the 1970s, China's GDP growth rate has been, on average, 10 %/year, and it has been calculated that during this period more than 850 million people, almost 60 % of China's population, have lifted themselves out of poverty[2].

China's importance is greater still in the energy sector. Since 2009, China has become the main energy consumer in the world[3]. **While China's GDP accounts for 16.2 % of the world total[4] and its population amounts to 18.3 %[5], its primary energy consumption stands at 23.6 % and its CO_2 emissions come to 27.2 %**[6]. In fact, in some subsectors these percentages are even higher: China is responsible for consuming more than 50 % of the world's coal and is also the world's biggest importer of crude oil, as well as being the second largest consumer of that fuel, after the USA.

To put it another way: in geopolitical terms, the Chinese energy sector is one decade ahead, in the sense that if current trends continue, China has the weight that will be due to it in the rest of the economic sectors by 2030.

Rapid growth is one of the most outstanding features of the Chinese energy sector. Between 2000 and 2018, the total primary energy demand increased by nearly 175 %, at an annual rate of around 6 %[7]. However, this was below the average growth rate of the economy, 10 %.

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1 According to October 2019´s WEO issued by the IMF, in 2019 China's GDP amounted to 14.1 billion dollars at current rates, compared to the USA's 21.4.

2 https://www.worldbank.org/en/country/china/overview

3 According to the BP Statistical Review 2019, primary energy consumption in China rose to 3,273.5 Mtoe, compared to 2,300.6 in the USA, the second biggest consumer.

4 IMF, World Economic Outlook 2019, in current currency.

5 World Bank.

6 /https://www.weforum.org/agenda/2019/06/chart-of-the-day-these-countries-create-most-of-the-world's-co2-emissions

7 International Energy Agency, World Energy Outlook 2017 and 2019.

The growth rate has stood out in nearly all the energy subsectors. China has become the world's biggest importer of crude oil, and the fourth biggest importer of natural gas. In the electrical sector, China accounted for more than 40 % of the growth in installed capacity during the past decade, with an average of 108 GW per year[8]. That is to say, every year, China added to its electricity system an equivalent to the total capacity installed in Spain.

Yet in recent years, growth in energy demand has slowed down, falling to below 5 %/year since 2012, and reaching minimum values in 2015 and 2016 (with a growth of hardly 1.1 %). However, since then it has shown an upturn thanks to the reactivation of the industrial sectors.

In spite of the strong economy, per capita energy consumption in China is only half the average for industrialised countries. The situation in China, lagging far behind where some indicators are concerned, such as the number of vehicles per inhabitant, anticipates that the growth sources for the demand are still far from being exhausted.

China's energy mix

China's energy mix has very singular characteristics. If we compare it with the average in the industrialised countries, what stands out most is the greater proportion of coal (58.2 % compared to 15.2 %), even though this has fallen by almost 10 % in recent years.

A second feature is the smaller proportion of oil, which in China accounts for about half the average for the countries in the OECD (19.6 compared to 38.9 %). As has already been mentioned, this is mainly explained by the lower number of vehicles per person.

Regarding the rest of fuels, the lower weight of natural gas (7.4 compared to 26.6 %) and of nuclear energy (2.0 compared to 7.9 %) stand out clearly, the consumption of both being rapidly increasing, however, thus making up for the decrease in coal consumption. The strong growth in renewable energies has placed China almost at the same level as the most developed countries (4.4 compared to 5.8 %), and even above the developed countries in the case of hydraulic power, thanks to China's ability to harness its immense water resources.

[8] World Energy Outlook, 2017, IEA.

Another feature of the country's energy system is the major imbalance in the country between the coastal areas of Eastern China (where most of the population lives and where most of the economic activity lies) and Western China (where the energy reserves are to be found). As has already been stated, if an imaginary line were to be plotted between the City of Heihe in the north and Tengchong in the south[9], splitting China in half, barely 6 % of the population lives in the western part, which occupies 60 % of the surface area, whereas 94 % of the inhabitants live in the eastern part.

By contrast, distribution of the energy resources is quite the opposite. The provinces of Inner Mongolia, Shaanxi and Shaxi (all central or western) located far from the consumption centres on the coast, are responsible for almost 60 % of the coal production. Oil production is rather more scattered. The most mature oilfields are in the east (the Daqing field, in the Province of Heilongjiang and the Shengli field in the Province of Shandong), while the most recent ones are in the west, in the Provinces of Shaanxi and Xinjiang. Natural gas extraction is also mainly concentrated in the western provinces.

The imbalance between the east and west in China means that there is a further demand in terms of infrastructures. Coal has traditionally been transported by rail from its place of extraction to the seaports in the north-east, from where it is distributed by ship along the coast. Apart from the infrastructures required, just the transport cost can add up to twenty-five dollars per tonne, thereby increasing the total cost of coal to the consumers[10].

A distinctive characteristic of the Chinese economy, which explains many of the singular features of its energy system, is the enormous impact of industrial activity. The industrial sector accounts for 40 % of China's total GDP, whereas in most OECD countries it only amounts to half this figure, around 20 %, or even less. The major weight of coal in China could not be explained if it were not for the dimensions of the industrial sector. As the *tertiarisation* of the Chinese economy advances, both the importance of coal and industrial activity will undergo a parallel decrease. However, there is an important difference: in the rest of the countries this transition took place along with a major improvement in their energy intensity (because services are

[9] World Energy Outlook 2017, Chapter 12.

[10] World Energy Outlook 2017, Chapter 12.

much less energy-intensive than industry), whereas this effect will be felt much less in China, owing to the major efforts made by the Authorities in recent years to impose efficiency standards on industrial activity. In this sense, China's starting point is an energy intensity that is much lower than the intensity the rest of the economies had when their industrial sectors were comparable in size to China's at present.

Coal Sector

As has already been pointed out, coal has been the main fuel responsible for sourcing the sharp growth in energy demand in China over the past decades. Total coal consumption has increased fourfold in the past thirty years. Even in the most recent past, growth has been considerable. Total coal consumption went from 700 Mtoe in 2000 to 1,900 Mtoe in 2011. Yet since 2011, growth has been negligible, and it will probably never reach those levels again.

The sector has also been subjected to an interesting exercise in deregulation, with major fluctuations in prices and in the level of activity that have caused many plants to close down. China's main challenge in the future is to absorb the socioeconomic effects from destabilisation and, later on, to restructure the coal-mining sector, which currently employs over four million workers.

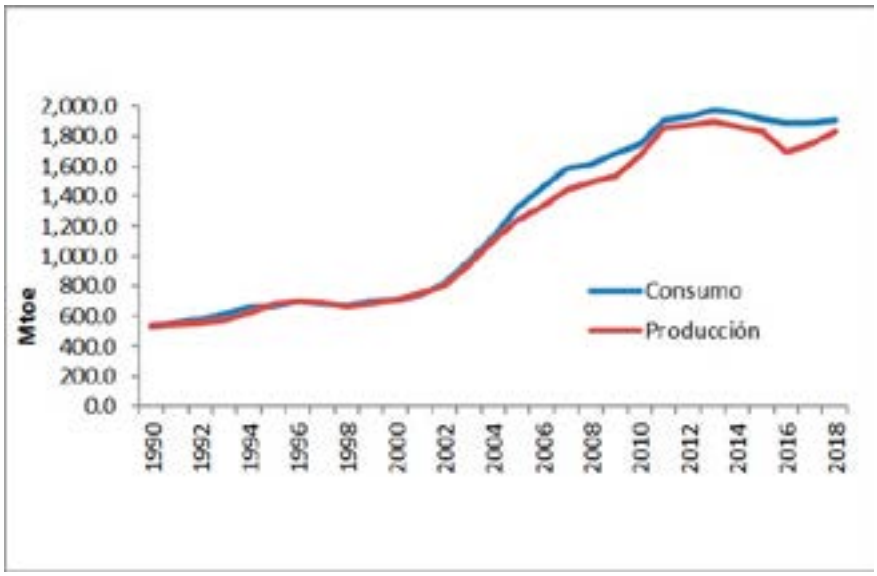


Figure 1. Coal production and consumption in China. Source: BP Statistical Review 2019. Own research.

As has already been indicated, in approximately 2002-2003, at the same time as the expansive phase of the economic cycle intensified, there was a sharp increase in both industrial activity and coal demand. The Government ordered the total deregulation of the sector in order to cater for this sharp growth, and did so in such a way that nowadays there is not one single coal price, although there are three indexes that are taken for reference purposes[11]. Price deregulation, together with the upsurge in coal demand, led to a production boom, albeit one that was insufficient to cope with demand, making China a coal-importing country for the very first time, India, Russia and Australia being the main suppliers. As is generally the case, the boom spread throughout the production chain, increasing the total extraction costs by more than 50 %, which, in turn, made imported coal even more competitive. After the world economy slowed down as a result of the international financial crisis, it became clear that the increase in extraction capacity had been much greater than the demand, putting many local firms in a difficult situation. As most of the growth in the activity had been financed with bank debt, the Government took charge of the restructuring of the sector in order to prevent a financial crisis as well as a social crisis. The Government's first step was to close down the least productive mines, then measures were taken to safeguard employment despite the production cutbacks, such as reducing the number of annual work days in the sector from 330 to 276. Thanks to these measures, the sector has stabilised, although it is estimated that not until 2020 will the excess capacity generated during the boom years have been completely absorbed.

The major challenge for the sector as from the present time is to adapt to the foreseeable decrease in demand over the next few years: the IEA estimates that demand will fall by 15 % by 2040. The two main coal consumption sectors are the industrial sector, especially heavy industry such as cement and steel manufacture, and the electrical sector. In the industrial sector, only the chemical sector is expected to increase its coal consumption in the next few years, in view of the greater efficiency and progressive slowing down of industrial activity. Furthermore, in the electrical sector, despite the increase of non-fossil fuel technologies such as renewable and nuclear, the demand for coal will carry on rising until 2030, after which it is expected to start falling.

[11] Datong, South China and Qinhuangdao, the latter being used as a reference in international transactions. WEO 2017.

As has been pointed out, although China's coal imports increased to 146 Mtoe in 2018 (approximately 8 % of the country's total consumption), they have fluctuated greatly in recent years, depending on international market prices. From a geopolitical perspective, coal supply in China is guaranteed by the surplus availability existing on the domestic market. Moreover, China's extraordinary influence in this sector renders it almost artificial to make a distinction between China's local market and the international market, given the close relationship between the two.

Oil Sector

The oil sector is of much greater geopolitical interest. Although the growth in demand is less marked than it is for coal (the average over the past ten years lies at 5.4 %/year, and 5.9 % for the last twenty years), it has brought about a much greater imbalance between consumption and production, in view of the flat profile of local production, making China the world's biggest oil importer. Chinese consumption amounts to 13.5 million barrels per day, compared to a production level that hardly reaches 3.8 million.

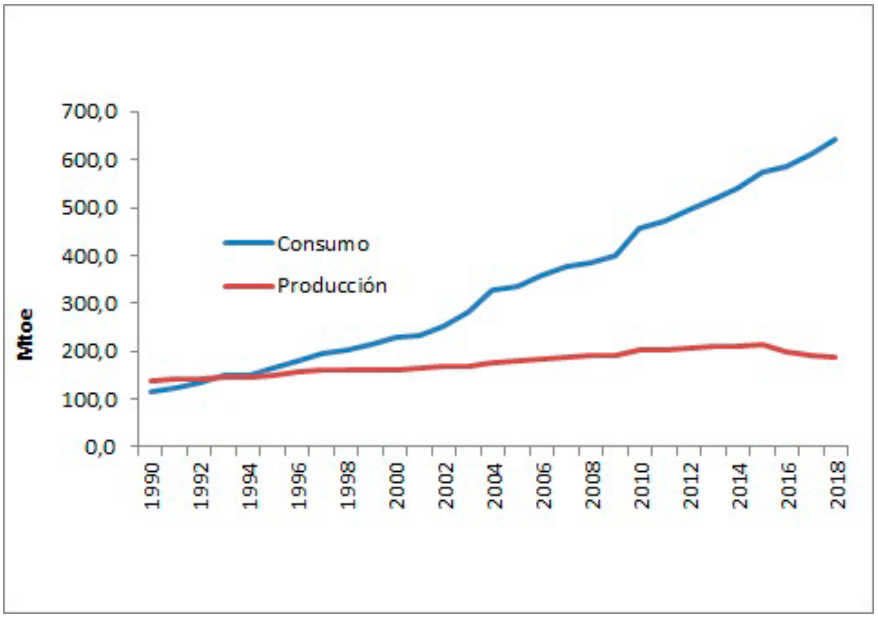


Figure 2. Oil production and consumption in China. Source: BP Statistical Review 2019. Own research.

Furthermore, unlike the case with coal, the demand for oil is far from stabilising in China, as it started at much lower levels. China

used to be known, not so far ago, as the land of the bicycles. In spite of the deep changes in recent years, to a certain extent the country is still the land of the bicycles, especially in some regions of the country: in Beijing, the number of vehicles per inhabitant is roughly 200 for every 1,000 (a level similar to Argentina), whereas in the inner provinces, this ratio falls to 80 per 1,000 (similar to Ghana)[12].

What is more, in the large cities, air pollution has made it necessary to take very restrictive measures where vehicle access is concerned. Beijing has implemented a non-transferrable lottery system, which grants the winners the right to drive a vehicle for a non-extendible period of six months. This system has stabilised the vehicle ratio in the city. A similar system was implemented in Shanghai in the 1980s, which managed to keep the ratio below 90 per 1,000, even though it is one of the richest cities in China.

Electric vehicles have become a strategic option. China is already the main market for such means of transport, one of the objectives of the Chinese Authorities being to develop both the capacity for manufacturing such vehicles and the batteries they require, as part of the "Made in China 2025" programme. Even so, internal combustion vehicles will continue to account for a significant share in the demand: the IEA goes as far as to estimate that even if the electric vehicles made aggressive inroads, around one-fifth of car sales only will be electric by 2025. That is, in 2050, most vehicles on the roads will still be of the internal combustion type.

In recent years, road transport for both passengers and goods has fed the demand for oil. The growth in demand will continue for the next few decades, not only owing to the increase in the number of vehicles, but also because of the population shift to the cities and the general expansion of economic activity. Despite there being considerable crude oil resources to tap, production in China has hardly gone up in recent years; this is due to the complexity and relatively high cost involved in extracting this resource. It has been calculated that oil prices of about 50-60 dollars a barrel make it almost unviable to exploit most of China's untapped reserves. Furthermore, in recent years, the main oil companies (CNPC, Sinopec and CNOOC[13]) have redirected their exploration activities to finding natural gas. This is more so for

[12] WEO 2017, Chapter 14.

[13] China National Petroleum Corporation (CNPC), China Petroleum and Chemical Corporation (Sinopec) and China National Offshore Oil Corporation (CNOOC).

the maturity of the existing oil fields, most of which have been operating for more than thirty years.

Chinese imports of crude oil will thus increase significantly over the next few years. The IEA estimates that the demand will increase by over 4 million barrels per day until 2040, a rise which will have to be supplied almost entirely in the form of imported crude oil. Such pressure will have major geopolitical repercussions.

China has managed to diversify considerably where its oil providers are concerned: the Middle East accounts for 30 % of China's total imports (of which Saudi Arabia and Iraq each provide 10 %, Kuwait 5 % and the rest of the States [14] in the region a further 15 %), South and Central America provide nearly 20 %, Africa (mainly Angola and Nigeria) and Russia, 15 % each. The situation differs significantly from just a few years ago: in 2010, Middle East and Africa provided more than 75 % of Chinese imports, and it was estimated that around 80 % of this traffic reached China via the Strait of Malacca.

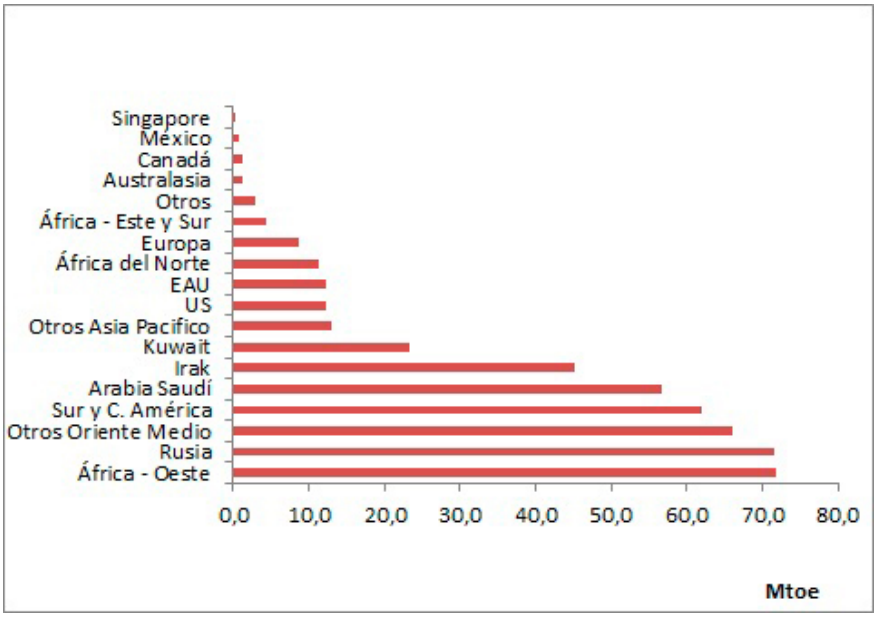


Figure 3. Chinese oil imports. Source: BP Statistical Review 2019. Own research.

Another way of analysing the geopolitical effects is right the opposite; To what extent do their exports to China account in

[14] Without including Saudi Arabia, Iraq and Kuwait.

the overall export matrix of different countries? In this sense, it can be seen that China's quota is extremely high in some cases, close to 60 % in some parts of Africa and above 40 % in South America. Exports from Russia to China exceed 25 %, in Kuwait and Iraq the figure is 22.5 % and it is 15 % in Saudi Arabia.

China also receives over a million barrels per day through the pipelines from Russia, Kazakhstan and Myanmar, constructed in the last decade to diversify its supply sources and reduce imports arriving by sea, especially via the congested Strait of Malacca[15].

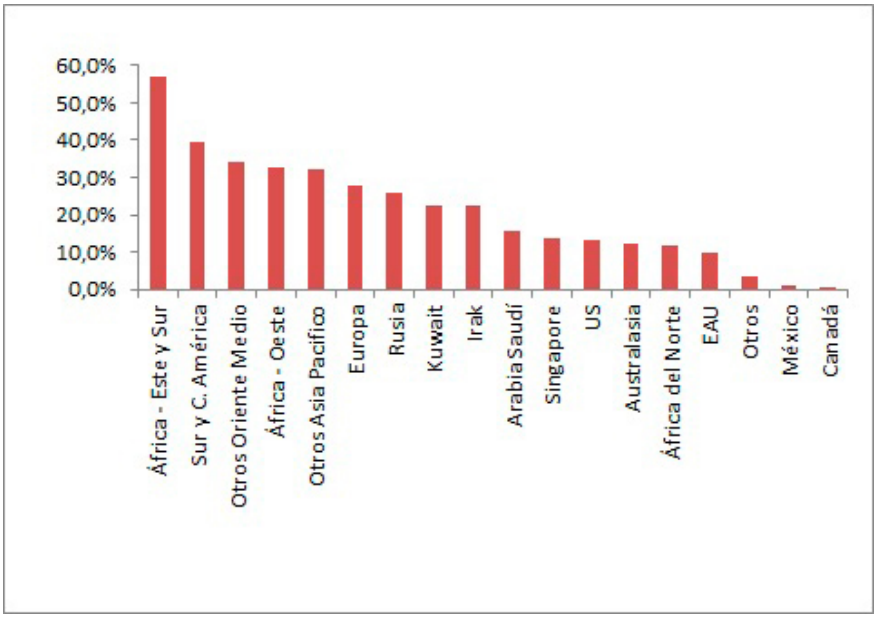


Figure 4. Importance of China in Oil Exports sourced in different countries. Source: BP Statistical Review 2019. Own research.

China's growth in the quotas in these countries has taken place at the same time as the decrease in oil exports to the USA, after unconventional oil production shot up in the latter. In fact, the situation of China and the USA is quite the opposite with respect to crude oil: demand is rising and production falling in China, where in the USA demand is falling and production rising.

This trend has enabled the USA to become a net exporter of crude oil and petroleum products since last September (net imports of crude oil were exceeded by net exports of petroleum

[15] WEO 2017.

products). It could be stated that the USA has achieved "energy independence", a totem in US energy policy since the famous "independence project", announced by President Nixon during a speech in November 1973, in the wake of the first Oil Crisis. The USA's new strategic independence has given the country's foreign policy greater room for manoeuvre in zones like the Middle East, while at the same time President Trump's character has made the way this new-found freedom is used more unpredictable, proof of which can be seen in the attack and execution of the Iranian General Qasem Soleimani in January 2020. While this was going on, China replaced the USA as the main importer of oil from Russia and most countries in the Middle East. Funnily enough, as will be dealt with in Chapter 3, it is now China that is acting as the guarantor of stability in the Middle East, while the USA is one of the most unpredictable factors in the new geostrategic scenario.

The growth of imports from China has also been projected in intense take-over activities from Chinese companies[16]. The strategy has evolved since the failed attempt to purchase the American giant Unocal in 2005. Ever since then, Chinese firms have been concentrating on countries where the political risk is higher (Russia, Kazakhstan, Angola or Mozambique) and on a greater number of operations, albeit of smaller size.

Initially, the foreign expansion of Chinese companies formed part of the Chinese Government's strategy known as "Going Abroad", which was reformulated as from 2013, to include more specific objectives. It is now known as the "Belt and Road Initiative (BRI)", and it is an ambitious infrastructure programme inspired by the historic "Silk Route" more than two thousand years ago, a corridor that connected China with the Mediterranean via Eurasia throughout centuries. The BRI initiative plans six corridors (five by land and one sea route) to connect Asia with Europe and Africa, with a total volume of investments that could be as much as one billion dollars in a total of 152 countries. The initiative envisages major investments in the energy sector, and in this sense, Chinese energy companies have made major investments abroad, mainly in the upstream sectors such as the exploration and production of hydrocarbons, but also in connecting infrastructures, such as pipelines and storage facilities, improving regional connectivity, and in different links in the technology supply chains.

[16] "China vs. The Rest: A New Era of Global Energy Deal-Making" by Q. Wang and G. Kretzschmar.

Both the BRI programme and the electrical super-grid known as "Global Energy Interconnection" (GEI) are Chinese strategies for reducing energy vulnerability, in this case by improving interconnections and reducing flows through the so called chokepoints, such as the Strait of Malacca or the South China Sea.

Africa has been one of China's top investment priorities, not only in hydrocarbons but also in other energy sectors. For instance, in Sub-Saharan Africa, a Chinese firm has been the main contractor in more than 30 % of the new electricity generation projects in the last five years. Chinese investors are involved in nearly all the region's energy sectors, such as oil, natural gas, coal and renewables, special attention being paid to hydroelectric projects.

Chinese "petro-nationalism", or energy security as the top priority in energy policy, has also manifested itself in other ways. For example, the China Development Bank (CDB) has opened credit lines for a total of 65 thousand million dollars to energy companies and to the Governments of Brazil, Ecuador, Russia, Turkmenistan and Venezuela[17]. Many of these controversial "loans for oil" were repaid directly with crude oil.

The refining and preparation of petroleum products is a different subsector. China has been constantly augmenting its refining capacity in recent decades. There are two medium-term challenges facing the sector: firstly, the change in the composition of the Chinese demand, hitherto focusing on middle distillates like diesel (owing to the demand for heavy machinery and heavy tonnage transport), which will progressively move towards lighter distillates such as petrol, due to the increase in demand for private vehicles[18].

This change will be a challenge for many Chinese refineries, designed to cater for the demand of diesel and heavy products. In fact, it is foreseeable that one effect of this imbalance between supply and demand, will be that China becomes a net exporter of certain petroleum products (like diesel) and a net importer of others (liquid petroleum gas in the short term, and petrol in the medium term). Whatever the case may be, it seems clear that between 2030 and 2040, China will become the country with the greatest refining capacity in the world, surpassing the USA, which currently has a capacity for 18.7 million barrels per day, compared to China's 15.7 million.

17 Ibidem.

18 WEO 2017.

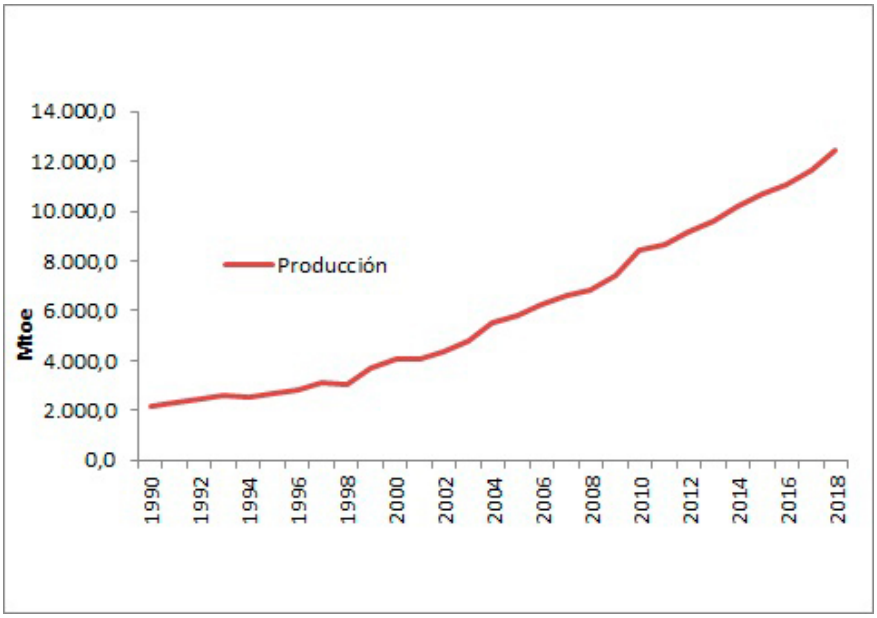


Figure 5. Production of oil products (refined) in China. Source: BP Statistical Review 2019. Own Research.

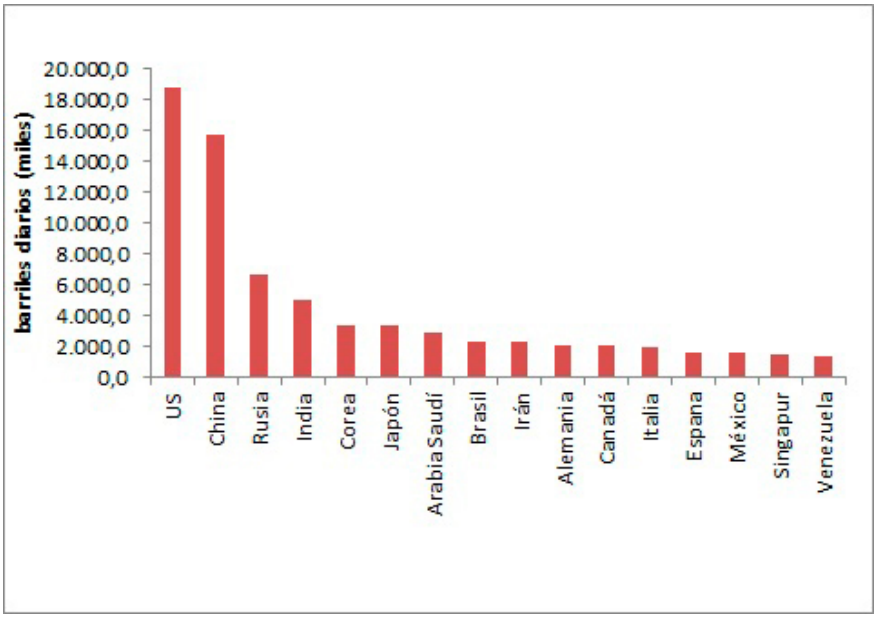


Figure 6. Refining capacity in different countries. Source: BP Statistical Review 2019. Own Research.

Natural Gas Sector

The natural gas sector has also undergone major changes, which will increase in the coming years. Natural gas recorded the swiftest rise of all the primary energy sources: in the past ten years, it increased, on average, by 13.4 %/year (and if we include the past twenty years, more than 14 %). In little over ten years, natural gas consumption in China increased fourfold, and now exceeds 280 bcm.

Even so, the growth in the coming years is still expected to be very high. Although consumption in industry may slow down, in the residential sector (approximately 25 % of the consumption) around 300 million people use gas, with a gas access rate of only 40 %. In the electrical sector (also accounting for about 25 % of the consumption), the gas share in the generation mix is very low (under 5 %), and it is expected to gradually replace coal in its rise to 10 %.

The growth in demand has not seen a simultaneous growth in production, which has remained constant in recent years. Nevertheless, unlike the case with oil, China has huge natural gas

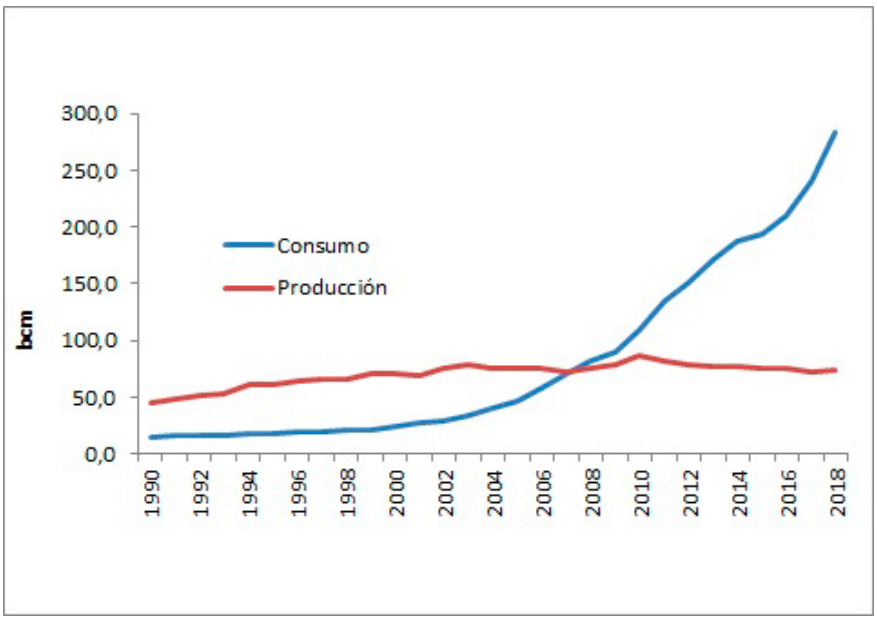


Figure 7. Production and consumption of natural gas in China. Source: BP Statistical Review 2019. Own Research.

reserves, which are estimated[19] at 50 trillion cubic metres (tcm), most of which would be unconventional reserves (approximately 15 % of the world's unconventional gas reserves are in China). The Tarim Basin (in the western province of Xinjiang) or the Sichuan Basin (in the province of the same name) are just some of the major fields.

Conventional gas production currently accounts for over 70 % of the total, but unconventional sources are expected to be the main driver of the supply in the coming years. The IEA estimates that conventional production could drop until it hardly accounts for 30 % of the total in 2040.

However, unconventional resources have so far not lived up to expectations. The 13th 5-Year Plan, which will be analysed in detail later on, set an unconventional production target of 110 bcm in 2020, but this objective is not going to be achieved. There are several reasons for this: on the one hand, the cost of drilling and extracting unconventional gas is still very high, and some resources, such as the Tarim Basin deposits, are particularly complex from a technical perspective. There are also environmental and social restrictions, given that the reserves lie in densely-populated areas. Yet one of the major reasons is that, up to the present, liquid natural gas (LNG) has proved to be a highly competitive alternative, owing to international market conditions and the fact that the regasification plants are close to the consumption centres. It must also be pointed out that the market is still highly regulated and revolves around the three national hydrocarbon companies: CNPC, Sinopec and CNOOC (the latter specialising in offshore exploration). Although unconventional gas regulation is theoretically more open since its own regulatory system was established in 2011, in practice CNPC and Sinopec hold the exploration rights to the areas with greatest development potential. Unlike the situation in the USA, where the unconventional gas revolution has been spearheaded by small firms in a highly deconcentrated market, China has not yet managed to transform its unconventional gas industry.

Another hindrance to the development of the industry is the capacity of the gas pipeline networks, which still have plenty of room to increase their capillarity: for example, the network of long-distance duct lines is 68,000 kilometres long, whereas in the USA (with a similar surface area) the networks exceed 500,000

[19] WEO 2017. Chapter 14.

kilometres[20]. Another drawback to developing the Chinese gas reserves is the limits imposed on other new companies accessing the network, which is a disadvantage that some of the market reforms currently under way is aiming to rectify.

The rapid growth in demand, coupled with the stagnation affecting production, has led to a sharp increase in imports. It was in 2007 when China became a net importer of natural gas, but since then imports have increased rapidly, and they now stand at 120 bcm, over 40 % of the demand for natural gas.

Approximately 60 % of the imports come in the form of LNG, compared to 40 % that arrive via the gas pipelines. The LNG matrix is concentrated in South-East Asia (Australia 45 %, Malaysia 10 %, Indonesia 10 %) and in Qatar (20 %). Imports from the USA are still limited (4.1 %), although they are expected to grow swiftly in the next few years, after the Trump Administration made the restrictions more flexible.

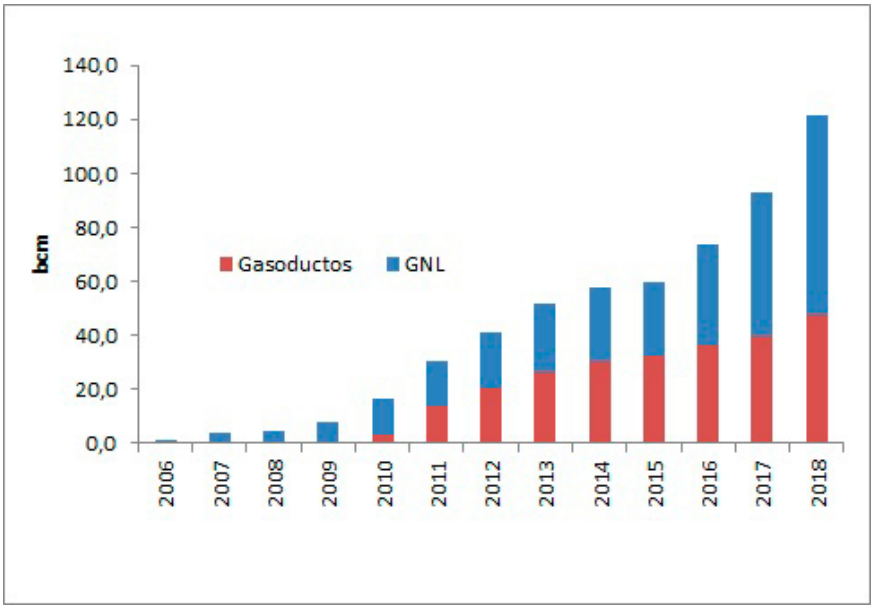


Figure 8. China´s natural gas imports. Source: BP Statistical Review 2019. Own Research.

Imports via gas pipelines come mainly from former Soviet Republics in Central Asia that share frontiers with China: principally Turkmenistan (70 %), and to a lesser extent Uzbekistan (13.2 %)

[20] WEO 2017, Chapter 14.

and Kazakhstan (11.3 %). China also has a pipeline connection with Myanmar (6 %).

The eastern route of the "Power of Siberia" gas pipeline is currently under construction. It will connect Russia and China for the first time at the beginning of the next decade. A second connection is also planned (possibly via the so-called Altai route), as is a fourth gas pipeline with Turkmenistan.

Where LNG facilities are concerned, China currently has eighteen regasification terminals with a total capacity of more than 70 bcm. If all projects under construction are added up, China's total regasification capacity in the coming years will approach 100 bcm. The inroads that China has made into the international LNG market have been considerable, allowing for the absorption of gas from the USA, as yet limited, but which can be expected to grow rapidly in the coming years.

The intense corporate activity of China's main hydrocarbon companies has not been limited to the oil sector, it has also spread to natural gas, sometimes, as is the case with several exploration areas in Vietnam's territorial waters, mixed with claims to the sovereignty over them[21].

Renewable Energy Sector

China is now the best market for renewable energies in the world, exceeding the EU as a whole and doubling the renewable capacity installed in the USA. Growth has been spectacular in recent years. Renewables currently account for approximately 25 % of electricity generation. Hydraulic energy has increased in recent decades, yet both wind and solar energy have consolidated their increase in the last few years, and have done so at a dizzy rate, with an average annual rise close to 40 %. The IEA predicts that production of renewable energy will carry on growing sharply until it exceeds fossil fuel production by around 2030, accounting for a 60 % generation share by 2040.

In the last five years, the growth in wind and hydraulic generation has been 20 GW of new capacity per year, and 30 GW for solar energy. In the hydraulic sector, the total capacity installed amounts to 350 GW (including the Three Gorges Dam, in the Province of

[21] Financial Times. China and Hong Kong: the ultimate test of authoritarian rule. 4 October 2019.

Hubei, which with a capacity of 22.5 GW is the biggest hydraulic power facility in the world). The most recent analysis of the hydraulic power potential that is technically and economically usable sets it at 660 GW, i.e., almost twice the currently installed capacity[22].

The rapid growth in photovoltaic solar energy has made it one of the mainstays of the Chinese electricity mix after only a few years. The total capacity installed in the country is estimated to be around 175 GW, well above the target set in the 13th 5-Year Plan, which was 105 GW capacity installed by 2020. The IEA estimates that photovoltaic solar energy could come to account for up to 10 % of China's electricity generation by 2040 (compared to the current 1 %). Apart from photovoltaic solar energy, China is also opting for other solar technologies, such as solar thermal and solar concentration systems.

China dominates some of the major links in the solar technology value chain, such as panel manufacturing, a market where China has played a decisive role in cost reduction in recent years. China's solar module exports are estimated at more than 20 GW per year. Chinese companies have also positioned themselves in other renewable sectors such as the manufacture of wind turbines, electric batteries or vehicles. According to IRENA, China is the country that has the largest number of patents in the renewables sector (about 30 % of the world total) way ahead of the USA (18 %) in second place, Japan and the EU (14 %).

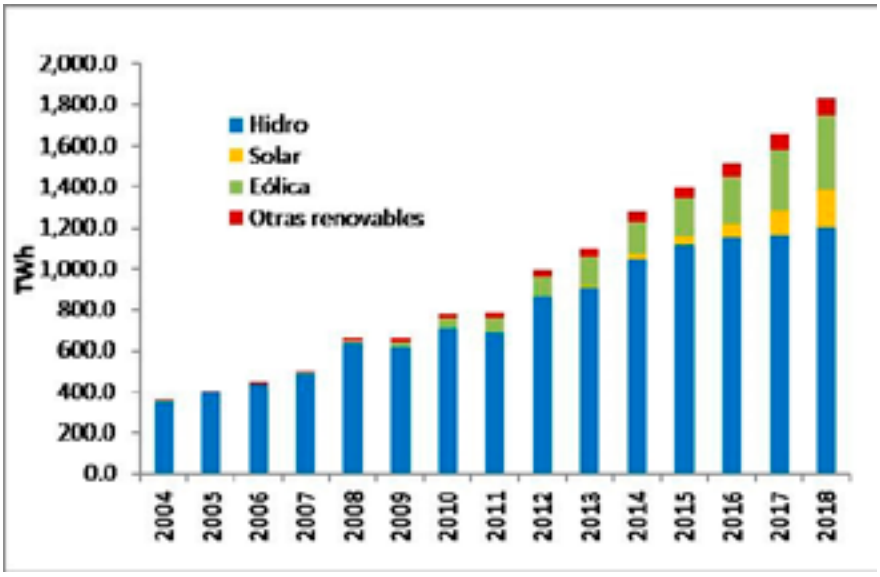
However, the strength of Chinese firms in this market must be put into perspective: it is a market with small entry barriers, a very high level of price competitiveness, and where the purchasers have considerable bargaining power, in view of the standardisation of the product. That is to say, although it is true that the leadership attained on the photovoltaic market by Chinese firms is of great economic and commercial value, owing to the sharp growth that is forecast on the coming decades, the strategic value is only relative from a geopolitical viewpoint, given that it is an easily replicable technology and one where it is difficult to keep hold of the profit generated.

Wind energy has also grown rapidly in recent years. Approximately 21 GW of new capacity was installed in China in 2018, amounting to around 46 % of the total capacity installed in the world[23]. As is

22 WEO 2017, Chapter 14.

23 https://gwec.net/china-wind-power-2019/

the case with solar energy, most of the wind farms are in the west of the country (in provinces such as Xinjiang, Inner Mongolia or Gansu), because the resource is more readily available there, but a long way from the main consumption centres. This fact, together with the limitations of the existing electricity grid, have caused many wind farms to be disconnected in recent years, due to the difficulties involved in pouring the electricity produced into the grid.



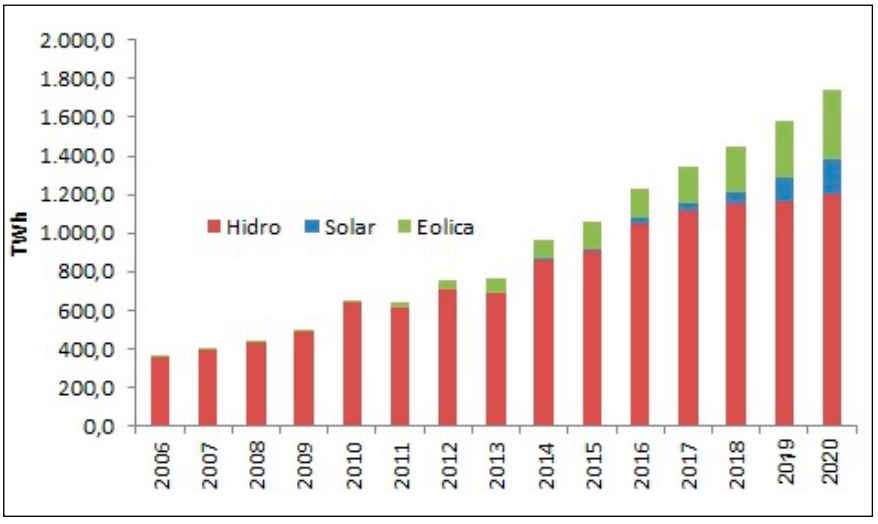


Figure 9. Electricity production in China from renewable sources. Source: BP Statistical Review 2019. Own Research.

Contrary to other countries, nuclear power is still growing in China, and this could make it the first nuclear power in 2030, rising from the current 35 GW to 145 GW by 2040. One third of the approximately 65 GW of nuclear power under construction in the world is located in China. The Government's policy for the supply of uranium consists in obtaining one third from domestic sources, one third from mines abroad in which Chinese has a shareholding, and the remaining third from international markets.

As nuclear power has expanded, Chinese nuclear technology has also made rapid progress in recent years. The State-owned company CGNPC has constructed five reactors in Pakistan utilising the second generation of PWR reactors, and is constructing two more using the third generation of reactors. CGNPC has also signed a contract with Argentina to construct two reactors, and it collaborates with EDF in the Hinkley Point project in the UK, with a shareholding of 33.5 %[24].

Environmental Commitments

International commitments regarding climate change are another basic element in China's energy policy. The Chinese energy sector emits over 11 Gt of CO_2 every year (about 30% of the world total), making it by far the biggest emitter in the world, twice the percentage of the second country on the list. China is immersed in an economic and urbanisation development process that is still far from completion. China's urban population is expected to grow by more than 300 million until 2030, and the average energy consumption in cities is three times greater than rural consumption. If we add industrial growth, transport development and other items, the envisaged increase in energy demand in China until 2030 will be somewhere between 25% and 40%. CO_2 emissions will therefore, continue to grow in China over the next few years, and are not expected to stabilise until 2030.

In an interesting manifestation of the new world geopolitics (which we will go into more deeply in the next chapter), China and the USA announced a bilateral agreement in November 2014 in which the two countries undertook to reduce their emissions over the next two decades, this commitment was the prelude to the subsequent Paris Agreement.

[24] WEO 2017.

As part of this agreement, China took on the following environmental commitments: to reach a CO_2 emissions peak in 2030, while aiming to do so earlier if possible; to reduce CO_2 intensity in its GDP by between 60 and 65 % below its 2005 levels; to increase the share of non-fossil fuels in its energy mix up to 20 %, and finally, to increase the volume of woodland by 4.5 bcm, when compared to the 2005 levels.

Energy Planning

Energy planning exercises are normal in nearly all countries. They are of particular interest in China, in view of the fact that the Chinese Authorities have a very positive attitude where fulfilling their objectives is concerned.

Since the early 1950s, the Chinese Government has approved successive 5-Year Plans, which were originally conceived to be basic pieces in the planning of a commanded economy and, later, as a result of the liberalisation of the economy, as tools for establishing the Government's strategic targets and general policies.

In December 2016, The National Development and Reform Commission (NDRC) and the National Energy Administration (NEA), China's Ministry of Energy, announced their 13th 5-Year Plan (2016-2020) for the energy sector. This basic document must be analysed jointly with the preparatory analyses for the 14th 5-Year Plan (2021-2025), which are now at an advanced stage[25].

Along general lines, in 2014 the Chinese President called for an "energy revolution" in the energy agenda, and this formed the basis for the successive 5-Year Plans, and for the "Strategy for a Revolution in Energy Production and Consumption" (2016-2030), published jointly by the NDRC and NEA in 2017. Sectoral plans were additionally approved for the various energy subsectors[26]. These documents outline a radical transformation in the Chinese energy sector for the next decade. Some of the main objectives in these plans are as follows.

[25] For example, last August, the biggest hydrocarbons company in China, CNPC, published its Outlook for 2050, a key piece in the work of the NEA for the new 5-Year Plan.

[26] They are available for coal, oil, gas, renewable energies, unconventional gas, methane, nuclear, hydroelectric, wind, solar, biomass, geothermal and for innovation.

By 2020:

- Keeping total primary energy consumption below 5,000 Mtce[27] (in 2018 it was 4,681.5 Mtce).
- Non-fossil fuels will account for 15 % of the primary energy mix (in 2018 the percentage was 14.7 %).
- The energy intensity of the economy will be reduced by 15 % with respect to the 2015 level (by 2018 it had been reduced by 13.2 %), and the CO_2 intensity by 18 % (by 2018 it had been reduced by 19.7 %).
- Energy self-sufficiency will reach 80 % (according to some estimates it has already been achieved).
- Other targets regarding emission control at coal based electrical generation plants.

By 2030:

- Guarantee energy access in rural areas.
- Keeping total primary energy consumption below 6,000 Mtce.
- Non-fossil fuels will account for 20 % of the primary energy mix.
- Natural gas will account for 15 % of the primary energy mix (it currently stands at 7.5 %).
- The further increase in primary energy will be met "mainly" by clean energies.
- The energy intensity of the economy will approach the average world levels.
- The proportion of non-fossil fuels in the electrical generation mix will reach 50 % (it currently stands at 30 %).

As can be seen, China is very close to complying with nearly all of the targets set in its energy strategy, with one exception: CO_2 emissions[28]. In CNPC's energy scenarios for drawing up the 14th 5-Year Plan, the most sustainable environmental scenario predicts that the primary energy demand in 2050 will be at the 2035 levels. However, if China is to be able to comply with its

[27] Million tonnes of coal equivalent.

[28] Resources, Conservation and Recycling Volume 128, January 2018, Pages 78-89. "China's energy revolution strategy into 2030". Qilin Liu a, Qi Lei b, Huiming Xu c, Jiahai Yuan d, e

Paris´ environmental commitments, the demand ought to fall to the 2017 levels[29]. CNPC forecasts that the oil demand will continue to grow until 2030 (with an increase ranging from 2 mb/d to 3 mb/d when compared to current levels, approximately half the increase of the past decade), and that the primary energy demand will carry on growing at a rate of 2 %/year, stabilising by 2040. In sectoral terms, transport accounts for half the oil demand, whereas in line with the Chinese economy's structural changes, there will be a reduction in industrial uses from the present 25 % to just over 10 % by 2030. With regard to coal, although its proportion in the energy mix will carry on falling, CNPC expects coal to still account for one third in 2050. One of the new elements included in CNPC's planning exercise is the limited growth forecast for natural gas in the coming years: after years of exceptional growth, the figures were somewhat lower in 2019 and, partly as a result, CNPC has lowered its predicted growth in the demand, especially in the industrial sector.

One remark should be placed here. While in almost all developed countries the electrification of economies means decarbonisation, in China this is tantamount to a step backwards, instead, due to the weight of coal in the electrical generation matrix.

As has already been mentioned, another key sector is transport. CNPC agrees with the IEA that despite the considerable slow down affecting the sale of internal combustion vehicles and the fast inroad made by electric vehicles (not to mention hybrids, and shared transport systems), combustion vehicles will continue to account for two thirds of the operating fleet in 2030. Last July, a degree of confusion was caused when the Ministry of Industry & Technological Information (MITI) published on its website, an answer to a petition from the Chinese Parliament, requesting a schedule for banning the sale of combustion vehicles. The MITI replied that it would consider establishing experimental conventional vehicle "free" zones, which could pave the way for a more ambitious strategy in the 14th 5-Year Plan.

Conclusions

The growth in China's energy demand in recent decades has made the Asian giant the biggest energy consumer in the world.

[29] "Glimpses of China's energy future", The Oxford Institute for Energy Studies. Michal Meidan. September 2019.

Where coal is concerned, China is the world's biggest producer and consumer, to the extent that the international markets move in step with China's domestic market. In the case of oil, the sharp growth in demand has not been followed by a similar expansion in production, making China the world's biggest importer. Something similar has happened with natural gas, although in this case China has huge reserves, which could be developed in the coming years. Environmental impact has become a key variable in China's energy policy especially since the deterioration of the air quality in its cities.

These vectors have had far-reaching geopolitical implications, which are dealt with in greater detail in the following chapters. Its investments in the energy sector and the growth in its imports, have enabled China to achieve great geopolitical influence in such regions as West Africa and in Central and South America; in other regions, like the Middle East, China is progressively taking over the role traditionally played by the USA, because Chinese growth is taking place at the same time as the USA is making its withdrawal, thanks to the sharp increase in its production of unconventional oil and gas, and to the reorientation of its foreign policy by the Trump Administration. China is not limiting itself to participating in the upstream sector, but, in keeping with the way the energy sectors are evolving, with less stress being placed on primary sources and an ever-increasing emphasis being given to technologies (which we will be analysing in the next chapter), China has developed a key potential in vital sectors, such as the manufacture of solar panels or the supply of rare earth minerals, which are required for the manufacture of components that are essential for these technologies.

The geopolitical implications can only be understood by a greater in-depth analysis of the changes that affect the energy sectors (Chapter 2), which will give us insight into how not only these changes but also the evolution of the traditional sectors, have affected the geopolitical relations between China and the USA (Chapter 3).

Second Part. The geopolitics of energy

Throughout history, there have been groups and societies whose economic, cultural, political and military influence spread beyond their original frontiers, to the extent that they formed genuine empires. The reasons for the rise and fall of these empires

have always been the subject of detailed examination. From Adam Smith's explanations focusing on the reserves of natural resources[30], and Max Weber's theories stressing social or cultural conventions[31], to the *Acemoglian* theses emphasising institutional aspects[32], many disciplines have put forward alternative explanations, sometimes complementary, regarding one of the most fascinating questions in history: how different countries manage to hold onto economic, political or military power levels for the lengths of time that they do.

When at the beginning of the nineties the University of Harvard´s Professor Joseph Nye[33] made his famous distinction between the sources of "hard power" and "soft power", he also formulated the following hypothesis: the greater importance of the latter upon the globalisation and digitalisation of the economies. However, it is debatable whether or not that has happened in the past two decades, especially after the economic and financial crisis at the end of the first decade of the millennium. The severe interruption of cash and credit flows, which in some cases left the international financial system on the verge of collapse, coupled with the simultaneous contractions of the main world economies, returned the sources of "hard power" to the forefront, and this also applied to competition for the energy resources, which is the subject of this article, together with other second generation "hard" sources, such as international trade (whose protectionist derivatives have surfaced in recent years), monetary policy (reinvented since then) or tax regulation (especially on the major multinational companies), which have taken centre stage where international debate is concerned.

It could be argued that the Internet era has blurred the contours between "hard" power and "soft" power, rather than causing the "soft" sources to prevail. For example… in which category are cyberattacks to be found? Or fake news? Or the attempts to interfere with election processes in other countries? These are moves that because of their objectives and sphere of action, would all fall within Nye's "hard" power category, yet because of the methods utilised, seem to fit better with "soft" power.

[30] The Wealth and Poverty of Nations, David Landes, or the more classic work by Adam Smith in The Wealth of Nations.

[31] The Protestant Ethic and the Spirit of Capitalism, Max Weber

[32] Why Nations Fail: The Origins of Power, Prosperity, and Poverty. Daron Acemoglu and James A. Robinson

[33] Bound to Lead: The Changing Nature of American Power

Whatever the case may be, it is useful to begin with the Nye's seminal distinction in order to give a light review of how power relations have evolved throughout history. The reason for this is that the sources of "soft power" have been kaleidoscopic and their layout more tortuous, whereas the sources of "hard power" have been more linear and thus easier to recapitulate. Thus, the great empires of ancient times, such as the Macedonian, Mongol or Roman Empires were founded to a great extent on the basis of advantages that could be perfectly attributable to military strategy or political organisation. Later on, with the advent of navigation by sea, a radical transformation took place both in combat technology and in economic and trade relations. The sources of "hard" power also changed, making control over the maritime routes the main factor leading to the predominance of the Spanish Empire (between 15th Century and 17th Century) and subsequently the British Empire (between the 17th Century and 19th Century).

The Industrial Revolution led to a new displacement of "hard" power sources. Although energy then already occupied an outstanding place, its role up to that point was secondary, both in maritime navigation (mainly by sail) and in military action (where mechanical force was mainly provided by animals). It was not until the Industrial Revolution that energy began to replace these other sources, and then it played the main role. It must be pointed out that changes were twofold: not only was the basic ingredient of the system displaced (it now became energy), but also in doing so, its size multiplied exponentially. According to the estimations of Angus Madinco, the world income per capita between Year 1 and 1820 only rose a minimum, hardly increasing from 467 to 666 dollars per year in constant terms. That is to say, it took 1,800 years for incomes to increase by roughly two hundred dollars. Once the Industrial Revolution got under way in 1820, the world per capita income (PCI) needed only fifty years to do likewise. In 1870, it stood at 884 dollars. And as from that time it grew at a dizzy rate. At present, the world capita income grows by more than two hundred dollars every year. That is to say, we are doing in one single year, what mankind took nearly 2,000 years to do.

