The Digital Utility Plant

Unlocking value from the digitization of production

By Capgemini Digital Transformation Institute

27%
the expected productivity improvement in next 5 years, compared to 21% improvement in past 25 years

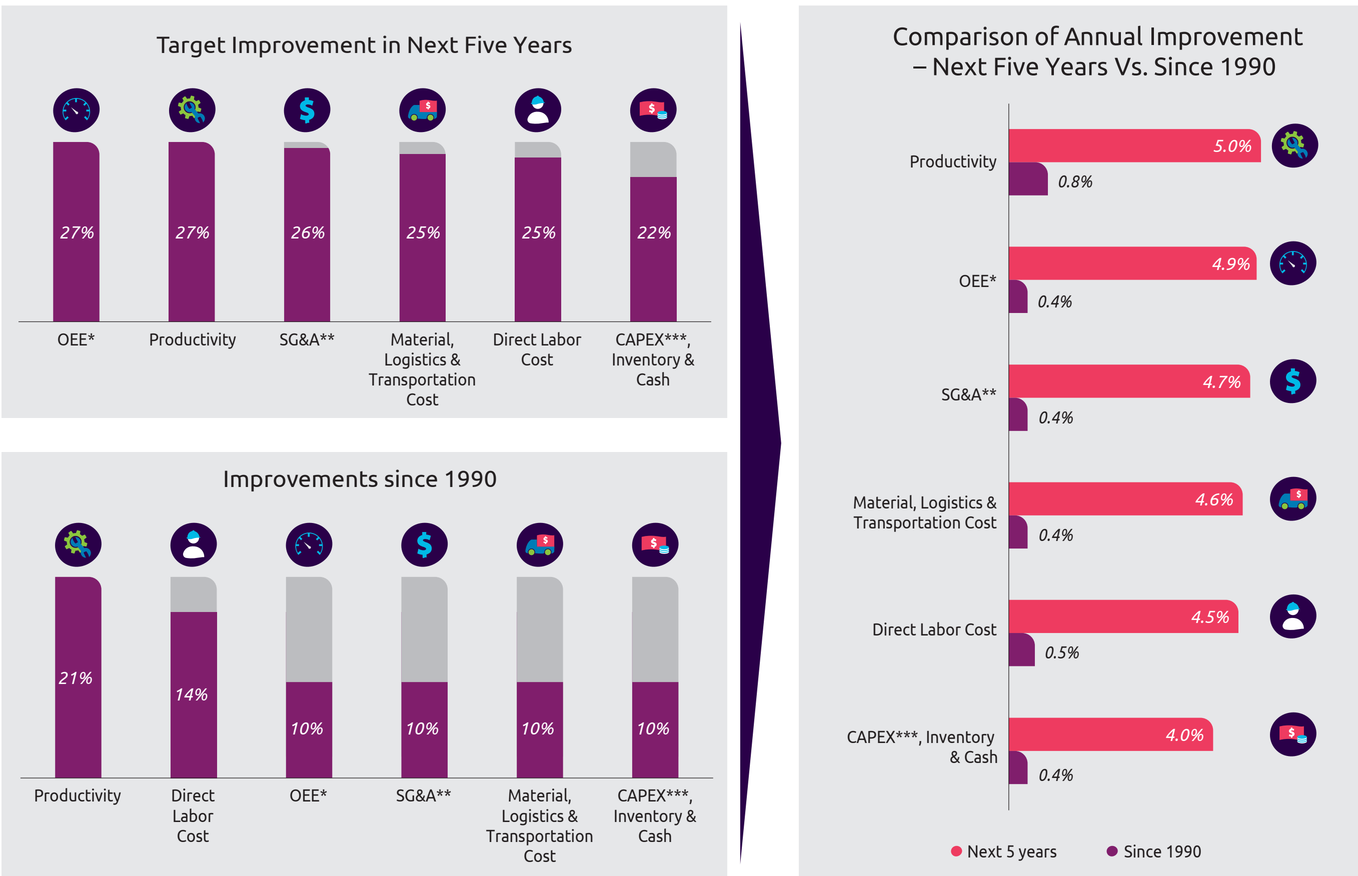
Digital utility plants power big improvements in production costs and environmental impact

Utilities around the world are leveraging digital technologies to enhance efficiency and optimize production. For example, E.ON, one of the world's largest owners of renewable power projects, upgraded its wind fleet with digital solutions[1]. The solution leveraged the Industrial Internet of Things (IIoT) and advanced analytics to increase annual energy production by 4% in the first year from the company's 283 turbines. This was equivalent to adding 10 turbines to their fleet at the time.

These are impressive returns, but we wanted to understand the wider picture of the value and benefits of digital plants. We surveyed 200 senior executives in utility companies around the world with annual revenues of more than $1 billion. The research methodology at the end of the paper has additional details.

The research shows that digital plants will drive significant gains across the utility production value chain. For example, cutting production costs by

Figure 1: Utility players expect digital plants to deliver a step change in performance gains



*Overall equipment effectiveness; **Sales, general and administrative expenses; ***Capital expenditure
Source: Capgemini Digital Transformation Institute, digital utilities survey, February-March 2017; percentages indicate expected improvements in each category

a quarter in an average power plant and lowering CO_2 emissions by 625 million metric tons, equivalent to 4.7% of expected global CO_2 emission from electricity production. Below, we examine the potential benefits and improvement gains across production processes, production costs, and emissions.

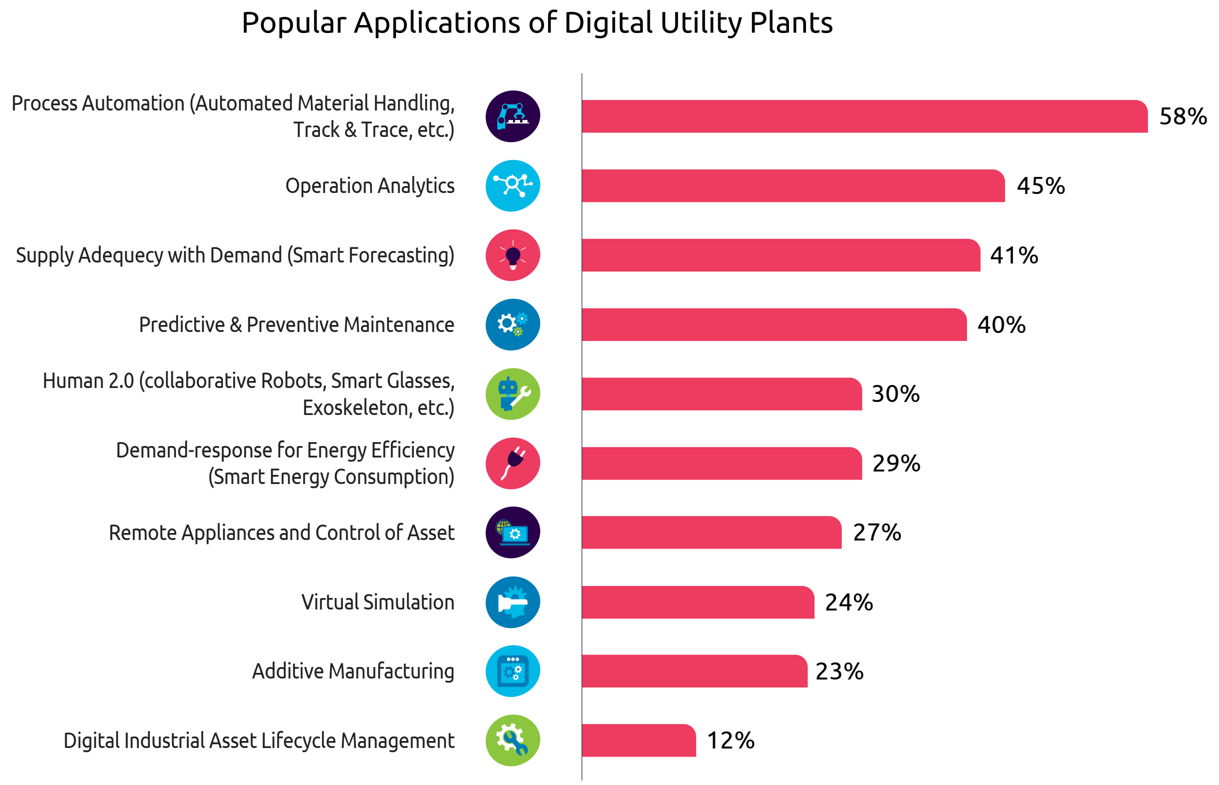
Digital utility plants lead to holistic improvement in the production process

Utility players expect digital plants to make production processes more efficient and reliable by massively improving crucial areas of production in the next five years.

This represents a step change in performance improvement. For example, since 1990, organizations have delivered a 21% improvement in productivity. But organizations are now targeting a 27% improvement in productivity in just the next five years (see Figure 1).

These improvements in operations will be driven by a wide array of digital applications, with more than half (58%) using process automation and close to half (45%) using operational analytics (see Figure 2). While process automation encompasses features such as automated material handling and smart track and trace, operational analytics turns data at the level of automation control systems into insightful information that is visible to authorized people in the organization.

