The Valuation of Negawatts: the Controversial Articulation of Demand-Side Management with the French Electricity Markets

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Sub-theme 28: The Politics of Valuation

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In the development of intermittent renewable energy production, flexible demand-side management (DSM) constitutes a promising solution to balance electricity production and consumption. In general, its flexibility involves consumers' changing their practices and agreeing to reduce or postpone their consumption. Since it can help to balance the network, DSM has technical value for the energy system, because the electricity saved or consumption postponed can provide the same balancing service as the additional production of electricity. From a societal perspective, its value also involves environmental gains derived from avoiding peak electricity gas-fired plants, which are considered to be more polluting than renewable energy facilities. Demand-side flexibility is also associated with the virtue of energy sobriety. Lastly, load shifting electricity can represent an energy source in negawatts, a neologism coined by Amory Lovins. However, the economic value of negawatts remains unclear. It is the same value as the value of megawatts? By extension, are load shifting and added production equivalent?

Since the liberalization of the electricity sector, the balance between electricity production and consumption has been managed through a market mechanism (Breslau, 2013, Karnoe, 2010) responsible for setting a price that reflects the scarcity of electricity or, on the contrary, its abundance, and which should encourage economic actors to adjust their production or consumption. The technical balance has been translated into market equilibrium. Since the 2001crisis in California, demand-side flexibility has been promoted as the keystone of a functional electricity market because it develops the demand's sensitivity to the market price (Joskow 2008). Following that logic, demand-side flexibility should be valued according to market mechanisms. However, because DSM is also associated with energy sobriety and energy transition, its societal value is not limited to market mechanisms, but can have value for the electricity system, including reducing the use of the network, avoiding polluting peak production, and facilitating the diffusion of intermittent renewable production. As such, demand-side management can gain political support and be valued in light of different objectives, values, and economic value calculations, not only per its participation in a centralized market.

The convergence of demand-side flexibility and the negawatt project prompted the emergence of a new economic actor: the load-shifting aggregator, a non-supplier operator that organizes the load shifting of different consumers and creates economic value of the activity by selling saved electricity. In France and the United States, regulatory authorities have recognized that load-shifting aggregators can develop independently of suppliers by selling services directly on the wholesale electricity market, day-ahead market, or balancing market. Those aggregators can benefit from additional support since, as new entrants—namely, renewable energy suppliers—in the energy sector, they face unfair competition from existing traditional suppliers.

To analyze the process by which load-shifting services have been valued economically, we have followed a pragmatic approach of valuation (Dewey 1939) updated by market studies scholars (Kellberg et al., 2013). The concept of valuation focuses on the social practices by which goods or services are valued that enable qualifying contributions and calculating, negotiating, maintaining, or

contesting economic value. Research using that concept tends to venture beyond the division between economic calculation and moral, political assessment by showing how different practices of judgment can be interwoven (Dubuisson–Quellier 2013). Economic value is always already undetermined, because the modalities of valuation are diversified and depend on the social contingencies of the exchange (Zelizer 1983).

Load-shifting aggregation ranks among the numerous activities that pose social and environmental benefits, whose economic valuation depends on the design of economic instruments and market rules: cleaner technologies (Doganova and Karnøe 2015), carbon-offsetting projects (Ehrenstein and Muniesa 2013), and maize for bioenergy (Hauber and Ruppert–Winkel 2014), among others. Economic valuation needs economic reasoning that can define equivalences between load shifting and other activities that already have economic value, including those for electricity sold on the wholesale market, CO_2 emissions reduction, and electricity network efficiency. According to the dominant liberal paradigm in the energy sector, a large part of that economic valuation comes from the marketization of such activities, but can also take support of other means.

The chief contribution of this paper is its explanation of the driving forces of the valuation process of energy services in the context of energy transition. The economic value of load-shifting aggregation has been highly controversial, given the several forms of economic reasoning available to link a flexible DSM activity to environmental and technical benefits. Some lines of reasoning consider that DSM should be financed by the electricity market, while others are more intuitive or emphasize different benefits for society that cannot be easily calculated.

By studying the valuation of natural resources by judicial institutions, Fourcade (2011) has demonstrated that the institutional context affects economic reasoning taken into account in valuation. Political and judicial institutions frame the valuation by supporting some lines of reasoning more than others. Their role should not be undermined, for they organize economic exchange through market rules and economic devices. A prime example of the institutionalization of economic reasoning is the long, complex institutional chain of equivalences that organized the financing of carbon-offsetting projects in developing countries by the EU Emissions Trading Scheme (Block, 2011, MacKenzie, 2010, Ehrenstein and Muniesa, 2013).

Because the energy sector is concerned at once with competition regulation, technical regulation, and environmental and technological policies, different deliberative institutions are deemed competent to translate values into established rules and calculation frames. Although the liberalization of the energy sector has precipitated the rise of independent regulatory authorities (e.g., competition authorities, energy regulation commissions), the French government and Parliament have also developed a unified energy policy, maintain political control over the sector (Reverdy, 2014), and support investments in specific technology such as renewables. Various deliberative institutions have the authority to contribute to the institutionalization of market rules, and each authority has its own deliberation requirements, legitimacy constraints, and institutional mandate. Amid those different characteristics, contradictory decisions replace one another or are potentially cumulative. The coexistence of the different regulatory activities and overlapping of institutional mandates encourages confusion, uncertainty, and controversy about the value of energy services.

Case and method

Since 2000, France has gradually opened the production and commercialization of electricity to competition. Electricity is carried by a transport network and distribution networks that remain a State monopoly, as they are considered to be a “natural” monopoly. The electricity market establishes an equilibrium in real-time (electricity is not stored) between variable consumption, which depends on consumers’ activities and weather conditions, and an offer, which is also variable,

due to equipment failures or the intermittent production of renewable energy like wind or solar power. To manage these disparities, sufficiently flexible capacities are required, such as hydraulic power or gas plants. Some plants serve only a few hours a year, but still need constant maintenance to be activated at any moment. The use of fossil-fuel power plants is not only very expensive, it also has an environmental cost (CO2 emissions, etc.).

