THEMATIC CHAPTER 4

Proposal for a Long-Term Energy Strategy

This thematic document arises from and also complements the publication *Elements for a Long-Term Low-Carbon Strategy*, produced by UNICEN.

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FUNDACIÓN AMBIENTE Y RECURSOS NATURALES

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SOME INTRODUCTORY CONCEPTS ABOUT ENERGY SYSTEMS

Long-term strategies (LTS) should systematically consider all the dimensions that interact, to a greater or lesser degree, to achieve the intended goal.

Therefore, in the vision of Fundación Vida Silvestre (FVS), addressing the energy system first requires framing it within a broader conception. This includes those aspects that are desired and vital for human development (in terms of social, welfare, health, as well as economic aspects) and the environmental conditions that support life on the planet in general and that of our society in particular.

Thus, the sustainability of the energy model in the long term will only be achieved by including the aspects mentioned in the previous paragraph in the analysis. In addition, the policies to be implemented must aim to include all these dimensions and not only those of the sector itself.

Energy systems play an essential role in the development of human society; while at the same time are one of the major responsible agents for the most significant environmental failures and problems: climate change, nuclear accidents and massive destruction of ecosystems with large hydroelectric works, among others. They also produce conflicts, tensions and distortions in the economy and society in general, given the economic and political weight of the actors involved in the sector and the great magnitude of the physical interventions typical of the technologies developed in the 20th century.

The aim of energy systems is to satisfy human needs by means of energy services, such as mobility, transport, climate conditioning, motive power and food preservation, among many others.

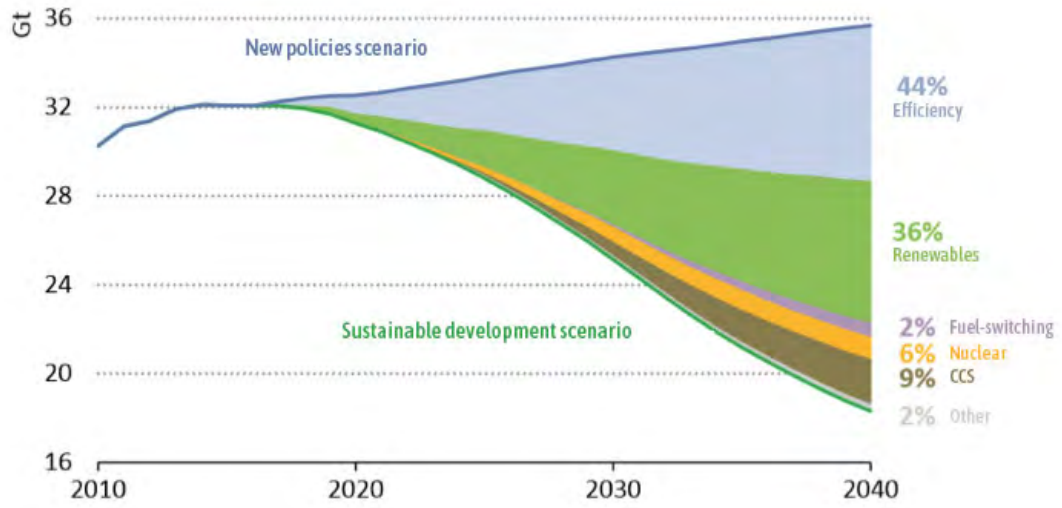
These energy services are produced by appliances that consume energy from some kind of source. As an example, the lamps that give us light (energy service of illumination) consume electricity (energy demand) produced by a power plant (energy supply).

A sustainable energy policy in the long term must focus on the provision of energy services by means of the correct and balanced contribution between energy supply and demand. However, when planning sector policies, the focus is put on energy supply and hardly any measures are outlined for the demand side, while both should be boosted in an equivalent way. As a consequence, energy plans, subsidies to the sector, institutions, national and private companies, and most human resources are focused on energy supply, fuel production, construction of large engineering works and the promotion of oil or nuclear activity and transmission and distribution lines, etc.

