With global warming, the conditioning of the ambient air is becoming essential in order to promote health and well-being. This is one of the reasons why the use of air conditioners is increasing in the world and especially in Brazil. According to the Energy Research Company (EPE), air conditioning (AC) is already responsible for **14% of the electric consumption** in the residential sector. The forecast is that 60% of Brazilian households will have at least one AC unit by 2030.

The recent increase in the use of ACs in Brazil, aligned with an upward growth trend, has drawn attention due to their potential impact on the electric sector, on energy costs and on the environment. The period of AC use coincides with the peak load hours, requiring the generation of additional energy from fossil fuel thermal power plants, which are more polluting and more expensive. Furthermore, Brazilian ACs still use HCFC and HFC refrigerants - which are gases that have a high potential for global warming.

The approval in 2016 of the Kigali Amendment to the Montreal Protocol, which controls the production and consumption of gases that harm the ozone layer, provided the opportunity to reduce the use of HFCs and, at the same time, to increase the energy efficiency of products that use HFCs in an integrated manner - and Brazil is one of the countries that can benefit from these opportunities. According to the EPE, by promoting more advanced standards of energy performance and labeling programs, Brazil could reduce its electricity demand by 25%. This may also contribute to a more competitive and innovative market.

The Kigali Cooling Efficiency Program (K-CEP) is an international philanthropic initiative that supports projects worldwide in order to promote clean and efficient cooling, in accordance with the Kigali Amendment. The Institute for Climate and Society (ICS) saw this scenario as an opportunity to leverage not only strategies for the promotion of the potential of energy efficiency in the Brazilian refrigeration sector, but also to strengthen the ecosystem of the NGOs that are involved in energy conservation.

The Kigali Project in Brazil is funded by the philanthropic resources of the K-CEP and its structure has four interconnected components, as follows:
To support the inclusion of the energy efficiency actions of AC in the planning of the electrical sector and also in the plan for the reduction of HFCs

To evaluate the technical and economic viability for a Brazilian market of high-efficiency compressors

To take action for the laboratorial adaptation and for the transformation of the Brazilian market of ACs

To take action so that the minimum levels of energy efficiency of ACs, the Brazilian Labelling Program and the Procel Seal, are revised to be closer to the world’s best practices
PLANNING THE DEMAND AND MITIGATING THE COSTS AND EMISSIONS

The efficiency gain of the AC contributes to the reduction of the demand peaks of electricity, particularly in the residential and commercial sectors—disclosing one of the fundamental elements in the planning of the electric sector. In addition to reducing the need for new electricity generation plants, the efficiency also helps in the reduction of the consumption of HFCs, which are gases with a high potential for global warming.

For this reason, the Kigali Project has an objective to insert efficiency measures into ACs, both in the energy plans drawn up by the Ministry of Mines and Energy (MME) with the technical support of the EPE, and in the future plan for the reduction of HFCs. This will be developed in coordination with the Ministry of the Environment (MMA), as a result of the ratification of the Kigali Amendment by Brazil.

Throughout 2018, our efforts to achieve this objective were focused on two strategies:

I) Technical support to the EPE. We contributed to the technical studies developed by the EPE by requesting specialized analyses on energy efficiency; the sharing of data and information about the air conditioning sector; and by helping in the revision of the Technical Note “The Use of Air Conditioning in the Brazilian Residential Sector: Perspectives and contributions for the advancement in energy efficiency”, which was published in December 2018.

Through this Technical Note, the EPE provided data and figures that reinforced not only the impact of AC on the demand in the residential sector, but also the potential advantages of energy efficiency:
• It is estimated that the electricity consumption for air conditioning for family households could increase from 18.7 TWh in 2017 to 48.5 TWh in 2035. This growth corresponds to a 5.4% increase per year in the period;

• The establishment of more rigorous minimum indices of energy efficiency, in turn, could contribute to the reduction of the electricity consumption in the residential sector to 14.5 TWh in 2035. This is equivalent to a 3,475 MW power plant (which is equivalent to more than 4 UTE Norte Fluminense power plants - one of the largest natural gas thermal plants in Brazil).

II) Ratification of the Kigali Amendment. From the perspective of accelerating the procedures for the ratification of the Kigali Amendment by the National Congress, the Kigali-Brazil Project team and partners, such as the Brazilian Institute for Consumer Defense (IDEC), have not only been monitoring the progress of this treaty by the committees of the Chamber of Deputies, but have also been open to discuss the subject with congressmen interested in this issue.

