Chapter 2
Smart Metering, Smart Grids, Smart Market Design

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“Smart grids” is a term that defies a clear definition. Yet it is essential to differentiate precisely to avoid misunderstandings. Some aspects are directly linked to the grid, while others are far wider and barely affect the grid at all.

The first question we have to answer is how “dumb” our grid is at present and which parts of it need to be made “smart.” The transmission system is relatively intelligent and controlled on the basis of reliable data. This can be seen looking at the sharp increase in renewable energy which has so far been handled in Germany and Europe without any significant blackouts. Medium and low-voltage grids, on the other hand, are “as dumb as dumb can be.” They are controlled virtually “blind.” We must therefore consider it a top priority to make these grids smarter, glean more information about their condition and load level and indeed be able to control them actively at all. To achieve this, not a single smart meter is necessary, however, since the amount of electricity entering or leaving each consumer’s premises is of less importance. Only the big industrial customers are relevant—yet their consumption is already measured accurately today. What is lacking are meter and control devices actually in the grid and possibly a few reference measurements for wind and photovoltaic.

The other meaning of “smart grids” concerns matching generation and consumption, though this has very little to do with the grid as such.

The spread of renewable energy will make energy feed-in more volatile. The wind doesn’t always blow and the sun doesn’t always shine. The generation side can only evolve efficiently towards a larger share of renewable, decentrally generated energy if a sufficient number of market players are able to respond actively to the price fluctuations that result from ups and downs in generation. Generation should no longer be solely guided by consumption: consumption must also be capable of

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responding to input. Producers must be persuaded to refrain from supplying or consumers given incentives to take more electricity. In other words, there are certain situations where consumers need to curb their energy consumption and economise, and others where they are called upon to top up their storage appliances, recharge the batteries of their electric cars, or run their tumble dryers at a cheaper rate because there is a plentiful supply available. Moreover, considerable storage facilities are necessary to ensure that this theory will finally work in practice—a major technological challenge. Contrary to what the name "smart grid" implies, however, this is not a task for the grid nor does the grid need to be smart. The term is, strictly speaking, a complete misnomer.

The grid itself is only involved in two respects: firstly, it must be able to cope in the event that the more intelligent connection between generation and consumption breaks down. Secondly, the grid could conceivably act as a collector and distributor of information.

Consumers and producers alike must be provided with far more information than in the past about actual demand and possible adjustment methods. At the same time, the use of these methods must be financially worthwhile—if not, they will fail to become accepted. Merely knowing the current level of electricity consumption will soon cease to interest consumers; they must also be shown ways to save money. Consumers will only align their demand more closely to supply if they are directly impacted by these fluctuations. We simply need a suitable business case. When this has been developed, individual users will contribute by changing their habits and agreeing to accept new technologies. The rewards will be a future-proof, secure, resource-efficient, and environmentally sustainable energy supply and a strategic insurance against abrupt price increases for conventionally produced energy.

What are commonly referred to as smart grids could be more accurately subsumed under the heading "smart market design," in which smart metering and smart control of medium and low-voltage grids play a key role. If generation and consumption are to be reorganised successfully in the manner described here, smart meters really are indispensable. Against this background, they are an important building block in our efforts to transform the energy world. Analogue meters are definitely on their way out. Basically, the electricity markets are simply going through the same transition that is already taking place—or has long been completed—in other areas, namely the digitisation of our daily lives, giving rise to new services that were previously unimaginable. I firmly believe that the introduction of smart meters is important. The entire industry must fight to make this technology the recognised standard, similar to DSL, for instance. One main problem here is that electricity is perceived to be boring compared to the Internet; it is a background process that is generally taken for granted. A new meter does nothing to increase the speed of electricity in the way that DSL spawns visible benefits for the population at large by speeding up communications.

The introduction of smart electricity meters is proving to be a complex undertaking. Specifying exactly what to introduce is not the only question currently waiting for an answer—it is also unclear who should do the introducing how and to what extent, while facets such as the timeframe, technology, costs, and market model are equally vague. The challenges confronting all stakeholders are daunting.

There are numerous initiatives and pilot projects, both in the US and in Europe, which seek to transform the world of power generation.

The European Commission has set up a smart grid task force to discuss the implementation of smart grids at the European level. Specific plans also exist, for example on the Swedish island of Gotland, where electric utilities and plant manufacturers have set up a large-scale demo grid using most of today's known technical solutions to demonstrate possible alternatives for the future. Gotland is large enough for a serious, full-scale project, yet at the same time a well-defined area owing to its status as an island. In Germany's rural north-west electric vehicles, storage facilities, charging stations, meter and control systems, ICT-based storage management, billing and marketing processes, and pricing and business models with suitable interfaces are currently being developed in a field test. Another electric utility just successfully mounted 10.000 smart meters in Berlin to test technology and customer acceptance.

