

The economics of the new electricity mix

Introduction

Fabrice Dambrine, engineer from the Corps des Mines, section president at the Conseil Général de l'Économie, member of the Council of State

The electricity transition's costs

Microeconomic analysis of the intermittent generation of electricity from renewable sources

Fabrice Dambrine, engineer from the Corps des Mines, section president at the Conseil Général de l'Économie, member of the Council of State

The public policies conducted in France and Europe during the past twenty years consider the electricity transition mainly to be the replacement of thermal power stations (using fossil fuel and nuclear energy) with means for generating electricity by using renewable forms of energy (mostly wind power and photovoltaics). In what proportion can these new means become part of the electricity mix without undermining the foundations of energy policy, namely: the security of the electricity supply, the access to electricity at a reasonable cost, and the protection of the environment? When addressing this question directly in terms of the costs of megawatts, we are inclined to believe that the transition will take place naturally, since the production costs of wind power and photovoltaics are steadily decreasing to the point of becoming competitive with other means used to generate electricity. But this belief induces us to overlook the physical limits inherent in these new means of production. On the one hand, the energy they produce is "fatal" (*i.e.*, lost if not consumed right away); and on the other hand, these means of production cannot be steered. For a secure electricity supply, it will always be necessary to keep installations "in reserve" that can be steered to respond to consumer demand.

A macroeconomic assessment of the electricity transition in France

Nicolas Govillot, Richard Lavergne and François Valérien, engineers from the Corps des Mines

A simplified macroeconomic model of how France's electricity mix will evolve by 2030 is presented. Each scenario in this model is evaluated using its total production cost, greenhouse gas emissions and impact on the country's balance of trade. Production data in half-hour increments are used from a three-year period. This simulation provides a tool for public decision-making.

Intermittent energy sources: How much?

Jean-Pierre Hauet, chairman of the scientific committee, Équilibre des Énergies

What proportion of energy from intermittent sources (mainly solar and wind power) should figure in the electricity mix? This question has spurred heated discussions. Methodologically and economically, the full costs of these forms of energy should be compared with the economic value of the kilowatts generated. As this analysis shows, the cost price and economic value are, at any given moment, non-linear functions of the penetration rate. Whereas costs are affected by two factors, saturation and lesser acceptability, the economic value has to be discounted considerably owing to three factors: the variability of production over time, the contingency of predictability, and the lack of congruency between places of production and of consumption. The resulting economic optimum evolves over time, especially as costs fall. Nonetheless, the share of intermittent energy sources depends mainly on the financial effort that we are willing to make. Technical and economic studies of how to optimize the electricity mix should be made that take account of all relevant parameters.

Storing electricity, the solution for intermittent renewables?

Étienne Beeker, France Stratégie, and Richard Lavergne, Conseil Général de l'Économie

Storing electricity is undoubtedly a major worldwide issue in the energy transition, since it is indispensable for uploading electricity from intermittent renewables (wind power and photovoltaics) to the grid. The value of storing electricity is related to the services obtained, especially in areas where the grid is insufficient. The centralization of hydroelectricity – still, by far, the prevailing technology – keeps it from satisfying all needs. The rapidly lowering cost of lithium-ion batteries represents an opportunity, especially for transportation, electricity grids and, to a lesser extent, consumers who produce their own current. Battery storage can compete with others forms of technology or services for managing flexibility: steering demand (load management), storing heat, etc. For mainland France, it would be utopian to imagine an electricity mix based only on hydro, wind and photovoltaic power and the storage of electricity, since its cost would soar within a foreseeable period of time.

