European Data Market
SMART 2013/0063
D 3.4

Data-driven innovation in European Utilities

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1 Short Summary

European utilities are amongst the most competitive and innovative in the world - they represent the backbone of the EU's economic system and are the primary actor of the ambitious EU's 2020 climate and energy package to achieve a smart, sustainable and inclusive growth. European utilities are also in the midst of an evolutionary transformation that started in the early 2000s and will peak in the course of the 2020s, with the mass rollout of smart gas and electricity meters in most Member States. This is a heavy Information and Communication Technology (ICT)-based transition that will ultimately turn this sector into one of Europe's highest data-intensive industries. But challenges abound: a general reallocation from power generation to downstream segments of the value chain is taking place and is accompanied by other micro-level trends such as the need for electricity grids to integrate a growing amount of distributed renewable energy resources, the increased demand for electric mobility, and the need to optimize existing network capacity.

To overcome these challenges, European utilities are rapidly becoming a high-tech data-intensive sector. This transformation implies an ever increasing integration, analysis and interpretation of large sets of real-time data coming from connected assets on increasingly automated smart electricity grids. Our research shows that the use of Big Data and Analytics (BDA) lies at the core of this transformation and that BDA implementations from around Europe are bringing tangible benefits to the utilities industry as a whole across all segments of the value chain:

- Data-driven applications in the electricity generation and water abstraction segment allow utilities companies to enhance and significantly speed up critical operational processes, optimize maintenance and reach higher levels of quality and safety: the overall financial benefits for the whole industry in the EU from BDA implementation in this segment are estimated at €16.3 billion across Europe's utilities per year.
- In the transmission and delivery segment, data-intensive BDA solutions can greatly advance network reliability and provide optimal load scheduling while improving outage detection processes, load flows management and maintenance issues identification. Benefits for the European utilities industry from BDA applications in this segment are estimated at €28.6 billion per year EU-wide.
- BDA solutions in the aggregation and metering segments can improve demand response management, introduce new and more effective anti-energy theft measures and greatly enhance fraud detection capabilities. An overall benefit of €8.8 billion per year could be achieved through BDA deployments across the whole of Europe's utilities companies in these segments.
- Benefits from BDA applications in customer operations could amount to an estimated €10.65 billion annually for the European utilities industry. In this segment, data-intensive customer engagement applications would enable, for example, peer-to-peer comparison of consumption unleashing virtuous imitation effects among consumers; also, a better use of existing information would greatly help utilities to personalize their customer relationship strategies and improve their customers' experience.

Yet, IDC research illustrate that not all European utilities have fully understood the potential of BDA. Our maturity model confirms that the median European utility has a BDA maturity level of 3 out of 5 (with 5 being the highest) and show a convergence towards the middle of maturity with nearly two-thirds of the European utilities in the middle stage. The next maturity level is not here yet but within reach: Europe's utilities are on the right path to fully exploit the advantages offered by BDA technologies but an extra effort is needed to make them become *the* data-driven industry in Europe.

2 Overview

2.1 Introduction

This document represents the deliverable D3.4 of the Study “European Data market SMART 2013/0063” entrusted to IDC and Open Evidence by the European Commission, DG Connect.

The present story focuses on the data technologies’ impacts on European utilities with specific reference to four macro-areas: field service optimization; asset optimization; predictive maintenance, and customer operations. The table below outlines the story’s general information and the key elements of the story’s description.

The document is structured in three main parts:

- In the first paragraph an overview of the technology-driven evolution of the European utilities industry will be provided;
- In the second paragraph a few case studies from the European utilities will be presented: the stakeholders involved in those case studies, the technology used and the impacts obtained by the innovative use of this technologies will also be investigated;
- The third paragraph will outline the key data-driven benefits, effects and impacts (where available) for Europe’s utilities industry and summarizes the key messages and conclusions to be taken from the case studies.

Table 1: The Story at a Glance

GENERAL INFORMATION	
Title	The Impact of Data Technologies on Europe’s Utilities
Link with information /Sources	• The Use of Industry Data to Facilitate Supplier-Led Smart Meter Rollout in the U.K.: The Case of the Smart Meter Installation Dataset. Jean-François Segalotto, Roberta Bigliani, Gaia Gallotti, Dec 2014 - Doc # EIRS56W Perspective • Perspective: IDC Energy Insights Western European Utilities Annual Survey Methodology, 2014, Roberta Bigliani, Gaia Gallotti, Giacomo Laurini, Luiza Semernya, Dec 2014 - Doc # EISC55W Perspective • Utilities Smart Customer Operations Quarterly Update: July–September 2014, Roberta Bigliani, Gaia Gallotti, Luiza Semernya, Oct 2014 - Doc # EISC54W Perspective • Gamifying the Enterprise, Roberta Bigliani, Adam Ajzensztejn, Jul 2014 - Doc # EISC02W Industry Development and Models • Meeting the demand for data driven change in the utilities sector, Report on adopting a Unified Data Strategy (UDS) to manage the exponential growth of Big Data, Informatica, October 2012

STORY DESCRIPTION	
Topic/object of story	How Europe's utilities are putting (new) data to use to achieve real-time operations and intelligent value-chains and, ultimately, face the current industry challenges through increased competitiveness.
Main examples	A series of success cases featuring both European utilities and technology companies.
Main impacts identified in this story	• Speed up of critical operational processes; • Optimized maintenance optimization; • Higher levels of quality and safety; • Advanced network reliability and provide; • Optimized load scheduling, outage detection, load flows management and maintenance issues identification; • Improved demand response management; • More effective anti-energy theft measures; • Enhanced fraud detection capabilities; • Improved customer relationship strategies and customers experience.
Main stakeholders	Advanced predictive analytics companies, European Utilities.
Key words	Big Data and Analytics (BDA), Field Service Optimization, Asset Operations, Predictive Maintenance, Customer Operations, Generation and Abstraction, Transmission and Delivery, Aggregation and Metering.

2.2 The Data-Driven Evolution of the Utilities Industry

2.2.1 The EU utilities industry: One of the most competitive and innovative in the world

The utilities industry[1] represents the backbone of the European economic system and is among the primary contributors to achieving the climate and energy objectives of the Europe 2020 strategy for a smart, sustainable and inclusive growth[2].

The ambitious EU climate and energy package for 2020 supplements and builds on EU-wide reform of the industry, which started with the first liberalization directives of the second half of the 1990s and culminated in 2007 with the so-called Third Package for Electricity & Gas markets, which aims at creating a single competitive and integrated energy market for the EU. This decade-long unbundling, liberalization and unification process, have made the European energy distribution industry one of the most competitive and innovative in the world.

[1] Please refer to the Methodology Note at the end of this document for the definition of the utilities industry adopted in this study.