In the United States support for smart grids became federal policy with the passage of the Energy Independence and Security Act in 2007. The law sets aside $100 million in funding per fiscal year from 2008 to 2012, establishes a matching programme to enable states, utilities, and consumers to build smart grid capabilities, and directs the National Institute of Standards and Technology to coordinate the development of smart grid standards, which FERC will then promulgate through official rulemakings. Smart grids received further support with the passage of the American Recovery and Reinvestment Act in 2009, which set aside $11 billion for the creation of a smart grid. Earlier this year, a major energy infrastructure company announced a $200 million competition for clean-energy innovation funds. The programme is aimed at fostering ideas that will help speed up the development of smart grids.

The best models out of all these initiatives will eventually become established. Even today, we can draw on a stock of experience that tells us which mistakes to avoid.

One of the first lessons learned has been that highly integrated systems quickly become outdated. They can only be adapted to new requirements and ideas by dismantling old meters and replacing them with new devices. The huge gap between the innovation cycles for metering on the one hand and processing and communications on the other suggest that a modular structure would be preferable. Standardised communication technology that is already in place should continue to be used. The "basic meter" should be separated from the communication and processing modules to which it is connected. This basic meter should initially only produce digital data, which can be output via various interfaces if required, so that each user sees what they consider to be the most important consumption data on the display. The device itself has more powerful basic functionality than conventional meters. If the basic meter restricts itself to generating digital data and presenting it in a standardised form, its service life will no longer be tied to the comparatively short life of computer hardware. The investment will be as resilient as possible with an effective ceiling on expenditure.

The German government made it clear in its recently unveiled energy concept that it intends to create a legal basis for the introduction of smart meters and the use of communications to interconnect and steer electricity producers, storage facilities, and consumers as well as grid operating resources. Minimum standards and interfaces for smart meters will in future be defined by the Bundesnetzagentur, which called for the refinement of the smart metering strategy back at the start of the year. Neither the lawmakers nor the regulatory authority should be charged with compiling a comprehensive catalogue of functionalities for smart meters, however. The market will bring forth a number of applications that are still inconceivable today—and that is a very good thing. In my opinion, we should therefore confine ourselves to defining basic functionalities and ensuring non-discrimination as well as open competition. If the meters are capable of measuring all essential parameters nationwide and making this data available on request, this will be a big step forward.

Secondly, it hardly makes sense to build a parallel energy communications infrastructure spanning a whole country alongside an existing industry. We are at the interface between energy and ICT. The scope of classic network control will be extended to include data transfer and communications between electricity suppliers and private households. Cooperation between these two sectors—energy and communications—is consequently a prerequisite of a smart market. It is painfully evident from current events in German industry that these two branches still talk to each other too little and that their knowledge of each other remains scanty. In the context of the smart grids debate, this is an untenable state of affairs. Telecoms providers must prove that their expertise can be translated into cost-efficient, standardised offerings for the connection of smart meters, thus sparing their energy counterparts the need to connect these meters to a communications system of their own. Smart grids are a multi-billion future market that unite the core competencies of the energy and telecommunications industries. The operators of electricity distribution systems require lines into every household as a precondition of bidirectional data exchange. This raises questions such as "Who pays the cost?" and "Who will ultimately profit from business with smart grids?" The outcome will depend crucially on who offers attractive packages to customers and who, in the end, comes up with the decisive innovation. It is imperative that attractive products and services in this market should be embedded in a competitive environment because competition is good for business.

The Bundesnetzagentur, as a multi-sector regulator, has a particular interest in leveraging synergies between the different industries involved. This, and systems thinking on the part of the infrastructure companies—whether telecommunications, electricity, gas, or water—is something we intend to push ahead with much more strongly in future. The creation of an infrastructure atlas is therefore a key project in the development of a nationwide broadband infrastructure that will also promote cross-sectorial collaboration. Information about the existing infrastructure will be made available across traditional sector boundaries. This instrument will enable the players concerned to take advantage of third-party infrastructures and reduce rollout costs.

Smart meters form the interface between the grid and the market. This technology can, and should, be utilised to achieve secure grid operation, the active integration of renewable energy, competition in open energy markets, and countless new services. Variable pricing is of paramount importance. This does not mean that every household should purchase its electricity direct from the energy exchange, but rather that electricity traders should compete to serve their customers with made-to-measure solutions—pricing models specially tailored to single persons who are out at work all day, to families, to users of auto-produced electricity, or to owners of electric cars. Packages of this kind need to become an established feature of the marketplace, if not the norm. What is now no more than a future scenario will then become a reality.