With the growth of intermittent renewable energies, the need for flexible demand-side management is going to increase. The first, most accessible solution consists in developing the shifting of large electricity consumers, for stopping their activity can free up significant power on the network. But this flexible management can also target the final consumer. A innovative company, Voltalis, created in 2006, developed distributed load shifting devices for private individuals. This technique consists in reducing electricity consumption at certain times, by remotely controlling particular consumer appliances. Using an electronic box installed in consumers' homes or small businesses, Voltalis can curtail the supply of electrical devices for short periods of time. By installing its box in many consumers' homes, the company thus releases up electricity in sufficiently large quantities to be taken into account by the French Transmission System Operator (TSO), Réseau de Transport de l'Electricité (RTE). This activity requires initial investment in automation infrastructure in private homes.

In terms of valuation, Voltalis has chosen not to remunerate consumers for their participation (consumers do not pay for the electricity they don't consume when their devices are shed, they don't benefit for electricity supply either). This strategy means that load shifting must not impact their comfort and electricity usage too significantly and limits the appliances concerned (heating, boiler), and restricts the load shifting times to half an hour. This strategy has the advantage of guaranteeing the TSO a load shifting capacity on short notice, as the company automatically controls the load shifting. This activity requires initial investment in home automation infrastructure in private homes but does not requires the installation of smart meters.

Voltalis promoted the marketization of load shifting activities. Marketization was previously an obvious strategy, because of a liberal paradigm associating demand-side management to market. But this strategy of marketization went problematic because of the uncertainty associated with the electricity prices. Through marketization, the load shifting activities became dependent on electricity market prices, which were not favourable since 2008. In a context of production equipment scarcity, or intermittent production, market prices are very high and richly remunerate the load shifting aggregator. But in a context of power overcapacity, load shifting is poorly remunerated. That is why Voltalis tried to influence the market design in order to increase its remuneration.

Our analysis starts with the struggle between experts on the question of the financial transfers generated by the activation of load shifting. The Energy Regulatory Commission (ERC) published a resolution on 9 July 2009. After a large political mobilization, the decision of the ERC has been broken by the Council of State in 2011. This decision has been followed by a decision from the Competition Authority, three laws (in 2004, 2013, and 2015) and a decision from the Constitutional Council (in 2014), before the mechanism of financing distributed load shifting has been stabilized.

A seminal investigation collected all products of public documents: research papers, experts' reports, Parliamentary reports, Parliamentary debates, legal decisions, technical documents from the independent regulatory authority, and the European Commission's decisions regarding these issues. A systematic investigation of the decision allowed the identification of the economic reasoning mobilized in regulation (Fourcade, 2011, Ehrenstein and Muniesa, 2013, Hirschman and Berman 2014). We examined how these arguments were constructed, simplified and translated from one instance to the other (MacKenzie 2011) in the technical areas of experimentation, media public space, political instances (Parliament or government), and institutions such as the Council of State or the Constitutional Council.

Energy Regulatory Commission (ERC)	9/7/2009	Deliberation on integration of distributed load shifting in adjustment mechanism
Council of State	3/5/2011	Cancellation of the ERC decision
Competition Authority.	20/7/2012	Decision n° 12-A-19
Parliament	16/4/2013	Brottes Law
Parliament	10/10/2014	Amendment of the energy transition law
Gouvernment	11/1/2015	Premium level announce
Council of State	1/2015	UFC-Que Choisir (Consumer association) submitting a complaint against the premium
Gouvernment	2/2015	Premium withdrawal
Parliament	18/02/2015	Amendment of the energy transition law
Parliament	26/5/2015	New article (n°46)

In the second phase, we conducted interviews with some contributors and asked for comments on decisions. Interviews focused on certain breaks in the dynamic of the exploration. We empirically reconstructed the trajectory of the regulation, the unexpected paths different from usual trajectories. For example, regarding the issue of the integration of demand-response managers into the wholesale electricity market. Each of these decisions produced different rules from the previous ones, with very significant effects on the profitability of demand-response management.

The emerging dynamic of valuation of load shifting

The uncertain process of valuing load-shifting activities started with a conflict about the articulation of the activity in light of an existing mechanism for the real-time balancing of the network—namely, the adjustment mechanism. The debate was initially limited to a technical forum involving concerned actors such as suppliers and Voltalis under the authority of the transportation system operator (TSO). Unwilling to accept the result of forum, Voltalis shifted the debate into the political and judicial sphere, as well as into the press, in order to involve political authorities in the design of the mechanism that would support load shifting. Such displacement introduced new political references into the valuation of load shifting, integrated environmental issues regarding, for example, transition temporalities, and created a risk of confusion, excessive support, and instable regulation.

Logical trial of the economic reasoning involved in valuation

Voltalis asked for having load shifting recognized by the TSO in the framework of the adjustment mechanism, one of the mechanisms used to balance production and consumption in the network in real time. The adjustment mechanism is leveraged in real time by the TSO when a supplier is unable to meet its customers' demand. Each supplier is a "Balance Responsible Entity" which means that it is responsible for the real-time balance between what it injects into the network (produced or purchased on the wholesale market) and what its customers consume. Suppliers are required to forecast consumption to supply the adequate quantity. If these customers consume more and the

suppliers are unable to meet their demand, the TSO needs the help of new production capacity or load shifting aggregators.