However, this huge economic growth did come at a cost. To achieve this, humanity had to undergo a process of energy transformation on an unprecedented scale. The development of the textile industry, the invention of the steam engine by

James Watt and its application in industry or in railways and ships for communication purposes, the discovery of electricity or the invention of the internal combustion engine, are just some of the major achievements in the Industrial Era. All of this involved a volume of energy transformation hitherto unknown. The most characteristic feature of the Post-Industrial Era is the huge leap in energy consumption, and thus in energy transformation.

The major energy transitions

In 1850, energy consumption in the USA amounted to a mere 2.1 billion BTU, almost entirely timber. In 2010, timber consumption was similar. The difference lies in the fact that the total energy consumption in the USA was 91.1 billion BTU, mainly accounted for by oil, followed by coal, natural gas, nuclear power and hydroelectric power. In the Industrial Era, mankind learnt to harness all these energy sources.

As energy occupied this prominent place among the sources of "hard power", energy geopolitics became a discipline it itself in international power relations. And ever since, the major energy transformations have had far-reaching geopolitical importance. Let's take a brief look at the most important transformations.

Timber was the main world fuel until midway through the 18th Century. Although there were occasional situations of shortage (for example, in the 1620s the British imported wood, first from the Baltic and Scandinavian countries, and later from their North American colonies), it was not until the 17th Century that the shortage began to be chronic in some countries.

The Industrial Revolutions of the 18th Century, and the spectacular growth in energy consumption, paved the way for the first major energy transition, from timber to coal, whose use started to become widespread as a heating fuel, for the industrial sector and for transport. By the end of the American Civil War in 1865, timber accounted for 80 % of primary energy consumption in the USA, compared to only 20 % for coal. Just a few years later, in about 1900, the situation was completely the opposite: coal then accounted for 75 % of the consumption while timber hardly reached 20 %[34].

[34] The Geopolitical Implications of Future Oil Demand

However, regarding availability of resources, timber and coal have very similar features, as is only to be expected, because from a geological perspective, the latter is normally formed from the former. Patterns are very similar for both timber and coal, not only with respect to their distribution throughout the world, but also as regards their transport and storage requirements. In this sense, from a geopolitical viewpoint, it can be said that the first great energy transition (from timber to coal), did not amount to a major discontinuity.

Nevertheless, the second transition, from coal to oil, in the first decades of the 20th Century, was completely different. The well-known decision taken by Winston Churchill, shortly after being appointed First Lord of the Admiralty as the First World War broke out, to replace coal with oil for the British Navy, was a decision considered to be risky, because it was a decision to replace a fuel that was autochthonous and relatively abundant in British territory, i.e. coal, with an imported commodity, i.e., oil. From that moment on, energy security, that is to say, the need to guarantee an uninterrupted energy supply at affordable prices, came to occupy an outstanding place on the geopolitical chessboard, and it has remained there ever since.

What geopolitical effects did the transition from coal to oil have? One element affecting Churchill's decision that is often ignored (Churchill and his decisions are often shrouded in a mythological mist, in which the man is often gifted with foresight, notwithstanding the fact that many of those decisions do appear to have contained indeed a degree of foresight), is that the decision was actually more obvious than it appeared at first. This is because oil was evidently more advantageous, since the technological race between coal and oil was already in progress, and rapidly being settled in favour of the latter, This being particularly the case after the invention of the internal combustion engine and its massive application to the incipient automobile industry, besides Henry Ford's revolutionary assembly line, which brought about a sharp increase in petrol consumption in the first decades of the 20th Century. However, the cost (or risks) involved in deciding for oil, as the more vulnerable fuel from an energy security perspective, were not yet apparent. In fact, in the first decades of the 20th Century, from a geopolitical viewpoint, oil was not very different from coal or timber. We will now see why.

It is often and mistakenly said, that the singularity of oil lies in the fact that its reserves are concentrated in only a few

countries[35]. Data disprove this statement though. The concentration of the world's coal reserves, for example, is much greater than the concentration of oil reserves (when measured by the percentage of the reserves in the five –or maybe ten- main countries). The same conclusion is drawn if a standard market concentration measurement is utilised, such as the Herfindahl-Hirschman Index[36]: the concentration of coal reserves in the world is much greater than for oil reserves, which are in fact closer to the relative dispersion of timber.

Herfindahl-Hirschman - Concentración de reservas	HHI
Madera	727.8
Petróleo	1,056.1
Carbón	1,431.9

Figure 10. Concentration of reserves by countries (2019)
Source. BP Statistical Review and own research.

If it is not the geological concentration of the reserves... What is it that makes oil different? What is it that has made oil the cause of "most of the conflicts that have taken place in the 20th Century[37]? As we have indicated, the truth is that the world oil markets were similar to the coal markets until the beginning of the 1950s (that is why Churchill's decision was relatively simple). It was only as a result of the decolonisation process, after the Second World War, that the process of nationalising oil resources occurred[38]. To be more specific, it was after the Suez Crisis when these incidents, fruitless until then (such as the one with the Iranian Prime Minister Mohamed Mossadeq in 1951, which led to an international boycott followed by a coup supported by the USA and Great Britain, which deposed him in 1953), began to be more successful. The second wave of nationalisations of oil resources commenced in the 1960s, in a more favourable international context, within the framework of post-colonialism that followed the Suez Crisis, when the USA broke its ties with the old European colonial powers, after feeling the risk of Soviet influence (or

[35] That is what is stated, for example, in The Geopolitical Implications of Future Oil Demand, Professor Paul Stevens, Chatham House.

[36] The Herfindahl-Hirschman Index (HHI) is a way to measure market concentration. This is calculated by squaring each agent's market share, in this case each country, and adding those quantities. The maximum result is 10,000, if there is a monopoly, and the value of the index is reduced as the market shares are distributed more evenly.

[37] Yergin, 1991

[38] Energía y Geoestrategia 2017. La política energética de los EE. UU. y sus implicaciones geoestratégicas . Isidoro Tapia Ramírez

Maoist influence, after the triumph of the Chinese Cultural Revolution) becoming involved in the decolonisation demands made in many countries in what was then referred to as the Third World.

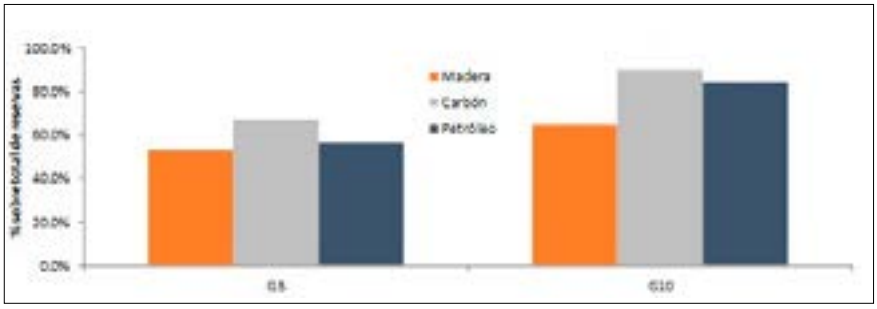


Figure 11. Concentration of reserves for the five (G5) and ten (G10) main producers, respectively. BP statistical review 2019. Own Research.

Examples of nationalisation of oil resources include Kuwait creating its own national company (KNPC) in 1960, or Saudi Arabia in 1962, which subsequently nationalised Aramco, paying basically fair compensations. Iraq also set up its own company in 1967 (INOC). The oil chessboard became reshaped in those years, as the major oil companies, the so-called "seven sisters[39]" lost influence, to the booming national oil companies (NOCs).

It was in this new scenario, when the seven sisters' hegemony of several decades had started to be questioned in the light of the booming national companies, that the two oil crises in the 1970s occurred (the first, in 1973 as a result of the Yom Kippur War, and the second one in 1979 after the Iranian Revolution). The combined effect of these crises was to be twofold: on the one hand, the cartelisation of the oil supply, after the Yom Kippur War, and the other, Saudi Arabia's pivotal role, decisive for understanding the dynamics of the world oil market after the Iranian Revolution in 1979 removed Iran from the international markets.

The cartelisation of the supply must be put into perspective, because its effectiveness throughout time has only been partial. In general, the OPEC has been able to preserve the aggregate share of its members at relatively stable levels. Only during

[39] Standard Oil of California (nowadays Chevron), Standard Oil of New Jersey (Esso/Exxon) and Standard Oil Company of New York (Socony) (known as Mobil, now part of ExxonMobil), plus Texaco (which later merged with Chevron), Gulf Oil, Anglo-Persian Oil Company (now BP) and Royal Dutch Shell.

relatively few periods, such as the beginning of the 1980s, and coinciding with the discovery of oil deposits in Alaska and the North Sea, or at the end of the 1990s, as a consequence of the dispute between Saudi Arabia and Venezuela, have the quantities produced in the OPEC been the subject of disagreement. By contrast, much less success was achieved when it came to the stability of oil prices, which have been subject to major fluctuations during these years. Although it is possible that the target-price has been evolving in time as well (for example, the public expenditure needed to prevent social unrest has increased since the revolutions in the Arab world at the beginning of the last decade), data suggest that the OPEC has been an effective tool in preserving the aggregate share of its members, but this is much less the case regarding the price, confirming a basic economic rule, of Walrasian inspiration: a target cannot be established simultaneously for quantities and prices, but only on one of the two, given that the determining of the second one takes place automatically through the clearing of the markets.

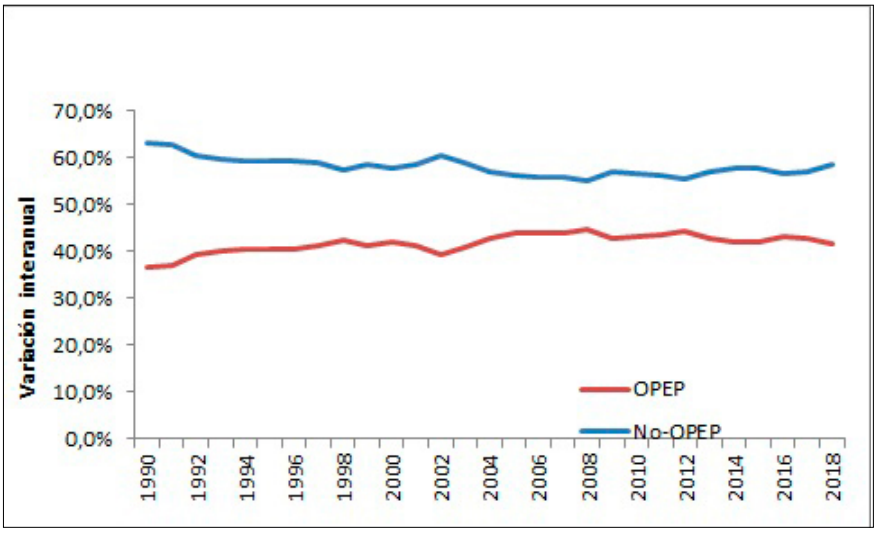


Figure 12: Oil production by group of countries. Source: BP statistical Review 2019. Own research.

The second feature of the market, already mentioned, is the pivotal role played by Saudi Arabia, which with the exception of the period described at the end of the nineties, has pursued a predictable and very steady energy policy in recent decades. Recently, aspersions have been cast on this stability, after the death of King Abdullah bin Abdelaziz, and the consequent replacement of the all-powerful Saudi Oil Minister Ali al-Naimi

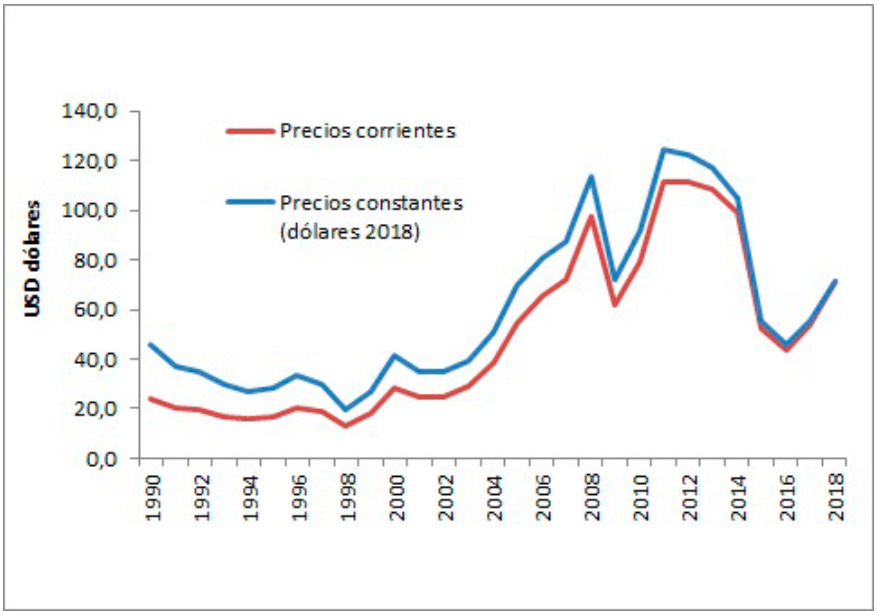


Figure 13: Spot price of oil for a barrel of Brent. Source: BP Statistical Review 2019. Own Research.

in 2016, who had occupied the post for two decades, changes that led to the historic decision to float on the stock markets 1.5% of the national company Aramco, a decision that was nevertheless lowered from the original intention to sell up to 5% of the company in one of the world's main financial centres –such as New York or London- instead of on the local Saudi market, which is eventually what happened. Although the repercussions of this decision are yet to be seen, the Saudi decision seems to have been mainly prompted by two factors, an attempt to modernise Aramco's governance and internal functioning, after several decades of isolation from any competitive tension, and also an attempt to diversify the company's resources, rather than a decision to redirect Saudi energy policy in general.

So, going back to the original question ... What really characterises the oil market? It has been pointed out that oil is the only commodity whose price was not reduced in real terms in the 20th Century, even though there were cartels organised for other products, such as tin, coffee or sugar[40]. The reason for this strength is not, as some have alleged, the greater concentration

[40] The Geopolitical Implications of Future Oil Demand, Professor Paul Stevens, Chatham House.

of its reserves, and neither is it the cartelisation of the offer, since price has only been a secondary factor in the policy pursued by the OPEC. The most convincing explanation is the soundness of the oil demand, which still registers positive growth rates, albeit in a less volatile way than in the past, thanks mainly to the advances made in the developing countries and, in recent years, to the boom lived in the USA.

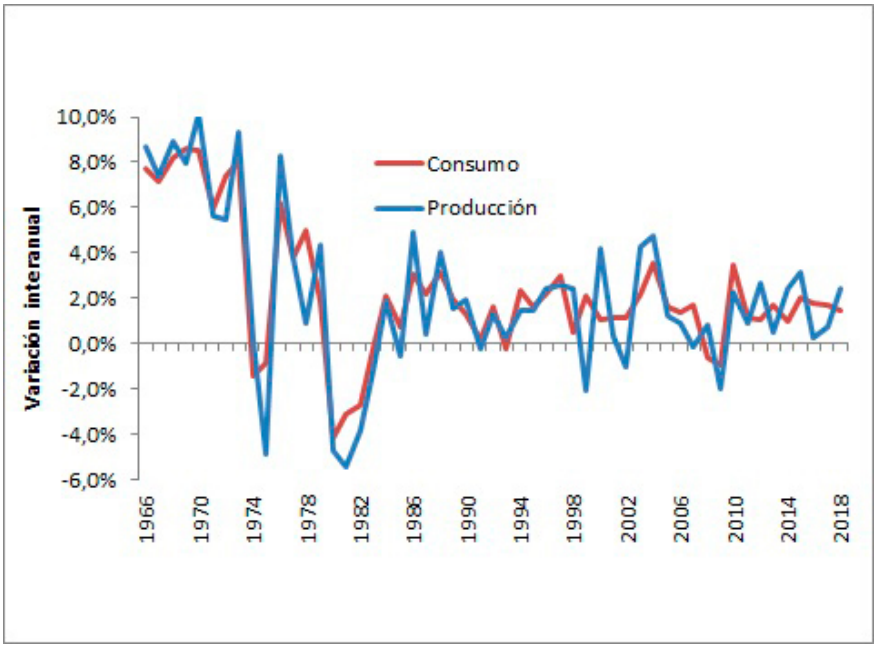


Figure 14. Growth rate in world oil consumption and production. Source: BP Statistical Review 2019. Own Research.

The long explanation given above about the oil market is a prerequisite to being able to answer the question that is the subject of this section, namely... What would the geopolitical consequences be, if we were to witness a new energy transition in the coming decades, one in which renewable sources were to displace fossil fuels?

The new energy geopolitics

As a preliminary step towards evaluating its geopolitical consequences, we must define in greater detail the energy transition considered as a subject of analysis: What transition are we talking about?

One possible exercise would be the following: What geopolitical consequences would emerge by 2040 or 2050, should the Paris Agreement commitments, to limit the rise in the world temperature "a long way below" 2 ºC with respect to pre-industrial levels, seeking to limit the increase to 1.5 °C, be accomplished? To do this, we would have to choose a specific energy scenario in 2040 or 2050 (for example, the International Energy Agency's), given that there are several alternative routes for complying with the environmental targets set in Paris (they can be achieved by opting for nuclear power or opting for renewables, for example; or even with coal, depending on how the technology for the capture and storage of CO_2. develops). In fact, it is more than likely that a combination of all these will be required, although the relative importance may vary greatly depending on the scenario.

Once the scenario has been set, we could ask ourselves about its geopolitical consequences. For example ... What does it mean if the oil share were to drop from 31 to 23 %, or if coal were to fall from 27 to 11 %, etcetera.

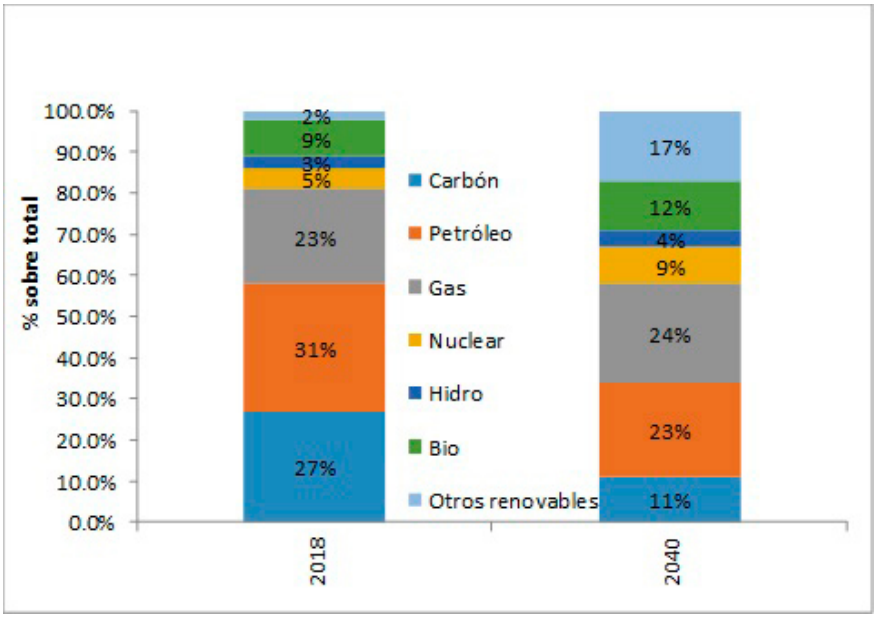


Figure 15. Energy mix in 2018 and 2040. Source: International Energy Agency, SDS scenario (World Energy Outlook 2019).

However, the limitations of an exercise of this type are clear: it could be the case that countries progress in the Paris direction, but they do not achieve the targets agreed upon there (for

example, that the reduction of fossil fuels in the energy mix were to go halfway only towards the IEA scenario), or that the targets were achieved by other means, for example, a lower contribution from renewable sources but greater progress made with energy efficiency (or more nuclear, or more coal with carbon capture). The geopolitical implications in some cases would be very different from others cases.

That is why it appears to be advisable to broaden the approach to the analysis, instead of sticking to one particular scenario. In this respect, there are a series of common characteristics in nearly all the scenarios compatible with the climate agreements. Vectors towards which the energy systems will move in the coming years, regardless of whether or not the final target established in Paris is reached:

1. Growth of renewable energies to the detriment of fossil fuels, especially coal and oil. This movement has already materialised in the electricity sector, where since 2012, most of the new capacity installed has been renewable.
2. The electrification of the energy systems. Electricity currently accounts for 19% of total energy consumption. Its importance in the mix will increase in the future, owing to the greater use of electricity in transport (due to the increasing utilisation of electric vehicles) and in the heating/cooling sector (through the use of electric heating pumps).
3. Energy efficiency. In the 20th Century, the average growth rate in the final demand for energy was 3 %, practically the same as the growth rate of the economy. However, in recent decades this link has been broken, given that the final energy demand has grown below the average for the economy: from 2000 to 2009 (before the economic crisis), the improvement in energy intensity was 1.8 % per year (i.e., the energy demand grew by 1.8 points less than the economic activity), and from 2010 to 2015 it even exceeded 2 %/year[41], although that rate has slowed down recently (in 2018 it was only 1.3 %). This trend can be explained in various ways: higher energy prices and the imposition of minimum regulatory standards (on the consumption of operating vehicles, on the use of electrical appliances or, more recently, on the energy ratings in buildings), technological

[41] Energy Efficiency 2019, IEA.

breakthroughs, and *tertiarisation* of economies, with a reduction in the influence of the industrial sector, more intensive in energy consumption than services. In general, all these factors, together with the obligations arising from environmental commitments, would indicate that an improvement in energy efficiency will continue, and even speed up, in the next few years.

This is, therefore, the energy sector that is plotted for the future: one in which renewable energies will partially displace fossil fuels, a more electrified energy system and one that is also more efficient. Now, we must find out what the geopolitical implications of these changes are?

A first appraisal is that, although it is advisable to analyse them on different levels, the transitional effects and structural effects are both equally important. They can both have major geopolitical consequences. For example, countries whose exports and public revenue feature large quantities of oil[42], may be subject to taxation pressures, which in some cases can lead to social or political unrest if they are unable to diversify their economic structures as a preventive measure. It must not be forgotten that the fall in oil prices in the 1980s was one of the factors that led to the collapse of the Soviet Bloc. Managing the potential periods of instability not only in the Middle East, but also in Latin America (Bolivia, Ecuador or Venezuela) or Africa (Nigeria, Angola or Mozambique) will be one of the key elements in the new geopolitical map. As IRENA[43] pointed out, "The emergence of a power vacuum in the current petro-states is potentially one of the major geopolitical risks involved in the energy transition".

Another factor to bear in mind will be the rate at which the energy transition takes place. Traditionally, the energy sector is associated with long periods of infrastructure maturity. The transport and electricity grids or gas pipelines are designed to operate for several decades; nuclear power plants are designed to last for 40 years, and in practice some of them will operate for over 60 years. Buildings are not replaced until at least 50 years

[42] In the following countries, the export of oil and its by-products accounts for more than 25% of the total exports: Iraq, Nigeria, Angola, Algeria, Kuwait, Azerbaijan, Brunei, Qatar, Saudi Arabia, Iran, Kazakhstan, Oman, Norway, Bahrein, Colombia, Trinidad, Russia, Surinam, Bolivia, Ecuador, Australia, Mongolia, Samoa, Mozambique and Myanmar.

[43] A New World. The Geopolitics of the Energy Transformation. IRENA, 2019.

have elapsed, and even vehicles, whose working life is shorter, are only replaced after 15 years. That is why long-term planning is so important in the energy sector. In spite of this, energy transitions have proved to be much swifter than one might have thought, and in some cases they have been completed in a mere 10 years. The aforementioned rapid growth in oil at the beginning of the 20th Century, would serve as an example, and so would the expansion of nuclear power in the 1970s (in this sense, the case of France was paradigmatic) or the so-called "dash for gas" in the 1990´s. The most convincing explanation is that the diffusion of technologies generally follows the Everett Rogers curve: however slow the adoption is at first, if a technology has clear competitive advantages, it will spread exponentially, owing to the presence of loops that feed each other. For example, if the oil share decreases in the total energy consumption, the producing countries will have strong incentives to speed up the extraction of their reserves (because they can expect lower prices in the future), flooding the oil supply market and causing an even greater drop in current prices, which will accelerate the downward spiral.

The energy transition rate increases the risk factors, because it makes it more difficult for the petro-states to adapt "smoothly", and increases the winners and losers, given that a swift transition will cause certain countries to opt for energy technologies or energy mixes that in the end will prove to be less competitive.

Another geopolitical effect of great interest will be caused by the following mutation of energy systems: as less importance is attached to fossil fuels in favour of renewable energies, the axis will shift from primary resources to technologies. It is often said that, in contrast to fossil fuels being concentrated in just a few countries, the relative abundance of renewable primary resources (such as the sun and air), automatically involves a de-concentration of the access to resources. Reality is rather more complex: indeed the availability of renewable primary resources is much more horizontal, yet there will still be supply chain restrictions. For example, this has occurred with the supply of certain metals, such as cobalt, utilised in the manufacture of turbines and batteries for electric vehicles (it is calculated that 50 % of all the demand for cobalt is currently used in the manufacture of batteries). More than 60 % of the world's cobalt supply comes from the Democratic Republic of Congo. From 2016 to 2018, the price of cobalt increased threefold, going from 26,000 dollars per tonne to over 90,000. However, in 2019, the price underwent a

severe drop, and some companies, such as Glencore, announced major production adjustments.

Concern over the supply of some of these materials, led the EU to create a list of key commodities[44], identifying their sources and the world reserves. It is worth noting that the main international reserves, for over half the 27 products that appear on the list, are in China. We will go back to this point later, when we analyse China's strategic position, and we will also examine how the country's foreign and energy policies have evolved in recent times.

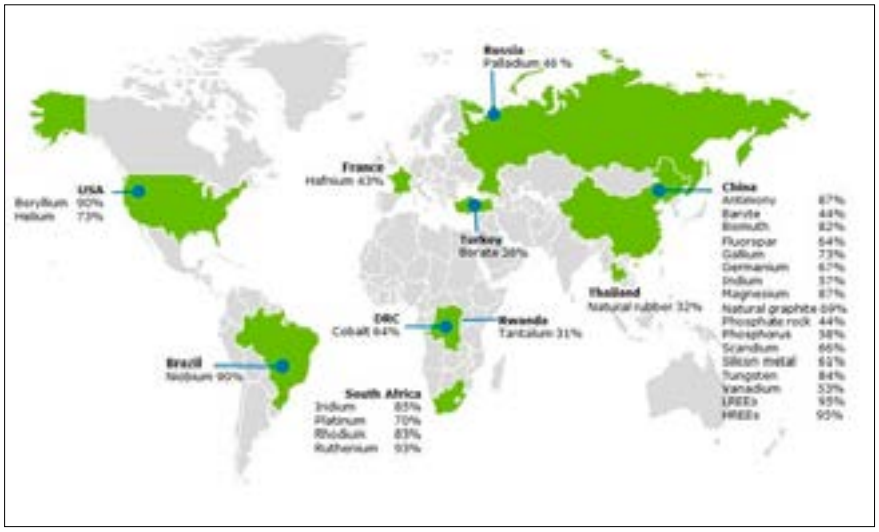


Figure 16. Map of rare earth mineral resources. Source. IRENA.

All in all, the restrictions that may affect these materials despite the notable concentration of their reserves, are not as great as the risks associated with the supply of fossil fuels. Most of these key raw materials can be replaced by other materials (albeit at a higher cost), and the potential for recycling them (unlike the potential for fossil fuels) also alleviates the possible disruptions to their supply.

The risks of energy supply interruption in the coming years will not come as much from access to resources, as they have in the past, but from other evolution vector already identified: electrification. As has already been mentioned, electricity currently accounts

[44] https://ec.Europe.eu/growth/sectors/raw-materials/specific-interest/critical_en

for approximately 20 % of the end consumption of energy. All the decarbonisation scenarios involve a substantial increase in the participation of the electrical sector[45]. In fact, the strategy adopted by most countries to date has been to decarbonise the electrical sector first, and then electrify sectors such as transport or heating/cooling.

Electrical systems are exposed to two types of vulnerability: on the one hand, their grid layout makes them more vulnerable to cyberattacks than the distribution of oil and the rest of fossil fuels, which are more exposed to physical interruptions at the so called "chokepoints" (such as the Strait of Ormuz). Renewable energies are often described as a "powerful democratisation vehicle, because they make it possible to decentralise energy supply, empowering citizens, local communities and cities[46]". Nevertheless, at the present time, until battery development allows for a complete and safe disconnection from the electrical grid, the growth of electricity within the energy mix is tantamount to a vulnerability of a different kind rather than its disappearance: the risk now takes the form of a grid rather than a bottleneck. Which of the two is the more serious? It obviously depends on the potential threats: in a future where cyberattacks pose a greater threat than physical disruptions, the former is probably a more serious risk.

A second vulnerability affecting electrical systems and also affecting major oil and gas pipelines, is the social response to interconnection projects, such as the super-grid planned in China or the 'Desertec' Project to utilise solar generation in North Africa to supply Europe.

The improvement in what has come to be known as "energy independence", i.e., supplying the energy demand from autochthonous sources, is often referred to as yet another effect of energy transition. Changing molecules of Saudi oil or Russian gas for electrons produced from solar radiation, is claimed to automatically improve countries' self-sufficiency ratio.

However, it is debatable whether this improvement in the rate of dependence will lead to an automatic reduction in the geopolitical risks. The major interconnection infrastructures, such as oil pipelines, gas pipelines or the electricity transport networks, also

[45] The International Energy Agency predicts that electricity will grow to between 30 % ("Current Policies Scenario") and 36 % ("Sustainable Development Scenario") by 2040.
[46] A New World. The Geopolitics of the Energy Transformation. IRENA, 2019.

act as shackles to national interests, aligning them in the same direction. And all of this regardless of whether they were originally devised as political domination tools, such as the Druzhba Pipeline, which throughout its 4,000 kilometres connects Russia with Ukraine, Belarus, Poland, Hungary, Slovakia, Czech Republic and Germany, or more recently the "South Corridor", which will connect Azerbaijan's gas reserves to Turkey and Europe.

It is clear that excessive energy dependence means high vulnerability (in the past, for example, Ukraine obtained almost all its natural gas from Russia). Yet an excessive re-nationalisation of the energy supplies can have the opposite effect, by limiting the international interconnection projects which require cooperation between countries securing their interests in the medium- and long-term.

Another one of the most important effects of energy transition will be felt on price stability. As has already been pointed out, fossil fuel price fluctuations have been one of the main causes of the volatility that has affected the world´s economy since the 1970s. The appearance, in some cases, of inflation shock phenomena affecting domestic economies, regardless of international crude oil price movements, came to be known as the "OECD sickness".

By contrast, price fluctuations will be slighter in an energy sector with a lower oil and gas share and a higher share of renewable energies, because the operating costs of renewable technologies are much lower, and most of those costs are fixed, which means that they are stable in time once those technologies come into service. Once again, that statement must be qualified: Price inflation is traditionally put down to high risks, because of their distorting effects. However, it might be the case that in the coming years the biggest risk is the opposite: that owing to the slackness of monetary conditions and the aging of the population (which causes greater saving rates), the biggest risk to economies might come from the opposite direction, deflation, a secular stagnation of prices or even a lowering of prices. If this were to happen, the supposed advantages of changing from an energy model that is **highly volatile regarding the prices of the factors, to another model with greater price stability, would be much lesser.**

This different composition between fixed and variable costs of the technologies harnessing renewable energies, adds a new factor

that has to be taken into consideration in geopolitical terms: the needs for financing. Energy transition has very high investment needs, with infrastructures that are expensive at the outset. Economic efficiency suggests that these infrastructures are financed by debt, not only because of their composition between fixed and variable costs, but also in view of the fact that it is the future generations that will benefit with their return. Access to affordable financing sources for these major projects has become a top priority geopolitical element[47], as can be seen from the creation of the China-backed Asian Infrastructure Investment Bank (AIIB). The decision of the European Investment Bank (EIB) in November 2019, to stop financing any fossil fuel projects that are not consistent with the Paris Agreements is also interesting in this respect.

Conclusions

We do not know all the details regarding what the future energy system will be like, for it being conditioned by a number of uncertainty factors of a political, technological and market nature, which could lead to a variety of scenarios. Nevertheless, there are a series of stylised trends, and it is highly likely that most future energy systems will move in those directions: a greater share of renewable energies to the detriment of fossil fuels, greater electrification and greater efficiency. What geopolitical consequences will these changes have?

Risk analyses often prove to be excessively optimistic when examining these changes. Changing the energy model will have important transitional effects, and many petro-states will suffer from a loss of wealth, economic activity and tax revenue, which could lead to outbreaks of social and political upheaval. It is also foreseeable that the rate of the changes is so rapid that it is impossible for the transition in those economies to take place in an orderly way.

Apart from the transitional effects, the energy paradigm shift will have major geopolitical consequences. However, it is not necessarily a question of minor risks, but rather a matter of other kind of risks. Competing for access to resources will be replaced by competition for access to technologies. The risks of

[47] The New Era of Energy Transition: Challenges, Investment Opportunities and Technological Innovations, Guest Editors: Kostas Andriosopoulos and Spiros Papaefthimiou

supplies being physically interrupted at the "chokepoints" will decrease, but the risks of systematic disruptions affecting the major electrical grids will increase instead, at least until batteries and storage systems are developed that will make it possible to create electrical mini-grids.

Energy systems will be less interdependent, to the benefit of the most vulnerable countries, but this will also limit the opportunities for cooperation that secure national interests in the medium- and long-term. Price volatility will not be as high. And the need for financing will greatly increase the strategic value of the multilateral Investment Banks and the access to financing resources.

By way of conclusion, in the next chapter we will use this geopolitical map to analyse China's strategic location and its relationship with the USA, focusing the analysis on energy, not only regarding its current situation, but also on how it can be expected to evolve in the coming years.

Third Part. The Rivalry between China and the USA

Chinese energy expansionism. Do we have anything to fear?

"China has generally never concerned itself with expansion, but rather to consolidate the control over its vast territories. And that's where its weakness lies" (Barack Obama[48])

In 2008, China restricted the sale of rare earth minerals to foreign buyers. The international markets began to panic, given the control China holds over those reserves, as we have seen in the foregoing chapter. Yet after a few months, the market pressures dissipated. The same happened with the geopolitical tension, although this took longer. The Obama Administration resorted to the World Trade Organization, which ruled against China; after this decision, China lifted the restrictions on export that caused the dispute. Throughout this entire period, although there were price fluctuations, these materials did not constitute a bottleneck where the expansion of the various renewable technologies was concerned. What prompted China to do this? Was the response of the international markets proportional?

[48] Ben Rhodes, "The World as It Is", 2018.

National Security Advisor, Henry Kissinger, entrusted by President Nixon to embark upon a discrete détente that was to lead to the re-establishing of diplomatic relations between the USA and China, at the beginning of the 1970s, became one of the best experts in the intricate labyrinths of Chinese diplomacy, and represented the different strategies in the international relations between China and the western countries on the basis of two board games: "Wei qi" and chess[49]. The aim of the former, very popular in China, is to take up more space on the board than the rival. It is played with stones (also black and white). The players take turns to place the stones in the vacant intersections. Once the stones have been placed on the board they cannot be moved, although they are removed if they are "captured" by the opponent. A stone is captured when it is surrounded, i.e. when all the adjacent squares have been occupied by the opponent's colour. While Chess is vertical, Wei qi is horizontal. The aim of the former is clear and direct: to trap the king. Wei qi is not a game of direct movements, it is a game of detours. As Kissinger wrote, chess teaches "the *Clausewitzian* concept of the centre of gravity" (all chess games begin with a battle to conquer the centre of the board), whereas "Wei qi" is based upon the art of "strategic besieging", in patiently building up small relative advantages. Chess generates "determination", "Wei qi", generates "flexibility".

As is the case with nearly all major powers, China's foreign policy has historically fluctuated between withdrawing into itself and international expansion. For example, in the 1970s, Maoism showed its most expansionist face: in 1971 direct aid from China to other countries accounted for 6.92 % of the GDP[50], much greater than aid granted from the USA or from the USSR. China was actively involved in Cambodia, Indonesia, India and Peru; there were also Maoism-inspired movements on the university campuses of the USA against the Vietnam War, and in May 68 in Paris (France), before the failure of the Cultural Revolution required the Chinese Authorities to take an introspective look back into their own country. Yet even during those expansive phases, Chinese strategy was always oblique, lateral, more akin to "Wei qi" than to chess. It almost invariably had a second characteristic: it was defensive, as Ex-President Obama stated in the quote that begins this chapter. Perhaps, as Kissinger pointed out, this is because China has always considered its civilisation to

[49] Henry Kissinger. On China. 2011.
[50] Maoism. A global history.

be superior to the rest, as the heir to the "Empire in the Centre", a civilisation whose origins cannot even be determined.

There is a clear reason why China has always pursued a defensive strategy: its geopolitical position does not need expansion, it has to consolidate though its vast territory. China has always view itself as being in the centre of the chessboard, (the "Empire in the Centre"): its historic mission was to protect that Empire, not to expand it. For example, during the Song Dynasty (960-1279), despite being the most advanced power where nautical technology was concerned, China did not embark on a quest to conquer or explore the planet, and it did not obtain overseas colonies, it merely concentrated on keeping control over its extensive frontiers. After the century of humiliations from "foreign powers", between 1850 and 1950 (a trauma in the collective Chinese subconscious similar to the one affecting Germany in the 1930s), after the victory of the Communist Party in the 1949 Revolution, China once against focused on regaining control over its territory, in a bad shape from the years before. To quote the first sentence in one of Mao's favourite books, "what has been divided for a long time, must now be united"[51]. After the victory, the new Chinese Authorities were at haste to point out that, with the exception of Formosa, and with Japan lying low after its defeat in the Second World War, the greatest threat to its interests came from the Soviet Union. Chinese discernment was commendable, because the ideological affinity between the two Communist Regimes pushed naturally in the opposite direction. China realised two decades in advance what US diplomacy would only begin to sense at the end of the 1960s: that Chinese and Soviet interests collided more than they coincided.

Chinese foreign policy during the first decades of the Communist Regime was aimed (successfully) at containing the Soviet threat to its frontiers. On occasions, this led China to participate in regional conflicts, in Vietnam, Indonesia or Cambodia, although it always did so adopting a carefully restrained strategy. In 1962, China attacked the frontier enclaves with India, but once it had conquered them, it withdrew immediately to its previous line of defence. It was such a carefully weighed up strategy that sometimes the rest of the powers found it difficult to comprehend. As Khrushchev said to Mao during the Taiwan Crisis in 1958: "if you launch missiles, I understand that you want to conquer the islands".

[51] The Romance of the Three Kingdoms.

The decline of the Soviet Block occurred at the same time as China made a big step forward. This took place as from the reforms made to its economy in the 1970s, after Mao retired and died. China's ascent in the final decades of the 20th Century occurred through economic growth, not military development, unlike Germany at the beginning of the 20th Century, and not as a result of its supremacy in a sphere of influence, unlike the Soviet Union later. The rise of China also had other singular features: Communist China, opposite to the Soviet Regime, has never embraced an ideology inherently opposed to coexistence with the other major power, the USA.[52] The Chinese Communist Party, with all its nuances, has always been more nationalist than internationalist (evidently, much more than the Soviet Communist Party). This "strategic detour" made China much more of a threat to US domination: throughout the last century, no other world economy exceeded 60 % of the US GDP. China reached this figure in 2014; and by 2019, exceeded 65 %[53]. As has been described, China is a much more "economically formidable, diplomatically sophisticated and ideologically flexible power"[54] than the Soviet Union ever was (whose GDP fluctuated between only 20 and 50 % of the USA's[55] during the Cold War).

That is surely why the western countries' response to the Soviet Union was a lot simpler: the "contention" strategy, first drawn up by George Kennan, responsible for business affairs at the US Embassy in Moscow. According to Kennan, the Soviet giant "sowed the seeds of its own destruction". The contradictions in the Soviet system, especially the economic and national ones, were so great that sooner or later it would bring itself down. The contention strategy consisted of avoiding any no-return situation, such as a nuclear confrontation between the major powers, until such time as the fall took place,

By contrast, the strategy followed in the case of China (or, to put it another way, "faced with" the ascent of China) has been much more complex to devise and implement. That is exactly why it has ranged from one extreme to another: from convergence

[52] The Sources of Chinese Conduct. Odd Arne Westad. Foreign Affairs. September/ October 2019.

[53] In current dollars. Measured in terms of the parity in purchasing power, China's GDP is now ahead of the USA´s

[54] Competition Without Catastrophe. Kurt M. Campbell and Jake Sullivan. Foreign Affairs.

[55] Maddison Project Data.

to rivalry, including "strategic competence". From economic interdependence to *decoupling*. This was not only the case with the USA, as we will further down analyse. In March 2019, the European Commission described China, for the first time, as a "systematic rival[56]".

For some time, the West followed a sort of duplicate version of the "contention" strategy. If in the Soviet case, it was felt that the contradictions were above all economic and the seams would burst on that side, yet where China was concerned the contradictions were thought to be political, and that the economic growth would end up by "naturally" leading to a transformation of its political institutions, a structured transition that although it would not necessarily lead to a political system similar to the western liberal democracies, would at least head in that direction. The ultimate and collateral aim of strengthening economic and trade relations with China (the "*engagement*", the recipe prescribed by virtually all the western foreign departments in the past decades), was a political transition in China.

However, in practice, the opposite has occurred. The era with Xi Jinping as the Chinese leader was characterised by a step backwards in the "liberalisation" of the country's institutions. Maybe the gap between the Chinese political system and the system of Western countries has narrowed, but if it has, it has taken place contrary to the expected way: because many Western countries have taken a step back with regard to the institutional pillars that were hitherto predominant, such as the separation of powers or judicial independence, or there has been a silent mutation of the parliamentary systems, making them presidentialist.

It was once the USA and Europe woke up from this sort of "second contention" dream, that they began to reconsider the global strategy of their relations with China. It must be admitted that the shadow of China is the most complex geostrategic challenge in recent decades: apart from the Soviet Union (which as we have seen, never exceeded 50 % of the US GDP), the rest of the countries that expanded their economic power in the second half of the 20th Century, were very convenient geopolitically for the USA, namely, Germany and Japan, whose progress was made merely in the industrial and commercial areas, given that their geopolitical influence was constrained by their prior military defeat; and South Korea, which had fallen under the strong

[56] The Triangle in the Long Game. Fidel Sendagorta.

influence of the USA since its decisive participation in the military conflict that split the Korean Peninsula in half in the 1950s. By contrast, China's rise is much more inconvenient for the USA from a geopolitical perspective.

The right question to ask about China's rise is not whether that rise can be kept contained, which is an increasingly rhetorical and melancholic question, but rather if there are reasons to be afraid of that ascent. The answer to that question is too complicated to be tackled in this article; in the following section we will concentrate therefore on the energy sector.

Before doing so, and to finish off this chapter, it is advisable to retrieve certain succinct lines that Deng Xiaoping wrote on retiring from public life, which were to emerge after the incidents in Tiananmen Square in 1989. Known as the "24 word strategy", he stated the following: "Observe carefully, secure our position, cope with affairs calmly, hide our capacities and bide our time, keep a low profile and never try to take the lead". As though he had already anticipated the arrival of Twitter, Deng Xiaoping also left an even briefer version: "The enemy troops are at the city gates. They are stronger than us. We should be mainly on the defensive".

Has the Chinese strategy changed since Deng Xiaoping wrote those words? Or perhaps, without having changed ….Are the USA and Europe misinterpreting this strategy?

The energy "Wei qi": is China in the role of the USA or in the role of Saudi Arabia?

China's growth in recent decades has been spectacular, almost unprecedented in history. In the energy sector, China has accounted for 40 % of the world's energy demand increase since 1990. As though it were a game of "Wei qi", China has taken advantage of this strong tailwind to place a stone in virtually all the squares on the energy board. On the oil market, it has become the world's main importer, and has expanded its refining and processing capacity coping with technical and economic difficulties, so that it can increase its domestic production of crude oil. Where natural gas is concerned, the inroads made by China have transformed the world LNG market. The way China's supply and demand evolve will be the crucial factors on a world scale in the next decade. It can now be said that the coal market is

basically a Chinese market. At the same time, China has opted for nuclear development, and is on the way to becoming the world's leading nuclear power, a position the country already occupies for renewable electrical technologies, with regard to both installed capacity and the key positioning of its firms in the research & development of patents, as well as in the manufacture of the technologies (six out of the top ten solar panel manufacturers and four of the main wind turbine manufacturers are Chinese firms). China is also at the forefront in other key areas in the energy sector, such as integration of the electrical grid, electric batteries and artificial intelligence. China is also in an exceptional position regarding control over rare earth minerals, many of which are vital for the manufacture of these new technologies. The efforts made by the Chinese State to achieve a position on nearly all the links in the chain for these technologies, through its programme "Made in China 2025" and the huge network of infrastructures envisaged in the "Belt and Road Initiative", will be the most important geostrategic elements in the energy sector for the coming years[57]. Most of the countries not only in Africa, but also in the Middle East, Latin America or Europe, find the Chinese proposition difficult to resist: "low cost technologies" with appealing financing terms, whether for the construction of electrical power plants, energy transport or 5G networks. And all of it with no strings attached, in contrast to the occupational, environmental or transparency conditions imposed when the investments come from other countries.

China has given more than enough proof that it has a deep understanding of the forthcoming energy transition: guaranteeing its own access to the primary resources in the present and most immediate future, while at the same time opting for the development of decarbonised technologies, thereby placing stones on nearly all the squares on the "Wei qi" energy board. Despite its dominant position in some markets (such as coal or crude oil imports), China knows that it is in no position, by itself, to slow down the energy transition under way, and has decided to diversify its industrial development as a preventive measure. If the energy sector in the past was similar to the game of chess, there being a winning figure at every moment (coal, oil, nuclear power or natural gas), in the coming years the transition towards a decarbonised energy system will move the axis away from primary

[57] A World Safe for Autocracy? China's Rise and the Future of Global Politics, Jessica Chen Weiss.

resources and towards technologies. That is why a strategy like China's makes sense, it is one that instead of laying siege to the winning square, distributes its pieces throughout the board.

China's movements on the energy resources access map have already transformed the geopolitical energy order. Sales of crude oil to China from Latin America and Africa have grown as quickly as Chinese influence has in these regions, although there are doubts about the capacity of the two areas to increase production any further, for geological reasons and political risk. Pipeline connection with Russia and with Kazakhstan, currently being expanded, constitute a pivotal change in power relations in Asia, strengthening the ties between the old Soviet giant and the new Chinese giant, an entente could have tectonic effects in Europe. Both Canada and the USA will also increase their exports to China, although the long distances establish a limit to them.

Maybe the most important geopolitical change is already occurring in the Middle East: China and the countries in the Middle East have reached a level of mutual interdependence that will continue to grow in the next few years. China is now already the main importer of oil in most of these countries, in a region where the profit from oil still has a great effect on the economies (40 % of Saudi Arabia's GDP, 45 % in Iraq's and 50 % in Kuwait's). Relations between China and these countries go well beyond just trading: Aramco has a shareholding in the Fujan Refinery's capital, and Abu Dhabi has granted Chinese consortiums major shareholdings in the most important oil concessions. To a certain extent, China is taking over the role that the USA traditionally played, as the principle agent in the region and hence, securing geopolitical stability there.

Moreover, China's new role has been retro-fed by two further changes, already mentioned: the increase in unconventional oil production in the USA, which has made the US a net exporter of jointly crude oil and petroleum products; and, at the same time, the turn in the Trump Administration's foreign policy, which has led the USA to explore the greater freedom of movement that it now has, even at the cost of jeopardising the historic strategic alliances in the region.

Several outbreaks of instability in the Middle East, in recent months, have made it possible to plot the most likely scenario for the coming years. All that is needed is a review of the most serious incidents: the attacks carried out on Saudi refineries

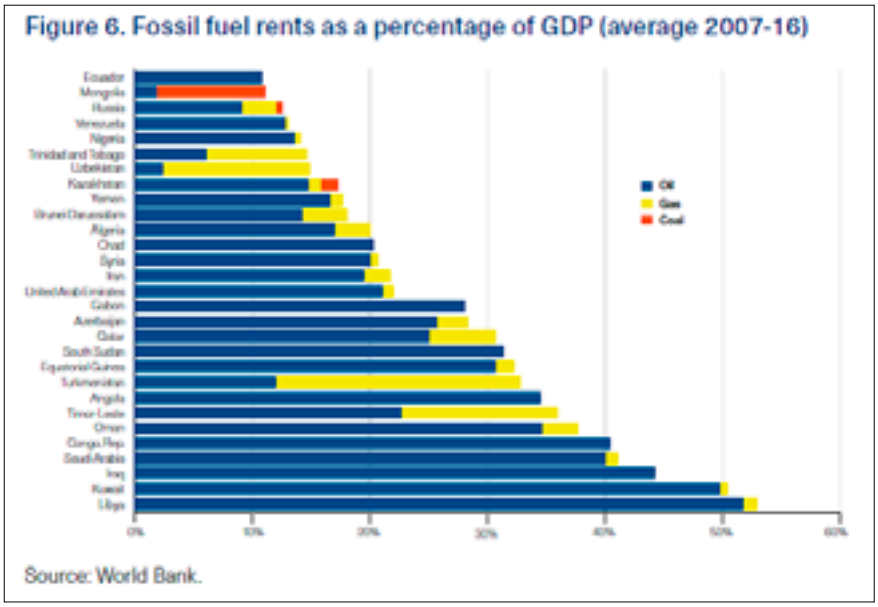


Figure 17. Profit coming from hydrocarbons in total GDP. Source: IRENA.

in September 2019, presumably sourced from Iran (and the uncertainty about whether the USA or Saudi Arabia would respond to them, which caused sharp fluctuations on the international markets), the USA's decision, a few weeks later, to impose sanctions on six Chinese firms for transporting oil from Iran, including a subsidiary of COSCO Shipping Energy –the world's largest crude oil transporting firm in the world-, and finally, the US attack on Iraqi soil that claimed the life of the Iranian General Qasem Soleimani. All these events, concentrated in a period of barely three months have, one way or another, involved the USA, a fact that is unprecedented in recent decades, when the USA always maintained a constant strategy aiming to keep the region stable (only interrupted by the Second Iraq War). At the same time, the containment shown by China during these incidents, especially the second one, which directly affected Chinese firms, shows that transition of roles in the Middle East is a geopolitical phenomenon of great dimensions that is already taking place.

There is also an additional factor, which could even increase China's strategic role in the region. Over the past decades, as we have seen, the international oil demand grew steadily, and it was the fluctuations in supply that caused the vicissitudes affecting the international markets. That is what is technically known as a "one-sided" market. In the coming years, this configuration of

the crude oil market is going to change. The most likely outcome is that the demand for crude oil stabilises first, before starting to decrease. And it will be the supply that is determined, because the producing countries will try to find an outlet for their reserves as soon as possible. In fact, it could be the case that we end up in exactly the opposite situation: we are still in a "one-sided" market, but one where it is the demand and not the supply that calls the tune. "Peak oil" has increasingly less devotees, but now there is talk of "peak demand" starting, with a certain basis. And what if the oil supply were never to run out, as the famous Hubbert curve predicted, because the demand for oil ceased beforehand? From a geopolitical viewpoint, the implications of this change are that China, as the world's main consumer of crude oil, would never become the equivalent to the USA. It would rather play the role that Saudi Arabia has been playing for the last few decades.

The victory of the Chinese Communist Party in 1949 was seen in the USA as a defeat, after decades supporting the Nationalist Government of Chiang Kai-shek. In the USA there was talk of "the loss of China". The lack of communication during the next two decades was the result, on the Chinese side, of the geostrategic priorities involved in consolidating the new regime, but on the American side, it was the result of an incorrect interpretation of the Chinese State´s new appearance. This is because, as the subsequent decades would show, coexistence between China and the USA was not only possible, but also desirable. At least, until relations began to go up in smoke in recent years.

From commitment to threat: the trade war and the Chinese-US relations

The trade conflict between China and the USA in recent years is far from being an isolated incident: it heralds a new pattern in the relations between the two countries. As Fareed Zakaria, normally a "dove" in foreign policy, pointed out in a recent article, a new consensus has emerged in US diplomacy, cutting across political formations: China has become both an economic and a strategic "vital threat" to the USA,[58]. The era of "compromise" has given way to "active confrontation". What is really being discussed is defining what this confrontation consists of.

[58] The New China Scare. Why America Shouldn't Panic about Its Latest Challenger. Foreign Affairs. January 2020.

Moreover, it is a positioning that has not only filtered through the US political classes, but also through public opinion: according to the Pew Research Centre, 60 % of Americans have an unfavourable view of the People's Republic of China, the highest percentage since that question started to be asked in 2005. Trump's decision in 2017 to withdraw the USA from the Trans-Pacific Partnership Agreement, which was already ailing a long time before, and the trade war between the US Administration and the Chinese Government, were manifestations of something much deeper: American strategists began to see China as an "adversary". The so-called "Thucydides Trap" (in reference to the work by the Greek author about the Peloponnesian War), i.e., a clash between an emerging power and a dominant power, would just be starting.

The trade war between the USA and China formally began in July 2018, when President Trump announced a 25 % trade tariff on a series of Chinese products for an import value of 50,000 million dollars (earlier, at the beginning of the year, the USA had imposed specific duties on solar panels, washing machines, aluminium and steel).

China soon responded, counterattacking the USA with another tariff (10 %) on a wider range of products, up to 200,000 million, threatening to increase it to 25 %. The truce agreed upon by President Trump and President Xi Jinping at the G-20 meeting in Buenos Aires in December 2018 de-escalated the war, giving the parties 90 days to reach an agreement, a deadline that was subsequently extended albeit unfruitfully because the negotiations collapsed in May, leading to an increase in the tariffs which took them to above 20 % (weighed to take into account their weight in the export basket), a level unknown in decades. The recent agreement signed in January 2020, known as Phase One", slightly reduced the effective tariff, and for the moment the situation has been prevented from entering an irreversible spiral.

