CROSS SUBSIDIES ACROSS NETWORK USERS: RENEWABLE SELF-CONSUMPTION

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Overview

To decrease the greenhouse gases from the electricity sector, policy-makers promoted photovoltaic (PV) technology with public supports. These supports led to a fast development of this technology and a significant decrease of the PV generation costs. Currently, some developed countries have reached the grid parity, which means that the PV generation cost is equal to the cost of the electricity withdrawal from the grid. When the grid parity is achieved, self-consumption becomes profitable and public supports are no longer needed. In France, the self-consumers are still incipients but they represent 36% of PV installations in 2016. The development of so called prosumers (a term to refer to people who both produce and consume) is not longer driven by direct supports but they benefit of indirect incentivizing such as the savings on the grid rate. Indeed, the grid rate is based mainly on a volumetric component in France but also in Europe (AF-Mercados, 2015). This indirect support raises a lot of concerns since decentralized generation may induce cross-subsidies from consumers to prosumers (Eid et al, 2014; Picciariello et al, 2015; Simshauser 2016). Indeed, the grid operators face a financial deficit because of the decrease in the volume of electricity withdrawal whereas their costs are mainly based of fixed costs (Felder et al, 2014; Perez, 2016). In this situation, grid operators have to increase the grid rate in order to balance their financial account. The cost of direct public supports decreases with the development of self-consumption but it maybe offset by the increase of the network tariff. This issue is leading the French regulator to set a special grid rate for prosumers.

In this article, a methodology to estimate the volume of self-consumption in France with a half-hour time step is presented. By applying the current Time-of-Use grid tariff, we computed the cross-subsidies from 2018 to 2021 for different customer profiles. This time frame corresponds to the current regulation for French grid operators. Then we investigated some rate-settings to avoid these cross-subsidies. Without changing the rate structure, cross-subsidies will represent less than 1€ for households and 3€ for firms in 2021.

This paper contributes to the cross-subsidies literature and gives insights to the decision-making by identifying the indirect cost for ratepayers links with the self-consumption development and the grid rate structure. Indeed, the paper introduces a new methodology to estimate self-consumption on a macro level in a short time step of 30 min with public data. Then, we compute the financial impact of the development of self-consumption for ratepayers with different grid rate structures.

Methods

With the coefficient of profiles provided by the main French distribution grid operator (which is called Enedis in France and manages 95% of the French grid), average load consumption and generation curves are estimated for different customer profiles by half-hour time steps. These load curves allow us to compute the amount of self-consumption from 2018 to 2021 by season. The development of PV capacities corresponds to the French government's goals. We apply the current Time-of-Use rate for each prosumer based on a peak and an off-peak tariff which varies depending on the seasons. By applying corresponding rates acoording to different seasons, financial deficit is estimated for the grid operator. Then, his financial account is balanced by increasing the fixed charge for the self-consumers. We compute the amount of cross-subsidies for each average customer profile for each year. Finally, different rate structures are tested in order to avoid cross-subsidies.

Results

Results show that 93% of the PV self-consumption occurs in peak-time and represents 95% of the cross-subsidies. Electricity self-consumption is higher in summer (68%) but the cross-subsidies are more significant in winter. Indeed, 54% of cross-subsidies occur in winter because the grid rate is higher in winter than in summer so the price effect is more prominent than the volume effect. Nevertheless, cross-subsidies represent less than 1€ in 2021 for residential customers and 3€ for firms because PV self-consumption represents 0.27% of the national consumption. In order to avoid cross-subsidies, the structure of the grid rate needs to be changed. We show the self-consumers are willing to pay an annual fee to finance the grid than pay the value of lost load.

Conclusions

This paper provides a new methodology to estimate the amount of self-consumption across seasons. We present quantified results on the impact of the development of self-consumption on the income of the grid operators. In 2021, cross-subsidies will be low because the amount of self-consumption represents less than 1% of the national consumption. However, a grid rate based on a volumetric charge is maybe no longer suitable especially for prosumers. Regulators need to take account of this parameter to implement specific grid rate for prosumers. They have to investigate the correlation between the amount of self-consumption and the cost of grid operators at each hour. One way is to increase the part of the fixed charge.

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