Figure 2: Utility players are implementing a wide range of applications

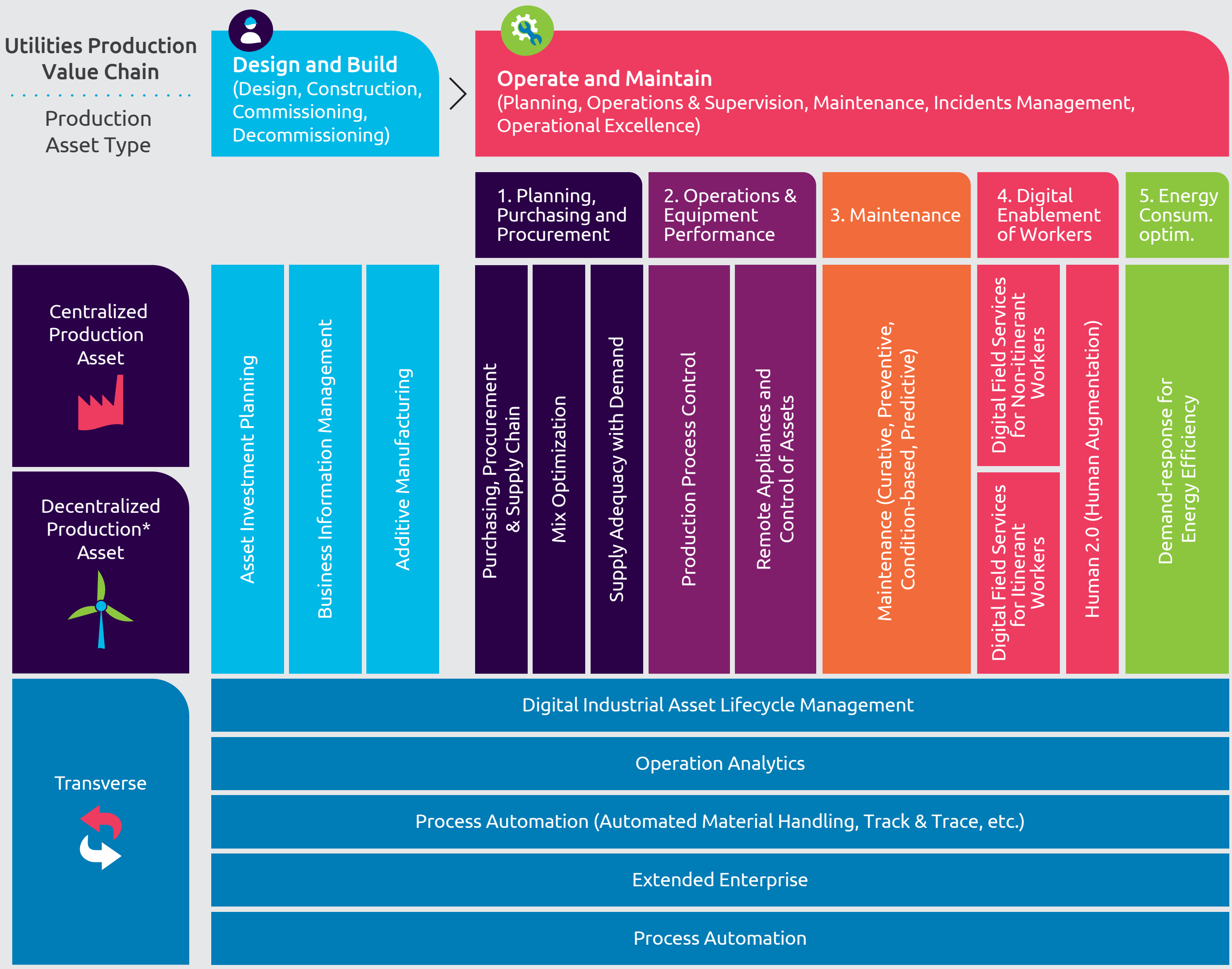


Source: Capgemini Digital Transformation Institute, digital utilities survey, February-March 2017; percentages indicate share of organizations implementing a particular application

What is a digital utility plant?

Digital utility plants leverage a large number of digital applications across the utility production value chain. A digital application is a combination of multiple technologies addressing a specific business requirement. For example, predictive maintenance, which is a combination of technologies such as IIoT, Big data, and artificial intelligence, is a popular digital application to improve productivity and reliability by minimizing unplanned downtime.

Capgemini Digital Utility Plant Framework



Source: Capgemini digital utility framework

$20Mn the production cost that can be saved annually in an average combined-cycle power plant in US

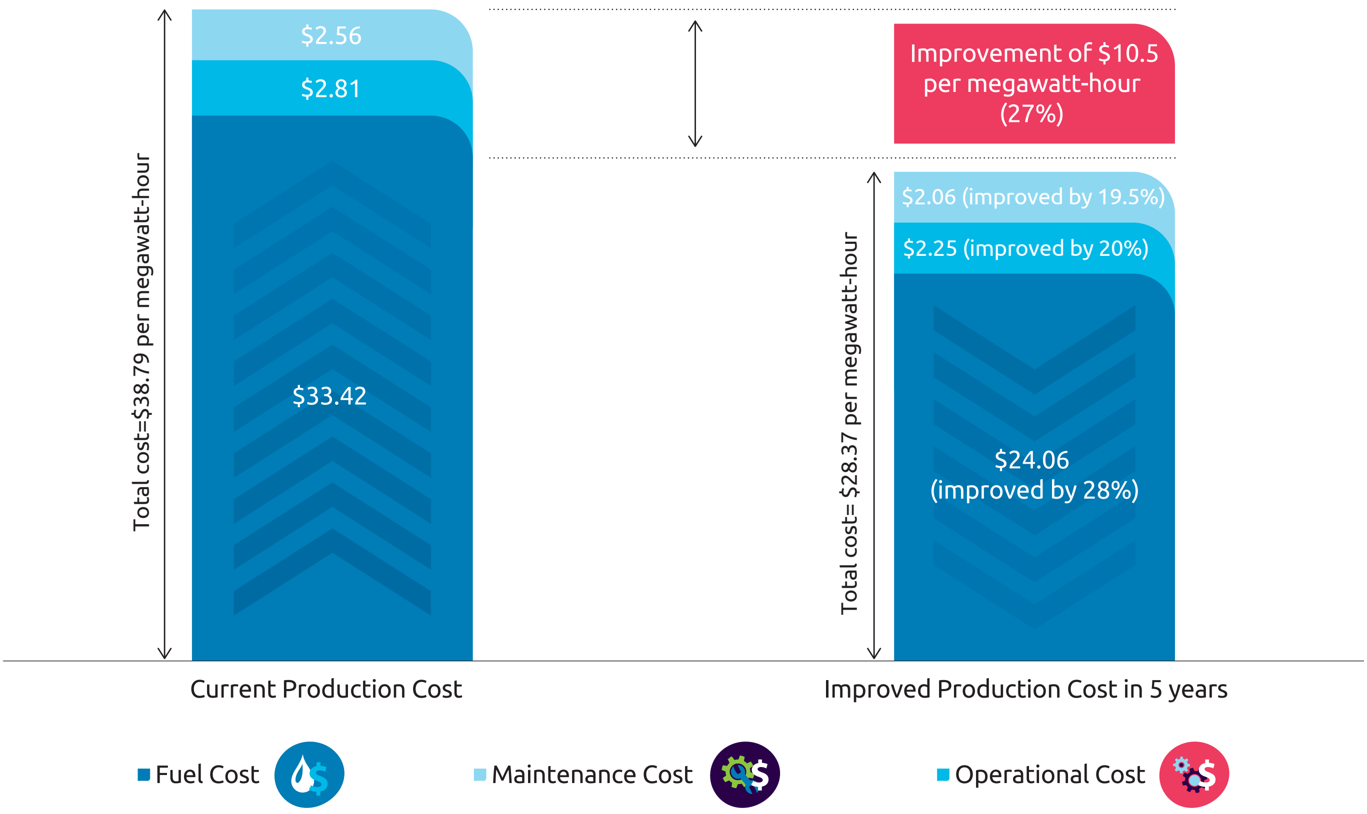
Digital power plan ts drive down production costs

The senior executives we surveyed expect digital power plants to achieve drastic improvements in all cost categories in the next five years from both hardware and software innovations. Advanced, digitally connected turbines and boilers—aided by advanced analytics—will drive efficiency by fine-tuning operational parameters. For instance, by optimizing combustion of fuel according to fuel quality, weather, and the cleaning requirement of boilers, organizations can realize fuel savings. Moreover, analyzing patterns in real-time machine data helps identify early signs of problems, allowing time for maintenance, improving machine availability, and extending asset life.

To understand the financial benefits of digital utility plants, we took the case of a hypothetical 400 mega-watt combined-cycle (gas-fired) power plant in the US, with a capacity factor[2] of 56%. Our analysis, building on the results of the primary research, shows that such a plant could expect to significantly reduce its major costs (see Figure 3):

- Fuel costs by 28%
- Maintenance costs by 20%
- Operations costs (by 19.5%).

Figure 3. Digital combined-cycle power plant in US will bring down the cost of producing energy by 27%

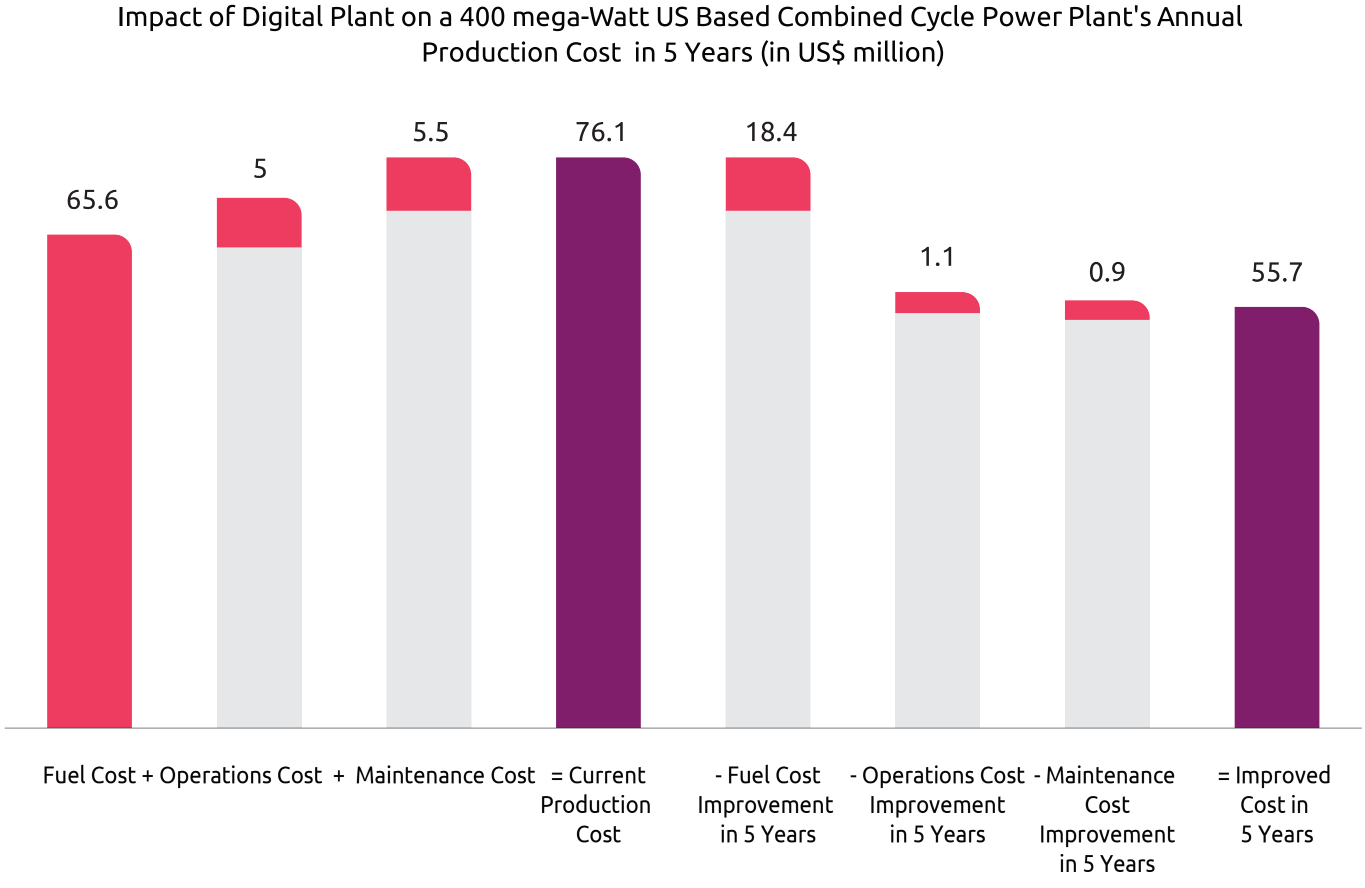


Source: US Energy Information Administration (EIA) Database, accessed in June 2017; Capgemini Digital Transformation Institute analysis.