During the year 2008, the experts failed to agree on the financial transfers associated by the activation of load shifting offers. The suppliers considered that the load shifting aggregator had to reimburse the "balance responsible entity" (the supplier of the customer who was shed) for the electricity that this supplier "injected into the network". The Voltalis CEO, Pierre Bivas, disputed this argument and maintained that the load shifting aggregator should not have to pay for the supply of electricity when the consumers had been shed. In the absence of consensus, the TSO appealed to the ERC to clarify the rules. The ERC published a resolution on 9 July 2009, in which it justified the existence of a payment to the supplier whose consumers has been shed by the load shifting aggregator.

To clarify the struggle and set a reliable rule, the ERC asked for the help of Claude Crampes, a neoclassical economist at Toulouse School of Economics. This discussion helped to define the role of load shifting in the adjustment mechanism. The reasoning of the ERC is formalized in a resolution. The reasoning was built on the postulate that the adjustment mechanism is based on a market mechanism. This mechanism is used by the TSO when one of the market actors is unable either to produce the electricity that it has committed to producing or to satisfy the consumers that it has committed to satisfying. The TSO then chooses between the offers, on the adjustment market, of producers (additional capacities) and those of load shifting operators to restore the balance. The TSO not only purchases a service which contributes to restoring the balance, it also buys electricity and sold it to the supplier that defaulted and needs it for its own consumers. The only way for the load shifting aggregator to participate in the network balance is to integrate this adjustment mechanism, which means selling electricity on this market. However, the load shifting operator does not produce this electricity: it obtains it from a supplier, which had committed to supplying it to its customers (as a "Balance Responsible Entity"), who then did not consume it. It is able to supply this electricity to the adjustment mechanism because the supplier of the customers shed honored its supply commitments. It is therefore logical for the load shifting aggregator to remunerate the supplier for this electricity which the latter injected, at least at the price of the supply (what the customers would have paid had they not been shed), and could pay the equivalent of the production and retail costs into the tariff, the "supply tariff".

According the ERC: Value of load shifting = Adjustment price – Supply tariff

Based on this organization of the adjustment market, it was possible to make explicit the rule of "economic precedence" between production and load shifting formalized in the French Energy Code. Respecting the order of economic precedence involved ranking offers according to their economic contribution to "social surplus". In other words, it had to be possible, on the market, to orient actors towards an economic solution that was optimal for all concerned. By clarifying the adjustment mechanism, the ERC demonstrated that the optimization of "social surplus" entailed paying the energy shed to the supplier that injected it.

Voltalis's argumentation was based on a simple formalization of the imbalance and adjustment problem. It considered that, in a situation of imbalance, TSO's alternative was to use additional production infrastructure or to resort to consumer load shifting. From the perspective of the network balance, the two solutions were equivalent: hence load shifting had to be remunerated at the same level as peak production. This reasoning had the merit of being simple. It did not involve the abstractions of the adjustment market, the Balance Responsible Entity, consumption profiles, etc. It distinguished the problem of the network balance, which was the responsibility of the TSO, from the transactions between suppliers. Thus, in response to the ERC's argument, Voltalis proposed that supplier, which needed the adjustment, remunerate the other supplier, for the energy that the latter injected but that their customers did not consume.

According to Voltalis: Value of load shifting = Adjustment market price

From the vision of ERC and suppliers, the rules defended by Voltalis create an important asymmetry between the Demand-Side Responses services developed by a supplier for their own clients and the same services provided by a independent aggregator like Voltalis. These activities would not be remunerated the same level whether they are integrated by the energy supplier offer or introduced by an independent actor.

The politicization of the economic valuation

The innovative start-up Voltalis intervened with Parliamentarians to circumvent the rules defined by the ERC. Faced with the ERC's technical argument, Pierre Bivas, the founder of Voltalis, tried to shift the debate from the independant authority sphere to the public space, directly appealing to the government and then by turning to the media. Pierre Bivas's ability to take the debate to political arena stemmed from his personal legitimacy and his own background and career. Bivas was not really an outsider: he was a graduate from the École Polytechnique and the École des Mines. In 1995, he was a technical advisor to the cabinet of Mr Hervé Gaymard, Secretary of Health and Social Security at the time, and in 1996 he was an advisor to Mr Jacques Barrot, in charge of Labour and Social Affairs. He therefore had social markers that lent him legitimacy perceived by the other actors in the field. Voltalis also benefited from the support of the group MOMA ("MOdélisation Mesure et Application", "modelling, measurement and application"), led by several members of the Corps des Mines with experience in ministry cabinets or as leaders of French corporations.

Receptiveness to Voltalis's arguments was connected to their relevance for political representatives. On the eve of the ERC's decision, Voltalis sent a letter to Nicolas Sarkozy, President of the Republic, and to his ministers Jean-Louis Borloo and Christine Lagarde. This letter asked the President to take action to ensure that the ERC would "*fully recognize the value of the new business and therefore put an end to EDF's absurd constraints designed to destroy it barely after it has emerged, burdening it with a tax paid to EDF to compensate for the energy savings achieved*". In this letter, the ERC's authority and expertise were overshadowed, turning this controversy into a struggle between EDF and Voltalis (the ERC was cited only three times, whereas "EDF" appeared 19 times). Pierre Bivas denounced lobbying, which he attributed to EDF, claiming that it "*exacerbates its pressure on the ERC for it to decide to introduce a tax on energy savings*". A few days later the title of the press release concerning the ERC's deliberation attested to this strategy of controversy: "*How EDF circumvented the ERC by making it adopt suppliers' point of view at the expense of consumers, therefore preferring ever greater production to energy savings and reinforcing EDF's dominant position in France*" (press release published in 2009). On many occasion, Voltalis presented itself as an innovative entrepreneur restricted by the historical monopoly. According to Voltalis, the ERC's opinion was the result of a "*corruption of minds*". Its strategy was to weaken the representation of the adjustment mechanism conveyed by the ERC to influence the audience towards its own reasoning, built around the claim that, from a network balance perspective, electricity production and load shifting were equivalent solutions.

