THE IMPACTS OF PHOTOVOLTAIC ELECTRICITY SELF-CONSUMPTION ON VALUE TRANSFERS BETWEEN PRIVATE AND PUBLIC STAKEHOLDERS IN FRANCE.

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Overview

With a nuclear electricty share of 76%, the COP21 host has not reached the grid parity for photovoltaic electricity because of the relatively low prices of its grid electricity. Nevertheless, this grid parity is about to be reached in the south of France for superimposed photovoltaic systems that have a lower LCOE than in-roof systems. In a context of energy transition, which aims to decentralize even more the electricity production, the electricity self-consumption is at the heart of concerns. Several levers might explain this interest, such as economical, social, environmental, legislative levers. Between 2016 and 2017, the French Government made significant advances in shaping the new legislative framework in order to favour the development of this decentralized electricity production. But some questions appear. Which stakeholder would receive or give the biggest transferred value? Is electric self-consumption a more efficient policy to develop photovoltaic systems in France? What type of policy support would reduce the disparity in the transferred values by stakeholder? Does the new policy allow the profitability and competitiveness of self-consumption? The main objective of this study is to calculate the different value transfers among stakeholders in France, according to a projected economic valuation scheme, when a self-consumption project is compared to a electricity full injection project. This study also analyses the profitability and competitiveness of average projects for average users's profile.

Methods

The development of this study is based on average consumption habits of French users. It is used aggregated data from ENEDIS, the distribution system operator. There are four average profiles calculated between October 2015 and September 2016, which are representative of all French consumers: household, commerce, small and medium business, and industry. A forecast of electric consumption for each consumer's segment, made by ENEDIS, adapts the average consumption for 2017. The model uses an interval of one hour to represent typical weekdays and weekend days for winter, summer, and mid-season. Moreover, the profile of photovoltaic electricity production is developed for a city of the region Provence-Alpes-Côte d'Azur (PACA), in the south of France, where the solar irradiation is the highest. The model uses data from the Photovoltaic Geographical Information System (PVGIS) of the European Commission that provides daily irradiation for each specific place. Two different simulations are made for each month, in order to have the energy yield by hours and by average days. The second simulation allows to adjust the electricity production profile developed by the first simulation. Then, the self-consumed electricity, the surplus and the extracted electricity are calculated according to the load and photovoltaic electricity production profiles. The model is developed to size automatically the photovoltaic system according to the load profile, the annual electric demand, and the profile of photovoltaic electricity production. An iterative calculation gives the peak power of the system that has to be installed in order to reach the self-consumption rate selected for the simulation. Moreover, the CAPEX and OPEX for photovoltaic systems in full injection and in self-consumption is selected automatically by the model. It is chosen a lifespan of 25 years for the systems, a discount rate of 4%, and an annual increase of 2% for the electric bill as a whole. In order to assess the value transfers between stakeholders, the model takes in consideration two situation: "With PV Full Injection" and "With PV Self-Consumption". It calculates the value transfers according to the unit €/MWh_selfconsumed, in order to visualize the transferred values for each megawatt hours self-consumed. The calculation of value transfers is based on the aggregation of different financial flows. It considers each component of the French electric bill and the economic valuation scheme (revenue for self-consumption and revenue for injected electricity), a mark-up made by the utility, and the investment for the photovoltaic system. The simulation made in this study are based on average. An analysis of sensitivity is made for the mandatory purchase tariff and for the self-consumption rate. The stakeholders that appear in this study are the French State, French departments, French municipalities, the distribution system operator (ENEDIS), the utility, and the user. The profitability and the competitiveness of a project are assessed by calculating its VAN and the VAN of the same project in full injection.

