ERICSSON

ENERGY MANAGEMENT SERVICES FOR THE CONNECTED HOME

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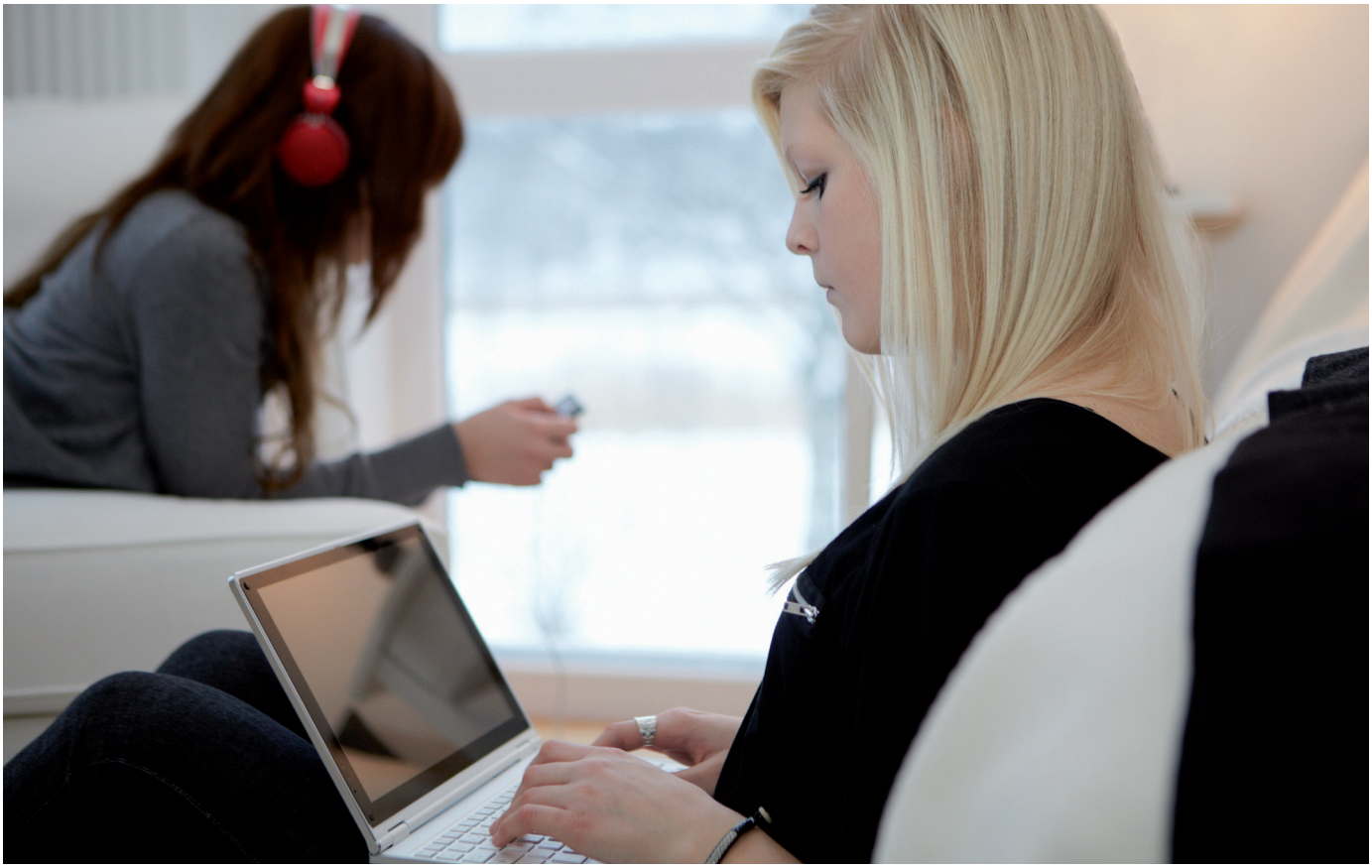


HOME ENERGY MANAGEMENT SERVICES

Energy management for the connected home – ready for takeoff

Access to electricity is a prerequisite for our society and a foundation for the future of both developed and developing countries. The way we live today and will live tomorrow requires a lot of electricity, and the demand in the global economy is expected to grow. At the same time, the climate effect from electricity consumption must be kept to a minimum. Technical development makes distributed generation and storage more affordable to consumers, enabling climate neutral electricity consumption. Balancing supply and demand becomes more of a challenge for the grid with distributed generation, a problem that can be solved, but one that requires attention.