The abstract reasoning used by the ERC to clarify the adjustment mechanism provided Voltalis with many opportunities to discredit it into political fields and media. Voltalis declared that the ERC "*adopted the perspective of the suppliers, who complain about the shortfall, and not the perspective of the consumers who benefit from the energy savings made*". The term "*shortfall*" was somewhat ambiguous here. For a reader who had not understood the abstraction that is the adjustment market, the "*shortfall*" concerned electricity which consumers had not consumed, and therefore which had not been produced. This is how the expression "*shortfall*" was interpreted by the green party Europe Écologie les Verts and the NGO Sortir du Nucléaire, which claimed that it meant "*that if a number of EDF customers agree to reduce their consumption, EDF demands to be paid as though*

they had consumed!" However, in the context of the adjustment market, this "*shortfall*" corresponded to electricity which the supplier had committed to supplying, which they had indeed produced and which had been valorized by the aggregator.

With this argument, Voltalis was able to disseminate doubt about the ERC. The company managed to convince quite a large proportion of the audience, including environmentalists and elected representatives from all sides, willing to believe that EDF, given its dominant position, was able to manipulate regulatory bodies and economic experts. This discourse was widely shared in the media and was particularly visible in the media and the political spheres. Throughout the summer of 2009, many media outlets reported and commented on the ERC's decision. Each newspaper published a significant number of articles on the topic: Le Monde (seven articles), Le Figaro (seven), Le point (four), Libération (eight), Le Nouvel Observateur (four), Les Echos (three), and L'Usine Nouvelle (six). These articles used the terms employed by Voltalis in its statements. Here are a few examples of titles: "*Why compensate EDF?"; "When EDF fights energy savings"; "When 'energy savings' clash with the electricity market*".

Voltalis drew also on environmental arguments, highlighting coherence with the "*Grenelle de l'Environnement*", a large participatory political event in 2009 that shaped the French environmental policy. It aligned with a shared representation of load shifting as consumption reduction, an action with a positive political value. It declared that its infrastructure ensured that EDF did not have to use "*fossil fuel plants, which are expensive and polluting*". This environmental argument, just like the figure of the innovator against the historical monopoly, was soon taken up by the Europe Écologie les Verts party and by the NGO Sortir du Nucléaire, which denounced "*organized racketeering*", an "*energy waste premium*".

The success of Voltalis's argument in the media can be explained by the ambition that the company exemplified. For most politicians interested in energy issues, the need to develop the modulation of consumption had become obvious. This company, which was the only one to provide a concrete solution, therefore had a large audience. Moreover, this debate that enjoyed broad media coverage, secured its legitimacy in the political sphere, and Pierre Bivas was regularly asked to speak in parliamentary debates. The support of Jean Louis Borloo and Europe Écologie Les Verts gave Voltalis legitimacy that it did not have in the technical sphere of the elaboration of the adjustment mechanism where economic expertise prevailed.

The main result of this media coverage and this politicization of the debates was the involvement of political representatives. On 22 July 2009, Jean Louis Borloo, Minister of Ecology, Energy and Sustainable Development, denounced "*the existence of legal and financial obstacles to the development of innovative energy saving offers*". He stated that he wished to remedy this situation and announced the creation of a working group to "*propose the necessary changes to the legal framework*", with the primary objective of "*encouraging energy savings while respecting each of the stakeholders' interests*".

Contributing a political valuation of load shifting by promising different benefits associated with the practice, Voltalis successfully fostered in the public sphere a conviction of the relevance of distributed load shifting and its environmental, economic, and social benefits. That promise took strength from the fact that it was consistent with a projection for the future characteristic of the current energy transition: a projection of energy savings, carbon-free electricity production, and the development of an electricity sector unbalanced by intermittent energy sources.

Uncertainties on value calculation

The difficulties encountered by the TSO and the ERC in clarifying the market rules emanated from the novelty of the concept. The ERC was the first regulator to have accepted to regulate the

integration of distributed load shifting on an electricity market. Elsewhere around the world, the debate was still ongoing. It was particularly intense in the United States. In 2010 the powerful Federal Energy Regulation Commission (FERC) gave its support to advocates of load shifting and demand response, ruling that the electricity shed could be valued on spot markets with the same value as energy produced (Order 745 Demand Response Compensation in Organized Wholesale Energy Markets), despite opposition from the suppliers and from a part of the academics. The FERC was highly intent on developing demand response as it considered that the lack of demand elasticity in relation to the electricity price made very steep increases in producer prices possible (it attributed the crisis in California to a lack of elasticity). It nevertheless recognized that this measure had to be re-evaluated according to a "*net benefit test*" to ensure that it still provided a greater overall economic benefit.

The FERC's decision to value load shifting as equivalent with production created strong uncertainty in France regarding load shifting regulation. The fact that the regulation authority in the United States, the precursor country in terms of energy regulation, had positioned itself in favor of the equivalence between load shifting and production, contributed to weakening the ERC's credibility. Moreover, on 20 May 2010, two renowned economists, academics and consultants, Jean-Marie Chevalier and Fabien Roques, published a column in the newspaper Les Échos, drawing on the same reasoning as Voltalis to criticize the ERC's decision: "(…) *the current regulatory framework does not allow for the development of demand shifting. The companies offering demanding shifting services (using smartboxes) are required to compensate producers for the electricity which the load shifting prevented them from selling. This appears to be contrary to the laws of market functioning, and breaks the symmetry between production and demand shifting.*"

In its 3 May 2011 a decision of the Council of State censured the ERC's decision of 9 July 2009. The Council challenged the Commission's right to establish new obligations based on this economic reasoning. The law did indeed state that distributed load shifting offers and peak production offers should be ranked by order of economic precedence. However, for the Council of State, no article indicated that the price of the energy shed had to be paid to the supplier that injected it to calculate this order of economic precedence. The Council of State considered that it was up to the law, and not the ERC, to rule on "*choices regarding the fairness and sustainability of the systems*". It reminded the ERC that "*the law must be applied as it is and not as the regulator would like it to be*."