In this sense, it is important to bear in mind that policies that emphasize demand - as implemented in many countries - can produce energy savings equivalent to those generated by policies that focus on energy sources, but at a much lower cost and with much smaller-scale social, environmental and health impacts.

FVS understands that, as is the case in many other countries, the Argentine energy system must be planned jointly considering both the different energy sources and the various energy consumption and service sectors. Figure 1 shows a world scenario to the year 2040 in which the expected reduction of emissions has a very important component of renewable energies (36%), as well as an even greater energy efficiency (44%).

FIGURE 1. GLOBAL SCENARIO FOR THE EVOLUTION OF EMISSIONS IN A LONG-TERM STRATEGY FOR THE ENERGY SECTOR



Source: IEA, 2018.

In terms of greenhouse gas (GHG) emissions reduction, Argentina's energy planning should aim at reaching zero or eventually neutral emissions by 2050, as proposed by the Paris Agreement.

The question that always opposes this objective is: why should Argentina, which is only responsible for 0.7% of the world's emissions, strive to change its energy matrix? There are several arguments:

- Global problems require global solutions. It will not be possible, politically, to be detached from the world trend. There will be no exceptions.
- The global trend leads us to a world where commercial exchange will be marked by the valorization of the carbon footprint of products and commodities, which will be "punished" if they come from carbonized energy matrixes.
- For Argentina to be able to reclaim in international contexts the mitigation of large emitters, its policy must be consistent and in line with its request

In addition, energy alternatives that lead to zero emissions or to carbon neutrality have a number of advantages that will be listed in the following chapters.

In virtue of the concepts developed, FVS proposes in this work, several strategic guidelines for the energy sector, as well as some necessary articulations with other dimensions to be considered. To this end, we will first analyze the supply matrix, then the policies from the demand side -where FVS places special emphasis-, in order to finally advance on a series of necessary structural changes and describe the list of co-benefits that will result from a decarbonized energy system.

TOWARDS A NEW SUPPLY MATRIX

Argentina's energy supply matrix, like that resulting from the average of the rest of the countries in the world, has a very significant component of fossil fuels, about 85%. To change this detrimental situation, we propose certain guidelines in the matrix of supply for the provision of energy towards 2050.

Fuels

The supply of natural gas can be increased, at local level, until it reaches its production peak in 2030 with the objective of substituting solid fuels and oil derivatives, while reducing imports. Then a path of declining local production begins. During this period, the policies of degasification of the Argentine matrix should be activated.

Therefore:

- The development of oil and gas activity and the construction of new infrastructure in the area should not be promoted, except as strictly necessary to achieve the transition described in the introductory paragraph.
- The hypothesis of development of Vaca Muerta, besides taking aim against sustainability, considers and assumes a series of very risky and not very feasible assumptions, such as:
    - The possibility of exporting gas, given that there are other gas producers that are geographically and economically better positioned than Argentina and that countries in the region and throughout the world are planning decarbonized matrices.
    - Disregard for the emergence of para-tariff barriers that punish CO_2-intensive matrices, hence penalizing the consumption of fossil fuels.
- Coal-fired power generation projects should be ruled out.
- Waste incineration technology should not be adopted to produce energy, because of its potential environmental and social impacts and because it indirectly promotes waste production.
- The use of fossil fuels for the petrochemical activity should be supported as long as this activity and its elaborated products are carried out under strict environmental considerations and throughout their entire life cycle.

Hydroelectricity

Hydroelectric power plants development has proven to be difficult to control. According to a 2014 Oxford University study published in *Energy Policy*, after having analyzed 245 projects in 65 countries between 1934 and 2007, it is concluded that the cost overruns of these projects average 96% and that their execution time is 44% longer than originally indicated. In other words, over the decades and in different countries around the world, these projects have failed to meet the agreed conditions.