Since June 2018, when the bill for the decree of the ratification of the Amendment was presented by the then President of the Republic, Michel Temer, to the Chamber of Deputies, the Amendment has successfully passed the Commission on Foreign Relations and National Defense and has already obtained a favorable opinion at the Commission of the Environment and Sustainable Development.
BUILDING EVIDENCE: THE COSTS AND BENEFITS OF THE ADVANCEMENT OF THE EFFICIENCY POLICIES

iCS and its partners have joined forces in order to develop technical analyses that enable the assessment of what would be the best energy efficiency target to be achieved in ACs, which includes a timetable and details of the conditions of economic viability.

2018 was also dedicated to the development of the regulatory impact study, in partnership with the Lawrence Berkeley National Laboratory (LBNL). Our intention was to conduct a comprehensive assessment of the potential impacts of minimum standards of energy performance of ACs on the electrical system, the final costs to the consumer, the greenhouse gas emissions, and also the additional amounts of investment by the manufacturers.

The preparation of the study had three main stages:

a) the collection of aggregated data from the air conditioning market and from the electric sector, for which we had the support of MitsidiConsultoria. We systematized the main data and disclosed it as an online publication available at: http://kigali.org.br/publicacoes/

b) the search for more accurate information on the reality of the costs of air conditioning manufacturing in Brazil.

c) the analyses of the cost-benefit and the impact on the manufacturer, by the LBNL.

Strategically, the iCS established a series of activities of communication, exchange, dialogue and engagement with the interested parties (from the government and from industry) in the process of the development of the study.
In order to monitor the transparency of the study, an advisory committee was formed with representatives from the MME, INMETRO, Procel/Eletrobras, the EPE and CEPEL. This enabled the exchange of information and established a greater interest in the research.

However, the dialogue with the industry required a longer process. During the process, and as the study advanced, windows of dialogue were opened and positive advances were made with ELETROS and with other companies.

The cycle ended with some victories:

**The benefits of the adoption of higher standards of efficiency are many and the costs are low.** The preliminary results of the analyses indicated that if the minimum standards of performance are increased from the current 3.02 W/W to about 5 W/W, i.e., the best technically possible potential, from 2021, this would have a low impact on the final consumer. The consumer could buy a new AC paying for the additional investment in less than a year, taking into account the reduced energy bills. On a national level, there would be a total economy of R$ 44 billion, by 2035, just with the energy that would no longer be required. This would also result in gains for the electric sector, with about 5 GW of additional demand avoided by 2035 and the corresponding reduction of 95 MtCO₂. Manufacturers would have their investment costs accommodated, with an estimated increase of economic return from the sale of more efficient ACs in the medium term.

**Building of the consensus that it is necessary to advance.** The efforts of coordination and engagement with the study resulted in important discussions and debates with those involved in the sector. The initial results were presented to the Managing Committee of Energy Efficiency Indices (CGIEE), which is an organization that is responsible for the establishment of the minimum standards of performance. We are also negotiating technical cooperation agreements with INMETRO and PROCEL.
ENERGY EFFICIENCY: WHERE THE ENERGY AND INDUSTRIAL POLICIES MEET

During the evaluation of the market of compressors for AC, it was discovered that the reality found in Brazil is complex, with the evidence of barriers that have a greater impact than the lack of investment conditions. The analysis of the energy efficiency in the compressor sector raises another issue - the interface between the industrial and energy policies.

One of the strategies of the Kigali Project is to investigate and propose ways to overcome the different barriers to air conditioners with levels of energy efficiency in line with the best international practices. In an initial hypothesis, we imagined that one of the possible alternatives would be to find ways for investment in new production lines of super-efficient compressors. To assess the issue, we established the partnership with CLASP, which is one of the most active and recognized institutions in energy efficiency in the world, in order to develop a diagnosis of the current market of compressors.

To develop this study, the iCS and CLASP talked with practically all those involved in the sector – from the compressor manufacturer to the main AC manufacturers, from the MME to the Ministry of Industry and Foreign Trade (MDIC), and even SUFRAMA. The diagnosis was concluded in December 2018 and published in January 2019. It can be accessed in the link: http://kigali.org.br/publicacoes/.
As a result of this study, issues were identified relating to the incentive scheme of the Manaus Free Zone, in which 100% of the assembly of ACs is concentrated. In order to obtain the tax benefits, the companies need to comply with a minimum acquisition amount of components manufactured in Brazil. This fact demonstrates a complexity in the case of the compressor, because there is only one company that is capable of producing this part in the country, which is a negative situation from the perspective of competitiveness. The inverter type compressor is still not manufactured in Brazil, which allows companies to import it provided that they contribute with R&D. This contribution is considered as a penalty to the manufacturer that brings the inverter technology, which is more efficient.