Technical development of solar panels, batteries, and so on, is key for this development. But equally important is the rapid development in the Internet of Things (IoT), enabling everything that can benefit from being connected to be connected. This is a disruptive change that will have a significant impact on utilities.

In the light of this development, Home Energy Management (HEM) services can play an important role to help consumers manage their electricity consumption. The objective of HEM services is to control and limit the climate effects of energy consumption through dynamic demand.

Currently, energy management services for homes have a limited propagation, and most consumers are not interested in buying such services. Sustainable energy is high on the political agenda; plenty of entrepreneurs are looking into this field, and we have seen many pilots and proof of concepts. Despite this, the uptake is still modest.

So, what are the barriers for a bigger propagation of energy management services to consumers? And what is needed to achieve bigger propagation of HEM services in Europe?

EXISTING MARKET DEVELOPMENT AND DEPENDENCIES

Energy utility value chain

GENERATION | WHOLESALE & TRADING | TRANSMISSION | DISTRIBUTION | RETAIL | ENERGY SERVICE COMPANY

Companies that deliver HEM services to consumers are named energy service companies (ESCOs). ESCO is a role that can be assumed by any market player in the open market, such as electricity retailers and independent energy service providers, or players originating from other industries (such as home security and entertainment).

A large portion of current services are supplied by retail companies assuming the role of an ESCO. In the Nordics, we estimate that HEM services currently account for less than 1 percent of retail company revenue (see chapter 3).

Smart meters and data availability

Smart metering is an important part of the future energy industry and will make an abundance of data available. Countries such as Italy and Sweden have completed smart meter rollout. Other EU member countries are well underway (Finland and Denmark). However, according to Berg Insight, smart metering penetration in the EU is expected to be only 27 percent in 2015 and to reach 58 percent by 2020 [1].

Smart meters are important sensors, providing possibilities for short interval (hourly or less) measurements and pricing of electricity. In combination with data hubs, as in Denmark and Norway, data can be used by ESCOs to develop new services. Metering and structural data about delivery points can be used for actionable advice to consumers. Actions can be taken manually or automatically based on data processing and direct feedback. This requires access to data being provided in a harmonized way, such as in a data hub or via a local technical interface on the smart meter. HEM services, however, can be developed without access to metering or structural data from smart metering systems or data hubs.

Developing HEM services based on available data

HEM services can be developed by combining data already available from the home owner, the distribution system operator (DSO), the retailer, and other available data. Consumers can volunteer data and allow ESCOs legal access to data by power of attorney, providing that the technical and practical issues are solved. The most obvious contractual and structural data needed are:

- delivery point ID
- current retailer
- the regulated DSO tariff structure and price
- electricity product and product pricing from the retailer
- electricity system generation and mix
- wholesale and retail market data for comparative analysis.

As a starting point, this data is available without centralized or regulated data storage and could already be used today to create innovative HEM services for consumers.

Role of the DSO

The smart meter is the asset of the DSO in many EU countries. The role of the DSO is primarily to have an efficient network operation with high security of supply and quality of service, rather than to facilitate ancillary services such as HEM. As a natural monopoly, the DSO business is regulated, including remuneration [2].

DSOs can benefit from HEM; as determinants and issuers of grid tariffs, they have an opportunity to use tariffs as utilization improvement instruments in cooperation with an ESCO. Examples of such benefits include better utilization of the distribution grid through peak shifting and time-differentiated contracts.

But with the regulatory limitations mentioned, the DSO and the smart meters are probably not the gateway to the connected home, although the smart meter is an important sensor.

Consumer engagement

The consumer benefits of HEM services are mainly to control and limit electricity consumption to minimize cost and make informed decisions about their environmental footprint. In a connected home scenario, consumers can benefit from home automation and the integration of HEM with other services such as security and entertainment.