From the environmental point of view, many of these projects, although not all, generate enormous environmental impacts that cannot be avoided. Consequently:

- The repowering of existing hydroelectric plants should be promoted, policy successfully applied in other countries.
- The feasibility study of the use of existing hydroelectric plants associated with pumping stations that allow the accumulation of energy and make the system more flexible should be promoted.
- The hydraulic projects to be developed must be limited to those that can demonstrate a very good environmental performance. Thus, large run-of-river power plants in the Argentine Northeast and Northwest regions (NEA and NOA) and the Condor Cliff - Barrancosa projects are excluded because of their strong negative environmental and social impacts.
- Tidal projects should also be ruled out due to their high cost and environmental impact.

Nuclear Energy

Nuclear projects have to be developed on the minimum scale necessary to sustain the know-how in this technology. It is not proposed as a means of mass generation, because of its high costs and potential danger to human health and the environment.

The setting-up of new nuclear power plants, if any, should be distributed all along the national territory, avoiding their accumulation in the province of Buenos Aires, just because of the fact of its counting with an authorization that was granted decades ago. Nuclear power plants should be located far from large cities, as is the case of the city of Buenos Aires and AMBA.

In this sense, no nuclear power plant may be located without the appropriate social licenses.

Renewable Energy

FVS has participated in several renewable energy modeling exercises in recent years[1]. Although it is not relevant to specify power per technology, it is important to point out certain advantageous characteristics that these energies have over conventional ones:

- Diversification of the matrix.
- Fast and modular construction, compared to large hydroelectric and nuclear power plant construction.
- Competitive costs and even lower than conventional ones, with a tendency to becoming more competitive in upcoming years.
- They are more predictable and less economically volatile.
- They reinforce self-supply. The renewable energy resource is totally national.

1. **https://www.escenariosenergeticos.org/escenarios/fvsa/**

- Availability throughout the national territory. The capture and production of renewable energy can be achieved in a large geographical distribution, tending to a balanced territorial and economic development in different regions of the country.

- Distributed generation. Use and capture of solar energy within the urban areas mainly, and to a lesser extent, wind energy.

If renewable energies are prioritized in the energy matrix, the total electrical power incorporated will be very high, in the order of tens of thousands of MW. This is justified by:

- The high penetration of intermittent renewable energy

- The migration of fuel end-uses to electricity, for example, for residential heating and electric vehicles, two major uses of gas and liquid fuels, respectively.

The menu of options considered for implementation is:

- Renewable fuels: in those applications that need fuels, bio-fuels, bio-gas, biomass and hydrogen are considered.

- Wind projects, especially inshore.

- Concentrated and fundamentally distributed solar thermoelectric and photovoltaic energy for the production of electricity. Solar concentrators, photovoltaic fields and distributed photovoltaic. The development of floating photovoltaic technology (FPV) is contemplated as an interesting option in the medium term.

- Solar thermal energy for water heating and in industrial processes that allow it.

- Significant participation of hydraulic projects, including those currently in force, although with the exception of large run-of-river plants in the NEA and NOA regions. Mini hydraulic projects are incorporated.

- Geothermal energy for thermal use and electricity production.

The technological and economic dynamics of the renewable sector are very large and it is not relevant to specify shares. However, it is clear from today's perspective that wind and solar energy will be major players in this transformation. Besides, all variants with a non-centralized format, i.e. distributed, either on the territory of the country or, for example, photovoltaic generation distributed within cities, contribute to a more sustainable and balanced model, which is why FVS especially promotes them.

ENERGY DEMAND AND THE RATIONAL AND EFFICIENT USE OF ENERGY

By integrating the development of Rational and Efficient Use of Energy (REUE) into energy policies, related services can be provided at lower costs, will require smaller investments and will have reduced environmental impacts. And, above all, the massive introduction of renewable energies will become viable.

Therefore, it is worth asking again: why are Argentine energy policies mostly supply-oriented? This counterproductive bias, repeated throughout the various administrations, leaves aside a significant "energy resource" that is considered the first "energy source".

Energy demand can and must be optimized and regulated in all consumer sectors (transport, habitat and industry), in all energy sources (oil derivatives and electricity) and in all end uses, transport, air conditioning, industrial electric motor-driven systems and lighting, among others.