Note: The production cost of thermal or nuclear power plants can be segregated into three major categories: fuel cost, operational cost, and maintenance cost. This chart explains the current composition of these cost categories to produce one mega-watt of power in a power plant in the US as well as the improved cost composition of digital utility plants.

Taken together, these savings would reduce annual production costs from $76.1 million to $55.7 million (see Figure 4). In other words, this represents an annual savings of $20.5 million or a reduction of 27% in production costs.

Figure 4. An average* 400 MW, combined-cycle power plant in the US can save $20 million annually using a digital plant in five years



Source: U.S. Energy Information Administration (EIA) Database, accessed in June 2017; Capgemini Digital Transformation Institute, digital utilities survey, February-March 2017; Capgemini Digital Transformation Institute analysis

*An average US plant had a heat-rate of 10465 BTU per kilo-watt-hour on average from 2011 to 2015 and capacity factor of 52.7%

4.7%

the share of global annual CO_2 emissions that digital power plants can eliminate by 2025

Examples of cost reduction in action include:

- In January 2016, Stadtwerke AG, a German utility company, achieved 61.5% efficiency in their combined-cycle power plant in Dusseldorf with the help of advanced digitally controlled turbines[3]. Compared to an average combined-cycle power plant that has approximately 45% efficiency, our analysis shows that this plant would be able to save approximately 27% in fuel costs.
- Duke Energy, the largest electric power holding company in the US, deployed an asset health monitoring and alerting system involving over 30,000 Industrial Internet-of-Things (IIoT) sensors[4]. It allowed the company to move from a semi-annual, manual, and paper-based asset inspection and reporting system to a fully automated, real-time system. In the three years of its operation, advanced analytics on the sensor data has helped the company avoid over $31 million in maintenance costs alone.
- Siemens' wind turbine monitoring system, deployed for wind turbines spread across the western edge of the Great Plains in the US, can solve 85% of all alarms within 10 minutes leveraging its remote diagnostic center's data analytics[5]. A study by the International Renewable Energy Agency (IRNEA) predicts that by 2025 such ease of maintenance and enhancement of turbine reliability will help cut offshore wind farms' operations and maintenance costs by 44%[6]. Also, considering the fact that wind and solar farms are often newly built, their digital transformation is easier because of compatible equipment.

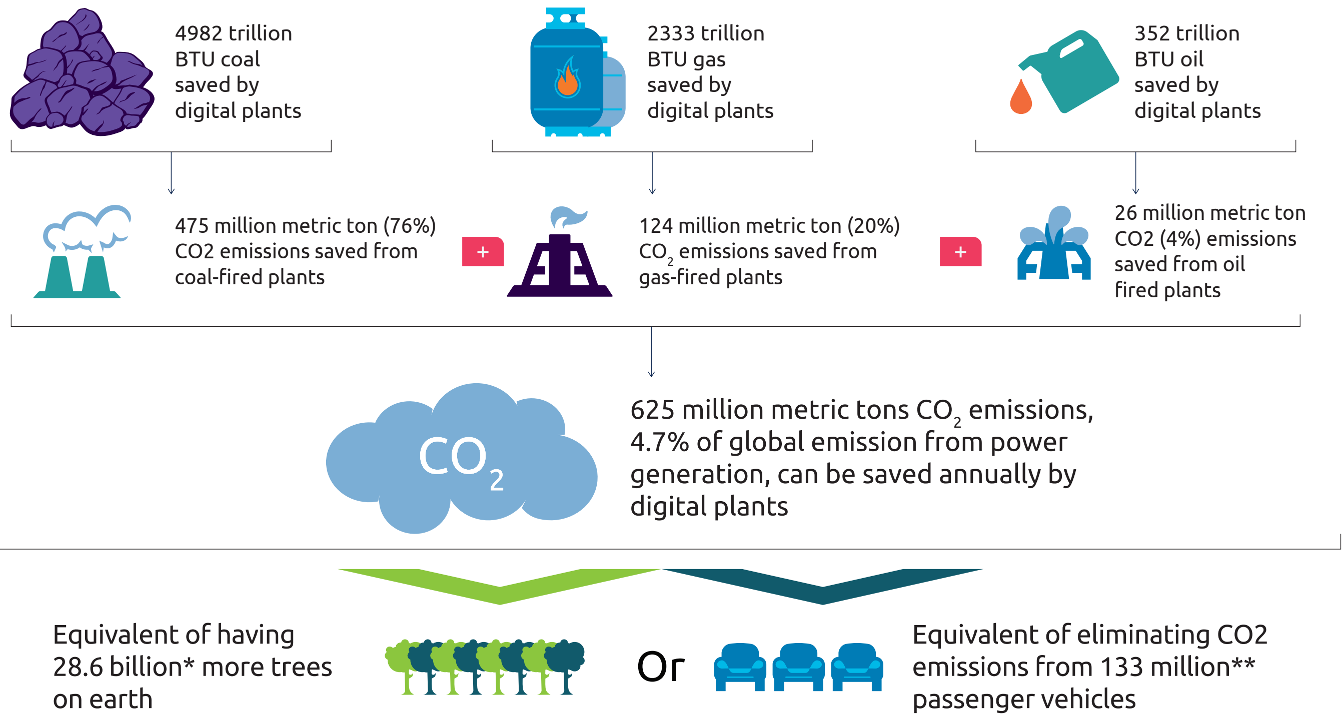
By 2025, digital power plants can effectively eliminate annual CO2 emissions equivalent to 133 million passenger vehicles

Carbon dioxide is one of the biggest threats to environmental sustainability, and the power generation industry is the biggest emitter of CO_2. In 2015, power and heat generation accounted for 42% of global CO_2 emissions[7]. Hence, governments and regulators have set aggressive targets to reduce emissions caused by this sector, especially by increasing the share of power generation from renewable energy sources. For instance, the European Commission's climate and energy framework sets a binding target for European Union (EU) Member States to make the share of renewables at least 27% of the EU's consumption in order to reduce green house gas emissions by 40% of 1990's levels[8].

While switching to renewables is certainly an effective way to meet CO_2 emission reduction targets, our research shows that digitization of fossil-fuel plants can also provide an important means to considerably reduce CO_2 emissions. On average, each digital power plant can save approximately 25% of fossil fuel (up to 28% in the US) in the next five years. Also, 19% of power plants are expected to be equipped with digital technologies in the next five years.

To calculate the impact of digital plants on reducing CO_2 emissions, we combined our survey insights with fuel efficiency and emission rate data available from the US Energy Information Administration (EIS). Our analysis shows that, by 2025, digital power plants can help remove 625 million metric tons of CO_2 emissions, which is 4.7% of expected global CO_2 emissions related to electricity production. It is equivalent to having 28.6 billion more trees on earth or eliminating the CO_2 emission effect

Figure 5. By 2025, digital plants will save 625 million metric tons of CO_2 emission globally



Source: Energy Information and Administration (EIA) Database, accessed in June 2017; Capgemini Digital Transformation Institute, digital utilities survey, February-March 2017; Capgemini Digital Transformation Institute analysis

*1 mature tree consumes, on average, 48 pounds or 21.78 kilograms of CO2 per year; **1 passenger vehicle emits, on average, 4.7 metric ton CO2 in a year: source United States Environmental Protection Agency Website, accessed June 2017.

Note:
To understand the impact of digital plants on global CO2 emissions related to power generation, we have applied our insights from survey data on the following data set provided by the US Energy Information and Administration (EIA).

1. The predicted share of electricity to be produced worldwide by fossil fuel
2. Average heat rate for each type of fuel (measurement of fuel that needs to be burnt to produce a unit of energy): natural gas—7.9 million BTU/MWh; coal—10.5 million BTU/MWh; petroleum—10.7 million BTU/MWh.
3. Emission rate for each type of fossil fuel: natural gas—53.05 kg/million BTU (0.42 metric tons/MWh); coal—95.35 kg/million BTU (1.00 metric ton/MWh); petroleum—73.16 kg/million BTU (0.78 metric tons/MWh

of 133 million passenger vehicles (see Figure 5).

An Indian utility recently upgraded one of its power generation facilities with state-of-the-art turbines and the latest digital technologies[9]. It is expected to boost the output of the plant by 10 MW and the heat-rate by 14%. This implies that CO_2 emissions from the plant will decrease by nearly 14%.

Another technology— Carbon capture and storage (CCS)— is on the horizon, promising to curb carbon emissions from utility plants by as much as 90%[10].

The technology makes it possible to capture, in a plant, the CO_2 produced from fossil fuel combustion and transport and store it. There are 15 large-scale plants globally that have deployed CCS as of 2016[11].

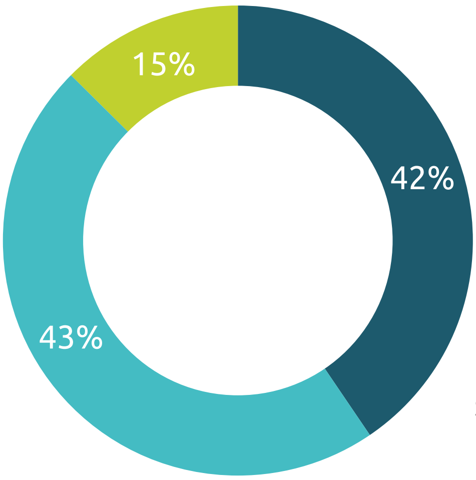
This number is expected to reach 21 by end of 2017. The large investment required and limited incentives due to negative impact on plants' efficiency have so far constrained wider adoption. However, the international movement to limit the buildup of greenhouse gases might serve as a boost.

Utilities are putting considerable energy into digital plant strategy

A large majority of utilities either have digital plants or are working on them

We found that 42% of survey respondents have a digital plant in operation with 43% saying a plant is in progress. The remaining 15% plan would have a digital plant initiative in next three to five years (see Figure 6).