The electricity transition: The viewpoint of economic agents

The electricity transition's incoherency with the policy for the energy transition

Dominique Finon, Centre International de Recherche sur l'Environnement et le Développement (CIRED)

To reduce CO₂ emissions, a sound decision would be to give up the two-pronged objective of raising the share of

renewables to 40% and reducing nuclear energy to 50%. This objective entails excessive costs and would not help reduce greenhouse gas emissions. The considerable means now allocated for the head-on development of renewables for generating electricity should be shifted to other purposes via mechanisms not related to the market. Among these finalities are, in particular, the promotion of energy efficiency (via the thermal renovation of buildings on a large scale) and the development of thermal energy from renewable sources. In their favor, these finalities would be efficient with regard to the climate objective (which hardly seems attainable given the decisions made). This reallocation of means makes sense insofar as households are paying specific taxes for funding green investors and the producers of solar power.

ENGIE and the energy transition – From dream to reality: An energy mix 100% renewable by 2050

Gwenaëlle Avicé-Huet, general manager of BU France Renouvelables, ENGIE

The energy transition calls for a revolution in our perception of the environment, an environment now being simulated and to be seen as limited. From this perspective, citizens, as well as firms and governments, take on a new role given the possibility of an energy mix with 100% renewables. This is the hope that ENGIE wants to help realize while taking into account its social, economic and technologic effects. The awareness of citizens, the competitiveness of renewables and the current progress of technology are reasons for hope that we can achieve 100%. The complementary development of various renewable energy industries (electricity, “green” gas and heat) will make it possible, in a regulatory context that is both stable and predictable, to change the balance of our energy mix and tip it toward renewable sources for all the energy we consume.

Automated meter readings, a necessary condition for a successful energy transition

Michel Derdevet, ENEDIS

To make the energy transition a success, the electricity grid is undergoing considerable changes: input from renewable sources, digitization, “electricity mobility”, steered consumption, etc. Automated meter management, which lies at the core of this revolution, is the first brick for making electricity grids smart. Smart grids will be necessary to reach the objectives set for the climate. This is a major stage in the energy revolution – an opportunity for France and Europe, even more so since they have internationally recognized leaders in this field.

Renewables and the electricity transition

Jean-Louis Bal, president of the Syndicat des Énergies Renouvelables

France has always successfully managed major transitions in its electricity grid. The transition that we entered a few years ago is in continuity with this past. It represents an awesome source of innovation and economic opportunities. This transition toward renewable sources of energy for generating electricity has taken on full meaning.

Thanks to the public policies adopted, we are fully benefitting from new forms of technology as their costs decrease, and this opens access to a range of solutions that are, or will soon be, competitive. Moreover, strides have been made in developing “flexible” tools that help renewables reach a very high penetration rate. Finally, this transition responds to a deep aspiration of people and firms in France, who are ready to play an active part in this new phase of our country’s energy transition.

Nuclear energy in the electricity transition

Valérie Faudon, Société Française d’Énergie Nucléaire

France is relying on nuclear power for a secure low-carbon supply of electricity at the lowest price in western Europe. It has committed itself to diversifying its electricity mix in the coming years as advances are made in the technical and economic efficiency of: renewable sources of energy, the means for storing electricity, and smart grids. Since the country will still need nuclear installations in 2050, it must start drafting an industrial program for updating its fleet of nuclear reactors. Worldwide, nuclear energy will be indispensable for “decarbonating” electricity grids; and the French nuclear fleet is already helping to reduce the carbon emissions of neighboring lands in Europe. Thanks to a positive balance in exportations, this fleet is, owing to its flexibility, making it possible for renewables to develop. In Europe, France is the country best able to build nuclear plants, at a time when plans for new reactors are mostly concentrated in Asia. Thanks to France, it will be possible, if public awareness allows, to launch European programs for nuclear energy in the coming decades.

The energy transition: Reducing the share of nuclear energy and increasing the share of renewables while not further weakening industry’s competitive edge

Stéphane Delpeyroux, Union des Industries Utilisatrices d’Énergie (UNIDEN)

Discussions are taking place about long-term plans for the French electricity industry, and RTE (Electricity Transmission Network) is presenting scenarios for the country’s electricity mix. Meanwhile, the government has postponed the objective of 50% of electricity from nuclear energy in 2025. UNIDEN is satisfied with this decision. This trade group wants to see France adopt the objective of being competitive in energy. Far from being incompatible with the rise of renewables, the goal of making industry competitive implies controlling the pace at which the electricity mix changes and maintaining the country’s ace in the hole, namely electricity from nuclear power.