In order to get to 2050 with a decarbonized and efficient energy matrix of consumption, it will have to be based mostly on electrical energy. Therefore, we must advance in the electrification of the energy demand. The reasons that explain the need for intensive electrification are:

i) All end uses can be provided with electricity[2], but not all with fuels.

ii) Electric power can be produced entirely from renewable energies, a necessary condition for the zero emission target by 2050. Although this transition will take some time (years or decades), the preparation of the consumer infrastructure, alongside with that for clean generation, is a responsibility that cannot be postponed.

iii) All conversions of secondary energy to the desired energy service are much more efficient if they are carried out with electric power.

iv) Electric power management can be carried out much more easily than with fuels (demand management, accumulation with recovery of vehicle braking, etc.). Therefore, it also enables a more efficient use of energy.

SAVINGS POTENTIAL

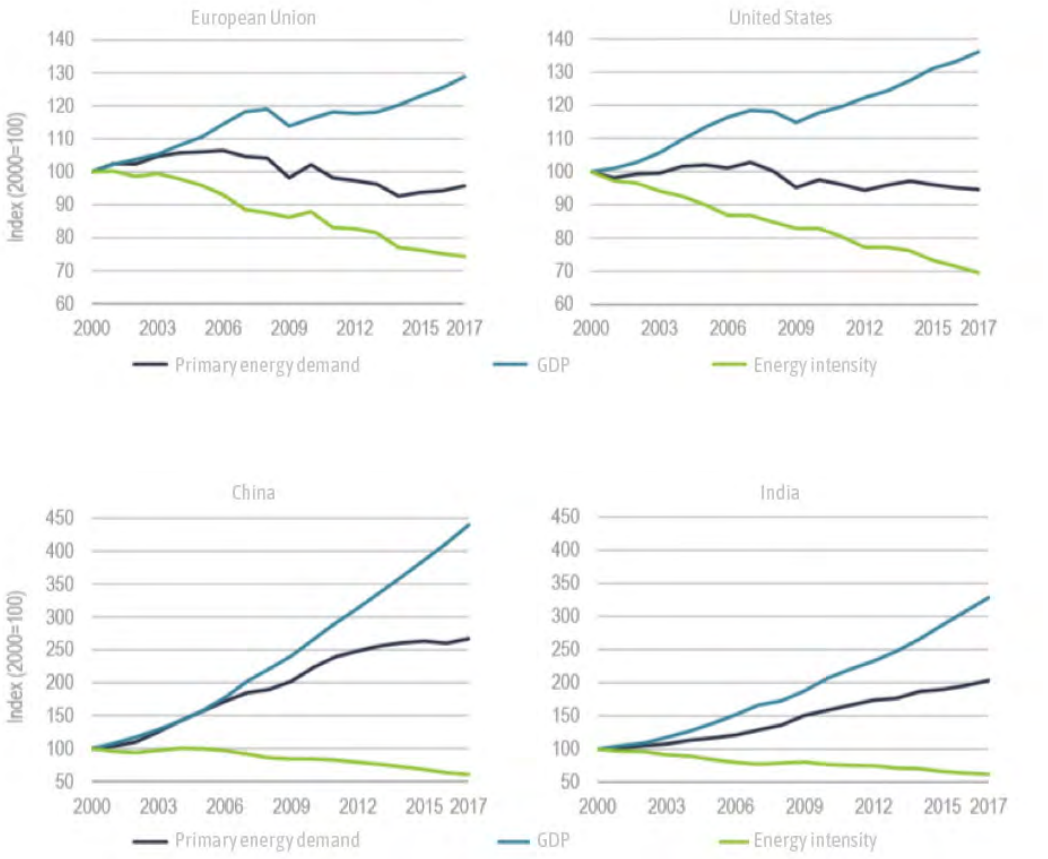
We can determine Argentina's savings potential to 2050 without entering into complex sectoral, technological and economic analyses, using a top-down methodology, taking generic values that we know are representative, valid and existing in other parts of the world, and transposing them to the Argentine context.