As HEM services are largely unknown to consumers, the following traditional engagement barriers are also likely to play a part for HEM:

- The perception of benefits from engagement is low compared with the work and hassle involved.
- Sustainability issues are not important enough to initiate engagement.
- There is limited awareness of the benefits of managed services.

With research, it is evident that utility consumer engagement has a seasonal variation and depends on geography. Consumers tend to sway between cost, sustainability, and security of supply. For example, a home owner in Sweden is likely to be cost-aware on a cold winter's day, but favor a sustainable alternative in the summertime. A consumer in South Africa, having experienced load-shedding, might vote for security of supply as the most important factor.

We believe that combinations of environmental footprint and economic incentives, as well as direct and indirect feedback, are important in raising consumer engagement and the willingness to pay for HEM services.

Security and integrity of data

Energy companies operate in an environment with some special prerequisites: smart metering enables utility companies to collect detailed information about consumers' energy consumption. Consumers get a new device installed in their homes – a device they cannot manage and see little use for. Home owners worry that having their homes constantly monitored and making that data available to third parties may compromise their integrity.

A recent report by the Swedish Energy Markets Inspectorate shows that almost half of the 900 participants in a survey expressed a negative opinion of the possibility of being compared with other similar types of consumers. In the Netherlands, the Dutch Senate blocked two smart metering bills due to privacy issues.

Data security using encryption and other technical safety measures also needs to be utilized when developing services, not only in smart metering systems. Such measures have already been suggested in recommendations by the European Commission and should be taken into account when developing HEM services.

Utility business models

In an unbundled market, retailers need to have an efficient customer management process to be able to generate revenue in a highly competitive market. To attract as many consumers as possible, retailers need some unique selling point to be selected as consumer suppliers.
In this context, it is contradictory for the retailer to promote energy management services to sell as little electricity as possible. The reason for retailers to sell HEM is normally to build customer loyalty rather than to reduce consumers' energy consumption.

Technical smart metering challenges for HEM

Smart metering systems offer support for grid and demand management operations and enable automated demand response programs. Smart metering systems collect detailed data about electricity consumption, and ESCOs can integrate HEM services with functions and data from smart metering.

However, there are some technical challenges for HEM in using current smart metering systems. For example, the lifespan of smart meters is 15-20 years, and some meter installations are already aging today. And the development of new HEM services will most likely uncover technical limitations of the smart meter as a potential gateway – limitations that we are currently unaware of. Exchanging outdated smart meters is costly and must be done by a certified electrician, which makes large exchange programs expensive. Technical data integrity requirements on meters are high in order to ensure charging of the actual, correct, consumption. These requirements limit third parties from access to meters to avoid tampering and theft, and to ensure physical safety.

To remedy this, a traditional IP gateway is likely to be used, utilizing the consumer's normal internet connection for communication. Likely to be used in predicting the development of the market, the gateway can be managed by the ESCO, as is largely the case for IPTV set-top boxes. The gateway is installed by the consumer, and it is cheap enough to be exchanged if technical limitations obstruct the deployment of new services.

EXAMPLES OF CURRENT HEM SERVICES

The HEM services currently on the market are used as early attempts to offer something new to Nordic and EU consumers. Generally, these services have a low adoption rate and are unmanaged in-home installations purchased and set up by the home owner. The majority of sales are done using introductory marketing campaigns, but sales then decline after that. The revenue for the ESCOs that offer them is most probably small, even though no official financial figures have been found to confirm this.
Examples of well-known successful deployments are:

- E.ON 100Koll, energy monitoring device about 10,000 installed [3]
- Enel Info+, energy display about 5,000 installed [4]

For services to provide a solid business case, they likely need to be marketed and sold in larger quantities. Introducing more interoperability with other services and adding automation capabilities may contribute to higher market penetration.