The electricity transition: Governance and models of development

The electricity transition: The end of the consensus in Germany?

François Valérian, engineer from the Corps des Mines, Conseil Général de l’Économie

The most visible sign of *Energiewende* – the energy transition in German – has been the massive support for gen-

erating electricity from renewable energy sources. Beyond the implied technical and economic choices, this policy has, for several years now, benefitted from a broad consensus that has served as the grounds for Germany's efforts to exercise moral leadership. However recent changes in the country's policies suggest that this consensus is wearing down.

The electricity transition: Between markets and policy objectives

Jacques Percebois, professor emeritus, Montpellier University (UMR CNRS Art-Dev), codirector of Energy Transitions, chair of climate economics (Paris Dauphine University)

In Europe, liberalizing the electricity industry has brought along regulations for boosting the penetration rate of renewables, such as solar or wind power. The existence of natural monopolies (grids) and the preservation of the general interest are forcing public authorities to accept several exceptions to the freedom to compete (sometimes with deviant effects). The market alone cannot orient long-term choices about energy, but it does stimulate innovation and efficiency.

The price of carbon, a factor in the electricity transition

Christian de Perthuis, professor, Paris-Dauphine University, and founder of the chair of climate economics, and **Boris Solier**, associate professor of economics, Montpellier University (ART-Dev – UMR 5281) and codirector of Energy Transitions, chair of climate economics

Given the malfunction of the European carbon market and the absence of coordination with policies for subsidizing renewables, setting the price of carbon has had a limited impact on the electricity transition, which is mainly switching power plants from fossil fuels to natural gas. The reforms in the electricity industry are examined that are needed to accelerate the transition by reducing the (now excessive) subsidies for renewables. The pricing of carbon in Europe should be broadened to converge toward a minimum price. At the same time, price subsidies for renewables should be dismantled, and public funds should be redistributed to three drastically underfunded priorities: public research, support for restructuring industries, and the fight against energy poverty.

50% or 50%?

Jean-Marc Jancovici, partner and founder of Carbone 4

50%, a magic number! Following the promise made by François Hollande during the 2012 presidential and parliamentary election campaigns (a promise made to attract votes from the "green" parties, historical opponents of nuclear energy), this percentage figured in the first article in the act of law on the energy transition and green growth. By the way, Hollande was right: the Greens represented 3% of the vote, and he won with 51.5%.... At no time has this figure been accompanied with an argument for explaining why it is more suitable than 48% or 80%, and even less with an argument about why it would make the future more sustainable for our species. Two applications of this 50% are presented that have diametrically opposite consequences on: the risks of nuclear energy, price trends in electricity for consumers, greenhouse gas emissions, and jobs. Hop... into a car!

Miscellany

Key figures on energy in 2017

Sous-direction des Statistiques de l'Énergie, CGDD, MTES

France's carbon accounting assessment: Already twenty years!

Jean-Philippe Lafontaine, IAE, Tours

In 1997, France published its first carbon accounting report for the period from 1990 to 1995. This report used the methodology and recommendations of the Intergovernmental Panel on Climate Change (IPCC). Since then, the basic principles of carbon accounting have not changed. Over the past twenty years, France has implemented measures for fighting against global warming that require more and more organizations to produce and publish data on their greenhouse gas emissions. The origins of French carbon accounting are reviewed, and an overall description compares what has been demanded of organizations and what has been done at the national level. Since the results obtained in reducing greenhouse gases have fallen short of expectations, questions are asked about the postulates underlying the choices made in matters of global governance of the climate and about the effectiveness of these decisions in curbing global warming.

Issue editor: Fabrice Dambrine