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Smart Grid Primer

Energy

SMART GRID: WHAT IT IS, WHAT IT DOES, WHAT IT MEANS FOR US

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7 July 2010

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TABLE OF CONTENTS

SMART GRID PRIMER

The new generation of electricity networks

A smart grid is an intelligent electricity network that can integrate the behavior and actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies. Put simply, a smart grid is a modernized electricity network.

Drivers

Modernization of the existing power grids is driven by multiple considerations, including the necessity to increase reliability, efficiency, and safety of power networks, to enable decentralized power generation (in particular from renewable energy sources) and flexibility of power consumption on the demand side.

Smart grid components

On its way to smart grids, utilities and grid operators will have to modernize network infrastructure, add a digital layer to enable information exchange and communications between its various components, and to transform their business processes to allow full use of new technologies. Most of the work will have to be done on infrastructure and will include implementation of communications, sensing and measurement technologies (e.g. smart meters) as well as advanced components (such as power electronics) and control methods (e.g. power system automation), and interfaces and decision support techniques.

Smart grid benefits

With all the new technology, smart grids should enable more efficient energy use and optimized use of available resources by utilities, more pro-active management of energy consumption by customers, and more reliable energy supply resulting in significant savings for the economy as a whole and stimulating economic growth through creation of new jobs and investment in energy infrastructure.

Multi-billion investment planned

Investment in smart grids will extend over many years reaching into billions of dollars. Pike Research estimates a total volume of $200bn in smart grid investment from 2008 to 2015. The US' American Recovery and Reinvestment Act includes $3.4bn grants to support electric grid modernization. German utilities expect to spend €20bn on smart grids until 2020.

Players

Among the publicly traded companies involved in the smart grid projects, we would like to highlight a German software vendor PSI AG (energy management software), US companies Echelon Corp. (smart metering solutions) and Itron Inc. (smart meters) as well as Atmel Corp. (wireless communications components).

ENERGY – SECTOR REPORT
7 July 2010

Companies reviewed:

PSI AG

Bloomberg: PSAN GY
Reuters: PSAGn.DE

Price as of 06.07.10, 17:30:	**€12.40**
Market cap.:	**€195m**
Free float:	**55.1%**

SAP AG

Bloomberg: SAP GY
Reuters: SAPG.DE

Price as of 06.07.10, 17:30:	**€36.65**
Market cap.:	**€44.9bn**
Free float:	**72.4%**

Companies mentioned (public):

Echelon Corp.	ELON.O
Itron Inc.	ITRI.O
Atmel Corp.	ATML.O
Software AG	SOWG.DE
Kontron AG	KBCG.DE

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EXECUTIVE SUMMARY

Smart grid is the next generation of electricity networks. In contrast to traditional, centralized electricity networks, smart grid implies decentralized energy generation and allows two-way electricity flow. Smart grid can be characterized as user-centered, market-based, interactive, reliable, flexible, and sustainable.

The main task of the smart grid is proving sustainable, economic, and secure electricity supply across an economy. These requirements define the main features of a smart grid, namely:

- Enabling integration of renewable energy sources into the grid to increase sustainability of energy generation,
- Using load adjustment and demand response techniques, and by moving to a more decentralized energy generation to improve efficiency of electricity supply, and
- Using load shedding and demand management to increase reliability (avoid blackouts) and security of energy supply.

Implementation of smart grids is driven in part by the necessity to modernized the current electricity infrastructure but also by the need to incorporate the increasing portion of energy supply from the non-controllable renewable energy sources such as photovoltaic (PV) and wind.

The task of implementing smart grid components lies primarily with utilities and grid operators. There are three major steps for utilities to undertake on their way to the smart grid implementation, including infrastructure modernization, addition of a digital layer, and business transformation.

Smart grid features

Unlike existing electricity networks, a smart grid enables two-way electricity flow between a utility company and an end-user. Other smart-grid features are based on its reliance on communications and information technologies and include integrated communication between various components of the grid, sensing and measurement technologies, advanced components and control methods as well as improved interfaces and decision support systems for grid operators.

Smart grid benefits

Implementation of smart grids is expected to bring about substantial advantages to utilities, end-users, and a society as a whole.

For utilities, the smart grid would allow to:

- Predict and reduce peak loads reducing thus need in excess capacity,
- Increase power flow over existing lines due to real-time monitoring and reporting of line conditions,
- Increase grid reliability by managing loads and preventing blackouts,
- Reduce transmission losses by enabling distributed energy generation,
- Enable integration of diverse energy sources (including distributed energy generation from renewables such as wind and photovoltaic), and
- Optimize asset use and thus reduce operating costs or avoid costs of adding capacity altogether.

On the customer side, the smart grid would enable consumer participation in power management by providing end-users with real-time price information and control functions. This should translate into reduced electricity bills. However, consumers will need additional motivation to get fully involved with the adoption of active consumption adjustment.

The society and the environment will benefit from increasing penetration of renewable energy sources and distributed energy generation, reduced energy losses, and increased grid reliability and security.