Figure 6. Nearly every utility is pursuing a digital plant strategy



Global Penetration Levelof Digital Utility Plants

- Yes - we have an ongoing (operational) digital plant initiative
- Yes - it is currently being formulated/work in progress (not in operation yet)
- No - but we plan to have a digital plant initiative in the next 3 - 5 years

Source: Energy Information and Administration (EIA) Database, accessed in June 2017; Capgemini Digital Transformation Institute,digital utilities survey, February-March 2017; Capgemini Digital Transformation Institute analysis

42%
the percentage of utility companies that have operational digital plants

Emerging economies are catching up with western early-adopters

France, Germany and the United States are among the early adopters, with 50% or more saying that they already have a digital plant (see Figure 7). One reason for this high rate of adoption is aggressive targets to move to cleaner energy over the next 5 to 10 years:

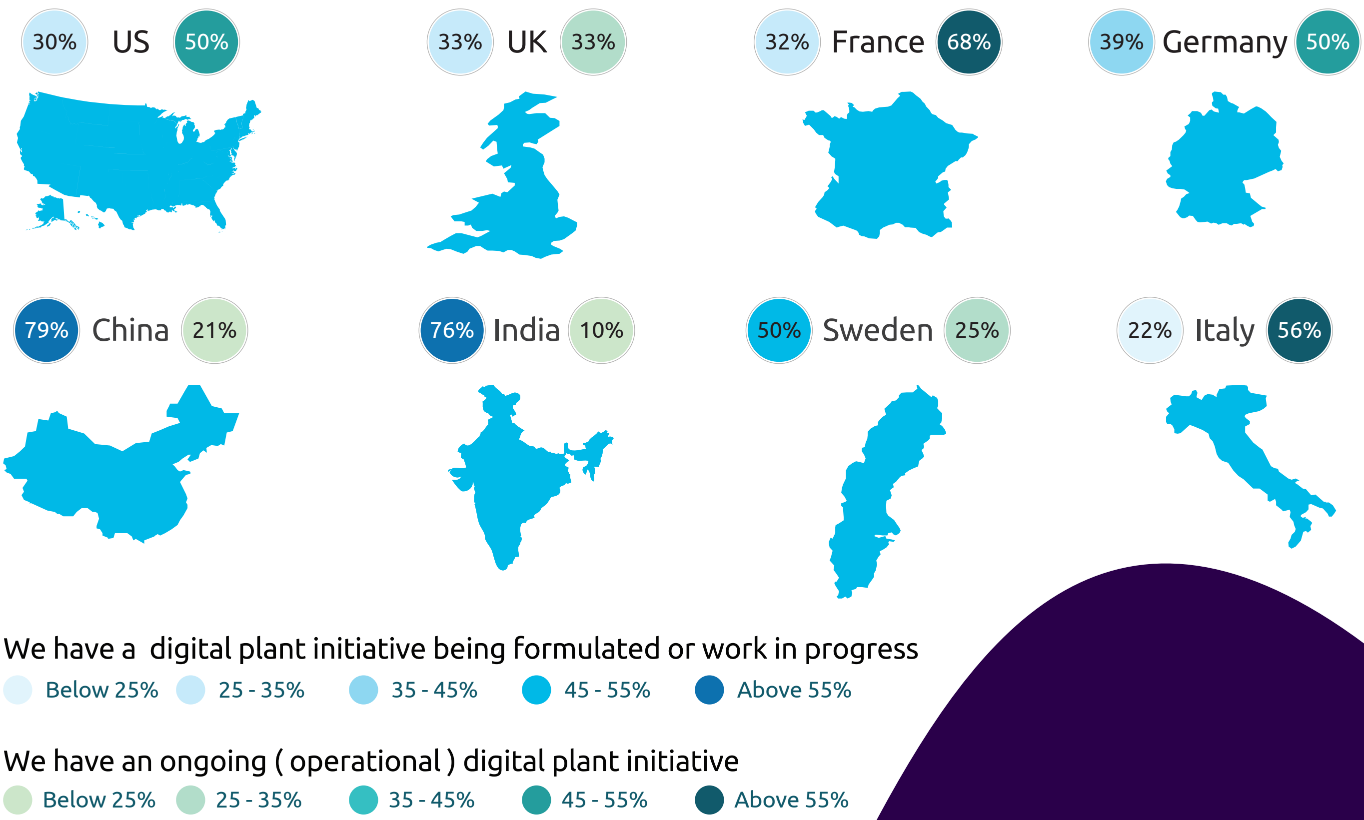
- France's electricity generation is heavily dependent on its aging nuclear plants[12], and the government wants to bring down the share of nuclear power to 50% by 2025 and increase the share of power from other renewable energy sources by 40%[13]. Moreover, EDF's nuclear plants refurbishment program, Grand Carenage, is driving digitization initiatives in its nuclear plants.
- Germany has an audacious plan to phase out nuclear power by 2022 and meet 50% of its energy demand from other renewable sources[14].
- The United States' Clean Power Plan emphasizes cost-effective ways of bringing down CO_2 emissions[15].

75%
the share of utility companies from China and India who will have digital plants within 3 years

All these policies and targets call for greater operational efficiency in both fossil fuel and renewable power generation, and it seems utilities are seeing digital plants as an effective means to meet these objectives.

Our study shows that China and India plan to catch up with the early adopters soon as they gear up to address increasing domestic electricity demand, while limiting carbon emission. EIA predicts China and India's electricity generation to grow approximately by factors of 2 and 2.7 respectively from 2012's level by 2040[16]. However, both the countries have committed to bring down their carbon emissions significantly by 2030[17]. In this crucial juncture, we found that digital plants will soon play an important role in these two countries' power generation, as more than 75% of respondents from both the countries said that they would have digital plants within 3 years. Additionally, the fact that almost 75% of all the digital plant efforts in China and India will involve at least one green-field project indicates that a large share of power plants will be digital since their inception.

Figure 7. Europe and the US lead digital plant adoption as India and China plan to catch up

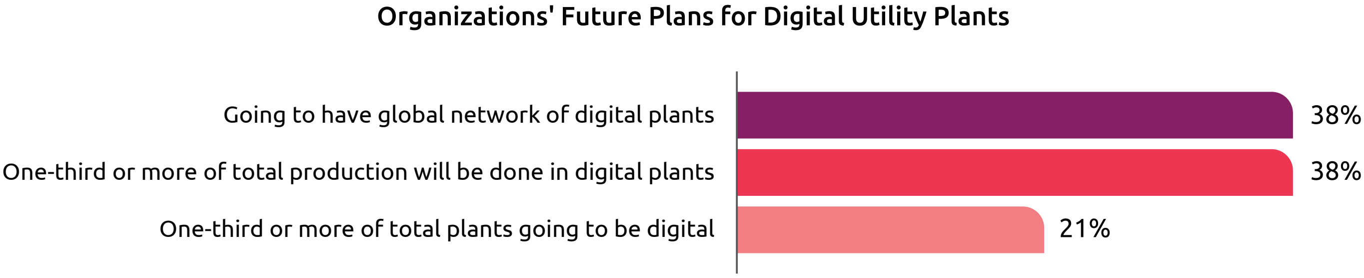


Source: Capgemini Digital Transformation Institute, digital utilities survey, February-March 2017; percentages indicate the share of organizations in each category

Utilities are planning to significantly power up digital plant investment in the next five years.

Our research shows that more than a third of utilities globally have a plan to drastically scale up their digital plant efforts (see Figure 8). Almost 40% respondents said that digital plants would handle one-third or more of their global production in the next five years.

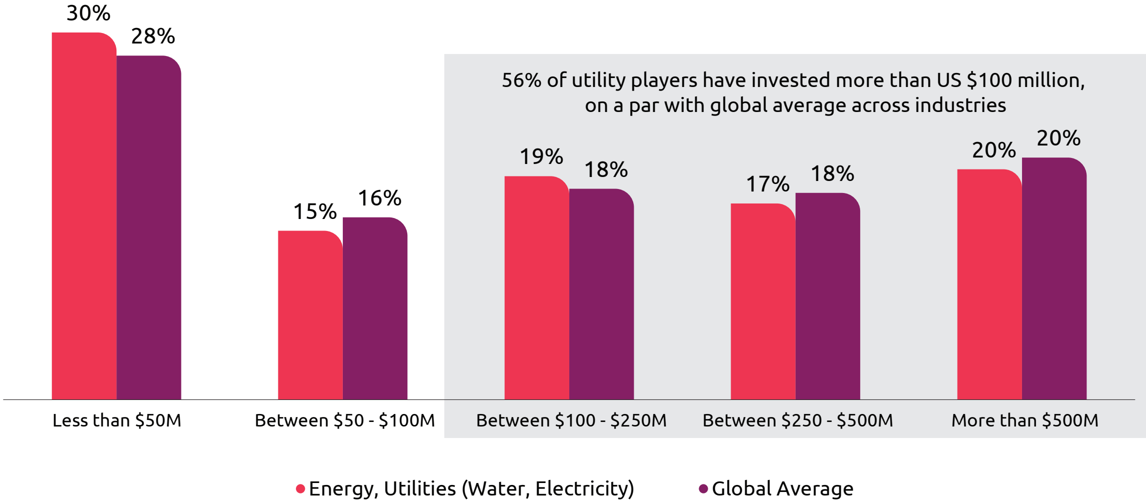
Figure 8. Organizations plan to rapidly scale up digital plants in the next five years



Source: Capgemini Digital Transformation Institute, digital utilities survey, February-March 2017; percentages indicate the share of organizations in each category

Our research shows that the utilities sector is already on a par with the global average in terms of investing in digital plants. We found that 20% of them have invested more than US$ 500 million over the last five years, while more than half of them (56%) have invested more than US$ 100 million in the same time period (see Figure 9).

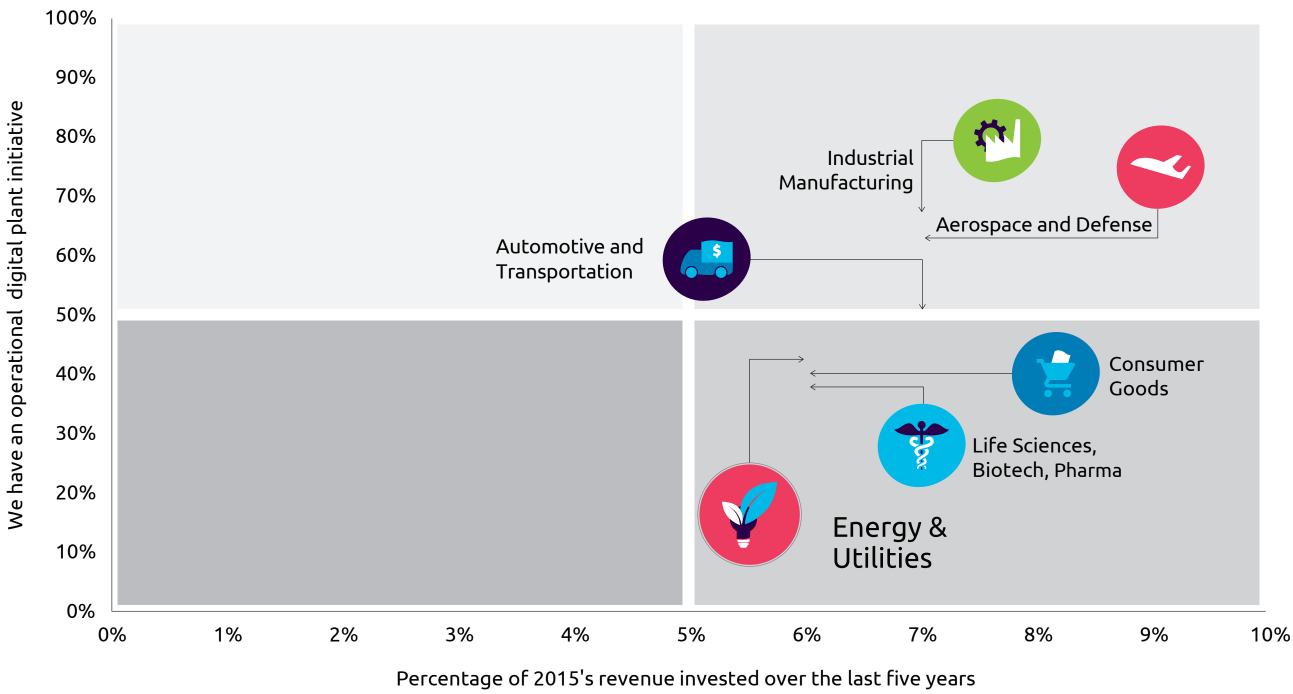
Figure 9. Utility sector is on a par with the global average in terms of investing in digital plants



Source: Capgemini Digital Transformation Institute, digital utilities survey, February-March 2017; percentages indicate the share of organizations in each categor

Our analysis also reveals that the utility sector's investment in digital plants is catching up with those sectors perceived as pioneers, such as aerospace and defense (see Figure 10). On average, utility firms have invested US $330 million over the five years.

