THE IMPACT OF PROSUMERS IN A SMART GRID BASED ENERGY MARKET

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Briefly put:
Prosumers have the ability to change the face of the energy market, impacting price stability and potentially challenging the economic basis for fossil fuel generation. But - consumers need carefully thought out business and regulatory strategies to make the transition from consumer to prosumer.

The basic aim of IMPROSUME was to define and study the role of prosumers in the future power market. Energy prosumers are not only consumers that also produce energy, but also sellers of energy and therefore active participants in the market. If a producer merely consumed what he produced he would only influence the demand side of the market. Obviously whenever surplus energy is fed in to the grid the supply side is also influenced. Consequently prosumerism is much more than homesteading. In fact it also extends beyond the act of selling the surplus energy that is not consumed. The prosumer might in fact wish to sell what he has for a given price and then buy what he needs from someone else, thus benefitting from the arbitrage. Enjoying the double role as producer and consumer and having access to the energy market is going to provide the prosumer with a tactical choice. How he capitalizes on this depends on his flexibility. Shifting demand or supply along a time line will empower the prosumer and enable him to maximize benefits in terms of his own needs, but also in accordance with the state of the grid and the market price.

The ERA-Net project , IMPROSUME, set forth to investigate the role of prosumers in the future energy market. Spearheaded by NCE SMART in Norway, University of Aarhus in Denmark and St. Gallen University in Switzerland, the project partners specified four fundamental issues that required more insight.

1. Would energy consumers adopt a prosumer role dependent on smart grid technologies?
2. What role could fit these and what kind of business model and context could be suitable to support and organize groups of prosumers?
3. To what degree would a group of well-organized prosumers be able to influence the future energy market?
4. And what type of energy market would that be?

The potential market contribution in a future smart-grid dominated energy market has been heralded as promising, but not well defined. Viable business models that can leverage the contribution of prosumers in a smart grid oriented market are still only vaguely defined. Naturally the whole concept also hinges on what incentives and stimuli are likely to drive future prosumers in the future. Also, what are the possible constraints? All of this comes down to what business strategies and regulations are required to ensure sound participation and sustainable growth.

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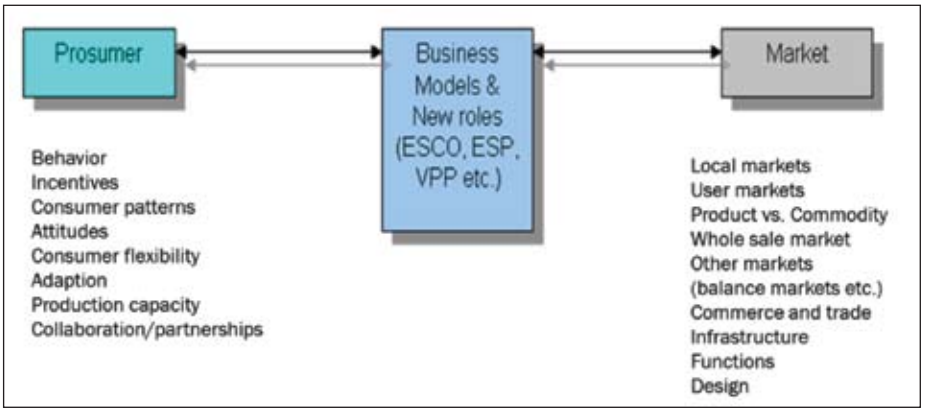
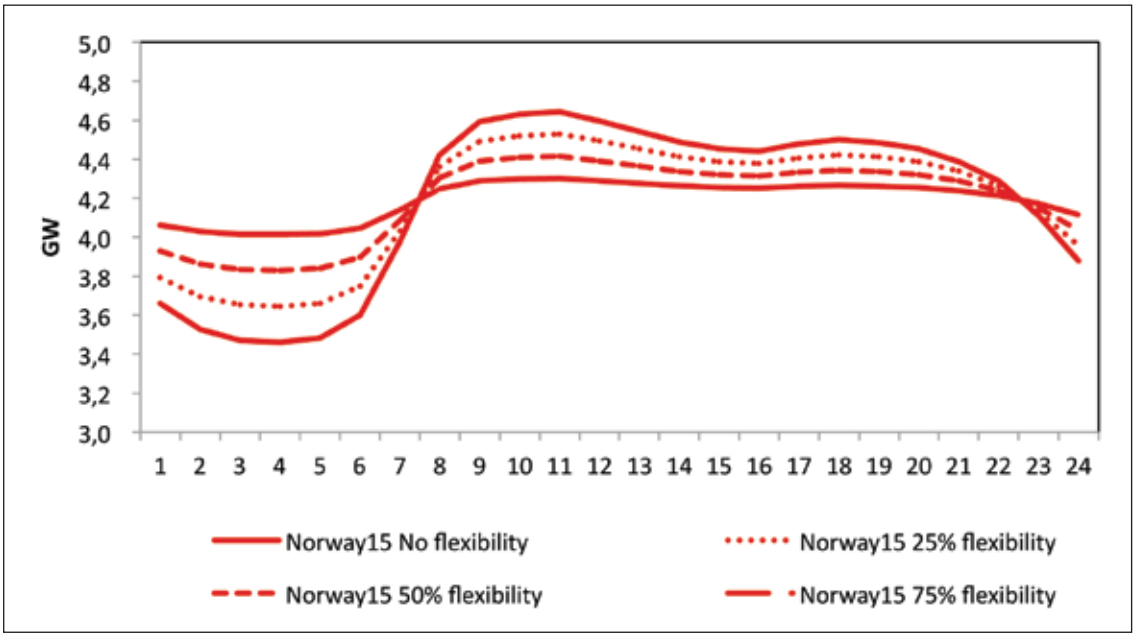
The project soon discovered that it had entered virgin territory. Truly, islands of knowledge related to technology, user engagement and smart grid in general can be found within this territory. But the overall picture, including the relationships between the individual prosumer, new business roles such as the VPP (Virtual Power Plants) and the energy market have not been well defined or explored.