For example, if we consider what happened in other countries where since the 80s have had much more developed efficiency policies than in Argentina as a reference, we get a ground for the possible savings potential, since our country still has a lot of potential to be harnessed, which is easily achievable and has not been tapped yet.

It is also possible to reference the evolution of energy intensities (EI), that is, the relationship between primary energy consumption and the gross domestic product (GDP) of a country. Between 2000 and 2017, in the United States, the European Union (developed), India and China (developing, with lower per capita GDP values than Argentina), the EI decreases linearly (non-cumulative rates).

2. This may be questionable at present only in the case of transport on ships and planes.

FIGURE 2. EVOLUTION OF THE GDP, PRIMARY ENERGY CONSUMPTION AND ENERGY INTENSITY IN THE PERIOD 2000-2017 FOR DIFFERENT REGIONS AND COUNTRIES OF THE WORLD



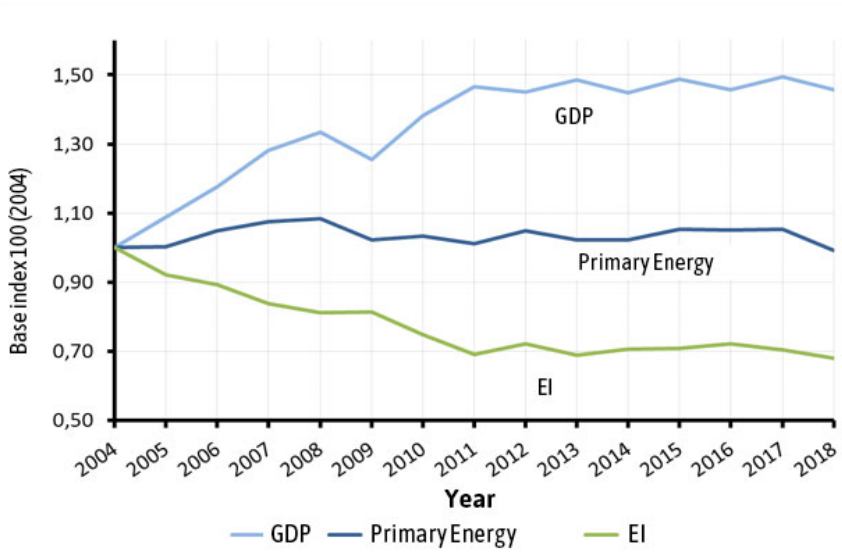
Source: IEA, 2018.

In this regard, Figure 2 shows that in the European Union, the United States, China and India the decline in EI over the last 17 years occurred at a linear rate of 1.47%, 1.76% and 2.35% respectively.

It is also interesting to note that in developed countries, given a GDP growth of between 30 and 35% (more limited than that of China and India), primary energy consumption was reduced by around 5%.

Figure 3 shows the case of Argentina. It shows the absence of effective REUE policies and, at the same time, reveals the possibility of enormous energy saving potential, which is still waiting to be tapped.

FIGURE 3. EVOLUTION OF THE GDP, PRIMARY ENERGY CONSUMPTION AND ENERGY INTENSITY IN THE PERIOD 2004-2018 FOR ARGENTINA



Source: own production.

It is possible to propose a saving hypothesis in the order of 40%-55% for Argentina in its energy intensity for 2050. Although a more in-depth study, accompanied by appropriate policies, could foresee greater savings.