Figure 10. Utility sector's investment is catching up with that of other pioneer sectors



Source: Capgemini Digital Transformation Institute, digital utilities survey, February-March 2017
Revenues considered for Utilities are global revenues with no distinction for generation, transmission or distribution businesses.

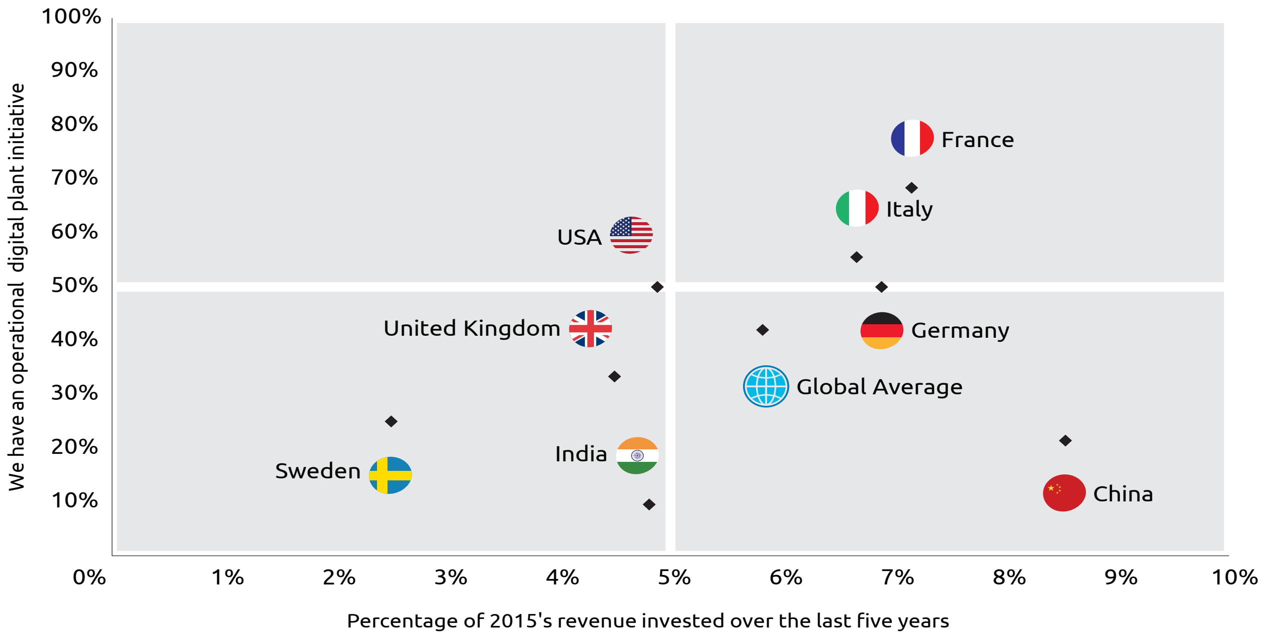
$330Mn the average investment on digital plants made by utility companies over the last five years

A deeper analysis shows that utilities in France, Italy, and Germany have been investing in digital plants aggressively over the last five years (see Figure 11), as has China. China has recently started making headway in digital manufacturing with the launch of its "Made in China 2025" initiative in 2015— an ambitious plan to upgrade China's manufacturing and reduce its reliance on foreign components[18]. In 2015, China also formally submitted its commitment to the UN climate talks to reduce its CO_2 emissions by increasing the share of non-fossil fuels in its energy mix[19].

Although these policy initiatives seem to have spurred the industry to invest in digital plants, recent reports from China indicate that progress so far is slower than expected. Earlier this year, the Vice Premier of the People's Republic of China said that: *"the country still had a long way to go to reach international advanced levels"* and *he "urged more efforts to make the country's manufacturing industry smarter and more competitive."*[20]

Also, we found that 75% of organizations in China have at least one greenfield digital plant project, which helps explain the high level of investment. However, as greenfield plants require time to move from concept to operational reality, it will be some time before we see an increase in the share of operational digital plants.

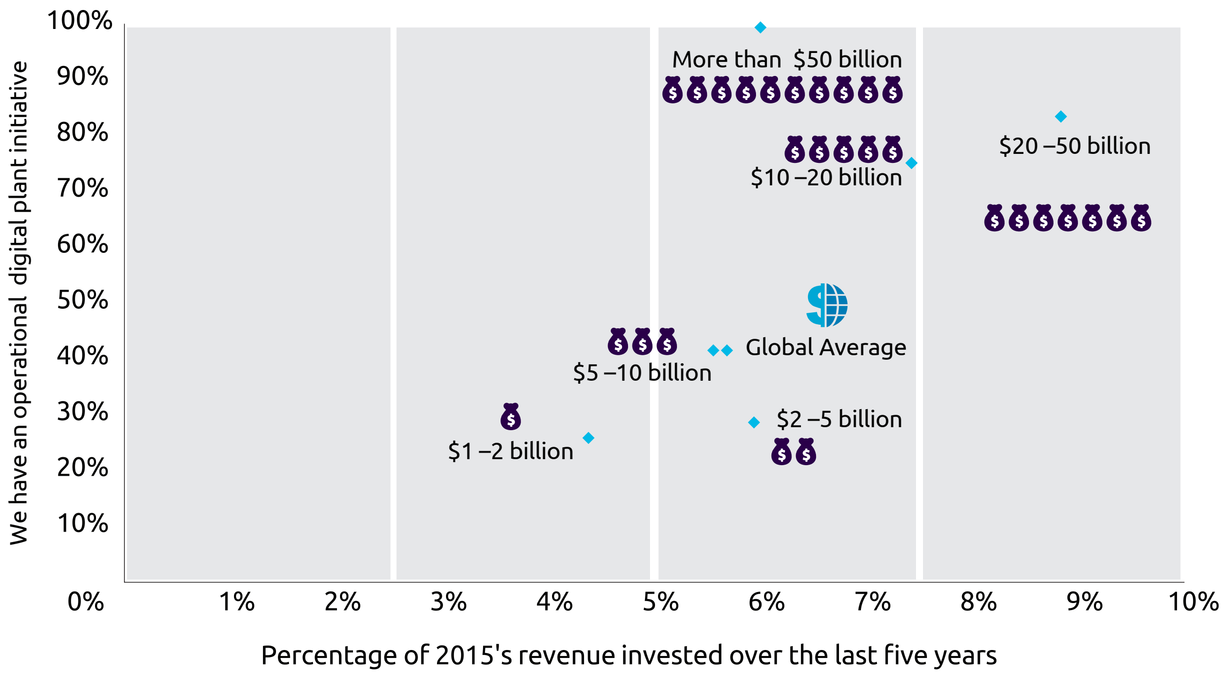
Figure 11: **France, Germany, Italy, and China are the most aggressive investors**



Source: Capgemini Digital Transformation Institute, digital utilities survey, February-March 2017

Larger utilities are more likely to have an operational plant than smaller utilities. However, smaller utilities are not far behind in terms of the investment they are making as a percentage of revenue. Much of the considerable investment from smaller utilities is an investment for the future. Many of these smaller companies (nearly 50%) have plans for digital plants rather than plants in operation.

Figure 12: Smaller players are not far behind in investing in digital plants



Source: Capgemini Digital Transformation Institute, digital utilities survey, February-March 2017

8%

the share of utility companies whose operations are digitally mature

Lack of digital maturity leaves benefits underpowered

Only a small fraction of utilities' operations are digitally mature.

The enthusiasm for digital plants from utility sector players is significant and encouraging. However, their ability to reap the benefits of their ambition raises a significant concern. Only a small minority (8%) of utilities' operations is digitally mature—what we call "digital masters"—which calls into question their ability to drive value from digital plant initiatives [21].

Drawing on a framework developed in the Leading Digital report, by MIT's George Westerman and Capgemini Consulting's Didier Bonnet, we assess utilities' operational digital maturity in two dimensions [22].

- **Digital capability:** measures the impact of internal operations initiatives
- **Leadership capability:** measures how those initiatives are executed and managed.

The analysis shows that only about 8% of utilities have attained digital mastery—a state of high maturity on both the dimensions of digital maturity. The largest grouping of utilities (73%) we would class as digital beginners (see Figure 13).

Figure 13. Very few utilities are digital masters of operations*

Source: Capgemini Digital Transformation Institute, digital utility survey, February-March 2017; Framework from Leading Digital, George Westerman, Didier Bonnet, Andrew McAfee, Harvard Business Review Press, 14 Oct. 2014.

* We analyzed digital maturity of only production related operations. Other operations such as transmission, distribution, retailing and customer interaction were not considered in this survey.

Dimensions of Digital Maturity of Utilities Operations

Digital capability — We measured how much of the production processes are digitized and what technologies are leveraged in the transformation. We scored each organization on the basis of digitizing ten key areas of production and leveraging eight relevant digital technologies.

Leadership capability — We assess key areas of governance, approach, skills, and clarity in vision.

Categories of Utilities based on Digital Maturity of Operations

Digital masters: Firms that have scored well in both the dimensions, which implies that not only have they made significant advances in digitizing their production and leveraging digital technologies, they also have the appropriate vision, skills, governance, and approach for digital transformation.

Fashionistas: This group is on a par with digital masters in terms of digital intensity, which means they leverage advanced technologies and digitize key production processes. However, they lack appropriate governance, approach, skills, and vision which hinders them from realizing the full potential of digital transformation.

Conservatives: Conservatives are as good as digital masters in terms of management intensity which means they have the right vision, skills, approach, and governance for their transformation, but they have undertaken small transformations, and lag behind significantly in terms of leveraging technologies and digitizing production.

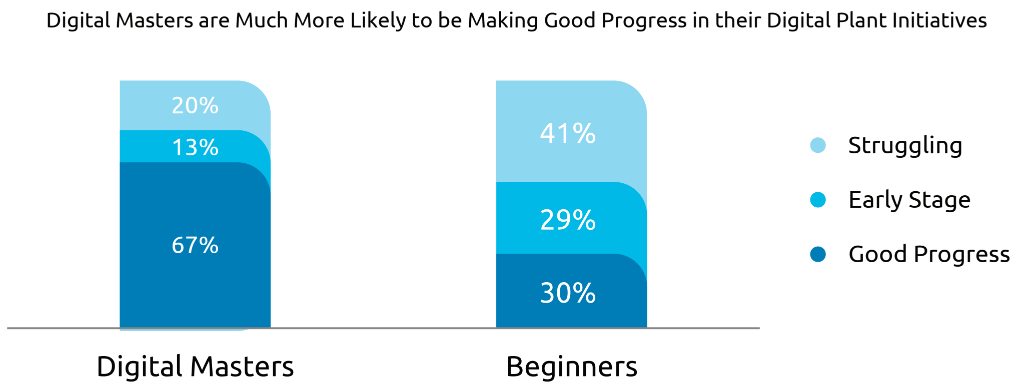
Beginners: This group needs significant improvement in both digital intensity and transformation management intensity as it lags behind digital masters on both fronts.