Implementation timeline

The implementation of smart grid components is gradual and ongoing. While there are no precise deadlines for smart grid implementation, many countries have adopted recommendations for gradual introduction of smart grid elements. In the USA, the state of electricity networks prompts urgent modernization so that the smart grid investment progresses rapidly. Additional support comes from the government that allocated part of its stimulus package specifically to smart grid investment.

The European Electricity Grid Initiative outlines the major steps towards smart grids for Europe until 2018. By 2020, 80% of European households should have smart meters. In Germany, the Energy Industry Act prescribes that all new or renovated buildings should be equipped with smart meters from 2010 and the utilities should be able to offer flexible tariffs to their customers from 2011.

Investment in the smart grid

Obviously, such a large-scale implementation project requires immense investment spread out over many years. Pike Research, a US market research company, estimates the total volume of worldwide smart grid spending from 2008 to 2015 at $200bn with the largest part going to grid automation projects. German utilities estimate to invest €20bn in smart grid until 2020.

Companies to benefit from the smart grid investment

Among the companies to benefit from the billions to be invested in smart grids, there are many large, established players including infrastructure manufacturers (such as Siemens, ABB, GE Energy and the likes) and software and IT service providers (including SAP, Oracle, Cisco Systems, IBM, Microsoft, Google, etc.). However, the overall impact from the smart grid projects on those players might be limited due to a small relative proportion of relevant revenue in the company's total revenue.

In our opinion, the beneficiaries with the strongest impact from the smart grid spending will be smaller specialized suppliers of components and technology. Of the publicly traded companies, we would like to highlight **PSI AG**, a German software vendor specializing on energy management software. In the USA, there are **Echelon Corp**. (develops smart metering solutions), **Itron Inc**. (specializes on smart meters), and **Atmel Corp**. (a semiconductor manufacturer supplying wireless communication components to smart meter manufacturers).

Unfortunately, many of the specialized vendors are in private hands (e.g. EnergyHub Inc., Sentec, Green Energy Options, Landis + Gyr, etc.) but are worth watching in case of a potential stock market appearance.

We would also keep an eye on Kontron AG (a German manufacturer of embedded electronics) and Software AG (an infrastructure integration software vendor with expertise in business process management). The two have product portfolios that would fit well into the smart grid world, but neither has indicated a direct involvement yet.

SMART GRID: WHY?

I come home after work, turn on lights in my apartment, warm up my dinner and make myself a cup of tea. Later in the evening, I relax in front of a TV watching a new episode of my favorite show, take a shower, and then retire for the day. While I'm relaxing, I let my dishwasher run and my washing machine do laundry for me.

All my actions rely on an essential good – electricity supplied by a local utility. While we cannot function properly without each other (I obviously need electricity for "normal" life, and the utility needs me as a paying customer), we in fact know little of each other. I receive my electricity bill once a year and the utility can vaguely expect when I turn on my home appliances (with the rest of the Frankfurt crowd). This ignorance, somewhat unfortunate and sometimes rather expensive, is about to become a thing of the past. In the new world of smart grids we both, my utility and I, will have much more power to collaborate and make more intelligent decisions about the use of energy.

Definition(s)

While the words "smart grid" surface every day now, there is no precise definition of what it in fact means. The simplest way to define a smart grid is to think of it as a modified, modernized electricity network.

In a more sophisticated way, a smart grid is "electricity networks that can intelligently integrate the behavior and actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies" as defined by the European Technology Platform SmartGrids[1].

Why do we need smart grids

One could speculate that the environmental considerations represent the main driver behind the transformation of traditional electricity networks towards the smart grids.

Traditional energy generation and transport is dictated by demand. The main "problem" with electricity is that it cannot be stored and should be consumed when it is produced. This means that utilities should be able to cover demand as it arises which leads to a significant generation capacity aimed at covering peak demand (peaker plants). Peaker plants usually rely on obsolete technology and sit idle most of the time levying high costs on utilities resulting in significant inefficiencies and hurting environment. Some features of a smart grid allow flattening demand peaks reducing thus the need in excessive peak capacity and optimizing asset base for the utilities.

In a drive for lower greenhouse gasses emissions, more thought is given to renewable energy sources such as solar and wind. However, those have one major flow – they are mostly unpredictable and energy generated with their help fluctuates wildly over time. The intermittent nature of solar and wind energy generation creates a set of problems for utilities ranging from the necessity to enable electricity collection from many small producers (e.g. individual roof-top PV systems) to having to guarantee grid stability in times of fluctuating electricity supply from wind power stations.

The smart grid provides solutions that enable integration of the renewable energy sources into the electricity networks.

Overall, the smart grid allows increasing efficiency of energy use and more efficient use of energy will also reduce harmful impact on the environment. The implementation of the smart grids could have a tremendous impact on the environment. According to a January 2010 report *The Smart Grid: An Estimation of the Energy and CO2 Benefits*[2] by Pacific Northwest National Laboratory (USA), smart grid implementation in the USA

[1] http://www.smartgrids.eu/?q=node/163

[2] http://energyenvironment.pnl.gov/news/pdf/PNNL-19112_Revision_1_Final.pdf

would reduce the total carbon emissions from U.S. utilities by 12% by 2030, an equivalent of 442m metric tons, or 66 typical coal power plants' worth per year.

