



## **ECONOMIC-FINANCIAL ANALYSIS OF AN INVESTMENT OF TANKS FOR ARLA 32 AT THE FLEET OF A TRANSPORTATION COMPANY**

*Gabriel Nery da Silva*  
*Instituto Federal de São Paulo – IFSP, Brazil*  
*E-mail: nery.gal.nery@gmail.com*

*Laiane Aparecida Soares Sena Nery*  
*Instituto Federal de São Paulo – IFSP, Brazil*  
*E-mail: laiane.sena1@gmail.com*

*Luiz Teruo Kawamoto Júnior*  
*Instituto Federal de São Paulo – IFSP, Brazil*  
*Bolsista de Produtividade em Pesquisa CNPQ – Engenharia de*  
*Produção e Transportes*  
*E-mail: teruo@ifsp.edu.br*

*Submission: 03/01/2017*  
*Accept: 13/01/2017*

### **ABSTRACT**

The objective of this work is to do an economic-financial analysis on the alternative of a transportation company to finance the costs with ARLA 32 consumption. In the current situation the company refuels, its vehicles with ARLA 32 acquired at wholesale and stored in the company's head office located in large São Paulo and, when necessary, at retail at unscheduled gas stations but which are located on the route. The alternative is to add a second tank for ARLA 32 at the vehicles to cancel these unscheduled external refueling. Based on the interview with the company's manager responsible for the project, costs' spreadsheets and company's documents, it was done the analysis comparing between those two modes which of them offers lower cost, through the capital estimate techniques and financial analysis NPV, IRR, payback and Profit Margin. The results demonstrated that the current mode is economic, because according to analysis criteria the project is not feasible.

**Keywords:** Economic-financial analysis; Investment analysis; Economy with ARLA 32; Environment impact.



## 1. INTRODUCTION

Logistics, among others aspects that define it, is the integrated management of all activities necessary to transport and/or store products within supply chain. This is a complex process and worsened by a characteristic that requires much strategy: to meet customer requirements. Logistics management by itself is of a particular complexity, added "customer requirement" factor as quality, charge characteristics, vehicles' suitable and others, implies a complex strategic planning, because all of it should suit at these requirements. Nevertheless, currently there is still an extremely important factor for the globalized world: sustainability.

Sustainability does not focus only on environment impact, but also on economic dimension and social well-being dimension. Environmental dimension refers to impacts caused by a product or service along all its life cycle; economic dimension concerns to all costs related to production and product or service's life cycle under commercial perspectives and customer, respectively; well-being dimension approaches impacts of an organization, product or process in society, it can be estimated by the analysis of the effects at local, national or global levels (FINKBEINER et al., 2010).

The concept of sustainable development was first time described in 1987 by the World Commission on Environment and Development under the leadership of the former Norwegian Prime Minister Brundtland (1987), exposing a development that is capable to cover today's needs for an intact environment, social justice and economic prosperity, without limiting the ability of future generations to meet their needs.

Logistics and sustainability integration can be understood as Green Logistics. According to site Green Logistics (2010), Green Logistics or Sustainable Logistics means to do logistics services taking into account the external costs especially associate to climate changing, air pollution, noise, vibration and accidents, looking for ways to reduce these externalities and reach a balance more sustainable between economy, environment and social aims.

Public policies taken by government in all the world incentive investment on technologies that cause less environment impacts, one of these incentives, for example, is the replacement of one fuel by another of less environment impact. This

took to many studies turned to analyze the air quality in a system “before and after” the fuel changing, for examples the studies done in Deli-India (GOYAL; SIDHARTHA, 2003; KATHURIA, 2004; RAVINDRA et al., 2006; CHELANI; DEVOTTA, 2007), due to its importance.

A project created in Brazil by the *Conselho Nacional do Meio Ambiente* (CONAMA) (IBAMA, 2012) turned to air pollution reduction enforced the vehicles manufacturers to develop a Liquid Reducing Agent of Automotive nitrogen oxide (NO<sub>x</sub>), in Brazilian Portuguese: ARLA 32; which acts in a determined type of system which is going to be presented later.