China retaliated by adding a 25 % tariff on all petroleum products coming from the USA, plus a 10 % tariff on LNG, which was subsequently increased to 25 %, in June 2019. The sale of petroleum products to China from the USA was limited, and is now practically non-existent. Crude oil sales have also fallen because of the fear that the restrictions would be extended. The most serious potential impact is in the LNG market: in 2018, exports from the USA to China were only 3 bcm (compared to a total of 70 bcm imported by China). However, Chinese

imports are expected to double in 2025, to reach 150 bcm, whereas the USA's export capacity is expected to rise from 30 bcm to 130 bcm in 2025. All the analyses for the future agree that there will be a growing interdependence between China, with massive imports of natural gas, and the USA, with massive exports of that gas. Although the trade war has not fully affected this sector as yet, there is a real possibility that both parties might use it in the dispute, even to the detriment of their own energy security. So far, the Chinese Authorities have focused on demand containment policies: the economic downturn, which has left its mark particularly in the industrial sector (whose growth rate is at its lowest for 20 years), and a reduction in the coal-to-gas conversion plans, to which one might add an eventual lowering of the gas share target in the future energy mix (currently standing at 15 %), are moderating the future scenarios for the gas growth, as we have seen in the preparatory work for the future 5-Year Plan. Although all of this is in "Phase One" of the agreement reached between the two powers, it was announced that China would purchase 18,500 million dollars' worth of energy products in 2020, and 34,000 million in 2021, although no announcement has been made as yet about relaxing the duties due on LNG and the rest of energy products. The IMF has predicted that the impact of the trade war will have a 0.5 point effect on world economic growth for 2020, and the OECD has predicted a figure of between 0.2 and 0.3 points above the growth in both China and the USA, evaluating only the measures that came into force last June.

As we have indicated, the trade war is only one aspect to a complex jigsaw puzzle. Although China does not import enough from the USA to respond dollar by dollar to the tariffs imposed by the Trump Administration, it can resort to other measures that are equally damaging to the US economy, such as devaluing its currency, altering the bond markets or restricting the export of products that are basic in the value chains, such as rare earth minerals, as it did some years ago. Yet all these measures would also have a very negative effect on China's own economy.

In addition to trading actions, the USA has also resorted to "gunboat diplomacy", such as bullying the Chinese firm Huawei, although it has not yet been joined by other countries like Canada, or by Europe, showing a lack of realistic options in some areas, such as the development of 5G technology and the influence that Chinese companies have acquired in that development.

The trade war, the technological dispute, the accusations about the manipulation of currencies or the insufficient protection for intellectual property in China, amongst other matters, has led to a deterioration in relations between the two countries that has already been nicknamed (probably prematurely) a new "economic iron curtain". Unless the controversy takes a different course in the coming months, its consequences in the medium- and long-term will be considerable: a new phase has dawned in relations between China and the USA, more conflictive and uncertain than diplomacy between the two countries witnessed since the 1970s.

The COVID-19 Crisis

At the end of 2019, when this article was about to go to print, the SARS-CoV virus, responsible for the COVID-19 disease, caused an exogenous shock that triggered the collapse of the entire world economy, and did so in what must surely be the shortest period of time ever.

The extremely contagious nature of the virus –according to preliminary estimates, the average COVID-19 patient infects between 1.6 and 3.9 people if there are no social distancing measures- and the hyperconnectivity of modern societies, caused it to spread rapidly, requiring the Authorities in different countries to take drastic social lockdown measures and to paralyse their economies.

In view of the many uncertainties surrounding the COVID-19 pandemic (as it was formally declared by the WHO on 12th March 2020) and how it will evolve, its economic effects on the energy markets are just as uncertain. Many of the effects could either be fleeting or permanent, depending on how long the most drastic measures last, on whether or not there is a resurgence of the disease in the coming months, the symmetry or asymmetry of its impact on the different countries, and the economic reactivation profile, which could be more favourable in those countries with major industrial activity (like China) to the detriment of others where the services sector plays a much greater role, especially with regard to such activities as tourism, trade or transport, where the effects can be expected to be more long-lasting.

The effects on the energy markets have been noticeable: transport (responsible for 30 per cent of world energy consumption[59]) has

[59] World Energy Outlook 2019

virtually come to a standstill, and there has been a slighter, yet also considerable, decrease in industrial activity (which accounts for a further 30 per cent of consumption), all of which has brought about an unprecedented fall in fuel consumption, mainly affecting crude oil and its by-products, but also affecting coal and natural gas.

This sharp drop in demand has also led to major disagreements between the main oil-exporting countries, especially Saudi Arabia and Russia, regarding the best way to respond to the situation, which has caused the barrel price to plummet to levels that had not been recorded since the beginning of the first decade of the Millennium.

The oil market is undoubtedly the most complex one to analyse: China's relatively lower participation in the aggregate consumption (due to the lesser weight of transport), and the fact that the Chinese economy is foreseen to recover more quickly, for the aforementioned reasons, could support the trend described in this article, speeding up China's predominance on the world petrol market. However, a prolonged drop in the price of the barrel might also have a severe impact on the supply side, especially on the production of unconventional oil in the USA, the country being taken over its recently acquired status of net exporter of oil products. Nevertheless, the resilience that unconventional production has shown in the USA in recent years, where the country has demonstrated to have a greater ability to reduce the cost of production than most analysts gave them credit for, and the foreseeable impact of the crisis on demand, will surely balance out the two effects in net terms.

The consequences on the natural gas market are just as uncertain. The expected normalisation of the market in the coming years depends largely on how dynamic the Chinese natural gas demand is. Any delay induced by slower economic growth could also bring about a postponement in the building of some of the infrastructures already planned, and jeopardise the feasibility of those that have already been constructed.

A third range of consequences pointed out, also prematurely, concern the impact that a world economic crisis might have on international commitments to act against climate change and the development of alternative energies. Yet, the most recent experience during the 2009-2010 financial crisis, suggests that neither the global warming process nor the Authorities' response

were greatly affected by the economic situation. In recent years, climate action has been more dependent on political factors than economic factors, and more dependent on global factors than national factors. It is expected that such dependence will continue in the future.

All in all, in spite of the major uncertainties that still surround the COVID-19 crisis where its impact on the energy markets is concerned, the most likely outcome is that some of the trends described in this article will speed up, especially in the oil market, whereas the trends in the natural gas market will slow down, without there being any major effect on the progress of electrification and renewable energies.

Final Considerations

Two major transitions are in progress from an energy viewpoint: the first is climate change. The second is the transition of the energy systems to try and prevent the former. They are two transitions that are not taking place simultaneously, they take over from each other: the quicker one is, the slower the other will be.

Their potential geopolitical consequences are very different: some countries or regions, such as Australia, the Caribbean or the Middle East, will be affected by both, whereas others, like Russia or Canada, will be affected mainly by the second one. Both have very marked transitional effects, which can lead to severe disruptions in the transformations of the economies. Whichever transition is predominant, there will be winners and losers. The geopolitical map will undergo major transformations in the coming years.

At the same time, these changes are occurring at a *"tucididian"* moment in history: China is threatening the USA's world economic dominance in a way that no other power has been able to in the past century. However, it is a challenge with singular characteristics: on the one hand, it is ideologically less aggressive than the one represented by the Soviet Union. On the other hand, it is much less convenient from the geopolitical perspective than other periods of sharp economic growth, such as those experienced by Japan, Germany or South Korea in the second half of the 20th Century.

In this article we have analysed a very specific aspect of these geopolitical movements: relations between China and the USA in

the energy sector. Because of their far-reaching implications, to a certain extent it is the energy sector that will be showing the direction in which geopolitical interests will be heading in the next few years.

Where the oil sector is concerned, the situations affecting China and the USA could not be more different. In China, demand is growing and production is falling, in the USA quite the opposite is happening. As a result, China is replacing the geopolitical influence that the USA has traditionally exerted in zones like the Middle East (with consequences that are already being felt), and to a lesser extent in Africa and Latin America. At the same time, China is strengthening its relations with Russia, in a move that could have major consequences in Europe.

The natural gas sector was called into play to act as a pole to align the interests of China and the USA in the coming decades. The rapid growth in demand in China and of exports in the USA, create a perfect scenario to foster a mutual interdependence between the two countries. However, the escalation in trade tension between the two countries, together with a slowing down of industrial activity in China, is seriously threatening future relations.

Where the new renewable energies are concerned, China is moving in a more determined way than the USA. China's sharp growth is enabling the country to adopt a diversified strategy, opting for a wide range of primary sources. China is also endeavouring to find a place in all the links in the value chain, from the extraction of rare earth minerals, to the manufacture of solar panels, wind turbines or electric batteries. China is thus moving its centre of gravity from primary resources to technological resources, and such a shift is also happening with the energy systems.

China is also acting decisively in other spheres, such as the infrastructures that interconnect other countries, via the "Belt and Road Initiative", through the intensive activity of many of its companies abroad, or by providing long-term financing sources through multilateral organisations, some of the key variables in the future development of energy systems.

Even if there were to be a far-reaching energy transition in the next few decades, the geostrategic tensions would not dissipate, but would merely change their form. The pressing need to act decisively in the energy sector to limit its impact on climate change must not lead to geostrategic complacency. The risks will

be different, but there will still be risks. The social challenges of the transition are formidable, in view of the fact that both climate change and the policies adopted to combat that change have effects that are often regressive, and such effects will be even more serious where the weakest inhabitants are concerned. The fact that, as we have already pointed out, the energy transitions are taking place at the same time as the most far-reaching geopolitical transition in the last century, means that the coming decades will be a period of great historical importance. In contrast to what the prophets of doom might say, we are now standing at the crossroads and are faced with a dilemma that constitutes as big a challenge as has ever been faced before. Energy is just one of many variables. But it is definitely one that will reveal some of the clues that indicate which course history will take.

Chapter two

Geopolitics in the Eastern Mediterranean: more than just gas

Felipe Sánchez Tapia

Abstract

The strategic value of the Eastern Mediterranean Basin, located at the confluence of three continents, has been recognised since time immemorial, being a scenario for conflicts between empires and civilisations, which made great efforts either to dominate it or, at least, to prevent their rivals from doing so. In the present days and from a geopolitical perspective, this part of the Mediterranean is considerably fragmented, this being a consequence of historical, cultural and religious differences, all of which have been greatly accentuated by the discovery of huge hydrocarbon reserves.

The potential economic benefits of exploiting these reserves have aroused the interest of all the Coastal States, which have logically attempted to exert their rights to these deposits, thus rekindling old disputes regarding the demarcation of sovereign space and raising the tension between the parties to alarming levels. This situation, which is in itself difficult, is further complicated by the involvement of external stakeholders. The interests of European countries like Italy, France or the United Kingdom, with large energy companies participating in the exploitation of those

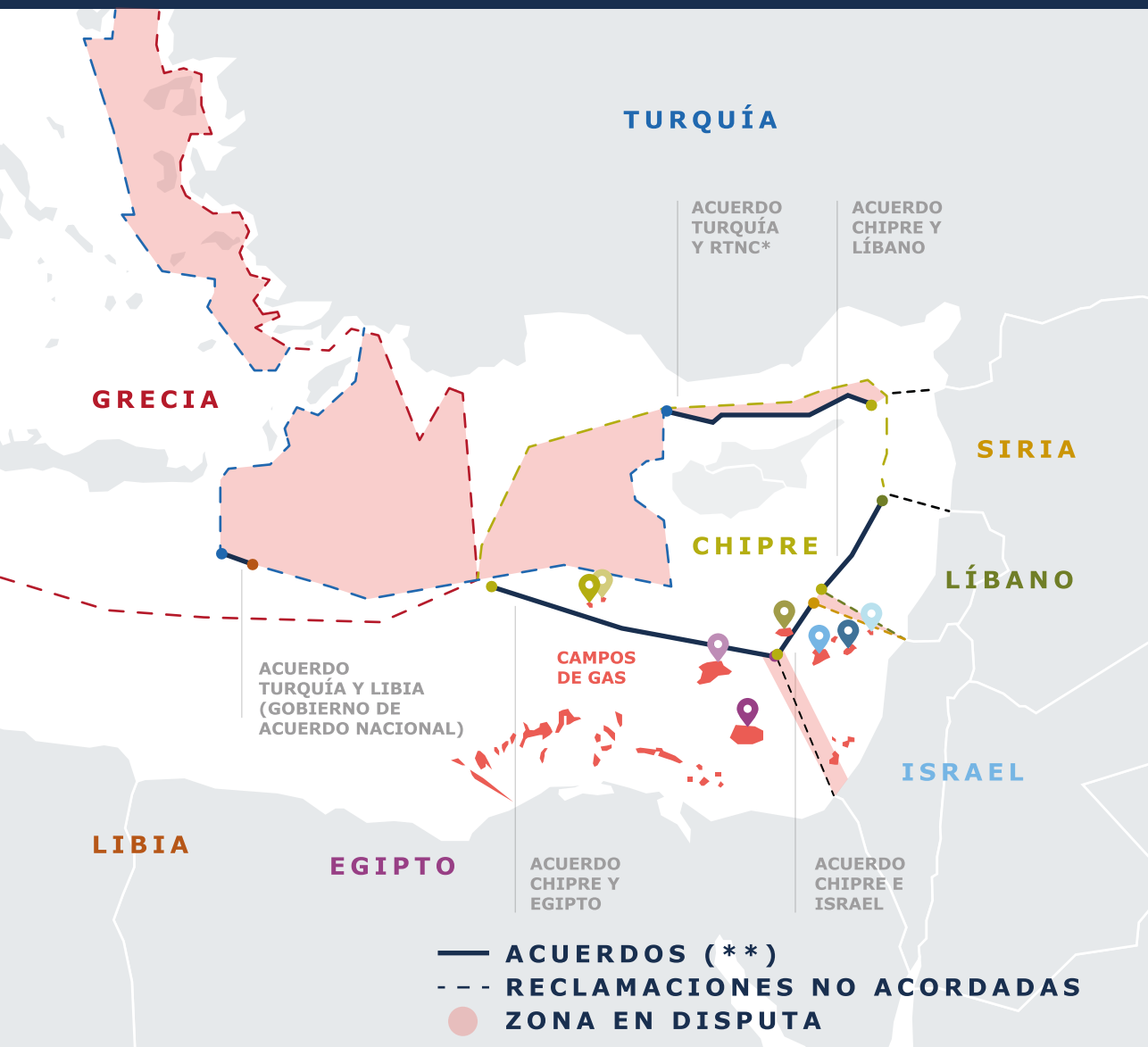
resources, are added to the rivalry existing between Turkey, on the one hand, and Greece, Cyprus, Egypt and Israel, on the other. It is a game of interests played by many groups, which offers magnificent opportunities to the global powers, the United States, Russia and China, to stage the strategic competitiveness for world domination that characterises the current geopolitical scene. The consequence is a growing instability in the Eastern Mediterranean that encourages the countries involved to increase their military presence, thus heightening the likelihood of armed clashes.

The COVID-19 outbreak has resulted in a temporary suspension of drilling activities. It is still too early to fully assess the impact of the pandemic on the regional stability. But it seems that it might well be a brief interlude. In fact, we are already witnessing a multidimensional conflict where the military footprint is still limited. However, if no action is taken to prevent it, it will tend to gather momentum.

Keywords

Cyprus, Egypt, Natural gas, Geopolitics, Greece, Israel, Aegean Sea, Eastern Mediterranean, Continental Shelf, Turkey, Exclusive Economic Zone.

RECLAMACIONES SOBRE ZONA ECONÓMICA EXCLUSIVA Y PLATAFORMA CONTINENTAL



PRINCIPALES YACIMIENTOS DE GAS

(*) LA REPÚBLICA TURCA DEL NORTE DE CHIPRE NO ESTÁ RECONOCIDA INTERNACIONALMENTE
(**) LOS ACUERDOS BILATERALES SEÑALADOS NO IMPLICAN SU RECONOCIMIENTO POR TERCEROS PAÍSES

- **ZOHR** — RESERVAS ESTIMADAS: 318 BCM
- **NOOR** — RESERVAS ESTIMADAS: 850 BCM
- **TAMAR** — RESERVAS ESTIMADAS: 318 BCM
- **LEVIATÁN** — RESERVAS ESTIMADAS: 605 BCM
- **KARISH** — RESERVAS ESTIMADAS: 50 BCM
- **AFRODITA** — RESERVAS ESTIMADAS: 129 BCM
- **CALYPSO 1** — RESERVAS ESTIMADAS: 169-226 BCM
- **GLAUCUS 1** — RESERVAS ESTIMADAS: 142-227 BCM

FORO GASÍSTICO DEL MEDITERRÁNEO ORIENTAL - EAST MED GAS FORUM

PAÍSES EAST MED GAS FORUM

EL EAST MED GAS FORUM FUE ESTABLECIDO EN ENERO DE 2019 EN EL CAIRO COMO FORO POLÍTICO DE COOPERACIÓN EN MATERIA ENERGÉTICA ENTRE PAÍSES PRODUCTORES Y CONSUMIDORES EN EL MEDITERRÁNEO ORIENTAL, INCLUYENDO A EGIPTO, CHIPRE, GRECIA, ISRAEL, ITALIA, JORDANIA Y LA AUTORIDAD PALESTINA A LOS QUE PODRÍAN UNIRSE FRANCIA Y, EN CALIDAD DE OBSERVADOR, ESTADOS UNIDOS.

FUENTES DE CONFLICTO

- DELIMITACIÓN DE LA ZONA ECONÓMICA EXCLUSIVA
- AGUAS TERRITORIALES EN EL MAR EGEO
- EXPLORACIÓN/EXPLOTACIÓN DE RECURSOS ENERGÉTICOS
- REFUGIADOS Y FLUJOS MIGRATORIOS

Introduction

In 1963, the Geography lecturer Saul Bernard Cohen, in his work *Geography and Politics in a World Divided,* wrote about the peculiarities arising in certain regions of the world that are "strategically located, occupied by a certain number of States in conflict and captive to the opposing interests of major powers with influence in the zone". He defined those regions as *shatter belts*[1]. This concept, development of the *crush zones* that other geographers such as James Fairgrieve had proposed earlier, could be applied, in the context of the Cold War, to the Middle East and to South-East Asia, zones where there was tension between the power of the Soviet Union and what he referred to as the Trade-Dependent Maritime World, which included, amongst others, what we usually call the Western World.

The term in itself, with no need for further explanation, is evocative and unequivocally conveys the idea of being in an area where a variety of interests converge and collide, an idea that the return of strategic competitiveness between the USA, on the one hand, and the "revisionist powers"[2], on the other, has once again come to the fore.

Continuing with Cohen and his definition, shatter belts possess a series of characteristics that make them particularly interesting from the perspective of this renewed competitiveness. Firstly, they contain resources that are of vital interest to the Maritime World. Although other regions may contain resources, even in greater quantities, the political, cultural and economic fragmentation hinders united action, which makes them exposed to both regional and global powers trying to exploit the differences to their own advantage. Moreover, and this is especially important at present, these zones offer "great freedom of action to exercise different forms of containment" while at the same time providing potential for establishing military bases from which "they can keep contiguous zones under check". The behaviour of foreign powers in making the most of these possibilities creates a vicious circle, bringing about further regional fragmentation that causes even greater conflict.

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1 COHEN, Saul B. *Geography and Politics in a World Divided*, Ediciones Ejército, Madrid 1980, p. 136 and following.

2 Terminology utilised in the *NATIONAL SECURITY STRATEGY of the United States of America, December 2017.*

Although the analogy is far from perfect, those are the circumstances that we observe in an area that, like the Eastern Mediterranean (EASTMED), is merely an extension of the Middle East: major geopolitical fragmentation caused by historical, cultural, religious differences, etc., greatly accentuated by the discovery of vast hydrocarbon reserves over which all the Coastal States wish to exercise their rights and which have attracted the interest of global powers, including the USA and Russia, and also European countries such as France and Italy, dragging in the European Union (EU) as a whole. What is more, China, with its Belt and Road Initiative, is not indifferent to what happens in this part of the Mediterranean. All these circumstances increase the complexity of the problems that have been faced there for decades, making the EASTMED an area of increasing instability.

This work, split into two major parts, attempts to provide elements that help to understand which factors affect the complicated geopolitical balance in the EASTMED. The first section, entitled "The Geopolitics of the EASTMED", gives a brief analysis of the geopolitical factors that affect the easternmost basin of the Mediterranean, including the historic questions that for decades have caused clashes to a greater or lesser extent between geopolitical stakeholders, paying particular attention to the energy factor, a question that is approached from three distinct viewpoints: (1) production; (2) exploring further deposits and fields; and (3) exporting the resources in order to make them profitable.

In a second part, entitled "Power relations and containment policy in the EASTMED", we will examine in greater depth the power resources available to the geopolitical stakeholders with interests in the region, especially military resources, or *hard power*, to use the terminology suggested by Joseph Nye, and how these are being utilised to achieve their respective goals. All of this will enable us to comprehend the reasons that are causing the different actors involved to increase their military presence in the Mediterranean, and the consequences that all of this has on stability in the region.

First Part - The Geopolitics of the EASTMED

For geographers, the Mediterranean's Eastern Basin means the waters lying to the East of an imaginary line running through the Italian Peninsula, Sicily, Malta and the Tunisian Coast. However, the zone that we are referring to in this document as the EASTMED

is somewhat smaller, because it considers only the area lying to the East of the line plotted from Cape Matapan, at the southern end of the Balkan Peninsula, to the coasts of Egypt, including the Aegean Sea and the bordering countries: Greece, Turkey, Syria, Lebanon, Israel and Egypt (Figure 1).

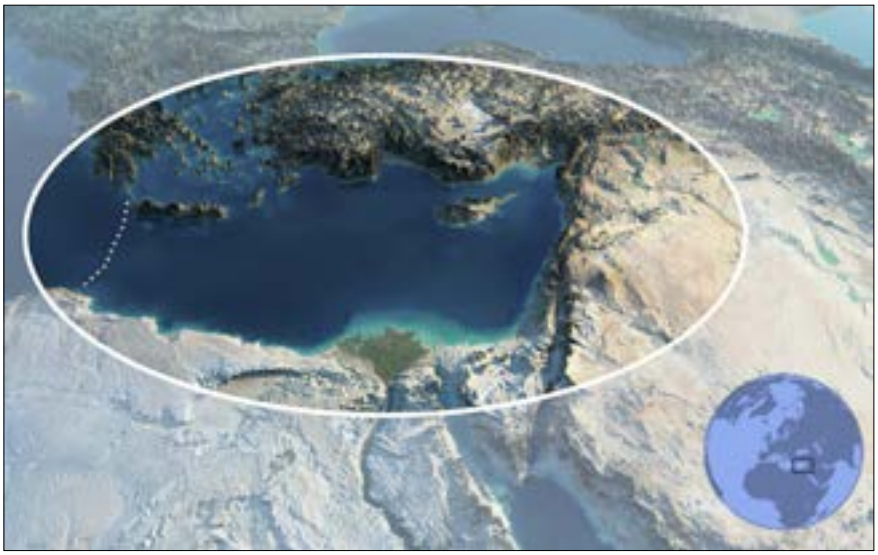

Figure 1: Eastern Mediterranean (EASTMED)

There are several geographical peculiarities and historic circumstances that come together in the EASTMED and that must invariably be taken into account when it comes to making any analysis involving the current conflict: on the one hand, the Suez Canal and Turkish Straits bottlenecks and, on the other hand, the island of Cyprus, control over which has been and still is of paramount importance in the struggle to dominate the trade routes.

1. *The Suez Canal*. Its opening in 1860 made trade possible via alternative routes to those discovered by the Spanish and Portuguese in previous centuries. This made it an object of desire for the maritime power of the day: England. British interests were initially guaranteed by the purchase in 1875 of nearly half the shares in the owning company and by establishing, *de facto* in 1882 and formally in 1889, the Protectorate of Egypt, which put it on a head-on collision course with the interests of the declining Ottoman Empire. British control over the Canal ended after it was nationalised by Nasser in 1956 and, ever since, the Canal has been managed by the Suez Canal Authority, a State-owned body dependent upon

the Egyptian Government. Its importance to world trade is clear, proof of this lying in the fact that more than 1,100 million tonnes of goods pass through the Canal every year[3].

The Convention of Constantinople (1888) is the international mechanism that currently regulates the Canal's legal system. Where navigation is concerned, it is based upon three principles: a) freedom to navigate at all times; b) freedom of passage for warships as long as they do not stop; c) the neutrality of the Canal, which prevents it from being attacked or blockaded in war time[4].

2. *The Turkish Straits: Bosporus and Dardanelles.* These Straits are the access route from the Mediterranean to the Black Sea and, from there to the Eurasian land mass. Their great strategic value at present lies in the fact that, from the beginning of the Russian Empire's expansion, the Straits have always been the only outlet to the open sea available to Russia's fleet during the winter months. Therefore, it is hardly surprising that control over these Straits has been one of Russia's strategic priorities for centuries. It was precisely the Soviet Union's attempt to guarantee control over the Straits after the Second World War that led Turkey to seek the USA's support and to join NATO in 1952.

   International use of the Straits is governed by the Montreux Convention (1936), which gives Turkey complete control over them (security, traffic regulation, etc.) while at the same time guaranteeing freedom of passage to international trade traffic, setting certain tonnage restrictions and staying time in the Black Sea for warships and their accompanying ships, when such vessels belong to States that *have no borders on the Black Sea.*

3. *The island of Cyprus.* Strategically located 50 miles off the Turkish Coast and at a similar distance from the Syrian Coast, this island has since time immemorial been used as a springboard or advanced base for access to the Middle East and to control navigation throughout the zone. That is why the UK occupied the island in 1878 after the Ottoman Empire was defeated in the Russo-Turkish War (Congress of Berlin),

[3] Data from 2018, Suez Canal Authority, available at https://www.suezcanal.gov.eg/English/Pages/default.aspx. Consulted in October 2019.

[4] Manual del Derecho del Mar [*Law of the Sea Manual*]. Vol. I (p. 113). Publications by *Ministerio de Defensa*, 2016.

an occupation that lasted until the Independence of Cyprus in 1960 and that in a way the UK still maintain nowadays since it retains two sovereign military bases there:: Akrotiri and Dhekelia (Figure 2).

Figure 2: Island of Cyprus.

After Independence, the great tension on the island between the communities of Greek and Turkish origins led to a coup d'état in July 1974 against Archbishop Makarios's Government, which caused Turkey to intervene, and this *de facto*, divided the country into two parts. Ever since then, the Republic of Cyprus (RoC), which is fully recognised internationally and is a member of the European Union, only has effective control over the southern part of the island; to the north, the Turkish-Cypriot community announced the self-proclaimed Turkish Republic of Northern Cyprus (TRNC), recognised only by Turkey, which owes its continued existence to the permanent presence of the Turkish Army[5]. Further to the United Kingdom, both Greece and Turkey were declared by the Guarantees Treaty (1960) to be guarantor powers of the island´s status[6], although the latter countries have positioned themselves as protectors of their respective communities' interests.

[5] At present, there are about 40,000 soldiers.

[6] Treaty of Guarantee, Nicosia, 16th August 1960, available at https://peacemaker.un.org/cyprus-greece-turkey-guarantee60. Consulted in February 2020.

There is no easy solution to the conflict. At present, the only option officially considered is to establish two zones and two communities integrated into one single Federal State (parameters agreed to by representatives of both communities before the United Nations in 1977 and 1979), the debate revolving around delimiting the powers of the Federal Government, the territorial question, returning properties to their rightful owners, internal displacement and, above all, the question of guarantees and the presence of troops on the island[7]. In recent years, under the auspices of the United Nations, there have been several rounds of negotiations, the most recent of these being held in the Swiss location of Crans-Montana in Summer 2017, hardly any progress being made however towards the settlement of those issues.

At a recent trilateral meeting held in Berlin (November 2019) between representatives of the two communities and the United Nations, an undertaking was reached to resume negotiations during 2020, with more participants this time, to include Greece and Turkey, in their roles as guarantors of the communities, plus the UK. However, the fact that presidential elections are due to be held in the northern part of the island in April this year has meant that a specific date for these negotiations has not yet been set.

These matters of a historic nature affect the security of the EASTMED in at least four closely-interrelated ways that we will briefly explain: the continuous conflicts in the Middle East and the resulting flows of emigration; the rivalry between Greece and Turkey over the distribution of territorial waters in the Aegean Sea; the rivalry between the coastal States with respect to the delimitation of their respective Exclusive Economic Zones (EEZ) and continental shelves; and, last but not least, the exploration and exploitation of energy resources.

Effects of the Middle East Conflict: the Refugee Crisis

One of the ways in which the tension caused by the Syrian Conflict has affected the already complicated regional relations is through the presence of over 5,600,000 refugees who have been forced

[7] Interview between the author and the Cypriot Embassy in Madrid on 29 November 2019.

to flee from their country of origin[8]. More than 65% of them, about 3,676,000, have found refuge in neighbouring Turkey and, apart from the human tragedy that this means, the impact on the Turkish society that has taken them in is considerable. Many of the refugees have made certain countries in the European Union their ultimate destination, which has brought about an increasing tide of refugees over the years, who -in some cases legally, but mostly illegally- have been trying to make it to European territory, especially via the Greek islands in the Aegean Sea, in view of their proximity to the Turkish coast.

Internal tension within the EU over this matter revealed the limited extent of European cohesion, causing an unprecedented political crisis. This crisis was only overcome by an agreement reached between the EU and Turkey in 2016, whereby the latter committed itself to accepting the return of those who were entering the EU illegally in exchange for the EU agreeing to finance refugee support projects in Turkey[9]. This ingenious agreement had almost immediate effects, drastically reducing the flow of illegal immigrants until it virtually came to a halt[10] (Figure 3).

However, with time, the application of the agreement has revealed its weaknesses and, above all, two different ways of viewing the problem. Turkey claims a failure by the EU to fulfil its obligations (a lack of financing[11], refusal to exempt Turkish citizens from requiring visas, etc.) and this would be grounds for recurrently relaxing the frontier control measures[12].

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[8] Data from ACNUR, Operational Portal, October 2019, available at https://data2.unhcr.org/en/situations/syria. Consulted in October 2019.

[9] The EU committed itself to the direct financing of refugee support projects divided into two trenches: 3,000 M€ in 2016-2017 and a further 3,000 M€ in 2018-2019.

[10] The agreement, signed in March 2016, envisaged that for every Syrian returned to Turkey from the Greek islands after crossing illegally, the EU would take responsibility for one Syrian coming from Turkey that had not attempted to embark on this voyage in an irregular way. The effects of the agreement were immediate. From a maximum of around 7,000 persons per day in October 2015, the average number of arrivals fell to 47 per day at the end of May 2016. EU Communications Office, available at https://op.europa.eu/es/publication-detail/-/publication/1aa55791-3875-4612-9b40-a73a593065a3/language-es. Consulted in October 2019.

[11] On 30 September 2019, of the 6,000 M€ promised, projects amounting to 5,800 M€ had been planned, contracts being signed for 4,200 M€ and 2,700 M€ having been paid out. Data source: European Commission at https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/facility_table.pdf. Consulted in November 2019.

[12] *EU has not fulfilled all its promises: Turkish FM*, Anadolu Agency, 23 January 2020, available at https://www.aa.com.tr/en/europe/eu-has-not-fulfilled-all-its-promises-turkish-fm/1710836. Consulted in February 2020.

This is well proven seeing how the flow of Syrian refugees into Europe was handled – a flow promoted on February 2020 by the Turkish Government, at the worsening of the Syrian war in the region of Idlib, on the northwest of the country. It is easy to imagine that the migration pressure on Greece, in particular, and on the EU, in general, would have an immediate effect, causing an inevitable increase in the internal tension within the EU for this reason.

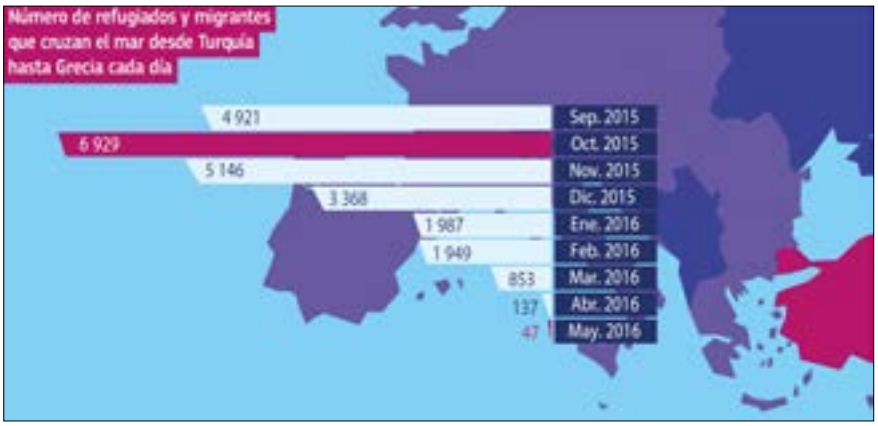

Figure 3 Flows of immigrants to the EU. Source: European Commission – Directorate-General for Migration and Home Affairs.

Recently, there has been an upsurge in the number of refugees reaching the Greek coast from Turkey in amounts that, albeit considerably lower than the figures for 2015 and 2016, have set the alarm bells ringing. (Figure 4).

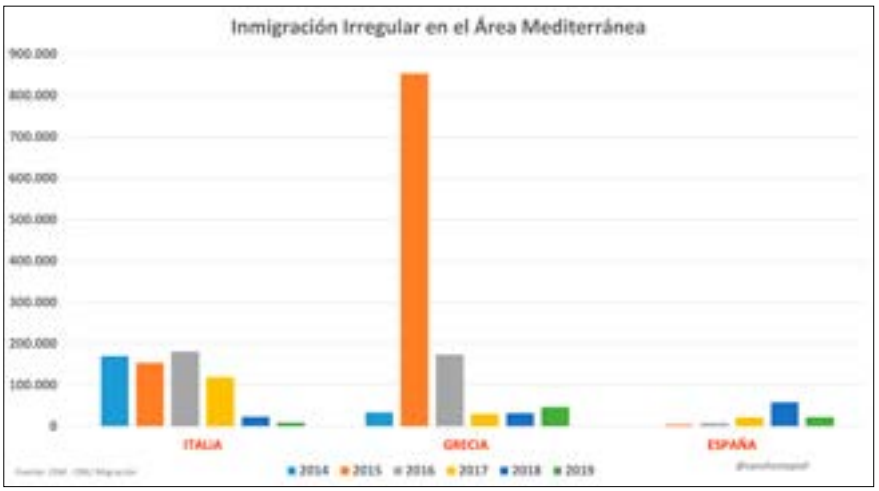

Figure 4: Irregular immigration in the Mediterranean area. Source: UNO Immigration. Compiled by the author.

One factor closely linked to this question is the possibility that terrorists from the Middle East might infiltrate the waves of refugees. Although this can never be completely ruled out, a reduction in the flow of refugees also limits the likelihood of terrorist networks making use of such weakness. So far, even though it has been detected that these routes have been occasionally utilised for this purpose, the procedure cannot be regarded as systematic[13].

The Aegean Sea

The Aegean Sea. This is the part of the Mediterranean that lies to the north of the arc formed by the islands of Crete, Kasos, Karpathos and Rhodes, between the southern tip of the Greek Peninsula and the Turkish coasts.

Figure 5: Aegean Sea

Disputes in this zone of the Mediterranean are quite frequent and arise from two different interpretations of the distribution

[13] EUROPOL, *Terrorism Situation and Trend Report 2019*, 27 June 2019, p. 42.

of sovereign zones: territorial waters and air space, without excluding the respective claims made regarding the EEZs and the continental shelf.

International Law, through the United Nations Convention on the Law of the Sea (UNCLOS)[14], sets the delimitation criteria for maritime spaces where the sovereignty of States is concerned. A distance of 12 nautical miles (NM) is generally established as being the extent of territorial waters within which a State has full sovereignty. For historic reasons, this general criterion has not been applied to that part of the Mediterranean and the territorial waters as applied to Greece and Turkey have been limited to 6 NM. Greece's attempt to increase its territorial waters limits to 12 NM during the UNCLOS ratification process in 1995[15], caused an angry reaction from Turkey, and the latter declared this question *casus belli*[16]. If the increase were to take place, the Aegean Sea would *de facto* become a Greek sea, restricting Turkish access to international waters (Figure 6).

Regarding the air space, it was defined by the Chicago Convention (1944) as the region of the Earth's atmosphere lying above States' full sovereign territory, including their territorial waters, but not beyond them. Once again, there are certain peculiarities concerning the Aegean Sea. For a variety of reasons, since 1931 Greece has been unilaterally extending its sovereign air space up to 10 NM, not restricting it to its territorial waters limit of 6 NM, a situation unusual in International Law that has never been accepted by Turkey, whose Air Force deliberately and habitually carries out flights within that zone.

Apart from daily complaints lodged by Greece for what the latter considers to be violations of its air space, this situation has also caused numerous incidents and moments of great tension, and even armed confrontations that have sometimes led to fatal casualties. This is a bilateral conflict in which other stakeholders, especially Russia and USA, have refrained from becoming directly involved. Neither of them is in favour of changing the status quo,

[14] Available at: http://www.un.org/depts/los/convention_agreements/texts/unclos/convemar_es.pdf. Consulted in October 2019.

[15] Greek Minister of Foreign Affairs, available at https://www.mfa.gr/en/issues-of-greek-turkish-relations/relevant-documents/territorial-sea-casus-belli.html. Consulted in October 2019

[16] Resolution of the Turkish National Assembly dated 8 June 1995, granting the Turkish Government full and permanent powers to declare war if Greece were to decide to extend its territorial waters beyond 6 NM.

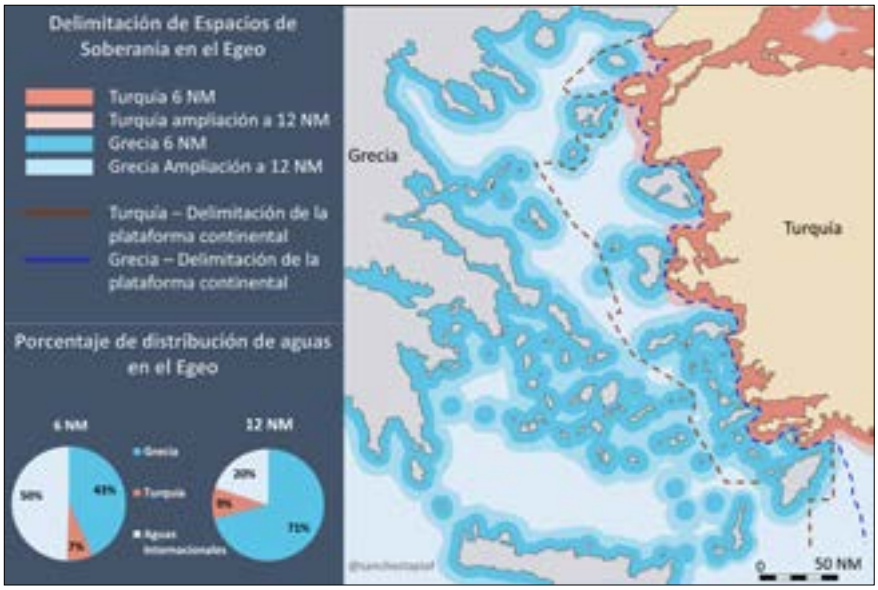

Figure 6: Delimitation of territorial waters in the Aegean Sea. Different sources. Compiled by the author.

in which Greece and Turkey have both contained themselves, avoiding an excessive "nationalisation" where their accesses to the Black Sea are concerned. Moreover, the fact that both countries belong to NATO is a powerful argument for playing down the conflict. It is highly likely that there will be isolated incidents, but it is very improbable that the conflict will degenerate into a large scale confrontation[17].

Delimiting the Exclusive Economic Zones (EEZ) and Continental Shelf

As is the case with territorial waters, it is UNCLOS that establishes 200 NM as being the maximum extension of any State's EEZ and continental shelf, although, where the continental shelf is concerned, the limit can be increased to a maximum of 350 NM in certain circumstances (Figure 7).

Making a distinction between continental shelf and economic zone is no easy matter, because they are two legal concepts established simultaneously on one single space: 200 NM. The continental shelf

[17] SÁNCHEZ TAPIA, Felipe. Geopolítica del gas y militarización del Mediterraneo Oriental [*Geopoliticof gas and militarisation of the Eastern Mediterranean]*. IEEE Analysis Document 05/2019.

Figure 7: Delimiting sovereign spaces according to UNCLOS. Compiled by the author.

includes the seabed and the subsoil, and established States' sovereign rights to the resources that lie there, regardless of whether these are expressly declared. However, the EEZ includes not only the seabed and the subsoil, but also the overlying waters. Unlike the case with the continental shelf, a State must make an express claim to it if that State wishes to exercise the "…sovereignty rights with a view to exploring, conserving and administering the natural resources…" that the State in question believes belong to it (Art. 56). In practice, this distinction is not very important when it comes to analysing disputes in the EASTMED, but it can be of great importance when it comes to solving a dispute of these characteristics by legal means or if the legitimate use of force is resorted to.

It is generally difficult to distribute these spaces because many interests are involved. Yet doing so in the waters of the EASTMED is particularly problematic for two basic reasons. Firstly, because the dimensions of the Mediterranean in this zone exclude the automatic application of the 200 NM criterion, which means that the coastal States in the region must set these limits by mutual agreement. And secondly, as not all the States with an EASTMED coastline have signed the UNCLOS (Turkey, Israel and Syria have not), it is not possible for the controversies envisaged in it to be

settled by that Convention[18]. The only option is to seek negotiated solutions between the parties that, acting in the spirit of "understanding and cooperation" indicated in the Convention, do "everything in their power to reach provisional agreements of a practical nature and, during this period of transition, [refrain from doing] anything that might jeopardise or obstruct the conclusion of the final agreement" (Art. 74).

None of this has happened, and the finding of hydrocarbons, which we will deal with later, makes this matter more difficult, because this discovery is precisely what has prompted certain countries to declare unilaterally, or by means of bilateral agreements if that was possible-, their respective EEZs. The criterion generally applied for this purpose involves establishing an equidistant line between the coasts of the two States (the equidistance principle). However, this principle is not universally accepted, given that Article 59 of the Convention states that "…the conflict should be settled on the basis of equity, and in the light of all the relevant circumstances" (principle of equity). It is the opinion of certain States that equity is not equivalent to equidistance, and to guarantee fairness certain other particularities must be taken into account, such as the respective lengths of their coastlines. This viewpoint becomes particularly relevant in cases where the rights generated by the island territories are at loggerheads with territory on the continental land mass and, in this respect, it must be considered that the jurisprudence applied by the current International Court of Justice tends to favour the latter over the former[19]. This is the cause of the controversies that we will now be analysing.

Greece - Turkey

The differences between the two States beyond the Aegean Sea have similar characteristics to the aforementioned ones. Greece applies the principle of equidistance to delimit its continental shelf, whereas Turkey argues that under no circumstances can an

[18] International Tribunal for the Law of the Sea or mandatory commercial arbitration. Moreover, on occasions appeals have been made to the International Court of Justice.

[19] Rulings given by the International Court of Justice on 24 February 1982, in a case involving the continental shelf, Tunisia against the Libyan Arab Jamahiriya, and on 3rd June 1985, a case concerning the continental shelf, Libyan Arab Jamahiriya against Malta – Summaries of the rulings, consulting opinions and providences from the International Court of Justice 1948-1991, p. 159 p. 198, respectively. In both cases the Court ruled against the principle of equidistance. Available at http://legal.un.org/icjsummaries/documents/spanish/st_leg_serf1.pdf. Consulted in December 2018.

island territory have the same rights as the continental land mass. As can be seen in Figure 8, the difference between applying one criterion or the other is considerable, rendering the two positions almost irreconcilable.

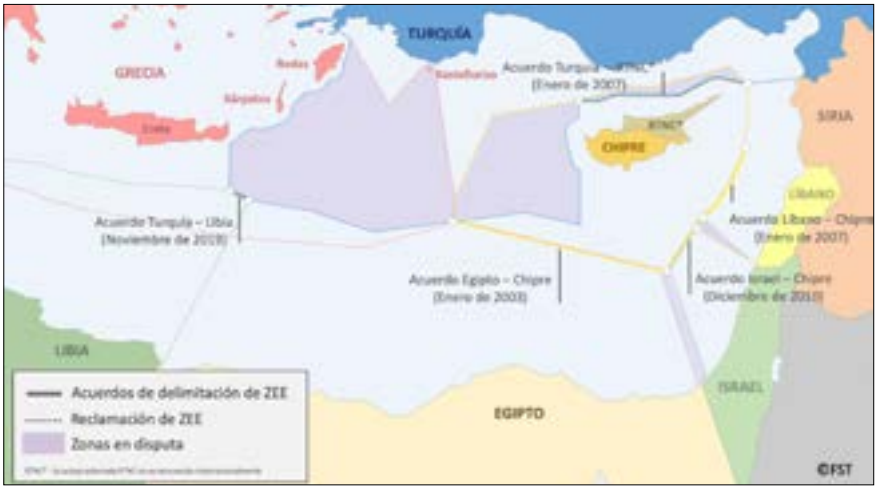

Figure 8: Delimiting the continental shelf: agreements and litigation. Source: Ministry of Foreign Affairs (Republic of Turkey), Ministry of Foreign Affairs (RoC), Ministry of Foreign Affairs (Greek Republic).

Neither Turkey nor Greece have expressly declared their respective EEZs in this zone of the Mediterranean. However they have done so indirectly by defining the limits of what they consider to be their continental shelf in numerous official communications (Notes Verbales) with the UN Secretary General throughout the years. Yet the signing of a Memorandum of Understanding (MoU) on 27 November 2019 between the Turkish Government and the internationally recognised Government of a divided Libya, the Government of National Accord (GNA), agreeing to the delimitation of their respective continental shelves and EEZs along an 18.6 NM stretch (Figure 8) put an end to that custom.

According to the Vienna Convention on the Law of Treaties, dated 23 May 1969, this MoU was officially recorded before the Secretary-General of the UN on 11th December, although, as is only to be expected, the UN has declined to comment on the legality of this declaration, because they lack the powers to do so[20]. Apart

[20] *Daily Press Briefing by the Office of the Spokesperson for the Secretary-General*, 11 December 2019, United Nations website available at https://www.un.org/press/en/2019/db191211.doc.htm. Consulted in December 2019.

from the legal effects this declaration might have, it is nevertheless true to say that expressly defining the limits of their EEZs in a zone in direct conflict with Greek territory (the island of Crete) amounts to a change in strategy. It is a change in strategy that has been accompanied by the deployment of troops in Libya in support of the GNA, which enhances Turkey's role as a regional power, which is essential for negotiation purposes and that cannot be side-lined. To quote the Turkish Vice-President Fuat Oktay, "…no plan in the region will succeed without Turkey"[21].

As was to be expected, the gesture caused an angry reaction from Greece, which expelled the Libyan Ambassador in Athens[22]. Furthermore, for the moment Egypt has refused to recognise the agreement.

As can be seen, any attempt by either of the parties to alter the unstable *status quo* leads to great tension. Armed clashes, albeit on an initially limited scale, cannot be ruled out.

Cyprus - Turkey

Delimiting the continental shelf between Turkey and Cyprus is just as difficult, hence, for similar reasons, Cyprus, considering that it would only accept the principle of equidistance in the absence of an agreement between the parties, defined its EEZ through Acts 64(1)/2004 and 97(1)/2014, informing on many occasions the Secretary-General of the UN about the coordinates[23]. Yet again, Turkey's interpretation of the principle of equity gives rise to two viewpoints difficult to reconcile. Cyprus considers that if it were to accept the Turkish theses, its EEZ would be greatly reduced (Figure 9).

Basing itself on the criterion of equidistance between coasts, the RoC has established delimitation agreements with Egypt (17 January 2003), Lebanon (17 January 2007) and Israel (17 December 2010). Initially, none of these come into conflict with Turkey's aspirations, but in this case the absence of the Turkish Cypriot

[21] *Vice-president: No plan in region will succeed without Turkey*, Middle East Monitor, 1 January 2020, available at https://www.middleeastmonitor.com/20200101-vice-president-no-plan-in-region-without-turkey-will-succeed/. Consulted in January 2020.

[22] *Greece to expel Libyan ambassador over maritime border MoU*, Ekathimerini.com, 6 December 2019, available at http://www.ekathimerini.com/247268/article/ekathimerini/news/greece-to-expel-libyan-ambassador-over-maritime-border-mou. Consulted in December 2019.

[23] The latest communication took the form of a Note Verbale on 7 May 2019.

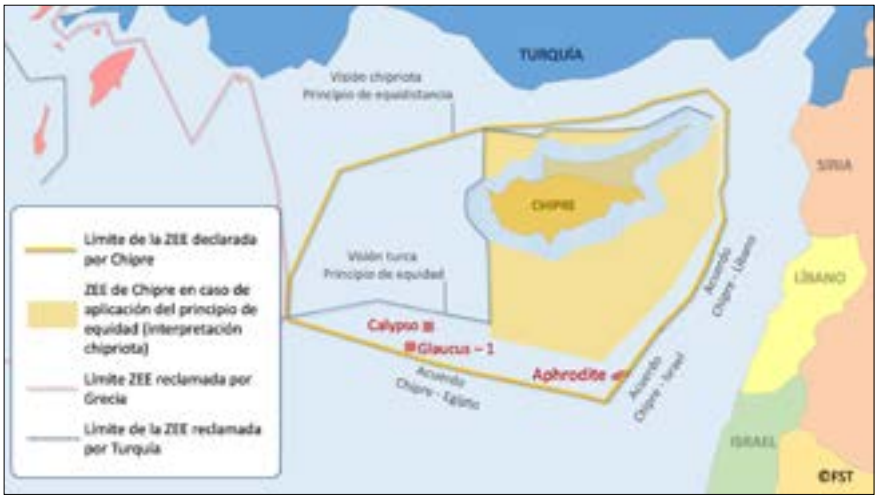

Figure 9: Cypriot assessment of potential losses affecting its EEZ if the equity criterion proposed by Turkey was applied. Source: Ministry of Foreign Affairs (RoC).

community in the negotiations led Turkey to regard them as null and void, officially expressing its non-acceptance. Turkey argues that if it did accept, the Turkish Cypriot community would be deprived of the potential benefits of being able to exploit certain resources under exactly the same conditions as the Greek Cypriot community.

Its role as guarantor of the Turkish Cypriot community's rights has enabled Turkey to easily reach an agreement with the self-proclaimed TRNC (2011) delimiting their respective EEZs, in this case based upon the principle of equity, an agreement that has obviously not been recognised by the RoC (Figure 8).

Israel - Lebanon

By virtue of Decree Nº 6433 dated 1 October 2011, the Lebanon officially declared its EEZ, depositing its coordinates in the UN in November of that same year[24]. As was only to be expected, the coordinates concerned were the same as those included in the agreement between the Lebanon and Cyprus in January 2007. However, Israel, which has not signed the UNCLOS, refrained from making an official declaration regarding its EEZ, although

[24] Decree 6433, Delineation of the boundaries of the exclusive economic zone of Lebanon, 1 October 2011, available at https://www.un.org/Depts/los/LEGISLATIONANDTREATIES/PDFFILES/lbn_2011decree6433.pdf. Consulted in December 2019.

it did do so indirectly by making an agreement with Cyprus regarding the delimitation of their EEZs. This agreement in December 2010 amounts, *de facto*, to a covert declaration. The problem lies in the fact that the northern limit of Israel's EEZ is not consistent with the southern limit of the EEZ declared by the Lebanon, which means that there is an overlapping zone covering a surface area of around 860 Km^2 claimed by both countries (Figure 7).

The USA has acted as a mediator in this dispute, albeit unsuccessfully, partly due to the presence of Hezbollah in the Lebanese Government and to the mutual mistrust between the USA and that group. As a result, the maritime frontier has become yet another cause to add to the conflict between the two countries that has almost permanently confronted them ever since the creation of the Israeli State in 1946. Israel and the Lebanon do not have diplomatic relations and for reasons of domestic policy in both countries, the current circumstances are hardly likely to invite either party to make concessions voluntarily.

Israel - Palestinian Authority (Gaza Strip)

Recently, the Palestinian Authority (PA) has taken actions aimed at obtaining formal recognition of its rights to the territorial sea and EEZ in accordance with UNCLOS, which it signed in January 2015 as a UN Observer State. The PA already held a first meeting coordinating with Egypt (June 2016) and after appointing an internal commission to study the delimitation of its waters, in September 2019 it submitted to the United Nations, the maps of the maritime zones it claims plus a list of their coordinates, in which it not only claimed the territorial sea, but also an EEZ that runs as far as is permitted by the agreements between Cyprus and Israel[25] (Figure 10).

However, the internal division between Hamas and Fatah, skilfully exploited by Israel, is tantamount to a PA's lack of effective control over the Gaza Strip, which for the time being hinders Palestine's aspirations where the maritime resources are concerned. In November 2019 intentions were revealed to hold

[25] Declaration of the State of Palestine regarding its maritime boundaries in accordance with the UN Convention on the Law of Sea, available at https://www.un.org/Depts/los/LEGISLATIONANDTREATIES/PDFFILES/PSE_Deposit_09-2019.pdf. Consulted in November 2019.

elections in the Palestinian Territories, including Gaza. If they are eventually held and a Government featuring both Hamas and Fatah is agreed upon, PA's claims to its EEZ will gain renewed force.

Figure 10: Sovereign spaces claimed by the Palestinian Authority. Source: Ministry of Foreign Affairs and Expatriates of the Palestine State.

Syria - Turkey / Syria - Lebanon

Although Syria has made it clear that it intends to exercise its rights over its EEZ, for the moment it has refrained from defining it exactly[26]. To a large extent, the reason for this is the Civil War that has been devastating the country since 2011. Be that as it may, Syria has not wasted any opportunities when it comes to reacting to its neighbours' declarations. In 2011, it did just this in response to the aforementioned Lebanese declaration of its EEZ (Decree Nº 6433 dated 1 October)[27]. Likewise, Syria also re-

[26] Act Nº 28, dated 19 November 2003, available at https://www.un.org/Depts/los/LEGISLATIONANDTREATIES/PDFFILES/syr_2003e.pdf. Consulted in November 2019.

[27] Note Verbale from the Permanent Representative of the Syrian Arab Republic before the United Nations on 19 October 2011, available at https://www.un.org/

sponded in 2018 to a communication from Turkey indicating the geographical coordinates that it considers to be the north-east limit of its continental shelf[28]. As the conflict draws to a close, we cannot rule out the possibility of this matter coming back to the fore.