Steps towards a smart grid

At present, electricity is mostly generated by large, centralized power plants running on gas, coal, water or nuclear fuel. It is then transported to end customers via high-voltage transmission and medium-voltage distribution lines.

The task of modernizing existing electricity networks (both transmission and distribution parts of it) falls mainly on their current owners, namely utilities or network operators. It consists of three major steps:

- Infrastructure improvement or modernization: to provide a "hardware" basis for smart grid functions;
- Addition of a digital layer: to enable information and data exchange and analysis; and
- Business process transformation: to allow full use of the new technology.

Transformation of traditional electricity grids into smart grids is gradual an ongoing. Obviously, the utilities and network operators face several challenges on their way to smart grids including the necessity to perform work on operating networks and to develop common standards to reach interoperability and compatibility of various network parts.

SMART GRID FEATURES

The easiest way to understand what a smart grid is and does is to look at its features and characteristics.

To deliver electricity from suppliers to consumers remains the main task of a smart grid, but the definition of suppliers and consumers becomes more ambiguous. The smart grid enables a **two-way electricity flow**, that is, from a utility (electricity producer) to consumers (households, businesses or industry) and from consumers to a utility (a new opportunity). This feature becomes crucial as households and businesses take part in energy generation with their photovoltaic (PV) and wind systems and contribute thus to an increase of energy produced from renewable energy sources. In many countries, utilities are required by law to incorporate renewable energy sources into their grids which creates an additional challenge for the grid operators who need to guarantee networks' stability despite fluctuating energy supply.

With the increased complexity increases the importance of incorporating **digital and communications technologies** in the electricity networks to make possible information exchange and management. These technologies will enable monitoring and control of power lines, communication between various parts of the network, and self-healing of electricity grids.

Enabling technologies

The fundamental technology drivers for the smart grid proliferation include[3]:

- **Integrated communications** (wireless or power line) based on open architecture: to allow real-time control and data exchange between various elements of the grid;
- **Sensing and measurement** technologies: to evaluate congestion and grid stability, to monitor equipment, to prevent energy theft, and to support control strategies. To the components of sensing and measurement technologies belong smart meters, meter-reading equipment, phasor measurement units (PMUs), and wide-area monitoring systems (WAMS);
- **Advanced components** such as superconductivity, storage, power electronics, diagnostics, "intelligent" appliances, etc.;

[3] *The Smart Grid: An Introduction*, by Litos Strategic Communication for the U.S. Department of Energy

- **Advanced control methods** incorporating power system automation that would enable rapid diagnosis and offer solutions for disruptions or power outages; and
- Improved **interfaces and decision support** including visualization techniques, software support for operators' actions, simulations, etc.

Standardization

Standardization plays an important role in a comprehensive worldwide project such as smart grid implementation in order to insure interoperability of smart grid components. The work on standards usually involves many industry players. An example of a standard gaining support across the board is ZigBee which is a wireless sensing and communications specification for network monitoring and control products. The ZigBee Alliance currently has 350 members including all major manufacturers active in the smart grid/smart meter market.

Role of electric vehicles

Electric vehicles will also play an important role in the smart grid economy. Normally, an electric vehicle would recharge at night when demand for electricity is low. During the day (preferably at peak demand time), such vehicles could be used to stabilize the grid by feeding in some electricity from their batteries when not in use. Not only would this reduce the need in peaker capacity, adjusting speed at which vehicle's batteries are charged or discharged would also help stabilizing the grid when excess electricity is generated from PV or wind sources. However, we view the impact from electric vehicles as rather small due to their still limited use.

Smart grid for end-users: pro-active consumption management

In the smart grid world, end-users become more pro-active in their relationship with energy providers as the smart grid enables consumers to actively manage their energy consumption.

On the consumer side, **smart meters** represent the enabling technology as they can provide accurate and detailed consumption information as well as real-time tariff information to both utilities and end-users. Smart meters enable remote readings (either through so-called mesh wireless networks or power line communications), real-time information on energy use (providing end-users with insight into their power usage patterns), and consumption adjustments depending on variable tariffs.

In an ideal world, a consumer would be able to actively control his energy use depending on actual tariffs (time-of-use tariffs). For example, some tasks (such as running a washing machine) could be scheduled for off-peak, low-tariff times of the day (or rather night). Such time-differentiated services are widely available in the communications industry so that the experience could be transferred to the electricity usage. Alternatively, a smart meter would be able to halt non-essential tasks briefly in order to reduce the load on the network and thus reduce demand spikes (e.g. during breaks in sport events).

In the real world, consumers will more likely prefer to interact with the grid only if it is easily done (through a simple and easily accessible interface) and does not interfere with their lives. A survey in the USA[4] indicated that consumers were willing to spend about two hours per year to set their preferences while the rest of the time all interaction would happen automatically.

Obviously, the prerequisites of the active interaction between a utility and an end user include availability of *smart appliances* that would communicate with smart meters as well as *high electricity prices* that would encourage active management of energy usage.