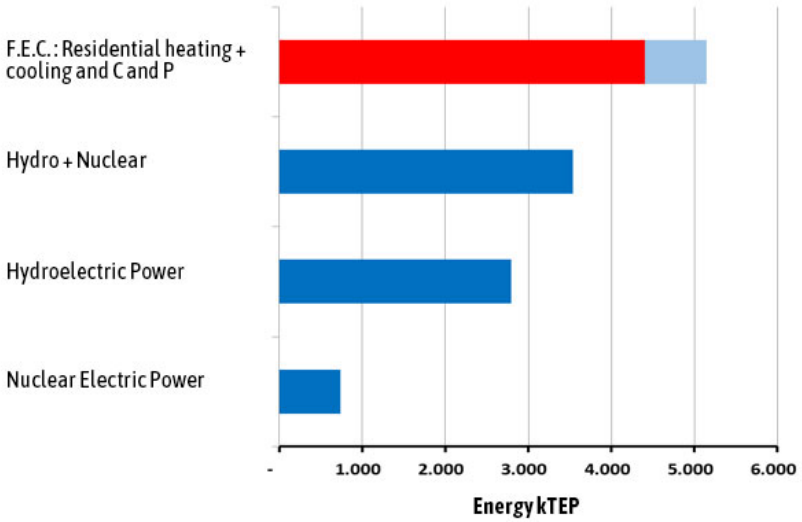
As an Example

Air conditioning in the residential, commercial and public sector, whether in summer or in winter, is another example of the existing and necessary savings potential. Figure 4 shows the magnitude of the end uses (in red) of air conditioning and the national nuclear and hydroelectric energy production (in blue).

It shows that the energy consumed only in air conditioning (mainly heating and cooling) is at least 30% higher than that produced by all hydroelectric and nuclear power plants in Argentina. This enormous distortion, between the policies promoted in the supply of energy and the non-existent ones on the demand side, produces an effect of great energy and resource waste, unnecessary pollution and lower economic productivity, among other damages.

These relative magnitudes have no correlation whatsoever with energy policies, institutional organization charts and the human and economic resources of our country. Nor are there any policies that deal with air conditioning or a National Directorate for Rational and Efficient Energy Use.

FIGURA 4. ENERGY PRODUCTION IN NUCLEAR AND HYDROELECTRIC POWER PLANTS IN ARGENTINA VERSUS ENERGY CONSUMPTION IN AIR CONDITIONING (2018)



Source: own production.

IMPROVEMENT POLICIES

Major policy approaches to improving energy consumption are based on three pillars:

1) Energy efficiency

a. Use of more efficient devices, based on policies that promote lower consumption technologies.

b. Substitution of fuel-based consumption for electricity-based consumption, which will significantly increase the efficiency of final conversion.

c. Design and planning that consider the environment, resources, health and wellbeing in an integrated way. For example, planning of cities, networks and means of transport, design of buildings and housing, industrial processes, lighting systems, etc., beginning with the formation of technicians and professionals with high training in sustainability issues.

2) Responsible or rational use of energy

Improvements in behavior, habits and customs based on generating environmental awareness and promoting specialized technical and professional education and training.

3) Energy adequacy

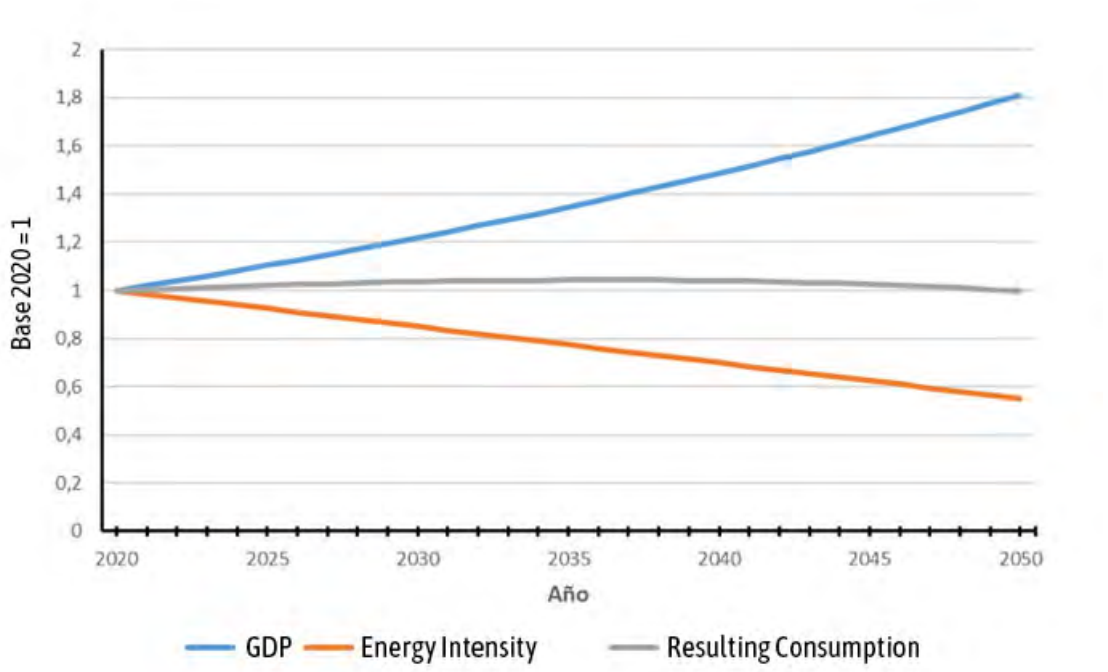
Policies to encourage the non-use of more energy than necessary, discouraging luxury consumption and the use of excessively large appliances.