It is very difficult to assess the impact of the public controversy and whether or not it influenced the decision of the Council of State, which gave its verdict based on legal and not technical arguments. This controversy and its repercussions into the politician's sphere contributed to relativizing the ERC's technical-economic reasoning and therefore to causing this technical decision to be seen in a new light, as a political decision. The Council of State expressed the need to organize a hearing of both Voltalis and the ERC. Voltalis called on several witnesses, including the economist David Spector and the former President of the ERC, Jean Syrota, who both put forward several critical arguments against the ERC's decision: the failure to take into account energy savings, the reasoning upheld by the FERC, etc. Since the ERC's reasoning had been debated and had become potentially disputable, the Council of State considered that the ERC had not restricted itself to just applying the law on a technical level. Other forms of reasoning were possible and therefore other valuation of load shifting. To clarify the law, the ERC had ventured into producing law. This decision was also made in a context of rivalry between the ERC and members of the Government and the Parliament who felt that the ERC had become the spokesperson of the European competition policy and of a market model that went against the Government's energy policy.

Regulatory complexity and technical controversies among academics provide opportunities for actors who want to weaken the authority of the ERC to spark an intervention by the government or the Parliamentarians. The strategy of weakening the technical arguments of the ERC leads to the

displacement of the delimitation of what falls under the political authorities and what depends on independent authorities like the ERC. The focus on technical uncertainties is a strategy to demonstrate that the positioning of the ERC is not only justified by economic efficiency but by arbitrariness or orthodoxy. The decision falls within the jurisdiction of political authority.

The academic support in the calculation of the economic value

While the Council of State's decision seemed to side with Voltalis against the ERC and the TSO, the other load shifting aggregators who worked with industrial clients and whose business models were probably less threatened, dissociated themselves from Pierre Bivas and validated the ERC's reasoning. They agreed on the fact that, from the strict perspective of the sound functioning of the adjustment mechanism, the aggregator had to remunerate the supplier that had been shed.

The ERC called on renowned academic economists in the field of energy, who regularly advised the European Commission and regulators: J. M. Glachant, Y. Perrez, C. Crampes, T-O. Léautier and M. Rious. These researchers then published a few press articles and scientific studies. They expressed a consensus around the remuneration of the supplier shed by the load shifting aggregator. Moreover, the FERC's decision was still fiercely challenged by US electricity suppliers and by renowned economists like W.W. Hogan, an economics professor at Harvard, followed by Richard J. Pierce, a law professor at George Washington University. Both stressed that the equation of "negawatts" with "megawatts" had to remain purely metaphorical. Pierce proposed that the value of load shifting be equal to the difference between the spot market price (the "marginal price" at Time t) and the selling price of the supply to the consumer, the same equation than the French ERC.

Value of load shifting = Spot market price – Supply tariff

The debates surrounding the functioning of the electricity spot market highlighted uncertainty regarding its ability to properly remunerate peak power investment or, conversely, load shifting capacities serving the same purpose. Before 2010, suppliers and academics highlighted a market failure in the Energy Only Market model: the weak revenues for peak generation and load shifting, discouraging investment in capacity. The TSO obtained from Parliament a vote in favour of a Capacity Mechanism in 2010. Load shifting has been considered by the TSO from the beginning as a privileged solution for the capacity mechanism. In order to develop capacity, the TSO supported industrial and distributed load shifting through specific call of tenders for capacities. This choice was justified by the desire to develop this activity and associated technologies. With this system, the aggregator was remunerated for the load shifting capacity they made available to the TSO and not for the consumption shed. Over the course of the implementation of this policy, the TSO made room for the distributed load shifting offer by taking into account its specificities, while trying to find a framework as fair as possible to the other actors of the market. With the new capacity mechanism designed by the TSO, load shifting activities can get new revenues from the capacities call of tenders.

Value of load shifting = Spot market price – Supply tariff + Capacity price

In 2013, the arguments of the ERC and academic economists gained currency in the administration and among government advisors. The administration wished to avoid the development of a speculative bubble around load shifting, similar to the one that had disorganized the photovoltaics industry, and understood the value of a rigorous conception of market rules. In the same period, the members of parliament were more involved in other issues like the redesign of the regulated tariff, in order to create a progressive tariffs producing strong incentives in favor of consumption reduction.

The Brottes law, published in the Journal Officiel on 16 April 2013, is reflecting the influence of the ERC and the administration and define "*a system of payment by the load shifting operator to the*

electricity suppliers of the sites shed". Given the risk of this payment reducing the load shifting operator's remuneration, the law provided for a premium, paid to load shifting operators, taking into account the benefits of load shifting for society. For the ERC, this law had the merit of clarifying the market mechanism, on the one hand, and the subsidy on the other: this subsidy could thus be calculated and debated, based on the identified benefits of the system for society. This subsidy could potentially be challenged by the other actors if they contest its legitimacy.

According to Brottes law of 2013 : Value of load shifting =

Spot market price – Supply tariffs + Premium + Capacity price

Political authorities leadership on valuation and market design

In 2014, the economic context was less and less favorable to load shifting, with the overcapacities of electricity production, low peak prices, and low incentives to invest in peak-load capacities. But there was a political opportunity for a new support for load shifting: deputy François Brottes wanted to develop Demand-Side Response Services, because the major section of his law of 2013, the progressive tariff, had been cancelled by the Constitutional Court. A political support in favor of the demand response management services could overcome the defeat of the progressive tariff. François Brottes considered the load shifting as an alternative to the progressive tariff and wanted to find ways to support distributed load shifting despite the low remuneration by the electricity market, so as to anticipate the development of renewable energies.