Investigations undertaken in the project were supported by surveys and interviews of house owners in the three participating countries. An investigation of comparable businesses was also conducted. Theoretical models were used to explain the results. Based on market intelligence gathered, models of the energy market in northern Europe in 10-15 years from now were created to support simulations based on basic findings. A good deal of empirical work directed towards individual households in Denmark was carried out too. However, this had little effect on the final market study.

The University of Aarhus addressed the psychological factors that influence consumers' intention to adopt Smart Grid technologies. Here a theoretical framework combining two psychological theories, i.e., the Technology Acceptance Model (TAM) and the Values-Beliefs-Norm (VBN) model were applied. According to the TAM, individuals' acceptance of a new technology is primarily determined by rational choice, implying that people focus on ease of use and their own benefits. Although it is highly likely that this influences the adoption of Smart Grid technologies, it is not likely that people actually expect large private benefits from Smart Grid technologies, at



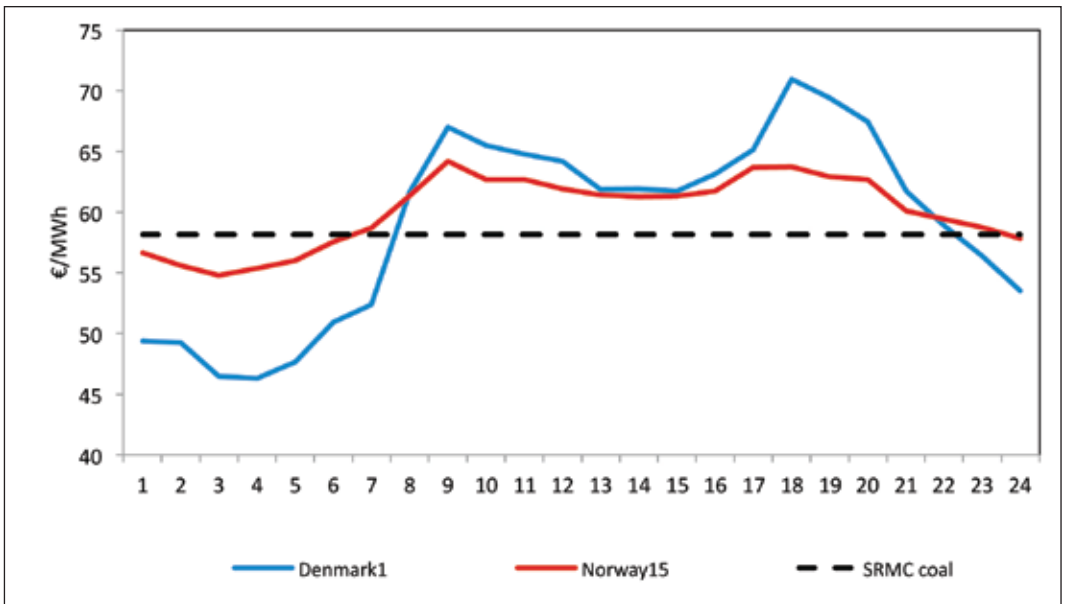


least not in the near term. The VBN model suggests that Smart Grid technologies are more likely to be accepted if its usefulness is assessed in terms of positive impacts for society and the environment (i.e., a better functioning grid and integration of more renewable electricity). Our data confirm that, as we expected, both personal and collective benefits are important for the acceptance of Smart Grid technologies in Denmark and Switzerland. However, in Norway, a lighthouse for solidarity and social commitment, collective benefits seem to play a less important role. Emphasis on personal benefits came forward as more important.