Currently the company in study refuels its fleet with ARLA 32 acquired at wholesale purchase and stored in the company's head office located in large São Paulo, named here as internal spending, and it also refuels at retail when ARLA 32 is consumed before the return of the vehicle to head office, in this case named as external spending.

To cancel these external spending, the company decided to analyze the feasibility of to add a second tank for ARLA 32 at the trucks, thereby the trucks would have quantity of product enough to run the entire path (round trip).

The objective of this work is to analyze between these two modes, which of them is more feasible for the company, considering the measures provided by law, what enforces the use of this component, the yearly spending with internal and external refueling and the result of the economic-financial analysis on the eventual addition of a second tank.

This work is classified as action-research and it aims to contribute with the scientific production of applied theory.

## **2. LITERATURE REVIEW**

### **2.1. Arla 32**

The large quantity of automotive vehicles that run in the urban centers is the cause of great emission of polluting gases that damage the air quality. Among the emitted gases are carbon dioxide (CO<sub>2</sub>) and nitrogen oxide (NO<sub>x</sub>), causers of the greenhouse effect. Facts like these motivated the creation of various public polices turned to decreasing of the impact caused by pollution. CONAMA created the



*Programa de Controle da Poluição do Ar por Veículos Automotores (PROCONVE)*, classified as automotive vehicles the automobiles, trucks, buses, and road and agricultural machines; aiming to reduce the levels of pollutants emissions by vehicles moved by diesel, inuring in January 2012.

This program required from manufactures the modification on the motors of the weighted vehicles, creating a system named Selective Catalytic Reduction (SCR) of treatment of the emitted gases (Auto Converter Recyclers, [201-]). The ARLA 32 does this treatment. According to Petrobras (2011) ARLA 32 is:

(...) Brazilian Portuguese abbreviation of Liquid Reducing Agent of Automotive nitrogen oxide (NO<sub>x</sub>) needed to SCR technology present in the automotive vehicles moved by diesel and classified as weighted and semi-weighted commercial (over 16t) made from January 2012. Number 32 refers to concentration level of urea solution (32.5%) in demineralized water. It acts on the exhaust systems as a reducing agent of nitrogen oxide (NO<sub>x</sub>) emission. ARLA 32 is a solution not inflammable, not toxic, not dangerous and not explosive, and, therefore, very safe. It is not harmful to environment and is classified in the category of low risk transportable fluids.

Yet according to Petrobras (2011), ARLA 32 is not a fuel or an additive for fuel; it is injected into the catalyst, after diesel combustion, to reduce chemically the nitrogen oxide (NO<sub>x</sub>) emission of vehicles moved by diesel. It is a urea solution that is according to Patterns ISO 22241. This pattern ensures the correct SCR equipment operation. The use of ARLA 32 provides the reduction of the NO<sub>x</sub> in up to 98%, converting it in nitrogen and water vapor. Nitrogen oxide (NO<sub>x</sub>) reacts with hydrolyzed ARLA 32, which provides ammonia (NH<sub>3</sub>), producing nitrogen gas (N<sub>2</sub>) and hydronium (H<sub>3</sub>O<sub>2</sub>).

The expected average consumption is of the order of 5% of the oil diesel consumption, may fluctuate depending of the use conditions of the vehicles and traffic (PETROBRAS, 2011). That is, for each one liter of diesel it consumes 50 ml of ARLA 32.

## **2.2. Investment and economic-financial analysis**

For companies, thus as any investor, the moment to invest and how and where to invest is always treated with much attention for the fact that it be directly and completely connected to the capital. To invest in whatever be requires serious analysis and that they consider as variables as possible, especially because to invest is to use an existent and guaranteed capital in something that may bring return, that is, it is uncertain.