Why should utility players strive to become digital masters?

Why does this lack of digital maturity matter? The answer is very simple—becoming a digital master

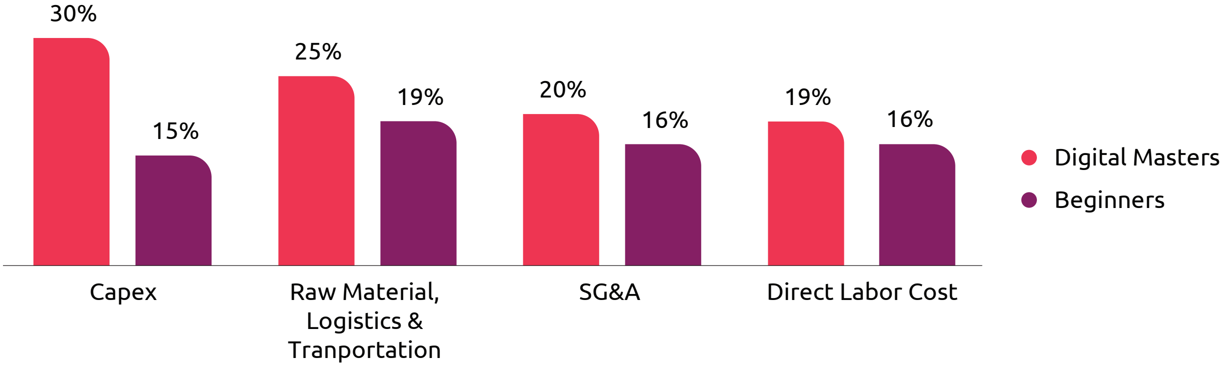
maximizes the chance of progress with digital plant initiatives and helps realize significantly higher gains in operational performance (see Figure 14).

Figure 14. Digital masters drive more value



Source: Capgemini Digital Transformation Institute, digital utility survey, February-March 2017; Percentages represent share of respondents

Digital Masters Consistently Achieve Better Outcomes in Crucial Cost Items



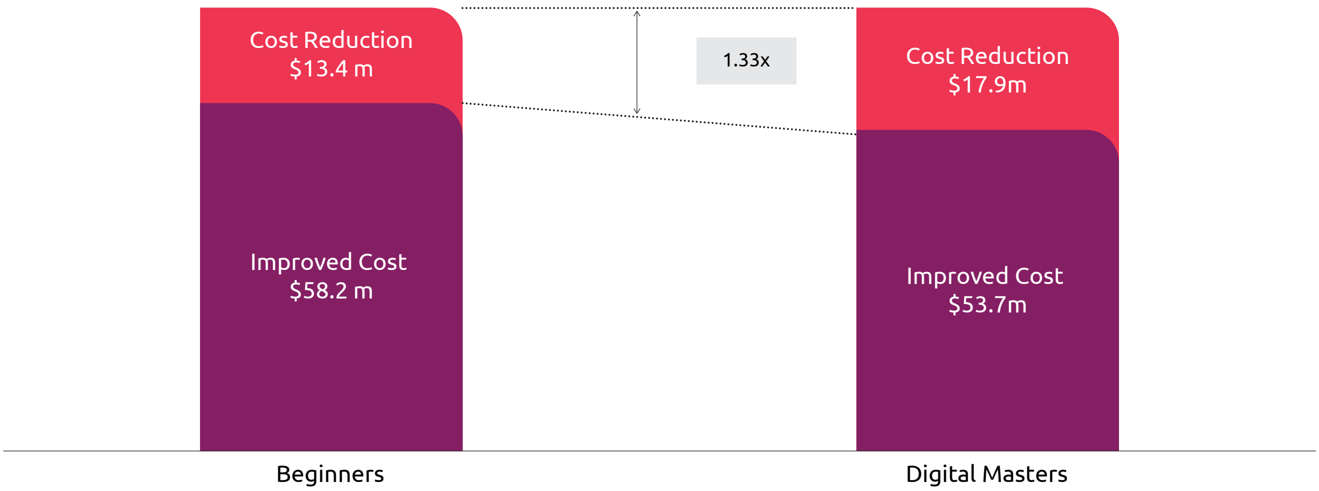
Source: Capgemini Digital Transformation Institute, digital utility survey, February-March 2017; Percentages represent realized improvement in corresponding KPIs

33%
the extra saving enjoyed by digital masters compared to beginners

These operational gains can translate into financial gains. To measure this, we considered two hypothetical, average combined-cycle (gas-fired) power plants, located in the US and with the same operational parameters and annual production cost of $76.1 million. If we apply the operational performance of the beginners group to one, and digital masters group to the other, we find that:

- The beginner plant would be able to save approximately $13.4 million
- The digital master plant would be able to save $17.9 million, which is approximately 33% better than the beginner (see Figure 15).

Figure 15. Superior cost item performance provides 33% higher savings for digital masters



Source: U.S. Energy Information Administration (EIA) Database, accessed in June 2017, Capgemini Digital Transformation Institute, digital utilities survey, February-March 2017; Capgemini Digital Transformation Institute analysis

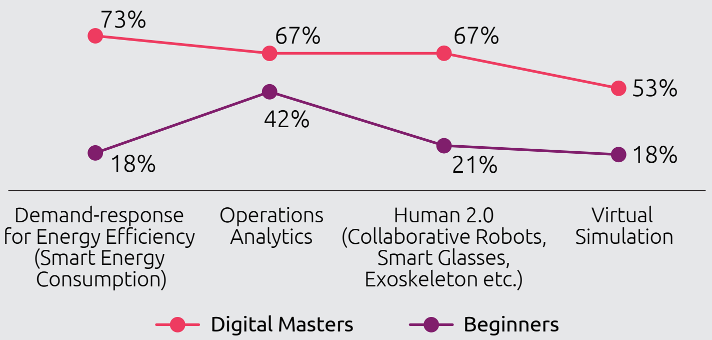
Savings are comparatively lower than depicted in Figure 4 because savings shown in this figure are calculated on the basis of current realized benefits rather than target benefits in the next five years.

DNA of digital masters in the utility sector

Digital masters lead beginners in digital capability parameters:

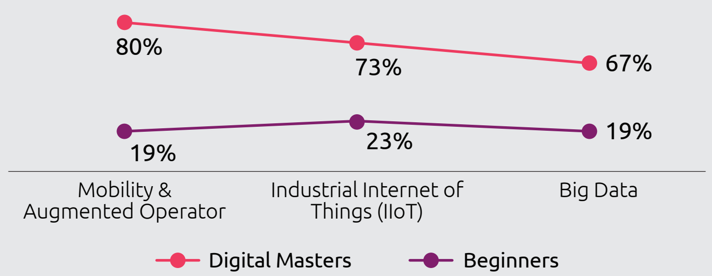
Identification of key features and high leverage of technologies are leading digital masters to higher levels of digitization of key production processes

Identification of Key Components of Plants



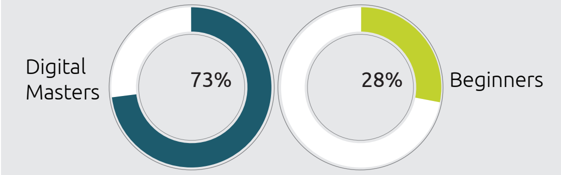
Percentages represent the share of organizations using or planning to use the mentioned applications

High Leverage of Advanced Technologies



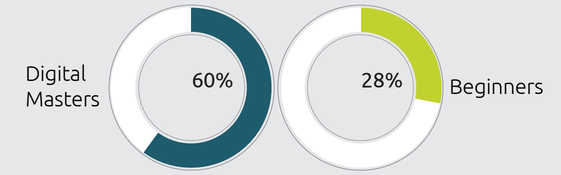
Percentages represent the share of organizations highly leveraging the mentioned technologies

Supply Chain and Logistics Digitization



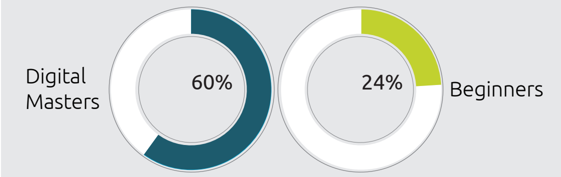
Percentages represent the share of organizations who have digitized more than 50% of supply-chain and logistics management processes

Maintenance Operation Digitization



Percentages represent the share of organizations who have digitized more than 50% of maintenance operations

Production Operation Digitization

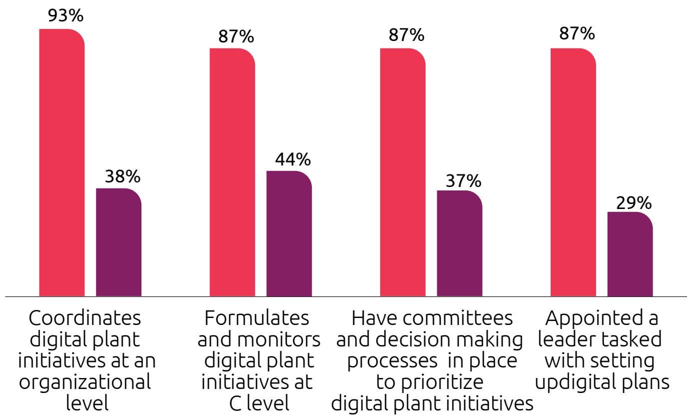


Percentages represent the share of organizations who have digitized more than 50% of power generation operations

Digital masters are ahead of beginners in leadership capability parameters:

Leadership-driven governance is creating better collaboration and effective monitoring.

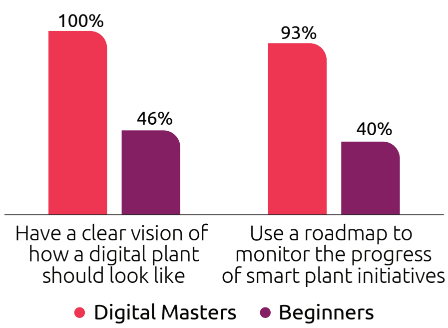
Leadership driven Governance



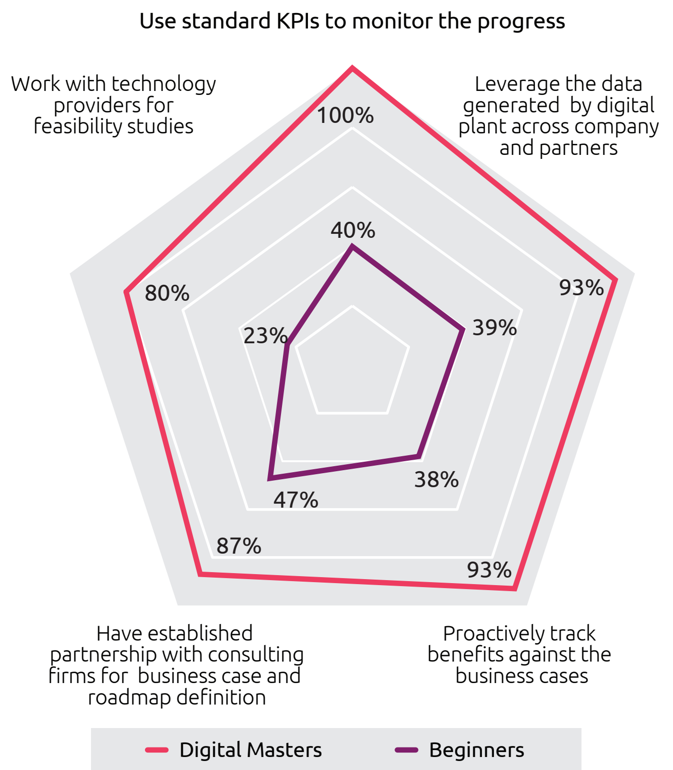
Percentages represent the share of organizations who strongly agree with the given statements

• Digital Masters • Beginners

Vision for Future



Effective Monitoring and Collaboration



Percentages represent the share of organizations who strongly agree with the given statements

How utilities can realize the full potential of digital plants

54%
the share of beginners who admitted that they do not have a clear vision for digital plants

Digital maturity is crucial to digital plant success. Drawing on our research and our experience working with utilities around the world, we believe there are a number of critical areas where utilities across all categories—beginners, conservatives, and fashionistas—can take steps to enhance their digital maturity and realize the full potential of digital plants.