As hypothesized initially it was found that the participation rate in the smart grid depends on the recruitment method and specifically what is the implicit or explicit default option. If standard recruitment procedure are used where electricity consumers are asked to sign up (opt-in model), the default option is to not have Smart Grid equipment installed in one's household. It was found that under this condition, participation is much lower than under an alternative procedure where people were told that everybody will get Smart Grid equipment installed in their household (the default option), unless they explicitly state that they do not want to (opt-out model). Being part of the Smart Grid is generally a difficult issue to make a decision on, because people may fear risks such as comfort loss or invasion on their privacy. It was postulated that in the-opt-in model, it is easy for people to avoid making a decision about these consequences, and they will easily procrastinate. The results gathered supported this hypothesis.

Both personal and collective benefits are important for the acceptance of Smart Grid technologies

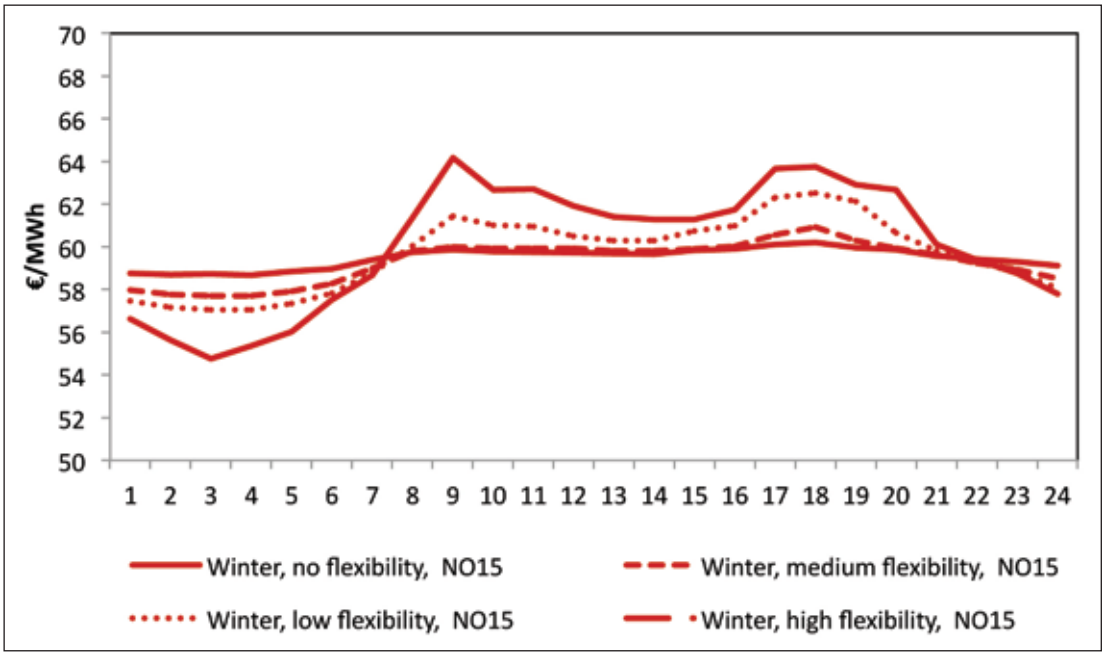
The Swiss party performed a conjoint experiment towards energy users in the SME segment to determine how people value different features that make up an individual product or service. This applies a statistical technique common in market research. A controlled set of potential products or services is shown to respondents and by analyzing how they make preferences between these products, the implicit valuation of the individual elements making up the product or service can be determined. These implicit valuations can be used to create market models that estimate market share, revenue and profitability of new product designs.