Characteristics of current services

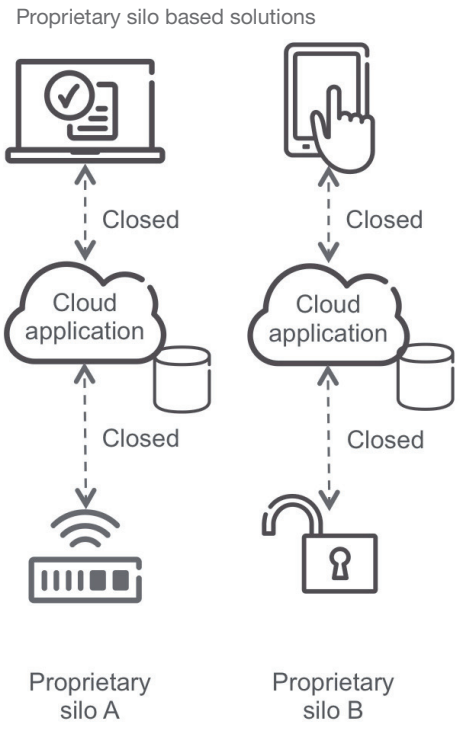
The characteristics that are common to most current services are:

- The solution architecture is primarily proprietary and in use by a single retailer or ESCO as a silo solution.
- Products are normally marketed by retailers, who sell equipment to build loyalty rather than to generate revenue.
- Units are largely used for monitoring only. Regulating appliances, heaters, and so on is done by the home owner.

Using a proprietary solution – a silo - makes development of the first HEM service potentially cheaper for an ESCO. As the solution needs to generate enough revenue to finance itself, the entry cost for consumers is high, resulting in low propagation. The second silo will be as expensive as the first because it is unlikely that the components will be reused.

Current trends in HEM development

There is an increased interest in the deployment of smart devices in the US, fueled by state regulation and targets for lower emissions and electricity consumption. Residential energy management companies are starting to adopt cloud- and analytics-driven technologies. It is expected that the IoT will make more data available for better management capabilities.
HEM is being bundled with security and entertainment and health services for the connected home. Marketing is based on a more leisurely lifestyle and home safety. Electric vehicles, distributed generation, and solutions for energy storage are becoming more relevant as part of HEM services, as the associated cost is decreasing due to technological advancements.



The stocktake's analysis has confirmed that information and communication technologies (ICT) are a significant enabler for [the] energy revolution. MARCHMENT HILL CONSULTING

DISTRIBUTED GENERATION AND STORAGE IS DISRUPTIVE

Distributed generation and storage is disruptive to the traditional utility business. True HEM services take commercial incentives and optimize the customer experience by assimilating price and service factors, including distributed generation and storage.

There are more emerging distributed applications designed to support grid performance, specifically to assist network management operations rather than to enhance customer experience. HEM will interact with these applications, but it remains to be seen exactly how.

Integrating renewables

Renewables have to become a larger contributor of electric power if emission targets are to be met. A large portion of renewable energy needs to come from consumers investing in solar, wind, and other types of generation. This will put more focus on business models and grid management, as the low-voltage part of the grid will be challenged.

In a recent report on integrating renewables into the grid, funded by the Australian Renewable Energy Agency (ARENA) [5], two major issues are highlighted:

1. economic/commercial issues: regulatory, commercial, economic, or political considerations that may help or hinder renewable deployment
2. technical issues: physical integration of renewable generation into the electrical system: managing power flows, voltage, frequency, system stability, and so on.

Of the 176 projects included in the report, including international projects, the majority are still looking at how to integrate fluctuating renewables, whether or not the investments pay off, and if the distribution networks are able to cope.

Australian initiatives

The Australian market is active in distributed generation; 116 Australian projects participated in the report from ARENA [5].

Australian consumers have become much more price sensitive over the past six years as prices have risen by approximately 100 percent. As a result, consumers have been looking for ways to reduce bills. Reducing energy consumption works in the short term, but network costs (which were driving the price increases) do not decrease with energy consumption reductions. Rising network costs accelerate cross-subsidies between consumers, which is why prices increase further in order to compensate. This is driving incentives for consumers to look for full disconnection options, potentially leading to a network death spiral.

In practice, the largest retailers in Australia (Origin Energy and AGL Energy) are starting to invest in distributed energy production, storage product bundling, and new business models. Both utilities are executing trials and pilot projects to learn as they go.

Germany's renewables market and subsidization

In Germany, residential users and farmers who produce their own electricity from renewable energy sources are subsidized. This has led to a large capacity of distributed generation. In 2014, renewables accounted for 26.2 percent of gross electricity production.

