Smart electricity grids,
a market on the edge of energy and domotics

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Abstract:
"Intelligence" — a word derived from *intelligentia* in Latin, made up of the prefix *inte-* ("between") and the root *legere* ("choose, pick") or *ligare* ("link") — refers to the thought processes that enable a living being to adapt to new situations, to learn, understand and, above all, act. Intelligence without action is futile. Artificial intelligence is now being installed in everyday objects. Everything is becoming "smart": homes, buildings, cars… especially in the energy industry. The example of smart electricity grids serves to establish a few links between the environmental transition and information and communication technology in order to show that a new type of economy could emerge at the point of convergence between these two trends.

Smart electricity grids — as defined by the European Commission, *i.e.*, grids capable of intelligently integrating data on the behavior and actions of users, consumers and/or producers for the purpose of providing an efficient, sustainable, secure and economic supply of electricity — represent an El Dorado for the energy or digital industries.[1]

For the energy industry, a major issue is to solve the fundamental problem of a lack of correlation between production and consumption. On the one side, production from renewable sources of energy is increasing; but on the other side, the volatility of consumption is also increasing as living standards rise along with the demand for comfort. Bringing this "decorrelation" under control without making costly investments (for stronger grids or better means of storage) is an intellectual but, above all, a financial challenge for companies whose investment capacity has been sharply curtailed in recent years. In effect, investments in renewables frontally attack the past investments made in energy: they depreciate the latter at a faster rate — sometimes in contradiction with the objective of reducing greenhouse gas emissions.

For digital technology, the energy market, though small in volume, is a welcome point of stability in a world where the pace of technological turnover deals out a new hand of cards every three years. Besides, smart grids open the way for the digital industry to obtain access to utility companies' customer files. Information and communications technology (henceforth ICT) can help utilities glean knowledge about their customers thanks to new data. Furthermore, smart devices and the Internet of things (IoT) boost markets where connection speeds are less important than the frequency of messages. In this respect, energy is an interesting market for digital technology.

[1] This article has been translated from French by Noal Mellott (Omaha Beach, France).

As for smart grids, questions arise about the new hand of cards being dealt out to economic stakeholders. The question that utility companies must ask has less to do with how many customers they have than with what new services they will offer to them. Given the much faster technological turnover in ICT, players in telecommunications have long considered the proposal of new services to their customers to be a critical factor for standing out among competitors.

The digital industry's interest in the energy market is not purely intellectual. It follows from a development strategy, clear evidence of this being the recent buyouts by firms such as Google of companies in the business of managing the demand for energy. Unless they cooperate on new offers, French players, whether in energy or ICT, risk coming in second after the American Web giants, the so-called GAFA(M) now dominant in the market. Opposite these giants, whose financial capacity is incommensurate with European power companies or ICT firms, the positioning of French players in this market must be all the smarter since it cannot be monolithic.

For now, we have to admit that national or even international firms have staked out positions mostly in experimental projects. Services for a large-scale roll-out are still in the pipeline. This remark does not hold for France alone. Everywhere around the world, start-ups are proposing new products and services; but the mega-order that would propel this market has not yet been passed. The massive installation of Linky (a smart electric meter) and Gaspar (a smart gas meter) has not sufficed to give a decisive boost to the roll-out of innovative services. The reduction in consumption (and of the average energy bill) thanks to these meters very seldom justifies the investment: for most consumers, from €80 to €100 per year compared with an investment ranging from €1000 to €1500. Projections based on an incremental improvement of these figures are not all that promising in the short or medium terms.