The Energy Factor

Although exploiting the first gas deposits in the EASTMED commenced in the mid-90s in the Nile Delta basin, close the Egyptian coast, it was the discovery of the Tamar gas field in 2009, in Israeli waters, that really attracted the interest of the energy industry worldwide. A report issued by the United States Geological Survey (USGS) service in March 2010 estimated at 3.5 TCM[29] the probable amount of gas that the EASTMED's Levante basin could contain, a quantity estimated on average as ranging from a minimum of 1.4 TCM to a maximum of 6.4 TCM[30]. In May that same year, a second report was issued by the USGS, this time on the Nile Delta basin, in which it estimated a quantity ranging from 2.6 to 12 TCM, with an average of about 6.3 TCM, as being the volume of gas that this zone could contain[31] (Figure 11). If their maximum values are considered, both basins could contain an amount of natural gas sufficient to meet the European continent's requirements for more than 30 years, at the present consumption rate[32].

Both studies also indicated potential discoveries of oil in the two basins (a total of 3,400 million barrels), but as yet no deposits have been found that are worth exploiting commercially.

Depts/los/LEGISLATIONANDTREATIES/PDFFILES/communications/syria_note_eng.pdf. Consulted in December 2019.

28 Letter to the United Nations SG on 10 September 2018, available at https://undocs.org/en/A/73/388. Consulted in November 2019.

29 Unless specified to the contrary, the North American measurement units are used throughout this document: 1 TCM = 1 billion m^3 (10^{12} m^3); 1 BCM = 1,000 million m^3 (10^9 m^3).

30 *Assessment of Undiscovered Oil and Gas Resources of the Levant Basin Province, Eastern Mediterranean*, US Geological Survey, March 2010, available at https://pubs.usgs.gov/fs/2010/3014/pdf/FS10-3014.pdf. Consulted in October 2019.

31 *Assessment of Undiscovered Oil and Gas Resources of the Nile Delta Basin Province, Eastern Mediterranean,* US Geological Survey, May 2010, available at https://pubs.usgs.gov/fs/2010/3027/pdf/FS10-3027.pdf. Consulted in October 2019.

32 549 BCM in 2018. BP Statistical Review of World Energy 2019, 68th Edition.

Figure 11: Gas fields in the EASTMED. Source: US Geological Survey. Compiled by the author.

It was to be expected that the possibility of making a good return on these resources would encourage exploration, and this is exactly what has happened: the discoveries made to date in both basins have lived up to expectations. As can be seen from Table 1, so far fields have been identified whose estimated volume amounts to approximately 2.5 TCM, which tends to suggest that there are still considerable quantities awaiting discovery.

Country	*Field*	*Year*	*Estimated Reserves (BCM)*	*Production Capacity (BCM / year)*	*Operators*
Egypt Proven Reserves 2.1 TCM (1)	*Zohr*	2015	849 (2)	31 (2)	ENI (Italy) 60% Rosneft (Russia) 30% BP (UK) 10%
	Noor	2015	850 (3)	12 (2) -	ENI (Italy) 40% BP (UK) 25% Mubdala Petr. (Abu Dhabi) 20% Tharwa Petroleum (Egypt) 15%
Israel	*Tamar*	2009	318 (4)	9,3 (5)	Delek Drilling (Israel) 22% Noble Energy (USA) 32,5% Isramco (Israel) 28,75% Tamar Petroleum (Israel) 9,25% Dor Gas (Israel) 4% Everest (Nepal) 3,5%

Country	Field	Year	Estimated Reserves (BCM)	Production Capacity (BCM / year)	Operators
Israel	*Leviathan*	2010	605 (4)	Being developed Planned 21 (4)	Noble Energy (USA) 39,66% Ratio (Israel) 15 % Delek Drilling (Israel) 45,34%
	Tanin	2012	34 (6)	Being developed (6)	Energean Oil & Gas (UK) 100%
	Karish	2013	50 (6)	8.2 in 2021 (6)	Energean Oil & Gas (UK) 100%
	Karish North	2019	33.7 (6)	As from 2022 (6)	Energean Oil & Gas (UK) 100%
Gaza	*Gaza Marine*	2001	28.3 (7)	Stopped (7)	British Gas (UK) 60% (8) Palestinian Investment Fund (PIF) 30% Consolidated Contractors Company (CCC) 10%
Lebanon	-		Being explored		Blocks 4 and 9 assigned. Being tendered 1, 5, 8 and 10 (9)
Cyprus	*Aphrodite*	2011	129 (4)	Planned in 2025 (4)	Delek Drilling (Israel) 30% Noble Energy (USA) 35% British Gas (UK) 35% (8)
	Calypso 1	2018	169-226 (10)	Being assessed	ENI (Italy) 50% TOTAL (France) 50%
	Glaucus 1	2019	142 –227 (11)	Being assessed	ExxonMobil (USA) 60% Qatar Petroleum (Qatar) 40%

(1) Source: *BP Statistical Review of World Energy, 67th Edition – June 2018*.
(2) Source: EnergyEgypt (https://energyegypt.net). Estimation of potential production capacity based on daily data (October 2019) turned into annual.
(3) ENI (https://www.eni.com/en_IT/operations/upstream/exploration-model/zohr-egypt.page)
(4) Source: Delek Drilling Co. (https://www.delekdrilling.co.il).
(5) Source: Israeli Ministry of Energy (http://www.energy-sea.gov.il/).
(6) Source: Energean Oil & Gas (https://www.energean.com/operations/israel/karish/)
(7) Source: Offshore Technology (https://www.offshore-technology.com/) The PA granted operating licence to BG in 1999.
(8) In February 2016 British Gas was taken over by Royal Dutch Shell.
(9) Source: *Lebanese Petroleum Administration* (https://www.lpa.gov.lb/index.php).
(10) Republic of Cyprus
(11) ExxonMobil

Table 1: Main gas fields in the EASTMED

The locations of these gas fields can be seen in Figure 12.

Figure 12: Main gas fields. Different sources. Compiled by the author.

A more detailed analysis would moderate expectations, for at present only Egypt and Israel have been able to begin commercial operations in these fields. However, the potential profits are certainly the one single factor that has had the greatest influence on regional relations over the past decade. Each one of the stakeholders has been formulating its energy policy in a way that best serves its interests, giving rise to new strategic alignments and reviving old confrontations.

It would be advisable, and we will be doing this in the next few paragraphs, to briefly analyse the geopolitical implications of the energy factor from the three different perspectives that we mentioned in the introduction: (1) production by the countries that are already exploiting, *de facto*, the gas fields in the EASTMED and those that hope to follow suit; (2) the exploration of further fields, where all the countries are currently active; and (3) exporting the resources that will bring them to profitability. In doing so, we will try to identify the opportunities for cooperation that will undoubtedly arise, and the potential causes of confrontation.

The producing countries: Egypt, Israel, Cyprus

Egypt

As pointed out already, it has been for some decades that Egypt began to exploit its energy resources in the zone immediately

off-shore from the Nile Delta coast, with production levels that by 2003 already made the country a net exporter of gas. The exports, initially limited to the regional area via gas pipeline (the Jordan Gas Transmission Pipeline), broadened their scope when its two LNG plants came into service, as from 2004: Damietta, with a processing capacity of 7.56 BCM per year[33] and Idku, with a capacity of 10 BCM per year[34]. Yet a considerable drop in production (33% between 2009 and 2016[35]), and the inability to cope with a growing domestic demand spurred on by a governmental subsidy policy, made it necessary to increase imports and reduce exports until a complete standstill situation was reached in 2015, to the extent that from then until the present time, Egypt has become a net importer of this commodity.

Ever since, the Egyptian Government has tried to reverse the situation and, in this sense, the discovery in 2015 of the huge deposits of Zohr could not have come at a better time. The fact that they came into operation towards the end of 2017 has enabled Egypt to increase its production to the extent that in 2018 it approached the 2009 levels, which amounted to an increase of 45% when compared to the minimum levels of 2016[36]. In October 2019, with a production of 84 mmc/d, the field has yielded the maximum production levels expected[37].

Something similar can be said of the Noor field, which was also discovered in 2015 and that in 2019 reached a production level of 32 mmc/d[38]. Such data, together with the prospects of shortly commencing production in new wells in other zones (western de-

[33] With a Unión Fenosa Gas (UFG) shareholding of 80% and EGPC (Egyptian General Petroleum Company) and EGAS (Egyptian Natural Gas Holding) holding the remaining 20%. ENI and Naturgy have a 50% shareholding in UFG. https://www.unionfenosagas.com/es/Negocio/_Licuefaccion. Consulted in December 2019.

[34] Operated by the joint venture Egyptian Liquefied Natural Gas (ELNG), consisting of the Egyptian companies EGPC (Egyptian General Petroleum Company) and EGAS (Egyptian Natural Gas Holding), with Royal Dutch Shell, PETRONAS and Engie. https://www.egyptianlng.com/. Consulted in November 2019.

[35] The production decreased from a maximum of 60.9 BCM in 2009 to 40.3 BCM produced in 2016. BP Statistical Review 2019, 68th Edition.

[36] *Ibid*.

[37] *Zohr field's natural gas production to exceed 3 bcf/d this month* – IEOC Chief, ENERGY EGYPT, 16 October 2019, available at https://energyegypt.net/zohrs-natural-gas-production-to-exceed-3-bcf-d-this-month/. Consulted in November 2019.

[38] *Eni strengthens record production from Nooros field offshore Egypt*, ENI, available at https://www.eni.com/en_IT/media/2018/03/eni-strengthens-record-production-from-nooros-field-offshore-egypt. Consulted in November 2019.

sert, Gulf of Suez), enable the Egyptian Government to hope that throughout this year (2020) the production may once again exceed domestic demand (Figure 13).

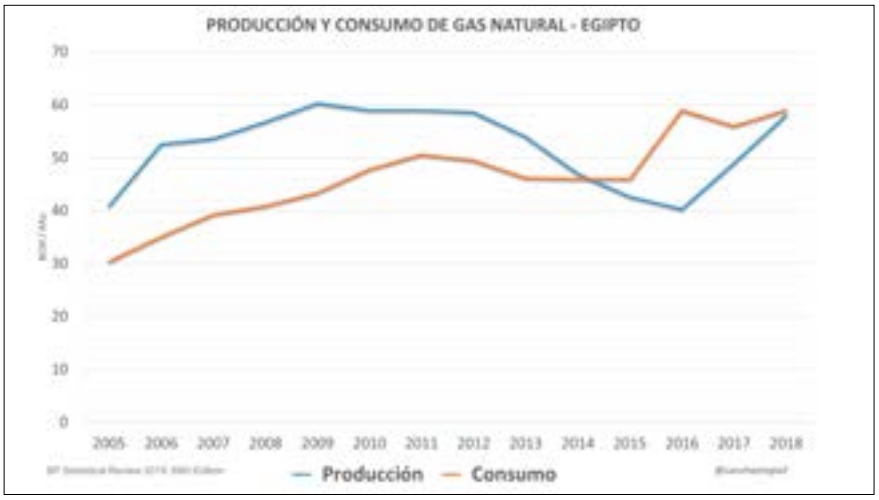

Figure 13: Production vs. Consumption – Egypt. Source BP Statistical Review 2019, 68th Edition. Compiled by the author.

Regardless of whether the target is achieved, it is true to say that these discoveries have made it possible to reactivate the Idku Liquefaction Plant, whose activities had been gradually diminishing from 2011 until it ground to a halt in 2014. The resumption of LNG exports as from 2016 enabled Idku to resume operations at full capacity as from 2019[39].

However, the same cannot be said for Damietta, which was forced to cease operating for the same reasons as for Idku. In this case, the unilateral interruption of the supply to the plant in 2013 led to a successful lawsuit being brought by the owners (UFG) against the Egyptian Government before the International Center for the Settlement of Investment Disputes (ICSID) for the losses caused, a suit that was ruled in favour of UFG who should receive 2,013 million dollars in compensation[40].

[39] *Egyptian LNG to return to full operation – Petroleum Economist*, ENERGY EGYPT, 22 September 2019, available at https://energyegypt.net/egyptian-lng-to-return-to-full-operation-petroleum-economist/. Consulted in November 2019.

[40] UFG and Egypt hold talks to resume the supply at the Damietta Plant. Press release issued by UFG on 18 February 2019, available at https://www.unionfenosagas.com/CarpetaCompartida/Comunicacion/Noticias/20190218-PR-UFG-Egypt-Negotiations-still-ongoing-No-agreement-yet-esp.pdf. Consulted in November 2019.

The application of this ruling by the Egyptian Government however is not being easy, the negotiations with UFG being extended for over a year, until reaching in February 2020 what would appear to be a final agreement[41]. However, the Egyptian Government's failure once again to abide by the agreement, partly as a result of SARS-CoV-2, has caused the Spanish company Naturgy to demand application of the ICSID ruling[42]. As a result, the lack of activity at Damietta suggests that exports will be affected by a degree of congestion, and this, if the problem is not solved, may stand in the way of Egypt's objective of recovering its status as a net exporter and becoming a genuine regional energy hub.

Israel

The next gas producer is Israel, the country with the second largest reserves in the region, after Egypt. Having begun exploring in its waters in the 1970s without major results, it is the Tamar and Leviathan Fields, discovered in 2009 and 2010, respectively, which together with other lower capacity fields found subsequently, guarantee the long-term domestic supply. This situation has enabled the Israeli Government to draw up an energy policy that will harmonise domestic consumption needs and export potential in an optimum way.

For reasons more closely related to energy security than to the environment, natural gas has burst onto the Israeli energy mix scenario as a replacement to coal, a fuel which the country does not have and which it has always had to import. In 2009, 33% of the electricity was generated by gas, whereas in 2018, this fuel accounted for 73 % of the production and, by 2030, this proportion will have risen to 83%, and then coal will definitely no longer be used[43]. In overall terms, once the industry and transport sectors are added, over the next 25 years the domestic consumption of gas will grow by more than 130%, increasing from 10.9

[41] "Naturgy recovers 1,700 million in gas after reaching a final agreement with Egypt". *El Confidencial. 13th February 2020.* Available at: https://www.elconfidencial.com/empresas/2020-02-13/naturgy-recupera-1700millones-gas-acuerdo-egypt 2452891/. Consulted in February 2020.

[42] "Naturgy considers the agreement with Egypt and ENI about Damietta to be unfulfilled". *Cinco Días, 23rd April 2020, available at https://cincodias.elpais.com/cincodias/2020/04/23/companias/1587648171 603149.html.*Consulted in May 2020.

[43] As from 2030, renewable energies (wind, solar and biomass) will cover the remaining 17%.

BCM in 2018 to more than of 25 BCM by 2042[44]. Based on these estimates, the Government has set aside 500 BCM for domestic consumption while releasing the rest of the production for the export market[45].

Israel began these first exports incipiently in 2015, and although they have increased gradually since then, the deficient infrastructure has so far meant that exports have been limited to the region: Jordan and Egypt. Nevertheless, with domestic supplies guaranteed and promising prospects of finding new reserves, the Government has more ambitious targets and hopes to become a net exporter of gas in a relatively short period of time. To do this, it needs to fully develop the commercial exploitation of Leviathan, which officially commenced on 31 December 2019[46].

The question of exploiting the resources in the EEZ claimed by the Palestinian Authority (PA), in front of the Gaza Strip, can also be considered. In this case, the dispute over energy resources is being affected by the dynamics of the Palestine-Israel conflict, on the one hand, and by the internal conflict in Palestinian territory between Hamas, who rules the roost in the Gaza Strip, and the PA, on the other hand. With reserves estimated at 28.3 BCM, equivalent to the 2015 gas consumption in Spain, the exploitation of the Gaza Marine Field (Figure 12) could make a decisive contribution to achieving the economic independence much sought after by the PA and of which energy independence is an essential part. Gaza Marine could provide the PA with 2,400 M$ in royalties and taxes in the years the exploitation lasted, while at the same time bringing about an extra saving of 560 M$ per year if it manages to dispense with the energy imports from Israel[47].

Yet the open conflict between Hamas and the PA makes it difficult for the latter to adopt effective strategies. Apart from the marked economic interest in keeping the Palestinian Territories

[44] Israeli Ministry of Energy, available at https://www.gov.il/en/departments/ministry_of_energy. Consulted in November 2019.

[45] Government Decision Nº 4442, dated 6 January 2019, available at http://www.energy-sea.gov.il/English-Site/Pages/Regulation/Adiri%20Committee%20Government%20Decision%20no4442.pdf. Consulted in November 2019.

[46] *Israel gets first gas from Leviathan with exports to follow*, REUTERS, 31 December 2019, available at https://www.reuters.com/article/us-israel-natgas-leviathan-idUSKBN1YZ0H9. Consulted in January 2020.

[47] OFFSHORE Technology, available at https://www.offshore-technology.com/projects/gaza-marine-gas-field/. Consulted in November 2019.

energy dependent, the mere possibility, however remote it might be, of part of the profit ending up in the hands of Hamas, leads Israel to hindering its development. Meanwhile, guaranteeing a minimum electricity supply to the Gaza Strip is an urgent matter. This circumstance has led the PA to accept the construction of a gas pipeline valued 88 M$, financed by Qatar, that will enable the electrical power plant on the Strip to operate with the gas supplied from Israel[48], which, *a priori*, goes against the Palestinians' long-term interests, besides the hesitation for the perpetuation of the Israeli supply.

Cyprus

Despite having to cover 90% of its energy requirements by importing oil by-products, Cyprus is the third country to be considered from a geopolitical perspective where natural gas producing is concerned. The reserves of this hydrocarbon discovered in the waters declared as EEZ have enabled the Government to develop an energy policy consistent with the EU's policy, which intends to make Cyprus not only self-sufficient in energy, but also an essential supplier of gas to the European market.

At least that appeared to be the case when in 2011 the US company Noble Energy announced that it had discovered the Aphrodite Field in waters lying about 160 Km to the south of the island. But the initial euphoria soon turned to caution. Lying at a depth of more than 5,000 m below sea level, the technical difficulties involved in exploiting the resources, coupled with the absence of infrastructures for exporting them, caused serious doubts about the viability of the project. Operating costs considerably higher than those originally expected forced operators (Noble Energy, BG and Delek Drilling) and the Cypriot Government to renegotiate the percentage of profit that would be allocated to each of the parties. The Government had no alternative but to moderate its expectations in order to reach an agreement, which was finally reached in November 2019, with production expected to begin by 2025 at the earliest[49].

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[48] ADNAN ABU AMER, *With Qatar's money, Israeli gas set to bring Gaza light*, AL MONITOR, 15 November 2019, available at https://www.al-monitor.com/pulse/originals/2019/11/palestine-qatar-israel-natural-gas-pipeline-gaza-power-cuts.html#ixzz65cEZaDpk. Consulted in November 2019.

[49] *Cyprus OKs Aphrodite development plan. Grants exploitation license*, OFFSHORE ENERGY TODAY, available at https://www.offshoreenergytoday.com/cyprus-oks-aphrodite-development-plan-grants-exploitation-license/. Consulted in November 2019.

On a geopolitical level, and in spite of the agreement reached, certain difficulties are still being faced. Firstly, Aphrodite runs towards Israel's EEZ, and the two countries have not managed to agree upon the quantities that correspond to each one of them or upon the various possible ways of operating. In May 2018, the media informed about the intentions of both countries to subject this dispute to international arbitration, but no progress has been made since then[50]. If no agreement is reached, Israel is against commercial activities beginning, because the country considers that such activities would irreparably damage its interests.

And secondly, Turkey, as guarantor of the Turkish Cypriot community, is against the exploitation of these resources before an agreement is reached between the two communities about the administration, management and distribution of the profit. Turkey has even threatened to use military force if necessary[51]. In the long term, Cyprus has followed the Norwegian model and established by Law a domestic sovereign fund to safeguard the interests of all Cypriots, especially future generations, regardless of which community they belong to. The fund will be provided with the income coming from future hydrocarbon exploitations[52].

However, until the division of the island conflict is resolved, immediate distribution of the potential benefits will invariably be controversial. The leaders of the two communities (President of the RoC, Nicos Anastasiades, and Mustapha Akinci and Ersin Tatar, of the self-proclaimed TRNC) have exchanged proposals about the temporary management of this profit, but the fact that the Turkish Cypriot community would not be involved in the handling and administration of these resources has prevented an agreement from being reached[53].

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[50] *Cyprus-Israel gas dispute poised for international arbitration*, CyprusMail, 2 May 2018, available at https://cyprus-mail.com/2018/05/02/cyprus-and-israel-dispute-over-aphrodite-gas-going-to-international-arbitration/. Consulted in November 2019.

[51] *Turkey threatens to use force in gas dispute, Cyprus says*, AHVAL News, 23 February 2018, available at https://ahvalnews.com/cyprus/turkey-threatens-use-force-gas-dispute-cyprus-says. Consulted in November 2019.

[52] RoC Ministry of Foreign Affairs.

[53] *President offered Turkish Cypriots a share of gas funds in return for Turkey's recognition of Cyprus' EEZ,* Cyprus Mail, 4 September 2019, available at https://cyprus-mail.com/2019/09/04/president-offered-turkish-cypriots-a-share-of-gas-funds-in-return-for-turkeys-recognition-of-cyprus-eez/. Consulted in October 2019 and *Greek Cyprus offers 30% of gas income to Turkish Cyprus*, HURRIYET Daily News, 6 September 2019, available at http://www.hurriyetdailynews.com/greek-cyprus-offers-30-pct-of-gas-income-to-turkish-cyprus-146356. Consulted in October 2019.

With expectations regarding the exploitation of Aphrodite a bit deflated, the recent discovery of the Calypso (2018) and Glaucus – 1 (2019) fields have given the Government's energy policy a renewed boost. Yet although the estimations made to date about the capacity of these fields are promising, both of them are still at the development phase and there are no reliable predictions about when production might commence.

Exploration Disputes

With the exception of Syria, embroiled in its domestic conflict, all other coastal countries have set in motion exploration activities within what they consider to be their own EEZs, with a high potential for conflict. In Egypt's case, the fact that there is no litigation with other coastal countries means that this country's activities can be carried out without difficulty. However, as we have already stated, all others are, one way or another, involved in disputes arising from a lack of agreement about the delimitation of waters.

As can be seen in Figure 14, the Lebanon and Israel have divided their respective EEZs into exploration blocks that have been tendered to companies interested in bidding for this activity. And as is only to be expected, it is the blocks that overlap and that are thus in the litigation zone that are problematic.

Figure 14: Exploration in Lebanon's and Israel's EEZs. Source: Israeli Ministry of Energy & Infrastructures and Lebanese Oil Administration. Compiled by the author.

In 2012, Israel, abiding by the exploitation licences that it had already granted earlier, divided its EEZ into a total of 69 sectors for exploration, each covering approximately 400 km^2. 18 of the sectors have already been awarded in two successive tenders (2017 and 2019) to Energean Israel, to a consortium of 4 Indian firms[54] and to Capricorn Offshore Exploration, a third round of tenders being planned to begin in 2021[55]. None of the blocks awarded by Israel are in zone in dispute with Lebanon, but several are in the zone claimed by the Palestinian Authority.

Likewise, in 2018 the Lebanese Government granted exploration and exploitation licences for its Blocks 4 and 9, the second of these being in the disputed zone, to a consortium composed of the Italian ENI, the French TOTAL and the Russian NOVATEK, which planned to begin drilling before the end of 2019[56]. A certain amount of delay meant that drillings in Block 4 were unable to start until February 2020, and the activities have yet to bear fruit, whereas in Block 9, the spreading of COVID-19 has prevented activities from commencing until at least the third or fourth quarter of this year[57]. A second round of tenders is in progress for Blocks 1, 2, 5, 8 and 10, and these could be awarded by the end of 2020. Two of the five blocks, 8 and 10, contain disputed overlapping areas.

The Lebanese Government, of which Hezbollah is an essential part, has a marked interest in exploiting potential resources in this zone, as it desperately needs financing. The presence of the Israeli fields of Karish and Karish North in the zone contiguous to the disputed waters, makes it likely that the deposits could run underground as far as Lebanese waters, which increases interest in that zone. It cannot be ruled out that, once the activities on Block 9 begin, at the end of this year, and under pressure from the Lebanese Government, the consortium awarded the exploration starts carrying out drillings in the disputed zone, which could cause incidents, without excluding an armed conflict.

54 ONGC Videsh, Bahrat Petro Resources, Indian Oil and Oil of India.

55 Israeli Ministry of Energy, available at https://www.gov.il/en/departments/general/gas_oil_history. Consulted in November 2019.

56 Lebanese Petroleum Administration, available at https://www.lpa.gov.lb/first%20licensing%20round%20results.php. Consulted in November 2019.

57 Lebanon's first ever well comes up dry: Update *Argus Media*, 27th April, 2020, available at: https://www.argusmedia.com/es/news/2100012-lebanons-first-ever-well-comes-up-dry-update. Consulted in May 2020.

Technically, the two countries are still at war, a situation that does not make the things easier. The military tension in the zone is high and the Israeli Navy frequently makes incursions into these waters[58]. Hezbollah's response is also swift, and its leader, Hasan Nasrallah, has threatened on previous occasions to directly attack the Israeli rigs[59]. To do this, Hezbollah apparently has Russian manufactured Yakhont anti-ship missiles, and Chinese C-802s, in their Iranian variety, known as Noor, the latter with sufficient range (300 Km) to reach any point on Israel's EEZ[60].

The second greatest dispute is the latent conflict between Cyprus and Turkey. The RoC Government divided its (declared) EEZ into 12 blocks for exploration and exploitation, which it has awarded in tender to different European countries (TOTAL, ENI and British Gas), US companies (ExxonMobil and Noble Energy) and other non-western firms (the Korean company KOGAS, Qatar Petroleum and the Israeli firm Delek Drilling). The self-proclaimed TRNC has also followed suit, in such a way that some of the 7 sectors it has defined overlap with the RoC's blocks. Moreover, part of Blocks 4, 5, 6 and 7 coincide with the Turkish claim regarding the continental shelf (Figure 15).

This circumstance has been and still is a destabilising factor with great escalation potential in which the use of military force now has to be reckoned as a factor for consideration. In this respect, the Turkish Government's arguments have already been put forward for impeding economic activity in the disputed zone and to prevent a *fait accompli* and, going on from words to deeds, it has put coercive diplomacy into practice with the active participation of its Navy, which seems to be bearing fruit. In February 2018, the drilling vessel Saipem 12000, owned by the Italian company ENI, was intercepted in Block Nº 6 by the Turkish Navy, being forced to cease its activities and leave the zone[61]. And more re-

[58] *Israeli Navy ship crosses into Lebanese waters – report*, TIMES of ISRAEL, 15 July 2019, available at https://www.timesofisrael.com/israeli-naval-ship-crosses-into-lebanese-waters-report/. Consulted in October 2019.

[59] *Hezbollah issues fresh threat against Israel's offshore gas rigs*, The TIMES of Israel, 18 February 2018, available at https://www.timesofisrael.com/hezbollah-threatens-to-strike-israels-offshore-gas-platforms/. Consulted in November 2019.

[60] MISSILE THREAT, CISIS Missile Defence Project, available at https://missilethreat.csis.org/country/hezbollahs-rocket-arsenal/. Consulted in November 2019.

[61] *Report: Eni moving drillship to Morocco after Turkish navy 'threatens force' in Cyprus*, Offshore Energy Today.com, dated 23 February 2018, available at https://www.offshoreenergytoday.com/report-eni-moving-drillship-to-morocco-after-turkish-navy-threatens-force-in-cyprus/. Consulted in December 2019.

cently, ENI and TOTAL suspended their exploration projects in Block 7 due to the possibility that Turkey might use force to oppose such activities[62].

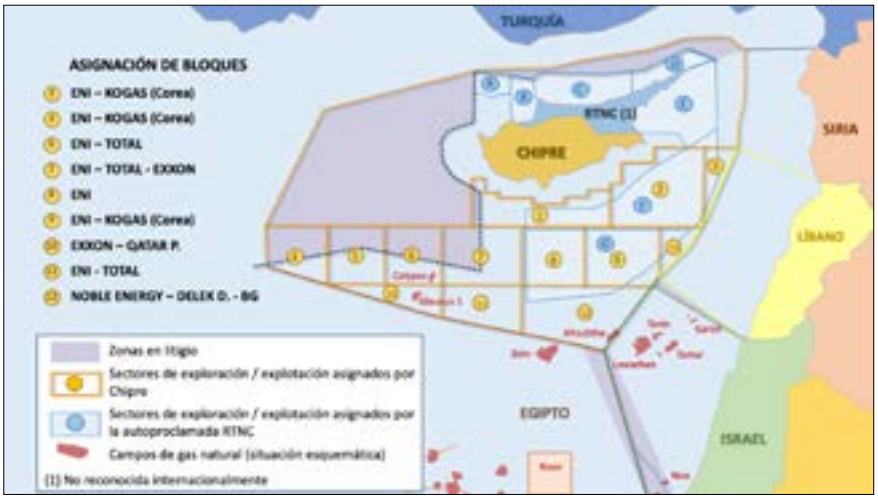

Figure 15: Allocation of exploration and exploitation sectors. Sources: Turkish Foreign Affairs Ministry, RoC Foreign Affairs Ministry. Compiled by the author.

These types of actions are supplemented with an active exploration strategy in zones that the RoC has declared to be part of its EEZ. To do this, the State-owned Turkish oil company TPAO, has two seismic research vessels, the BARBAROS Hayreddin Paşa and the ORUC REIS, and two drill rigs, the FATIH and the YAVUZ available, which usually operate in these waters. A third drillship, the KANUNI, has recently been purchased by TPAO, and will join the fleet once the situation returns to normal after the COVID-19 crisis[63]. They always appear escorted by Turkish Navy vessels and have been observed in Blocks 1, 2, 3, 6, 7, 8, 9, 12 and 13, on occasions not much farther than 35 NM from the Cypriot coast, which has led to protests from the RoC Government (Figure 16).

62 *ENI-TOTAL consortium back down from field 7 in Cyprus in face of Turkish threats*, New Greek TV, 4 November 2019, available at http://www.newgreektv.com/news-in-english-for-greeks/world/item/30776-eni-total-consortium-back-down-from-field-7-in-cyprus-in-face-of-turkish-threats. Consulted in November 2019.

63 "Turkey procures its third drillship: Report". Hurriyet Daily News. 9th February 2020. Available at: https://www.hurryietdailynews.com/turkey-procures-its-third-drillship-report-151887. Consulted in February 2020.

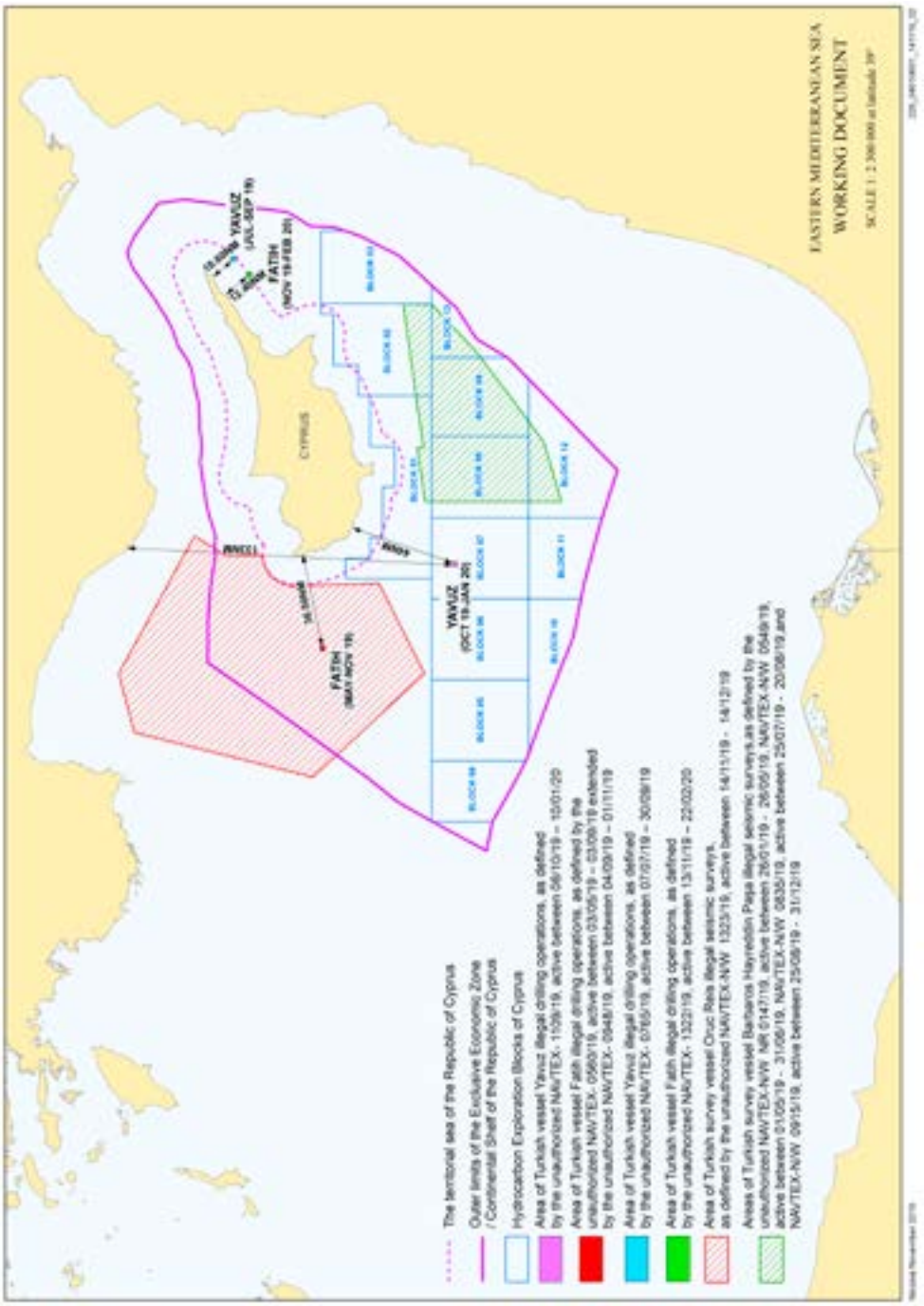

Figure 16: Activities of the Turkish exploration vessels. Source: RoC Foreign Affairs Ministry.

These protests have not gone unheeded and have caused a significant reaction from the EU. Declared illegal on repeated occasions by the European Council[64], in July 2019 punitive measures were taken against Turkey[65].

More recently (November 2019), these measures were supplemented by sanctions consisting of a prohibition on travelling to the EU and the immobilisation of goods belonging to the firms and persons responsible for these activities or that collaborate with them[66].

In this scenario of growing tension, the effects of the pandemic caused by SARS-CoV-2 have already left their mark in these waters. The fall in European demand, which midway through April was more than 20% in countries like Spain or France, when compared to the same period in the previous year together with the collapse of energy prices[67], have caused the major companies to reconsider their investments. Consequently, ExxonMobil, ENI and TOTAL have announced delays in their operations in the EEZ claimed by the RoC, hoping that the end of the economic crisis will enable them to resume activities[68]. To begin with, this ought to provide an opportunity to allay tension. However, the truth of the matter is that Turkey is keeping up the rate of its drilling activities in the zone, which once again has sparked off criticism from the RoC, Greece, Israel and Egypt[69].

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[64] The Council expressed itself in these terms on at least 6 occasions: 22 March 2018, 20 June 2019, 15 July 2019, 14 October 2019, 18 October 2019 and 8 November 2019.

[65] Council's conclusions dated 15 July 2019, available at https://www.consilium.europa.eu/es/press/press-releases/2019/07/15/turkish-drilling-activities-in-the-eastern-mediterranean-council-adopts-conclusions/. Consulted in November 2019.

[66] Council´s decision dated 8 November 2019, available at https://www.consilium.europa.eu/media/41313/st13262-en19.pdf. Consulted in November 2019.

[67] Global Energy Review 2020, *International Energy Agency (IEA*), April 2020, available at: https://www.iea.org/reports/global-energy-review-2020/natural-gas#abstract.. Consulted in May 2020.

[68] EXXONMOBIL POSTPONES CYPRUS DRILLING: REPORT, *Natural Gas World*, 13th April 2020, available at https://www.naturalgasworld.com/exxonmobil-postpones-cyprus-drilling-report-78031 and Eni, Total Postpone Drilling In Block 6 Offshore Cyprus, Eastern Mediterranean Monitor, 5th May 2020, available at https://eastmedmonitor.com/?p=2935 . Consulted in May 2020.

[69] Turkey intensifies E. Med drilling despite COVID-19*, ANADOLU Agency*, 4th May 2020, available at https://www.aa.com.tr/en/economy/ turkey-intensifies-e-med-drilling-despite-covid-19/1828274. Consulted in May 2020.

Export Potential

If the impact of the exploitation and exploration activities eventually leads to regional conflictivity, the search for solutions for exporting the resources provides cooperation opportunities, bringing about strategic alliances between countries with shared interests.

On a regional level, Israel has clinched agreements to export to Jordan: 1.8 BCM for 15 years from the Tamar Field (January 2017) and 45 BCM for 15 years from the Leviathan Field (September 2016) [70], although these agreements have caused clashes in the Jordanian Parliament. Nevertheless, it must be admitted that regional market options are limited, so the European market has become the priority target for exports from the EASTMED (Figure 17).

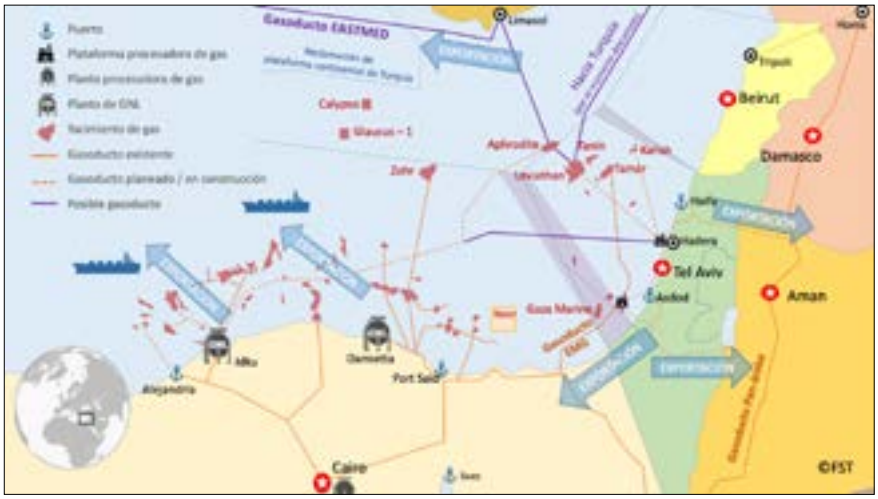

Figure 17: Export Potential in the EASTMED. Different sources. Compiled by the author.

The first of the options available for monetising these resources is the so-called triangular strategy, which involves exporting Israeli gas to Europe and possibly Cypriot gas as well, via the Egyptian liquefaction plants of Idku and Damietta.

As part of this strategy, agreements have already been reached between the Israeli company Delek Drilling and the Egyptian

[70] Delek Drilling, available at https://www.delekdrilling.com/natural-gas/national-security-foreign-relations. Consulted in December 2019.

company Dolphinus Holding, involving the export of an initial total of 64 BCM from Tamar and Leviathan, which will be subsequently increased to 85.3 BCM, for 15 years. For that purpose, Delek Drilling and Noble Energy, operators in those gas fields, have guaranteed the use of the EMG gas pipeline, with a capacity of 7 BCM/year, which could eventually be increased to 9 BCM/year, by the purchase of 39% of its shares in October 2019[71]. The gas coming from the Israeli fields will begin to flow through this pipeline in midway 2020[72]. However, this option is fraught with security risks due to the endemic instability in the Sinai region through which the EMG runs.

Cyprus, on its part, considered several options for future exports, but finally opted too for the Egyptian route. Before the agreement concerning exploitation of Aphrodite, the Government had established a Memorandum of Understanding (MoU) with Egypt to export the gas from Aphrodite via the Idku LNG Plant. However, that requires the prior construction of the gas pipeline that, with a planned capacity of 8 BCM / year, connects the more than 300 Km that separate the gas field from the plant. Under these conditions, and if all the difficulties are overcome, commercial exploitation of this field could begin in 2025, almost 15 years after it was discovered.

Yet this strategy has at least two weak points. The first of these is the disagreement between Cyprus and Israel over the sharing of the gas from Aphrodite on either side of the dividing line between their respective EEZs, which must be settled as a prerequisite to commercial exploitation of the field by either of the parties. As has already been pointed out, some reports indicate the possibility of this dispute going to international arbitration, which could considerably delay a solution to the problem[73].

The second weak point, once the first has been overcome, is the limited capacity of the Egyptian plants. According to the data, in 2025, the total quantity supplied to Egypt from Cyprus and

[71] Delek Drilling.

[72] *In milestone, Israel starts exporting natural gas to Egypt*, The Times of Israel, 15 January 2020, available at https://www.timesofisrael.com/in-milestone-israel-starts-exporting-natural-gas-to-egypt/. Consulted in January 2020.

[73] STERGIOU, Andreas, *GEOPOLITICS AND ENERGY SECURITY IN THE EASTERN MEDITERRANEAN: THE FORMATION OF NEW "ENERGY ALLIANCES"*. Chapter 2 of the Report: The New Geopolitics of the Eastern Mediterranean – Trilateral partnerships and regional security, Peace Research Institute Oslo (PRIO) and Friedrich-Ebert-Stiftung, 2019.

Israel could amount to 13-17 BCM/year[74]. Gas coming from the Calypso and Glaucus fields would have to be added to this figure, although when this might occur is as yet unknown. On the basis of their respective capacities, it would be necessary for both Idku (10 BCM/year) and Damietta (7.56 BCM/year) to be operating at close to 100% of their maximum capacities, a situation that at present only exists for Idku. It is of essence therefore that the dispute between the Egyptian Government and the owners of Damietta is solved, to enable this strategy to be satisfactorily implemented. The construction of a third train at Idku could also relieve the saturation of its potential.

The second project for developing regional cooperation is the EASTMED gas pipeline, in which Israel, Cyprus, Greece, Italy and the EU have all shown interest. The aim of this 2,000 Km long line with an initial capacity of 10 BCM/year (approximately 2% of Europe's annual consumption) is to convey the gas from the basins in Israel and the RoC to Greece, from where it will be distributed to Italy in cooperation with IGI Poseidon, before being transported via the IGB network (Interconnection between Greece and Bulgaria), to the countries in South-East Europe[75]. The project is backed by the Governments of Israel, Cyprus and Greece, whose Heads of State signed an agreement in January 2020 to construct it and put it into service in 2025[76]. Meanwhile, the EU has qualified its development as a Project of Common Interest (PCI), financing feasibility studies until 2021 for an amount of 69 M€[77].

Despite the political push, the actual possibilities for the EASTMED are currently the subject of speculation, because the technical difficulties involved in laying it are considerable, especially regarding the section that has to run between Cyprus and Crete, where the seabed reaches depths of over 3,000 m. The estimated cost of the gas pipeline is approximately 7,000 M$, but most ex-

[74] Under the current contractual conditions, 5.68 BCM/year would come from Israel and 8 BCM/year from Cyprus. If these amounts were increased to use the total capacity of the EGM gas pipeline, around 17 BCM/year could flow to the Egyptian plants.

[75] IGI Poseidon, available at http://www.igi-poseidon.com/en/eastmed. Consulted in November 2019.

[76] *Greece, Israel, Cyprus sign EastMed gas pipeline deal*, REUTERS, 2 January 2020, available at https://www.reuters.com/article/us-greece-cyprus-israel-pipeline-idUSKBN1Z10R5. Consulted in January 2020.

[77] Innovation and Networks Executive Agency, EastMed Pipeline Project – Development Phase, available at https://ec.europa.eu/inea/en/connecting-europe-facility/cef-energy/7.3.1-0023-CYEL-S-M-17. Consulted in November 2019.

perts believe that it will be considerably higher, possibly as much as 10,000 M$. With such prospects one should not be too optimistic. As certain estimates put the average price of the gas supplied to the European markets via different routes at about 6-6.5 $/mmBTU midway through this decade, which is when EASTMED would come into service, the competitiveness of gas commercialised in this way is highly questionable, so the same applies to the feasibility of the project[78].

We must also add the difficulties arising from the imperative need to use the continental shelf claimed by Turkey. To begin with and according to UNCLOS (Art. 79), the continental shelf can be freely utilised by any State for the purpose of laying underwater cables and piping, but the coastal State can, and must, guarantee its environmental protection for its conservation. Arguments can always be found for protecting the environment, which, in practice, is tantamount to veto.

The Eastern Mediterranean Gas Forum (EMGF) was established in January 2019 in Cairo, in order to coordinate and encourage these initiatives. It is a political forum for cooperation in energy matters between the producing and consuming countries in the EASTMED, including Egypt, Cyprus, Greece, Israel, Italy, Jordan and the Palestinian Authority, which may be joined by France and, as an observer, the United States[79]. The creation of the EMGF seems to be closely linked to the economic aspects of the so-called "Deal of the Century" that the North American Administration has proposed to the PA in an attempt to put an end to the perennial Palestine-Israel conflict. The simultaneous presence of Israel and the Palestinian Authority in it would endorse this hypothesis. Moreover, the USA finds the EMGF to be a tool of great interest for developing alternatives that can limit Russia's domination of the gas supply to Europe. The effectiveness of the EMGF in achieving one or other of these objectives remains to be seen, but for the time being, the immediate result is rather destabilising: Turkey, the self-proclaimed TRNC, the Lebanon and Syria consider it to be exclusive, in the best of cases, if not directly drawn up against their interests.

[78] ELLINAS, Charles, *EastMed gas pipeline increasingly doubtful*, Cyprus Mail, 2 December 2018, available at https://cyprus-mail.com/2018/12/02/eastmed-gas-pipeline-increasingly-doubtful/ . Consulted in November 2019.

[79] *France asks to join Eastern Mediterranean Gas Forum*, REUTERS, 16 January 2020, available at https://www.reuters.com/article/us-egypt-gas/france-asks-to-join-eastern-mediterranean-gas-forum-idUSKBN1ZF1V2. Consulted in January 2020.

At other times Israel seriously considered the possibility of exporting its gas through Turkey, although the political drifting apart of the two countries means that, at present nobody considers this possibility as being realistic. Turkey, lacking in significant energy resources and 46% of whose consumption depends on Russian gas imports[80], hopes to become an energy hub, channelling into Europe the gas from Russia, the South Caucasus and the Caspian Sea and Iran. To quote Fatih Birol, Director of the International Energy Agency, "If we take into consideration Turkey's geographic location surrounded by gas producers and its proximity to consumer markets in Europe as well as the recent steps to empower LNG infrastructure, that goal to become a gas trading hub is not far away"[81]. The commissioning of the TANAP gas pipeline, whose European section was opened in November 2019[82], and Turkstream gas pipeline, commissioned in January 2020, have enhanced these aspirations. When the time comes, and if Turkey is able to consolidate this role, Israel might once again be interested in exploring the possibilities of developing this option.

Second Part - Power relations and containment policy in the EASTMED

As we stated in the introduction, all the circumstances so far described make the EASTMED an extension of the Middle East shatter belt, where constantly mounting tension has become ostensible militarisation, with a consequent increase in the frequency with which incidents occur involving the Navies or Air Forces of the coastal countries.

Although force has lost relative importance when compared to other power resources, possessing powerful and efficient military resources is still perhaps the first requirement for a nation that aspires to play a role in an international context; this being particularly true in this part of the world.

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80 BP Statistical Review of World Energy 2019, 68th Edition.

81 *Turkey to leverage strengthened LNG infrastructure in gas trade*, Daily Sabah, 22 March 2019, available at https://www.dailysabah.com/energy/2019/03/22/turkey-to-leverage-strengthened-lng-infrastructure-in-gas-trade. Consulted in December 2019.

82 *Turkey and Azerbaijan mark completion of TANAP pipeline to take gas to Europe*, EURACTIV, 2 December 2019, available at https://www.euractiv.com/section/azerbaijan/news/turkey-and-azerbaijan-mark-completion-of-tanap-pipeline-to-take-gas-to-europe/. Consulted in January 2020.

That is why if one is to understand the complexity of regional geopolitics in the EASTMED it is essential to analyse, at least briefly, the military power in the zone and to try to establish the power relations existing between the various geopolitical stakeholders. With a view to this, we must take into account the fact that the strategic alignments referred to above, grouping Egypt, Israel, Greece and Cyprus, on the one hand, and individually, Turkey, Syria and the Lebanon, on the other hand, are merely associations and forums of cooperation that do not establish strong ties between them, far from the commitments and obligations that would unite them if they had established a formal alliance. So, without losing sight of the fact that these alignments exist, it seems appropriate to analyse the military power in the zone from the perspective of each individual country. This section of the document will be dealing with that task.

Regional Military Power in the EASTMED

Naval Power

A quick glance at the naval units available to each one of the countries leads to the conclusion that the Turkish Navy is the most powerful of all the ones in the region (Table 2).

	PATROL BOATS	*SURFACE COMBAT SHIPS (Frigates / Corvettes)*	*AIRCRAFT CARRIERS*	*SUBMARINES*
EGYPT	61	9	2	6
GREECE	33	13	-	11
ISRAEL	45	4*	-	5
TURKEY	52	19	1*	12
SYRIA	32	-	-	-
LEBANON	13	-	-	-
CYPRUS	6	-	-	-
JORDAN	7	-	-	-

* Under construction. Could come into service during 2020.

Table 2: Naval Resources. Source: Military Balance 2019.

Turkey not only possesses more warships with combat capacity (corvettes, frigates and submarines) than the rest of the countries, but these have also recently been modernised and improved. At the beginning of the last decade Turkey set in motion an ambitious naval construction programme whose target is to develop an unrivalled naval force in the region by 2030, supported by its own powerful defence industry, guaranteeing the country's independence in this matter. One essential part of this programme is the incorporation of a strategic projection vessel, the ANADOLU, a replica of the Spanish amphibious assault ship Juan Carlos I, currently being constructed by the Turkish shipyard SEDEF with support from the Spanish company Navantia, and which could be delivered to the Turkish Navy at the end of this year[83]. This ambitious programme aims to guarantee Turkey's superiority in the EASTMED, substantially contributed already by Turkey's military presence in the north of Cyprus, which could be further increased by establishing a base in Famagusta, which would facilitate naval operations in the zone[84].

Although the Israel Navy was traditionally limited to coastal surveillance missions (patrol boats), in recent years it has increased its capacity to deal with the threats posed by the new strategic environment, which include protecting its energy facilities from attacks by Hezbollah from the Lebanon or by Hamas from the Gaza Strip. Israel intends to equip its naval forces with the surface combat capacity that it has lacked in the past, having purchased 4 class Saar-6 corvettes manufactured in Germany, which should be entering service during the course of 2020, although COVID-19 is slightly delaying their delivery[85]. A fleet of 5 Dolphin class submarines, also manufactured in Germany, which can transport nuclear weapons, boosts the country's naval capacity[86].

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[83] *Turkish Navy's flagship to enter service in 2020*, Anadolu News Agency, 21 November 2019, available at https://www.aa.com.tr/en/science-technology/turkish-navys-flagship-to-enter-service-in-2020/1652082. Consulted in January 2020.

[84] *Turkey plans to establish naval base in Cyprus*, Daily Sabah, 25 December 2019, available at https://www.dailysabah.com/politics/2019/12/25/turkey-plans-to-establish-naval-base-in-cyprus. Consulted in December 2019.

[85] Arrival of first Sa'ar 6 corvette delayed due to corona virus. *The Jerusalem Post* 2nd May 2020, available at https://www.jpost.com/israel-news/arrival-of-first-saar-6-corvette-delayed-due-to-coronavirus-626660 . Consulted in May 2020.

[86] In 2020, the Israeli Navy may sign a second contract to purchase a further three submarines before 2030. *Israel Submarine Capabilities*, NTI, 16 October 2019, available at https://www.nti.org/analysis/articles/israel-submarine-capabilities/. Consulted in May 2020.

According to IHS Jane's, the Greek Navy is well-equipped and has a magnificent reputation. In spite of this, the number of naval units it possesses places it somewhat behind the Turkish Navy, with which it habitually has to measure itself, not only in the Aegean Sea but also in the EASTMED. The economic crisis being faced by Greece at present currently rules out any possibility of modifying this situation.

In the past five years, Egypt has also taken steps to increase its naval capacity, something that traditionally was never considered a priority. The country is endeavouring to establish two fleets that can operate independently in the Red Sea and in the Mediterranean, based around two Mistral Class LHDs supplied by France in 2016, to which Egypt will add some vessels from Russian origin[87], French frigates[88] and 4 Class 209/1400 German submarines[89]. Furthermore, in collaboration with the French Naval Group, Egypt has commissioned three Gowind 2500 Class corvettes, constructed locally[90]. The defence material purchases are proof of the Egypt's supplier diversification strategy and, above all, its wish to replace the USA as its main arms supplier, which opens up major niches for competition from other powers. Russia and European countries try to make the most of this opportunity.

The navies of the rest of the countries are merely token forces, limited to a few coastal surveillance patrol boats.

Air Power

The characteristics of modern combat aircraft range so greatly from one model to another that it is difficult to make a comparative analysis between them. These differences are particularly significant when it comes to comparing combat aircraft (fighters

[87] Tarantul Class missile launching boat.

[88] In 2015, to renew its old fleet of frigates, Egypt signed a contract with France to purchase French frigates of the Aquitaine class, the first unit being delivered that same year. So far, it is the only one to has been received, the number of further frigates that Egypt might purchase being unknown.

[89] TRAN, Pierre, *French Naval Group and Germany's ThyssenKrupp square off in Egyptian warship deal*, Defense News, 12 September 2018, available at https://www.defensenews.com/naval/2018/09/12/french-naval-group-and-germanys-thyssenkrupp-square-off-in-egyptian-warship-deal/. Consulted in January 2020.

[90] *Egypt launches its third Gowind 2500 corvette in Alexandria*, NAVALTODAY.COM, 13 May 2019, available at https://navaltoday.com/2019/05/13/egypt-launches-its-third-gowind-2500-corvette-in-alexandria/. Consulted in January 2020.

or fighter bombers) which are really what provides a country with its air power. To simplify the task, Table 3 classifies these aircraft into four major groups, or generations, each of which amounts to a qualitative technological advance on the previous generation[91]. It is merely a numerical list, which does not attempt to indicate the actual capacities of the respective air forces, for which it would be necessary to assess key questions such as fleet maintenance, the technical training of the pilots and their morale, etc. However, the contents of this table constitute the basis for trying to estimate the relative rankings of the countries as regards their air power.

