Contributing to a Carbon-Free Economy with Smarter Homes

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The European energy landscape is rapidly evolving. The transition to cleaner, more renewable energy mixes is clear, as countries try to achieve their "20-2020" as well as their long term goals. Yet this transition comes at a cost, as more renewable energies involve more intermittency and thus more difficulty in balancing the grid and ensuring the security of supply.

As these new realities bite in grid operators and energy suppliers are turning more and more to consumers, be it with energy efficiency, and more recently with demand response programs, aiming to come up with more economical ways of obtaining grid flexibility. For the past years, the focus has been on obtaining decentralized flexibility capacities mainly from commercial and industrial users, as the economics of valuating these capacities at a residential level have been seen as economically challenging. In this context, smart home technologies appear promising, yet the dynamics of the markets for these products, in Europe, raise more questions than answers.

CODA Strategies' has conducted extensive research on smart home technologies, their impacts on European energy systems and the development of the business models behind their potential deployment. Results of our research and our simulation models will be presented throughout this document in order to paint a picture of the potential impact of Smart Home technologies on the success of the European energy transitions.

Due to the nature of the European energy systems, certain grid operators have, in the past, turned to residential consumers in order to obtain much needed flexibility. This has been the case, for example, in France, where as a results of the high share of nuclear generation in the energy mix, electrical space and water heating was heavily stimulated. Controlling these uses also became important: the electrical water heating control program today has an impact of roughly 20 TWh on the French grid. Replicating the relative success of this program, however, has been difficult, both in France and in other European countries. Some deployments, such as thermostats, and more recently smart thermostats have had modest impacts in the past few years, but the potential of the residential market as a provider of flexibility is still virtually untapped.

Up to now, most "Smart Home" technologies have been deployed on a promise of improved comfort, especially for home automation technologies. This may explain why the "Smart Home" market has yet failed to achieve the massive expansion that was expected of it. CODA Strategies research, based on interviews of more than 2000 European households, shows that comfort functionalities are at the bottom of the list of attributes that are required of a Smart Home System. On the other hand, the study highlights that energy efficiency and security functionalities are at the top of European residential consumers' priorities. Systems that automatically inform the user of technical issues (like abnormal electricity consumption, water leaks, etc.) as well as control systems such as equipment stand-by management systems federate considerable interest from interviewees.

The research shows another significant issue: demand solvability. Through its interviews, CODA Strategies has tested the propensity to pay and the price sensitivity of potential users of Smart Home systems. The number of interested customers varies from 35% (price at 1 € / month or less) to 1% (price at roughly 60 € / month). This practically means that the market will develop more rapidly if the equipment is only partially, or not at all funded by end-users.

Traditionally, the business models of deploying smart home technologies involve significant investment from the end-user (several thousands of euros) and support from a qualified installer. New business models are however appearing, supported mainly by:

- The deployment and valuation of energy management systems (the valuation of the flexibility pays, in part or fully, for the system), the socialization of the investment
- The socialization of the investment, for example, through the deployment of a system providing aid or assistance to the elderly, etc.
- Etc.

The deployment of Smart Home technologies as energy management systems allowing for the valuation of energy efficiency and demand response capacities seems very promising, as it provides a solution to the issue of demand solvability. In the context of the energy transitions engaged in the European countries, such deployments would tend to obtain support from grid operators and other energy supply value chain stakeholders. Indeed, several models of service provision are appearing throughout the E.U. countries, both independent (as is the case of residential demand response provider Voltalis, in France, and Be-Smart in Switzerland), to utility supported programs such as RWE's Smart Home offering, EDF's Energy Box offering, E.On's push for decentralized storage as self-consumption support, etc. (these activities will be briefly described in the presentation). The markets are also evolving to better integrate decentralized flexibility valuation. For example, demand response can now be monetized in a number of EU countries (details in the presentation), making the potentialities of Smart Home technologies even more attractive.

In order to better understand these potentialities, CODA Strategies has developed a bottom-up simulation model of the impacts of "Smart Home" technologies, for demand response, in 8 European countries. The model quantifies the equipment parks in the 8 targeted countries and constructs using a bottom-up methodology, the load and consumption curves on the 2010 – 2022 period. Using these curves and a series of market scenarios, CODA Strategies determined the electricity consumptions, by equipment, by type of household and by annual, monthly or daily periods, as well as the demand response potential over the period (more details about the methodology of the simulation model in the penetration).

The model highlights extensive potential for residential demand response, especially from loads that are easily manageable through a basic Smart Home system (e.g. heating). For example, in the case of France, the model identifies more than 3 GW of curtailment potential, towards 2015, that increase to close to 6.4 GW towards 2020 (all the figures and scenarios will be described in the presentation). The model also simulates the potential valuation of these capacities, based on projected market figures. The impact of these capacities is consequential: valuated as ancillary services, residential demand response capacities support the grid integration of intermittent renewables and do so in a cleaner and more economic manner than conventional generation.

While the impact of the capacity is important, obtaining it and monetizing it under the current conditions is more challenging. CODA Strategies' research highlights that a residential DR program operator is required to make consequential investments in order to deploy the system to residential consumers, with limited or no funding from end-users. In France, for example, an investment of close to 1,000 € per individual household (including equipment, installation, customer acquisition) is required. Deployment of infrastructure capable of providing multiple value added services (including energy

conservation and control) could be a solution, as it would allow costs to be supported by several individual operators. Actility's Thing Park product is an example of such an infrastructure platform.

In conclusion, CODA Strategies research highlights the importance of the development of energy-management oriented Smart Home applications towards supporting the energy transitions that EU countries are currently undertaking. A business model built on the valuation of the decentralized flexibility of residential consumers can bring a paradigm shift in the development of the Smart Home systems market, but the economics for the potential operators depends on market structures and the capacity to attract multiple applications to their platforms.