There are many studies in literature that aim to analyze investments, propose methods more efficacies, consider variables each time more precise and others many focus that can minimize the loss chances in investments or to maximize the profits. Sarkar (2000) proposed an investment-uncertainty analysis in real option models affirming that this relation is not always correct. He concluded that sometimes the increase of the uncertainty could increase the probability of investment with positives impacts on the investment.

Because of this, Lund (2003) discussed these investment-uncertainty analysis' results based on mathematics models, seeking to identify those positives aspects and gains opportunities even in uncertainty, and he concluded that is needed caution in that affirmation.

It is reasonable to remember, in the case of this work, the investment-motivating factor is the legal obligatoriness regarding use of vehicles, fuels, additives and/or reducing agents that cause less impact on environment. As already said, to combine logistic management with sustainability goes beyond a need; it is a responsibility of all. Governments in general take attitudes and promote public polices to decrease environment impacts.

A study done by Yeh (2007), for example, analyzed the scenario of eight countries that encouraged considerably the adoption of alternative fuel vehicles, indicating positives and negatives points regarding incentives.

To think in to invest leads to the need for an economic-financial analysis on the investment, which is possible with the capital estimate techniques, which evaluate if determined project or investment is or not feasible. Being the study an analysis of a possible company investment with acquisitions of new tanks for ARLA 32, it is needed to calculate the feasibility of this investment. There are four methods needed for evaluation: Net Present Value (NPV), Payback, Internal Rate of Return (IRR) and Profit Margin; and the criteria for acceptance are the analyzed project or investment be feasible in the four methods.

### **2.3. NPV**

NPV considers the value of money over time and consists in the minimum return that a project needs to provide to keep unaltered the company market value (GITMAN, 2010, P. 369). It is given by the formula:



$$NPV = \sum_{t=1}^n \frac{CF_t}{(1+r)^t} - CF_0 \quad (1)$$

Being:

CF = net cash flow generated by project at time t

CF<sub>0</sub> = initial cash outlay on project

t = the nth period in time in which the money will be invested in the project

n = period

r = cost of capital

The criterion based on NPV for acceptance-rejection decision-making is:

- If NPV bigger than zero, accept the project;
- If NPV smaller than zero, reject the project.

## 2.4. Payback

The method known as Payback Period has like objective the risk analysis. Assaf Neto and Lima (2011) say that this method, in essence, consists in the calculus of the time required to the amount of capital spent on the investment be recovered through its cash flow. Payback highlights itself by its simplicity and large utilization by the decisional units. Gitman (2010) describes it as the time required to recover the initial cash outlay on a project, calculated from net cash flow.

Conceptually, the criteria for decision are payback period smaller than the maximum period acceptable and payback period bigger than the maximum period acceptable, at the first case, accept the project, and at the second case, reject it. The fragile point of this method is in the subjective of the maximum period acceptable, because it is defined without grounded criteria, commonly being defined by company administration visions or even by feeling.

To analyze investments turned to fleet also requires that the payback period be feasible in relation to the renovation fleet time, because according to literature (VALENTE et al. 2014), is suggested the replacement fleet in average after eight or nine years due to depreciation and maintenance costs.

## 2.5. IRR



It is the yearly rate of return composed that is gotten if to invest in the project and receive preview cash flows. Mathematically, it is the interest rate  $r$  that takes NPV be equal to zero. It is given by the formula:

$$\sum_{t=1}^n \frac{CF_t}{(1 + IRR)^t} = CF_0 \quad (2)$$

The criterion based on IRR for acceptance-rejection decision-making is:

- If IRR were bigger than the capital cost, accept the project;
- If IRR were smaller than the capital cost, reject the project.