	COMBAT AIRCRAFT				TRANSPORT	REFUELLING IN FLIGHT	SPECIAL MISSIONS
	Before 1980	4th Generation (1)	4.5 Generation	5th Generation			
EGYPT	75	246	24		59		11
GREECE	33	200(1)			15		8
ISRAEL		428		18(2)	15	10	23
TURKEY	48	270			66	7	7
SYRIA	146	71					
LEBANON	9						
CYPRUS			11				

(1) 85 of these planes could be improved to Generation 4.5.
(2) In the process of being delivered until a total number of 33 F-35I aircraft in 2021.

Table 3: Air resources. Source: World Air Forces 2020 (FlightGlobal). The data concerning the fleets of F-16 belonging to Egypt, Greece, Israel and Turkey were taken from the F-16.net website (http://www.f-16.net/).

An analysis of the air forces ranks Israel as leader of the coastal States. Apart from the high technical level of its pilots[92], the Israeli air force is the only one that possesses F-35I aircraft, in the Israeli version known as "Adir" (powerful, in Hebrew) of the ultramodern 5th Generation of combat aircraft manufactured by a multinational consortium led by Lockheed Martin, to which not

[91] There are also many different ways of classifying this in the world. For the purpose of this work, we have utilised the classification into generations proposed by the prestigious specialist journal Airforce Magazine in the article by HEBERT, Adam J., Fighter *Generations*, of April 2008, available at https://www.airforcemag.com/article/0908issbf/. Consulted in December 2019.

[92] IHS Jane's.

only the USA belongs, but also Turkey, UK, Italy, Denmark, the Netherlands, Australia, Canada and Norway[93]. These aircraft have already been successfully used in operations in Syria[94]. If the programme is not delayed, Israel will have two squadrons (33 units) of F-35I before 2021, to which a third squadron with 17 units will be added during the decade.

The Egyptian Air Force is far from being insignificant, and is regarded as the most powerful in North Africa[95]. In recent years its air force has made a great effort to modernise itself and improve its inventory, to which it has recently added twenty-one 4.5 Generation Rafalle aircraft manufactured in France, which confirms the policy of moving away from the USA where defence purchases are concerned. What is even more interesting is that Egypt has reached an agreement with Russia to purchase more than twenty 4.5 generation aircraft, Su-35s, cancelling previous projects to acquire the F-35, which has exposed Egypt to the possibility of sanctions being applied by Washington[96].

Faced with this state of affairs, incorporating 5th Generation aircraft into its inventory in the near future has become a top strategic priority for Turkey, because if it fails to do so its air-force will be lagging far behind both Israel and Egypt.

With a view to this, Turkish planners decided to include their country in the F-35 manufacturing consortium in order to acquire 100 units of this aircraft, of which 35 would be Version B, with a vertical take-off capacity, making it possible to deploy these planes on the country's strategic projection vessel ANADOLU. This would have made the Turkish Air Force the most powerful in the region. Yet the purchase of the Russian manufactured S-400 anti-aircraft defence missile system led to the country being expelled, at least temporarily, from the consortium.

Although negotiations between Turkey and the USA over this matter are still open and Turkey's readmission cannot be ruled

93 Lockheed Martin, available at https://www.lockheedmartin.com/en-us/products/f-35.html. Consulted in December 2019.

94 Lockheed Martin, available at https://www.lockheedmartin.com/en-us/products/f-35/f-35-global-partnership/f-35-israel.html. Consulted in December 2019.

95 IHS Jane's.

96 *Egypt risks U.S. sanctions over Russian fighter jet deal: U.S. official*, REUTERS, 18 November 2019, available at https://www.reuters.com/article/us-emirates-airshow-usa-egypt/egypt-risks-u-s-sanctions-over-russian-fighter-jet-deal-u-s-official-idUSKBN1XS203. Consulted in January 2020.

out, Turkey has embarked upon the development of its own combat aircraft, also 5th Generation, the TF-X, whose first prototype was scheduled to fly in 2023, the centenary of the founding of the Republic. However, unexpected difficulties could scuttle the project and, at present, a delay has been announced and the new date of 2030 has been set for the first flights[97].

With these prospects in mind, Turkey is seeking alternatives, and one of these once again lies in the Russian defence industry, Turkey having shown interest in aircraft manufactured in Russia (SU-57 and SU 35)[98]. However unrealistic this option might appear, if it were to occur this would trigger the tension between Turkey and its fellow NATO members, especially the USA, to the extent that a final rupture could take place between them.

The economic crisis has had a negative effect on Greece's plans to modernise its air force and it has found itself forced to postpone, better than to cancel, its plans to purchase 5th Generation combat aircraft. Greece has had to settle for a modernization programme limited to the overhaul of 85 aircraft from its fleet of F-16 fighters, in their most advanced version: the F-16V Block 70/72, known as "Viper"[99], conseidered as 4.5 Generation.

Balance in Regional Power

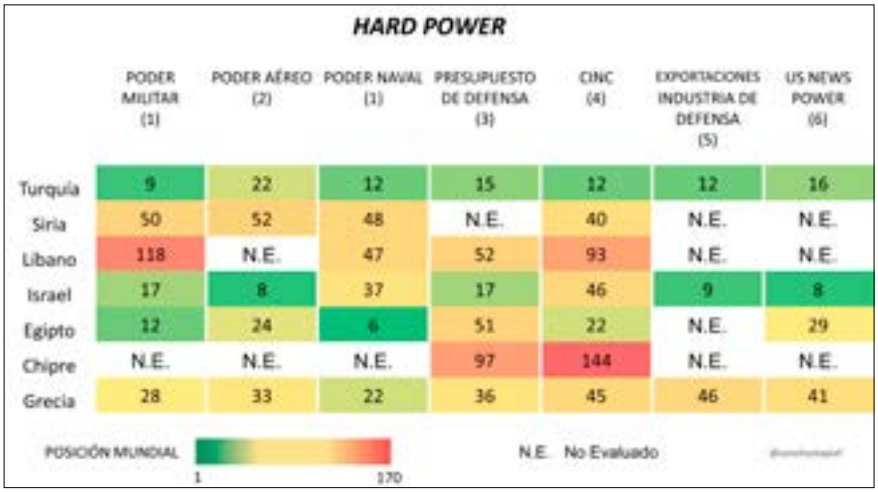
In geopolitics, the concept of power is useful in relative terms, rather than absolute terms, and it takes on value only when it is compared to the opponent's power. It is not an easy exercise and also requires, in addition to the quantitative analysis, a qualitative appraisal including other factors that are crucial in establishing the effectiveness of an armed force, such as the availability of financial resources from the defence budget, the personnel training and capacitation systems, morale, experience, logistical skills, development of the national defence industry, the country's technological expertise, etc. Fortunately, there are many indexes in

97 *Homegrown fighter jet to fly with domestic engine by 2020*, Daily Sabah, 10 January 2020, available at https://www.dailysabah.com/defense/2020/01/10/homegrown-fighter-jet-to-fly-with-domestic-engine-by-2029 . Consulted in January 2020.

98 *Turkey says purchase of Russia's Su-35 and Su-57 fighter jets possible*, TASS Agency, 29 August 2029, available at https://tass.com/defense/1075503. Consulted in December 2019.

99 *Greece to upgrade 85 F-16 fighter jets to Viper configuration*, The Defense Post, 28 April 2018, available at https://thedefensepost.com/2018/04/28/greece-upgrade-85-f-16-fighter-jets-viper/. Consulted in January 2020.

the world that rate these aspects in order to establish a relative ranking of military power. Table 4 features the positions of the EASTMED countries in some of these indexes that assess aspects associated with *hard power*[100], or coercive power.



Global Fire Power (https://www.globalfirepower.com/)
(1) World Directory of Modern Military Aircraft (https://www.wdmma.org/)
(2) Military Balance 2019 (International Institute for Strategic Studies)
(3) Composite Index of National Capability (CINC)
(4) SIPRI
(5) U.S. NEWS Power Index

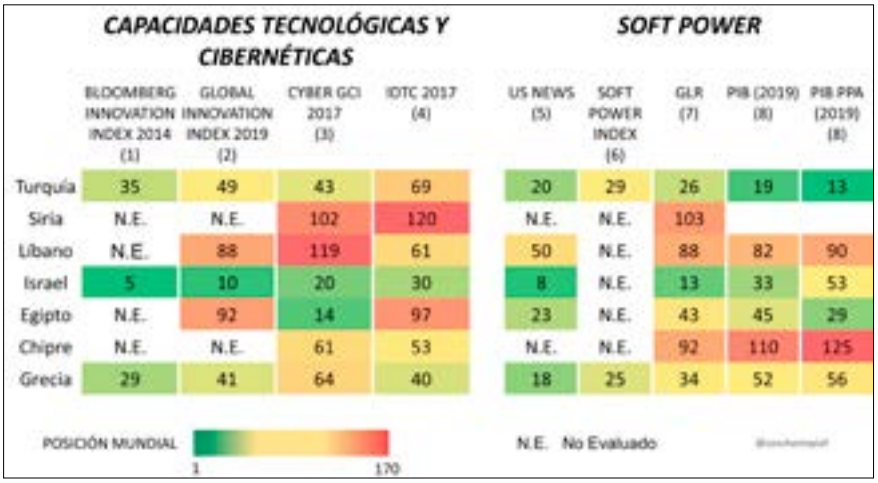
Table 4: World ranking for the EASTMED countries according to different hard power indexes. Different sources. Compiled by the author.

Except for specific aspects, in terms of *hard power*, we can observe a balance between Israel and Turkey, followed closely by Egypt. However, it must be pointed out that Turkey is clearly superior to Israel where naval power is concerned, whereas Israel is superior to Turkey regarding air power. There is also a clear imbalance favourable to Turkey, in any of the indexes above, when compared to Greece and Cyprus together, which is consistent with the recurrent use of naval force by Turkey in the exploration activities it carries out in the waters in dispute with Cyprus.

However, as we know all too well, a State's power in the current international context is not limited to *hard power*. Unfortunately, measuring a State's *soft power*, even in exclusively comparative terms, is extremely difficult. In Table 5 we have selected, albeit

[100] The concepts of *hard power* and *soft power* were introduced by Joseph Nye in the 1990s (Bound to Lead: The Changing Nature of American Power, 1990).

in a rather subjective way, certain indexes or classifications that can enable us to structure the EASTMED countries on the basis of their capacities able to be utilised as sources of *soft power*, or those, such as technology and cybernetic capacity, which can enhance their potential in exercising power in any of its forms. Each one of these in isolation is not conclusive. What matters here is that the power relations according to the parameters chosen paint a very similar picture to the one we have observed in terms of *hard power*.



(1) BLOMBERG Innovation Index 2014 (https://www.bloomberg.com/graphics/2015-innovative-countries/)
(2) Global Innovation Index 2019 (https://www.globalinnovationindex.org/home)
(3) Global Cybersecurity Index 2017 - International Telecommunication Union (ITU) (https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-GCI.01-2017-PDF-E.pdf)
(4) Communications Technology Development Index 2017 - International Telecommunication Union (ITU) (https://www.itu.int/net4/ITU-D/idi/2017/index.html)
(5) International Influence (US News) (https://www.usnews.com/news/best-countries/best-international-influence)
(6) Soft Power 30 (https://softpower30.com/)
(7) Global Leadership Ranking 2018 – WorldPR Agency – Western Perception Index 2018 (https://docs.zoho.com/file/60eu68264879adb814e65b82fae32f7576e4e
(8) Gross Domestic Product - International Monetary Fund (IMF)

Table 5: World rankings for the EASTMED countries according to different technological development indexes and soft power. Different sources. Compiled by the author.

Once again, the balance is favourable to Israel, clearly ahead of the rest of the countries, especially in the field of innovation and

technology. And this is a crucial factor in today's world. Israel has a consortium of firms and State agencies that devote considerable resources to studying civil and military applications of new technologies, such as artificial intelligence (AI); the development of nanosatellite constellations that will exponentially increase their recognition and early-warning capacities; or the development of high-power laser interceptors, the latter with US support[101], to mention just a few of the technologies that by 2030 will have considerable influence in determining a nation's military superiority[102]. Therefore, it is only to be expected that Israel will increase its military advantage during this decade.

There is a certain balance between Greece and Turkey in the field of innovation and technology, and the same applies where *soft power* is concerned, although Greece has a certain advantage. The fact that Greece belongs to the EU gives this country a "power boost" over Turkey. To a certain extent, Greece can drag the EU as a whole into supporting its interests in the zone. So, it is to be expected that Turkey would tend to support the use of force in its disputes with Greece and Cyprus, whereas the latter two would try to maximise the influence they have on international relations through their membership of institutions such as the EU.

The geopolitics of the major powers: opportunities for global contention

The current geopolitical panorama has brought the renewed competition between the major global powers, USA, Russia and China, to the shatter belt of the EASTMED, an area of special interest to all of them, albeit for different reasons.

Russia

Russia's main interest in controlling this region lies in its necessities in security matters, bearing in mind the major role that these waters play in accessing the Black Sea and the Suez

[101] H.R. 6725 (115th): United States-Israel Directed Energy Cooperation Act, available at https://www.govtrack.us/congress/bills/115/hr6725/text. Consulted in December 2019.

[102] LEÓN, Gonzalo, Repercusión Geoestratégica del Desarrollo Tecnológico [*Geostrategic Repercussion of Technological Development*]. Instituto Español de Estudios Estratégicos, March 2020.

Canal, a geopolitical constant since the period of the Tsars. However, its role as Europe's main gas supplier means that it cannot remain impassive to the development of the EASTMED's energy resources. In spite of having tried to intervene in the regional market with its companies, it has only been partially successful in Egypt, where Rosneft operates together with ENI, BP and Mubadala Petroleum in the Zohr Field[103], and in exploring the waters of the Lebanon, where resources are yet to be discovered. Russia has hardly made any inroads in Israel, so Gazprom has had to content itself with the signing October 2017 of a non-binding MoU with Delek Drilling to study new projects in the country[104] however it being excluded from the tenders to exploit Leviathan, despite having submitted the most economical bid at the time[105]. And that is all. At the present time, the limited real possibilities of developing export options have enabled Russia to keep a low profile, yet this may change if any of them materialise, in which case greater involvement could be expected.

If Russia does not manage to directly participate in the profits involved in exploiting these resources, it will do everything in its power to prevent any competition that is detrimental to its interests. That is why it has conveniently positioned itself in the region, especially in Syria, where it has established two permanent bases: the Latakia air base and the Tartus naval base[106], with A2/AD capacities[107], which will enable it to exert power over the accesses to the Suez Canal and the Black Sea (Figure 18).

The strategic advantage that a base in Egypt would provide to complete its A2/AD structure is clear. That is why Russia has shown a special interest in improving its diplomatic and trading

[103] ROSNEFT, available at https://www.rosneft.com/. Consulted in December 2019.

[104] Delek Drilling. National Security and Foreign Relations, available at https://www.delekdrilling.com/natural-gas/national-security-foreign-relations. Consulted in January 2020.

[105] BARKAT, *Amiram. Gazprom bids highest for Leviathan Partnership*, GLOBES, Israel's Business Arena, 16 October 2012, available at https://en.globes.co.il/en/article-1000790600. Consulted in January 2020.

[106] *Iranian ambitions for the Syria's Mediterranean coast*, Ports Europe, 19 November 2019, available at https://www.portseurope.com/iranian-ambitions-for-the-syrias-mediterranean-coast/. Consulted in December 2019.

[107] From Anti-Access/Area Denial, an operational concept which attempts to prevent an adversary's access to a particular region and to limit its freedom of action in that region. It habitually includes anti-aircraft capacities, anti-vessel capacities and other offensive weapons, such as ballistic missiles, smart weapons, etc.

Figure 18: Russian presence in the Eastern Mediterranean. Different sources. Compiled by the author.

relations with Egypt, as well as enhancing military cooperation, as we have already seen when analysing the Egyptian air and naval forces. The Egyptian policy of diversifying arms purchases affords a wonderful opportunity to engage in a closer relationship with a country that during the Cold War was already a privileged partner of the Soviet Union and that, given its leadership role in Africa, could also serve as a bridge for Russia to make inroads where Africa is concerned.

The greater the influence Russia exerts on Egypt, the greater its capacity will be to affect the development of the regional energy cooperation structure that is being developed, and, in this sense, Russia could share the same interests as Turkey, a country with which it also has built a satisfactory relationship.

China

China's presence has also made itself felt in this part of the world, however, its nature not being currently military. Its Belt and Road initiative makes use of several regional land and sea routes and is in the process of establishing a dense network of investments and trade relations for strategic objectives, that are viewed with suspicion by the West[108]. Chinese firms already control the ports

[108] For further details, see SÁNCHEZ TAPIA, Felipe. El dragón y la media luna: una aproximación a la presencia de China en Oriente Medio [*The dragon and the half-*

of Kumport, the third most important in Turkey, close to Istanbul[109], Piraeus[110], in Greece and, in 2018, it took over the management of the port of Haifa, in Israel[111]. Interest in the latter country is not limited to trading matters, and Israel´s advanced development as a technological power has enhanced Chinese investments to such an extent that, according to Benjamin Netanyahu, they have reached a third of the total investments in this sector[112].

Control over the Suez Canal makes Egypt a vital partner in the Belt and Road project, which is why diplomatic relations between the two countries are at the very highest level ever. Since 2012, China has been Egypt's top trading partner, and the former's direct investment in the latter has spectacularly increased. China has committed 20,000 million dollars to financing the megaproject to build the new administrative capital in Cairo[113].

So far, apart from the Chinese Navy's occasional visits to ports, the country's military might has been almost absent from the Eastern Mediterranean. Yet sooner or later, China could feel the need to provide security to its increasingly dense network of interests, so its naval presence in the Mediterranean could become regular. China is already constructing a base in Djibouti[114], from where it could easily project the naval force with an ocean-go-

moon: an approach to China's presence in the Middle East]. IEEE analysis document, 16/2019. Available at http://www.ieee.es/Galerias/fichero/docs_analisis/2019/DIEEEA16_2019FELSAN-ChinaOM.pdf

109 *Chinese consortium buys into Turkish port with USD 940 million investment*, press release from Invest in Turkey dated 28 September 2015, available at http://www.invest.gov.tr/en-US/infocenter/news/Pages/280915-cosco-pacific-buys-turkish-kumport.aspx. Consulted in January 2020.

110 GEORGIOPOULOS, Georg. *China's Cosco acquires 51% stake in Greece's Piraeus Port*, Reuters, 10 August 2016, available at https://www.reuters.com/article/greece-privatisation-port-idUSL8N1AR252. Consulted in January 2020

111 HAREL, Amos. *Israel Is Giving China the Keys to Its Largest Port – and the U.S. Navy May Abandon Israel*, Haaretz, 17 September 2018, available at https://www.haaretz.com/us-news/.premium-israel-is-giving-china-the-keys-to-its-largest-port-and-the-u-s-navy-may-abandon-israel-1.6470527. Consulted in January 2020.

112 ABRAMS, Elliott. *What's behind Israel's growing ties with China?* – Council on Foreign Relations, 21 June 2018. Available at https://www.cfr.org/expert-brief/whats-behind-israels-growing-ties-china. Consulted in January 2020.

113 WOOD, Davis. *Egypt Loves China's Deep Pockets*, Foreign Policy, 28 August 2018.

114 Although this base will be large enough to enable any of its fleet's vessels to moor, more than being a base where China wishes to station its military strength, it is a base to provide logistical support for its limited military deployment in the region and in Africa.

ing capacity that it is preparing, and for which it already has an aircraft carrier on its stock list[115], two or three more also being under construction[116].

United States

Neither has the USA remained undisturbed by the developments in the EASTMED. In April 2019 and within the context of Turkish-US relations that had deteriorated considerably for a variety of reasons, Senators Bob Méndez (D) and Marco Rubio (R) presented a legislative initiative in which, amongst other considerations, they proposed not only reinforcing the strategic dialogue with the RoC, Greece and Israel, but also imposing sanctions on Turkey, as well as increasing US military presence in Mediterranean waters while creating a USA-EASTMED Partnership Centre for energy, with a view to developing cooperation on this matter[117].

This initiative is a Bill that still has to go through a long process before it becomes an Act, if it is eventually passed. However, recent North American diplomatic activity tends to confirm this trend. During the visit of Mike Pompeo to Greece, in his capacity as the Secretary of State (5-7 October 2019)[118] the two countries signed a protocol to extend the mutual cooperation agreement in defence matters, which included greater US military presence in the country (Souda Naval Base (Crete) and Larisa Air Base) as well as the possibility of using the Alexandroupolis port.

The signing of this agreement, for which conclusion the tension in the EASTMED has played a considerable part, has deep strategic implications, because without a shadow of a doubt it is indicative of the USA's alignment in this part of the Mediterranean in a way that is harmonious with its global interests. It must be remembered that as the containment of China and Russia are the prior-

115 The *Liao Ning*, of Russian origin. Military Balance 2019.

116 *The Secret of China's Aircraft Carriers,* The National Interest, 28 November 2019, available at https://nationalinterest.org/blog/buzz/secret-chinas-aircraft-carriers-100852. Consulted in January 2020.

117 *H.R. 2913 - Eastern Mediterranean Security and Energy Partnership Act of 2019*, available at https://www.congress.gov/bill/116th-congress/house-bill/2913/text. Consulted in November 2019.

118 *Joint Statement Regarding the Second United States-Greece Strategic Dialogue 2019*, US Department of State, 7 October 2019, available at https://www.state.gov/joint-statement-regarding-the-second-united-states-greece-strategic-dialogue-2019/. Consulted in December 2019.

ity objectives of the US National Security Strategy, its position in the EASTMED should contribute to this aim. Therefore, strengthening its ties with Greece and Cyprus, in addition to satisfying the interests of its major companies where energy matters are concerned, guarantees a strengthened military presence in the zone and secures land access (from Greece) to countries that are vital for the containment of Russia in the European scenario, such as Rumania, Hungary and, further north, Poland.

North American military presence in the zone may also be necessary to contain Iran, which also forms part of its security strategy. Iran is extending its influence along these coasts through its allies in the Lebanon (Hezbollah) and the Syrian regime. It is aiming to establish a corridor that links the country with the Mediterranean coastal areas via Iraq and Syria. In the latter country, Iran has established the basis for a strategic positioning on its coastline by signing a leasing agreement for the container terminal in the Port of Latakia, from which it could directly threaten Israeli and US interests[119].

US actions in the region cannot be carried out without taking their toll and, as a result of the aforementioned activities, its relations with Turkey, an equally vital partner in the US containment strategy, not only in Europe but also in the Middle East, are being seriously threatened.

France and the UK

As we have already seen, the European powers whose companies participate in the exploitation of the resources are also in the region. France, which has unequivocally sided with the association comprising Greece, Cyprus, Israel and Egypt[120], has traditionally kept naval forces permanently in these waters[121]. Furthermore and more recently, Cyprus has guaranteed France the use of its Evangelos Florakis Naval Base, for which purpose it is currently

[119] *Iran to lease Syrian container port of Latakia*, PortSEurope, 8 April 2019, available at https://www.portseurope.com/iran-to-lease-syrian-container-port-of-latakia/. Consulted in January 2020.

[120] *Meeting of the Foreign Ministers of Egypt, France, Cyprus and Greece - Final Communiqué (Cairo, 8 January 2020*), French Ministry of Foreign Affairs, available at https://www.diplomatie.gouv.fr/en/country-files/cyprus/news/article/meeting-of-the-foreign-ministers-of-egypt-france-cyprus-and-greece-final. Consulted in January 2020.

[121] Marine Nationale, Opérations permanentes [*National Navy, Ongoing Operations*], available at https://www.defense.gouv.fr/marine/missions3/operations-permanentes/operations-permanentes. Consulted in January 2020.

being enlarged[122]. To leave proof of this privileged relationship, from time to time the French Navy takes part in naval exercises with the Greek and Cypriot Navies[123]. As far as the United Kingdom is concerned, and as we have already mentioned, the UK is permanently present at its two "sovereign" military bases.

Conclusions

The last decade has borne witness to significant changes in the geopolitical situation affecting a region such as the Eastern Mediterranean, which has traditionally been the scenario of competitiveness between the regional and global powers. The discovery of gas deposits in the waters of Cyprus, Israel and Egypt that, particularly in the latter two cases are significant, has raised expectations in those countries not only of becoming energy self-sufficient, but also of obtaining considerable profit from exporting resources that, even in times of ecological transition, are likely to still be in demand on a large scale in the coming decades.

In their quest for these potential resources, the coastal countries have come against yet another cause for conflict to be added to the already complicated geopolitical relations, making these historical rivalries even worse. As a consequence, the conflicts between Turkey and Greece in the Aegean Sea; between the two communities on Cyprus, which not only have an effect on the island but also affect relations between Greece and Turkey and, by extension, relations between Turkey and the EU; between Israel and the Lebanon; and between Israelis and Palestinians, to point out the most obvious ones, all now contain an energy aspect as one of the factors that imperatively affect their development and, thus, must be borne in mind when solving them.

The exploitation of these resources has encouraged cooperation between countries with shared interests, such as Greece, Cyprus, Israel and Egypt, which have established cooperation forums and mechanisms that are supported by both the EU and the United

122 *Cyprus plans Mari naval base expansion to host French Navy ships*, NAVAL NEWS, 23 May 2019. Available at https://www.navalnews.com/naval-news/2019/05/cyprus-plans-mari-naval-base-expansion-to-host-french-navy-ships/. Consulted in January 2020.

123 *France, Italy and Cyprus to Conduct Joint Naval Exercises in Eastern Mediterranean*, Greek Reporter, 11 December 2019, available at https://greece.greekreporter.com/2019/12/11/france-italy-and-cyprus-to-conduct-joint-naval-exercises-in-eastern-mediterranean/. Consulted in January 2020.

States, such as the Eastern Mediterranean Gas Forum (EMGF) or the consortium formed with a view to constructing the EASTMED gas pipeline. Yet the scope of these structures is limited. Firstly because the link it establishes between the countries taking part in them is weak, far from the commitments that formal alliances require. And, secondly, because those that have been left out find them not only exclusive, but also drawn up against their interests.

Turkey emerges as the regional power whose interests are most adversely affected by these developments, and it has felt obliged to demonstrate that, whatever the outcome, its interests must be considered. In view of Turkey's naval superiority, it is foreseeable that it might resort to the use of force to back up its foreign policy.

Fear of being faced with a *fait accompli* and of losing the initiative is causing these countries to embark, within their possibilities, on programmes aimed at modernising and improving their military potential, in order to project power beyond their own coastlines, especially where their naval forces and air forces are concerned. All of this has led to a growing militarisation in this part of the Mediterranean, and this is giving rise to an unsettling increase in clashes and incidents, which are currently limited, but that could easily escalate.

The major global powers have been closely watching the events taking place in this part of the world. Prompted by reasons associated with its own security and energy interests, Russia has been adopting a pragmatic foreign policy in the zone that, while refraining from recklessness, has not wasted any opportunities. Russia has remarkably managed to establish itself firmly in the region, and has free-flowing relations with nearly all the regional stakeholders and has become a force that has to be reckoned with. So far, Russia´s involvement in the exploitation of these hydrocarbons has been limited, mainly because the export options from Israel, Egypt and, in the future, Cyprus, to European markets do not yet pose a serious threat to Russia's dominant position as the main exporter of gas to Europe.

China has also made major inroads into the Mediterranean with its Belt and Road initiative, and although its military presence is almost non-existent for now, the country may be forced to resort to it in the future to protect its increasing interests.

The interests of the USA, which has a considerable military presence in the Mediterranean, are more difficult to make out. Firstly,

it wishes to curtail the expansion of its rival powers, Russia and China, and secondly, it would like to keep Iran in check, for which purpose it would need cooperation from Turkey. Yet this goes against the interest of its major companies, which are playing an active role in the exploitation of energy resources in the waters of Egypt, Israel and Cyprus, with whom it wishes to maintain, or try to maintain relations of a priority nature. Furthermore, The USA's bilateral relations with Turkey are going through difficult times, which is why Turkey and Russia have moved closer together. This situation does not benefit the USA at all, given that sooner or later it could find itself having to redress the balance with Turkey.

Both regional and global dynamics are making the Eastern Mediterranean a region of growing instability where the military potential never ceases to grow. It is hardly surprising that the classic resorting to the use of force as the *ultima ratio regis* is becoming increasingly habitual. The current cooperation structures are proving insufficient to manage the growing number of disputes, which will be difficult to limit if new security architectures are not implemented that inclusively involve all the States in the region. Dialogue forums on a par with the Organisation for Security and Cooperation in Europe (OSCE) in the area of European security, which played a basic role during the Cold War, or, the 5+5 dialogue initiative that brought together countries on the northern and southern shores of the Western Mediterranean (Spain, France, Portugal, Italy and Malta, on the European side, and Morocco, Mauritania, Algeria, Tunisia and Libya, on the African side) could serve as a model for this purpose.

The waters of the Eastern Mediterranean are beginning to get very rough, as if a storm were brewing. But fortunately the future has not yet been written. On this occasion it is not the forces of nature that are making it choppy, and it is mankind's hands to calm down the waters. Let's see if the will exists to do so.

Chapter three

Electrical sector´s security in Spain

Alberto Carbajo Josa

Abstract

Electricity as such cannot be stored, that is why it is necessary to produce the same quantity as is consumed and keep a dynamic balance between generation and demand. A change in the energy model must be accomplished, as part of the climate change challenge, in view of the energy sector's larger responsibility for greenhouse gas emissions. Fortunately, technological breakthroughs affecting electricity production facilities using renewable energy sources make this energy transition possible. However, its production is random and unpredictable, so supplementary services are required to keep the aforementioned balance and guarantee the supply´s security. Renewable energy sources are scattered throughout the land, so networks will have to be laid that enable this energy to be collected, providing the producer and the consumer with a more active role in the supply. Technological breakthroughs in communications, with equipment that features state-of-the-art digitalisation and smart network devices with a dual flow of energy and information, will constitute the basis on which the consumers' decisions are made. Digitalisation breakthroughs and an increase in the information available make this process easier, but one of the major risks faced by digitali-

sation is cybersecurity in matters concerning data protection and vulnerabilities affecting critical infrastructure, because we are talking about the possibility of citizens' essential services being affected. Leaving a region, or even a whole country, without electricity for just a few hours undoubtedly has serious consequences. Cybercrime attempts to attack the critical infrastructures of organisations and States, which these then have to face through costly cybersecurity processes.

OPERACIÓN DEL SISTEMA ELÉCTRICO EUROPEO

DESCARBONIZACIÓN
ELIMINACIÓN DEL CO_2 RESULTANTE DE LA COMBUSTIÓN

DISTRIBUCIÓN
LA ENERGÍA RENOVABLE ESTÁ DISTRIBUIDA POR EL TERRITORIO

DIGITALIZACIÓN
FACILITA EL DESARROLLO DE LAS RENOVABLES, A LA VEZ QUE REPRESENTA RIESGOS

LOS RIESGOS CIBERNÉTICOS Y LA MITIGACIÓN DE LOS MISMOS

Electrical sector´s security in Spain

Introduction

In our increasingly "electrified" society, guaranteeing a reliable electrical supply is vital for it to operate properly. Any interruption to the electrical supply has a high economic and social impact, proof of this being the consequences of the most recent "power cuts" in major cities.

Today's society demands increasingly improved supply quality, although it is necessary to evaluate this from an economic viewpoint and strike the right balance between supply quality and economic cost. Ultimately, this will always affect the general public, which is why we must suitably manage the cost-reliability factor.

The European Electrical System is a developed and reliable one, which is rarely affected by major incidents, but to achieve this, the supply guarantee must be planned and managed by the empowered authorities in the long, medium and short term, with suitable energy policies that contain a sufficient investment plan. The large-scale incorporation of renewable energy into the system, whose primary sources of energy are not manageable because they vary greatly and are difficult to predict, is an extra risk factor that has to be faced now by the system operators; the German nuclear moratorium, a consequence of the incident at the Fukushima Nuclear Power Plant, which will lead to the closure of more than 8,000 MW of nuclear power plants, will undoubtedly be a challenge for the German Electrical System that could affect its supply guarantee and thus the European electrical supply; energy-saving measures and activities in the area of demand management are actions that will improve the coverage margins and will thus lead to an improvement in the supply guarantee indexes.

The reduction in the system's coverage margin not only leads to a decrease in the reliability of the supply, but also to a rise in the production cost on the electricity market, because it will be necessary to resort to the most expensive plants to cater for demand peaks.

Electricity is not a commodity that can be stored (at least, "not on a large scale" and, at present, not in an economically viable way). This means that overcapacity is required (we need to have a greater capacity for generating electricity than the peak consumption) and it has to be managed in real time (generation = consumption).

All of this means that if the electrical system is to operate correctly there has to be a dynamic and permanent balance between production and consumption. Any unbalance between demand and generation means that frequency deviates from its nominal value, 50 Hz in Europe. This deviation increases when the generation-demand gap is wider and the system inertia is lower.

Electricity is negotiated on a market where, every day and for every hour, the generators submit sale offers on the electricity market and the consumers submit purchase offers. This market is managed by the market operator, in Spain, "OMIE" (Operador del Mercado Ibérico, Spanish pole). The market has one daily session, six sessions every other day and one continuous intraday session that operates in a similar way to the Stock Exchange. Most of the energy is negotiated at the daily session, whereas in the intraday bids some of the scheduled quantities are adjusted once the daily market has been fixed. The two types of session operate in a similar way. On the daily electricity market, the generators (hydraulic, nuclear, thermal, renewables) submit their sales offers for each of the hours in the following day. Marketers and major consumers (domestic and industrial) submit their purchase bids, i.e., the energy they are expecting to consume in each one of these hourly periods. The international interconnection capacity is also included as just another market variable. If our energy is more expensive than French or Moroccan energy, we import; if it is cheaper, we export.

On an hourly basis, the OMIE market operator puts the bids in order from the lowest to the highest sale price (supply) and from the highest to the lowest purchase price (demand). The price of the electricity and the quantity of energy that is going to be sold and/or purchased by each one of the agents is established as from an equilibrium point between the supply and the demand. An algorithm called EUPHEMIA is responsible for calculating that equilibrium point for each one of the hours in the following day, and it takes into account all the variables (including interconnections with the rest of the European markets). Another important point worth noting is that the electricity market is a marginal market, i.e., regardless of the price a producer has bid, he will receive the price of the most recent producer to enter the market,

From a physical perspective, this system operates in real time through the principle of solidarity that physical laws impose on the different constituent subsystems –countries–, minimising the impact of possible incidents because they provide each other with

mutual support. The frequency value is the same throughout this synchronous system.

In the event of an electrical incident, the synchronous generators in all neighbouring countries automatically react, modifying their production to make up for the variations experienced in the country where the incident has occurred. After a predetermined time has passed, it is up to the facilities in the affected country to once again guarantee the generation–demand balance.

Adjustment services and supplementary services

To keep the aforementioned balance, which can be altered at any time by variations in the production system or in consumption, in the way the electrical system operates, the resolutions concerning the technical restrictions (these are caused by the technical limitations of the system that render the matching program obtained on the electricity market unfeasible) and the supplementary services are available; all of which constitute what are known as the adjustment services.

The function of the supplementary services, managed by the system operator, is to adapt the production programs resulting from energy contracting in order to guarantee compliance with the quality and security conditions required to supply electricity.

The operating procedures, which are administrative resolutions, respectively contain the characteristics of the primary, secondary and tertiary regulation supplementary services in the electrical system. The differences between them, amongst other questions, lie in the different periods of acting time that manage to maintain that balance and, thus, the value of the frequency.

In Spain, according to the provisions contained in Royal Decree 1454/2005, the system adjustment services are composed of the following: the technical restrictions resolution, as identified in the programs resulting from the physical bilateral contracting and the production markets (daily and intraday), as well as all the technical restrictions that might appear during the real-time operation; they also consist of the supplementary services, which are the services needed to guarantee the electrical supply under the required security, quality and reliability conditions. They are classified into:

- Those associated with frequency-capacity regulation (primary, secondary and tertiary reserve)

- Transport network voltage control
- Resumption of the service after the incident

The management process for dealing with the deviations between generation and consumption -as an essential means for guaranteeing balance between production and demand- must constantly guarantee that the required regulation reserves are available. In economic terms, the set of system adjustment services has only a very slight effect on the cost of the electrical supply, yet, as has already been pointed out, these services are essential to guarantee the security and quality of the electrical supply.

Primary Regulation

Its purpose is to automatically correct the instantaneous unbalance that occur between generation and consumption. Primary regulation is provided by the speed regulators with which the generators are equipped. Their time frame for acting is up to 30 seconds. It is a mandatory supplementary service that is not explicitly paid for.

Primary regulation of the generator units must allow a statism to be established in their regulator that enables them to vary their load by 1.5% with respect to the nominal capacity. The consequent capacity variation must take place in 15 seconds when disturbance causes frequency deviations of less than 100 mHz and linearly between 15 and 30 seconds when the frequency deviations are between 100 and 200 mHz. The insensitivity of the generator unit regulators must be less than ±10 mHz with zero voluntary deadband. (See Figure 1).

Secondary Regulation

Its purpose is to maintain the generation-consumption balance, correcting any deviations from the exchange programs planned in interconnection between Spain and France, and deviations in frequency, with respect to the established setpoint value. It is a centralised supplementary service for frequency-capacity regulation that acts between 20 seconds and 15 minutes as from the unbalance. At this point, the "generators" no longer "wage war on their own account" as in the primary regulation, the regulation setpoint is calculated by a central system called RCP (Regulación Compartida Peninsular, Shared Mainland Regulation) managed by Red Eléctrica SAU, whose function is to maintain the objective

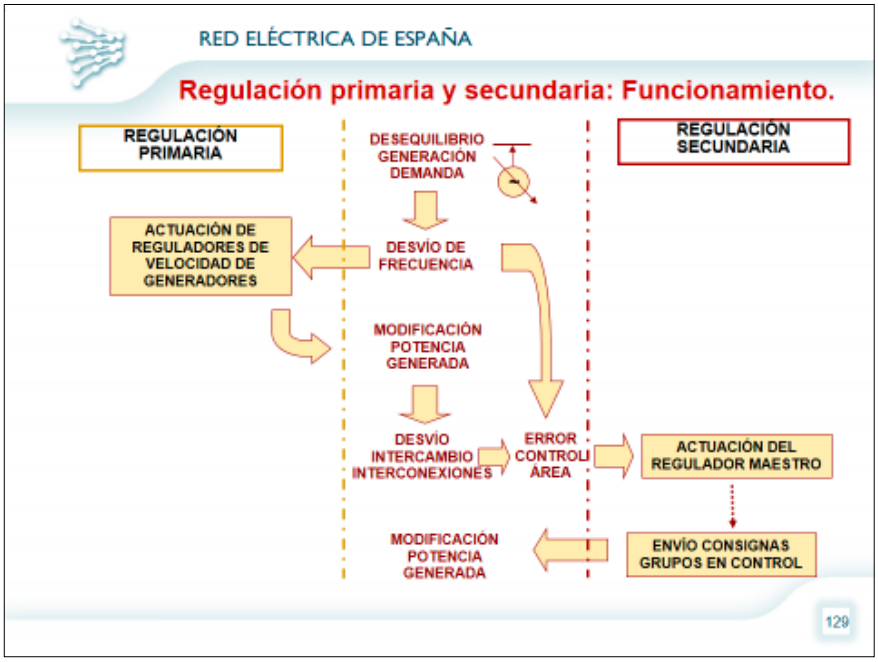


Figure 1. Primary and secondary regulation operation.

frequency of the grid and the energy exchanges programmed in the international interconnections with other countries.

The secondary regulation is provided by the generators, whose supplies are selected by competitive mechanisms. The regulation setpoint needed on a mainland level to adjust the frequency and the balance with France and Portugal is shared out in different values (CRR in Figure 2) between different groups of producers within what are known as regulation zones (AGC in Figure 2). Each zone is made up of a group of plants that can provide the secondary regulation service. The zones are governed by the system operator master regulator, known as RCP. Each one of these zones, in turn, shares out the master regulator regulation setpoint to comply with the requests in the required time. The dynamic response requirement for each regulation zone corresponds to a time constant of 100 sec. For the time being, the demand does not participate in this service.

The day before the supply and after the daily market and the technical restrictions process, the enabled producers tender their fluctuation band of power available, obtaining remuneration for it. The cost of providing the secondary regulation band falls on the demand and is one of the main costs of the system's adjustment

services. The demand and generators that cause the need because they have deviated from what was programmed on the market, pay for the use of the power that is utilised. The secondary regulation service is a supplementary optional service, remunerated for two concepts: availability (band) and utilisation (energy).

Availability or regulation band

Every day, the system´s operator publishes the secondary regulation reserve requirements, both to be uploaded or to be downloaded, in order to program the following day. The producers tender one regulation band for each programming unit enabled to provide this supplementary service. The bids are allocated, applying minimum cost criteria, until the requirements are covered, a marginal price being established for the band in each hour.

Secondary regulation energy used

The producer is also remunerated for the use of that power. The second regulation energy is utilised automatically, on the basis of the band allocation established by the System Operator the day before via the market concerned.

Figure 2. Shared mainland regulation.

Secondary regulation energy utilised as a result of the real time monitoring of the regulation requirements, is valued at the marginal price of the tertiary regulation energy that it would have been necessary to program every hour, to be uploaded or to be downloaded, to replace the energy.

It must be pointed out, within the European Union's decision to opt for the real and effective integration of markets and the implementation of the European Single Market, that a great amount of work is actively being done in the European agencies for the cooperation of energy regulators –ACER– and System Operators –ENTSO-E– to establish cross-frontier mechanisms for balance and reserve energies between the Member States that will result in a more competitive electricity market. Amongst other things, the cross-frontier balance services will permit renewable energies to be integrated in a better and more secure way.

Tertiary Regulation

Its purpose is to replace the secondary regulation reserve that has been utilised. It is provided by the manual action of uploading and downloading the power from the generation plants or pumping consumption plants that offer it at the lowest price, in the case of energy to be uploaded, or at the highest repurchase price in the case of energy to be downloaded. The tertiary reserve is defined as the maximum power variation that a production unit or a pumping consumption unit can bring about in a maximum of 15 minutes, and that can be maintained for a minimum of 2 hours. Tertiary regulation is a supplementary service with compulsory bidding and it is remunerated via the operating market concerned. If necessary, a tertiary regulation service is allocated based on the bids sent for that purpose by the production units; the price of the service is determined by the most recent bid allocated in both directions, uploading and downloading, in each hourly period.

Deviation management

Its purpose is to deal with any deviations between generation and consumption that might appear after the closure of the intra-market session and until the beginning of the effectiveness deadline for the following session.

Deviation management fulfils a function of serving as the connection between the tertiary regulation, and the intraday markets, providing the system operator with a more flexible mechanism for overcoming the unbalance between generation and demand, without jeopardising the availability of the required secondary and tertiary regulation reserves required. To achieve this, before every hour, there is an assessment of all the deviations reported and/or expected before the next intraday market session commences and, if deviations are identified that are greater than 300 MWh, lasting several hours, the required deviation management market is called.

Allocation is based on the bids to increase and reduce generation and pumping consumption submitted at each announcement. The modifications programmed for resolving the deviations are valued at the marginal price of the bids allocated in each hourly period.

Transport network voltage control

The aim is to guarantee suitable control over the voltage at the transport network hubs, in such a way that the system operates under the required security and reliability conditions, the electricity is supplied to the end consumers at the required quality level and the production units can function in the conditions established for their normal operation. The following are providers of this supplementary service: generator units whose net power is not less than 30 MW and with either direct connection to the transport network hubs or connection to them via a dedicated line; qualified consumers not subject to a tariff, whose contracted power is not less than 15 MW, that are connected directly to the transport grid; and the distribution grid managers.

Service resumption

Its purpose is to resume the supply if there has been a disturbance on a national or regional scale. It is based on the capacity that certain generator units have to start up without external supply within a certain period of time, after a general zero voltage has affected the facilities, and to keep on generating in a stable way throughout the service resumption process, or to carry on in island operation on their auxiliary services, prepared to serve as a voltage sending and energising point after the disturbance. This supplementary service is still at the development phase.

Recently, eight European electrical system transport operators (TSO) launched the Trans European Resumption Reserves Exchange (TERRE) platform which enables users in Europe to manage, in a coordinated way, the balance between electrical generation and electricity demand, after the intraday market programs have been adjusted.

This platform supported by the international interconnections, permits balance energies to be managed even more efficiently, by replacing the domestic balance markets and the bilateral energy exchange mechanisms between interconnected neighbouring systems with a multilateral European system.

Its use will contribute to reducing the end price of energy and will optimise the integration of renewable generation in Europe. Therefore, it amounts to a decisive step forward in implementing the domestic electricity market in Europe.

As a summary, the purpose of the adjustment markets run by the system operator is to adapt the production programs resulting from physical bilateral contracting and from the daily and intraday markets, all with a view to guaranteeing compliance with the quality and security conditions required to supply electrical power.

Electrical protection

The electrical system comprises a series of facilities, mostly outdoor, connected on the surface, which means these facilities are exposed to constant aggressions. Some of these are fortuitous, such as lightning strikes or the installations being struck by falling trees that cause short circuits that need to be isolated so supplies to consumers are not affected. Other aggressions are not accidental, being brought about deliberately and maliciously to cause failures/breakdowns that have a general effect on the supply.

In view of the aforementioned, the systems are equipped with protection devices whose purpose is either to protect the personnel or the switchgear from the consequences of short-circuits or to isolate the zone where these have taken place to prevent the consequences from spreading throughout the entire grid.

The System Operator, in collaboration with the agents affected, establishes the criteria not only for coordinating the protection

systems on the grid being managed, but also for coordinating these systems with the protection systems that form part of the distribution facilities connected directly to that grid being managed. The transport network is interconnected with the high-voltage meshed distribution grid at many points, by means of transport transformers (220, 400 kV) – meshed distribution (30, 45, 50, 66, 110 and 132 kV, generally), which constitute the frontier element. There are also transformers between the transport network and the unmeshed distribution grid, also called radial grid. A distinction can be made between two major groups of protection systems for isolating the above-mentioned faults. The first group contains those systems whose purpose is to protect the unit or "closed" operation (sensitive devices exclusively to protect against electrical faults located between current transformers) whose nature, for the purposes of coordination, makes them completely independent from the rest of the protection systems. Such systems do not require coordination analysis in the strict sense. The second group contains the "open" operation protection systems, sensitive to electrical faults located not only inside the element to be protected but also outside it. Their main characteristics is interdependence, so these systems need to be coordinated if they are to obtain the required selectivity.

The basic coordination criteria have to be established for every element in the electrical system that is analysed, lines and cables, transformers, bars and bar couplings, and these criteria have to be established for each one of the different types of electrical fault and the permitted adjustment intervals. Lower and upper Limits are formulated for each function, they being imposed on the adjustment depending on the location of the fault, i.e., whether it acts as a main protective device or a remote support protective device.

The energy transition

One of the signs of climate change is global warming due to the greenhouse effect caused by the high CO_2 concentration in the atmosphere. The use of fossil fuels to generate electricity and for transport and mobility make a major contribution to this high concentration.

In the European Union, the need for an environmental protection and the energy policy have led to the following targets being set

for 2030, in the "Clean energy for all Europeans package", also known as the "Winter Package":

- 40% reduction in CO_2 emissions with respect to the levels emitted in 1990
- 32% of the final energy mix from renewable sources
- 32.5% increase in energy efficiency

The new European Commission is considering more ambitious CO_2 reduction targets, but greater flexibility will be required if this proposal is to succeed, because, for the first time, political obligation is ahead of technology.

These targets can only be achieved if there is a considerable increase in the electrification of the economy in order to obtain a hybrid energy model based on electrification and the utilisation of decarbonised gases and/or renewable gases (as long as the technological breakthroughs make it economically feasible to produce hydrogen and to capture and confine CO_2).

With a view to achieving this, certain clear trends are now emerging towards renewable generation and the storage of energy through pumping and batteries, response on demand, to backup generation (as clean as possible) and to energy interconnections. A broad consensus is needed to define the path that leads to a more sustainable generation mix.

The inroads electricity makes into the economy will be somewhat mitigated with the results that are obtained from applying energy efficiency measures, but if there are major growths in the demand for electricity, the gradual closure of coal-based generating plants, which should lead to their disappearance, has to reconcile with the need of firm power caused by the increases in demand.

The mobility sector is another sector that is mainly responsible for the emission of pollutants. In this case, the use of electric automobiles and vehicles with decarbonised gases will be essential when it comes to sharply reducing pollution levels, as long as the electricity is produced using sources that do not emit CO_2.

Furthermore, States have been basing their CO_2 emission reduction targets principally on electricity generation, a sector where the marginal cost of reduction is higher and the risk of relocation is lower. However, emission reduction is also required in sectors of the basic industry that are exposed to the relocation

risk, so compensation is applied because of the cost of purchasing emission rights in order to reduce the risk of relocation.

An emissions market has been established with a view to achieving emission reductions in the electrical sector and in the industrial sector. In this market, certain permitted emission quantities are allocated, known as emission rights, which decrease in time. If the actual emissions from each facility are greater than its rights, it can go to the market and obtain the missing rights. The market contains the surplus CO_2 rights from the companies with actual emissions lower than the allocated quantity.

Therefore, electricity is an energy vector that due to its characteristics plays a basic role with ever-increasing participation in the eventual consumption of energy. Electricity production has to develop as part of a threefold commitment involving supply security, environmental sustainability and economic competitiveness. Indeed, electricity production has certain environmental consequences that must be assessed at each and every phase of the kWh life cycle, in order to be able to thoroughly analyse their implications. We are focusing here exclusively on the pollutants emitted during the electricity generation process.

The main pollutants caused by electricity generation are emitted because of the combustion process in fossil fuel power plants. CO_2 gas emissions have a global effect, which although harmless to human health, are one of the main causes of the greenhouse effect. Acidifying and eutrophying emissions such as NO_x (gases that are precursors of tropospheric ozone), SO_2 and emissions of solid particles have local and regional effects.

Emissions of an acidic nature, SO_2 and NO_x, can be almost completely controlled by using cleaner fuels and, above all, by installing gas cleaning plants. The only drawbacks are an increase in production costs owing to the investment costs, and the products that have to be added, with the resulting relative loss of competitiveness.

Renewable energies

Developing renewable energies is one of the principle points in Spanish energy policy, characterised by the need to reduce energy dependence on other countries (we import 80% of our primary energy needs, whereas the European average is around 55%). Other characteristics of the policy are reducing carbon

emissions, complying with the environmental and efficiency commitments undertaken (Kyoto and 20-20-20 goals prompted by Directive 28/CE/2009) and the ""Clean energy for all Europeans" package.

Renewable energies have been implemented to a considerable extent in the Spanish Electrical System, especially wind generation, which with an installed power of 25,310 MW at the end of 2019, lies second in the ranking of installed power in the electrical system of mainland Spain, coming second only to combined cycle gas power plants. Moreover, it must not be forgotten that conventional hydraulic generation, with an installed power of 17,085 MW at the end of 2019, is the third technology in the ranking, although there have not been any significant rises in recent years; in this case a further 3,329 MW of hydraulic pumping must be added. By the end of 2019, other renewable technologies, such as solar photovoltaic energy with 8,454 MW of installed power or solar thermal energy with 2,304 MW, were also making a significant contribution to the total. The rest of the renewable technologies implemented in Spain account for much less in the production mix; those technologies are biomass, mini-hydraulic technology or the incineration of renewable waste. The generation capacity from renewable sources made it possible for 38.9% of the net annual generation in 2019 (247,002 GWh) to be renewable, with wind making a contribution of 21.5%, conventional hydraulic accounting for 10.0%, solar providing 5.7%, and the rest of the renewables, 1.5%. Energy produced without CO_2 emissions has risen to 151,918 GWh, which amounts to 61.5 of the total. By 2030, almost 40% of the primary energy consumed is expected to come from renewable sources.

The objective of these wind and solar photovoltaic technologies is to transform into electrical power, the maximum amount that can be produced with the sun and wind conditions available, and for them to do this regardless of the requirements of the electrical system at any particular time. From the perspective of integration into the electrical system, the main characteristic is that their operating regime depends exclusively on the meteorological conditions on the site at any given time.

These local meteorological conditions vary greatly, which means that the generation depending on them is also variable. A wind farm may be at a standstill due to a lack of wind, yet a few hours later it could be producing its nominal power thanks to a

wind increase. This happens more regularly in the case of solar photovoltaic generation, which does not produce energy at night, but on sunny days manages to produce almost its maximum power at the mid hours of the day. One consequence of this is that the utilisation factor for these technologies, (that is the ratio between the percentage of energy actually produced throughout a specific period of time and the energy that could have been produced if the facility had been generating at maximum power throughout the same period of time) is low; the utilisation factor is about 25% for Spanish wind farms and, thanks to technical breakthroughs, it is also about 25% for photovoltaic technologies.

A low utilisation factor means that to make certain inroads in energy terms, it is necessary to install greater power than for technologies with a high utilisation factor. However, in certain situations, given the high installed power, there will be a simultaneity in the production of a technology, moments with high wind situations throughout the Spanish mainland for wind generation, or sunny summer days for solar photovoltaic energy, so the production to be incorporated during those moments will be very high, which could hinder this integration, especially if the demand is limited, as might happen during the night or on certain Sunday or Bank Holiday mornings

Generation technologies are fundamentally classified on the basis of their manageability. The term *manageability* is defined in Royal Decree 661/2007, which states that unmanageable generation is "that which has a primary source that cannot be controlled or stored and whose associated production plants are unable to exert control over production following instructions from the system operator, without resorting to a waste of primary energy, or, if the firmness of future production prediction is not sufficient for it to be considered a program". To begin with, and as is established in Appendix XI of the aforementioned Royal Decree, the following are considered to be unmanageable: special regime generators using wind, solar (thermal and photovoltaic), geothermal, wave and tidal, hot and dry rock, ocean thermal and marine current technologies, as well as hydraulic flow generators with an installed power less than 50 MW, unless they have been specifically rated as manageable by the system operator of a generating plant with the consequent application of the requirements and determinants associated with that condition.

That is to say, to integrate the renewable energies, in view of their great variability and that their performance is difficult

to predict, what is needed to guarantee the dynamic balance, are facilities that can store the surplus energy at times of lower demand and resort to them when the demand is greater than the energy that is offered by the renewable energy plants at that particular moment. These storage facilities are either pumping facilities or, when the technology offers storage solutions not only on a daily but also a seasonal basis, batteries, which are now being developed on a large scale so that they can be used when they become economically feasible. In this respect, H_2 can play a major role, when its production utilising the various methods that are currently being researched make this viable.