For us, the big question remains how the interaction will be conducted and to what degree a utility or a network operator would be able to interfere with the households' electricity usage patterns by turning off appliances within a household to reduce peak

[4] *The Smart Grid: An Introduction*, by Litos Strategic Communication for the U.S. Department of Energy

demand. Here, we are concerned about a potential interference with personal privacy (an important issue to be resolved before the smart grid goes online).

Still, the monetary benefits of smart meter adoption look rather attractive. According to the UK's Department of Energy and Climate Change, adoption of smart meters by all UK households would bring about the net benefit of GBP2.5bn to GBP3.6bn over 20 years[5].

In a pilot project in Germany, E.On and RWE demonstrated that the usage transparency enabled by smart meters has allowed reducing energy consumption in private households by up to 10%[6].

Smart grid for utilities: more information, more control

The smart grid brings some sizeable benefits to energy producers and network operators as well.

One of the biggest challenges currently is predicting demand for electricity. Utilities can only approximately estimate how much electricity will have to be produced to cover peak demand and activate their capacities accordingly. **Load adjustment** is one of the central features of the smart grid. It relies on mathematical prediction algorithms to forecast the capacity needed to cover peak demand. Additionally, as described above, **demand response support** systems allow automatic interaction between energy producers and energy consumers with a goal to coordinate demand and flatten its peaks.

More precise forecasting and less pronounced spikes in energy demand lead to a more efficient and optimized use of existing generating assets, less reserve capacity and therefore lower overhead costs by utilities. As a consequence, less new construction, i.e. capex, will be required.

Using active **load shedding** techniques, network operators will be able to prevent power outages making electricity networks and electricity supply more reliable.

Ability to transport electricity from many smaller, distributed energy sources such as solar and wind will lead to **decentralization of energy generation** bringing energy closer to its consumers and reducing transportation losses.

Finally, using dynamic price adjustments (**time-of-use pricing**) utilities should be able to influence consumer behavior on electricity use increasing thus the overall efficiency of power usage.

All these features of the smart grid will help utilities increase efficiency and reliability of energy generation and distribution through:

- optimal use of available infrastructure;
- more information and control over power line conditions at any given time to prevent overloads and blackouts;
- reduction of grid congestion and increasing utilization of existing networks translated in increasing the revenue.

To summarize: why do we need to go through the whole ordeal

The smart grid differs from existing traditional electricity grids by being less-centralized, more consumer-interactive, and allowing a two-way electricity and information flow between a utility and its customers.

When implemented, the smart grid should bring about substantial benefits to all participants, including the utilities, consumers, environment, and the society as a whole. In particular, the smart grid will:

[5] http://www.electronicsweekly.com/Articles/2009/06/11/46269/smart-metering-market-declining-ims-research.htm

[6] Boersen-Zeitung, *Versorger rüsten Verteilernetze auf*, 8.04.2010

- Increase efficiency of energy use by optimizing asset utilization through load forecasting, and by reducing power consumption at peak times through active demand management;
- Reduce costs by optimizing use of available resources (less idle back-up capacity needed) and through decentralization of energy generation (lower transportation costs);
- Increase reliability and transparency of power distribution by optimizing power routing (e.g. peak vs. off-peak times) and load shedding,
- Support proliferation of renewable energy sources by coordinating power production from large number of small producers (e.g. roof-top PV) as well as distributed power sources (e.g. wind parks), and
- Stimulate economic growth by investing in energy infrastructure and creating new jobs.

REGIONAL DEVELOPMENT

Smart grids in the USA

Generally speaking, the electricity networks in the USA require urgent modernization, which coincides nicely with the timing of the smart grid investment. US utilities and network operators invest intensively in infrastructure adopting smart grid components. Support from the US regulators helps as well. The current administration encourages utilities to invest in smart grids by using incentives such as guaranteeing utilities cost recovery and/or favorable depreciation on new smart grid investment and legacy systems which were made obsolete by such investment.

Under the American Reinvestment and Recovery Act, $3.4 billion is designated to Smart Grid Investment Grant awards, which will be matched by industry funding for a total public-private investment over $8bn.

According to Sentec, a UK-based company involved in design of smart meters, due to a strong government support the USA is about five years ahead of Europe in adopting smart metering.

Smart grids in Europe

European grids are in a better technological state than those in the USA. However, new investment is necessary in Europe as well, mainly to make the grids compatible with an increasing portion of renewable energy. According to RWE[7], a German utility, in 2008 a total of 10.6% of the net installed generation capacity in Europe was based on renewable energy sources (excluding hydro power) while 67.3% was related to fossil fuels. Within the renewable capacity, 65GW was wind, 9.5GW solar and 0.01GW solar thermal. For 2020, those capacities are forecasted to increase to 208GW from wind (a more than threefold increase), 52GW from solar (a more than fivefold increase), and 2.4GW solar thermal. With increasing energy flow from non-controllable renewable sources, grid operators will have to balance out "huge spikes and drops" in energy supply. As the solution for this predicament RWE sees adding new flexible capacity, retrofitting the existing generation portfolio, and introducing smart grids in combination with e-mobility (electric cars).