Beginners:

Use business case analysis to see the benefits of digital plant initiatives and prioritize them by taking the organizations' strategic goals into account.

The majority of beginners fail to see the potential of digital plants. Our study reveals that 64% of beginners do not strongly believe that digital plants are going to disrupt the power generation process in the near future, while only 44% of them believe digital plants will significantly increase collaboration among different divisions. Moreover, the majority of beginners (54%) admit that they do not have a clear vision of what a digital plant could look like.

In order to see the benefits of digital plants, beginners need to perform a thorough business case analysis. David Vasko, director of advanced technology at Rockwell Automation says: *"Determine the things that are most important for you, and analyze whether they could be improved by digitally connecting together, and that's how you need to assess the potential of digital transformation,"* summarizing the principles of business case analysis for digital transformation. Our study shows that approximately 90% of digital masters perform business case analysis by establishing partnerships with consulting firms and technology service providers, while 55% of beginners ignore this approach.

More importantly, beginners need to prioritize a number of digital plant initiatives that will be most effective in helping achieve their organization's strategic goals. For example, Engie, a French utility giant, has a strategic goal of boosting decentralized power generation from renewables. Hence, they are developing a digital platform to optimize power generation from 68 wind farms and 14 solar farms spread across six European countries, including France, Germany, and Italy[23]. This platform will forecast maintenance requirements, identify areas of under-performance, and provide field technicians with instructions in real time.

Identify the most appropriate digital plant technologies and features by performing proof-of-concepts for the prioritized digital plant initiatives.

Identifying appropriate technologies and features is one of the most crucial milestones for digital plant initiatives. For instance, Iberdrola, a Spanish multinational utility company, plans to leverage digital technologies to boost operational efficiency. In order to achieve this target, it has meticulously chosen an array of technologies and mapped them to prioritized digital initiatives [24].

Surprisingly, we have found that only 20% of beginners use big data or IIoT, the two most important technologies for digital plants. The same is true for the identification of key features. For instance, only about 30% of beginners use decentralized production control and smart forecasting, the two most crucial features for digitally enabled distributed generation from renewable sources.

Performing proof of concept is one of the most effective tools in identifying appropriate technologies and features. Our study found that almost 75% of digital masters perform proof of concept for key technologies, and approximately 70% of them are leveraging Big Data and IIoT.

Set up an effective governance process and establish KPIs to track the benefits against business cases.

Once the appropriate technologies and features have been identified and mapped to prioritized business cases, beginners need to adopt an effective governance model to ensure the success of digital initiatives. Salient features of an effective governance model include:

- **Identifying a leader and forming a decision-making committee:** More than 85% of digital masters appoint their leaders and form committees as soon as the strategic goal is defined. E.On, for example, appointed Matthew Timms, the former chief of SAP Digital, to lead E.On's digital business unit, which was formed to digitize processes and create digital products [25]. However, only 30% of beginners follow this practice.
- **Establishing a roadmap to monitor the progress of digital plant initiatives:** This is another practice that 93% of digital masters religiously follow compared to 40% of beginners. A real-life example of such a road map is Iberdrola's "Digital 2020 Plan," which strives for 36% top-line growth by 2020 compared to 2017 by leveraging operational efficiencies and digital products[26].
- **Using a standard set of KPI to constantly track benefits against business cases:** After identifying the leader and establishing a roadmap, it is crucial to identify the KPIs to measure a digital plant initiative's success and continuously monitor it. Duke Energy, for example, continuously monitors standard KPIs, such as power demand fulfillment, availability, and operating cost, to measure the success of its project of optimizing wind and solar farm utilization[27]. However, our study shows that only 39% of beginners use a standard set of KPIs to track benefits against business cases, while all digital masters do so.

Conservatives:

Go for a holistic transformation rather than point technology solutions.

Conservatives have a tendency to pursue small-scale projects; this is evident from the findings of our survey according to which almost 60% of them implement point technology solutions, and only 35% pursue holistic transformation projects such as operating model transformation. In order to unleash the full potential of digital power plants, conservatives can follow the footprints of Enel, an Italian utility giant that plans to reduce maintenance capital expenditure by €200 million and overall operating expenses by €900 million by digitizing its asset base, operations, processes, and connectivity[28].

Outline a strategic investment plan to scale up the digital plant initiatives.

A holistic transformation of the power generation process is possible when digital plant initiatives are scaled up with adequate investment. In order to support its holistic digital transformation, Enel will invest €4.7 billion over a period of three years[29].

Compared to the massive scale of investment conducted by Enel, only 16% of conservatives have invested over $500 million over last five years compared to 40% of digital masters and 20% of companies across all categories (global average). We also found that only 20% of conservatives believe digitals plants will account for one-third or more of their total number of plants.

Fashionistas:

Synchronize the digital effort by engaging the leadership and driving the initiative from the top.

To realize the full potential of digital power plants, Fashionistas need to synchronize their ambitious but disjointed efforts and align their digital plant objectives with their strategic goals. Driving the digital initiatives from the top-most level is an effective way of doing so as Philipp Irschik, head of strategy, Energie Steiermark, Austria describes: *"One of our CEOs leads the digital transformation from the front, and under him, there's a committee of people from different business functions, such as strategy, innovation, and sales, who prioritize and coordinate digital initiatives across the group."* The importance of driving the initiative from the top-most level is also evident from our survey results according to which 90% of digital masters formulate their digital plant initiatives at the C-level, while approximately the same number of digital masters (93%) claimed their digital plant initiatives are coordinated at the organizational level.

Develop and nurture skills among employees who can make the most out of opportunities presented by digital plants.

The full potential of ambitious digital transformation efforts can be realized only when employees are skilled enough to make best use of advanced technologies and features. In addition to hiring digital skills and up-skilling existing employees, Fashionistas also need to consider strategies adopted by leading utility companies.

Nurturing startups: EDF has a venture capital fund, Electranova Capital, to finance start-ups that focus on clean-technologies, which often leverage digital technologies to enhance power generation or optimize consumption[30].

Establishing a Center of Excellence: Engie has established a center of excellence, called a digital factory, to bring together internal and external experts for developing applications on a large-scale to foster the digital transformation of Engie's 24 business units[31].

Setting up employee-driven programs: Enel has a program called 6Digital that identifies employees with strong digital skills and uses them as evangelists to preach digital culture and enhance digital skills[32].

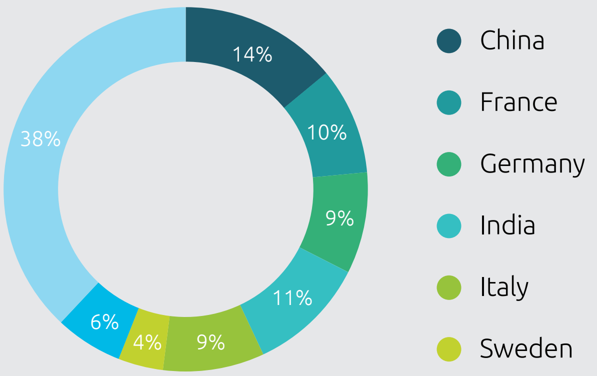
Conclusion

The utility industry has a strong history of innovation. Drawing on this innovation heritage will be key to harnessing the power of digital plants, with new technologies offering exciting new ways to drive performance improvement. However, while many utility companies have set a strong ambition for the digitization of production, many are likely to emerge disappointed. Building digital maturity will be critical to unlocking the full potential of intelligent plants and building a new future for the industry.

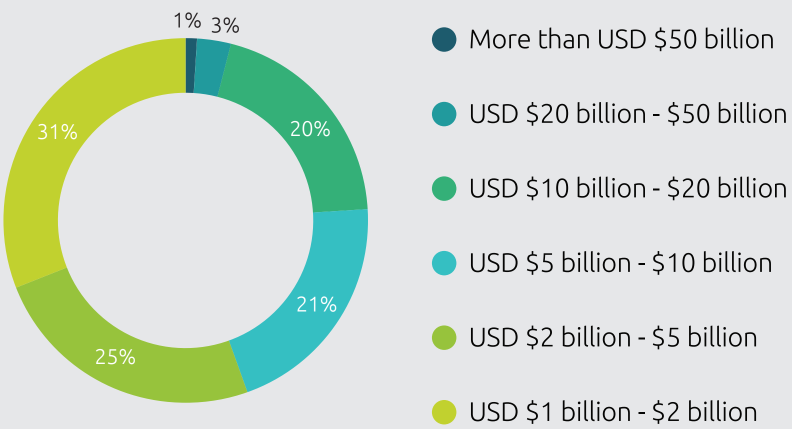
Research methodology

We surveyed 200 executives at the director or more senior level, in utility companies with reported revenue of more than $1 billion each for FY 2015. The survey took place from February to March, 2017 and covered eight countries: the United States, United Kingdom, France, Germany, Italy, Sweden, China, and India. Please see below for additional details.

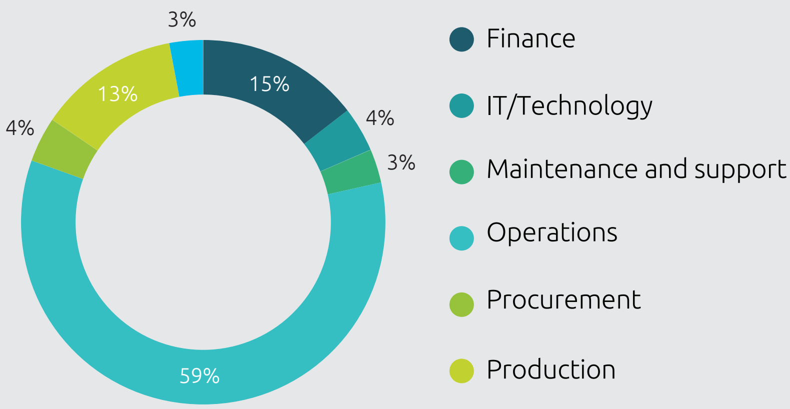
Respondents by country



Respondents by company revenue



Respondents by role



In addition to the main survey, we also conducted web-based research to collect key data points.