The question of payment by the load shifting aggregator to the supplier to compensate for the supply of "*injected electricity*" was once again brought up for discussion in Parliament by François Brottes, in the form of an amendment (no. 16) in the framework of the debate on the energy transition law (on 10 October 2014). This amendment held that: "*The payment is made by the load shifting operator for the share of shed electricity consumption (…) that does not result in energy savings, and by all electricity suppliers for the shed electricity consumption (…) that does result in energy savings*." The justification for this amendment was based on a definition of "*injected electricity*" fully coherent with Voltalis's reasoning, very different from the initial reasoning of the 2013 Brottes law. This amendment provided a new definition of "*injected electricity*", associating this notion with the additional electricity effectively injected through the "*postponement effect*". The postponement effect refers to additional consumption after load shifting, linked to the fact that the heating or the boiler runs on full power after being stopped to restore the setpoint temperature in the home.

According to Amendment of 10 Oct. 2014: Value of load shifting = Spot Market price

*– Supply tariff * (Share of Postponed Electricity) + Premium + Capacity price*

According to several participants in the discussions, Voltalis exerted significant influence on members of Parliament and the Minister Ségolène Royal. Furthermore, Brottes and other deputies did not understand the ERC reasoning requiring the aggregator to pay the supplier whose consumers were shed. The deputies did not understand the notion of "injected" electricity. There was a debate as to whether the shed electricity was saved or postponed. Some deputy understood it was postponed, others that it was saved. The deputies did not either understand why the supplier had to be paid for electricity saved. The amendment, drafted by government advisors, provided for new financing for load shifting and, at the same time, closed the debate in Parliament: if consumption was postponed, a payment to the supplier seemed legitimate. If it was saved, and therefore not produced, the suppliers could finance it. This new presentation of the mechanism was more comprehensible to deputies than the original mechanism defended by the ERC.

The fine design of the mechanism was delegated to the independent regulator. At the government's request, the ERC therefore calculated a premium that should reflect the "socio-economic" benefits of load shifting, the benefits for society that are not reflected by the existing formula. Different kinds of socio-economic benefits were listed: capacity reserve, reduction of peak prices and of CO2 emission. The ERC first identified which benefits should be taken into account or not, based on the electricity market rules and the other existing mechanisms. For example, the contribution to securing capacities was excluded from the premium as it was financed by the existing capacity mechanism (defined simultaneously).

The ERC considered only the benefit in terms of CO2 emissions avoidance as being relevant for calculating the premium. It evaluated the volume of CO2 avoided, based on data that still remained uncertain: the share between the postponement of consumption and the reduction of consumption. If the postponement was null and the reduction of consumption equal to the shed electricity, the value of the CO2 avoided would be €26/MWh, and if it was 50/50, the value of the CO2 avoided would be €13.5/MWh.

Controversies about societal benefits

This delegation of the calculation of the premium to the ERC helped indirectly to reopen the political debate to new actors. Considering that a premium of €13.5/MWh would be inadequate for the development of load shifting activities, Ségolène Royal defended the upper value, €26/MWh. It was justified by the wish to provide significant economic support to launch the activity, knowing that the premium could quickly be reduced if it was too generous. But, according to the ERC reasoning, this choice suggested that there was no postponement effect in load shifting. This calculation faced strong resistance from the members of the *Conseil Supérieur de l'Énergie*, a body made up of Members of Parliament, ministries, local authorities, suppliers, suppliers' employees, and consumers. The ERC communicated also an unfavourable evaluation.

The "technical" and "independent" work of calculation done by the ERC revealed the spread between the political support and the economical valuation of the benefits. It helped opponents to develop legitimate arguments. The debate enlarged to new actors that were not involved since this calculation, the consumer rights association.

Resuming the ERC expertise, *UFC-Que Choisir* presented a complaint against the premium before the Council of State. Consumer associations saw Voltalis as an actor that just automatically cut heating installations for 20 minutes at the time when it seemed that consumers needed heating the most. In consumer's forums, Voltalis was accused of misleading consumers by arguing that their equipment would reduce consumption without consequences on the comfort, and by preventing the withdrawal of the "box" by costly intervention. Some consumer associations enlighten the fact that Voltalis install the equipment in low rent social houses with the complicity of some lenders, seduced by the concept and the possibility of energy bill control of the residents.

The attacks were not only directed toward the supporting mechanism or the premium, they were directed toward the technology, the contracting practices, the absence of benefits for consumers. It is more a political valuation of the load shifting practices that is encouraging the opposition of consumer association that a possible miscalculation of the societal benefits.

The controversy associated with the premium led the Senate to make a new proposal. Amendment no. 934, presented by Mr Poniatowski during the discussion of Article 46 bis at the Senate, on 18 February 2015, introduced a call for tender mechanism to replace the premium for load shifting operators. With a call for tender mechanism, the economic value of load shifting totally changed: it was determined no longer by an estimate of the socio-economic benefits it provided (through the premium, defined by a specific calculation) but by a sufficiently high price level to remunerate load

shifting actors. The TSO and ERC experts nevertheless questioned the appropriateness of this new call for tender, which added to many existing frameworks. They felt that they had already done a lot to develop load shifting, particularly with the calls for tenders for load shifting capacity set up by the TSO, and they questioned the relevance of an additional support.

According to Amendment 18 Feb. 2015:

*Value of load shifting = Spot Market prices – Supply tariffs * (Share of Postponed Elec.) + Specific call of tender + Capacity price*

In fact, this proposal reversed the economic reasoning. Distributed load shifting would switch from the status of market device to another status, similar to that of renewable energies, the financing of which was secured by subsidies. It would become protected from the uncertainties of the market, which at that point was unfavourable. Load shifting would benefit from a "protective space", a kind of technical niche for uncompetitive technology, that need investment and sociotechnical improvement in order to become competitive (Smith and Raven, 2012). The energy transition policy freed itself from the electricity market and would impose its own agenda.