Figure 1: Electricity consumption in France and consumption peaks

Peak demand (GW)
Consumption, corrected (TWh)
Consumption, gross (TWh)

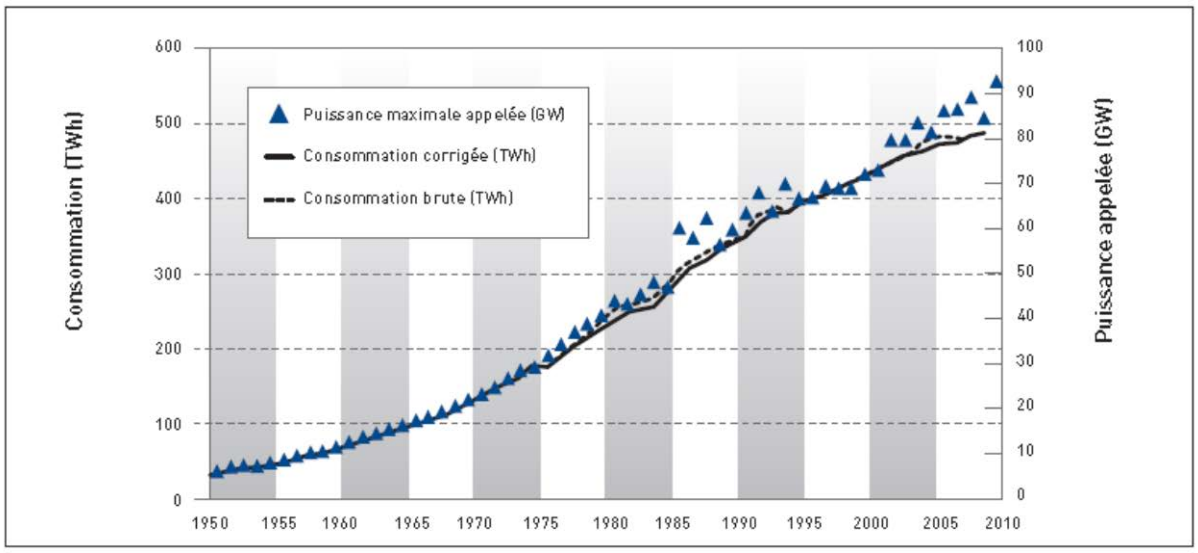


Table 1: **Predictions of peak power** during the winter (between 2012/2013 and 2024/2025)				
	2012/2013	*2014/2015*	*2019/2020*	*2024/2025*
Peak power at normal temperatures (GW)	86.9	88.2	91.0	94.9
Peak power "with one out of ten chances" (GW)	102.0	103.8	107.7	112.0
These predictions rely on a baseline scenario of estimates made in 2009 of the supply/demand equilibrium. *Source*: Electricity Transmission Network (RTE: Réseau de Transport d'Électricité).				

The upsurge: A new business model

An unspoken postulate in the foregoing description is that energy consumers and producers are structurally distinct economic agents. Will this distinction remain relevant in the coming years?

As consumers, thanks to advances in technology, start using the energy they themselves are producing, they will eventually internalize the requirements weighing on the production of renewables, since they will be their own customers. Although this self-production and -consumption is still more a communications gimmick than a deep economic trend, the wording of regulatory texts has taken it seriously.

For this new business model to develop however, groups must form who enter into transactions outside the usual commercial circuits for merchandise (even if the merchandise is electrons or more broadly, calories, frigories or what not…). Self-consumption needs to reach a threshold volume before having a significant impact on global energy consumption.

This model, wherein commercial relations rapidly take shape outside the established circuits, brings to mind what has happened to consumers in dealings with hotels and taxis or for car-sharing or selling used goods. All these business models have had two preliminary conditions: *a)* an "asset" with a marginal value of zero (apart from eventual costs) that individuals want to sell or rent while taking account of their investment; and *b)* an information system that reliably conveys information about the quality of this asset (for sale or rental) and reliably transmits the corresponding financial transaction.

Logistics is still a constraint in the energy market, whether for electricity or natural gas. Besides the costs of the grid, and unlike in telecommunication networks, there are physical — and therefore costly — restrictions on the transmission or transportation of energy. For this reason, as for goods of little value for which the question of logistics overrides the quest for the best price/quality ratio, the approach to user (consumer and producer) groups will remain local.

A new model for electricity: Why now?