Meanwhile, apart from pumping and batteries, the variability of the renewables can be made up for by firm but flexible generation, i.e., rapid response generation, where the hydroelectric plants and the combined cycle plants consuming natural gas (with lower specific emissions of CO_2 than the current coal power plants) will play a major role during the first decades of the energy transition and can be displaced when the storage facilities (pumps and batteries) have reached a state of economic viability and are operational.

The European electrical system

The Spanish mainland electrical system forms part of the European interconnected system that includes most of Continental Europe as far as Poland and Greece, it being also connected to Morocco, Algeria and Tunisia by two 400 kV undersea cables under the Strait of Gibraltar. Within this regional area, the European electrical system is run by the operators of the systems (TSOs) that are associated in ENTSO-E, whose basic cooperation areas are the development of the European network of electrical infrastructures and the coordination of the European electrical system, as well as working jointly in innovation and technological development matters. Furthermore, the European Union Commission has entrusted this association with developing the grid codes currently in force. It is also the main technical advisory group in electrical energy matters where the European institutions are concerned. Its involvement is essential when it comes to accepting the challenges posed by emission reductions, the large-scale integration of renewable energies, flexibility or new technologies.

Data concerning the size of the system (2018)

Electrical Systems	*Power installed (MW)*	*Net Generation (TWh)*	*Pumping Production (TWh)*	*Demand (TWh)*
ENTSO-E	1,083,705.0	3,659.20	46.3	3,328.80
Continental	868,944.5	2,913.85	41.7	2,862.55
Nordic	100,328.5	385.95		381.05
Baltic	9,214.0	20.00	0.7	28.20
Great. Britain	90,207.0	285.80	3.4	304.00

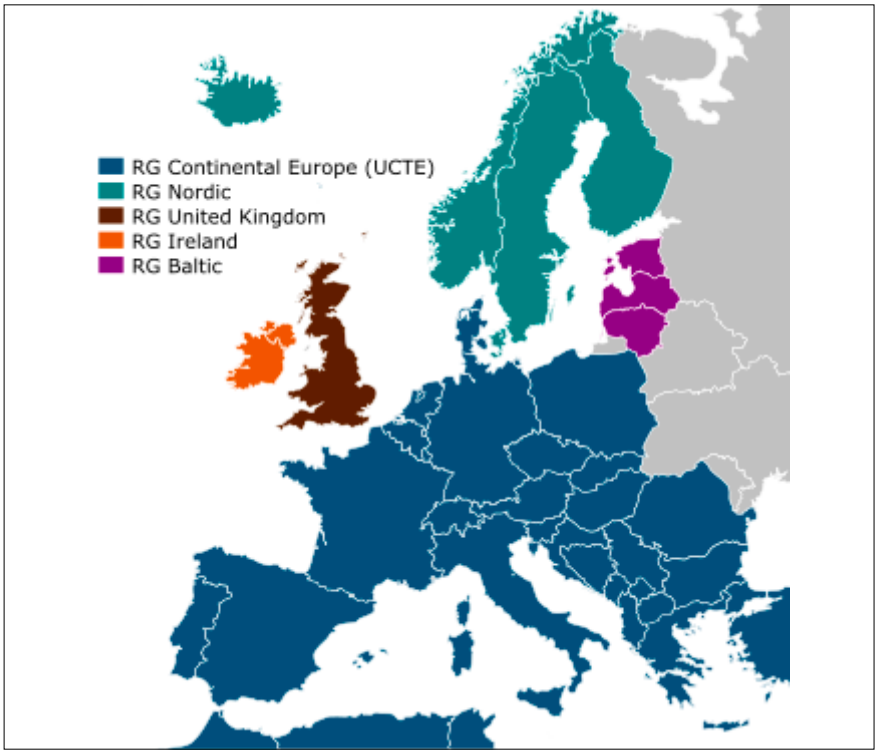


Figure 3 Scope of the European electrical systems

The electrical interconnections

The international interconnections that can be seen in Figure 3 have a series of advantages for the connected countries. The main one is contribution to security and the continuity of the

electricity supply for the interconnected systems, thanks to the possibility of energy exchange if need be. The interconnections are the most significant instantaneous backup to supply security.

The second advantage of the interconnections, which is subordinated to the first one, is an increase in the efficiency of the interconnected systems. Every day, commercial electricity exchanges are organised, with the capacity that is left over on the lines, after the capacity occupied for security reasons in the countries' electrical systems has been deducted. These exchanges take place making the most of the electricity price differences between the respective electrical systems and they also allow the electricity to be generated utilising the most efficient technologies, which enable it to flow from where it is cheapest to where it is more expensive.

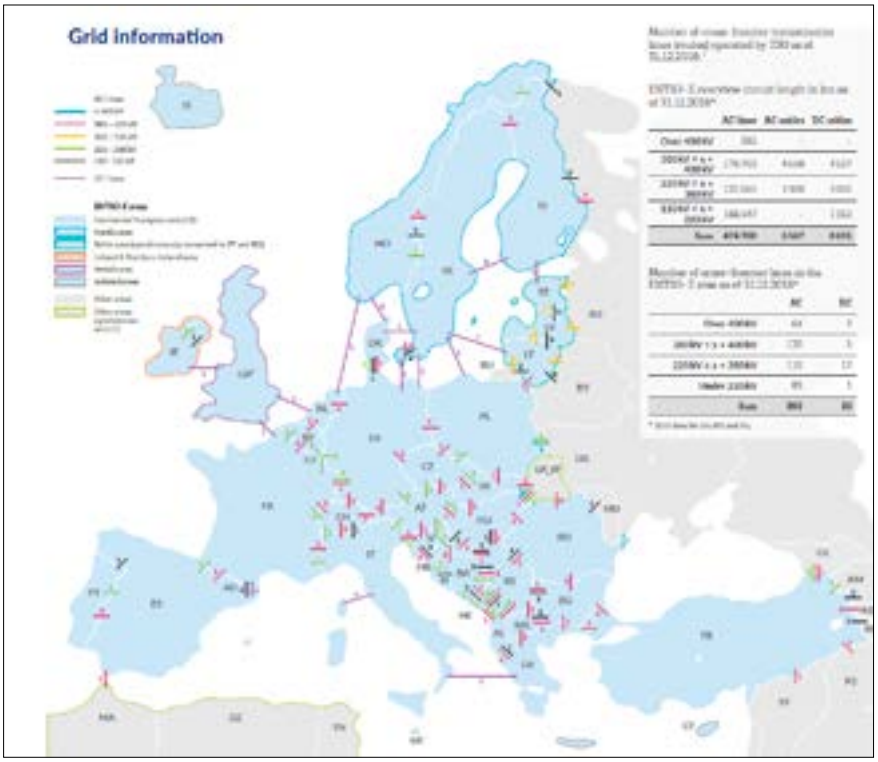


Figure. 4. Electrical interconnections in Europe.

There is also a third advantage: increased competitiveness between neighbouring systems. The electricity imports from other countries require the agents from any given country to make more competitive proposals if they want their offers to be

accepted, thereby bringing about a reduction in the wholesale electricity price.

In summary, interconnections have the following benefits for the electrical systems:

- They contribute to supply security, providing mutual support functions between neighbouring systems. Interconnections are the most significant instant backup to supply security.
- They provide greater stability and guarantee frequency between the interconnected systems.
- They allow for a better use of renewable energies.
- They facilitate commercial electricity exchanges, increasing competition by making the most of the electricity price differences between the interconnected electricity systems. Interconnections play a basic role in what is known as the Internal Electricity Market in Europe (IEM), which seeks to integrate into one single market, all the markets that currently exist in the European Union.

In view of all the above, interconnections play an essential role in integrating the electricity markets. This is the precise aim of the Internal Electricity Market in Europe (IEM). It is seeking to integrate all the markets within the European Union into one single market. However, on many occasions the limited interconnection capacities are a major barrier to achieving this objective.

Exchange capacity is defined as the maximum value of instant electric power that can be imported or exported between two electricity systems while abiding by the security criteria of both of those systems.

When calculating this capacity, the operator of each system coordinates with the neighbouring operators in conducting studies. The studies take into account the generation and demand forecasts as well as the facility maintenance periods. They also carry out simulations that consider any failures that might affect the various network elements. All these studies are conducted for different planning horizons, from annual to daily predictions, so it will be possible to carry out the maximum commercial exchanges while adhering to all the security criteria.

A high exchange capacity level has to be maintained in order to enable each country to obtain all the advantages listed above. In this sense, the European Union recommends that by 2030, this

accounts for at least 15% of the production capacity installed in each one of them.

Planning the development of connections between two national systems has traditionally been carried out bilaterally by the two countries concerned. However, this situation has been changing in recent years in view of the target set by the European Union to create the IEM. Grid planning is being transferred from a national to a European domain, because the entire development of the transport network, and especially the interconnections, affects the way other systems and electricity markets operate. From this perspective, every two years, the association ENTSO-E (European Network of Transmission System Operators for Electricity) publishes the Ten Year Network Development Plan (TYNDP), which establishes the European transport network developments that have to be carried out in a 10 years horizon.

The European direct current is already a trend between the infrastructures mentioned in the TYNDP. England, for example, which is already connected with France, the Netherlands and Ireland thanks to links of this type, has also planned to reinforce these by connecting with Belgium and Norway. Other links already operating are the following: the one in the North Sea that connects Norway with Denmark and the Netherlands, and Sweden with Denmark and Germany; the one in the Baltic Sea connecting Sweden with Poland, and Finland with Sweden and Estonia; and the one in the Mediterranean, linking Italy and Greece. On the Iberian Peninsula, seabed studies have been planned and are under way for the construction of an undersea link from Gatica (near Bilbao) to Coubnezais (near Bordeaux) especially designed to enhance the exchange capacity with France, which will also be strengthened by other interconnections across the Pyrenees.

Second part

Digitalisation

The world has become completely dependent on a stable electricity supply. The electricity grids form part of a country’s critical infrastructures just like the main hospitals, airports, etc. That is why any interruptions to the electricity supply are unacceptable and often involve governments imposing fines on the grid operators. There is no frontier between what has been

referred to as OT (Operational Technology) and IT (Information Technology). The electrical substations of the future, digitalised, will require greater interoperability between many sellers, not just the classic OT sellers, and they will come with new ideas, such as the virtualisation of sensors, machine learning and other ideas that have hitherto only been seen in other industries.

Digital transformation can be a disheartening task and one that is somewhat risky in this sector. The electricity companies have inherited highly complex and obsolete IT systems, and they have to carry on working with them, while at the same time facing the challenges involved in regulation. In the past, these companies have adopted new technologies late in the day. Now that a wave of digital services and products are hovering over them, they feel a pressing need to embark on major processes that have arrived late, such as improving work management, stores or billing to customers. At the same time, these changes cause risks, such as a lack of coordination or adopting short-term technological solutions that prove to be not as optimum. Digital positioning must be adjusted to each company, taking into account its size, geographical factors, architecture and the expected benefits.

The sector leaders in Europe and the United States have developed ongoing improvement strategies, distinguishing between operational or back-office efforts, on the one hand, and customer-oriented efforts, on the other.

It is necessary to develop a multifunctional mentality throughout the company. In most of the utilities, the function of IT is expected to be to enhance the company's digital transformation –which appears to be logical, given its nature and intrinsic relationship with the information and communication technologies-. Nevertheless, the arrival of intelligent and connected assets means that the technology is no longer merely a facilitator of the transactions. It has really become the essence of the way in which firms operate and make their services arrive.

Unfortunately, many business units do not see their relationship with IT as being strategic, just transactional and tactical. However, although IT takes charge of the process, it is the electricity plant operators, the employees and the directors who have to implement the transformation. They are the ones that must operate their plants and utilise the latest generation grid control and administration systems to enhance the value of the service.

When developing their digital agenda, electrical companies have to consider all the value levers within their grasp. Technologies such as Blockchain can significantly reduce transactional costs. What is more, operating costs can also be cut back thanks to modernisation projects –such as advanced grid control energy storage and the micro-networks, thereby improving the profitability of energy generation and distribution. And, finally, as the business models move away from the sale of basic products towards distributed energy resources, customers are incorporated into the value chain and the distribution systems carry out energy transactions in real time, the utilities will have to invest in digital capacities that enable and boost the emerging ecosystems.

Another possibility that is emerging is Artificial Intelligence (AI), which has proved to be useful when it comes to predicting natural disasters, and also for climate forecasting and, thus, also for predicting how renewable energy plants will perform, when their resources, highly variable and difficult to predict, are out of any human control. However, certain problems have already been detected where AI is concerned, especially their algorithms, the rules that govern the machine, which are either affected by the developer's bias and tendencies or by the possibility that the machines get out of control and become a threat to the electrical supply. Therefore, AI development can be synthesised into the following three key questions: How can we teach the machines to be intelligent? What should we teach them? and Why?

Both humans and machines need a high level of information to understand what is happening around them. Machines can represent the outer world through packages of data. The content of this data is vital for constructing the "artificial mind", thus the cognitive and moral characteristics of the mathematician who develops the algorithm are important, because the awareness of the AI depend on them. This can cause a problem, because the developers' biases can be passed on to the AI.

The algorithms utilised enable the AI to identify, classify, categorise and generalise through the most sophisticated machine learning and deep learning methods, The former tries to feed the machine with a high dosage of data that have been predefined and categorised by the human so that the machine can recognise them in the future and rebalance its analysis model on the basis of the experience, so that the margin of error can be reduced. The latter, which is more exact, makes the information pass through multiple layers, which are similar to a neuronal network,

enabling the AI to concentrate in greater detail and create its own reference models.

The developer, using machine learning, has to predetermine the main characteristics of the object, to enable the machine to comprehend what it is, and thus identify it later. In the process of deep learning, through multi-layers, the machine is able to define by itself patterns from images and obtain the characteristics that define the object. This method also makes it possible for the AI to recognise substantial differences between photographs also enabling it, for example, to distinguish between different objects even if they are similar.

Artificial Intelligence is divided into several categories, depending on the data identification and correlation capacity that it has. A "narrow" or "weak" AI is responsible for a task automatically, classifying in accordance with certain predetermined parameters that it refines on the basis of the amount of data available. They are routine and technical tasks. The second type of AI, still more theoretical than real, is known as "general" or "strong" AI. It has a capacity for abstraction, reflection, creativity and improvisation.

Many analysts consider that China has the best chances in the race for its command of the artificial intelligence. It is a country with a greater surface area than its competitors and has more variety when it comes to climate and landscapes. It also has a much greater population and the Asian culture's conception of privacy is different from the West's. A bigger population means more data with which to feed the algorithms, whereas geographical diversity means a variety of scenarios in which to train.

The fragility of some artificial intelligence technologies will become a cause for growing concern in the future. Somehow, the emergence of critical AI systems as targets for cybernetic attacks will begin to reflect the sequence that was observed 20 years ago in the Internet, which quickly attracted the attention of criminals.

Reciprocally, the defenders will increasingly depend on AI to counteract the attacks, pinpoint the weaknesses and strengthen their systems to combat potential attacks. In time, this artificial intelligence aimed at security could also help people to obtain a better understanding of the concessions from delivering personal information in exchange for the use of one application or another additional benefit.

5G technology and the "Internet of Things" are now ready for commercial distribution. Although it will take time for these networks, telephones and other devices to be implemented on a major scale, the growth will take place quickly.

Although smart phones are the focus of interest for 5G technology, it is probable that the number of phones with this technology will be limited in 2020. Nevertheless, in time, more IoT (Internet of Things) devices will be connected directly to the 5G network instead of via a WiFi router. The adoption of 5G will increase the surface exposed to attack making the devices more vulnerable to a direct attack. For domestic users it will also be more difficult to monitor all the IoT devices. In general terms, the ability to make backup copies or to easily transfer huge volumes of data to storage facilities based in the cloud, will enable attackers to set their sights on new targets.

These technologies: the Blockchain, the artificial intelligence and the 5G, are based on the data flow feeding them, hence digitalization is the key that will allow their development.

Digitalisation must set the pace towards obtaining a tangible increase in the firm's value through greater cash flow, risk reduction and service improvement. To achieve this, the digital changes have to be incorporated into a company architecture safe in the knowledge of a sound understanding of the cost, the benefits and the technology. This structure defines the activities to be performed, how to group them together and how to connect them. Whatever the goal may be, a robust architecture will prevent costly errors, offer greater flexibility and update itself as technological progress is made.

The most advanced industries where digitalisation is concerned, have successfully applied supple methods that shorten times and follow the philosophy of "thinking big, starting small, failing cheaply, climbing rapidly". Yet the electrical sector is still at an early stage in taking up these principles. To comprehend the intrinsic uncertainty surrounding the new business models, companies must go through a cultural change, and educate and advise teams about the risks and advantages of agile implementation.

It is by no means easy for any organisation to make far-reaching changes in its strategy and its culture. But if electricity companies want to be competitive in the 21st Century, they cannot afford to ignore the capacities and opportunities offered by digital technologies.

Developing and implementing digital technology in the energy sector is now proving to be essential if one is to progress towards a new sustainable, efficient and secure energy model. The energy sector is undergoing a deep-rooted change prompted by the need for *decarbonisation*, to achieve greater *decentralisation* for electricity generation and to facilitate *digitalisation.*

These 3 Ds characterise the energy transition that is beginning to have some far-reaching effects on the world's electricity systems. The first two aspects, the greater use of renewable resources that are clean but variable and their decentralised nature, involve the use of a greater and generally more complex grid infrastructure and thus a greater amount of data, given that these sources are generally located a long way from the electricity consumption centres and the typical size of the plant is much smaller than the traditional thermal power plants.

Digitalisation of the entire energy sector value chain means operating grids that are increasingly complex and sophisticated. The ongoing actions aimed at mitigating climate change, the arrival of new technologies in the battery field, renewable energies or the growing use of electric vehicles all require smart grids to be provided simultaneously to back them up.

As has already been pointed out, the energy model of the future can benefit from the technological breakthroughs made both in generation, with the large-scale development of renewable energies, as in information technologies, which is going to permit the sought-after objective of focusing on the consumer. The scattered renewable sources and the location of the consumers will reflect a highly decentralised energy model. The technological progress made in communications, with equipment having state-of-the-art digitalisation and smart devices, will mean that there will be smart grids with a two-directional flow of energy and information that will be exchanged between generators and customers, both scattered, and distribution operators and, in turn, the latter will also be able to exchange information with the system´s operator.

The development of digitalisation has given rise to a hyper-connected civilisation, which is conducive to rapid technological progress, while at the same time opening up a host of possibilities in all the sectors and spheres of activity. However, the process of digitalising the energy sector is not without risks, because it can also lead to new threats, cybercrime being the most obvious one. The energy sector is not unaware of this problem, in view of

the serious affects that such criminal activities can have on the electrical system as a whole, and the economic consequences arising from attacks of this nature. One of the major risks faced by digitalisation is cybersecurity in matters concerning the protection of information and the vulnerability of the critical infrastructure. One example of a cybernetic attack affected Telefónica, which was brought to a standstill after being infected by the *Wannacry* ransomware in 2017.

Electrical cybersecurity

Industrial Control Systems (ICS) have frequently been the victims of undirected attacks, with ransomware infecting operator work stations or other control components. The input vectors were mainly phishing emails and extractable devices, but there have also been cases where the infection was caused by using remote maintenance systems set up incorrectly. In all cases, the damage code exploited known vulnerabilities that affected obsolete software and an inadequate segmentation between office networks and production networks. Everything seems to indicate that this type of incidents will carry on posing a significant threat to the ICSs in the next few years.

There are more than 4 million electrical substations in Europe (Pavla Mandatova, 2013, Eurelectric) and, to an attacker, this means 4 million potential entries into the electrical grid. In the new smart grids, nodes without any cybersecurity measures will be connected to digitalised substations, geographical information systems, etc. The security level of the new smart grids will be jeopardised by the weakest link in the chain, and that is why operators will be required either to replace all those nodes that are obsolete from a cybersecurity viewpoint, or, to update them.

In general and when the attacks are successful, the time gap before the information system becomes jeopardised is still very short. The time from the first hostile action until an asset is jeopardised, is frequently measured in terms of seconds or minutes. However, the time it takes to discover or detect it, which largely depends on the type of attack, is usually expressed in days, weeks or months. For the consultant Price Waterhouse in its cybersecurity area "the technological risk is becoming increasingly serious, and there is one key point: apart from having to be prepared to protect its assets, a company now has to be prepared to respond. It is important for a firm to be resilient to an attack, for it to

know how to act and find a solution right away, because time is of essence".

Although it would appear to be difficult to stop these advanced attacks, it is necessary to use all the resources available to detect intrusions and to stop activities that might affect a country's or an organisation's critical infrastructures. There are security standards for combating electricity grid attacks. These standards cover information exchange and interoperability on the electricity grids, as well as defining the security level and determining how to assess the risks and threats facing a control system; they also establish which security requirements must be complied with to reach an advanced security level.

As control systems become increasingly essential on the electrical sector value chain (generation, transmission and distribution) and as information technology systems are increasingly connected to the operational technology systems, so risks to cybersecurity increase. According to the World Economic Forum, cyberattacks posed the biggest technological risk in 2018 and the third most likely. That is why the World Energy Council recommends that energy companies regard cybernetic risks as basic company risks. Firms must cooperate to assess, understand and create resistance to these risks, which threaten service continuity, data and systems, and thus a company's reputation. Technical and human factors have to be improved, and all the stakeholders must prepare standards and practical improvements to combat these current threats.

Yet when we talk about the impact a cyberattack might have on critical infrastructures, and particularly on electricity systems, we are talking about essential everyday services for the general public being affected. Leaving a region or even a country without electricity for a few hours is something to which we are not accustomed and it undoubtedly has major impacts, affecting not only companies but also society.

That is why the electrical sector, together with other essential services such as water, gas, etc., are increasingly being targeted by cybercriminals, all the more so when what they are seeking is notoriety and trying to cause considerable damage to the State. Hence the importance of public bodies that provide coordination on a national scale to security in the vital assets.

According to the 2019 Trends and Threats Report issued by the National Cryptology Centre (CCN-CERT) IA-13/19, digital

sovereignty means a country's attempt to regain control over its own and its citizens' data. States, the groups sponsored by them, and the actions they carry out against other countries still constitute the biggest cyber threat. The objective pursued by this type of attack is always the same: to get hold of information to improve their strategic, political, economic or innovative position and to exploit the human weaknesses of the victim, from whom sensitive or confidential information is obtained for a subsequent attack.

In recent years, personal data attacks have increased, perpetrated not only by cybercriminals or *hacktivist* groups, but also by States. The aim is usually to commit certain crimes, identity theft (credentials), impersonation or espionage, all of which make attacks easier. The incessant connection of new "IoT" devices to the Internet, fostering the distribution of damaged codes or participating in DDoS attacks, (Distributed Denial of Service) is also an element that adds significantly to the problem.

The number of activists involved in threats has increased significantly, and this is partly due to the fact that there is easy access to new attack tools and partly due to the permanent difficulty of demonstrating who has committed the crime. There is also evidence of States increasingly using damaged codes, aimed at exploiting the weaknesses of the information systems for critical infrastructures. The objective of such attacks is often to obtain information about the extent to which the organisations' security measures have been implemented, all with a view to obtaining sufficient data to be able to plan future attacks; this activity has been detected particularly against European targets. The National Institute of Cybersecurity (Incibe) deals with more than 100,000 incidents per year involving companies and private individuals, of which 700 are strategic operators (ranging from electricity companies to telecommunication companies, ports, etc.). The increase in the number of attacks against Spanish companies is fairly high and inversely proportional to the expense they incur in guaranteeing data confidentiality. The investment is often poor, scattered and nearly always has a sense of urgency that renders it useless to construct a genuine business strategy. It is the sickness of our times: societies that are more digitalised yet more exposed to cybercrime. Perhaps that is why the surveys show a waste of willingness. A study conducted by Willis Towers Watson and ESI Thought Lab, states that organisations all over the world want to increase their investments in cybersecurity by 34% during the next year, and almost 12% will do so by more

than 50%. But those who think that money will solve the problem are wrong. Without comprehensive solutions at all business levels the response will fail, according to the experts.

The monetisation of the information captured, propaganda and recruitment are the main objectives of this group of threatening agents. However, in view of the availability of *Crime-as-a-Service* and the potential sabotage of "IoT" devices, the attacker could put the device out of service or limit its functionalities.

Hacktivists are still active in the disclosure of confidential information collected from the websites attacked, in carrying out Distributed Denial of Service (DDoS) attacks, in order to attract media attention, without generally attempting to monetise their actions. International analyses show that cyberterrorism will increase significantly in the coming years.

There is also a source of incidents of an internal nature. Most of the damage seems to be caused by the accidental actions of employees, which can take a material form with attacks on the data supply chain.

Thus, a product that contains publically known weaknesses when it is purchased must also be regarded as defective from the perspective of IT security. Software maintenance by the manufacturer, the removal of vulnerabilities, should not only be habitual procedure and the means for complying with the applicable legal standards, but it should also be required by the consumer, as part of the service.

Cybersecurity is on all governments' agendas and those of any industry, and the same applies to electricity grid operators. If an electricity grid operator loses the service of a node on the grid, this can affect the customers connected to that node, or if it happens to be an infrastructure that is critical for operations, this might affect millions of customers, given that the potential impact of a cybersecurity incident in which control is taken over the grid that intercommunicates the different substations and the control centre, may have devastating consequences.

The growing use of numerous kinds of devices called "intelligent" or "smart", combined with the need to provide support for the communication networks that lie behind them, makes it clear that there is a need for new security mechanisms. Therefore, when it comes to tackling potential problems, it is vital to implement measures and mechanisms such as the following:

- an Authority responsible for cybersecurity in the energy sector;
- a requirement to send reports about incidents affecting the system;
- consumers must be informed about the risks faced by the system in this new context.

All of these measures, as indicated in the report entitled "Cyber Security Strategy for the Energy Sector", published by the European Parliament, must be implemented following common security standards and in a way that is in keeping with the requirements already established by the EU.

Threats and cyberattacks

Threats have moved on from having specific targets: document theft, stealing information, illegal use of the organisation's assets, etc., to trying to affect a country's essential elements; the latest threat report issued by the National Cryptology Centre (CCN-CERT) explains it in the following way: "the objective pursued by this type of attack is […] to steal information in order to improve their strategic, political, economic or innovative (espionage) position. This objective has been joined by the attempt to influence public opinion in the countries that have been attacked or to interfere with the normal provision of essential services (sabotage)". Moreover, new concepts appear such as "cyberwar" between countries whose fields of operation are no longer land, sea or air, but cyberspace and communication technologies; their objective is to alter or damage a nation by attacking its essential resources, such as electricity.

One such example in the electrical sector was the incident that occurred in Ukraine with the blackout that affected several electrical power plants in the country, in an attack with computer viruses. A large number of people were left without electricity for 6 hours, in the cold on 23rd December 2015. The same virus set the alarm bells ringing a few days later, when it was detected in the air traffic control network of the Ukraine´s airport.

The virus is called BlackEnergy and it was the first virus ever to be involved in an extensive power cut. Before that, the virus Stuxnet, the work of Israel and the United States, seriously damaged several Iranian nuclear power plants, but did not leave anybody without electricity.

BlackEnergy is just one of the components utilised in the attack, carried out by top-level computer mercenaries. Ukraine, after being at war with Russia for two years, did not hesitate to point the finger at the latter as being responsible, believing that Russia wanted to cause chaos and give a show of strength to its neighbour. However, this could not be confirmed because the attackers had covered their tracks too well. It was a sophisticated attack carried out by a team of computing experts that used a variety of cybernetic weapons. The attackers would appear to have had a plan, were well coordinated and knew how to use viruses and remote access programs to blind the system's defences and cause undesired changes to its infrastructure.

The incident occurred in the following way: an employee at an electrical power plant in Ukraine received an email inviting him to open an attached document. On doing so, the attachment installed a malicious code in the equipment, opening a rear door that the attackers used to silently display the "BlackEnergy" virus in a lot of the company´s equipment. This virus lay in wait silently, spying and learning all the plant's movements. At a given moment, the attackers activated it and remotely installed a new module in BlackEnergy, the so called KillDisk, which is programmed to destroy files that are vital to a power plant's computers. They then remotely manipulated the computers to cause the blackouts and the operators found themselves powerless as the substations shut down while they could not regain control over the equipment. Once the work was done, they activated KillDisk, which destroyed the hard disks, thus deleting all traces of the hackers in the system.

To add to the confusion, they cybernetically bombarded the company's websites and telephone exchanges, in such a way that the customers were unable to call the company or be informed through the net about what had happened. The cyberattack enabled them to take control over the systems at 3 of the main regional electricity distributors. This chaotic situation affected 100 and 35 kV substations and caused power cuts that affected a total of 225,000 inhabitants.

In Ukraine's case, the resilience capacity was critical for recovering the service in approximately 6 hours as there was an emergency backup system that made it possible to regain manual control.

The KillDisk module has now been adapted to attack industrial systems; it is the icon of a world where critical infrastructures, the media included, have become the main target.

Subsequently, the Trojan horse, BlackEnergy, was detected again in Ukraine, in an airport computer. Nothing happened and the virus was removed, but it raised the alerts to maximum, because nobody knew the extent of the plague, if there were more hidden in other computers or whether they could affect railway communications or other critical points.

As years went by, BlackEnergy was modified to increase clientele. It has been responsible for bank frauds or distributing spam, and has even succeeded in reaching the highest goal of a Trojan virus: politically motivated electronic espionage. In 2014, BlackEnergy was detected in more than 100 governmental and business organisations in Poland and Ukraine. It was also found in NATO computers, European bureaucracy, a North American university and a French telecommunications supplier.

Nuclear Power Corporation of India Limited (NPCIL) has confirmed that the biggest and most modern nuclear plant in the country was attacked with malware. The virus used had been found previously in cyberattacks linked to groups in North Korea.

The cyberattack was announced publicly when the VirusTotal website published data sent that appeared to indicate a fault affecting the system at the plant, located in Tamil Nadu, in the south of the country. The data indicated the presence of a *dtrack*, a malicious program, although those responsible for the nuclear plant published a denial. Nevertheless, according to experts there could have been a breach of security.

The Cybernetic Emergencies Team became aware of the attack and the problem was immediately investigated by specialists from the Atomic Energy Department.

The nuclear sector is one of the most important in India. NPCIL operates 22 reactors in seven different places in the country.

According to a United Nations report published last August, cybernetic groups in North Korea, (many of which are under direct control of the Government) have spread thanks to their "growing sophistication" and have provided Pyongyang with about 2,000 million dollar (approximately 1,800 million euro), which it has used in its weapons of mass destruction program.

Indian policy, is to bring the Internet to the country's huge population within the framework of the Digital India Programme, criticised owing to its lack of cybersecurity laws and updated legal framework. Delhi announced tenders to enable private firms to prepare the best facial recognition network in the world, which will be linked to the national biometric system, where over one thousand million citizens are registered, despite the steady filtering of the private data of its users.

The *dtrack* malware was used in an attack in 2016 in which financial information was stolen from millions of Indians, according to experts. The cybersecurity firm Kaspersky has stated that the virus is "similar to the *DarkSeoul* campaign", an espionage program that spies on banks and the media in South Korea attributed to the Lazarus Group, connected to cyberterrorist groups from North Korea.

In September 2017, the same company, Kaspersky, reported what has been called *Dragonfly 2.0* – a series of intrusions into utilities all over the world. In the last seven years, these attackers have infiltrated the control systems of electricity grids in several countries, including the USA.

There are precedents regarding other attacks by groups targeting major critical infrastructures. This has now become one of the concerns of governments all over the world: serious insecurities affecting many critical systems, such as nuclear plants, electrical power plants or traffic control systems. Critical infrastructures have weaknesses and at this very moment there are groups compiling information about them in almost every country.

According to a recent survey targeting the gas and oil industries, IT attacks aimed at these facilities have generally increased. Half those interviewed stated that the attacks had increased by between 50 and 100%.

An incident like Ukraine shows how, just by a mere click on an email attachment can trigger a disaster that leaves hospitals and industry without an electricity supply for six hours. We must seek total and integrated visibility with regard to what is happening in our infrastructures and correlate all the events in an integrated way.

The classic approach to protect organisations from cyberattacks was based on defending the perimeter; it involved segmenting the networks and setting up security barriers to prevent external attackers from accessing the companies' internal systems. In the

case of electricity systems, they were completely isolated from the rest of the internal and external networks, which rendered them less exposed to potential intrusions.

This strategy is becoming less effective all the time, given that with digitalisation and the new technologies, the new ways of working in firms require companies to adapt their systems so they can be accessible from a greater number of devices and from a variety of locations, so that it is possible to make the most of the firm's information. In the specific case of electricity systems, the proliferation of "IoT"-type architectures to be able to compile data from sensors, or the use of major *Big Data* solutions, is making companies consider new methods for suitably protecting the critical systems that are on a par with the challenges that are emerging in these scenarios.

In this development of new architectures, new security solutions also appear, to mitigate and prevent new attacks. These solutions are based on breakthroughs in analytics, artificial intelligence and *Big Data*, making detection and response easier when faced with different kinds of attacks.

These systems are evolving rapidly. However, in the case of specific solutions for electricity systems, owing to the fact that the technological paradigm has only changed recently, in some cases the solutions are still at the experimental stage.

Future Trends

The mentioned CCN-CERT report shows the trends for the near future, where the State agencies will continue to conduct intrusion campaigns as part of their national strategies, for which purpose they will definitely use their cyber capabilities.

The entities in the government sectors, defence, think tanks and NGOs will continue to be priority targets for their operations. These intrusions will probably be backed up by suppliers in the telecommunications and technology sectors, and may include commitments in the supply chain, as has been observed in previous years. It is to be expected that future cyberattacks will increase in volume and sophistication. The following paragraphs outline what can be expected in the near future:

- Cyberattacks sponsored by States will increase;
- Supply chain attacks;

- The cloud as a target;
- Sophistication of the damage code;
- Cyberattacks aimed at people;
- Utilisation of smart devices in cyberattacks;
- Continuation of DDoS attacks and their association with the IoT;
- Increase in cryptojacking;
- The damage code will be more deceitful;
- Automatic learning to block new threats;
- AI as a tool in the cyberattacks;
- Adopting 5G will increase the surface area of attack.

EU action and regulations

The current status of cybersecurity in the EU energy sector indicates that there is still a long way to go. Intelligent energy systems, which are currently grouped together into *Smart Grids*, require progress to be made in consistency for the entire EU, in order to prevent damage to the system. It must not be forgotten that these types of incidents must be dealt with before a successful energy transition can be achieved so that situations like the one that occurred in Ukraine on 23rd December 2015 do not happen again.

The European Authorities are aware of the risks affecting the following four major "cyberdependent" sectors: transport, health, finances and energy. What has come to be known as the "Internet of Things" –digital interconnection of everyday´s objects– is now a reality, and it is predicted that in 2025 there will be tens of thousands of millions of digital devices connected in the EU. At the same time, computing systems may be affected by security incidents, ranging from technical failures to viruses, which are becoming more frequent all the time and increasingly difficult to combat.

If we stick to the European energy sector, it is clear that it is in the middle of a transition process towards "decarbonisation", with a strong element of decentralisation where generation is concerned. Technological breakthroughs and digitalisation are modifying the European electricity grids and gas networks. All of this means that there is a risk of exposure to cyberattacks and incidents that can jeopardise supply security. The idea is to assess these risks and take measures to mitigate them.

That is why the European Union gave its approval to the NIS Directive (concerning security of network and information systems) in July 2016. Its purpose was to increase cybersecurity in the EU by developing national skills and capacities on the subject, increasing cooperation in Europe and adding requirements in security matters and incident notification for the "operators of essential services", which includes the mandatory notification of incidents in such sectors as energy.

These operators of essential services have to follow the guidelines of a cooperation group appointed by the NIS Directive, comprising representatives of the Member States, the European Union´s Agency for Network and Information Security (ENISA) and the Commission. In June 2018, this Group established a specific work line for energy. In view of the fact that every economic activity sector is affected by specific cybersecurity problems, it is necessary to develop sectoral approaches within the broader framework of general cybersecurity strategies.

On 3rd April, the European Union Commission published Recommendation 2019/553 on cybersecurity in the energy sector. Although it was a minor legislative act, the Commission's positioning serves to back up the numerous initiatives that have been taken in favour of computing security.

The association European Network of Transmission System Operators for Electricity (ENTSO-E) is discussing a document about this matter. The document by "ENTSO-E Cyber Security Strategy" is still being prepared. This document has been prepared by the Digital Committee, which accepts that with the increase of information and connectivity exchanges between TSOs and DSOs (system and distribution operators) for services (digitalisation, Internet, etc.) respectively, a rise in the risks to cybersecurity is taking place. In view of all of this, it is essential to have a common cybersecurity strategy that makes it possible to cope with the risks that emerge, and does so in a way that is less costly to the TSOs (making the most of synergies and sharing expertise).

The strategy concentrates on three basic pillars:

- Secure and resilient: prevention and fulfilment (secure), monitoring, response, recovery (resilient)
- Inter-TSO and DSO: focusing on common aspects (the cybersecurity of every TSO is set at national level)

- Information, service and infrastructure: comprehensive strategy that includes all levels/aspects.

The draft of the document contains 4 elements as strategic topics, which are considered to be vital parts of cybersecurity:

- *Risk Management*: this means identifying the critical assets of the European electricity grid (especially the ones affected by ENTSO-E), and drawing up a mitigation plan for the risks involved. The emphasis is placed on the need to comply with international standards concerning cybersecurity risk identification/management, etc.
- *Architecture*: it is essential to guarantee cybersecurity from the outset from a design/planning perspective, to conduct cybersecurity tests and to carry out audits.
- *Support and Central Services* (ENTSO-E): this organisation wishes to provide common solutions and platforms for sharing information and best codes of practice for identifying threats, mitigation mechanisms, etc. The emphasis is placed on the importance of giving training programmes on matters concerning cybersecurity, because the key is not the system itself but the person that uses it.
- *Governance*: the objective is to enable all the TSOs to be sufficiently mature and to be aware of and committed to cybersecurity. The ENTSO-E Digital Committee would be the supervisory body for implementing the strategy.

The European Commission has allocated ENTSO-E (via an EC funding programme: Connecting Europe Facility) an amount for innovation projects involving cybersecurity. This will make it possible to optimise the cost of ENTSO-E and is also in line with the strategy considered and serves to supplement it.

Finally, it is highly likely that the EC will draw up a cybersecurity Network Code in the future. Therefore, the TSOs must be prepared to face up to and comply with the standards required by the future NC.

International cooperation in cybersecurity

Cooperation and information exchange are key elements here, so the Commission has set in motion initiatives such as the Roundtable (Rome, March 2017) or the High-Level Conference (Brussels, October 2018) on cybersecurity in the energy sector; it

has also given backing to specialist bodies, such as the European Energy Information Sharing & Analysis Centre.

A European cybersecurity framework has also been created to certify products, processes and services. It will be valid throughout the Union and will be of particular interest to the energy sector. The Commission has undertaken to periodically review its recommendations in this matter in the light of the progress made "in agreement between the Member States and the stakeholders".

All in all, the initiative approved by the European Executive intends to guide the Member States and stakeholders, "particularly grid operators and providers of technology", in cybersecurity matters, taking into account the specific conditions: the energy sector's specific real-time requirements, the cascade effects, and the combination of traditional and state-of-the-art technologies.

Regarding the real-time requirements of the energy infrastructure components, Member States are urged to ensure that the interested parties (energy network operators and technology providers) apply specific preparatory measures, bearing in mind that some elements in the energy system, such as relays and protective devices, have to react in milliseconds, which complicates the application of cybersecurity measures.

That is why the European recommendation has called on network operators to apply the most recent security standards to new facilities and to study supplementary physical security measures for existing old facilities, as well as to guarantee secure communication in real time, when products are available *ad hoc* on the market.

It is also suggested that they resort to private networks for tele-protection programs in order to guarantee the service quality level required for the real-time restrictions, as well as to split the general system into logical zones, and to establish time and process restrictions within each one of those zones.

Whenever possible, energy network operators should also select a secure communication protocol taking into account real-time requirements. They should likewise include a suitable authentication mechanism for machine-to-machine communication, which also applies those same requirements.

The so called "cascade effects" refer to the fact that the electricity grids and gas pipelines are interconnected throughout Europe, and a cyberattack that causes disruption to the energy

system or manages to interrupt part of it could trigger off serious consequences in any part of the system.

Member States are also recommended to ensure that energy network operators and technology suppliers apply suitable preparatory measures, and that they do so after having assessed the interdependence and the critical condition of the electricity generation and flexible demand systems, the substations and the transmission and distribution lines, as well as the parts that will be affected (also in cross-frontier situations) in the event of a cyberattack or a cyberincident.

Member States must likewise ensure that the energy network operators have a structured communication framework for sharing early-warning signals and cooperating in crisis management. The specific measures that the European Commission recommends to energy network operators include making sure that the new devices (such as the "Internet of Things") invariably have a suitable cybersecurity level. They will also have to consider the cyberphysical effects on establishing and periodically reviewing the continuity plans for the activities and establishing design criteria and an architecture for a resilient network, which will have to feature a minimum of the following aspects:

- In-depth defence measures at each site, adapted to each location and adapted to their criticality.
- Identification of the crucial nodes, both in terms of energy production capacity and the effects for each customer.
- Collaboration with other operators and technology suppliers to prevent cascade effects.
- Design and creation of communication and control networks that make it possible to confine the effects of possible equipment and system failures, and guarantee rapid and appropriate mitigation measures.

In this sense, it is important, whenever possible, to incorporate the internationally accepted cybersecurity standards into the regulations, and that not only the stakeholders but also the customers adopt this approach when connecting devices to the network.

The technology suppliers ought to provide solutions that have already been tested, both for traditional technologies and state-of-the-art technologies. They should do this free of charge and as soon as they become aware of the problem. Furthermore, the

network operators are urged to take a series of measures in their operations, including the following:

- Analysing the risks of connecting traditional devices with others from the "Internet of Things".
- Taking the required measures against malicious attacks coming from consumption devices controlled maliciously.
- Establishing an automated ability to monitor and analyse security problems (failed attempts to initiate sessions, alarms that open doors, etc.).
- Periodically conducting specific cybersecurity risk analyses of all the traditional facilities, especially when old and new technologies are connected. – Keeping updated the software and hardware for the traditional systems and for the "Internet of Things".
- Considering cybersecurity when preparing tenders. Collaborating with the technology suppliers in replacing the traditional systems when necessary.

The recent Cybersecurity Report on Europe's Electricity and Gas Sectors, published by the Council of European Energy Regulators (CEER) focuses on examining cybersecurity, one of the top priorities for the various European Union´s Member States, because they are currently working to comply with the deadlines established in the current legislation, especially as regards the Directive on Network & Information Systems Security. In recent years, several cybernetic security vulnerabilities have made themselves patent in the energy sector emphasising the need to carry on working actively to consolidate new measures for combating these types of threats. In an attempt to overcome this problem, the authors of the report offer a series of recommendations that will help to close the gap between the current situation and the optimum cybersecurity situation in the energy sector; these recommendations take into account the efforts being made to implement the existing regulation concerning cybernetic security.

The proposed recommendations concern the need to increase the participation of the European energy regulators, activate collaboration between the parties involved and provide better guidance regarding the type of measures and actions to take. This can only be done by identifying the different stakeholders who play an active role in finding the complex solutions to the cybersecurity problems faced by the energy system, or that could play such a

role in the future. According to the authors of the report, although this is not necessarily an exhaustive list, the following are some of the most outstanding stakeholders that will be involved: TSOs, DSOs, suppliers, generators and market operators. Another priority task highlighted in the report, involves giving a more important role to CEER (Council of European Energy Regulators) and ACER (Agency for the Cooperation of Energy Regulators in the European Union), since both bodies can make a significant contribution to establishing an international cybersecurity culture and supporting and supplementing the work done by the national regulatory agencies. In view of what has been stated above, the authors have reached the conclusion that cooperation between the different members will be of vital importance when contributing to the creation of a homogeneous and secure ecosystem, which makes it possible to develop a culture that is conducive to greater innovation and digitalisation in the energy sector.

Tightening up cybersecurity and encouraging new technologies such as Blockchain know no bounds. International cooperation in this field is necessary because of the benefits that might come from sharing experience and expertise. Collaboration takes place through international affairs and institutional links where opportunities are found for collaboration and programmes are drawn up to develop more effective regulations and more reliable operations in the National Electrical System and the Wholesale Electricity Market.

According to the Inter-American Development Bank, cybercrime costs the world as much as 575 thousand million dollar a year, which amounts to 0.5% of the global gross domestic product. Therefore, designing, improving and strengthening the electricity systems is a strategic task, because a variety of economic activities depend on it, as well as many indispensable services that guarantee the safety, security and welfare of the population. That is why in 2017, Mexico published the *National Cybersecurity Strategy*, looking ahead to 2030, and insofar as regulation is concerned, its Regulatory Commission published the *Grid Code*.

Mexico and Germany aim to be strategic partners in cooperation where the energy sector is concerned. The German Federal Government has commissioned German Cooperation for Sustainable Development (GIZ) to support Mexican institutions to increase the sustainability of the energy system by encouraging renewable energy sources and energy efficiency. To achieve these objectives and encourage more secure, reliable

and environmentally sustainable sources of energy, the GIZ implements programmes and activities that enhance and inform, teaches skills and exchanges information regarding the best codes of practice, as well being responsible for awareness campaigns and giving specialist advice.

As part of this collaboration, forums were organised in which experts participated from the public and private sectors and academic circles. The conclusion was that Mexico had to make the most of digitalisation in order to improve reliability and cybersecurity in the electrical sector.

Two events were held to promote discussions about digitalisation in the development of electrical systems and to combat the challenges that potential cyberattacks pose to the sector's infrastructure. The first event, "Cybersecurity in the electrical sector" was implemented by the GIZ, in coordination with the Energy Regulatory Commission (CRE) and the National Center for Energy Control (CENACE). At that event, those present had the opportunity to obtain and exchange expertise and knowledge with experts not only from the organising bodies but also from the Florence School of Regulation, the Electric Power Research Institute (EPRI), the National Institute for Electricity and Clean Energy (INEEL) and the German Association of Energy and Water Industries (BDEW). Along the same lines, practical cases were submitted from countries like Germany, Estonia and Mexico, the latter via the Federal Electricity Commission (CFE). Common challenges, policies and regulations associated with the protection of critical infrastructure were discussed, which stressed the need for cybernetic security in the electrical sector.

In the second event, "Encounter between Blockchain and Energy", not only the Energy Alliance and the CRE participated, but also Blockchain Lab and DKTI Solar, from the GIZ. At this event, those present were made familiar with the Blockchain application for private networks, through international experiences like Estonia's, because the latter was the first State to use this technology to facilitate Government operations; and Chile, which has initiated the transformation in Latin America with the use of open platforms in the energy regulation sector, as well as its potential utilisation in detecting cyberattacks, in order to make the electricity grid more reliable.

Today's electricity grids are becoming smarter and more modern … and more interconnected. It has already been

mentioned that we are facing a new energy world. It is a world of decentralised energy generation, of intermittent renewable sources, like solar and wind energies, plus an increasing commitment from users.

However, all the advantages of a more flexible, dynamic and connected grid will also mean new risks and threats to security, namely cybersecurity. In view of cybersecurity's importance, regulations must be applied and their fulfilment must be monitored.

Cybersecurity measures must comply with both the standards and the regulations. Such an approach benefits the sector, heightening awareness of the risks and challenges associated with a cyberattack.

The regulating bodies have seen the need for a structured approach to cybersecurity. In the United States, the Critical Infrastructure Protection requirements, established by the North American Electric Reliability Corporation (NERC CIP), determine what things are necessary to guarantee the electrical system in North America. The European Programme for Critical Infrastructure Protection (EPCIP) does the same in Europe.

In view of the change in favour of open communication platforms, such as Ethernet and IP, the systems that manage the critical infrastructures have become increasingly vulnerable. The computing approach to cybersecurity is not always suitable with the operating limits that electricity companies have to face.

As the electricity companies experience a convergence between IT and OT, it will be increasingly necessary to develop multifunctional equipment to tackle highly singular secure technology challenges that include both worlds. Protecting against current cyberthreats requires closer collaboration between engineers, those responsible for critical facilities and security managers, who must share their knowledge in order to identify potential problems and attacks that affect their systems.

Designing protective devices for cybersecurity

An adequate protection requires a whole set of measures, processes, technical resources and suitable organisation. Being equipped with a proper defence against cyberattacks is an ongoing process and needs constant and continuous effort.

Electricity companies can adopt an approach based on four points, when establishing and keeping their systems cybersecure:

- *Carrying out a risk assessment.* The first step involves carrying out a comprehensive risk assessment based on internal and external threats. This will enable OT specialists and other interested parties in electricity companies to understand what their weakest points are and to draw up risk security and mitigation policies.
- *Designing a security policy and processes*. An electricity company's cybersecurity policy provides a set of rules to be followed. These must be headed by the set of standards laid down by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC), which suggest recommendations and codes of good practice regarding information security management. They describe the list of assets that must be protected, identify the threats to those assets, the unauthorised actions and the responsibilities if the security policy is breached. It is also important to be able to rely on well-devised security processes. The cybersecurity system processes have to be reviewed and updated regularly in order to follow this evolution. One of the keys is to conduct a review once or twice a year.
- Carrying out projects that implement the risk mitigation plan. It is important to select a cybersecurity technology based on international standards, to guarantee that a suitable security can be pursued and that the proposed risk mitigation actions can be taken. A "security from design" approach based on international standards can help to reduce the risk still further, by guaranteeing the components in the system.
- Managing the security programme. Effective management of the cybersecurity programmes also involves managing the life cycles of the information and communication assets, so it is important to have rigorous and "updated"" documentation concerning the firmware for the assets, the operating systems and the configurations.

It also means that it is necessary to have exhaustive information about plans for updates and about technological obsolescence, as well as to be aware of the known vulnerabilities and the existing patches. Cybersecurity management also requires that the occurrence of certain events necessarily leads to an assessment,

such as particular points in the life cycles of the assets or when certain threats are detected.

One of the most important rules, given the characteristics of these types of incidents, is the preparation of an exhaustive analysis of the access logs. This analysis should help to clarify the facts and enable the user to draw more precise conclusions about whether an electrical service failure was intentional or not.

The most important conclusion when faced with this type of situations is the importance of exchanging information about cyberattacks and the way such attacks are dealt with. This will enable other firms to learn from these situations and find out how to implement procedures if they suffer from a fault or detect a problem affecting the network infrastructure, basing their approach on the actions taken by others.

For electricity companies, security is a matter that concerns everybody, and installing technology is not sufficient. They must also implement organising processes to cope with the challenges posed by a decentralised grid. This means regular assessment of and ongoing improvement to the firm's cybersecurity process and physical security, to safeguard our new energy world.

However, an analysis of cybersecurity risks or merely an analysis of the vulnerabilities known to affect a control system, are activities that are not yet in great demand by utilities in the electrical sector.

Cybersecurity risk assessment features a traditional methodology for security risk analysis, which supplements to each other and provides security (safety) and cybersecurity, as from the early phases of a system.

When managing cybersecurity, it is better to define at the design phase, which cybersecurity requirements/measures a system has to comply with and then guarantee the system's security level throughout the project's life cycle; this applies to both the systems themselves and the system components.

Once the cybersecurity risks have been estimated, it is necessary to establish the measures that are required and that will be sufficient to reach the desired security level for the product or system analysed. The objective is to conduct a risk analysis at the design phase. Four security aspects are assessed as from the design phase:

- Secure platforms. Considering cybersecurity from the design phase for a system or product enables those involved to select the most appropriate hardware and software to construct the solution.
- Security measures such as safe boot for a system, authentication certificates, etc., are based on secure platforms and on advanced cryptography algorithms. Defining the security requirements at the design phase makes it possible to identify the components needed to attain the desired security level and to assess the platform to prevent computing or memory capacity problems.
- Secure applications. Conducting a risk analysis and identifying the potential threats at a phase before the designing and encoding of an application will be carried out thinking about potential countermeasures for those threats; this will improve the events, logs and evidence that make it easier to investigate an attack and, all things considered, it will be more robust.
- Secure products. A secure product is based on secure platforms and applications. A process has to be implemented that guarantees the system by reducing its vulnerabilities, minimising the permits authorised for the applications, configuring the services following the manufacturers' good codes of practice, minimising the number of services installed and the number of ports that can be accessed from secure and insecure interfaces.
- Secure Architectures. Finally, consideration must also be given to defining secure architectures at the design phase, by establishing different security zones, which will be analysed independently to find out the security level they have to reach depending on their criticality, the number of threats and the likelihood of those threats taking place.

Once segmented into zones, the traffic between those zones must be identified and suitable security measures implemented, as shown in Figure 5.

A system's security has to be based on mature processes to guarantee that the defined measures are considered at each stage in a system's life. Standard IEC-62443, which is explained in Figure 6, defines 4 security levels and describes which functional requirements a product or system must fulfil to reach the desired level.

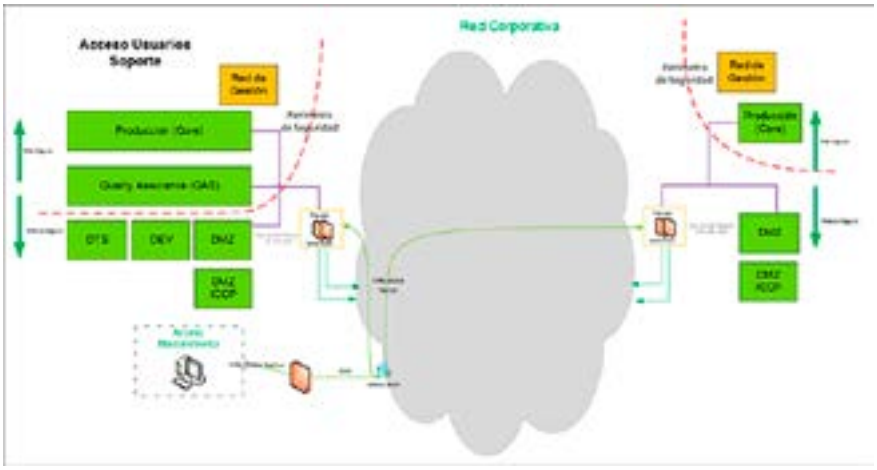


Figure 5. Segmentation and perimeter security measures for an advanced DMS.

Figure 6. Security levels defined by IEC-62443.