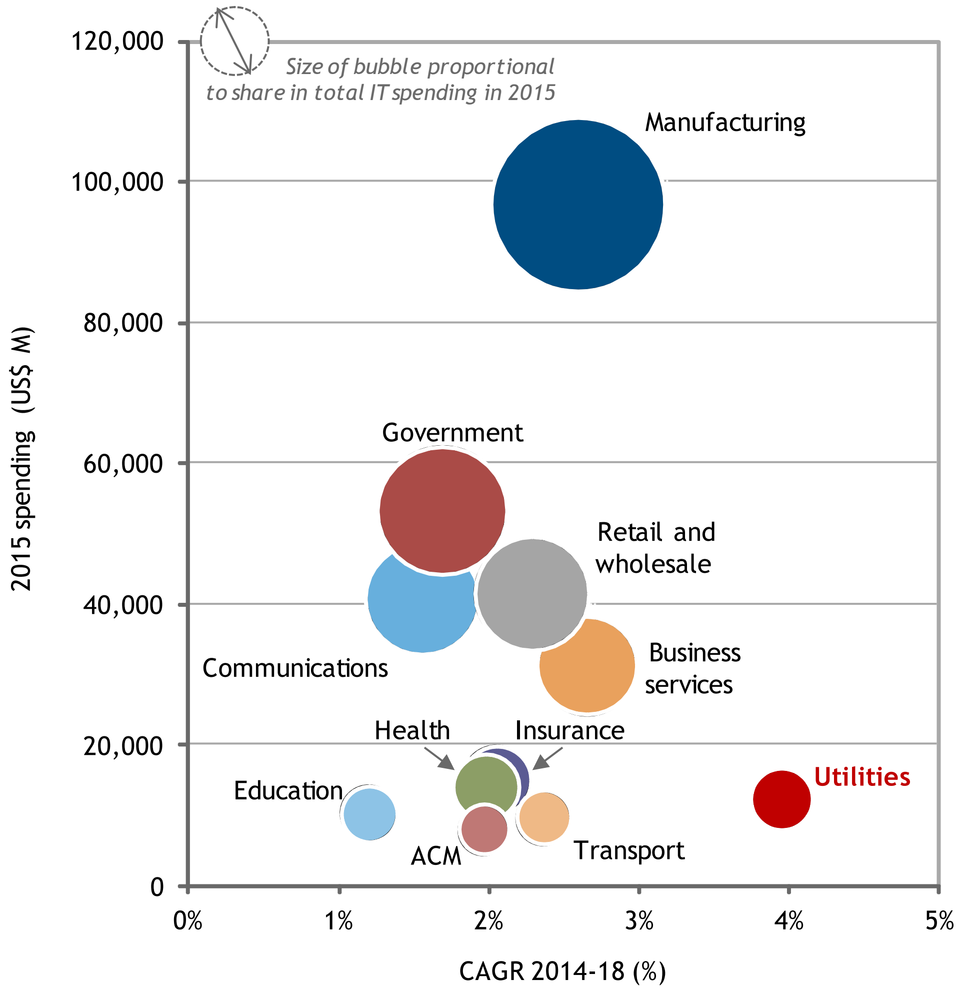
[2] The primary objectives of Europe 2020 are a 20% reduction in greenhouse gas emissions, a 20% increase in energy efficiency, and a 20% increase in the share of renewable energy sources in final energy consumption, compared to 1990 levels.

Operationally and technically, the industry is in the midst of an evolutionary transformation that started in the early 2000s and will peak in the early 2020s, with the conclusion of the mass rollout of gas and electricity meters in most Member States and the gradual evolution of traditional utility networks into flexible smart grids. This is an Information and Communication Technology (ICT)-based transition that will ultimately shape utilities into a highly data-intensive industry.

The scale of this transition will be clearly visible in the industry's spending on Information Technology (IT), which will even outgrow IT spending in larger and traditionally more technology-intensive industries. In fact, IDC expects Western European utilities' IT spending (including hardware, software and services) to expand from about 11.6 billion US$ 2014 (approximately € 9.5 billion) to almost 14.6 billion US$ (approximately €12 billion) in 2018, a 4% CAGR,[3] the highest of any other industry, outranking the next largest industry by IT spend growth – banking and finance – by as much as 1 percentage point (see Figure 1).

[3] The compound annual growth rate (CAGR) is a useful measure of growth over multiple time periods. It can be thought of as the growth rate that gets from the initial value to the ending value assuming that the initial value has been compounding over the time period. It is calculated by taking the (N)th root of the total percentage growth rate, where (N) is the number of years in the period being considered.

Figure 1 Western Europe IT Spending by Vertical Market ($M, 2015; % CAGR, 2014-18; % share by vertical, 2015)



Source: IDC Energy Insights, 2014

2.2.2 New and long-standing challenges in the utilities industry: The transition to smart electricity grids

While utilities remain the beating heart of EU economies, the industry is facing a number of unprecedented challenges to its traditional business models.

At the macro level, energy utilities in mature markets, including in the EU, are facing a fundamental shift in value generation away from power generation to downstream segments of the value chain. This goes hand in hand with decreasing demand and profitability, demanding de-carbonization and energy efficiency targets, and the need to upgrade and substitute aging distribution infrastructure and generation plants. These macro trends add to their micro-level determinants and consequences, such as the need for electricity grids to integrate a growing amount of distributed renewable energy resources (biomass, biofuels, wind, and solar), the growing demand for electric mobility and energy management systems, optimization of existing installed network capacity through programs and systems designed to shape customer demand and adapt supply.

Overall, on the electricity market, the shift to intelligent grids implies the transition from traditional network management to smart network management, smart integrated generation, and smart markets & customers, as briefly explained below:

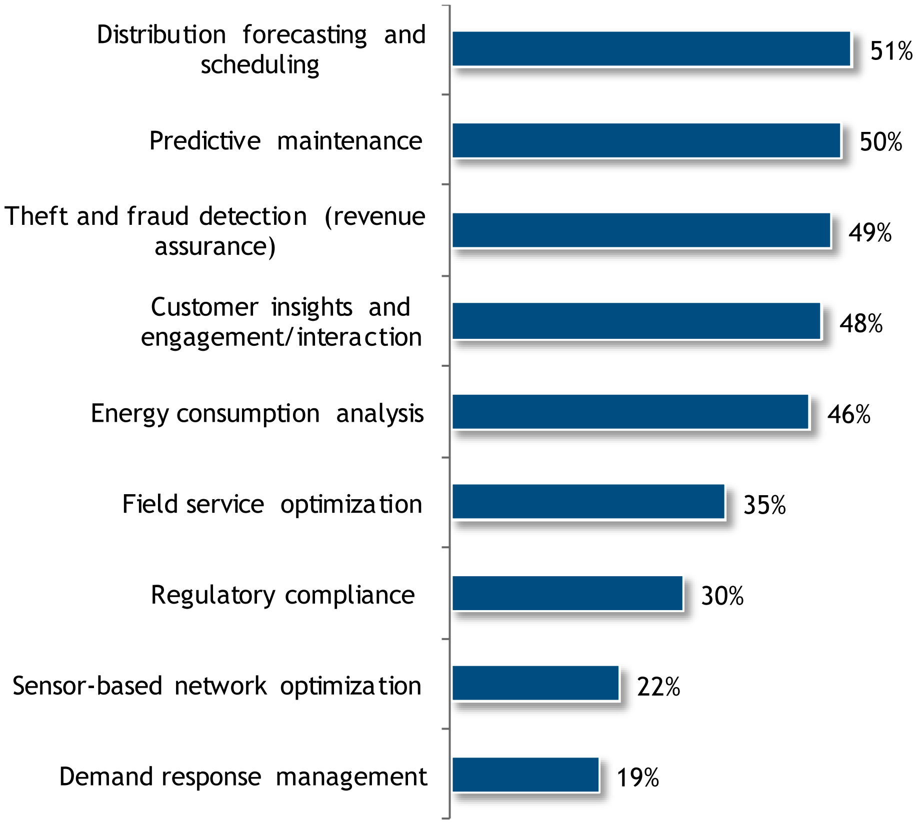
- Smart network management: automation of conventional electricity grids enabling faster fault detection, outage management and self-healing capabilities; advanced network operation and control; smart metering.
- Smart integrated generation: balancing of the grid with a growing share of irregular renewable energy sources, including distributed generation by residential producers-consumers (prosumers); integration of more power-hungry appliances such as electric vehicles and heating and cooling systems; integration of intelligent energy storage solutions.
- Smart customer markets: development of demand response programs (in which the end-user’s demand curve is shaped through price signals or through direct control of connected appliances); provision of energy information to the customer for energy efficiency or smart home applications; aggregation and management of small-scale distributed energy resources, including storage, in so-called virtual power plants.

As a result of these trends, the utility business is rapidly transforming to become a high-tech data-intensive sector. This transformation implies an ever increasing integration, analysis and interpretation of large sets of real-time data coming from connected assets on increasingly automated smart electricity grids.

2.2.3 How to tackle these challenges and why: Collecting and making sense of data

Widely publicized case studies and academic and commercial research highlight the profitability and productivity advantage gained by organizations that increasingly rely on data-driven decision making. Big Data and Analytics (BDA) now feature on the top of the agenda for a growing number of executives - the utilities industry being no exception to this. According to IDC Energy Insights' latest survey of European utilities, use cases for BDA cover a wide range of operational areas, spanning supply, maintenance, and field service optimization to customer operations and demand response (see Figure 2). A handful applications stand out as the most popular among utility companies, including distribution forecasting and scheduling (i.e., prediction of the power supply needed in the distribution network to balance demand); predictive maintenance (i.e., shift from calendar-based to real-time, condition-based maintenance); revenue assurance (i.e., ensuring that the power supply to the distribution network is fully billed for, by detecting energy theft or fraud); customer insights and interaction (remote metering at short time intervals via smart meters allows for the analysis of consumer behavior, enabling efficiency and demand-supply optimization programs via direct customer engagement).

Figure 2: Most Popular Use Cases for Big Data and Analytics among Utilities (% of respondents)



Q: Do you use or plan to use Big Data and analytics for any of the following use cases?

N = 37

Source: IDC Energy Insights, 2014

2.3 Data-Driven Utilities already at Play: Application Areas and Case Studies

BDA and data-driven application show a tremendous potential in the utilities industry as an increasing number of companies (in Europe and elsewhere) will continue adopt these technologies and expand the number of use cases in the foreseeable future. In this section, a selection of BDA implementations in utilities companies around Europe is presented and analyzed. For clarity purpose, we have adopted four macro use-case areas (i.e. field service optimization, asset operations, predictive maintenance, and customer operations) and organized the selected implementations along these applications fields.

2.3.1 Field service optimization

This set of cases focuses on the use of data and analytics applications to maximize process efficiency and the productivity of service teams in the field. Real-time, data-driven mobile workforce automation applications are being rolled out across the industry to support the management and scheduling of installation and maintenance work and reduce associated costs, for instance by optimizing truck roll distances and lead times or by predicting issues that technicians will likely be facing in the field, and, in general, prioritizing work in the best possible way based on all information available at any given time.

The case of ElectraLink's Smart Meter Installation Dataset

Starting in the second half of 2016, the U.K. will embark upon the last stage of its smart meter installation program, a process that will target 100% coverage of domestic and small business consumers by 2020. This will require the installation of up to 53 million smart meters in over 30 million properties at an estimated investment of £12.1 billion, almost £2 billion of which is forecast to be spent on the installation process alone (excluding equipment costs).

The scale of the program, coupled with the peculiar structure of the U.K.'s retail energy market and the fact that meter installation is voluntary to the consumer, makes smart meter rollout more complex in the U.K. than in most other EU countries. Smart meter installation will be supplier-led (as opposed to the distributor-led model that prevails across the EU), which in turn means that the process will be non-coordinated and non-geographical, something that would make it easier from a logistics and scheduling perspective.

The Smart Meter Installation Dataset (SMID) is a new commercial service offered by ElectraLink, the provider of the Data Transfer Service (DTS), the regulated exchange facility that participants to the U.K.'s energy market use to transfer process and customer data between them, and which effectively underpins competition in the market. Leveraging industry process data from the DTS and property stock information from the Energy Saving Trust (EST) and complementing them with predictive analysis, the SMID generates situational information about property features and possible issues that operators are likely to encounter on a property-by-property basis during the rollout process. Key information and predictions generated by the service include the likely location of the meter in each property, the likelihood of suppliers encountering asbestos structures around the meter, or whether they will face issues with the distribution assets that reach the meter.

When tested, the accuracy of predictions generated by the SMID was found to be high. Presently, the SMID correctly predicts meter location in just under 90% of cases, with accuracy for less common locations such as cellars/basements or communal cupboards around 60%, i.e., 27 times more accurate than random sampling alone. For less frequent issues with distribution assets (including the presence of asbestos), the SMID also shows significant accuracy. The system predicts individual issues with DNO assets to be present in around one in every 50 properties in the country and still correctly predicts over a third of them. In particular, data in the SMID for asbestos-related issues was found to be almost 150 times more accurate than random sampling alone, accurately predicting almost 40% of these issues.