Household electricity prices in Germany have been among the highest in Europe for at least five years, to a large extent due to the renewable energy surcharge that pays the state-guaranteed price for renewable energy to producers. This surcharge accounted for 21 percent of the electricity price in 2015.

Although consumer prices are high (which should help conserve consumption) and so is the share of electricity from renewables, Germany is still struggling to meet the emission goals for 2020 [7], largely due to the heavy use of fossil-fueled power plants when renewable generation is low.

OBSTACLES IN THE EXISTING MARKET

There is a gap between the spirit of the EU energy policies and the implementation in member countries. On an overarching level, the EU has recognized the importance of ICT, smart grids, and common functionalities for smart meters. However, the regulation has not settled enough to be interpreted similarly by national regulators.

Demands on market functions, smart meters, and metering systems vary between countries, which is a poor foundation for the wide-scale implementation of HEM services that rely on functionality of smart metering systems.

Economic incentives for consumers

Why should consumers really care about HEM services? Their economic gain is small; prices are moderate in most markets, and electricity is a relatively small part of the household budget.

In Sweden, 38 percent of households selected fixed-price contracts in 2014. These consumers are willing to pay a premium price, surrender demand flexibility, and real-time pricing to avoid risk. About 40 percent have signed a variable price contract, and about 15 percent of the households stick to the default supply contract. Only 0.2 percent had agreed to real-time pricing [6].

Prices have increased in markets where distributed generation has been introduced, both in the EU and on other continents, by implementing surcharges or certificate trading for renewables. Time-of-use (ToU) pricing schemes will also strengthen economic incentives for consumers to manage their energy consumption.

Consumer engagement and sustainability

From a sustainability aspect, there is a shift in attitude from the younger part of the population, which according to some research prefers sustainable alternatives. However, consumers' reasons for engagement tend to sway between economic benefit, sustainability, and security of supply: research is inconclusive, depending on seasonal variation and differences in geography.

However, it is likely futile to rely on a change in behavior to reach environmental goals and limit the climate effects of electricity consumption. Feedback that covers a combination of environmental, economic incentives, and consumption aspects is important to raise consumer engagement and the willingness to pay for HEM services.

Electricity utility market

In the Nordics, utility companies are starting to offer energy products that make it worthwhile for consumers to actively manage their electricity consumption, with, for example, ToU and other types of transparent, dynamic pricing. Currently, no statistics are available on the effects of these measures, but uptake is expected to rise with cold weather and when costs climb.
HEM services, such as displays, web services, and apps, are offered from single utilities. These are often offered as part of an energy contract to create a lock-in effect, contradicting the EU goal for an agile market, and to avoid consumer lock-ins.

For electricity utility companies, there are some obvious challenges: consumers and society expect fewer electricity sales to support environmental goals. To compensate for the decrease in sales, these companies need to take on the role of an ESCO, invest in innovative energy products and new ICT systems, and offer new types of services in a market where regulation and market rules are still being developed. For multinational and global utility companies, differences between countries add complexity when regulation and legislation differs.