The European Electricity Grid Initiative (EEGI) published the "Roadmap 2010-2018 and Detailed Implementation Plan 2010-2012"[8] outlining the major steps towards smart grids in Europe. With the amended Energy Industry Act and the Metering Access Ordinance, which came into effect in October 2008, the comprehensive use of smart meters should be achieved within a period of six years – "through a maximum of competition with minimum restrictions for consumers and undertakings, as far as economically justifiable".

[7] RWE, *The Need for Smart Megawatts: Power Generation in Europe – Facts & Trends*, December 2009

[8] http://www.smartgrids.eu/documents/EEGI/EEGI_Implementation_plan_May%202010.pdf

80% of all European households should be equipped with intelligent metering systems until 2020.

Smart meters have been in deployment in Italy (serving 32 million customers) and Sweden.

In Spain, Iberdrola plans the first phase of smart-meter roll-out for 100,000 households with a potential to install up to ten million meters, while Enel plans to install 13 million smart meters until 2015.

France is another European country with a planned roll-out where 35 million electric meters will be replaced with smart meters until 2016.

Smart grids in Germany

In Germany, the Energy Industry Act (Energiewirtschaftsgesetz) specifies that from 1 January 2010 all new or renovated buildings should be equipped with intelligent meters that enable measuring actual energy consumption. Additionally, by the year-end 2010, utilities should be able to offer variable tariffs to energy consumers in Germany.

In February 2009, during a panel session hosted by the Federal Network Agency about smart metering in the electricity and gas industry, investments in smart metering was identified as a basic requirement for innovation and efficiency in the energy sector.

According to Landis + Gyr, the world-leading manufacturer of smart electricity meters, the problem in Germany seems to be lack of a precise definition of what a smart meter is which creates uncertainty in the market. Anecdotal evidence suggests that smart meters are viewed by Germans as a threat to privacy or as too expensive.

MARKET SIZE AND PROSPECTS

Unlike in the USA, where investment in electricity networks has been strong over the past year, Europe experienced a significant slowdown in electricity demand in 2009 in the wake of the economic crisis. As a consequence, utilities reduced their spending to a great extent with much negative impact on the suppliers of grid components. Nevertheless, the outlook for 2010 has improved.

Investment necessary to implement smart grids is substantial and requires a long-term commitment. According to a German business daily Boersen-Zeitung[9], German utilities will have to invest €20bn until 2020 to provide first comprehensive, nationwide smart grid coverage.

German Federal Network Agency (Bundesnetzagentur) estimates that in 2009 utilities invested in distribution networks €5.8bn of which €450m went to suppliers of intelligent metering, control and communications infrastructure. In 2008 and 2009, the Agency approved an investment budget of €13bn, of which €9bn went to transmission system operators. Special attention is given to projects targeted at guaranteeing quality of energy supply, connecting new power plants to the grid, and at transportation of energy from renewable sources such as off-shore wind parks.

IMS Research, a market research company specializing on electronics industry, estimates that shipments of smart electricity meters in Europe will more than double in 2010 focusing mainly on high speed power line communication (PLC) meters. For the USA, IMS Research estimates the smart meter shipments to more than double in 2010 after 8m units were shipped in 2009[10].

Global spending: estimated $200bn

Pike Research, another market research company specializing on clean-tech technology markets, expects the total global spending on smart grid technologies to reach $200bn

[9] Boersen-Zeitung, *Versorger rüsten Verteilernetze auf*, 8.04.2010

[10] http://www.imsresearch.com/press_release_details.html&press_id=1403

from 2008 to 2015[11]. Of this, 84% would be invested in grid automation initiatives, while 14% would be spent on advanced metering infrastructure (AMI) and 2% on electric vehicle management systems.

COMPANIES BENEFITING FROM THE SMART GRID DEVELOPMENT

Utilities

While multi-million investments are necessary in the short- to medium-term for installing smart-grid infrastructure and systems, in the long run utilities will benefit from the smart-grid adoption in a variety ways. Increased network efficiency would translate into more electricity transmitted over the existing lines and thus into *more revenues* for utilities. More efficient energy management will lead to smoothing of demand peaks and thus will reduce the need for back-up (peaker) power plants *reducing operations and maintenance costs* for utilities. So far, we could not find any precise estimates on the utilities' revenue or margin impact from the smart grid adoption.

Infrastructure manufacturers

The most obvious short-term beneficiaries of the smart-grid boom are hardware/ infrastructure manufacturers such as **Siemens**, **ABB, GE Energy** and the likes who will provide the necessary smart-grid compliant equipment.

Hardware and components manufacturers

Additionally, companies specialized on manufacturing of various components of the smart grid (e.g. smart meters) will enjoy strong demand for their products. The following is a short list of companies participating in the development or manufacturing of components for the smart grid. The last column provides our opinion of the impact the smart grid development would have on the financial performance of a particular company (depending on its share in total revenue). However, only a few of the cited companies are listed (highlighted in bold) and therefore a direct investment opportunity is limited.