Cybersecurity measures for an existing control system

The process for increasing the security level of a SCADA, a DMS or an electrical substation is explained below. This will be done by following the Standard IEC-62443.

To make sure that it is ready to start updating the system and to reduce the time that the system will be non-operational because of these updating activities, the work that has to be done "*in situ*" is marked in blue, and the work that can be done in the office or without affecting the system operations is marked in orange.

Figure 7. Workflow when Implementing security measures for an existing project.

The first step, see Figure 7, when defending a system is to know what is going to be defended, which is elementary, but often forgotten. Not only the owner of the asset but also the person in charge of the system updating project, must carry out this information collection activity *in situ*. During this process, a cybersecurity expert will perform the non-intrusive tasks on the system to obtain information from all the system components, such as type of device. The personnel responsible will also be interviewed, in order to:

- Compile network architecture concerning the system and any other subsystems there might be
- Know what inventories there are (assets, configurations)
- Know what the security policies or applicable regulations are
- Assess the system vulnerabilities

This process can be done *in situ* or in the back-office using the information collected, but this will depend on how critical the system is.

The system can be classified on the basis of its criticality to the electrical operator, the government, etc., and define the security level required or desired for this system. To carry out this process, the electrical operator can use the security level definitions given in IEC-62443 or defined by other organisations such as the American National Institute of Standards and Technology (NIST).

All the threats to the system will now be listed and classified, together with the likelihood of each threat occurring in the different zones, or assets of the system being studied plus their impact, not only in economic terms, but also on the environment and people. By way of example, we imagine the impact of a general power cut in a hospital or a wastewater treatment plant.

This will enable us to identify the risks, rank then in order of criticality and analyse the ones that one is prepared to accept.

Once the risk analysis is complete and the security level to be attained has been defined, the functional requirements that an industrial or electric control system has to implement to reach security level 1, 2 or 3 are defined in part 3-3 of Standard IEC-62443.

The functional requirements that can be implemented are identified by criticality or by the ease with which they can be implemented in the existing system and are able to improve the system's general security.

A good measure for reducing service interruption time to a minimum and guaranteeing that the measures to be implemented are properly applied, is to create a mirror platform.

At this phase, once a copy of the system has been made to make sure we can return to a previous state if necessary, we can implement the measures that have been designed.

The following must be tested before running the system:

- The new functionalities
- The disappearance of vulnerabilities/risks identified at the initial phases
- The correct operation of the system

Finally, a copy of the updated system is made, a new baseline will be created with the updated inventory and a new iteration will commence to attack any new risks that might have appeared or those already identified.

The Blockchain

Blockchain technology consists of an open virtual platform that is distributed, where economic transactions of different kinds take place between users. This technology dispenses with intermediaries represented by banking institutions and evolves towards a decentralised system where the users carry out the operations directly. The transactions are no longer opaque processes and now become information available to all users, without ceasing to be confidential. Therefore, Blockchain could be defined as a large ledger that contains an account of all the operations performed since its creation, organised into blocks and encrypted into security codes so they cannot be modified maliciously (Figure 8).

Figure 8. Example showing how Blockchain works. Source: Financial Times.

Blockchain's usefulness is not limited only to economic transactions, because other types can be carried out, such as energy transactions. Another concept associated with this technology is the smart contract, which is a document available on the platform that contains the terms and conditions of a particular contract. The advantage of such contracts is that when the requirements specified in the document are fulfilled, Blockchain automatically executes the terms and conditions among the participants, for

example, the energy exchange, making the process easier and removing non-payment situations.

At present, Blockchain still has a few limitations. First of all, the legislation in countries has to be adapted to technology developments and made uniform for everybody. The decentralisation of the system means that many users are exchanging information and running complex algorithms at the same time, which limits the number of transactions and the rate at which they are run. Where the security plot is concerned, the private names of the users can be vulnerable to cyberattacks. Moreover, the Blockchain platform is not completely anonymous. Although it is true to say that the public name does not reveal your identity, the transactions are public and can reveal confidential information. In summary, the principle characteristics of Blockchain technology as explained above can be grouped into the following points:

- Distributed network: every user constitutes a node and they all have the same privileges.
- Direct transmission between users: there are no intermediaries, the transactions being carried out directly between the users.
- Transparency and pseudo-anonymity: the transactions are published in the ledger with the public names of the users.
- Unalterable registers: once a block is added to the chain, it is practically impossible to modify the information about the transactions contained.
- Smart contracts: digital contracts that are executed directly when the specified conditions are fulfilled.

Applying Blockchain in the energy sector

Blockchain technology is a powerful tool for facilitating the transition to smart networks. A smart network is characterised by being decentralised, where users can consume and produce energy at the same time (*prosumers*). This makes it difficult for the system to be managed from a central body, as it is done at present time. Furthermore, the information flow in a smart network becomes two-directional via the smart meters and the electric vehicle can play a key role in flattening the demand curve (Vehicle to Grid).

The opportunities that Blockchain technology offers are thus perfectly adapted to the requirements of the energy system of

the future, - decentralised, flexible, transparent and open -. In an energy market operating with Blockchain technology, the energy would have a value in tokens and consumers would be able to exchange tokens for energy through transactions.

Conclusions

The European electrical system is a very robust and interconnected system, both of these characteristics paving the way for energy transformation to progress towards a system that is more environmentally friendly, due to the massive use of renewable energies. However, the characteristics of these energies, their random nature and the difficulty with which they can be predicted, make integrating them in conditions of security a complex process. That is why the electrical system operators have been equipping themselves with certain tools to guarantee the continuity of supply with a high presence of these energies.

Furthermore, the electrical grids that run through the territory are mainly surface infrastructures exposed to the aggressions of atmospheric phenomena or natural accidents, so they have to be equipped with electrical protective devices that are coordinated with each other in order to overcome the problem of potential faults, failures or short-circuits that may occur.

This transformation of the electrical sector, consisting of a decarbonisation, will become a reality through the renewable energies that are distributed, for which purpose breakthroughs will have to be made, and are now being made, in digitalisation, applied to the immense volume of data that are produced as consumers play a more active role in the supply.

However, as we interconnect via the smart networks, we are also increasing the risk of malicious actions being taken by agents whose objective is to attack the electrical infrastructures in an attempt to interrupt continuity of supply.

Control systems are no longer isolated systems that attackers are not very familiar with. They are now critical infrastructures for the smooth running of any society, government or industry.

Implementing security measures will always be more time and cost effective if it is taken into consideration as from the system or product design phase. Manufacturers are making an effort to improve the security of their sensors and of the systems they make up, but operators must require the implementation of

security elements into the systems they operate on the basis of specific standards and frameworks for industrial and electrical control systems.

The systems currently available do not have sufficient security measures. If they need to be integrated with other elements on the new electricity grids, they have to be updated and must reach a security level that is high enough to prevent them from being controlled by an attacker and/or from being used to attack the entire network infrastructure

Finally, we must not forget to take into account that what most of these attacks have in common is that they use the weakest link in the security chain, people and IT systems within the reach of everybody, such as email or a manipulated USB device (*Pendrive*). The attacker manages to win the confidence of the victim, who then executes the malware or malicious code in his computer

One course of action taken by many firms to increase security is training, awareness and sensitisation for all the personnel associated with the business processes, because people can make the difference between the success and failure of an attack. The idea of including all the stakeholders in the supply chain, from collaborators and suppliers to the manufacturers of the devices, etc., is now beginning to take hold.

In view of the above, the pace at which technology is developing and the rate at which new threats are appearing, it would be a mistake to think that systems are impregnable and that there are security measures that can keep you fully protected against any attack. The truth is that attackers are growing in number all the time and have increasing resources. Many of them are even financed by governments, which is why companies no longer invest just in protection, but also in training their groups and making them aware of the dangers, as well as updating their resilience mechanisms so that they can react in the event of a successful attack.

In conclusion, faced with a situation where attacks on critical systems are increasing all the time, it is vital to be constantly investing in security from both economic and human resources perspectives; implementation of technical measures, suitable government and security processes, the awareness of persons and contingency mechanisms will be key for keeping electrical systems stable.

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Chapter four

Energy sustainability in the defence and security sector – global, European and NATO context

Manuel Francisco Arribas Tiestos

David Martín Borreguero

Abstract

In an increasingly complex environment of supranational organizations and multilateral and national agencies, of multiple concepts and different approaches, regulations, legislative packages and standards with the common goal of achieving a fair ecological transition of our economy and current production models towards an environmentally sustainable and carbon-free future, the defence sector has been involved in the last decade and is adopting an increasingly active and exemplary role in the energy and environmental sustainability of its operations.

The defence sector is immersed in a process of cultural transition and paradigm shift through which the concept of energy as a «commodity» is shifting towards a concept of energy as a «military capability».

The rational, efficient and sustainable use of energy results in an increase of the resilience and a reduction of the vulnerabilities not only in military deployment operations, in which first and

foremost, reducing the need for supply and refuelling saves humans lives, as well as increases the autonomy and scope of their missions, but also in their daily operations in its homeland fixed facilities, reducing the costs associated with energy consumption and freeing the unspent budget for other purposes.

The defence sector is progressively defining its own energy and environmental philosophies and policies, and establishing long-term strategies and plans aimed at achieving national and European objectives of improving energy efficiency and reducing carbon emissions.

While these aspects might be somehow distant from the defence sector only a few years ago, the objectives of energy efficiency and reduced environmental impact are increasingly resonating in the military environment, and progressively becoming part of the priorities established under the defence global policies and strategies.

Keywords

European Defense Agency, Defense sector, energy sustainability, energy transition.

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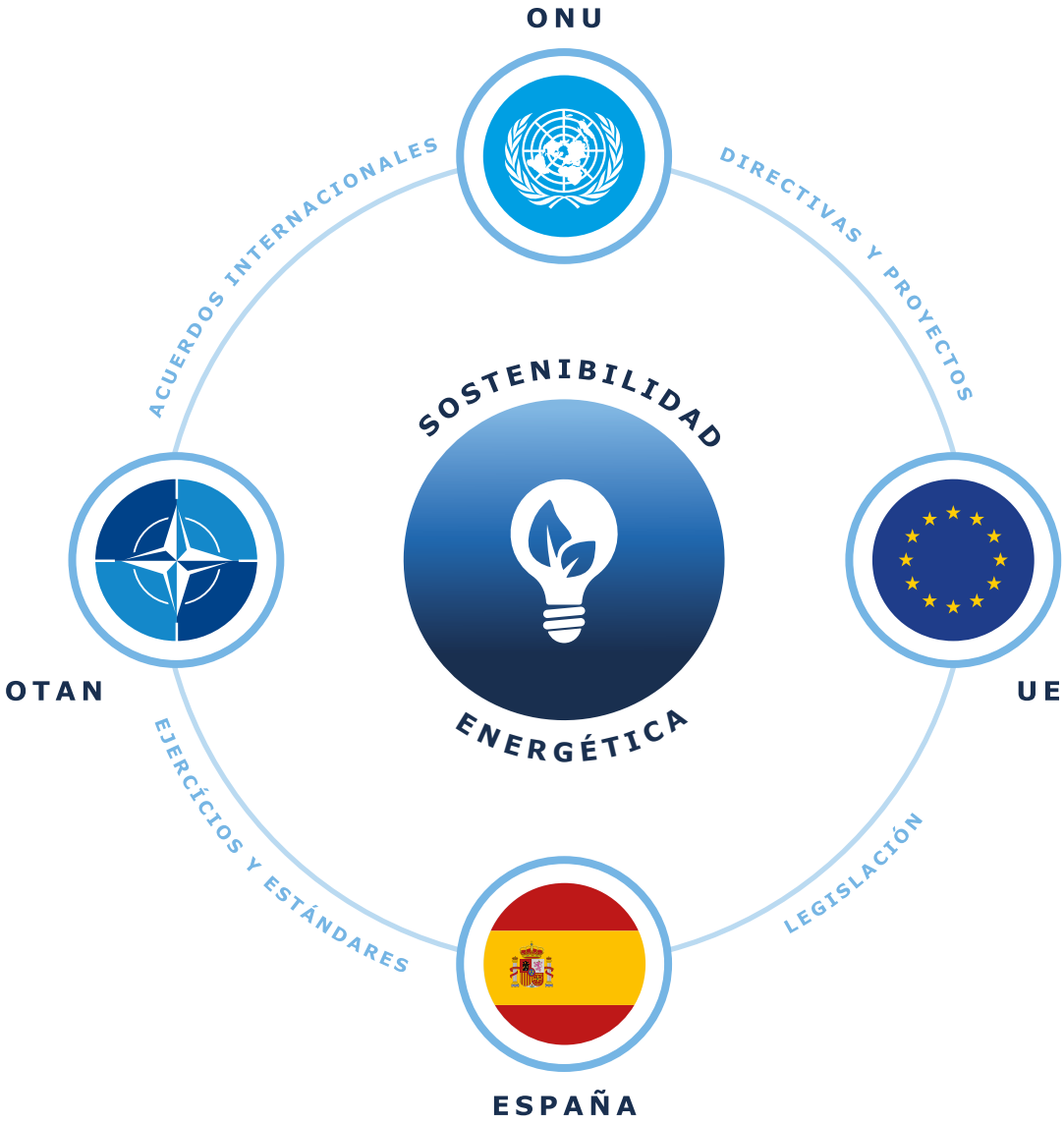

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ESTADO MAYOR DE LA UNIÓN EUROPEA (EUMS)

OTAN

CUARTEL GENERAL

PROGRAMA DE CIENCIA PARA LA PAZ Y SEGURIDAD (SPS)

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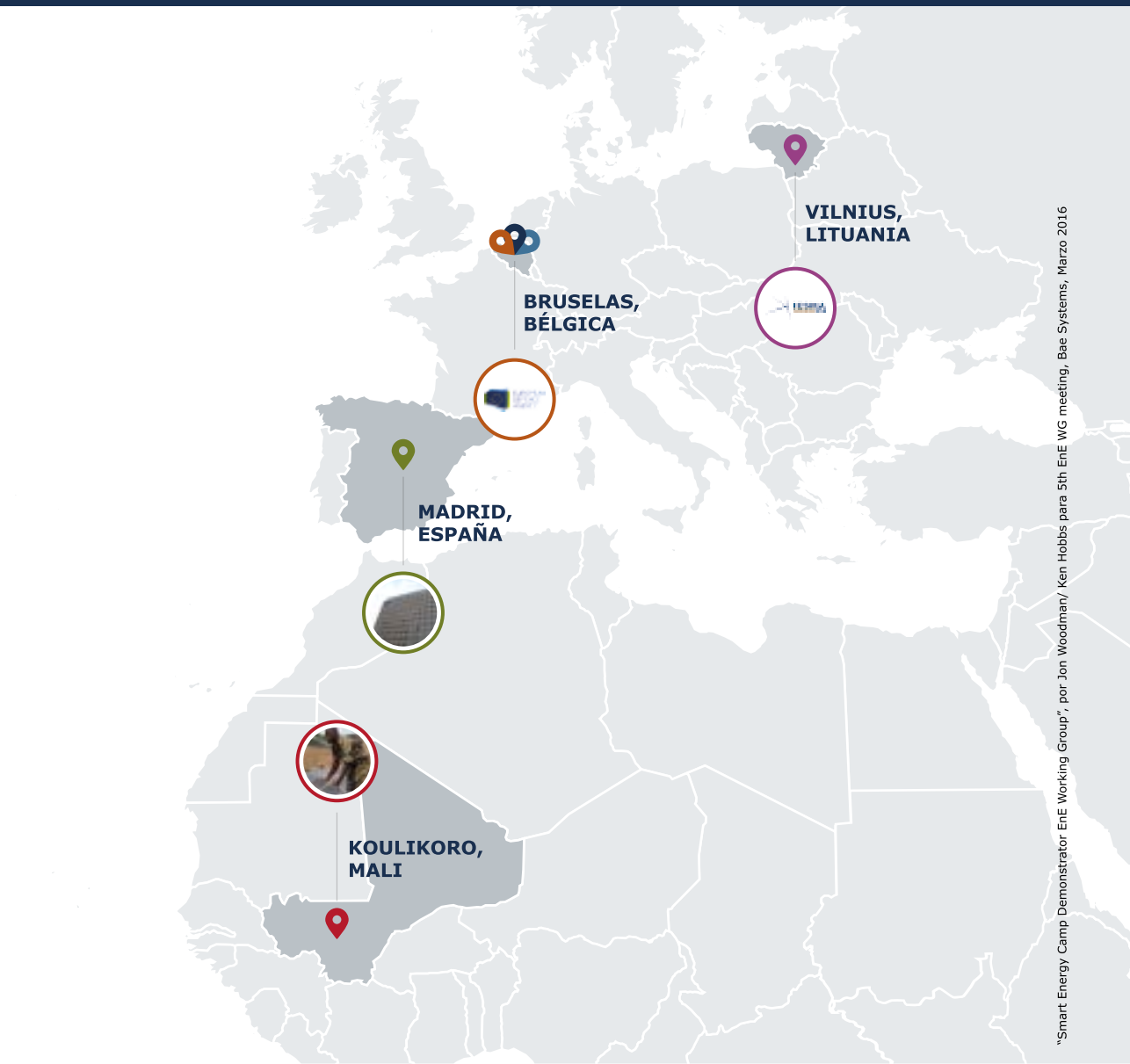

"Smart Energy Camp Demonstrator EnE Working Group", por Jon Woodman/ Ken Hobbs para 5th EnE WG meeting, Bae Systems, Marzo 2016

PROYECTOS:

- REFORMA EDIFICIO ISDEFE
- SMART ENERGY CAMP TECHNICAL DEMONSTRATOR (SECTD)
- ANÁLISIS CONSUMO ENERGÉTICO DE DEFENSA EN UE
- OSRA AND CAPABILITY DEVELOPMENT PLAN
- INNOVATIVE ENERGY SOLUTIONS FOR MILITARY APPLICATIONS (IESMA)
- FORO CONSULTIVO SOBRE LA SOSTENIBILIDAD ENERGÉTICA EN EL SECTOR DE DEFENSA Y SEGURIDAD (CF SEDSS)

Global context regarding energy efficiency and climate change

The Paris Agreement

The 21st Conference of the Parties (COP21) under the United Nations Framework Convention on Climate Change (UNFCCC), held in December 2015 in Paris, was a turning point in the global fight against climate change. The agreement reached, known as the Paris Agreement, established for the first time a common cause and binding commitments applying to all the Signatory Parties, focusing on the implementation of all the actions needed to combat climate change and to adapt to its effects, establishing clear and measurable targets, as well as a fund and a financing mechanism that jointly supports the developing countries.

Once it was open for signing in April 2016, the Agreement came into force in November of that same year, 30 days after complying with the twofold criterion of ratification by 55 countries that are responsible for at least 55% of the world emissions[1].

The Paris Agreement focuses on the urgent need to tackle and strengthen a response coordinated at a world level, to the challenge of global warming and a climate change that could be tragic, or even catastrophic, and that in the light of the adverse and extreme meteorological events that can already be observed now, could be even closer than we think if we do not take the right decisions and act accordingly.

The Paris Agreement reached by the parties establishes a world plan of action with the long-term goal of limiting the average world temperature increase to well below the 2 ºC above the pre-industrial level, continuing with its efforts to limit that increase to 1.5 ºC. The Parties undertake to reach the emission ceiling for greenhouse gases (GHG) as soon as possible, and since then establish a reduction path that will lead to a balance between anthropogenic emissions and absorption by GHG sinks in the second half of 21st Century.

With a view to this, the Agreement encourages the Parties to conserve and improve the GHG sinks and deposits, including forests, and establishes commitments that are binding on all the

[1] https://unfccc.int/es/process-and-meetings/the-paris-agreement/que-es-el-acuerdo-de-paris, consulted on 15th November 2019

Parties to set and maintain Nationally Determined Contributions (NDC) to reduce GHGs, with results reported every five years, and that will grow successively with respect to the preceding ones until they reach the highest level possible. The greater difficulties faced by the developing countries and the leadership and support role to be played by the most developed countries, will invariably be taken into account at all times. In view of this, targets are set for adapting and reducing vulnerabilities to climate change through international cooperation, knowledge & technology transfer, improving ability, awareness, education and training where climate change is concerned.

The Green Climate Fund (GCF), established in 2010 by the 194 countries that act in the capacity of Parties to the UNFCCC within the Convention's own financial mechanism, took on a crucial role after the signing of the Paris Agreement in 2015. The Fund uses the public financing from the Parties to support the efforts and initiatives of the developing countries to reduce their GHG emissions and adapt to climate change. This public financing takes the form of grants, loans, shareholdings in companies and guarantees, all with a view to encouraging and attracting a greater volume of private investment to financing initiatives that will lead to a transition from the current development model, which is mainly based on the utilisation of fossil fuels, to other sustainable and low-emission models that are climate resilient this being done in a way that is fair to all communities, especially those that are most vulnerable[2].

In 2023, and every five years from then on, the collective progress and world balance achieved with respect to the Agreement's goals will be assessed; this assessment will serve as the basis for correcting, strengthening and improving the initiatives set in motion, and for preparing others that will help to achieve climate neutrality by 2050.

According to the data contained in the Sixth Assessment Report (AR6) issued by the Intergovernmental Panel of experts on Climate Change (IPCC), in 2017 global warming caused by humans reached approximately 1 ºC above the preindustrial level. Furthermore, according to the summarised guide issued by the Spanish Meteorological Agency (AEMET) and the Spanish

[2] https://www.greenclimate.fund/who-we-are/about-the-fund, consulted 15 November 2019

Climate Change Office (OECC) concerning that report and entitled "*Climate Change: Global Warming at 1.5 ºC"* [3]:

- At present, "*the average world temperature is rising at a rate of 0.2 ºC per decade, reaching a warming of 1.5 ºC between 2030 and 2052*".
- "*Compliance with the current mitigation commitments made in the Paris Agreement is not sufficient to limit global warming to 1.5 ºC, even if such compliance is supplemented by ambitious measures on a large scale after 2030. With the* Nationally Determined Contributions (NDC) under the *Paris Agreement, a warming of around 3ºC would be reached in 2100, when compared to the preindustrial level*".
- "*In the simulated paths that limit warming to 1.5 ºC, CO_2 emissions are reduced as from 2020, until net zero emissions are achieved by about 2050. Net zero emissions will be reached by around 2075 for the paths that limit global warming to 2 ºC*".
- "*All the paths that limit global warming to 1.5 ºC use CO_2 capture techniques to remove 100–1000 $GtCO_2$ throughout the 21st Century*".

In its annual bulletin on Greenhouse Gases published in November 2019[4], the Word Meteorological Organization (WMO) warned that the GHGs that trap heat in the atmosphere reached in 2019 a new unprecedented record. The average world concentration of carbon dioxide (CO_2) reached 407.8 parts per million (ppm) in 2018, after having reached 405.5 ppm in 2017, on the assumption of a 2.3 ppm/year rate of increase and exceeding the average growth in the past ten years (the CO_2 rate of increase for the ten-year periods 1985–1995, 1995–2005 and 2005–2015 rose from 1.42 ppm/year to 1.86 ppm/year and to 2.06 ppm/year, respectively). The methane and nitrous oxide concentrations also rose sharply, doing so in greater quantities than in the previous ten years.

[3] AEMET and OECC 2018, "Climate Change: Global Warming of 1.5 ºC", *Ministerio de Transición Ecológica*, Madrid, December 2018, https://www.miteco.gob.es/es/cambio-climatico/temas/el-proceso-international-de-lucha-contra-el-cambio-climatico/ipcc_informe_especial_15pdf_tcm30-485656.pdf

[4] https://public.wmo.int/es/media/comunicados-de-prensa/la-concentraci%C3%B3n-de-gases-de-efecto-invernadero-en-la-atm%C3%B3sfera-alcanza, consulted 15 November 2019

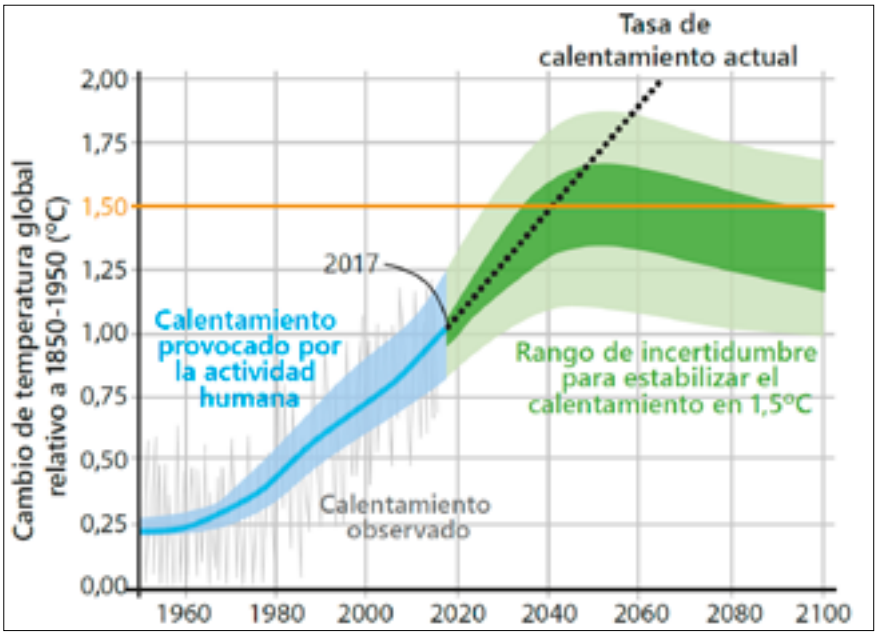

Figure 1- Projection of the average global temperature increase. (Source: AEMET and OECC 2018, "Climate Change: Global Warming at 1.5 ºC", Ministerio de Transición Ecológica, Madrid, December 2018).

Merely by way of reference to the impact that global warming can cause, the Secretary General of the WMO, Petteri Taalas, mentioned in this bulletin that *"…the last time that there was a comparable concentration of CO_2 on Earth, was between 3 and 5 million years ago. At that time, the temperature was 2 to 3 °C warmer and the sea level was 10 to 20 metres higher than it is now"*,

Furthermore, the United Nations Environment Program (UNEP) warned in its Report on the disparity of emissions in 2019[5], that the gas reduction plans currently approved by the countries that signed the Agreement would lead to a rise of at least 3.2 ºC, and that their efforts should be increased threefold, to keep the average global temperature below 2 ºC, or fivefold, to keep the average global temperature below 1.5 ºC when compared to preindustrial levels. According to data in the same report, annual reductions of 7.6% will be required all over the planet as from 2020 to achieve the 1.5 ºC degree goal.

[5] https://wedocs.unep.org/bitstream/handle/20.500.11822/30798/EGR19ESSP.pdf?sequence=17, consulted 15 November 2019

Yet despite the evidence of climate change and its devastating consequences, which are now being felt by millions of people and ecosystems in different and varied regions around the planet, and in a particularly hard way for the most vulnerable, the climate summit known as COP25, under the chairmanship of Chile and held in Madrid, ended in disappointment, without serving to reach any major agreements and revise upwards the national objectives and plans, postponing those agreements, once again, until the next Conference of the Parties, which will take place in Glasgow in 2021.

European context in relation to energy efficiency and climate change

European Framework for Climate and Energy: energy policy and strategy. The Energy Union

From an economic perspective, there are many areas and aspects where the joint action of the European Union (EU) and its Member States, always and invariably abiding by the competencies inherent to each State, in line with the subsidiarity principle that governs the EU, is much more effective and efficient than isolated actions on a national level[6].

The basic framework that governs the EU's actions and defines its competencies in the energy field is the Treaty on the Functioning of the European Union[7] (TFUE). Article 194 of this document states the following:

> "1. In the context of the establishment and functioning of the interior market and with regard for the need to preserve and improve the environment, the Union policy on energy shall aim, in a spirit of solidarity between the Member States, to:
>
> a) aensure the functioning of the energy market;
>
> b) ensure the security of energy supply in the Union;

[6] European Commission, "SEC(2011) 1566 final, EXECUTIVE SUMMARY OF THE IMPACT ASSESSMENT. Accompanying the document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. Energy Roadmap 2050", Brussels 15 December 2011

[7] Official Gazette of the European Union, CONSOLIDATED VERSION OF THE TREATY ON THE FUNCTIONING OF THE EUROPEAN UNION, 30-03-2010, https://www.boe.es/doue/2010/083/Z00013-00046.pdf

c) promote energy efficiency and energy saving and the development of new and renewable forms of energy, and;

d) promote the interconnection of energy networks."

The EU's competencies in the area of combating climate change, including GHG reductions in the energy sector and in other sectors, are also defined in the TFUE, Articles 191 to 193. To be specific, Articles 191.1 and 191.4 state, respectively:

"1. Union policy in the area of the environment must contribute towards achieving the following aims:

- conserving, protecting and improving the quality of the environment,
- protecting human health,
- utilising natural resources carefully and rationally,
- promoting measures on an international level aimed at dealing with regional or global environmental problems and combating climate change in particular".

"4. In the context of their respective competencies, the Union and the Member States shall cooperate with third countries and the empowered international organisations. The ways the Union cooperates can take the form of agreements between the latter and the third party stakeholders. The preceding paragraph shall be interpreted as not affecting the capacity of the Member States to negotiate in international institutions and to reach international agreements".

Articles 192 and 193 also describe legal procedures and define the scope of the decisions that are taken at an EU and Member State´s level.

Furthermore, the TFUE contains other provisions that affect the EU's energy policy:

- Supply security: Article 122 of the TFUE;
- Energy networks: Articles 170 to 172 of the TFUE;
- Domestic energy market: Article 114 of the TFUE;
- Energy foreign policy: Articles 216 to 218 of the TFUE.

The EU, acting as Party to the UNFCCC, has committed itself to combating climate change and is leading the most ambitious efforts to achieve this and to obtain a carbon neutral society, economy

and production model within its territory by 2050, through very ambitious and harmonised legislative packages, which include many areas, such as energy, environment, climate change, trading of emission rights, national targets, circular economy, green contracting, promoting renewables, transport, sustainable finance, or innovation & development, amongst others. The EU is also working actively with third countries, outside the EU, and is providing financing for developing countries to support activities that help to achieve the Paris Agreement targets[8].

In this sense, the European Commission's long-term strategic vision for 2050, for a prosperous, modern, competitive and climatically neutral economy, called "A clean planet for all" and approved in November 2018, contains nearly all of the EU's policies and is aligned with the Paris Agreement.

Starting from this long-term vision, the EU has defined a "*strategic framework for an Energy Union*"[9], and has completed a modern, advanced and efficient regulatory framework for achieving its greenhouse gas reduction targets and realise a socially fair transition to a clean economy and production model, focusing mainly on production, efficient energy utilisation and energy saving, it being now responsible for over 75 % of the emissions.

That strategic framework defines five closely-linked dimensions or overriding aims that mutually support each other, with a view to promoting energy security, sustainability and competitiveness, namely[10]:

- Energy security, solidarity and trust: diversification of the EU's energy sources, through solidarity and cooperation between Member States;
- A completely integrated European energy market: enabling the free circulation of energy throughout the EU via suitable infrastructures and the removal of technical and regulatory barriers;

[8] https://ec.europa.eu/clima/policies/eu-climate-action_es, consulted 15 October 2019

[9] European Commission, "COM(2015) 80 final. PACKAGE CONCERNING THE ENERGY UNION. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, TO THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE, THE COMMITTEE OF THE REGIONS AND TO THE EUROPEAN INVESTMENT BANK. Strategic framework for an Energy Union that is resilient with a prospective climate policy", Brussels, 25-2-2015

[10] https://ec.europa.eu/energy/en/topics/energy-strategy/energy-union-0, consulted 15 October 2019

- Improved energy efficiency: as a contribution to the moderation in demand and in the dependence on energy imports, the emission reductions and the growth of the labour market and the economy;
- Action against climate change and conducive to decarbonising the economy: commitment to the Paris Agreement and retaining leadership in the renewable energies sector;
- Focusing on research, innovation and competitiveness: prioritising and promoting progress in clean-energy production technologies as a contribution to energy transition and improved competitiveness.

EU´s targets and legal framework on climate and energy, 2020

This package of measures for 2020, established by the EU leaders in 2007 and included in the legislation in 2009, forming part of the Europe 2020 strategy, had three aims:

- 20% reduction in GHG emissions (compared to the 1990 levels), in the housing, agriculture, waste and transport sectors (excluding aviation), which account for 55% of the EU emissions.
- 20% renewable energies in the EU´s energy mix, and a 10% share of renewable energies in the transport sector.
- 20% improvement in energy efficiency.

There was also the target of a 21% reduction in GHG (compared to the 2005 levels), in the aviation sectors and major installations in the industrial and electrical sectors, which account for 45% of the EU emissions.

To achieve this, the EU acted in different areas through a variety of legislative packages and mechanisms, including:

- Emission Trading Scheme (ETS), to reduce GHG in the aviation sector and major installations in the industrial and electrical sectors.
- National targets for reducing emissions in the housing, agriculture, waste and transport sectors (excluding aviation), which vary on the basis of the wealth of the Member States.
- An energy efficiency plan and a legislative package that includes the following Directives: energy efficiency, energy

performance of buildings, promoting sources of renewable energy, eco-design and energy labelling.

- A plan to mobilise private investment in energy efficiency.
- Financing programmes for renewable energy technologies (NER300) and for research & innovation (Horizon 2020).

EU´s targets and legal framework on climate and energy, 2030

The basic targets[11] of this framework, adopted by the European Council in October 2014 and revised in 2018, for the period 2021 to 2030, are three:

- a reduction of at least 40% in greenhouse gas emissions (when compared to 1990); the sectors included in the ETS will have to reduce their emissions by 43% when compared to 2005, and the sectors not included will have to reduce their emissions by 30% when compared to 2005, these being mandatory targets for each Member State.
- at least a 32% share of renewable energies, with an upward review of the target in 2023;
- at least a 32.5% improvement in energy efficiency, with an upward review of the target in 2023;

With a view to this, in December 2018 the European Commission completed what came to be known as the Winter Package or Clean Energy for All Europeans Package[12], which was subsequently endorsed by the European Council and the European Parliament at the beginning of 2019; it consists in an update of the energy framework and policy in the EU.

This new legal framework for energy contains 8 legislative measures (directives and new or modified regulations), whose provisions came into force midway through 2019 (and have to be transposed by the Member States to their national legislation within a period of 1 to 2 years). The main aim of this framework is to facilitate the EU's ecological transition, and to do so in compliance with the commitments taken on at the Paris Agreement to reduce greenhouse gases.

[11] https://ec.europa.eu/clima/policies/strategies/2030_es,_ consulted 15 November 2019

[12] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans, consulted 15 November 2019

A brief description is given below of these 8 legislative measures, on the basis of the information that appears at the relevant websites from the European Commission[13] and from the Energy Diversification and Saving Institute (IDAE)[14],

Energy Efficiency Directive (Directive 2018/2002)

Energy efficiency is still a key aspect in this legislative measure, because the best way to save energy and reduce budgets is by not using energy, and there is no better CO_2 reduction than CO_2 that is not emitted.

This directive, which updates and includes new provisions that were not contained in the text and provisions in the same Directive in its original version in 2012 (Directive 2012/27), sets a new efficiency target of 32.5% for the EU in 2030, that can be given an upward review in 2023, and increases the annual saving obligation in energy consumption to beyond 2020. In general, the new or modified articles in this Directive affect different policies and schemes in the energy field at a Member State level, but do not particularly affect the Defence public sector. The following, amongst others, remain basically unchanged: the provisions in the original Directive concerning the need to define long-term renovation strategies for buildings (Article 4), the exemplary role of Public Administration in taking energy efficiency improvement measures, the target rate for annual refurbishment of 3 % for public buildings belonging to the Central Administration, the need to create a suitable inventory for air-conditioned public buildings and the exemptions for the defence sector (Article 5), contracting and purchasing services and high energy-efficiency goods, exemptions for the defence sector (Article 6), the provisions regarding energy audits and energy management systems (Article 8), or the measurement of energy consumption (Article 9).

Energy Performance of Buildings Directive (2018/844)

Buildings account for 40% of energy consumption and for approximately 36% of CO_2 emissions, which makes the sector the largest energy consumer in Europe.

[13] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans,_ consulted 15 November 2019

[14] https://www.idae.es/informacion-y-publicaciones/marco-legislativo-2030-el-paquete-de-invierno, consulted 15 November 2019

This directive, which updates provisions and includes new ones with respect to the text and provisions contained in the same directive in its original version in 2010 (Directive 2010/31), promotes new aspects for achieving the decarbonisation of the EU by 2050, including several aspects that mainly affect the defence public sector, except for the exemptions envisaged by the Energy Efficiency Directive, such as defining and implementing building renovation strategies by stages and in the long term, or the use of smart automation, control and management equipment and facilities to reduce energy consumption. It also contains provisions for supporting electro-mobility in buildings, requiring support infrastructure and recharging points to be provided, and a Smart Readiness Indicator (SRI) to be defined, that will measure a building's capacity to utilise smart systems making it possible for the building´s operation to adapt to the user's needs, optimising energy consumption.

The provisions in the original Directive concerning minimum energy efficiency requirements in new buildings or major refurbishments of existing buildings (Articles 6 and 7), or in the technical systems of buildings (Article 8), nearly zero energy consumption buildings (Article 9), energy efficiency certificates (Articles 11, 12 and 13) or the inspection of air-conditioning and central-heating systems (Articles 14, 15 and 16) remain basically unchanged.

Directive on the promotion and use of energy from renewable sources (Directive 2018/2001)

This directive, which updates and includes new provisions when compared to the text and provisions in the same directive in its original version in 2009 (Directive 2009/28), sets a new target of 32% regarding the contribution of renewable energies in the EU´s energy mix by 2030.

A better design and greater stability of supporting schemes for renewable energies, the simplification of the administrative procedures, and the regulatory framework for self-consumption, could have a positive effect and somehow promote the hitherto only slight penetration made by renewables in the defence sector.

Regulation concerning Governance of the Energy Union and Climate Action (Regulation 2018/1999).

The "*Winter Package*" includes a governance system for the *Energy Union*, through which each Member State must prepare

an integrated national energy and climate plan (NECP) for 2021-2030, which covers the 5 dimensions of the *Energy Union* described above, and in which the Member States describe how they are going to achieve their targets for each one of these 5 dimensions, as well as a long-term strategy for the decarbonisation of the economy by 2050.

This governance system makes it possible to compare each Member State's national plans and synchronise the periods for submitting reports within the deadlines set in the Paris Agreement, establishing a clear and sound framework for guaranteeing joint achievement of the EU's set of binding energy efficiency targets, the penetration of renewable energies and the interconnection of the electrical system.

Legislative measures (4) for designing the electricity market

The elements in this electricity market design, whose aim is to make the electricity market more integrated, flexible, effective and better oriented towards the new market realities, consists of four legislative measures: one regulation concerning the domestic electricity market, one directive concerning domestic electricity market standards, one regulation on preparing for risks in the electricity sector and one regulation which involves establishing the Agency for the Cooperation of Energy Regulators (ACER).

Long-term strategy for 2050

On 28 November 2018, the European Commission presented its long-term strategic vision for a prosperous, modern, competitive and climatically neutral economy from now to 2050 and for keeping the global temperature increase below 1.5 °C, by investing in research and technologies and by the participation of all the European, national and local institutions, companies, Non-Governmental Organisations (NGOs) and citizens, and by harmonising policies that include nearly all areas.

This strategy is based on seven main strategic components:

1. Maximising the benefits of energy efficiency, mainly with zero emission buildings.
2. Maximising the deployment of renewable energies and the use of electricity to completely decarbonise Europe's energy supply.

3. Adopting a clean, secure and connected mobility.
4. Improving the competitiveness of EU industry and adopting the circular economy as being essential in helping to reduce greenhouse gas emissions.
5. Developing a suitable infrastructure of smart networks and interconnections.
6. Making the most of all the advantages inherent to the bioeconomy and creating essential carbon sinks.
7. Developing and implementing technologies for the capture and storage of carbon to counteract the remaining CO_2 emissions.

Energy Sustainability in the context of the European Defence Sector.

On 17 June 2019, the Council of the European Union (Ministers of Foreign Affairs and Ministers of Defence) adopted the Council's conclusions on security and defence in the context of the European Union's Global Strategy[15].

For the first time since the founding in 2016 of the Consultation Forum for Sustainable Energy in the Defence and Security Sector[16] (CF SEDSS), a European Commission initiative managed by the European Defence Agency (EDA), the Council of the European Union has recognised the work done and the results achieved by that Consultation Forum, which brings together delegates from the Ministries of Defence and the Armed Forces (AF) of a majority of EU Member States, including more operational profiles of energy experts and energy managers and more strategic profiles with responsibility for making policies and drawing up energy strategies, for discussing and identifying the hindrances and difficulties faced by the defence sector in implementing the packages of measures prepared by the European Commission (EC) for improving management and energy efficiency, promoting renewable energies, and protecting critical energy infrastructures relevant to the defence, as well as for sharing their expertise and good practices and, just as important, creating a community of experts in energy within the defence sector.

[15] https://www.consilium.europa.eu/en/meetings/fac/2019/06/17, consulted 1 December 2019

[16] https://eda.europa.eu/european-defence-energy-network/consultation-forum, consulted 1 December 2019

In section "Energy Challenges", within Paragraph 49 of the Council's conclusions document on security and defence dated 17 June 2019[17], the Council called for closer cooperation to cope with the challenges in energy security, by means of energy efficiency, renewable energy solutions and the protection of critical energy infrastructures, inviting the Member States, the European External Action Service (EEAS), the European Commission and the EDA to develop sustainable and secure energy models in the defence sector, aimed at increasing resilience and operational efficiency, all within the complex context of current climate change.

Furthermore, in June 2019, the Council of the European Union adopted a new strategic global agenda for the EU between 2019 and 2024, which recognises the consequences of climate change, such as desertification, land degradation, water and food shortage, energy insecurity, and the risks that these consequences pose to people and their territories and also the risks of potential conflict between communities, stressing the need to speed up the transition towards renewable energy sources, to increase energy efficiency, to reduce dependence on external energy sources, to diversify supply sources and to invest in mobility solutions for the future.

The Ministry of Defence's participation in energy sustainability initiatives in the Defence Sector through the European Defence Agency (EDA)

EDA's Energy and Environment Programme

The aim of EDA's Energy and Environment Programme is to support the Armed Forces of the EU Member States in their transition to a more sustainable operating model, with low carbon emissions and low environmental impact.

The Programme focuses on compiling and analysing data concerning energy consumption, energy efficiency, the utilisation of alternative energies and sustainability in the defence sector. It is run by its own Energy and Environment Working Group (EnE WG), with participation from the National Contact Points (NCP)

[17] Council of the European Union, "Outcome of Proceedings. Subject: Council Conclusions on Security and Defence in the context of the EU Global Strategy - Council Conclusions (17 June 2019)", Luxembourg, 17 June 2019

designed for that purpose by the Member States' Ministries of Defence and personnel from the EU Military Staff (EUMS), coordinated by an EDA´s Project Officer.

The Programme is designed to identify areas of common interest to the European Armed Forces, with a view to: devising and providing a comprehensive framework and approach to energy management, reducing their dependence on imported fossil fuels by improving energy efficiency, and incorporating new energy technologies into military skills, as well as to understanding the cultural and management problems in the defence sector that limit energy sustainability and resilience.

The Infrastructure General Directorate (DIGENIN) of the Spanish Ministry of Defence has been participating actively in this Working Group since 2015. The activity focuses on several projects that, either financed from EDA's operational budget, or through the contributions made by the Member States that are participating in each project (CAT A and CAT B projects), include prospective studies and/or feasibility studies, or technology development or implementation projects, respectively, along the lines and within the objectives established by the Working Group.

These projects are described in greater detail below.

Smart Blue Water Camps Project (SBWC).

This project tackles and analyses the limitations and problems affecting the European Armed Forces regarding water utilisation and management at military bases, from the perspectives of conservation, sustainability and technological innovations, and its objectives are:

- To improve supply security.
- To reduce environmental impact (reducing consumption and CO_2 emissions).
- To cut down on costs by reducing consumption and applying new water treatment processes.
- To reduce dependence on potable water suppliers.
- To raise military personnel's environmental awareness.

Spain, together with Greece, Italy, Ireland, Portugal and Cyprus, has taken part in the first phase of this project, which ended in autumn 2017. The Spanish Ministry of Defence's contribution

consisted of analysing the water management by the Royal Guard Barracks.

The details of the project, indicators for the analysis of data and conclusions regarding this first phase of the project, are compiled in a Final Report. Once all the risks had been analysed, the Final Report recommends that a rainwater collection and a grey water treatment system should be installed for use in cisterns in the Nissen huts and office buildings; this would cover an annual water demand of up to 8,712 m³.

The figure below shows a comparative analysis of the risks studied for the specific case of the Royal Guard Barracks, between the business-as-usual (BAU) baseline, which indicates the current situation at the Barracks, and the implementation of the best proposals, Rainwater Harvesting + Greywater Recycling (RWH+GWR), where a risk reduction can be observed (increase in the response capacity) in such aspects as supplying, recycling and reusing water or the resilience of the facilities to an increase in the number of users.

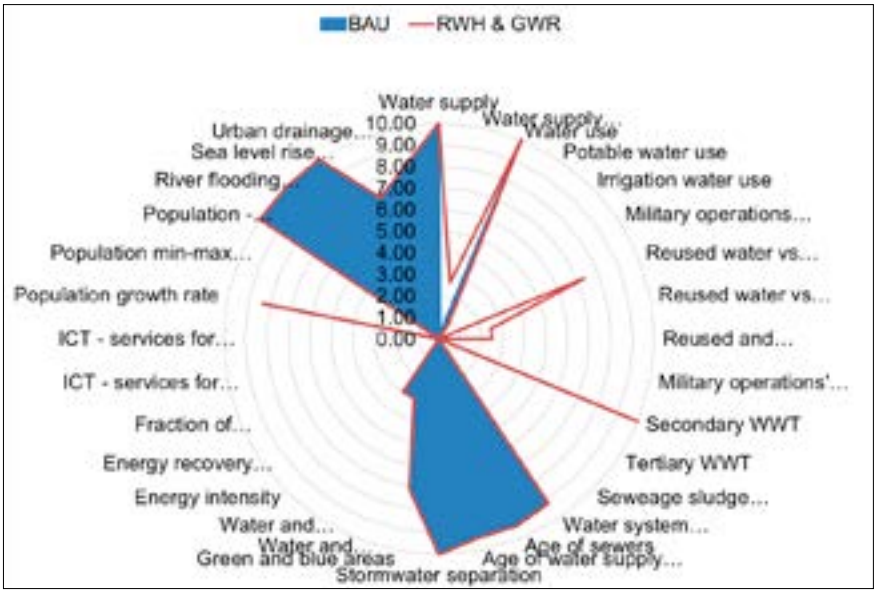

Figure 2- Comparative analysis of risks after implementing improvements to the water supply and treatment facilities at the Royal Guard Barracks. (Source: Associate Professor Dr. Christos Makropoulos, Dr. Ifigeneia Koutiva, PhD Panagiotis Kossieris, Dr. Evangelos Rozos. SMART BLUE WATER CAMPS Final Report, October 2017).

Phase II of this project will concentrate on the computerized modelling of the activities proposed as a result of Phase I and

a detailed analysis of the water cycle and the impact of the proposed activities.

Phase III will implement and monitor the results obtained from the activities proposed at Phase I and modelled at Phase II of the Project.

The forthcoming meetings of the EnE WG will serve to define the scope of these two phases in detail and to assess their cost, which should be financed from contribution made by the Member States that decide to participate in them.

Participation at Phases II and III of the Project will constitute an opportunity to obtain a greater in-depth working knowledge of the comprehensive management of the water cycle, and to research into other possible actions to take that could be implemented as a pilot project at the Royal Guard Barracks and at other facilities belonging to our Armed Forces.

Smart Energy Camp Technical Demonstrator Project (SECTD)

The first phase of this project consisted on the installation of generation and energy management equipment at the EU Training Mission (EUTM) in Koulikoro (Mali).

Figure 3- Information concerning the EU Training Mission (EUTM) in Koulikoro (Mali).
(Source: EUTM Mali Mission website, http://eutmmali.eu/en/eutm-mali-mission/).

The purpose was to analyse the benefits obtained from incorporating new energy generation, use and management technologies into the traditional distribution networks at military camps. The equipment installed included fixed and portable photovoltaic panels, and control and monitoring equipment for managing the demand of electricity and water consumption, all the equipment being installed in one single camp building.

The specific objectives of this project were:

- To check the efficiency of different types of photovoltaic panels in the specific climate conditions in the zone.
- To experiment with the integration of renewable electrical generation and battery storage technologies in an operational deployment mission scenario.
- To experiment and assess the impact of technologies on the demand management.
- To make the troops aware of energy efficiency and the use of renewables, and to make them regard energy as a military operational capacity.
- To obtain real and reliable data in order to develop planning models for common defence and security models in an EU context.

As part of this first phase, which was completed on 2016, data was obtained about water and electricity use and consumption and about waste production, which revealed both the problems and opportunities involved in integrating the new energy efficiency technologies and sources of renewable energies in deployment operations. Some of the data include the characterisation and measurement of electricity consumption at the camp (71% for air-conditioning, 12% for lighting, and 10% for sanitary hot water), the measurement of the contribution of rigid solar panels (on the ceiling) of 80% of the building's peak load, or the reduction of energy consumption by adopting demand management measures, which included reducing the average instantaneous load through ON/OFF cycles in each air-conditioning unit, or regulating (increasing) the temperature from 20 ºC to 24 ºC in the air-conditioning units themselves, which reduced energy demand by 50%.

The first phase of the project also served to obtain valuable conclusions and to make recommendations, which included the decision to extend the activities and apply them to the rest of the camp, to incorporate other energy management and production technologies and to analyse their benefits and impact, and to increase the energy generation capacity instead of increasing the battery storage capacity, which would have been a less efficient option in terms of electricity supply availability and cost.

Phase II (SECTD-II) of this project is likewise split into two phases (in progress):

Figure 4- Aerial view of the Koulikoro Camp; Building 55 at the Koulikoro Camp; Forces deployed at the Koulikoro Camp installing flexible photovoltaic panels.
(Source: Presentation "Smart Energy Camp Demonstrator EnE Working Group", by Jon Woodman/ Ken Hobbs for the 5th EnE WG Meeting, Bae Systems, March 2016).

– Phase II-1, Feasibility Study (6 months), in order to conduct a feasibility study to implement and monitor a technical demonstrator that integrates different technologies in an optimum and intelligent way to efficiently generate and consume energy, as well as to manage water consumption and waste in a more sustainable way, invariably complying with the camp operating procedures, and finding out which commercial off-the-shelf solutions (COTS) are either suitable or can be adapted for utilisation in a military deployment environment.

This Feasibility Study, which was delayed several times owing to the serious security problems in Mali, was completed in 2019. While the authors are writing this article, we are waiting to receive the Final Report, which will define the scope, cost and financing instruments for Phase II-2 of the Project.

– Phase II-2, Implementation (12 months), it is subject to a positive assessment of the Feasibility Study and the approval by the Member States that are willing to participate in it, and its aim will be to carry out the activities established during the previous phase, and to monitor the findings obtained from the resulting technical demonstrator, with a view to demonstrating its actual ability to achieve the established consumption

reduction and energy efficiency targets and to improve the management of consumption, water cycle and waste.

This Phase II of the Project (SECTD-II) promises to yield very interesting data and conclusions that will be of great value to both the Ministry of Defence and the Armed Forces in their deployment missions, when it comes to reducing their energy consumption and increasing their resilience and operability. The data and conclusions could also be of use to Spanish industry where visibility and benefits are concerned.

Data Collection and Analysis and Sharing Project (DCAS)

The EDA and the Ministries of Defence of the Member States are using this project to help them compile energy consumption data for the defence sector on a European scale, including the utilisation of energy for air-conditioning in buildings and facilities and for transport (land, sea and air). The energy types include not only and mainly electricity but also any other fuels, whether they are fossil fuel, biofuels or synthetic fuels, as well as the generation of electricity itself at renewable energy facilities. As the information is of a sensitive nature, it will subsequently be studied and analysed in an aggregate form.

The specific aims of this initiative are as follows:

- To find out the type and quantity of energy consumed and generated by the defence sector in the Member States.
- To motivate the defence sector to establish standard operating procedures (SOP) for registering and analysing energy consumption data.
- To establish standard energy performance indicators (EnPIs) common to all the defence sectors in the different Member States.
- To help the Ministries of Defence and the EDA to make decisions about investments in infrastructures and research and technology projects (R&T).
- To justify the recommendations given by the defence sector to the European Commission concerning the review of European Directives and the allocation of European funds.

So far, 22 Member States are providing their energy consumption data for this initiative, this accounting for 97.5% of the expenditure

and 90.1% of the defence personnel in the EU, which means that this information can be considered sufficiently representative.

The Member States' aggregate energy consumption information is reported to the European Commission, in order to draw up an energy consumption register for the defence sector and to prepare strategies that can be adapted to the sector's peculiarities, all with a view to contributing to the national and European targets: greenhouse gas reduction, energy consumption decrease, energy efficiency increases, and an increase in the use of renewable energy sources.

Since its inception in 2016, the Spanish Ministry of Defence's DIGENIN has been playing an active role in this initiative.

The first findings from the analysis of the consolidated data since then, indicate approximate energy consumption shares of 35% in buildings, 15% electricity consumption on activities associated with military operations and 50% on transport (of which 60% is accounted for by aviation).

When the data for 2016 and 2017 are compared, it can be seen that there is a slight reduction in energy consumption (including electricity and fossil fuels), which falls from 42.48 TWh to 40.58 TWh, revealing that not only have renewable energies made little impression on defence, but also that defence is heavily dependent on natural gas imports.

Defence Energy Managers Course Project (DEMS)

This EDA´s initiative appeared in 2016, with a view to training those responsible for energy management at the Ministries of Defence and Ministries of the Armed Forces interested in the principles of energy management systems (EMS) and in their implementation, focusing mainly on ISO 50001. They are semi-*in-person* training courses, the theoretical aspects being taught *in-person* in Brussels (for one week), and, most important, tutoring and lending support afterwards in implementing the energy management system, to take place in whatever facilities each ministry decides upon.

Total Energy and Environment Military Capability Assessment Framework Project (TEEMCAF)

This study focuses on developing a smart tool that, making use of artificial intelligence and utilising strategic, operational and

tactical data of all kinds, is able to analyse, prioritise and provide innovative technological design and management solutions for generation, consumption and energy efficiency, for the water cycle and waste cycle, as well as behavioural aspects that will help in decision making aimed at optimising military operations and reducing their environmental impact.