But, in order to succeed, this new proposal needed a strong support from political authorities, comparable to renewable energy. The load shifting activity should not have been questioned. It was not the case : it became questioned by consumer representative and ecologists, which could be considered as key concerned actors in the energy transition project.

The load shifting valuation was once again debated in Parliament in spring 2015. Several amendments supporting distributed load shifting were proposed by opposition deputies, who accused the government and majority deputies of supporting the strategy of large companies. Voltalis's influence was very clear in these statements. The opposition suspected the government of having changed the text between the Senate and the Assembly. Conversely, influenced by consumers associations, the Greens expressed doubts as to the actual energy savings achieved with distributed load shifting. In view of the virulence of the debates and the confusion they had caused, the deputy François Brottes organized a round table with the economic actors concerned (essentially EDF and Voltalis) for a more direct examination of the conflicting technical and economic arguments.

The bill, ultimately passed by Parliament upon a new reading on 26 May 2015, shows quite a clear decline of Voltalis's influence on Parliament and the Environment Minister. The doubts had grown due to the virulence of the debates. The administration was convinced of the need to be more cautious about providing economic support for distributed load shifting.

Thus, Article 46 bis concerning load shifting clarified the payment to the supplier by drawing on the ERC's technical argument of its first decision (Article L. 271-3). The law clarified the mechanism: the call of tender will correspond to the capacity mechanism. Moreover, the law did not allow for a combination of the benefits obtained on the grounds of energy savings (L. 271-3) with the remuneration obtained through the calls for tenders for capacity. The writers of the bill (deputy, administration and advisers) wished to avoid the uncontrolled accumulation of sources of financing for distributed load shifting.

According to Energy Transition Law (2015): Value of load shifting = Spot Market prices – Supply tariffs + Max (Capacity price, Share of Saved Energy)

During the debate in different political forums (e.g., parliaments, senates, the Energy Superior Council, the Council of State), the societal benefit of load shifting faced increasing interrogation. The analytic work done by the ERC and the administration helped to qualify and calculate the benefit in

economic terms, yet also fueled the debate about the non-calculable benefits. The political valuation chafed against the idea that load shifting should be supported regardless of costs and market valuations. Doubts about the benefits of load-shifting encouraged a stricter definition of the mechanism, thereby reducing the spread between its value and market valuation.

Lessons learned for the valuation of energy services

The case contributes to the study of specific kinds of valuation in which political issues, economic calculation, moral valuation, and market mechanisms are intertwined (Fourcade, 2011). Along those lines, the study is limited to the design of rules and devices by which new economic activities can be valued. The study does not take into account how actors will develop those activities, appropriate rules, and devices, for the valuation debate is limited to the institutional and political sphere. It demonstrates that valuation is a political and institutional construction that can follow two strategies: economic valuation through marketisation and economization of environmental benefits, on the one hand, and political valuation of the activity, on the other. Those strategies are intertwined, as well as opposed and competing.

Strategies of valuation

In the context of energy transition, a variety of valuation issues and methods are associated with energy services: network integrity, sobriety, consumer rights, and market integrity. This analysis helps to identify two strategies of valuing energy services and managing the relationship among market-based, political, and economic issues. Theses two strategies are both mixing large variety of political issues, but there are not organizing them with the same hierarchy.

Market-base valuation via the marketization of technical and environmental benefits. This valuation strategy consists in relying mainly on electricity market mechanisms. Above all, the market price informs the economic value of energy services. That strategy does not exclude other political issues, including the security of supply and climate change mitigation. But such issues should be evaluated and integrated in the market as externalities or market failures. In this strategy, market failures have to be proven and political issues valued economically before the market is redesigned. Market integrity is highly valued. Other political issues can be translated into economic value and articulated appropriately in terms of the electricity market. According to the strategy, load shifting will develop only if the economic value, determined by the market price and premium fixed according to the reduction of environmental externalities, is sufficient for the profitability of investments. During the period that we have investigated, the problem was that the market price and other calculated socioeconomic benefits were insufficient for developing load shifting.

Supporting that strategy, the TSO and ERC endeavored to design rules to integrate distributed load shifting into the market, based on rigorous analytic economic reasoning. Their analytic decomposition not only effectively formulated the obligation for aggregators to remunerate the supplier whose customers had been shed, but was primarily concerned with isolating the value produced by the market compared to other forms of economic support (e.g., subsidies). The aim was to avoid the level of subsidies granted to the technique concealed by the complexity of the market and thus ensure that the subsidies did not escape informed public debate. The ERC remained faithful to the established market model, for it was required to be transparent and justify its decisions.

Direct political valuation of the activity through a judgment of its political desirability. The evaluation of the technology per political values justifies whether the technology should develop or not, whatever the actual market revenues and costs. In that approach, the economic value from marketization is secondary; market mechanisms and subsidies should cover the costs and encourage investments. Support for load-shifting activities depends on the global political valuation of the

technical solution, and the technology is politically desirable because it responds to different issues visible in the political and media sphere: security of supply, climate change mitigation, but also energy sobriety and consumer information and participation. In that strategy, economic mechanisms should be defined to contribute to the diffusion of the new technical solution. Market integrity is not dominant, and market design can be subordinated to varied political considerations. On the side of the French Parliament and the government, the objective was to enable the activity considered useful for society, yet control its cost, irrespective of how it was articulated with the market.

In this mode of valuation, a larger variety of arguments counts. Voltalis skillfully argued that existing regulation was stalling innovation. Its strategy contributed to politicizing the debate and to introducing distributed load shifting into the energy mix. Its discourse emphasized the political benefits that the market and socioeconomic calculation had not exploited, which could justify the existence of direct support. Several political actors became convinced that the activity had to be supported by ensuring a certain volume of business, irrespective of the economic value reflected by the electricity market and by the integration of the (estimated) value of a ton of CO_2. For the French minister and members of Parliament in charge of writing the energy transition law, distributed load shifting had become a pillar of the energy transition. Similar to renewable energies, it could be supported through measures overriding the market. In that sense, economic calculation was secondary yet could help to identify costs to be supported. The design of economic devices was guided by the objectives of covering the costs.