Smart grid component manufacturers

Company name, country	Primary focus and smart-grid products	Type, ticker	Sales (last FY)	Impact from smart grid development
Echelon Corp., USA	*Control networking hardware and software* Integrated software and hardware smart metering solutions.	**ELON** (Nasdaq)	$103.3m	High
EnergyHub, Inc., USA	*Energy management tools* Design of energy management tools for consumers and utilities. Has a partnership agreement with Itron (integration of Itron's ERT reading technology with EnergyHub's energy management devices). Uses ZigBee standards.	private	$0.74m	High
Green Energy Options, UK	*Monitoring and control devices and applications* Design of displays for smart meters, controllers. Uses ZigBee standards.	private	n.a.	High
Gridpoint, Inc., USA	*Smart grid software* Software, hardware and services for integration, aggregation and management of distributed sources of energy consumption, generation and storage. Goldman Sachs and Robeco are among the investors in Gridpoint.	private	n.a.	High
Itron Inc., USA	*Electrical Components & Equipment* Electricity, gas, water and heat meters, data collection and communication systems, including automated meter reading (AMR) and advanced metering infrastructure (AMI); meter data management and related software applications; as well as project management, installation, and consulting services. Has a partnership agreement with EnergyHub (see above).	**ITRI** (Nasdaq)	$1687.45m	High
Jennic, UK	*Wireless microcontrollers* Design of wireless communications technology for advanced metering infrastructure (AMI)	private	n.a.	High

[11] http://www.pikeresearch.com/newsroom/smart-grid-investment-to-total-200-billion-worldwide-by-2015

Company name, country	Primary focus and smart-grid products	Type, ticker	Sales (last FY)	Impact from smart grid development
Landis + Gyr, Switzerland	*Smart meters* Development and manufacturing of smart meters for utilities, incl. electricity, gas, and heat meters. The market leader with a 12% worldwide market share (2007, IMS Research)	private	$1364m	High
Powerhouse Dynamics, USA	*Energy management solutions* Energy management solutions for private households (energy usage monitoring software)	private	n.a.	High
Sensus, USA	*Advanced Metering Infrastructure (AMI), Automated Meter Reading (AMR)* AMI systems, smart meters.	private	$792m	High
Sentec, UK	*Smart meters* Design of smart meter technology for utilities	private	GBP5m	High
Tendril Networks Inc., USA	*Energy management software, hardware, service* Products for controlling energy consumption. Provides energy management software, hardware and services for both consumers and utility companies. A customer of Ember. Uses ZigBee standards.		$0.90m	High
Atmel Corporation, USA	*Semiconductors* Design, development, and manufacturing of microcontrollers and other components (computation, wireless communication, etc.) for smart meters. Uses ZigBee standards.	**ATML** (Nasdaq)	$1217m	Medium (component supplier)
Elster Group, Germany	*Advanced Metering Infrastructure (AMI) and integrated metering* Smart meters for gas, electricity and water utilities. Market leader in gas and water meters with a 22% and 14% market share respectively (2007, IMS Research)	private	€1,255m	Medium (primary focus on gas and water)
Ember Corporation, USA	*Semiconductors, software* Software and radio chips with embedded networking software for sensing and control applications. Uses ZigBee standards.	private	$6.10m	Medium (component supplier)
Freescale Semiconductor Inc., USA	*Semiconductors, microchips* Embedded semiconductor solutions (microcontrollers, processors) including intelligent controllers for smart electricity, water, gas and heat meters in addition to communication solutions. Uses ZigBee standards.	private	$5266m	Medium (component supplier)

Sources: companies, Steubing AG Research

Software and IT service vendors

Smart grid implies not only electricity flow but also exchange of immense volumes of data and information. To realise the advantages of active network management, data collected by monitoring equipment and smart meters should be processed and analysed. Correspondingly, software plays an undoubtedly vital role.

It should not come as a surprise that software vendors and IT service companies will take active part in the adoption of smart grids worldwide due to a high reliance of smart grids on information technology. Many of them have already announced specialized products (e.g. Cisco Systems, Oracle Corp., Microsoft, Google, IBM, etc.) or participate in smart grid projects (e.g. Atos Origin, a worldwide IT services firm, is a partner of ERDF in France developing a computer network for the smart metering project). For the large companies, however, the overall impact of the smart grid projects on financial performance will be limited due to a relatively small scale (in relation to the total revenue of a company).

German companies with a potential share of the smart grid market

SAP AG: strong presence in the utilities market

As one would expect, **SAP** (Reuters: SAPG.DE) is one of the active players in the software for utilities. In May 2009, the company introduced a new product, SAP AMI[12] Integration for Utilities, aimed at integration of metering processes in the utilities' back-

[12] AMI – Advanced Metering Infrastructure

end systems. Having already a strong presence in the utilities market with its traditional enterprise resource planning (ERP) software as well as with newer customer relationship management (CRM), billing, and business intelligence solutions, SAP could capitalize on its ability to offer an end-to-end solution reducing thus integration effort.