Overall, the SMID provides better data and greater transparency in the market, improving planning efficiency and reducing the massive cost associated with the U.K.'s non-centralized, non-geographic, and voluntary mass meter installation. This case is a concrete example of how the ability to work with data that is already available in the market can innovate, delivering tangible benefits in the form of:

- **Reduced installation risk**, in terms of better prediction of issues and therefore installation outcomes, **and costs** in the form of improved scheduling estimates and more efficient use of workforce.
- **Knowledge base building.** Using existing data from the whole country means suppliers and meter operators don't have to start from scratch but can rely on a minimum set of data at the start of the rollout.
- **Knowledge sharing**. As the rollout progresses, new data are inputted in the system by the participating suppliers, significantly improving the accuracy of the predictions generated through the dataset.
- **Cost sharing**. The use of the service to meet a common requirement for all participants means that the cost of its development and update is effectively shared across the industry.
- **Better customer experience**. Along with cost reductions, the use of the SMID helps minimize disruptions for end users, ensuring accurate appointment scheduling and installation times.

2.3.2 Asset operations

Use cases falling in this critical macro-area focus on the use of BDA solutions to better forecast the demand that assets will have to meet, plan production, usage and supply of energy and water, and analyze and predict outages at central generation/abstraction plants, as well as distribution network faults and leakages. Since these cases apply to the management of core operational infrastructures and asset-intensive processes, in many cases legacy systems and existing operational technologies will be leveraged using off-the-shelf and custom BDA systems to create integrated, real-time analytics platforms.

The case of Thames Water's Asset and Operations Real Time Analytics

The majority of the over 50 million customers in England and Wales are served by licensed private monopoly suppliers for their water and wastewater services. Currently, most suppliers are vertically integrated companies, responsible for providing a range of services, from managing the collection, storage, treatment, and distribution of water and sewage, to customer service.

Since privatization in 1989, demanding regulation has made the U.K. water industry one of the leading in the area of water loss management. Ofwat, the economic regulator of the water industry in England and Wales, is responsible for assessing the performance of water companies and setting the investment and service package that customers receive, as well as set five-yearly limits on the prices the companies can charge their customers. Price limits and eventual penalties on water companies are imposed by using Overall Performance Assessment (OPA) scores, which are based on the regulated operators' annual reporting of their operational efficiency, customer service, investment program delivery and financial performance.

Thames Water, the U.K.'s largest water and wastewater services provider, serving 14 million customers in London and the Thames Valley area with 2.6 billion liters of drinking water and about 4 billion liters of waste water in the average day, is at the forefront of actively tackling the issue of water leakages and costs for wastewater management in order to improve on compliance with increasingly demanding operational targets. With U.K. water companies fined more than 765 million US$ for underperformance and Thames Water itself having missed its leakage target for three years in the 2005-2010 regulation period, the company decided to take a series of actions aimed to improve its physical infrastructure and IT systems.

In the summer of 2011, Thames Water's Asset and Operations Real Time Analytics (AORTA) program was initiated in partnership with Wipro to lay the foundation for advanced and real-time analytics capabilities for Thames Water's operations control center, while mitigating business dependency on legacy systems. The program was designed to improve Thames Water's performances through business insights leading to better, faster, and more informed decisions; reliable and auditable process to calculate and report leakages; the ability to manage and monitor raw water abstraction and ensure license compliance; well-built energy and carbon management capabilities; and a single view of real-time sensory data.

AORTA consists of a situational analytics solution built by Wipro using the PI System (OSIsoft's enterprise historian infrastructure for management of real-time data and events). The system serves the purpose of holding the time-series data for clean water, wastewater, and submetering. Data is used for network modeling, leakage targeting, low-pressure incident reporting, energy consumption monitoring, demand forecasting, and risk assessment. It provides a single view of operations and a consolidated view of the network, through 500 schematics representing Thames Water areas; a platform for predictive trend analysis and leakage management; analytics powered by 22 years of historic data, around 1.8 TB of online data, and 1.04 TB of offline data; data collection at 15-minute intervals from around three million sources, including external communications and company assets such as pumps, valves, trunks, reservoirs, and more than 100,000 flow and pressure meters and loggers.

The platform was released in two phases. The first, completed in January 2012, aimed at mitigating business and operational risks related to Thames Water's aging infrastructures and legacy operational management system. The second phase was completed in October 2012 with the unification of existing local clean water filtration applications into a single solution and the deployment of the Energy Management System. Key benefits provided by the AORTA solution to Thames Water's business include optimization of leakage calculations and reporting, energy savings across the top 25 Thames Water sites, and about 20%-25% savings of the chemical usage in the treatments and filter beds forecasting.

The case of ERDF

In October 2013, ERDF, the domestic electricity distribution arm of French global utility EDF partnered with analytic data platforms, applications and services provider Teradata as part of the strategic initiative focusing on the redesign of the information system used to manage, process and analyze large sets of data generated by their smart grid.

ERDF, France’s leading medium and low voltage electricity distribution network operator, managing some 1.2 million km of power lines, equivalent to 95% of the total in mainland France, is installing some 35 million smart electricity meters, a rollout that it is set to complete by 2022. Each meter is expected to send readings every 10 minutes to ERDF, totaling a projected 2,000 billion readings per year, once the whole infrastructure is in place. Intuitively, the legacy system that had been used by ERDF thus far could no longer be scaled to support such large and growing datasets and complex analytics. The massive volume of data generated from the smart meters, including traditional power consumption data as well as multiple new types, analytic profiles and categories analyzed from smart meter data usage, requires ERDF to deploy a brand new and very powerful, flexible and scalable data infrastructure (data warehouse appliances, database and analytics systems).

ERDF’s deployment of the Teradata Data Warehouse Appliance with the new Teradata Database, backed with the provider’s professional services for systems maintenance and integration, is part of the distributor’s strategy to substantially increase its analytic capabilities by making fresh data quickly available. With this detailed, end-to-end data, ERDF can better understand and profile usage patterns, their effect on the distribution network, and scale the system more effectively, ultimately providing improved service to its customers.

The deployment plan for the Teradata solution and services implementation is to design and implement a resilient and scalable enterprise-class data foundation that will be able to meet the performance attributes that the data volumes mentioned above will require at their peak. The environment will support the considerable forthcoming workload and help ERDF strengthen its analytic capabilities and result in more informed business decisions and enhanced economic value.

2.3.3 Predictive maintenance

Use of BDA applications for maintenance optimization is a crucial focus area for utilities and one where major economic benefits can be extracted, given the critical monetary and national-economic value of the asset infrastructures involved, particularly for companies operating in the generation/abstraction, and transmission and distribution businesses.

Central to the use of advanced analytics applications in asset management is the shift from traditionally scheduled, calendar-based maintenance processes to so-called predictive maintenance. In predictive asset maintenance, advanced algorithms are applied to a mix of new and existing situational process intelligence data, compounded by critical external sources to identify and preempt maintenance issues and asset failures, and perform condition- as opposed to calendar-based maintenance, ultimately maximizing the return on production plants and distribution network assets.