It is worth highlighting that a study conducted by FVS in 2013 estimated that the use of REUE policies in the period 2012-2030 would have avoided the investment of USD 35 billion in infrastructure works in the electricity sector alone.

CONSOLIDATION OF SUPPLY AND DEMAND IN A LONG-TERM STRATEGY

After what was exposed in previous chapters, it is possible to propose a general trajectory of the energy system. This trajectory proposes a component of REUE that implies a level of reduction in energy intensity of 1.5% per linear year, which accumulates, in a period of 30 years, a decrease of 45% with respect to the base year 2021, in line with international experience. This reduction means a feasible floor that could be overcome, given that Argentina has done little on the subject and there is much room for improvement. At the same time, it is estimated that GDP growth will follow a 2% annual pace during the same period. The result of this exercise is shown in Figure 5.

FIGURE 5. EVOLUTION OF FINAL ENERGY CONSUMPTION IN ARGENTINA, UNDER THE ASSUMPTION OF 2% ANNUAL GDP GROWTH AND 45% REDUCTION IN ENERGY INTENSITY IN THE PERIOD 2021-2050



Source: own production.

It should come as no surprise that in Figure 5 energy consumption has remained constant for 30 years, as this phenomenon has been repeated in many countries and regions of the world over the past two decades. This demonstrates the powerful effect of demand-side policies. It is therefore imperative that REUE policies are included in the long-term energy strategy.

From all this, the lines of action to be applied to reach zero emissions or carbon neutrality by 2050 are presented below.

In Terms of Consumption

1) Implement energy efficiency in all appliances that run on liquid fuels, natural gas and electricity, with a goal of reducing energy intensity by 45% by 2050.

2) Replace natural gas appliances with electric appliances where replacements are simpler: home heating, water heating and food cooking, in a first stage.

3) Put a stop to the advancement of installations of natural gas networks, in a first stage north of the "Río Colorado" (in the north of the country the heating services -great demanders of natural gas- are practically unnecessary). Continue in a second stage with the rest of the territory, analyzing a policy for the subject.

4) Increase the efficiency of trucks and light and semi-heavy vehicles in transport. Successively replace liquid fuels with natural gas (released from residential consumption) and, finally, natural gas with electricity, moving forward with the electrification of public transport, in the first instance, and of private vehicles in the second.

5) Strengthen the electricity transmission and distribution networks. Develop intelligent networks (Smart Grid)

In Terms of Supply

1) Reduce the use of fossil fuels so that GHG emissions are on a path towards elimination or neutrality by 2050.

2) Promote the use of renewable fuels, biomass, biofuels, biogas and hydrogen, when their use is necessary.

3) Transform the energy supply matrix towards a predominant production of electricity.

4) Promote cogeneration as a source of heat and electricity.

5) Establish incentive and regulatory policies that level the possibility of energy storage.

6) Design and reinforce the networks and structures for the transmission and distribution of electric power in harmony with the technologies promoted towards 2050 (Smart grid, distributed generation, demand management, energy storage, among others) and with the migration from fuel consumption to electricity.