Comparing telecom and energy

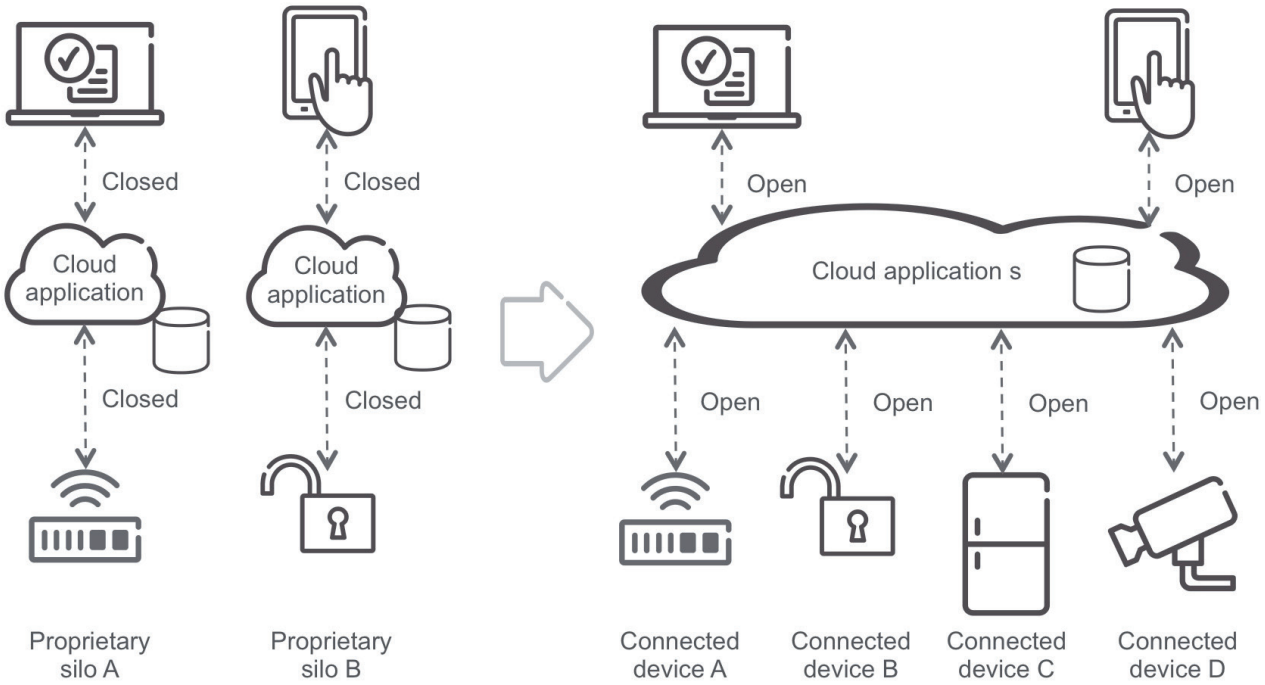
Both industries exhibit network effects and increasing return to scale. They have a legacy from policy making and monopolistic or oligopolistic characteristics.
The markets have been subject to deregulation with the aim to create competitiveness and promote innovation. For competitiveness to thrive, regulation is pushed upstream to allow for innovation.

Mobile telecom

Changes in mobile telecom were driven by market liberalization, open standards, and operator cooperation in non-competitive areas (such as roaming and clearing). A similar approach in the electricity market will create trust and offer stability for new investments.

However, mobile telecom services other than voice and text were driven by consumers wanting to send and

From proprietary silo based solutions to an open horizontal architecture



retrieve data on the move. The combination of a flourishing open market and standards, mobile broadband, cameras, apps, and services underpinned the rapid development. Telecom operators were largely unable to respond to the market's demand for new services, which opened up the market to new entrants. But the uptake and willingness from consumers to pay for new services were driven by human behavior and basic needs.

At the same time, HEM services alone are unlikely to be sufficient for the market to take off. A combination of economic, lifestyle, time saving, and other factors must be addressed simultaneously. Societal and climate benefits come as a bonus to ease consumer conscience about environmental footprint.

There are similarities, but there is the disadvantage of the above reasoning not having been proved by research.

Market matures with horizontal architectures

If the main purpose for ESCOs, and especially retailers, is to offer HEM services to build customer loyalty, it is natural that their solutions have a lock-in effect. The primary goal is not to be compliant with competitor offerings that would potentially enable a consumer to switch to another ESCO using the same technology. If an ESCO can assume that it will keep the consumer for a longer period, it can model the price parameters and distribute the investment over a longer period. An added benefit is if the consumer perceives the lower entry cost to be more attractive. In similar cases, a silo solution and proprietary technology is the best option for the ESCO, as long as it is not significantly more expensive than the alternative.

A consequence of similar tactics is that only small pockets of the market will develop. Still, this might be a way forward for the market to attract the necessary investment capital and try out different business models to lay a foundation for a larger propagation of HEM services.

Ericsson is convinced that a larger propagation of HEM services is conditioned by low entry costs for consumers, especially when electricity prices are moderate. The major share of the current entry cost is hardware and software. Key enablers to decrease entry costs are scale and competition among technology suppliers to continuously improve price performance ratio.