## 2.6. Profit margin

It refers to profitability ratios. According to Gitman (2010) it measures the percentage of each sales' Real (currency) that remains after deduce the investment costs. It permits to evaluate the company's profits in relation to a given level of actives or investment. Assaf Neto and Lima (2011) say that it is the relation between the cash inflows (profit) and the output value (cost). In other words, it indicates how many the company gets as return from each \$1 applied in determined investment, all results expressed in values actualized by the minimum acceptable rate. How bigger the profit margin, better. It is given by:

$$\text{Profit margin} = \frac{\text{profit} - \text{cost}}{\text{profit}} \quad (3)$$

For approval its result must be bigger than zero.

Because it has direct connection with the minimum acceptable rate, profit margin needs to be analyzed by the company technic area.

## 2.7. Performance indicator

Because it is a quantitative work, some numbers are important for analysis; among them is the average consumption per kilometer run. It is appropriate to analyze this average with some performance indicator. A performance indicator per kilometer run (VALENTE et al., 2014) is the cost per tonne transported (Ctt), it is given by:

$$Ctt = \frac{Ckm \times km}{Cc} \quad (4)$$

Being:

Ctt = cost per tonne transported

Ckm = cost per kilometer run

km = mileage to be run in the month

Cc = charge capacity of the equipment

### 3. METHOD

The company in study acts in the Brazilian Market there are 76 years with road transportation services. As any company, this dedicates itself to perform a work with excellence, efficiency and efficacy, meeting customers' requirements. The object of study or situation-object is the ARLA 32 consumption in the transportation trips.

The motivation of this study came from the existence of a project in the company known through the purchase manager. The project treats of the alternative of the company to defray the spending with ARLA 32 consumption. At the actual situation the company refuels, its vehicles with ARLA 32 acquired at wholesale and stored in the company's head office located in large São Paulo and, when necessary, at retail at unscheduled gas stations but which are located on route.

The alternative is to add a second tank for ARLA 32 at the vehicles to cancel these unscheduled external refueling. For achievement of this study, it was done an interview with the manager that, duly authorized, explained the project intentions and gave spreadsheets and documents containing costs with ARLA 32 consumption in the year of 2015, data related to average consumption per kilometer run and technical data related to the trucks, and quotations of installations of new tanks.

These data were divided and analyzed with the help of the capital estimate techniques and financial analysis NPV, IRR, payback and Profit Margin, to verify the project feasibility. The results are discussed in the section 4.

### 4. RESULTS AND DISCUSSIONS

First off, all these data were divided in two points:



- Internal costs: are the purchase costs with ARLA 32 at wholesale price, that stays stored in the company and is used at the scheduled refueling; and
- External costs: are the costs related to refueling out of the company, at retail price, and they happen due to ARLA 32 be consumed before the end of the trips of the trucks.

This division permitted the vision of the amount spent in external refueling that comes from the retail purchase and appears like a cost that the company needs to avoid, because the price of the liter of ARLA 32 at retail reaches up to 248% of the value of the wholesale price.

Currently the companies' vehicles that fit into SCR system have a tank for ARLA 32 with capacity of 60 l. The vehicles are refueled with ARLA 32 at company's head office at average cost of R\$ 1.13/l due to wholesale purchase. The price of ARLA 32 in the path is R\$ 2.81/l in average. This cost impacts in two ways: the product already bought that stays stopped without use at the company's head office, and the cost higher in the unscheduled refueling. The company then searched to analyze the feasibility of to add another tank for ARLA 32 at the truck, doubling the current capacity. However, the cost of addition is very high and it took the company to verify which mode offers lower cost: to keep the current mode or to add another tank.

This took to the second step, what was to research in literature, tools of investment analysis that could be applied in the situation. Because the company has a particular interest regarding the time needed for the return of this possible investment, the payback period has bigger importance for the decision.

The quantitative data needed for analysis comprehend: capacity of the tank for ARLA 32, average monthly consumption, cost of purchase and installation of the second tanks. According to technical data from Mercedes Benz (2015) and company's registers, the capacity of the trucks' fuel tank is 500 l. it is appropriate then to analyze the fleet fuel consumption average with a performance indicator (Ctt). Data collected from the company showed Ctt average equal to 1.90, therefore, a full tank permits to travel in average 950 km. Considering the average consumption defined by Petrobras, a full tank for ARLA 32 permits to travel 1,200 km, therefore,

any routes where the round trip exceeds 1,200 km is going to need refueling. In fact, there are many routes that exceed 2,000 km only in the one-way trip, since the company operation is of nationwide.