7) Avoid any type of generation that is effective or potentially harmful to human health and the environment: coal-fired power stations and some large-scale hydroelectric projects.

8) Keep nuclear energy to a limited extent, decentralizing its production away from large cities.

Other Measures

1) Promote and create scientific and technical institutions and reorganize the organizational charts of the national and provincial government structures, prioritizing the relevant technological areas in the 21st century (in those corresponding to the energy sector). Foster transversality with those other areas with strong links: transport and habitat.

2) Asistir con un paquete de políticas coordinadas y efectivas, dotadas de recursos humanos y económicos suficientes, elaborando un Plan de Transición Energética Justa que acompañe los procesos de recambio tecnológico, cambios de actividad económica y formación de capacidades profesionales, entre otros, y las grandes transformaciones que se derivan de las propuestas anteriores.

CO-BENEFITS

Among the co-benefits of implementing the lines of action presented are the following:

Environmental

The reduction of energy consumption and the shift to renewable energies entails a number of other benefits for the environment, from which significant reductions can be expected:

- Atmospheric pollution from the use of fuels: emissions of CO and particles (toxic to humans) and SO_2 and NO_x (precursor gases to acid rain).
- Land degradation and pollution: surface mining of coal and uranium, gas and oil extraction and radioactive waste disposal.
- Destruction of ecosystems: caused by flooding from large dams.
- Damage to water bodies: damage to marine and river fauna, etc. by oil spills; alteration of natural cycles of hydrological regimes; damage to fish fauna by large dams.
- Thermal pollution and problems associated with cooling systems of thermoelectric power plants.
- Visual and sound pollution, etc.

In Terms of Employment

Both renewable energy and REUE produce more jobs per unit of economic investment made than their equivalent in conventional production.

As an example, a publication analyzing nine clean energy alternatives and two from the fossil fuel industry (Garret-Peltier, 2017) found out that for every $1 million invested in energy efficiency activities, 7.7 full-time jobs were created, in renewables 7.5 and in the fossil fuel industry 2.7.

In Terms of Health

The gases emitted by fuels used in transport, industry and the residential sector are responsible for a large number of diseases and deaths from respiratory diseases. According to a World Health Organization estimate, air pollution causes the death of four million people annually around the globe. In turn, depending on the city, transportation can be directly responsible for 15 to 70% of outdoor air pollution in urban areas.

SOME NECESSARY STRUCTURAL CHANGES

The institutions linked to energy must have structures that represent in quantity and quality the technologies to be promoted. In particular, renewable energies and the REUE should be hierarchically arranged at a high level in the institutional organization charts and be of a similar magnitude to those dedicated to conventional sources, mainly fossil fuels, which should start to decline as 2050 approaches.

REUE must cover all consumer sectors and all energy sources, articulating transversally with all areas involved. To this end, research and technological development structures must be promoted and created in the areas of renewable energies, REUE, energy accumulation and all those technologies of the 21st century.

It would also be desirable, in some cases, to reconvert or update the objectives of the institutions dedicated to conventional energies. This enormous task should be included in the Fair Energy Transition Plan proposed above. The Plan would aim at helping the technological, employment, professional and institutional transitions from the old to the new format, minimizing the social and economic impacts that the change would produce.

On the other hand, the scientific and technological apparatus, as well as society - from its representative entities - must be part of the planning and decision making in the energy issue.

REFERENCES

Ansar, A., et al. (2014), Should we build more large dams? The actual costs of hydropower megaproject development. *Energy Policy* (2014), **http://dx.doi.org/10.1016/j.enpol.2013.10.069**

Balance Energético Nacional (2018). Secretaría de Energía de la Nación. Available at: **https://www.argentina.gob.ar/energia/hidrocarburos/balances-energeticos**

FVS,(2013). *Escenarios energéticos para la Argentina (2013-2030) con políticas de Eficiencia Energética.* Buenos Aires, December 2013.

Garrett-Peltier, H. (2017I. Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model, *Economic Modelling,* Volume 61, Pages 439-447, February 2017, Elsevier

IEA (2018). *Energy Efficiency 2018,* Market Report. France.