Beyond enabling targeted maintenance optimization and reducing operation and maintenance costs, predictive asset management applications provide continuous monitoring of the health and performance of critical plant equipment and network assets, and ensure their availability and reliability.

The case of EDF

In June 2013, European energy producer EDF Group initiated a project to use advanced analytics to monitor its French nuclear power plant assets, in partnership with specialist performance management and predictive analytics software solutions provider InStep Software.

As a result of the rollout of InStep's PRiSM software, France-based EDF, the world leader in nuclear energy production, now uses predictive analysis in its real-time monitoring of 58 nuclear units at 19 sites. The software is used by EDF in its total quality management initiatives, as part of one of its services for remote analysis of power plant process data, which is the early diagnosis of equipment faults based on automatic recognition of patterns in data.

InStep's PRiSM is an advanced pattern recognition application software that is used as a predictive analytics platform for continuous real-time monitoring of the health and performance of critical assets. It uses advanced algorithms on data retrieved from the archive of the PI System to identify subtle changes in system and equipment behavior and provide early indication and diagnosis of asset health and performance problems. The software automatically notifies plant personnel of detected problems allowing for diagnosis and repair prior to failure.

EDF has been using PRiSM since 2008 to centrally monitor its gas turbine power plants and has progressively extended it to hydro and other fossil-fuel facilities. The software will now be used to support EDF's ongoing efforts to improve the availability and reliability of critical nuclear assets, enable more targeted maintenance work and schedules, prioritize maintenance optimization, reduce operation and maintenance costs, and provide continuous equipment health checks.

2.3.4 Customer operations

Customer operations are one of the widest application areas for BDA technologies and services. Use cases range from operational processes, such as demand response and distributed resource management in electricity distribution, to customer relationship management, customer engagement, marketing and sales, with the provision of usage information and gamified applications, or the use of behavior analysis in customer segmentation and targeting.

Cases analyzed below provide examples of two of the most promising use cases of data-driven applications in the marketing and customer engagement areas. Here, BDA are used for individual customer intelligence, to improve marketing efficiency and increase cross- and up-selling, as well as for behavior analysis into how energy is used, so that the customer can be engaged with energy efficiency programs and saving opportunities can be offered.

As smart meter rollouts are completed across the EU, utilities will be able to fully reap the benefits from such use cases, greatly enhancing energy efficiency initiatives as well as increasing customer satisfaction and loyalty.

The case of British Gas

In March 2014, Centrica-owned British Gas, the U.K.'s leading energy supplier, delivering electricity and gas to around 11 million homes, announced it was implementing a high-performance analytics system designed to improve the effectiveness (i.e. response rate) of the company's outbound marketing campaigns, enhancing the company's customer intelligence capabilities and enabling it to offer its customers more relevant products and services in an increasingly competitive market.

The project combines reporting and analytics capabilities provided as-a-service by business analytics firm SAS. It is part of the energy provider's effort to better understand its customers and improve loyalty making the most of its existing customer databases, optimize its multi-million pound spending on direct marketing campaigns, and shape its overall marketing strategy, including its large call center operations. These actions are in turn part of the company's broader evolutionary effort to become a customer-centric organization.

Systems deployed by British Gas include:

- A customer intelligence and scenario analysis solution (SAS Marketing Optimization) designed to maximize the ROI of direct marketing activities based on a number of business variables. For example it allows the company to predict how constraints (e.g., resource and budget constraints, contact policies) will affect its overall contact strategy, so that common problems such as contacting customers too often or too little and exceeding budgets can be avoided.
- Data analytics visualization software (SAS Visual Analytics), enabling marketing at British Gas to map out and understand analytic insights, such as data patterns and correlations, and share them within the company or with customers using a self-service, easy-to-use business intelligence environment. The software delivers in-memory analysis and interactive dashboards for reporting in-depth visualization of data of multiple types, sizes and from multiple relational database sources.

The case of E.ON

Starting October 2013, E.ON UK – one of the U.K.'s so-called "Big Six" energy suppliers with around 5 million domestic, enterprise and industrial customers – has partnered with behavioral energy efficiency and smart grid software company Opower to provide its customers with an online tool to help them save energy through tailored advice and local comparisons. The tool, called the "Saving Energy Toolkit" is designed to help households understand and transform their energy consumption patterns through analytics and simple peer-to-peer comparison mechanics.

The online Saving Energy Toolkit provides an analysis of a household's energy use, including where and when energy is being used with a breakdown of costs and how energy use changes on a monthly basis. This is done through a "what uses most" chart breaking down heating, lighting, hot water, and appliance energy consumption. The household's electricity and gas use is also compared with around 100 anonymous E.ON customers of a similar size and type, as well as against the most energy efficient homes in its local area. It also provides comparisons of how each household's energy use stacks up to these homes and tips on reducing energy usage in order to encourage positive behavioral change, and represents information using simple graphics to let customers easily identify where they can make savings.

In more detail, the Saving Energy Toolkit provides E.ON customers with:

- A "similar home comparison" three bar graph which shows their monthly energy use compared to similar homes in their area;
- A "what uses most" chart which reveals how energy is currently being used in the home (split between heating, lighting, hot water, appliances and "other");
- "My energy use" charts which detail how energy use changes on a month-by-month basis;
- A "compare monthly costs" section which shows how energy costs for the current month compare against the previous month, and how they've been affected by weather and energy consumption;
- Tailored hints and tips and energy goals, integrating the above information to help reduce energy usage. A short version of hints and tips can be posted on the user's Facebook timeline or Twitter feed.

The Saving Energy Toolkit is available to all E.ON domestic customers that manage their account online (customers can opt out of the service if they don't want their data used for this purpose). Currently, energy use and comparison data is updated on a monthly basis using either estimated or accurate meter reads provided by the customer and can go back as far as January 2012. E.ON is in the process of rolling out additional functionalities in the Saving Energy Toolkit for customers equipped with smart meters.

In collaboration with over 90 utility partners in nine countries, Opower has built a business case for customer engagement through use of data insights and behavioral science that aims at identifying the cost savings and revenue potential across common areas of utility operations. In a recent white paper, the company has published an estimate of potential benefits from behavioral energy efficiency in 26 European countries. Results show that the savings from deploying such programs wherever it is cost-efficient amount to 12 terawatt-hours (TWh) of energy, 1,590 megawatt of capacity, 3.3 million tons of carbon-dioxide equivalent (CO2e), and €2.4 billion every year. [4]

2.3.5 Big Data and Analytics in utilities: A First Europe-wide Maturity Model

With European utilities making their first forays into Big Data, in early 2014, IDC carried out a survey aimed at benchmarking BDA maturity across 80 companies in eight markets (Italy, France, the U.K., Czech Republic, Hungary, Poland, Romania, and Slovakia). [5] The study identified key traits that distinguish utilities whose BDA efforts have met or exceeded their overall expectations (high achievers) from competitors whose BDA efforts have fallen short (low achievers).