However, the overall impact from smart grid products on the SAP financial performance will be limited. In 2009, the company generated €8.2bn in product revenue (license and related services), of which only €650m (or nearly 8% of total) came from utilities.

PSI: utilities software specialist

Probably, the most attractive opportunities are opening up for a smaller German software vendor **PSI AG** (Reuters: PSAGn.DE). PSI has been specializing on energy management software for utilities for over 40 years and has all major transmission and distribution operators as well as many municipal utilities in Germany as its customers. The company generated revenue of €147m in 2009, of which €59.8m (nearly 41% of total) came from energy management products.

Watch list: no current development, but an option for the future

Kontron AG specializes on embedded computers and components and has already solutions for communications and energy sectors. According to CFO Gauglitz, Kontron is not currently involved in any production or development of smart-grid relevant technologies or products. However, the company would not rule out a possibility of a future involvement should an opportunity arise (including an acquisition of core technology).

Another potential player in the arena could be **Software AG** with its strengths in integration software as well as large databases, capable of real-time processing of high data volumes. Additionally, the recent acquisition of IDS Scheer complemented Software AG's product portfolio with Business Process Analysis functionality. As mentioned before, business process transformation is one of the steps utilities should undertake on their move towards smart grids. In this, IDS Scheer and Software AG could provide much needed tools.

A table below presents a summary of the current market valuation for the listed companies mentioned in this report (stock prices as of close on July 6, 2010).

Company name	Price	MC/Sales			PER		
		2010e	2011e	2012e	2010e	2011e	2012e
PSI AG	12.40	1.21x	1.12x	1.05x	22.1x	16.5x	13.3x
Echelon Corp.	7.46	2.77x	2.77x	1.54x	-9.3x	-14.9x	-746.0x
Itron, Inc.	59.22	1.19x	1.19x	1.02x	18.2x	15.2x	13.4x
Atmel Corp.	4.57	1.39x	1.39x	1.18x	18.2x	11.9x	10.0x
Kontron AG	7.374	0.85x	0.85x	0.72x	16.1x	11.1x	9.5x
SAP AG	36.65	3.93x	3.93x	3.35x	17.3x	15.4x	13.8x
Software AG	84.43	2.24x	2.24x	2.02x	14.5x	12.9x	11.6x
Average:		**1.94x**	**1.93x**	**1.55x**	**13.9x**	**9.7x**	**-96.3x**
Median:		**1.39x**	**1.39x**	**1.18x**	**17.3x**	**12.9x**	**11.6x**
		EV/EBITDA			**EV/EBIT**		
		2010e	**2011e**	**2012e**	**2010e**	**2011e**	**2012e**
PSI AG		11.9x	9.6x	8.0x	15.8x	12.2x	9.8x
Echelon Corp.		-10.2x	-16.2x	34.2x	-7.2x	-10.1x	n.a.
Itron, Inc.		9.9x	8.5x	8.1x	15.3x	11.3x	10.9x
Atmel Corp.		8.9x	6.1x	5.1x	13.3x	7.1x	5.6x
Kontron AG		7.7x	5.6x	4.9x	10.6x	7.1x	6.1x
SAP AG		11.5x	10.2x	9.2x	12.7x	11.2x	10.0x
Software AG		9.2x	8.3x	7.6x	10.4x	9.4x	8.5x
Average:		**6.97x**	**4.60x**	**11.00x**	**10.1x**	**6.9x**	**8.5x**
Median:		**9.17x**	**8.30x**	**7.99x**	**12.7x**	**9.4x**	**9.2x**

Sources: Thomson One database (consensus and stock information), Steubing AG Research

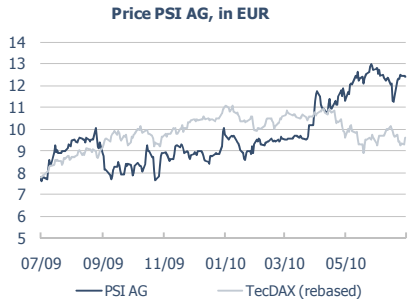
STEUBING AG RESEARCH

PSI AG: COMPANY PROFILE

PSI AG
Software
7.07.2010

Bloomberg: PSAN GR
Reuters: PSAGn.DE

Price as of 6.07.10, 17:30:	**€12.40**
Market cap.:	**€195m**
Free float:	**55.1%**



Business description

PSI is a software vendor who develops and integrates software solutions and complete systems for utilities, manufacturers and infrastructure providers in telecommunications, traffic and safety markets. The company's products fall into three categories, namely Energy Management (utility solutions for electricity, gas, oil, water, and district heating, grid management, and energy trading and sales), Production Management (standard and customized solutions for production planning, production controls, logistics, and resource optimization), and Infrastructure Management (control solutions for monitoring and operation of telecommunications, transport, public safety, environmental protection, and disaster prevention infrastructures). The company employs more than 1400 employees and is directly present in 15 countries. Its headquarters are in Berlin, Germany.