Results

For 2017, the average value transfers from a situation in full injection to self-consumption, both with superimposed photovoltaic systems, show that ENEDIS, which is the distribution system operator, would suffer from a loss of revenue. On the other hand, the French State would benefit from these transferred values in the case of profiles that use systems with a peak power below 100 kWp: household, commerce, and small or medium business. In the case of a self-consumption project for the industry profile, the result is a shortfall for the French State. It is also interesting to note that French municipalities, French department and utilities would suffer from shortfall of revenue too. When an analysis of sensitivity is made for the self-consumption rate, with an addition and subtraction of 20%, the tendencies for ENEDIS and for the French State are the same. Other results linked to the savings of the French State suggest that it is possible to do savings when the mandatory purchase tariff for self-consumption is lower, equal, or higher than for full injection. Results show logically that a higher self-consumption rate means that the State has more opportunities to put a mandatory purchase tariff for self-consumption higher than for full injection while earning from the value transfers. In this study, it is also questioned how a mandatory purchase tariff for self-consumption, given a mandatory purchase tariff for full injection, could allow a minimum delta between the higher and lower transferred value by stakeholder. On the one hand, if a focus is made on the first years since 2017, this minimum is reached by a Feed In-Tariff, that is to say if the mandatory purchase tariff is above the retail market price, including taxes, paid by the user. On the other hand, if a focus is made for the lifespan of projects beginning in 2017, this minimum is reach by a Net-Billing, that is to say if the mandatory purchase tariff is between the wholesale market price and the retail market price. This result applies to the profiles Household, Commerce, and Small or Medium Business. If this minimum is reached with an adequate mandatory purchase tariff, it would be also possible to have a self-consumption project more economical attractive than a full injection project. Finally, average results indicate that self-consumption is profitable for all profiles excepted for households. Furthermore, the profitability of self-consumption and full injection is almost the same for small or medium businesses. On average, the competitiveness of self-consumption on full injection is certain for projects of industries. Nevertheless, all these results are average tendencies that depend on the specificity of a project and its self-consumption rate.

Conclusions

The value transfers that appear in the results of this study, suggest non-negligible changes in the development of photovoltaic electricity. Undoubtedly, the shortfall of ENEDIS, for every self-consumption project, would be counterbalanced by an increase in some services tariffs for other customers. The savings that could be made by the state highlight the interest for the French State to switch from a policy in favour of full injection to a less costly policy in favour of self-consumption when LCOE is approaching the grid parity. Nevertheless, these savings do not appear to be directly at the benefit of consumers because the value of the tax that covers the development of photovoltaic electricity (CSPE) is fixed on their electric bill in the future. The results of profitability show that the bigger the installation and electric demand are, the more profitable the self-consumption project is. It is also suggested that self-consumption project are more profitable and more competitive when the self-consumption rate is increased. Several tendencies state that the support policy aims to stimulate a self-consumption with a high self-consumption rate rather than investments in photovoltaic injections that would be oversized for the user's electric demand. Furthermore, this policy tends to favour self-conumption for big installations with a high electric load.

References

French Energy Regulatory Commission (CRE) (2016), *Délibération de la Commission de régulation de l'énergie du 17 novembre 2016 portant décision sur les tarifs d'utilisation des réseaux publics d'électricité dans les domaines de tension HTA et BT*, France.

French Ministry of Environment, Sustainable Development and Energy (MEDDE) (2014), *Rapport sur l'autoconsommation et l'autoproduction de l'électricité renouvelable*, France.

IAE PVPS (2016), *Review and Analysis of PV Self-Consumption Policies*, France.

French Government (2016), *Ordonnance n° 2016-1019 du 27 juillet 2016 relative à l'autoconsommation d'électricité*, France.

French Energy Regulation Commission (CRE) (2016), *Cahier des charges de l'appel d'offres portant sur la réalisation et l'exploitation d'Installations de production d'électricité à partir d'énergies renouvelables en autoconsommation*, France.

French Ministry of Environment, Sustainable Development and Energy (MEDDE) (2017), *Pricing Order Draft for electricity produced by photovoltaic installations with a peak power below 100kWp*, France.

French Government (2017), Law n°2017-227 on the 24th February 2017 for renewable electricity self-consumption, France.