Average hourly prices, Denmark and Norway, winter weeks (S01-S05), base case 2025

The data gathered reveals a "more is less"-effect. It is important to produce an acute offer and not saturate the customer with all kinds of things. The idea is to provide more than a basic service, but be careful not to bundle too many things. The research done also implies a phenomenon, which has recently been discovered for consumer psychology, namely " the presenter's paradox". The very basic assumption is that presenters and consumers have different and assumingly even opposite perceptions about costs and benefits of smart metering. Only an integrated view of those perspectives reveals how smart metering services are best designed: with an optimal level of service.

The work of the Swiss group precipitated into a model that specifies a generic value proposition per segment that can be used for practical marketing as well as for business strategy development. This value – segmentation model was used extensively in other IMPROSUME work.



An investigation was also conducted to determine the influence of energy prices. A commonly declared objective behind smart metering is to achieve tighter coupling between the end user side and the wholesale market. The idea is to increase the awareness of energy prices among users in real time to have them respond accordingly, thus increasing price sensitivity and therefore also price elasticity on demand. However, with persistently low energy prices players in the end-user market will wish to add high margin products and services to assure return on earlier investments or to take advantage of what smart grid technologies can offer in terms of service development both within and beyond the energy domain. Low prices will de-commoditize the end-user energy market and possibly amplify the "presenter's paradox", making it hard to create business with a clear energy profile. Energy is thus likely to become a marginal, nameless, but necessary element of a product or service bundle. Consumer controlled business development will require very affordable and easily applicable technologies to be sustainable. It is more likely that professional players will step in and offer a "full service package". In both cases we are likely to see a decoupling of the end user market and the whole sale market. This can eliminate a treasured smart metering effect, namely to increase price elasticity for demand through increased consumer consciousness.

The use of the simulation model created together with the Norwegian University of Life Sciences made several aspects of the 2025 energy market pronounced. Several price zones in the Nordic countries and Northern Germany were included in the model. A lot of market intelligence about future commissions and decommissions of plants, new transmission lines, wind and sun power projects and other things were included to create the model. Based on assumptions related to such entities the simulation model concluded that average prices in the future will only be marginally higher. This suggests that a low price scenario will be maintained. Consequently ancillary services are likely to dominate. The collective impact of prosumers can be very significant. The project scope did not allow analysis of the full array of possible prosumer activities. Focus was placed on the demand side only. However, with only a limited penetration level the damping effect on price variation will be significant. By curtailing demand during peak hours, either by shifting 25% of the hourly consumption above average to night hours or by meeting this demand by self-generated energy, price variations will be curbed. This applies to the Nordic market as well as the German price zones included. Mere load shifting will yield a rebound effect during night that will raise the average price during night hours, especially during the winter. If consumption level during peak hours is met by self-generated energy instead the rebound effect will vanish and reduce the overall price accordingly. The role of prosumers will become even more pronounced during dry years where the operational latitude of hydroelectric plants in the Nordic market is more limited. An interesting thing to note is that a well-organized population of prosumers is likely to reduce or even eliminate the economic basis for fossil fuel plants. This is important if goals related to climate control are going to be met. If the present pressure on coal prices in Europe persists while quota prices remain low the importance of prosumers will increase.

This suggests that macro effects of energy prosumerism, well controlled within the framework of smart grid technologies, may have very significant implications. But the question remains how a "critical mass" of prosumers should be mobilized. Subsidies may be a temporary solution. But this encourages a form of homesteading that will reduce the prosumer's importance during peak periods. If we take into account that collective benefits have limited mobilizing effects on people more attractive, individual incentives must be defined. This is where the segmentation model developed by St.Gallen comes in handy. The user or any party acting on his behalf must be encouraged to move across an initial threshold. A part of this threshold is constituted by people's apprehension of new technologies as was shown in the project. Consequently significant investments in sound and educating communication will be required. Further investments must be made in terms of good product and service development. The introduction of ancillary, high margin services to increase attractiveness and to assure a sound ROI is likely to be key. But the paradox is that bundling services with low price energy to create different combos may make the latter oblique to the user and therefore create a decoupling effect that makes the user even more ignorant of energy prices. Therefore it is essential that we find ways to share the general market benefits and the potential societal effects in new ways to motion the energy user into sustainable prosumerism. MI

ABOUT THE AUTHOR:

ABOUT THE ORGANISATION:
IMPROSUME was defined as a joint venture with several academic and industrial partners. The consortium was headed by NCE Smart Energy Markets in Norway with University of Aarhus in Denmark and St.Gallen University in Switzerland as the two other principal partners. The work was co-sponsored by the European ERA-Net Smart Grid cooperation.