BDA maturity of European utilities – overview of results from IDC's Maturity Model

IDC's BDA Maturity Model examines five dimensions — data, technology, processes, people, and intent, a superset of strategy inclusive of justification and budgeting practices (see below). The model assesses each dimension against five stages of maturity, each one defined by a set of supporting capabilities of growing complexity (Table 2).

Table 2 Big Data and Analytics Maturity Levels

Maturity Stage	*Supporting capabilities*
Level 5 Optimized	Operationalized, continuous, and coordinated BDA process improvement value realization
Level 4 Managed	Measured; project, process, and program performance measurement influences investment decisions and standards emerge
Level 3 Repeatable	Intentional, defined requirements and processes, unbudgeted funding, and project management and resource allocation inefficiency
Level 2 Opportunistic	Accepted, recurring projects, budgeted and funded program management, and documented strategy and processes with stakeholder buy-in
Level 1 Ad hoc	Experimental, siloed proof-of-concept or pilot projects, undefined processes, lack of resources, and individual efforts

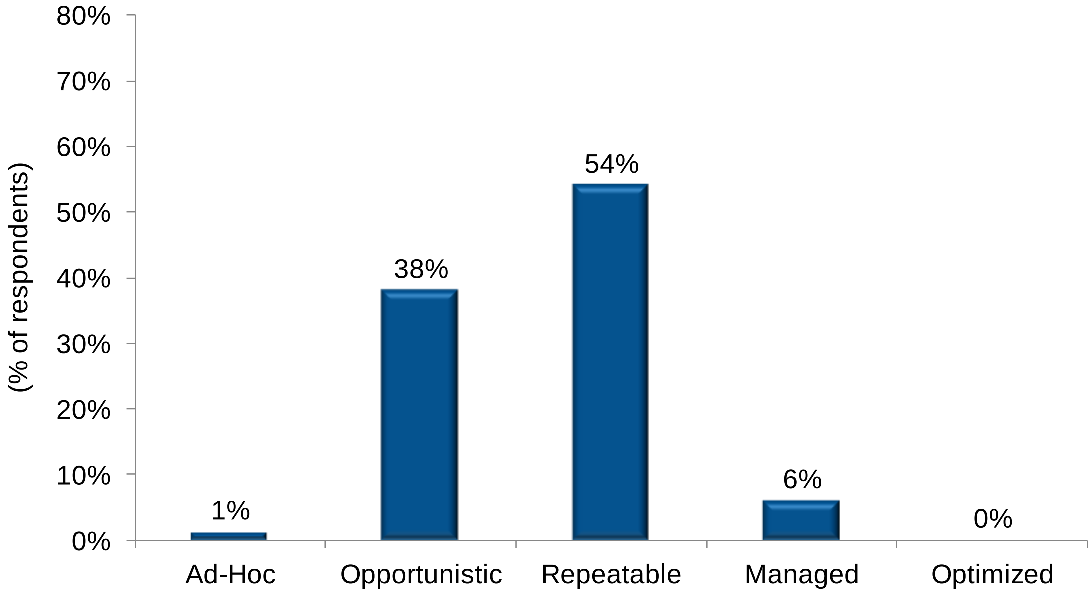
Source: IDC Energy Insights, 2014

[4] *Unlocking the Potential of Behavioural Energy Efficiency in Europe (Opower, June 2014).*

[5] *Business Strategy: IDC Maturity Scape Benchmark: Big Data and Analytics in European Utilities (IDC # EIOS03W, May 2014).*

Figure 3 depicts the distribution of utility companies in the sample across the five levels of BDA maturity. This is a composite view, pooling maturity across all five dimensions (data, technology, process, people, and intent). The results show a convergence toward the middle of maturity, with nearly two-thirds of utilities in the middle (repeatable) stage.

Figure 3: Big Data and Analytics Maturity Distribution across Stages: European Utilities



N = 80

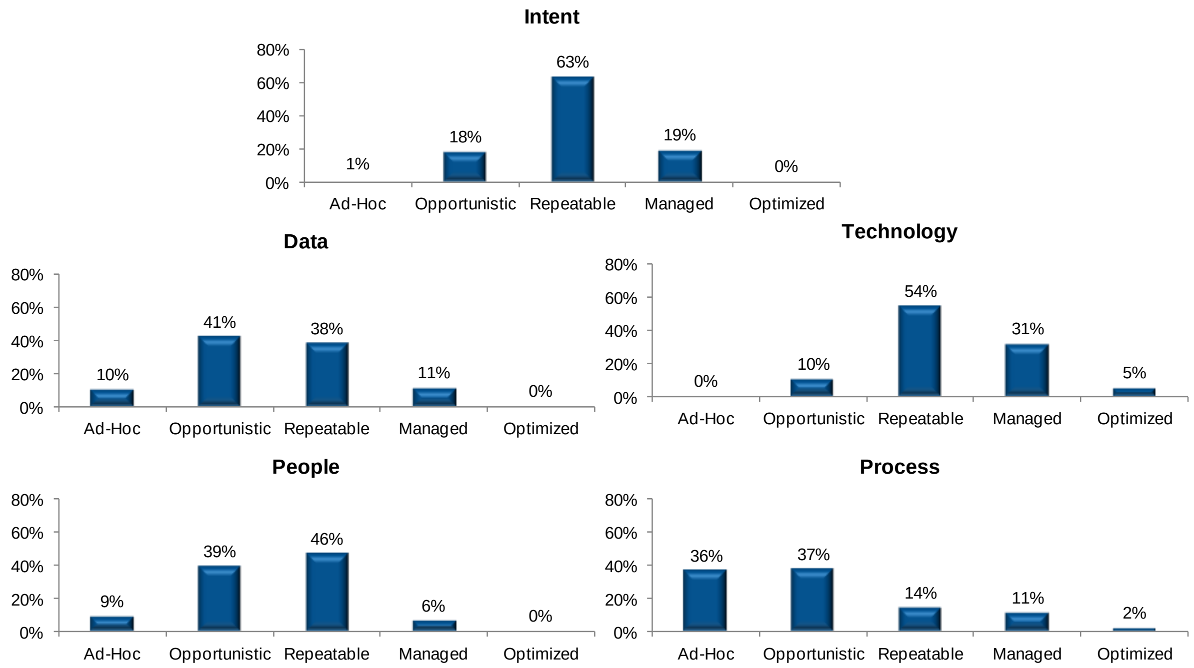
Source: IDC Energy Insights, 2014

IDC also measured maturity at a more granular level, across the five dimensions of the BDA Maturity Model:

- **Intent.** The measure of intent includes strategy, capital and operational budgets, performance metrics, sponsorship, and project and program justification.
- **Data.** The measure of data includes the quality, relevance, availability, reliability, governance, security, and accessibility of multi-structured data.
- **Technology.** The measure of technology includes the appropriateness, applicability, integration, support for standards, and performance of technology and IT architecture to relevant workloads.
- **Process.** The measure of process includes the processes of data collection, consolidation, integration, analysis, information dissemination and consumption, and decision making.
- **People.** The measure of people includes technology and analytical skills and intragroup and intergroup collaboration as well as organizational structures, leadership, training, and cultural readiness.