Developing the current market from mainly proprietary solutions to an open, horizontally integrated architecture would enable scale, exchangeability of components, and competition between suppliers. Such cost synergies enable more services at less cost per service, contributing to higher propagation.

FINAL REFLECTIONS AND RECOMMENDATIONS

There is much discussion within the energy industry about the smart, connected home and the IoT. Together, internet connectivity, the IoT, the cloud, mobile computing, and social technologies make the connected home possible. Another key component is electricity, a resource that can be measured, controlled, optimized, and managed.

In a connected home, the consumer can control and manage a number of services via connected devices in the home. These devices can range from heating systems to automated door locks, thermostats, televisions, and more. The connected home utilizes a package of services that collectively add value for consumers.

The IoT market is projected to grow rapidly. Cisco Systems puts the value of the Internet of Everything at USD 14.4 trillion [8] over the next decade, a growth driven by connectivity. According to Gartner, the number of connected devices in the world will reach 25 billion by 2020 [9].

These trends lay the foundation for HEM services.

Utility industry drivers

The era of building new, big centralized solutions is coming to an end. The expansion of new generation needs to come from renewables and distributed generation to a larger extent. Furthermore, nuclear power plants in Germany and Sweden have been shut down or are being phased out, and there are concerns over fossil-fueled power plants. The energy system of tomorrow will therefore include a larger share of renewables and distributed generation.

Smart grids and automated demand response alone will not accomplish the needed change in time for the EU to fulfill its 2020 goals. Smart metering penetration is expected to reach 58 percent by 2020 [1], but grid management will not be instantly automated.
The energy utility industry needs to utilize the opportunities offered by distributed generation and storage to facilitate change and continue to drive a development that supports renewables.

HEM services, designed specifically to enhance customer experience, will play a significant role in enabling and furthering the exploration of solutions for residential generation.

Role of regulators and authorities

The role of authorities and regulators is to establish the long-term conditions for development and provide insights and knowledge to politicians. Decisions on regulatory refinement and change must aim to remove barriers for renewables and for consumers to contribute to a sustainable society via HEM.

Conditions differ between countries, but the following steps need to be taken to enable a significantly faster and bigger propagation of HEM services:

1. Full deployment of smart meters that register consumption by the hour and deliver metering values at least once per day.
2. Enable secure access to smart meter data in the home via a Home Area Network (HAN) interface – a "HAN port." Some regulators are reluctant to specify standards for a read-only HAN port, but without a standardized socket the device market will not be able to scale.
3. Ensure that consumers own their data and are entitled to access all data in digital form from the retailer, the DSO, and possibly a meter reading player. Data access must be cost-efficient, secure, and practical. It must also be possible for a consumer to allow an ESCO to get access to data via power of attorney.
4. Ensure that all ESCOs are treated equally and have a common and harmonized way to interface with the DSOs – these interfaces could potentially become more advanced as the market develops. For markets

> We believe that the future eventually will belong to demand-driven decentralized models of service that empower individual consumers through sustainable energy solutions that are affordable, personalized, convenient, and reliable. NRG CEO DAVID CRANE

with more than one DSO, the deployment of a data hub should at least be considered to handle the DSO interface to the ESCOs and to other market players.
5. Without delaying the necessary development, internationally harmonized solutions should be investigated at consumer level. Today, utility industry policies are heavily influenced by national concerns. In order to unleash the scale and propagation of HEM services, internationally harmonized markets are needed. This is especially true when focusing on the home, the consumer, and consumer products.
6. Reduce barriers for consumers to build distributed, climate neutral power generation in cooperation or on their own. This includes simplicity and transparency for permissions, connections, and liabilities, as well as taxation and other possible fees.

Retailers

In most markets, the price of electricity is defined by the market itself. Electricity is a commodity, and the possibility for retailers to motivate premium prices due to differentiation is next to impossible. There are a few examples where retailers use their local presence to do something good for society or to bring out environmentally sustainable products in order to motivate premiums. However, the effect of this on prices is moderate. Some retailers use bundling with insurances or price securing products to increase the average revenue per user. But price effects are also moderate for these bundled products. Acquiring new consumers is relatively expensive, and price, visibility, and brand are important in order to be successful.