A new business model is not a necessity however, since the price of what is to be exchanged is low (a few dozen euros per megawatt hour — a French household consumes between four and five MW per year). After all, logistics is a drawback. Furthermore, tinkering with home installations must, given the dangers, be formally forbidden. Under these conditions, what reasons might lead to adopting this new model?

The FIRST is inherent in the mode of production of renewables, which clearly resembles the business model in car-sharing or rental services for tools, equipment, etc. In the case of renewables, investment costs weigh heaviest, while production costs are often marginally low, even tending toward zero. Unlike for conventional goods, maximizing the use of production units is a factor that carries ever more weight for renewables. The latter cannot indefinitely benefit from the priority currently granted to them for uploading onto the grid. Given that these production units will figure for twenty to thirty years among the owners' assets, the long-term issue, worthy of consideration, is to find outlets other than self-consumption for renewables.

The SECOND reason is the much lower production costs of renewables. In some localities, renewables are able to compete with electricity from the grid. If the cost of storing electricity drops significantly, a break-even point might even be within reach. Let us have a (technical) dream: an energy mix with 100% renewables by 2050. Although the facts of the market will probably turn out to be less than that, renewables will, for sure, represent a significant part, if not the majority, of the energy mix.

The THIRD reason is the upsurge in digital applications for assembling the new business model's building blocks. Given its ability to predict production, act at a distance on points of consumption, and relay reliable information through blockchains, thus making it possible to bill transactions, digital technology has proven that it can rapidly, sometimes suddenly, spur industries (other than those involved in producing dematerialized goods, where this transition is already history).

The FOURTH reason is that this business model is starting to work for the big firms that, positioned as intermediaries, are capable of capturing a significant share of transactions. The counterpart to the already low marginal costs is a heavy initial investment. Amazon, Uber and Airbnb have, at different stages of maturity, switched to this sort of business model. Other businesses are imagining that they can duplicate this model.

And… in other sectors of the economy?

It is very tempting to try duplicating this business model in the market for "environmental goods". After all, an inevitable trend in our societies is, we might say, toward an irreversibly sober consumption of resources, thanks to ICT. This means assigning a value to nature. Let us take the example of CO_2. At present, calculations are made of how much of this gas economic agents emit into the atmosphere. However the value per tonne of CO_2 has not proven convincing on the markets set up under the European Union Emission Trading Scheme (EUETS): wide price disparities between countries, ranging from 30 cents to more than €300 per tonne. Nonetheless, natural resources do have a price even though it is not obvious how to set it nor how to convince economic agents to accept it.

ICT's increased efficiency has given a boost to the environmental transition in the broadest sense. Smart electricity grids combine two critical factors for the emergence of a real market between unorganized groups of consumers and producers (often one and the same), namely: the low marginal costs of production and the possibility of being competitive with substitutes.