Figure 4 presents the maturity distribution of utility companies and its variability across each of the five dimensions. Maturity in the "technology" dimension cluster focuses on the middle ("repeatable") stage, leaning to the right ("managed") stage. Maturity in the "data" and people dimensions, while still showing significant concentration in the middle stage, skews to the left, lower ("opportunistic") stage. "Intent" shows the strongest concentration in the middle stage across the five dimensions and therefore the least variability among the companies surveyed. Finally, "process" shows the least maturity in utilities of any of the five dimensions, with concentration of respondents in the "ad-hoc" and "opportunistic" stages.

Figure 4: Big Data and Analytics Individual Dimensions Maturity Distribution Dashboard: European Utilities



N = 80

Source: IDC Energy Insights, 2014

In essence:

- In general, European utilities have a median BDA maturity level of 3 out of 5 (with 5 being the highest);
- In particular, across the 5 dimensions of BDA maturity (intent, data, technology, process and people), utilities in Europe are faring the highest in “technology” and the poorest in “people” and “processes”.

In other words: European utilities feature a medium level of maturity when it comes to the application of BDA as reflected in the distribution of utilities across IDC's BDA Maturity Model's maturity stages. The results show a convergence toward the middle of maturity with nearly two-thirds of utilities in the middle "repeatable" stage. The “repeatable stage” (i.e. the next level of maturity) is not here yet but within reach across a few fundamental dimensions, namely “technology”. This means that Europe’s utilities are on the right path to fully exploit the advantages offered by BDA technologies.

2.3.6 Data-driven Innovation Benefits and Impacts

From the analysis of the case studies identified above, and from the results of the maturity model presented in the previous section, IDC Energy Insight’s has produced a first estimate of the main benefits to be obtained by European utilities (at EU 28 level) from data-intensive smart grid analytics applications

The estimates of these benefits have been aggregated along the key utility value chain segments (generation/abstraction; transmission & delivery; aggregation; metering; customer) and are summarized at EU28 level in table 3 below:

Table 3 Key Use Cases and EU28-Wide Benefits of Data Exploitation in the Utilities Industry by Value Chain Segment

Utility Value Chain Segment	Most Relevant Use Cases	Estimated Overall Impact [6] on EU28 Utility Companies (€M/year)
Generation / abstraction	• Investment planning • Asset operations • Regulatory compliance • Predictive maintenance	16,300
Transmission & delivery	• Network investment planning • Asset operations • Regulatory compliance • Predictive maintenance • Sensor-based network optimization • Distribution forecasting and scheduling • Renewable energy and storage support • Outage detection • Transformer loading • Demand response management • Distributed resource management • Field service optimization	28,600
Aggregation	• Distributed resource management • Demand response management	1,300
Metering	• Advanced metering infrastructure (AMI) operations • Regulatory compliance • Theft and fraud detection (revenue assurance) • Field service optimization	7,500
Customer	• Demand response management • Distributed resource management • Customer insights (segmentation and targeting) • Energy consumption analysis • Customer engagement/interaction • Account management	10,650

Estimated Overall Impact on EU28 Utility Companies	**64,350**

Source: IDC Energy Insights, 2014

Generation and Abstraction: Estimated Impact

The overall financial benefits on EU28 utilities from data-driven applications in electricity generation and water abstraction are estimated at €16.3 billion per year (around one-quarter of the total estimated benefits to the entire industry from BDA solutions).

[6] *See additional details on the Methodology Note at the end of this document*

The most relevant use cases in this area fall in the broad asset management, maintenance and planning cluster. Data-intensive applications in this segment allow utilities in the production business to enhance and speed up critical operational processes and, most of all, optimize maintenance and reach higher levels of quality and safety standards, significantly increasing the return on assets. As mentioned, given the critical monetary and national-economic value of the asset infrastructures and the financial volumes involved in production, use of BDA applications for generation and maintenance optimization is a crucial focus area for utilities and one where major economic benefits can be extracted.

Transmission and delivery: Estimated Impact

The operation of extensive transmission and distribution networks for electricity, water and gas for long-distance transport and end-point delivery is the value chain segment that is expected to enjoy the largest gains from smart grid analytics-based automation. As smart networks rollout is completed, transmission and distribution companies across the EU28 are forecast to net up to €26.8 billion a year in benefits from BDA applications, or 44% of the total estimated benefits to the utilities industry from data-intensive analytics solutions.

The most promising applications in the segment include those enabling:

- Distribution forecasting. Developing a power supply strategy to improve the reliability of the network and provide optimal load scheduling;
- Automated outage detection. Sensing and assessing outages through the analysis of meter data delivered through advanced metering infrastructure (AMI).
- Transformer loading. Combining smart-meter data with other grid data points to highlight complete transformer load flows for project planning;
- Predictive asset management. Using situational intelligence to identify and preempt maintenance issues and asset failures and perform condition-based maintenance.

According to smart grid analytics solutions provider C3 Energy, benefits to the typical European energy distributor from BDA applications in the fault detection and condition-based maintenance alone could be worth over €50 per point of delivery per year, while benefits from all applications in the segment could yield more than €130 per point of delivery per year.

Aggregation and Metering: Estimated Impact

At €1,300 million per year electricity aggregators represent the smallest segment in terms of potential financial gain from data-driven smart grid applications (under 3% of the total benefit to the industry). Applications mainly include virtual power plant automation, storage support and demand/supply flexibility management.

On the other hand, deployment of data-driven applications for the metering segment of the utility business is expected to result in overall gains of up to €7.5 billion a year (12% of the total) for EU28 companies, once smart electricity, gas and possibly water meters become the norm.

Key data-driven applications include:

- Energy theft and fraud detection. Identifying theft and fraud using smart meters and credit data and ensuring that the network output is fully billed for;
- Demand response. Issuing a day-off call for demand response based on customers' enrolled network connectivity, devices associated with loads, and supply.

Revenue assurance and demand response management applications could yield around €40 per meter per year to the average energy retailer in Europe.