Quotations performed by the company considered 32 trucks. They are what fit into the categories already cited about SCR system and routes bigger than 1,200 km of round trip. The lowest cost quoted with installation of the equipment was R\$ 1,460.00 per unit, totalizing R\$ 46,720.00.

In 2015, the company spent with ARLA 32 consumption the amount of R\$ 110 thousand, approximately 98 thousand liters, with internal purchase. Besides that, it spent R\$ 11.4 thousand, approximately 4 thousand liters, with external refueling. This results at internal average monthly cost R\$ 9.1 thousand and external R\$ 950.00. Therefore, around 10% of the monthly spending comes from external refueling.

New tank addition at the trucks would imply in make account the 4 thousand external liters in the internal count, that is, 4 thousand liters would be acquired at an average cost of R\$ 1.13/l, which totalizes R\$ 4.5 thousand to be accounted in the yearly internal costs. This represents 40% of the value of the external spending. The 60% of economy amounts to R\$ 575.00 monthly.

The values above permit to calculate the NPV, IRR, to scale out the payback period and get the profit margin of the extra new tank acquisition, based on the maximum fleet duration 9 years, because after this period the fleet is replaced. Considering the acquisition value R\$ 46,720.00 as investment initial capital and the average monthly economy projected in R\$ 575.00, payback period would be 6.8 years, NPV would be -R\$ 8,764.13, IRR would be 0.55% per month and profit margin would be 33%. Table 1 shows the calculus results.

Table 1: economic-financial analysis result.

<b>NPV</b>	<b>-R\$ 8.764,13</b>
<b>IRR</b>	0,55%
<b>PAYBACK</b>	in 82 periods (months), equivalent to 6,8 years
<b>PROFIT MARGIN</b>	33%

The study shows that the current mode is the best option in this situation. The monthly and annual impact of the suggested changing is small and its payback period is unfeasible mainly in relation to fleet replacement period. The profit margin

percentage value seems feasible, but the time does not. Although it predicts a profit of 1/3 over the investment value, the time necessary for such is very big, which leads to opt for others investments with faster liquidity. Considering that the criterion for acceptation is the feasibility in the four analyses, this project should be rejected. Choosing to keep the current mode, the company may apply the value in others kind of investments more profitable.

## **5. FINAL CONSIDERATIONS**

To perform analyses before to effect any investment is very important, because it permits to scale out and visualize possible results of an action, this fits including in the personal life. In the actual business scenario where costs and profits, as well as planning and actions are differentials for the success and the company position in the market, it is imperative that each step be calculated.

Many times, companies' contract specialized consultancies to perform projects and investment analyses, but in this work, it was possible to show that with some data, researches, and bibliographic survey, considering the relatively simple character of the investment, it is also possible to perform projects and analyses, where the biggest intent is to collaborate with actions and decision-makings more assertive.

To bring the result of a study as being negative, that is, unfeasible for application, does not have to be treated as failure, on the contrary, the study shows that without a previous analysis the company could do an investment to improve its fleet which would not bring the hoped results, giving the opportunity to use the same investment capital in other ways more profitable and satisfactory.

As last considerations it is worth pointing out that the result pointed out for unfeasibility, that is, it is not advisable to follow away with the project, opens space for new discussions and new ways to treat the need of seeking cost reductions and profit increasing, in this way we can suggest for continuation of the study: analysis of installations of bigger tanks inside the company in order to buy and store bigger quantities, in order to decrease costs with purchase; analysis of changing on the vehicle routing, aiming external purchase at potential gas stations; negotiation techniques for the value paid at ARLA 32 wholesale purchase, among others.