Financial performance

In 2009, PSI reported a 14% top-line growth with revenues reaching €147m. By segment, revenue from the Energy Management products were €59.8m (nearly 41% of total), from Production Management products €62.2m (42.3% of total), and from Infrastructure Management solutions €25m (17% of total). The growth rates were 8.5%, 7.8% and 56% y-o-y respectively. Markets outside Germany contributed 34% of total revenue, up from 28% in 2008. Operating margin was 5.3%, up from 4.8% in 2008. With the net income of €6.6m (€0.46 per share), the net margin was nearly 4.5% (after €4.1m or 3.1% in 2008). For 2009, PSI paid a dividend of €0.21 per share.

Stock information

The PSI stock is listed in the Prime Standard of the German Stock exchange since 1998. The company has about 15.7m shares outstanding with a free float of 55.11%. RWE Rheinland Westfalen Netz AG is the largest shareholder with a 17.77% stake. 10.61% of the shares are held by an employee consortium.

	2007	2008	2009	2010e	2011e	2012e
Price, €	5.90	3.60	8.85	12.40	12.40	12.40
EPS, €	0.14	0.34	0.46	0.56	0.75	0.90
ROE	5.6%	12.3%	10.0%	n.a.	n.a.	n.a.
PER	42.1	10.6	19.2	22.1	16.6	13.8
Price-to-cash flow	12.4	5.1	10.9	14.6	11.9	10.0
EV/Sales	0.7	0.6	1.1	1.1	1.0	0.98
EV/EBITDA	12.4	7.7	12.7	12.0	9.6	8.1
Dividend yield	-%	-%	2.4%	2.0%	3.0%	3.6%
EBT/EV	3.0%	7.2%	4.4%	n.a.	n.a.	n.a.

Sources: Thomson One, Steubing AG Research

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SAP AG: COMPANY PROFILE

Business description

SAP AG is the market leader in business software with nearly 100,000 customers in more than 120 countries. The company is directly present in more than 50 countries worldwide. SAP started as a provider of back-end enterprise resource planning (ERP) software in 1972 and evolved into a provider of comprehensive solutions for the main areas within an enterprise including customer relationship management, supply chain management, business analytics, as well as an integration platform. The company has also expanded its addressable customer base from large enterprises to medium- and small-sized companies. In addition to organic growth, SAP has made a few large acquisitions over the last five years, notably a business intelligence software vendor Business Objects (2006) and an infrastructure software company Sybase (2010, pending). SAP employs more than 47,000 people worldwide.

As mentioned above, in 2009 SAP has introduced a solution targeted at utilities with advanced metering infrastructure (AMI). SAP enjoys a strong positioning in the utilities market and has a few large utilities as partners for pilot projects (e.g. EnBW in Germany). While we expect SAP to benefit from the smart grid implementation, the overall impact on the financial performance will likely be limited due to a relatively small relative contribution that utilities make to SAP revenues (about 8% of the software and related services revenue in 2009).

Financial performance

In 2009, SAP reported total revenue of €10.67bn (a decline of 7.8% y-o-y due to customers cutting their IT budgets in a recession), of which €8.2bn came from software licenses and related services. Germany generated 19% of the total revenue for the company. Service industries (including utilities) comprise the largest segment in SAP revenue with a 23.5% share of total. SAP reached operating income of €2.6bn (an EBIT margin of 24.3%) after €2.84bn in 2008 (an EBIT margin of 24.6%). For 2009, the company paid a dividend of €0.50 per share.

Stock information

The SAP stock is listed in Germany and is a member of the blue-chip DAX30 index as well as on the NYSE in form of American Depositary Receipts (1 ADR = 1 ordinary share). The company has 1226m ordinary shares outstanding with a free float of about 72.4%.

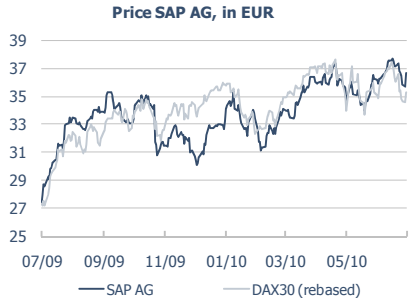
	2007	2008	2009	2010e	2011e	2012e
Price	35.53	25.24	33.00	36.65	36.65	36.65
EPS,	1.59	1.57	1.47	2.13	2.37	2.67
ROE	29.5%	25.8%	20.6%	n.a.	n.a.	n.a.
PER	22.3	16.1	22.4	17.2	15.5	13.7
Price-to-cash flow	19.1	11.8	17.2	15.6	13.9	12.6
EV/Sales	4.5	2.5	3.8	3.7	3.4	3.1
EV/EBITDA	14.6	8.5	13.5	11.0	9.8	8.7
Dividend yield	1.4%	2.0%	1.5%	1.6%	1.8%	2.0%
EBT/EV	6.3%	9.4%	6.0%	n.a.	n.a.	n.a.

Sources: Thomson One, Steubing AG Research

SAP AG
Software
7.07.2010

Bloomberg: SAP GY
Reuters: SAPG.DE

Price as of 6.07.10, 17:30:	**€36.65**
Market cap.:	**€44.9bn**
Free float:	**72.4%**



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