In an internal scenario in which subsidies and tax incentives have become the focus of the political discussion and the direction of the national economy, we believe that the study performed by CLASP can contribute to provoke discussion and to propose alternatives with respect to the regulatory and political obstacles, and towards the advancement of a market of efficient compressors. On a broader level, it exposes the case of the air conditioning sector as an example of the urgency of a strategic integration between the industrial and energy policies.
CONFRONTING THE BARRIERS TO THE TRANSFORMATION OF THE MARKET OF ACS

It is not sufficient just to update the minimum standards of energy performance and to revise the labeling and the Procel Seal. In addition to this, it is necessary to facilitate the conditions for the transition of the market of ACs. This requires the adaptation and expansion of the laboratorial capacity and the definition of various incentives, such as sustainable procurement and the lines of financing, etc.

In order to contribute to the transformation of the market of ACs, the iCS acted on two fronts:

Laboratories capable of partial load tests. Taking into account the opportunity to include the adaptation of the CEPEL as an activity to be supported by the PROCEL Funds Application Plan in 2019 (PAR/2019), the iCS sought the help of partners from civil society and academia to jointly reinforce the importance of this investment. As a result, the process of public consultation of PAR/2019 had abroad participation of those involved in the civil society, academia and industry.

Incentives can help leverage the market of more efficient ACs. With the results of the regulatory impact study indicating low costs of investment and significant benefits to the manufacturers in the medium term, it has become possible, from 2019, to promote a discussion with all the interested parties—the companies from the sector, the government, significant purchasers of AC, and financial institutions, with a view to seeking feasible investment solutions in the Brazilian context.
LESSONS LEARNED AND THE CHALLENGES FOR 2019

2018 ended with positive advances and also with many lessons learned. We did not imagine that a simple AC could bring so many benefits to the country, or that the Brazilian market was so complex and unique. We have learned the need for the extensive involvement of the different and varied interested parties that make up this ecosystem. Slowly but surely, we have maintained the clarity of our objective.

In 2019, there will be many challenges. There is the need to consider the institutional changes with the new federal government. There is also the need to strengthen the dialogue with all the interested parties in order to define a regulatory agenda that allows the revision of the test methods, to update the labeling and the Procel Seal, and the implementation of a methodology that enables the automatic revision of the MEPS in the future.
The entrance of iCS into the forums that act on the technical regulation of air conditioners in Brazil has had positive effects with respect to the alignment of the groups with global trends in this area. This is the case, for example, of the ecological refrigerants and the incentive for the adoption of more rigorous energy efficiency indicators that contribute to the saving of electrical energy in the country.

Within the ambit of the Management Committee of Energy Efficiency Indicators (CGIEE), iCS played an important role, contributing with constructive suggestions that influenced the increase of the minimum energy efficiency indicator for air conditioners, resulting in the publication of the joint ministerial ordinance 002/2018. iCS encouraged the participation of other institutions from civil society to contribute to the drafting of ordinance 002/2018.

An important highlight of 2018 was the start of the development of the cooperation agreement between Procel/Eletrobras and iCS. This agreement has the objective to enable the development of regulatory and economic studies to support the definition of energy efficiency policies and the determination of minimum efficiency indicators for the refrigeration sector.

Victor Zidan da Fonseca
ELETROBRAS - CENTRAIS ELETRICAS BRASILEIRAS S/A
PRFP - PROCEL - National Program for the Conservation of Electrical Energy
BEYOND THE DIMENSION OF RELEVANCE

The relevance of a project that aims to study the possible scenarios and the impacts of the increase of the efficiency of products that are intensively and extensively used by the Brazilian population would be, by itself, evident. However, the Kigali Project exceeds the dimension of relevance and should be considered, in fact, as being strategic for the country. It is strategic in that it proposes to make recommendations to the institutions involved with the Brazilian policy of energy efficiency for household appliances, based on research, interviews with the productive sector, and the analysis of data and information. If implemented effectively, it could cause a market transformation, with the best cost-benefit ratio for society.

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EVALUATION OF THE BRAZILIAN COMPRESSOR MARKET

This technical and economic feasibility study evaluates the Brazilian market for air conditioner (AC) compressors, reviews policies that affect cost and/or restrict access to high efficiency compressors, and identifies other economic and technical barriers to their availability in Brazil.
The Future of Energy Efficiency in Brazil

In 2017, Brazil increased its energy expenditure by 1%, even with the drastic effects of the severe economic crisis that it experienced. The challenges and the possibilities for the future of the energy efficiency in the country were the theme of the Debate, a program on the Canal Futura channel, which included Kamyla Borges Cunha, iCS consultant and coordinator of the Kigali Project. In the discussion, the potential generation of 450,000 jobs in the next 12 years in the area of energy efficiency in Brazil was discussed.
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