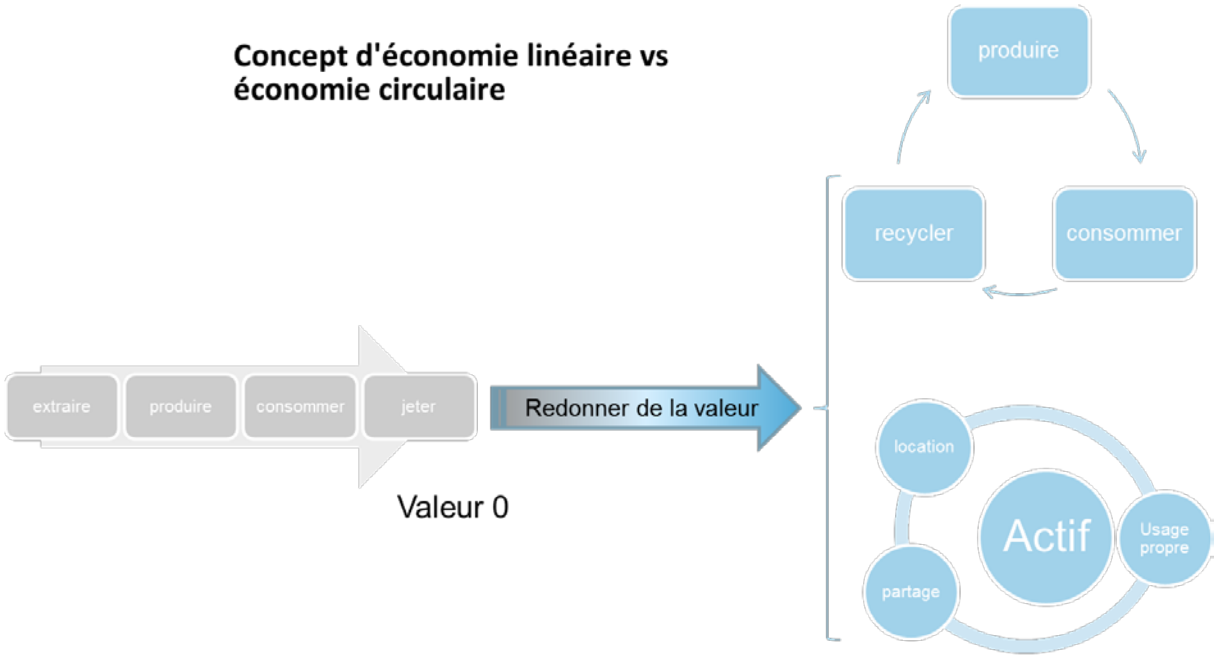
Nonetheless, such markets do not seem to be emerging naturally in many other branches of the economy. In effect, few sectors can convincingly answer the question: how does digital technology — owing to its capacity for massively processing data and reducing the transaction costs of information — make a difference in competitiveness? Other than the transportation industry, which has many similarities with electricity grids, the business of recycling household appliances might be mentioned (usually incidentally). By using a data base with information about repairs, appliances could be sorted very fast as a function of the problems reported.

A digital circular economy: For when?

The concept of a circular economy arose in relation to energy and, more broadly, the environmental transition. The basic principle underlying a circular economy (regardless of the often quite differing definitions of it) is to restore an economic value to a good that has no use-value for its owner. This is done either by transforming (recycling) the good or by renting it (car-pooling for rides, car-sharing for vehicle rentals). This is a relatively old concept in businesses with costly assets. In the building trade, ownership and use have been decorrelated for a long time now. The value of real estate is no longer the updated sum of the income that can be drawn from it. It often foils calculations that are purely economic.

Figure 2: Linear vs. circular economy

Extract=> Produce => Consume => Throw away (Value 0) => Replenish the value
Produce, Consume, Recycle
Sharing, Renting, Using: Assets



Two deep trends have breathed new life into the concept of a circular economy.

— The first is the environmental transition since it will restrict access to natural resources, either upstream in the production process (for many raw materials produced by the mining industry) or downstream (for energy due to the impact of anthropogenic emissions containing carbon). The value to be restored to a good of no use or to a waste or scrap product is, of course, to be compared with the value of the good produced in the usual manner. If the latter price rises, the costs of restoring the used good (and, as a consequence, the potential margin) can rise too — thus providing an incentive for reusing the product.

— The second trend is the lowering cost of information and transactions. It mainly affects the value of assets to be shared or rented. A platform for rentals necessitates large volumes of transactions in order to amortize the initial investment.

In electricity, two other, more incidental, factors are to be taken into account:

— The drop in the production cost of renewables opens prospects for turning a profit. For this reason, a business model of the sort discussed will eventually prevail, but setting the date for its adoption is a high-stake wager.

— The development of electric and self-driving vehicles (both of them using electricity for electronic equipment) opens the way for newcomers in the transportation market. Designing electric vehicles is a much more accessible, less complicated activity than designing vehicles with internal combustion engines.

These business models are nascent. Reaching the profit-making point is mainly a matter of costs and the competitive advantage. Given the speed at which new business using these models are staking out positions, a sudden upheaval can occur in the economy. Though unable to predict when this train of changes will pass, let us try to be ready for that day so as not to be left behind!