## **REFERENCES**



ACR. Auto Converter Recyclers. **Selective Catalytic Reduction (SCR)**. Available in <<http://autoconverterrecyclers.com/selective-catalytic-reduction-scr/>>. Access on 30 Mar. 16.

ASSAF NETO, A.; LIMA, F. G. (2011) **Curso de administração financeira**. 2. ed. São Paulo: Atlas.

BRUNTLAND, G. H. (1987) **Our Common Future: The World Commission on Environment and Development**; Oxford University Press: Oxford, UK.

CHELANI, A. B.; DEVOTTA, S. (2007) Air quality assessment in Delhi: before and after CNG as fuel. **Environmental Monitoring and Assessment**, v. 125, p. 257–263.

FINKBEINER, M.; SCHAU, E. M.; LEHMANN, A.; TRAVERSO, M. (2010) Towards Life Cycle Sustainability Assessment. **Sustainability**, n. 2, p. 3309-3322.

GITMAN, L. J. (2010) **Princípios de Administração Financeira**. 12ª ed. – São Paulo: Pearson Prentice Hall.

GOYAL, P., SIDHARTHA. (2003) Present scenario of air quality in Delhi: a case study of CNG implementation. **Atmospheric Environment**, v. 37, p. 5423–5431.

GREEN LOGISTICS. **What is Green Logistics?** Available in <<http://www.greenlogistics.org/index.htm>>. Access on 30 Mar. 16.

IBAMA. **Programas de controle de emissões veiculares**. Disponível em <<http://www.ibama.gov.br/areas-tematicas-qa/programa-proconve>>. Access on 13 Apr. 16.

KATHURIA, V. (2004) Impact of CNG on vehicular pollution in Delhi: a note. **Transportation Research, Part D: Transport and Environment**, v. 9, p. 409–417.

LUND, D. (2005) How to analyze the investment-uncertainty relationship in real option models? **Review of Financial Economics**, v. 14, n. 3-4, p. 311-322, Mar.

MERCEDES-BENZ. **Mercedes-Benz Vehicles – Trucks**. Available in <<https://www.mercedes-benz.com/en/mercedes-benz/vehicles/trucks/>>. Access on 15 Apr. 16.

MERCEDES-BENZ. **Mercedes-Benz Veículos – Caminhões**. Available in <<https://www.mercedes-benz.com.br/caminhoes/>>. Access on 15 Apr. 16.

PETROBRAS. **FLUA PETROBRAS – Informações Técnicas**. Available in <<http://www.br.com.br/wps/wcm/connect/5df1c10049be25f7aa7cfb178ce5d3a5/ft-quim-ureia-flua.pdf?MOD=AJPERES>>. Access on 30 Mar. 16.

PETROBRAS. **Tire suas dúvidas sobre o Flua, o Arla 32 da Petrobras**. Available in <<http://www.br.com.br/wps/wcm/connect/6d340a804031b9838cd6af342bd5f783/faq-flua-petrobras-arla32.pdf?MOD=AJPERES>>. Access on 30 Mar. 16.

RAVINDRA, K.; WAUTERS, E.; TYAGI, S. K.; MOR, S.; VAN GRIEKEN, R. (2006) Assessment of air quality after the implementation of compressed natural gas (CNG) as fuel in public transport in Delhi, India. **Environmental Monitoring and Assessment**, v. 115, p. 405–417.

SARKAR, S. (2000) On the investment–uncertainty relationship in a real options model. **Journal of Economic Dynamics & Control**, v. 24, p. 219–225.



VALENTE, A. M.; NOVAES, A. G.; PASSAGLIA, E.; VIEIRA, H. (2014) **Gerenciamento de transporte e frotas**. 2ª ed. rev. – São Paulo: Cengage Learning.

YEH, S. (2007) An empirical analysis on the adoption of alternative fuel vehicles: The case of natural gas vehicles. **Energy Policy**, v. 35, p. 5865-5875.