Overall Strategy Research Agenda (OSRA) and Capability Development Plan (CDP)

As has been explained in the document presenting this EDA´s initiative[18], the Overall Strategy Research Agenda (OSRA) is a new approach to align the strategic research agendas developed by each one of the EDA's technological capacity areas (CapTech) with the Member States' operational requirements and needs.

All in all, that strategic agenda establishes a systematic procedure for promoting collaborative research in the defence sector at a European level, which has already been set in motion through the Preparatory Action on Defence Research (PADR) and which will go on by creating a European Defence Fund, as part of the EC-Council's Defence Research Programme (EDRP) within the framework of and as the main pillar of the European Defence Action Plan (EDAP).

The OSRA serves as the link between developing defence skills, on the basis of the needs and requirements indicated by the Member States in the Capability Development Plan (CDP), and the research and development of technologies in different domains within the sector, through the concept of "Technology Building Blocks (TBBs)".

These "blocks" or "bricks" known as TBBs, are equivalent to the technological development levels attained from the results of research, development and technology projects that, jointly between several TBBs, permit the "construction" or "development" of a functionality or solution that responds to an existing required military skill or one that is planned for the future and represented via the "General Military Tasks (GMTs)" established in the aforementioned CPD.

By way of a simple example to enable the reader to get a better idea of this relationship, we could imagine that the Joint Chiefs of

[18] OSRA- Overarching Strategic Research Agenda and CapTech SRAs Harmonisation. Connecting R&T and Capability Development Plan, EDA

Staff of the Armed Forces have pinpointed the need to be able to pilot surveillance drones manufactured from totally degradable materials, and that these must be driven by hybrid systems using clean fuels and batteries that are also degradable, for use in the Arctic on a scientific mission, but that to produce these drones we would need to rely on secure and developed technologies (TBBs) such as completely degradable materials for the chassis of the drone that are compatible with the operational requirements of the vehicle, turbines and hydrogen storage tanks, or batteries made of biodegradable material meeting the same operating requirements. All these technologies would have been developed from studies and research & technological development projects.

There are different Technological Capacity Areas (CapTech) within the EDA, which bring together experts from the ministries of defence, the armed forces, the industry and the scholars of the Member States, and that have an area of responsibility or domain that defines the scope of their work and their strategic lines of research and development for technologies in such fields as munitions, CBRN and human factors, land, navigation and control systems, radio frequency sensors, materials, or energy, shown in their own Strategic Research Agendas (SRA), together with their respective roadmaps, in order to make sure that these technologies are developed when required by our armies.

All these strategic agendas, sets of TBBs and roadmaps for the different CapTech are integrated into the Overall Strategic Research Agenda (OSRA), dispensing with duplications, and analysing cross-cutting and the synergies between TBBs defined in different military areas.

The following TBBs have been defined in the energy and environment area for development between 2020 and 2027:

- TBB-01: Alternative fuels and propulsion and distribution systems.
- TBB-02: Energy storage: electric, electrochemical, mechanical, structural and thermal.
- TBB-03: Efficient technologies for motors and energy distribution systems.
- TBB-04: Energy management technologies: efficient and innovative systems.
- TBB-05: Solar generation (thermal and electric).

- TBB-06: Militarisation of environmental technologies: water and wastewater management.
- TBB-07: Heat recovery technologies.
- TBB-08: Wind energy.
- TBB-09: Integration of energy and environmental technologies.
- TBB-10: Militarisation of environmental technologies: energy assessment technologies.

Consultation Forum on Energy Sustainability in the Security and Defence Sector

The authors consider this Consultation Forum to be the platform that is most actively working and contributing to the progress being made by the defence sector towards more sustainable energy models, in the area of fixed military infrastructures, normally of a dual character (civil and military), such as office buildings, academies, hospitals, or canteens; leaving the study and the initiatives concerning strictly military operational aspects and deployment missions to the Energy and Environment Group, also belonging to EDA and NATO.

Objectives, structure and dynamics of the Consultation Forum.

The European Commission intends to use this Consultation Forum for Sustainable Energy in the Defence and Security Sector (CF SEDSS), to highlight the importance of the defence sector in Europe because of its major energy consumption, and how this sector must be taken into account when it comes to achieving the national and EU greenhouse gas reduction, energy saving and energy efficiency targets, as well as the use of renewable energy sources and biofuels for 2020, 2030 and 2050.

The main purpose of this Consultation Forum is to bring together and establish a community of energy experts in the defence sector, and to support the European defence sector in its progress towards obtaining greater expertise in energy efficiency and renewable energy projects in the defence area and in implementing projects in those fields. The Consultation Forum acts as a platform for sharing successful cases and good codes of practice and for discussing and identifying the difficulties faced by the Armed Forces in implementing (including the exemptions) the Energy Efficiency Directive (EED), the Energy Performance of Buildings

Directive (EPBD) and the Renewable Energies Directive (RED), while at the same time improving the resilience of the critical energy infrastructures for defence regarding the implementation of the Directive on protecting European Critical Infrastructures, identifying the obstructions and barriers that prevent the defence sector from fully benefiting from sustainable energy.

The Consultation Forum is trying to achieve this without imposing any activities or regulations whatsoever on the defence sector and is also aiming to examine the potential for establishing and developing specific energy plans and projects in the defence sector, that will enable it to reduce its energy and carbon footprint and its cost, as well as identifying the financing sources available within the EU and other suitable financing mechanisms

This Consultation Forum's structure has been evolving since it was formed in 2016, revolving round Working Groups that focus on the following specific lines of activity, always in fixed military facilities that are dual purpose (civil-military) in nature:

- Management and energy efficiency in military installations:
  - Compiling energy data, analysis.
  - Energy management system.
  - Energy awareness, human factors.
  - Financing energy projects in the military field.
  - Protecting energy infrastructure.
  - Structure of buildings.
  - Electrical and mechanical systems in the construction sector.
  - Information & Communication Technologies (ICT), measurements and smart energy management in buildings.
  - Renovating and refurbishing existing military buildings.
  - Zero energy consumption buildings.
- Renewable energies:
  - Use of renewable energies for military transport.
  - Renewable energy storage.
  - Energy conversion.
  - Utilisation of military zones for renewable energy generation.
  - Renewable energy in military deployments.

The Spanish Ministry of Defence's DIGENIN has been playing an active role in these Working Groups, and co-moderates the Working Group associated with energy efficiency in buildings.

Achievements

As a consequence of the work carried out jointly by all of the Consultation Forum participants during the first two stages, the first from October 2015 until October 2017 and the second from October 2017 until August 2019, a greater in-depth working knowledge has been obtained about the applicable legislation and, what is much more important still, about the particularities of the defence sector when compared to the civil sector, which one way or another makes the current legislation not directly applicable, or, at least, means that it has to be adapted on some scenarios before it can be implemented and complied with.

Moreover, thanks to the effort made by those involved in the forum, the holding of successive conferences and the presentation and exchanging of experiences and good practices, it has been possible to successfully create for the first time, a group of energy experts within the defence sector and a platform and communication tools that enable those experts to communicate with each other and exchange knowledge.

Finally, the consultation forum has served as a think tank for innovative and collaborative projects in the defence sector. Three such projects have received the backing required from the Member States, enabling them to be developed through specific working groups, and they are now at the competition phase for obtaining European financing, an extraordinary achievement that would have seemed highly unlikely just a few years ago.

In October 2019, based upon all the aforementioned facts and the successful results from the first two phases and in order to tackle the new challenges in the energy field, the European Commission launched the third phase of the Consultation Forum. It will last a period of four years -until 2023- and it adds a new aim, such is to connect the defence and energy communities on both a domestic and a European level.

Findings, lessons learnt and good practices.

As a result of the discussions between all the participants and the experiences they shared during the CF SEDSS, a series of

difficulties and limitations were identified that are common to all the Member States in the defence area; these difficulties and limitations prevent them not only from correctly, completely and efficiently implementing the European Directives relevant to energy efficiency and promotion of renewable energies, but also from effectively contributing to enabling the defence sector to achieve its potential where energy saving and carbon emission reduction are concerned.

The main difficulties and obstructions that have to be overcome have been identified and appear structured in the Final Document containing the conclusions and recommendations from Phase II of the CF SDESS[19], in the following way:

- Human factors:
  - Lack of commitment, awareness, motivation, communication and training in the defence sector in general, and also at all levels of the hierarchical scale of the organisation in particular; this is particularly critical at the decision-making level and its function.
- Economic and budgetary factors:
  - Budget limitations, or even a lack of budgetary lines for implementing the energy efficiency improvement measures; normally, such measures are adopted as scheduled maintenance activities and periodical replacement of equipment in buildings, being financed through the respective budgetary lines and carried out by different personnel belonging to areas and departments other than that related with the energy efficiency, their objectives and priorities being also different from those aiming to improve the energy efficiency.
  - Restrictions on access to external financial mechanisms, not only due to the nature of the activities and the general purpose of the sector, not contemplated in many of the European financing programmes, but also owing to legal incompatibilities within the public administration of each Member State.

[19] European Defence Agency, "GUIDANCE DOCUMENT CF SEDSS II Results and Recommendations for Sustainable Energy in the Defence and Security Sector", Brussels, July 2019, https://www.eda.europa.eu/docs/default-source/events/eden/phase-ii/guidance-document/cfsedssii-guidance-document.pdf.

- Limited knowledge not only about the existence of the different external financing mechanisms available, but also of the procedures and requirements established in this respect.
- Payback periods are normally too long to make it possible to achieve the economic benefits from the investments required.

– Organisational and cultural factors:

- Lack of commitment and genuine awareness within the organisation. A cultural change in the organisation is needed, and this applies to all the hierarchical levels and the different professional and personal profiles, each one under a different motivation.
- Energy is considered to be a basic product, or "commodity", which is consumed just like any other basic product in order to carry out an activity or operation, and not as a capacity enhancer whose efficient and effective use permits an increase in autonomy and makes it possible to reduce vulnerabilities and risks where these same activities or operations are concerned.
- There is no clear vision or understanding of the connection between energy efficiency improvement and improving the capacities and effectiveness of the operations.
- Energy efficiency is not considered to be a priority, or at least, its priority level is lower than the priority given to other activities and functions, neglecting the fact that an improvement in the former can lead to the latter being more effective.
- Lack of capacity: a lack of human resources, knowledge and experience.
- Lack of elements and motivation for implementing energy efficiency and energy saving improvement measures, as a result of a disconnection between the budgetary lines and the plans for energy supply, improvement of energy efficiency, maintenance of facilities and awareness campaigns.
- Lack of motivation for implementing energy efficiency improvement measures, as a consequence of the disconnection between the organisations' operating and budgeting functions.

- There is no one single person responsible, with seniority and experience, appointed by the organisation to perform the task of energy manager: the energy manager function is normally regarded as a general responsibility shared by the entire organisation and distributed among several departments and functions, each one of which with its limitations and objectives, with nobody taking the initiative.
- Lack of communication between areas and units within the same organization, preventing good codes of practice from spreading.
- Military personnel are frequently posted to other locations or reassigned.
- There is no long-term incentive system in the organisation that gives recognition and reward for effective decision-making leading to energy saving and cutting down on cost.
- There are policies and strategies with general high-level objectives in the organisation, which do not develop into specific targets and actions to be implemented in each unit or area.
- Uncertainty regarding the long-term planning relevant to the future use and occupation of buildings and facilities, due to the reorganisation of functions and areas in the ministries of defence and armed forces.

– Contextual factors:

- The energy sector is too extensive; there are a large number of concepts, standards, legislative frameworks and regulations that can lead to confusion and make it difficult for the organisation to define a specific approach to energy efficiency and a philosophy for improving it and adapting it to its own particularities.
- There is a constant and intense debate, as yet unfinished, about the scope of the energy management system (EnMS) and/or environmental management system (EMS) such as ISO 50001, ISO 14001 or the Eco-Management and Audit Scheme (EMAS), and whether or not military operation activities ought to be included and the impact that such inclusion would have on operational capabilities.

– Legislative and regulatory factors:

  - The objectives of improving energy efficiency, promoting the use of renewable energies and alternative fuels and reducing carbon emissions are established and undertaken on a national level between each Member State and the EU following the principal of subsidiarity and proportionality that governs European Law. It is then up to each Member State to decide how to achieve those objectives through the different contributions made by the various sectors in those countries. The defence sector of each Member State is generally exempt by its Central Government from complying with those objectives, apart from the exemptions shown in the European Directives concerned, so there is no legal obligation to comply with those objectives apart from the minimum energy efficiency requirements imposed by the respective technical building codes or for supplying efficient equipment under the public sector contracting legislation.
  - Furthermore, in some cases, the applicability of the exemptions shown in the European Directives for the defence sector is open to interpretation, requiring further legal and judiciary work to interpret the provisions contained in those directives, with the resulting delay in the commitment to investments and the subsequent performance of the energy efficiency improvement projects.
  - There are legal difficulties that prevent money saved from improving energy efficiency being used for other purposes under other budget allocations.
  - The accounting regulations and procedures impose great difficulties on the public sector in general, and the defence sector in particular, when it comes to signing energy performance contracts (EPC) with energy service companies (ESCOs), because they establish very demanding requirements for initial capital investments for accounting purposes. There are also many problems involved in the way these contracts are drawn up and an unawareness of how to prepare them properly; these difficulties range from defining the energy performance indicators needed to correctly monitor the saving made by the energy service company, to aspects and implications concerning the ownership and maintenance of the equipment.

– Technical and management factors:
  - Building inventories are usually very outdated and do not contain information that is suitable for correctly prioritising and planning energy efficiency improvement activities.
  - Creating and updating defence building inventories is very complicated, because there are a large number of buildings (normally hundreds), some of which are listed for their historical heritage and are often dual purpose (civil and military), even their purpose being in other cases unknown, as they have been put to different uses in the past.
  - There are no specific energy consumption benchmarks for defence, and such benchmarks are very important when analysing a building's energy efficiency performance and prioritising activities aimed at improving it.
  - Reading energy consumption data is very limited, and is generally done using conventional meters that give the basic measurement. Such meters are unable to break down for analysis the overall energy consumption data per building in the base or by building types, or even by the type of facility in each building by means of smart meters.
  - There are no plans for the regular reading and monitoring of energy consumption at a suitable level, owing to a lack of human resources and/or material resources, and the outsourcing of the maintenance services.
  - Simplistic definitions or a lack of energy performance indicators (EnPIs), the target being normally limited to reducing the kWh/soldier, without taking into account factors such as the utilisation and occupation of the buildings, or meteorology.
  - The analysis of energy consumption and the estimation and planning for future energy needs are generally simplistic or inadequate.
  - A lack of strategies and refurbishment plans for buildings in stages in the long term. Most of the activities are carried out when a budget is available, and then all at the same time until the budget runs out.

Nevertheless, despite all these difficulties and problems arisen of different kinds, the European defence sector is undoubtedly advancing towards a greener and more environmentally-friendly

operating framework, and is immersed in its own ecological transition towards more sustainable and efficient energy models. Proof of this are all the initiatives in which this sector is involved not only within the framework of the EDA and NATO, but also within a national context in collaboration with the industry and national research centres (such as those described later on in this article), and even at a local level as a unit or military base, where there are many minor projects being undertaken and where progress is being made thanks to the initiative and personal effort of many members of the Armed Forces.

By way of example and for reference purposes only, a description is given below of good practices in three different Member States. These examples were presented during the CF SEDSS and their beneficial impact has been given the recognition it deserves.

Major refurbishment of the building at the headquarters of ISDEFE, an Agency of the Spanish Ministry of Defence.

In 2010, ISDEFE, the Spanish Ministry of Defence´s Agency purchased a building to house what has now become its headquarters and corporate offices, in Calle Beatriz de Bobadilla, Madrid. After a period of sharp growth, all its employees now work in the same building, whereas before they were working in different offices in different buildings in Madrid.

This completely obsolete building was transformed into a smart building with a high energy performance that can be easily and rapidly adapted to a variable number of users and uses, after activities were carried out on the outer envelope and on the components and materials inside the building, and after high energy-efficiency systems and technical equipment were installed, including photovoltaic solar and thermal energy production solutions and co-generation solutions.

The refurbishment project was undertaken in compliance with the construction and environmental legislation currently in force in Spain and with the energy efficiency and thermal installations requirements stipulated in the Spanish Technical Building Code (CTE) and the Rules for Thermal Installations in Buildings (RITE), this being done in order to achieve the highest possible energy rating (A or B) and also to enable it to produce as much of its own energy for self-consumption, while also complying with the strictest security measures in the defence sector, including the following:

- Dividing zones on the basis of security levels and safe access.

– Security at the control points for documentation:
  • Control points: NATO / EU / ESA.
  • Classified documentation: NATIONAL / NATO / EU / ESA.
  • TEMPEST Room (zone protected against unintentional electromagnetic emissions, produced by electronic emissions and ITC systems).
– Security systems in the building.

The layout requirements for the various spaces in the building were similar to those required for buildings of the same type in the defence sector, such as the Ministry of Defence building, or buildings in the Headquarters and Logistical Command of the three armed forces.

All technical systems in the building are monitored and controlled in real time by a centralised Supervisory Control and Data Acquisition System (SCADA) that keeps the entire building at the required comfort levels with the most efficient energy consumption, bringing about major energy and cost saving, with updated recoupment periods of 3.92 years for the lighting system (LUXMATE lighting control system and DALI electronic ballasts), or 11 years for the VRV (Variant Refrigerant Volume) water condensed system (which is expected to be shortened by making further cost savings before the 11-year period is completed).

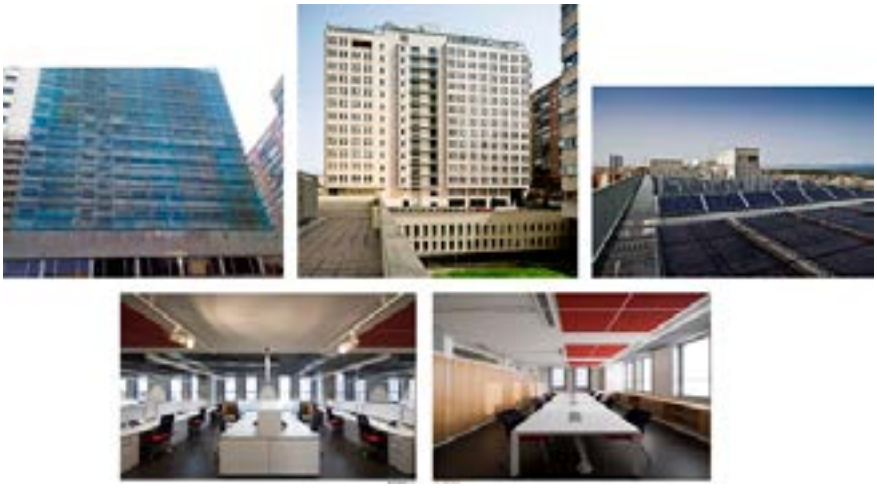

Figure 5- Major refurbishment of the ISDEFE S.A building. (Source: Presentation "ISDEFE Headquarters. From obsolete to efficient and smart building. A Defence example", CF SEDSS Phase 1, ISDEFE, Spanish Ministry of Defence, Thessalonica 2017).

Energy efficiency maximisation project through behaviour changes. UK Ministry of Defence.

The behaviour of the users of a building includes not only their habits and their way and ability to act and react to different occurrences and stimulations, it also depends on their knowledge of and awareness about the problem concerned, and this is influenced by the standards underlying the organisation's culture.

Different publications and studies estimate that a potential energy saving of between 5% and 20% can be achieved by changes in behavioural patterns.

The UK Ministry of Defence launched this study and action programme regarding the behaviour of its staff where energy efficiency was concerned; it being conducted by its agency, the Defence Science and Technology Laboratory (DSTL), focusing on the simplification of the wide variety of behaviour change models and methodologies with a view to finding a suitable and effective approach for the defence sector.

The proposed approach is based upon what the UK Ministry of Defence has called model "COM-B" (Behaviour based on Capabilities, Motivation and Opportunity), and the application of a systematic methodology for identifying, firstly, the different behavioural profiles and motivations that prompt each one of these profiles, as well as the suitable changes in their environment to obtain the desired behaviour change,, and secondly, the types of interventions that are considered to be more effective (FISH approach).

Figure 6- COM-B Model and FISH Methodology, DSTL. (Source: Presentation "Maximising MOD's Energy Efficiency Behaviours (MMEEB)", CF SEDSS Phase 1, DSTL, UK Ministry of Defence, Rome 2016).

Energy consumption database using smart meters, Austrian Ministry of Defence.

In 2018, the Austrian Ministry of Defence launched a programme to replace its thousands of conventional electricity, water & hot water and natural gas meters with smart meters at 30% of its military bases, and made plans to expand this programme to the rest of the bases at a rate of 5% per year until the replacement programme had been implemented in 75% of its facilities in 10 years. Reading conventional meters, which is done manually, amounts to a major effort in terms of man hours and yields a high error rate, whereas reading smart meters is an automatic process where the information is encrypted and sent via an Ethernet connection to a new centralised software system, for data management and analysis.

This data management and analysis system enables the user to read and store the energy consumption data, to show the energy consumption information and the cost of all types of energy per unit, building, department, etc., to obtain energy consumption reference values, and to compare consumption between buildings of a similar construction, among other matters. It also serves as an interface with other databases and, what is of paramount importance: it makes energy consumption much more transparent among the users.

This initiative enabled the Austrian Ministry of Defence to find out the ideal frequency and level for reading, monitoring and analysing the energy consumption data so that they could identify and act on the equipment and facilities where there are energy consumption deficiencies, thereby saving energy and cutting down on its cost.

According to the results so far, the Austrian Armed Forces have obtained annual savings of 3% on the cost of energy, and an investment return period of between 5 and 7 years for their system.

The CF SEDSS as a think tank for future collaboration projects

The CF SEDSS is not only acting as a meeting point between communities in the defence sector and the energy sector, and as a platform for debating and exchanging knowledge and good practices regarding the defence particularities where energy sustainability is concerned, it is also serving as a think tank for many ideas concerning initiatives and collaboration projects in the field of energy sustainability in the EU defence sector.

A total of 28 ideas for developing collaboration projects and studies in the energy field where identified at the first two phases of the CF SEDSS, all of them being backed by different Member States. This was really surprising if we take into account the fact that this energy community in the defence sector did not exist until the establishment of the CF SEDSS in 2016. Another fact that is just as important and relevant, thanks to the methodology and the *identifunding* tool developed by the EDA, is that it has been possible to identify various European financing mechanisms that are suitable for each of these ideas promoted by the defence sector, something that would have been unthinkable only a few years ago.

The objective and scope of these ideas include developing tools for the correct analysis and energy management of defence buildings, replacing lighting systems with LED technology at military camps through ESCOs, the correct standardisation of energy consumption and the establishment of Energy Performance Indicators (EnPIs), the development of capabilities in defence to carry out energy audits, measurements and verification, or writing performance contracts, devising awareness campaigns, refurbishing buildings to nearly zero energy consumption standards, passive air-conditioning systems, energy recovery systems, tools for selecting the optimum energy storage technologies, or the deployment of a hydrogen production and supply infrastructure so that hydrogen can be utilised as a fuel and as an energy vector.

NATO context in relation to energy efficiency and climate change

In line with what has been expressed above, and as is the case with the rest of the supranational and multilateral agencies, there are many sustainable initiatives, projects and technological solutions within the North Atlantic Treaty Organization (the Alliance), that are promoted by each one of the Allies on a domestic level; these all have to be linked and coordinated within the Alliance through the exchange of knowledge and good practices.

As a political and military organisation, NATO does not intend to become a platform for environmental policy, it would much rather concentrate its efforts on activities that add operational value and provide clear benefits to the military missions through pooling multinational approaches between the Allies.

Concept of Smart Energy

The Alliance views energy as an "enabler" or "multiplier" of military operational capabilities, essential for implementing and controlling the operations involved in each military mission. Moreover, energy efficiency is one of the key for guaranteeing operational resilience and reducing the logistical and budgetary impact on NATO of maintaining deployment missions.

Although the term "Smart Energy" is not formally defined by NATO, from a practical viewpoint the meaning and definition used in the Alliance refers to Smart Energy as the "capacity resulting from the planning, management and optimised use of technologies for the generation, distribution and consumption of energy to improve the resilience, range and mobility of the Allied Forces"[20].

In 2011, the Emerging Securities Challenges Division (ESCD) of NATO´s World Headquarters introduced the concept of energy efficiency in the military sector as "Smart Energy". At the Chicago Summit in May 2012, the Heads of State and Prime Ministers of Allied Governments declared their consensus regarding the smart energy concept, agreeing "to work towards considerably improving energy efficiency in our military forces", a consensus that was reiterated during the Wales Summit Declaration in September 2014. These declarations gave NATO the mandate to deal with the energy efficiency problems in the defence sector, for which it defended a multinational approach.

The Wales Summit Declaration also adopted the "Green Defence Framework", which includes energy efficiency and environmental protection with the overall aim of improving the effectiveness and efficiency of NATO's missions.

Via its ESCD, NATO's work after the Chicago Summit Declaration concentrated mainly on technologies for land operations and military camps, which led to an examination and review of strategies, policies, scorecards, procedures and human behaviour, in order to contribute to integrating smart energy into the NATO Defence Planning Process in the medium- and long-term.

The barriers and impediments that hinder the Allied armies' progress in improving energy efficiency and sustainability in

[20] Michaelis, Susanne, Smart Energy Officer, NATO HQ " Capable Logistician CL19 – NATO SMART ENERGY UNIT", 28 May 2019, http://www.natolibguides.info/ld.php?content_id=32333295

military operations identified by NATO during these years, are similar to those identified in the CF SEDSS for non-operational fixed military facilities of dual purpose:

- The fact that there are many national strategies, policies and standards for the smart use of operational energy between the Allies, but in an isolated manner. Furthermore, there is a lack of cooperative effort and integration between the defence, industry and research sector, and a lack of communication and collaboration between the operational and scientific communities.
- In general, there are no energy efficiency requirements when military material is purchased, and neither is there a standard terminology or a suitable level of expertise and awareness about energy efficiency.
- The interoperability between armies was, and often still is, deficient.
- Lack of a framework or strategy for smart energy and of a manager who can act as the contact point or focal point for all the matters concerning smart energy.

On the basis of these conclusions, NATO´s Heads of State and Government agreed that their military forces should be more efficient in the use of energy. To achieve this, it was recommended that a smart energy strategy should be developed and implemented based on four courses of action: 1) training, 2) standards and doctrine, 3) research and technology, and 4) goals and objectives, as well as appointing national citizens responsible for implementing that strategy and establishing a Working Group or Functional Area within NATO's structure dedicated to smart energy.

To overcome these difficulties and obstructions, NATO devised and launched several initiatives aimed at improving energy sustainability and the efficient use of resources in general, in the operational areas, such as:

1. A package of proposals for specific projects in the area of "Green Defence" and the Science for Peace and Security Programme (SPS), to progress with smart energy solutions, improve standardisation and interoperability, including:
    - "Smart Energy Training and Assessment Camp (SETAC)": with a view to setting up a military test camp where the following can be carried out: troops can be trained, tests can be conducted on new technologies, tools can be tested

for generation, saving, storage, water and waste, the impact of new operating procedures can be analysed, and troops can be made aware of the importance of energy efficiency; all of this will be done to significantly reduce dependence on fossil fuels.

The facilities at that camp can be divided into "Multinational Integrated Logistic Units" (MILU) (waste treatment unit, wastewater treatment unit, energy generation unit, force protection unit, etc.), and every unit can be utilised by companies or manufacturers to test their products while they provide the camp with their services, all the information being monitored and controlled from a control centre.

The SETAC concept for NATO's Smart Defence programme was launched in April 2017, with the idea of bringing together the defence sector, companies and knowledge & research centres, to make information exchange easier and to encourage the Allies to agree upon common standards for smart energy capabilities and to improve interoperability.

- Technology conferences and fairs focusing on Innovative Energy Solutions for Military Applications – IESMA)[21]: IESMA is a biannual event organised by NATO's Energy Security Centre of Excellence, sometimes in collaboration with centres of excellence in Allied countries. It brings together experts from military, industrial and academic sectors and its aims are to facilitate the exchange of knowledge, good practices and lessons learnt, and to demonstrate smart energy technologies for the progress of energy efficiency in the army. Another aim of IESMA is to speed up the transfer of innovative energy technology from the civil sector to the military sector, to apply standard technologies in situ and to adapt the most innovative technologies for practical use in the army, making an effort to improve the armed forces' operational capacity and increase their range and resilience in environments where security is jeopardised and there are logistical limitations.
- Proposals for projects concerning technologies for energy storage in batteries, as part of the SPS programme.

[21] https://www.iesma.info/, consulted 1 December 2019.

2. Exhaustive studies regarding the Allies' energy requirements for military activities, focusing on comparing the efficiency of different national approaches to reducing energy consumption.
3. Reviewing the Allies' and NATO's methodologies, operating procedures, regulations and energy policies, in order to progress with the smart energy concept.
4. Incorporating a smart energy component into the "Capable Logistician" exercises, consisting of demonstrating how the smart energy solutions provided by the Allies work and integrating them.
5. Highlighting the Allies' efforts in progressing in the field of smart energy, by including this as part of NATO's activities and informing about it in NATO publications.

Green Defence Framework

In its document "*Green Defence Framework*"[22] issued in February 2014, the NATO Council defines the "Green Defence" concept as "a transversal multi-sided effort covering a wide range of activities, including operating efficiency, environmental protection and sustainable development". A "Green Defence" covers many areas, which include the defence operations, logistics, engineering and planning, and also takes in a great number of stakeholders: civil and military, allies and partners, international organisations and the private sector.

The efforts and initiatives of the Green Defence Framework revolve around three axes: the first of these revolves around NATO itself and its bodies, the second, in support of the Allies, and the third one revolves around international collaboration with other international agencies, bodies and industry.

NATO, as an organization, hopes to improve efficiency where both energy and the use of resources are concerned, and intends to apply environmental sustainability to all its activities, without this having an adverse effect on its operating effectiveness. With a view to achieving this, there are various committees, working groups and NATO bodies all working on different aspects of the "Green Defence", such

[22] North Atlantic Council, Green Defence Framework, February 2014, http://www.natolibguides.info/ld.php?content_id=25285072, consulted 1 December 2019.

as the Working Group on Energy Security. NATO also keeps regular contact with other defence organisations, such as the European Defence Agency (EDA), to identify and prevent overlapping, as well as to make the most of the synergies that could arise from the joint work.

In this sense, NATO applies "green" principles and regulations to its Headquarters, to its command structures and to its agencies, establishing "green" accounting and consumption baselines to enable progress to be measured. Furthermore, these principles and practices for improving energy efficiency and environmental sustainability are also taken into consideration through its Centres of Excellence, and introduced in its training, drill and exercise programmes. Finally, NATO's Science & Technology Organisation (STO) devotes part of its research efforts to laying down the foundations for a more environmentally-friendly military future for the Agency through several research groups, some of which are described below.

Where support for NATO in the efforts of its Allies is concerned, the Agency serves as a platform for supporting and promoting cooperation between the Allies, through which the nations can share their expertise, good codes of practice and green technologies, all with a view to contributing to the efforts of the Allies in improving Green Defence not only on a national scale, but also in deployment operations.

The various initiatives on a national and international level that have been launched in recent years to examine the development of technological solutions and the adoption of new approaches and policies that contribute to cutting down on energy consumption in military operations, are of vital importance for preventing the loss of human lives when transporting fuel and for reducing vulnerabilities from affecting military camps and arms systems, which become exposed while refuelling operations are being carried out. The serious risk to which troops are exposed by fuel supply in deployment missions in hostile environments, together with the high economic impact on the mission and the considerable inefficiency in the use of resources and fuel, are all revealed in the statistics taken from the NATO Multimedia Library, in its "Smart Energy" section"[23]:

[23] NATO LIBGUIDES, Smart Energy, available at http://www.natolibguides.info/smartenergy, consulted 15 December 2019.

- "*3,000 US soldiers were killed or injured between 2003 and 2007 as a result of attacks on fuel/water convoys in Afghanistan/Iraq*".
- "*On average, there is one victim for every 24 supply convoys in Afghanistan/Iraq*".
- "*The cost of fuel transport to dangerous areas could be as high as US$ 600 per gallon, or even greater*".
- "Only one third of the fuel burnt in a conventional diesel generator is transformed into *electricity. The other two thirds are wasted in the form of heat*".
- "*In Mali, the road used to transport supplies has been named the "road to hell", because of the attacks and accidents*".
- "*At present, a soldier has to carry an average of 7 different batteries that account for about 20% of the total weight that they have to carry with them*".

As a result of these joint efforts by the Allies through the Agency, the following have been developed: NATO's "Single Fuel Policy" has been developed in the logistics area, promoting the use of only one fuel for all the aircraft, vehicles and ground equipment; the "NATO Policy on Power Generation for Deployed Force Infrastructure"; and the vision on "Fuels of the Future"

In the area of weapon systems, the Naval Armament Group is involved in maritime pollution, waste management and energy efficiency and energy generation; the Army Armament Group has developed a series of projects that contain environmental and energy saving elements; and the Industry Consultation Group is considering the implementation of dual purpose (civil/military) ecological technologies for developing its capabilities, as long as implementation does not prove to be detrimental to operating efficiency.

In the area of environmental protection, NATO has a sound base of principles, policies and standards (Standardisation Agreements or STANAGs) that are applied to its environmental management operations.

Finally, regarding international cooperation, NATO hopes to provide a platform to enable the Allies to benefit from specialist knowledge, experience and better practices from member countries, other international organisations and industry. NATO's lines of research and activity are invariably coordinated with the

rest of the external stakeholders in order to prevent overlapping and to identify areas of common interest and cooperation. In this sense, it has already been demonstrated that cooperation between the Alliance and industry through NATO exercises, which industry uses as testing benches, is both useful and mutually beneficial when industry utilises these to demonstrate the efficiency and interoperability of its "smart" energy technologies. One such example is the "Capable Logistician" exercises.

NATO's "Capable Logistician" Exercises

Capable Logistician Exercises[24] are multinational exercises carried out by the Allies and backed by NATO that take place in different locations. Their main aim is to practice and improve the planning, management and performance of multinational logistics in support of the force, in a scenario of cooperation between allied forces, focusing on NATO standards and interoperability.

Three such exercises were carried out up until the date on which this article was written: Exercise CL13 (Slovakia, 2013), CL15 (Hungary, 2015), and CL19 (Poland 2019). In all three, NATO Headquarters assigned one Smart Energy unit with equipment and personnel from NATO's Member States, whose general objectives are:

- To demonstrate the potential that innovative technologies have for reducing fuel use inefficiencies in military deployment camps.
- To demonstrate the positive impact of the smart energy capabilities in increasing operational efficiency.
- To test interoperability and evaluate NATO's standards in this respect.

Although diesel generators will continue to be the main source of energy in military deployment camps throughout the coming decades, NATO estimates that fuel waste could be reduced by between 5 and 20% by better planning and a greater knowledge of energy flows in military deployment camps, without this meaning further expenditure or having to install any new equipment. It is estimated that with a moderate investment fuel consumption

[24] Michaelis, Susanne, Smart Energy Officer, NATO HQ " Capable Logistician CL19 – NATO SMART ENERGY UNIT", 28 May 2019, http://www.natolibguides.info/ld.php?content_id=32333295

could be reduced by 80% without affecting the soldiers' comfort, and improving operating efficiency at the camps.

The tests and demonstrations in those three CL exercises were as follows:

- CL13: installing a military tent with thermal insulation and LED lights, a hydrogen fuel cell and photovoltaic panels to generate energy without fuel.
- CL15: installing more than 50 items of equipment (Smart Energy (SE) micro-grids, hybrid power generators and renewable technologies) to supply smart energy to other logistical units, simulating electricity supply cut scenarios, diesel pollution and the destruction of the infrastructure by flooding.
- CL19: deploying a Smart Energy Unit with more than 30 items of innovative equipment for the generation, storage, distribution and consumption of energy in a smarter way, interacting with the rest of the Multinational Integrated Logistic Support Units (MILU)).

The innovative equipment deployed for the SE Unit included modern diesel generators, hybrid generators, photovoltaic panels, microgrid control software, thermally-insulated tents, high energy-efficiency air-conditioning, LED lighting, units for producing and purifying atmospheric water, shading solutions for the tents, non-intrusive energy consumption measurement kits, and a tool for energy simulation at the camp.

The Smart Energy Unit focused on improving the functionality and interoperability of the equipment deployed, and on demonstrating the benefits of this equipment when it comes to reducing fuel consumption, which was cut by 80%.

Ministry of Defence participation in R&D&I projects in NATO´s setting

Different directorates and bodies dependent on the Spanish Ministry of Defence have participated in research groups via NATO's Science & Technology Organisation (STO). Such groups include SAS-083 "Power and Energy in Military Operations" (Directorate General of Armament and Material - DGAM) or SET-173 "Fuel Cells and Other Emerging Manportable Power Technologies for the NATO Warfighter" (National Institute of Aerospace Technology - INTA/Energy Area)

Moreover, personnel from INTA's Energy Area formed part of the "Improving Efficiency and Operational Range in Unmanned Vehicles using Fuel Cells" Project (IUFCV) together with Australia´s Commonwealth Scientific and Industrial Research Organisation (CSIRO) and jointly with *Universidad de Sevilla*, financed by the Science for Peace and Security Programme (SPS), intended to develop passive hybrid fuel cell systems and batteries for unmanned vehicles.

Research Group SAS-083. Power and Energy in Military Operations (DGAM)

As was described in the 2013 Annual Report of the STO[25], this research group focused on "a) analysis of the impact of necessarily increasing the energy demand and power in military operations, b) defining the energy consumption and current power baselines, in order to make it possible to know the minimum consumption and power requirements for operations, and c) defining performance indicators and models that make it possible to carry out an analysis of scenarios for optimising the power and the energy consumption".

As a result of this research, the Allied Nations taking part were able to pinpoint areas where there was room for improvement in operations and to understand where and how to act to improve energy efficiency and reduce cost. A methodology was developed to calculate the total cost of the energy (FBCE, Fully Burdened Cost of Energy), which takes into account all the expenses incurred for personnel, resources and logistics required to transport and protect the fuel, and a Fuel Consumption Prediction Model (FCPM) for deployment operations, which contained all the operational factors in the supply chain (transport, infrastructures, human resources, maintenance, protection and energy storage).

By applying these methodologies and expertise, the Canadian Army managed to save over 1 million Canadian Dollars by replacing TQG (Tactical Quiet Generators) with the next generation of more energy efficient generators, Advanced Medium Mobile Power Source (AMMPS) in an Air Fight Brigade in Afghanistan.

25 NATO STO, "Science and Technology Organization 2013 Annual Report", July 2014, https://www.nato.int/nato_static_fl2014/assets/pdf/pdf_topics/20180522_STO_Annual_Report_2013.pdf

SET-173 Research Group. Fuel Cells and Other Emerging Manportable Power Technologies for the NATO Warfighter

As described in the Final Report issued by this research group[26], and in more summarised form in the article entitled "Frontline NATO: Energy, Science and the Warfighter" featured in the publication "Journal of Energy Security"[27], the research group SET-173 focused on the applicability of fuel cell technologies and other emerging energy generation technologies for supplying rechargeable batteries for the many systems and different electronic apparatus that provide superiority in combat, not only in Wearable Technology (WT) combat uniforms, but also in portable systems and remotely controlled systems, as a replacement for conventional generators, with the latter's maintenance problems and their need for fuel supply, and also to replace small non-rechargeable batteries, with their high logistical and environmental footprint.

Fuel cells have many advantages over conventional generators; they make less noise, they have a minimum heat signature, they need less maintenance and they can be utilised indoors, thanks to their low emissions. As they can be used to charge rechargeable batteries, there is no need to supply batteries, so the logistics of the mission are simplified.

Although hydrogen, methanol and propane fuel cells have already been tested in some military exercises by several of the Allied Forces, there are still many difficulties to be overcome, such as their working life, reliability and sensitivity to temperatures, their high initial cost and their cost per kW. Furthermore, fuel cells are as yet unable to operate with conventional fuels such as JP8, a problem that is currently being researched and where certain progress is being made, albeit still in laboratory environments.

[26] NATO STO, " Fuel Cells and Other Emerging Manportable Power Technologies for the NATO Warfighter – Part I: Power Sources for Manportable / Manwearable Applications", October 2014, https://apps.dtic.mil/dtic/tr/fulltext/u2/a616465.pdf

[27] ALBERT HUSNIAUX, AHMED GHANMI y MARC GIETTER, Journal of Energy Security, "Frontline NATO: Energy, Science and the Warfighter", 20 November 2013, http://www.ensec.org/index.php?option=com_content&view=article&id=468:frontline-nato-energy-science-and-the-warfighter&catid=139:issue-content&Itemid=425

IUFCV Project (Improving efficiency and operational range in low-power unmanned vehicles through the use of hybrid fuel-cell power systems)

The Energy Area of the INTA (National Institute of Aerospace Technology) has formed part of the IUFCV project, together with the CSIRO (Commonwealth Scientific and Industrial Research Organization) from Australia and the *Universidad de Sevilla*.

This project, financed by the Science for Peace and Security Programme (SPS), concentrates on the development of passive hybrid fuel cells and batteries for unmanned vehicles, in compliance with the specifications for three existing platforms: an autonomous underwater vehicle and two unmanned land vehicles, which will be tested in operating conditions.

As is explained at the website for the project[28], "*the main advantage that hybrid energy-generation systems using fuel cells have, over systems that are equipped only with batteries to store them, is that they can obtain a higher specific energy and a higher energy density, providing a redundant power supply which reduces the likelihood of failure, improves performance and offers the possibility of using different fuel types to supply the cell, such as hydrogen, methane, LPG, etc.*"

National context regarding energy efficiency and climate change

The legal framework for the energy and climate policy in Spain stems from the transposition of the EU legal framework into Spanish Law, which is in itself heavily conditioned by the agreements and commitments taken on as a result of the Paris Agreement, ratified by the EU in 2016 and subsequently by Spain in 2017.

The European directives referring to the improvement in energy efficiency and promoting the use of renewable energies have been partially and unevenly transposed, often in incomplete form, to Spanish Law, mainly through the following Royal Decrees, Regulations and Technical Codes:

- Royal Decree 235/2013, dated 5 April, whereby the basic procedure is passed for the certification of energy efficiency in buildings (partial transposition of Directive 2010/31/EU).

[28] http://iufcv.com/objectives/, consulted 15 December 2019

- Royal Decree 564/2017, dated 2 June, whereby Royal Decree 235/2013, dated 5 April, on the basic procedure for the certification of energy efficiency in buildings is modified.
- Rules for Thermal Installations in Buildings (RITE) (approved by Royal Decree 1027/2007 and modified by Royal Decree 238/2013)
- Technical Building Code (CTE). (approved by Royal Decree 314/2006 and modified by Royal Decree 732/2019)
- Royal Decree 56/2016, dated 12 February, whereby Directive 2012/27/EU concerning energy efficiency is transposed, with regard to energy audits, accreditation of service providers and energy auditors and promoting energy supply efficiency.
- Royal Decree 1597/2011, dated 4 November, which regulates the sustainability criteria for biofuels and bioliquids, the National Sustainability Verification System and the dual value of certain biofuels for the purpose of their computation (partial transposition of Directive 2009/28/EC).

Furthermore, as a result of the provisions established in the European directives and legal packages, and the commitments taken on by virtue of the Paris Agreement, there are a series of plans, strategies and national programmes, aimed at improving energy efficiency, promoting renewable energies and reducing greenhouse gases, including the following:

- Energy Efficiency Action Plan (PAEE) 2014-2020, as a consequence of the requirement envisaged in Article 24.2 of Directive 2012/27/EU, as a central tool in the Spanish energy policy, whose implementation will make it possible to achieve the objectives established in the energy efficiency directive.
- Long-Term Strategy for Energy Rehabilitation in the Spanish Building Sector (ERESEE) 2014, in compliance with the obligation envisaged in Article 4 of Directive 2012/27/EU.
- Energy renovation programme for buildings and infrastructures belonging to the general State´s Administration: co-financing of comprehensive or partial actions carried out on buildings, infrastructures and external lighting that manage to reduce both CO_2 emissions and final energy consumption, by improving energy efficiency.

- Aid programme for energy refurbishment of existing buildings (PAREER-CRECE Programme): co-financing of refurbishment actions conducive to energy saving, improving energy efficiency, making the most of renewable energies and reducing carbon dioxide emissions, through the improvement of the thermal envelope, the improvement of the efficiency of thermal and lighting facilities, and the replacement of conventional energy with biomass or geothermal in the thermal facilities.

National Energy and Climate Plan (PNIEC) 2021-2030 (updating the draft from 20 January 2020), in response to the obligations imposed by the Governance Regulation of what is known as the EU "Winter Package", setting out the strategy and plans needed to achieve the EU goals and to make sure that the information submitted by the Union and its Member States to the United Nations´ Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. is coherent, comparable and transparent.

Finally, and specifically for the public sector area of the defence, the Spanish Ministry of Defence has set an energy and environment policy whose lines and guidelines are indicated in two Instructions:

- Instruction 56/2011, dated 3 August, issued by the Secretary of State for Defence, concerning environmental sustainability and energy efficiency in the area of the Ministry of Defence, which contains the Ministry of Defence's deep commitment to developing its military operations and activities in a way that is in keeping with environmental conservation, to improve efficiency in the use of resources and in energy consumption, requiring the Army, Navy and Air Force, as well as the Management Bodies and Autonomous Entities of the Department, to comply with the orders established in this instruction and to incorporate the principles of saving and energy efficiency and of using alternative sources of energy, among the general principles of their actions and in their contracting procedures.

  To do this, it has decided to implement ISO 14001 Environmental Management System not only at its Bases, Barracks and Establishments, but also during its international operations and missions, whenever this is possible.

  Furthermore, for NATO´s operations, the recommendations contained in document AJEPP-3 «Environmental Management

System in NATO Operations» will be adopted, and the environmental considerations in STANAG 7141 «Joint NATO Doctrine for Environmental Protection During NATO Led Military Activities» will be taken into account when those operations are being planned.

With a view to achieving the goals set by this Instruction, the Armies, Managing Bodies and Regional Entities of the Department must allocate at least one twelfth of their total investment resources on infrastructure to actions associated with environmental sustainability and energy efficiency, and must earmark financial, material and human resources that enable the Environmental Management Systems and energy efficiency programmes to always be implemented adequately in their respective organic structures.

The Instruction establishes the gradual application of the infrastructure resources as from the coming into force date until 31 December 2013, and to apply the resources with full force as from 1 January 2014.

- Instruction 59/2014, dated 4 December, issued by the Secretary of State for Defence, modifying Instruction 56/2011, dated 3 August, concerning environmental sustainability and energy efficiency in the area of the Ministry of Defence, extending the gradual application of the infrastructure resources until 31 December 2016 and to apply the resources with full force as from 1 January 2017, in view of the economic recovery situation affecting the country.

Moreover, the Ministry of Defence has its own system for managing assets and energy. It is called SINFRADEF, and it contains information about consumption and energy efficiency in all its buildings.

It is important to emphasise here, owing to the impact it might have on the energy policies, strategies and action plans of the Ministry of Defence and the three Armed Forces, that the draft for the "National Energy and Climate Plan (PNIEC) 2021-2030" that Spain submitted to the European Commission makes no explicit reference to any defence sector exemptions, when it did make such references in the "National Energy efficiency Action Plan 2017-2020" for the purpose of keeping a record of the buildings owned by the Armed Forces or by the Central Administration utilised for defence purposes, for the inventory of air-conditioned buildings belonging to the Central Administration that have to pay

the refurbishment tax of 3% a year, according to the European Energy Efficiency Directive.

Participation of the Ministry of Defence and Armed Forces in R&D&I Initiatives and Projects on a national level

The Department's R&D&I policy, brought together in the Technology & Innovation Strategy for Defence 2015, defines some technological goals associated with the field of generation and energy efficiency in operations.

Some goals, such as "Energy Storage", or "Microgeneration of electricity" aim to develop technology applicable to defence horizontally, including the various kinds of storage technologies, fuel cells or renewable energies applicable up to a microgrid scale.

When applied to systems, energy efficiency improvement refers to such goals as "Generation and electricity management at bases and in camps" and electrification and propulsion improvement goals for land, naval and aerial platforms, as well as to improve energy efficiency in the fighter system.

Some of the most outstanding projects in this area are described in summarised form below.

Projects in the COINCIDENTE (DGAM) Programme

ATHEMTO Project

This project, undertaken by INSIA-UPM with the collaboration of the INTA, focuses on developing a hybrid propulsion system for a tactical vehicle (URO VAMTAC), which makes it possible to improve energy efficiency and reduce emissions, while keeping major advantages on a tactical level (reduction of the heat and acoustic signature, improvement of the starting torque and range increase).

ALPAM Project

This project, carried out by the company Albufera Energy, focuses on developing a primary aluminium-air battery, lighter than the conventional ones and more environmentally friendly. Although its application was focused on the fighter system or supporting the latter, it is a first step in the development of metal-air batteries for use in Defence.

Army Innovation Projects

GREEN PC

The Army, through the Armoured Infantry Brigade (BRIAC) and the Army Logistics Support Command (MALE), developed a renewable energy generation and storage system on an armoured (TOA) vehicle, aimed to supply a mobile command post. The project has so far had two advanced prototype phases, and it has been tested in several exercises. It combines photovoltaic and wind energy with lead-gel batteries and an auxiliary generator set.

Variable speed and co-generation generator set

Developed by the staff at the Engineers' Maintenance and Materials Centre (PCMMI), this generator set enables the user to regulate power through speed variation, making it possible to improve efficiency by 20% when compared to conventional generator sets, while producing sanitary hot water or heating.

Antarctic Campaign Office

Amongst the many energy efficiency projects carried out by the Antarctic Campaign Office (OCA) at the Gabriel de Castilla Base, is worth noting the installation in earlier campaigns of wind turbines and the use of high-efficiency generator sets (with variable speed and cogeneration as in the aforementioned project). Currently, a project is being developed in collaboration with DGAM and the OCA to install energy generation systems using methanol fuel cells, which will permit not only distributed generation in sensors throughout the island where the Base is located, but also the generation of the energy needed to supply the sensors and the communication equipment during the winter stage, when the Base is completely unattended.

Grand Smart Box

The Grand Smart Box system, an energy source management centre, was developed for the Air Force's Second Air Deployment Support Squadron (SEADA). It enables the generator sets to be used very efficiently at deployable bases, reducing fuel consumption and the associated emissions. It is an electronic

power system that allows for the smart management of a variety of energy generation sources, not only generator sets of different capacities but also renewable sources.

INTA Projects

Projects by Sub-Directorate General of Air Systems / Energy Area

The Energy Area's experience in clean technologies includes carrying out the AVIZOR Project, to develop and Unmanned Aerial Vehicle (UAV) driven by a fuel cell, the development of R&D&I projects on batteries, super condensers and fuel cells, the assessment of solar energy systems and the development of a smart grid incorporating storage systems to batteries and fuel cells.

Projects by Sub-Directorate General of Land Systems

The experience of the GREENMAR Project for developing an air-conditioning system by geothermics and aerothermics along with modular construction solutions – an experience subsequently utilised to develop the hangar for the A-400M in Seville and other Air Force facilities – has caused the participating companies to extend their collaboration to other energy efficiency improvement projects (ENERGYSIS and MAGISTER).

ENERGYSIS Project

This project, carried out in collaboration with Spanish industry, focuses on developing an efficient system for generating transportable energy that operates like an energy island, through the use of renewable and autonomous energies (geothermal and solar thermal) and by the simple management of the energy resources required for air-conditioning and sanitary hot water (ACS) for low energy demand modular structures utilised in crisis situations, areas that are difficult to access or affected by natural catastrophes, refugee camps and military camps linked to deployment operations.

MAGYSTER Project

As described at the project's own website[29], this project focuses on implementing a modular building system, featuring a

[29] https://gaptek.eu/project-magyster/, consulted 1 December 2019.

series of new technologies to obtain the positive activation of all the construction elements, envelopes, floor framework and foundations.

The ultimate aim is to obtain active architectural modules that are able to integrate geothermics and renewable energies and that permit a reduction of the assembling time, offering the possibility of being disassembled and reassembled at another location either with the same layout or a different layout.

Conclusions

Climate change, carbon footprint, mitigation, environmental sustainability, sustainable development, energy efficiency and ecological transition, are key words, which are appearing increasingly in our lives, and inevitably, in society in general.

The defence sector is not unaware of all the above, and both the Ministry of Defence and its Armed Forces are committed to protecting the environment, energy sustainability forming part of its defence strategies and defence policies as a result of the legislation and regulations, both national and international, that affect them.

Energy sustainability, the efficient and sustainable use of energy, is a challenge for Armies and for the Navy, because in the operational field and when carrying out their activities they have to bring together compliance with the national defence goals – mission accomplishment as we say in military circles – with the energy sustainability targets to which the Spanish Government has committed itself, and the targets to which the European Union and NATO have committed themselves.

Transition in the defence and security sector towards energy sustainability concerns all those involved, from the Ministry itself to the Defence Industry and to the research centres and bodies. A joint and coordinated effort from all the stakeholders will permit and guarantee that the sector makes an energy and ecological transition to more sustainable operating models, and that our Armed Forces are once again an example to be followed, in this case in energy sustainability, contributing to the fight against clima.

Composition of the working group

President	**Mr. Claudio Aranzadi** *Industrial Engineer and Economist.* *Ex Minister of Industry and Energy.*
Secretarie	**Mrs. Marta Camacho Parejo** *Director of Institutional Relations Spain and Global Affairs of Repsol.*
Coordinator	**Mr. Felipe Sánchez Tapia** *Colonel Spanish Army.* *Chief Analyst of the IEEE.*
Members	**Mr. Isidoro Tapia Ramírez** *Energy Economist-Project Finance Department European Investment Bank.*
	Mr. Alberto Carbajo Josa *Engineer of Mines and Energy. Economist* *Adviser to Red Eléctrica Corporación Ltd.*
	Mr. Manuel Francisco Arribas Tiestos *Army Lieutenant colonel Spanish.* *Energy Efficiency Department of the General Directorate of Infrastructure of the Ministry of Defence.*
	Mr. David Martín Borreguero *Energy Consultant for the Ministry of Defence Integral Infrastructure Consulting Area, Isdefe.*

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