Customer: Estimated Impact

Finally, benefits from BDA applications in customer operations amount to an estimated €10.65 billion, annually (17% of total estimated benefits to the entire industry from data-intensive solutions). Customer engagement applications enabling peer-to-peer comparison of consumption and gamified applications leveraging social mechanics are the ones holding the most potential in this segment in terms of both the financial and efficiency gains.

Understanding customers' wants, needs, and expectations through better use of existing information as well as the analysis of unstructured data found on social media or emails can help utilities personalize their customer relationship strategies (engaging and tailoring marketing initiatives to the individual client), greatly improving the customer experience, enhancing satisfaction and reducing the risk of churn. It is estimated that the overall return that an electricity supplier can derive from an engaged customer is in the order of 20%-55%, including through better customer relationship, lower cost-to-serve via digital channels, more effective direct marketing, behavioral demand response and energy efficiency. [7]

[7] *The Value of the Engaged Energy Consumer (Opower, October 2014).*

3 Conclusions

While utilities remain the beating heart of the EU economy, the industry is facing a series of unprecedented challenges to its traditional business model. The electricity industry, for example, is struggling with a shift of value from generation towards the lower segments of the value chain. The industry is also facing lower demand and profitability levels. At the same time, there is a growing need to upgrade distribution infrastructure to integrate a growing amount of distributed renewable energy sources, electric mobility and energy management systems, while optimizing installed network capacity to shape customer demand and adjust supply capabilities accordingly.

Big Data and Analytics (BDA) play a fundamental role in helping utilities to successfully tackle these challenges. A handful of applications stand out as the most popular among Europe’s utility companies, including distribution forecasting, predictive maintenance, theft and fraud detection, and customer insights & interaction. By focusing on selected use cases, our research has shown that BDA implementations are rapidly taking place across a growing number of utilities in Europe with positive effects in several industry areas and throughout all segments of the overall utilities value chain. BDA, for example, can help maximize process efficiency and productivity of service teams in the field (field service optimization) by deploying real-time, mobile workforce automation applications to support maintenance work and reduce its associated costs. Big Data and Analytics solutions can also improve asset demands’ forecasting, production planning, energy’s & water’s usage and supply and can also help analyze and predict outages at central generation/abstraction plants (asset operations). Intensive data-driven and data-based applications are also instrumental to put in place effective predictive maintenance systems through the use of advanced algorithms that allow identifying and preempting maintenance issues and asset failures, ultimately maximizing the return on production plants and distribution networks. Customer operations will also benefit from BDA applications as they will improve utilities’’ marketing efficiency and expand cross- and up-selling opportunities; they will enhance behaviour analysis capabilities, so that customers can be engaged with energy efficiency and savings programmes.

We estimate that the potential economic benefits to EU28 utilities from the deployment of data-intensive applications across the value chain could amount to over €64.3 billion a year. Benefits for €28.6 billion and €16.3 billion per year could affect companies in the distribution/transmission and in the generation/abstraction segments. BDA applications in customer operations could also reach substantial economic benefits (€10.65 billion annually). Aggregation and metering, on the other hand, would benefit from less generous financial gains from data-driven smart grid application - less than 3% and 12% of the total benefit to the industry per year, respectively.

All in all, our maturity model confirms that the median European utility has a BDA maturity level of 3 out of 5 (with 5 being the highest). The results of IDC’s survey show a convergence towards the middle of maturity with nearly two-thirds of the European utilities in the middle "repeatable" stage. The “managed stage” (i.e. the next level of maturity) is not here yet but within reach across a few fundamental dimensions, namely “technology”. This means that Europe’s utilities are on the right path to fully exploit the advantages offered by BDA technologies and become *the* data-driven industry in Europe.

4 Main Sources

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- Gamifying the Enterprise, Roberta Bigliani, Adam Ajzensztejn, Jul 2014 - Doc # EISC02W Industry Development and Models

- Meeting the demand for data driven change in the utilities sector, Report on adopting a Unified Data Strategy (UDS) to manage the exponential growth of Big Data, Informatica, October 2012
- The Value of the Engaged Energy Consumer (Opower, October 2014).

5 Methodology Note

Definition of Utilities Industry

Throughout this study, we define the Utilities industry as part of the energy sector (NACE D and E). The utilities industry and utilities companies is considered to include electric, gas, water, and others as defined by the General Industrial Classification of Economic Activities within the European Union Divisions (NACE Rev. 2).

- Electricity Generation (NACE 35.11)
- Electricity Transmission (NACE 35.12)
- Electricity — Distribution (NACE 35.13)
- Electricity — Supply/Retail (NACE 35.1)
- Electricity — Trading (NACE 35.14)
- Gas — Transportation/Distribution (NACE 35.22)
- Gas — Supply/Retail (NACE 35.21, 35.23)
- Gas — Trading (NACE 35.23)
- Water (collection, purification, and distribution of water) (NACE 36)
- Steam and hot water supply (NACE 35.3)

Estimated Overall Impact on Utilities Companies

The estimated overall impact on EU28 utility companies per value chain segment was calculated by IDC Energy Insights through a variety of sources, including internal data and the latest available research and economic analysis from industry-specific literature, as well as from long-standing relations and specific interviews with vendors and industry players.

In particular, IDC Energy Insights performed the following steps:

- Identification and selection of a limited number of applicable case studies per each use case area covering the entire spectrum of the utilities industry (i.e.: the four application areas identified in this study - field service optimization, asset operations, predictive maintenance, customer operations – plus a series of other suitable use cases such as investment planning, regulatory compliance, outage detection, etc…).
- Impact estimate of data-intensive smart grid Big Data and Analytics Solutions on the utilities companies involved in each identified and selected case study.
- Allocation of the impact estimate at individual company level to the appropriate value chain segment, i.e.: generation/abstraction, transmission & delivery, aggregation, metering, and customer.
- Definition and selection of the unit on which bases to parametrize the impact estimate at utilities company level and extrapolate it to the universe of utilities companies across the EU28. The unit selected as the bases for the parametrization exercise is the number of points of delivery to final customers per each utility company.
- Extension of the estimated impact at the individual utilities company level to the universe of the whole of the utilities companies in the EU28.
  This step was carried out by dividing the value of the estimated impact at individual utilities company by the number of points of delivery within the individual company. The obtained value was further multiplied by the total number of points of delivery to final customers across the whole utility industry in EU28 to obtain the overall estimated impact on EU28 Utilities companies.

  The process can be summarized as per the following formula:

  $Ic / Pc = Ip$

  $Ip \times Pt = It$

Where:

Ic = Estimated impact at company level
Pc = Number of points of delivery served by individual company
Ip = Estimated impact per single point of delivery
Pt = Total number of points of delivery served by all companies in EU28
It = Estimated Overall Impact in EU28.