Retailers naturally want to sell value-added services like HEM to grow their business. Our conclusion is that HEM services do not really contribute directly to the retailer's bottom line, but rather to build customer loyalty. Cost to serve is therefore an important factor for every retailer to be successful. Since the cost to acquire new consumers is relatively high, retailers put a lot of focus on keeping the right consumers loyal – and again, brand is extremely important.

Retailers may fear losing the direct customer relationship to ESCOs. But by assuming the role of an ESCO, the retailer can potentially extend the direct customer relationship and build customer loyalty. Still, in the long run, real ESCOs will be able to challenge retailers' offerings against each other by bundling energy products, indoor climate, and other connected home services such as entertainment, security, and health. Retailers will need to evaluate their positions as the new market landscape evolves. Who are their competitors and with whom should they cooperate? What are the key assets to maintain and invest in? Can they do this alone?

Developing a new set of competencies and an ecosystem of partners will be crucial to control costs and gain clock speed. Assimilating the IoT and advanced analytics to build HEM services for the connected home may require expertise outside retailers' core business, but can be acquired via partnerships.

Ericsson's strong view is that it cannot be in the best interest of retailers to invest in their own, silo-based, proprietary HEM solutions. Product offerings may become expensive, resulting in low propagation. Customer experience and brand value are at risk if the long-term perception is that consumers are locked-in, or that the technology they are investing in is incompatible with other brands. This may seem tempting in the short term, but can hardly be justified in the long term considering the potential negative brand impact in this evolving market landscape.

Embracing open technologies promotes cooperation and new, as yet unknown, ecosystems. Open standards for technology also enable retailers to win consumers who have already invested in connected home products and services, but who want to change supplier.

ESCOs and customer experience

Systems for the connected home are gaining popularity by enabling increased comfort, energy savings through energy management, and home security services. The automation system monitors and controls the connected devices that can also be accessed remotely.

True HEM services take commercial incentives to optimize the customer experience by assimilating price and service factors. ESCOs that provide HEM bundled with connected home services are likely to gain market share initially. As the market matures, HEM services are likely to grow in relative importance by offsetting the investment in connected home services with lower cost for electricity and potentially other existing connected home services with large propagation, especially in home entertainment.

As already stated, an interoperable horizontal architecture is key to scale, low entry costs, short time to market, and large propagation. Large propagation of HEM services and a general growth of the connected home market is the prime focus for any ESCO. To grow, ESCOs will need to engage with many retailers and DSOs, and excel in swift integration of new devices and services.

Ericsson's contribution

In a recent report about the connected home by Ericsson ConsumerLab [10], 47 percent of respondents said they were highly interested in the idea of connected

home services. Energy utilities and home security areas are already associated with connected homes and are considered to form the foundation of the service.

At Ericsson, we believe that everything that can benefit by being connected will be connected. That is the foundation for our vision of 50 billion connected devices. The connected home is a key contributor in this development.

There is obvious value in connecting devices throughout the home: allowing a security system to manage the smart thermostats and to control energy consumption when the home is empty, as well as to predict when family members return home via positioning and to provide personalized services as soon as they open the door.

The user experience is unleashed by devices and components that communicate, utilizing the combined strengths of the IoT, the cloud, advanced analytics, machine learning, and more.

To accomplish this, technology and service suppliers need to be smart and innovative to deliver products with low entry costs – services and features that enable the value and user experience needed for a larger propagation. Ericsson is convinced that open interfaces and horizontally integrated architectures enable scale and exchangeability of components, and these characteristics are needed to achieve competition among the suppliers that drive the development.

Ericsson has played a key role in the evolution of the telecom industry by using innovation to empower people, business, and society, making it easier for people all over the world to communicate. Now it's time to enable devices to connect and communicate.

Ericsson is not only supporting retailers, ESCOs, and device manufactures in this journey, but also engaging in projects to try out new technologies, better understand consumer behaviors, possible new ecosystems, and business models, as well as smart grid technologies and network automation for DSOs. Ericsson engages in activities to enable the low-carbon economy [11]. One such example is the smart city project for Stockholm Royal Seaport [12].

Ericsson also intends to work more intensively with policy makers and regulators to better support the growth of HEM services for the connected home.

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