However, that political valuation encountered unexpected opponents during the discussion of the transition law in 2015. Most notably, Green parliamentarians expressed doubts about energy efficiency, and consumer associations questioned the share of benefits between aggregators and consumers. Consequently, the coalition supporting the new practice was not as stable as Voltalis had expected. Because of this lack of consensus, direct subsidies at the level of costs became less acceptable. That is why market-base valuation logic went back at the end of the deliberative process.

Struggle between valuation strategies

In the case of load shifting, both market-base valuation and direct political valuation were intertwined. The story of load-shifting valuation is one of a struggle to determine which of the two modalities of valuation—the market mechanism or direct political valuation—would dominate. A key factor of success in that battle was the ability of each dominant strategy of valuation to integrate different kinds of value in its own valuation scheme.

The amalgamation of valuation strategies. Between marketization and direct political valuation, Voltalis did not choose, but sought to amalgamate them without respecting the specific logic of each. For one, it defended a strict equivalence between the megawatt and negawatt on electricity markets. It invested in the marketization mechanism of valuation, but sought political support to manipulate the market design in order to make it more favorable. Even from a political valuation perspective, Voltalis's strategy introduced confusion since the economic benefit was consider to stem from a market mechanism not under political control. The market could evolve in a highly favorable way, generate revenues higher than expected costs, and yield large rent. Parliamentarians and the Ministry of the Environment did not question the marketization of load shifting, but only acknowledged that market mechanisms were not financing the development of load shifting and played with the rules in order to help that financing.

The concealment of valuation strategies. Voltalis challenged the ERC's economic reasoning by sowing doubt about the need to remunerate the suppliers of customers shed. Its rhetorical strategy allowed it to weaken the legitimacy of the ERC on the subject in the long term and to gain the sympathy of journalists, some politicians, and environmental associations. The chief weakness of the

market-based valuation defended by the ERC was that it drew on counterintuitive abstractions, even if they were rigorously logical. It was difficult for those who had not understood the rules of the adjustment mechanism to understand why the aggregator had to remunerate the supplier's shed customers. Voltalis was able to reverse the arguments by isolating pieces of the reasoning, thereby introducing sophisticated reasoning into the foundation of a confusing dynamic in the political sphere and media.

Discerning and isolating values. To clarify the integration of load shifting into market mechanisms, the ERC sought academic support to articulate load shifting activities in terms of market mechanism. The ERC remained inflexible in calculating the premium, thereby avoiding political pressure. However, it did not consider the sociotechnical transition dynamic, the hurdles faced by innovative offers, the economic power differential between existing producers and new entrants, or the relevance of the creation of a protective space for developing the activity. Political authorities attempted to preserve their decision-making autonomy from the independent authority. Ultimately, the uncertainties associated with the need for a capacity market, the dysfunctions of the CO_2 market, and the benefits of load shifting in terms of energy savings allowed them to justify adjustments to the rules proposed by the ERC.

How valuation strategies challenged each other. Throughout the institutionalization of distributed load shifting, each valuation strategy challenges the alternative strategy and contributed to a learning dynamic. For one, political valuation challenged the market valuation by highlighting the societal benefits not taken into account in the first design of the mechanism. Benefits in terms of energy savings, climate change mitigation, and the long-term development of demand-side flexibility were not entirely integrated with the electricity market in the first articulation. If the market mechanisms were not questioned directly, then non-marketable benefits were enumerated in political debates. The market valuation also challenged the political valuation by qualifying the different societal benefits of load shifting and clarifying its economic value. The ERC tracked approximations and reinterpretations, fought the influence of economic actors such as Voltalis, and ultimately helped to clarify economic debates by defending its independent expertise (e.g., in the calculating the premium).

Conclusion

This article's contribution is its clarification of two alternatives in regulating economic activities, especially related to technical and environmental issues. The first is an economic organization dominated by market institutions, wherein political issues are integrated into the market when they are sufficiently supported by political authority and legitimated as market failures. In this case, the market must be "technologically neutral". The second is an economic organization dominated by political choice in favor of some technology, wherein the market has an instrumental and limited role limited to the competition between service providers.

The choice between those alternatives has an important relationship with the way that economic activities are valued. In the first case, they are valued economically by a market price and economic equivalences. The economic value is uncertain and depends on both different contextual variables and the demand for the activity. In the second, activities and technologies are valued politically, at least at first. A political evaluation validates the benefits for the society, and the economic value is determined by the cost of the development of them. Market procedures (e.g., call of tender) or market devices (e.g., feed-in-tariffs) aim at reducing the cost of the political decision.

The alternatives are both present in the energy sector, and often, the choice between them is not stabilized. Arguably, the coexistence of the valuation strategies is a source of institutional weakness and instability. Political valuation has the preference of political authorities, whereas the market

valuation is supported by independent authorities. Yet, the two strategies can be explored at the same time due to the diversity of issues, uncertainty about efficiency, and uncertainty about the market's side effects. In particular, uncertainty about the valuation strategy creates some overlap in competencies between independent and political authorities, thereby contributing to rivalries and antagonisms.

However, the exploration process also enables confrontation and a learning dynamic. Each strategy has to integrate opposing arguments and issues in its own frame of valuation. In that struggle for domination, the positions are not fixed a priori, but recomposed throughout different confrontations. It is therefore unsurprising that the articulation between marketization and political issues involves long, uncertain circulation among several authorities. Nobody can end the controversy and stabilize the rules by focusing on individual valuation strategies. On the contrary, everybody has to acknowledge some issues of others in order to dominate the valuation process.

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