References

1 GE Newsroom, “E.ON Achieves More Output from 469 Wind Turbines through GE’s Wind PowerUp* Services,” October 2014.

2 Capacity factor of a power plant is the ratio of its actual output over a period of time to its potential output had it operated in its full capacity. It indicated the level of utilization of a plant’s capacity.

3 Seimens press release, “Siemens sets new world records at Düsseldorf power plant ‘Fortuna,’” January 2016.

4 Industrial-iot.com, “Duke Energy Avoids Unplanned Downtime and Improves Reliability with IIoT and Predictive Maintenance,” December 2016.

5 blogs.siemens.com, “Powerful Insight for Smarter Wind Turbine Work Flow,” April 2017.

6 irena.org, “The Power to Change: Solar and Wind Cost Reduction Potential to 2025,” June 2016.

7 European Commission Joint Research Centre, Institute for Environment and Sustainability, “Trends In Global CO_2 Emission,” November 2016.

8 European Commission official website—ec.europa.eu, “2030 climate & energy framework,” accessed in August 2017.

9 GE, “NTPC GE Joint Venture and GE Wins contract of $64.51M for R&M of Steam Turbine 3X200 MW for NTPC Ltd at Ramagundam Super Thermal Power Station,” February 2017.

10 Center for Climate and Energy Solutions, “CARBON CAPTURE USE AND STORAGE,” Accessed July 2017.

11 Global CCS Institute, “THE GLOBAL STATUS OF CCS: 2016 Summary Report,” November 2016.

12 Energy Policies of IEA countries, France, 2016 review, page 9.

13 Energy Policies of IEA countries, France, 2016 review, page 10.

14 Energy Policies of IEA countries, Germany, 2013 review, page 9.

15 American Council for Energy Efficient Economy, “The Clean Power Plan”, accessed August 2017.

16 International Energy Outlook 2016 by EIA, pages 92 and 93.

17 International Energy Outlook 2016 by EIA, pages 92 and 96.

18 Cheung Kong Graduate School of Business, “Made in China 2025: A New Era for Chinese Manufacturing,” September 2015.

19 World Resources Institute, “STATEMENT: WRI Calls China INDC ‘A Serious and Credible Contribution,’” June 2015.

20 Xinhua News, “China urges efforts to boost smart manufacturing,” February 2017.

21 We only assessed the digital maturity of utilities’ operations and did not look into other dimensions, such as customer experience.

22 George Westerman, Didier Bonnet, Andrew McAfee, Harvard Business Review Press, “Leading Digital,” October 2014.

23 engie.com, “The digital transformation by ENGIE,” accessed in August 2017.

24 iberdrola.com, “digital-transformation,” accessed in August 2017.

25 eon.com, press release, “eon-strengthens-its-digital-expertise.html,” published in November 2016.

26 iberdrola.com, “At the forefront of digital transformation,” accessed in August 2017.

27 genpact.com, case study, “Predictive analytics enables duke energy to cut costs and better operate and maintain assets,” accessed in August 2017.

28 enel.com, press release, “Enel group presents 2017–2019 enhanced strategic plan, focused on digitisation and customers”, published in November 2016.

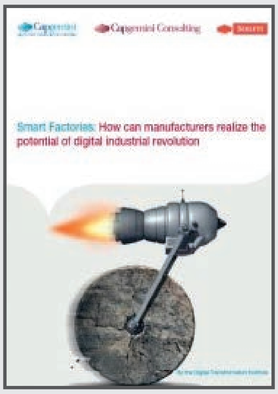
29 enel.com, press release, “Enel group presents 2017–2019 enhanced strategic plan, focused on digitisation and customers,” published in November 2016.

30 digitalforallnow.com, “Start-Up: EDF electrifies energy-innovation,” published June 2015.

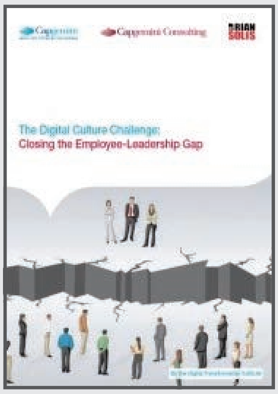
31 Engie press release, “ENGIE creates its Digital Factory and announces two global partnerships with C3 IoT and Kony”, June 2016.

32 cionet.com, “Orchestrating Digital Leadership,” page 21, accessed August 2017

Discover more about our recent research on digital transformation



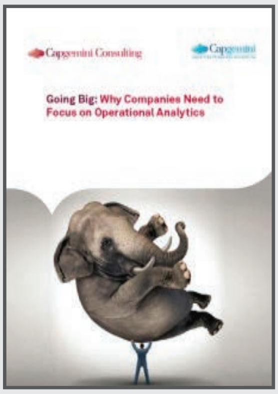
Smart Factories: *How can manufacturers realize the potential of digital industrial revolution*



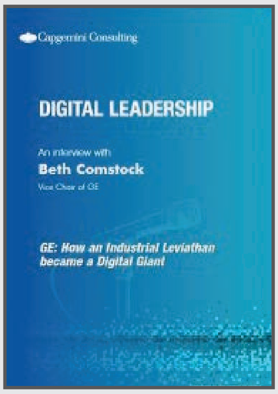
The Digital Culture Challenge: *Closing the Employee-Leadership Gap*

Digital Transformation Review 10: The Digital Culture Journey: *All On Board!*

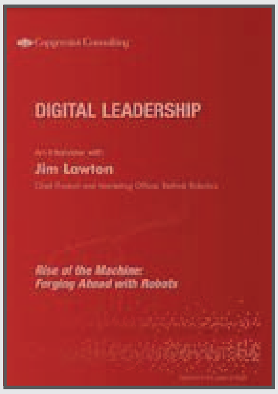
Industry 4.0: *Sharpening the Picture beyond the Hype*



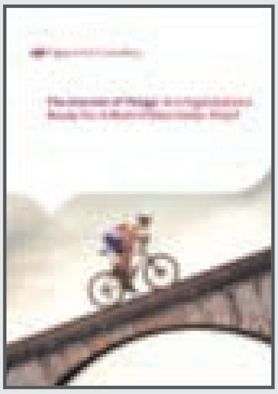
Going Big: *Why Companies Need to Focus on Operational Analytics*



An interview with Beth Comstock, Vice Chair of GE



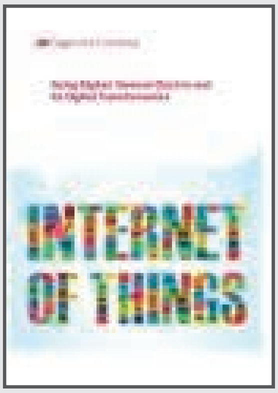
An interview with Jim Lawton, Chief Product and Marketing Officer, Rethink Robotics



The Internet of Things: *Are Organizations Ready for A Multi-Trillion Dollar Prize?*

Securing the Internet of Things Opportunity: *Putting Cybersecurity at the Heart of the IoT*

Big Data Blackout: *Are Utilities Powering Up Their Data Analytics?*



Going Digital: *General Electric and its Digital Transformation*

Operational Excellence through Digital in Manufacturing Industries

About the Authors

Philippe Vié
Vice President, Capgemini Consulting
philippe.vie@capgemini.com

Philippe is vice president at Capgemini Consulting. As Digital Utilities Transformation co-founder, he shapes relevant transformation programmes following maturity assessment and/or in-depth transformation analysis and design phases.

Jerome Buvat
Global Head of Research and Head,
Capgemini Digital Transformation Institute
Jerome.buvat@capgemini.com

Jerome is head of Capgemini's Digital Transformation Institute. He works closely with industry leaders and academics to help organizations understand the nature and impact of digital disruptions.

Aritra Ghosh
Senior Consultant,
Capgemini Digital Transformation Institute
Aritra.ghosh@capgemini.com

Aritra is a senior consultant at Capgemini's Digital Transformation Institute. He likes to follow how emerging digital technologies are commercialized and what disruptions across industries they bring in.

Alexandra Bonanni
Consultant, Capgemini Consulting
alexandra.bonanni@capgemini.com

Alexandra is the head of Capgemini Global Energy Transition Strategy Lab. She is an "Enernet" geek and likes to follow how the energy & utilities companies are undergoing a revolution and how digital technologies act as a lever of both growth and performance in the industry.

Amol Khadikar
Manager,
Capgemini Digital Transformation Institute
amol.khadikar@capgemini.com

Amol is a manager at the Digital Transformation Institute. He keenly follows the role played by mobile, software and data science in digitally transforming organizations.

The authors would like to especially thank Sumit Cherian, Subrahmanyam KVJ and Apoorva Chandna from Capgemini Digital Transformation Institute for their contribution to this report.

Digital Transformation Institute

The Digital Transformation Institute is Capgemini's in-house think-tank on all things digital. The Institute publishes research on the impact of digital technologies on large traditional businesses. The team draws on the worldwide network of Capgemini experts and works closely with academic and technology partners. The Institute has dedicated research centers in the United Kingdom and India..

dti.in@capgemini.com

For more information, please contact:

Global

Perry Stoneman
perry.stoneman@capgemini.com

Thierry Batut
thierry.batut@capgemini.com

Camilla Carlsson
camilla.carlsson@capgemini.com

USA – Canada

Bart Thielbar
bart.thielbar@capgemini.com

Spencer Brown
spencer.brown@capgemini.com

Brad Little
brad.little@capgemini.com

France

Roshan Gya
roshan.gya@capgemini.com

Aldemajid Boutayeb
aldemajid.boutayeb@capgemini.com

Germany

Andreas Weiler
andreas.weiler@capgemini.com

Christoph Von Tucher
christoph.v.tucher@capgemini.com

Spain

Carlos Garcia-Ruiz
carlos.garcia-ruiz@capgemini.com

Antonio Alonso Rubio
antonio.alonso.r@capgemini.com

Norway

Astrid Laukeland
astrid.laukeland@capgemini.com

Niclas Jacobsson
niclas.jacobsson@capgemini.com

UK

James Forrest
james.forrest@capgemini.com

Peter King
peter.king@capgemini.com

Portugal

Joao-Paulo Matos
joao-Paulo.matos@capgemini.com

Belgium

Pierre Lorquet
pierre.lorquet@capgemini.com

Netherlands

Marcel Van Breeden
marcel.van.breeden@capgemini.com

Italy

Antonio Barile
antonio.barile@capgemini.com

Nordics

Anders Barsh
anders.barsh@capgemini.com

Mexico

Leonardo cueno
leonardo.cueno@capgemini.com

Brazil

Rodrigo Modesto
rodrigo.modesto@capgemini.com

China

Yanpeng Zhen
yanpeng.zhen@capgemini.com

India

Somnath Chatterjee
somnath.chatterjee@capgemini.com

Australia

Jan Lindhaus
jan.lindhaus@capgemini.com

South East Asia

Gaurav Modi
Gaurav.modi@capgemini.com

About
Capgemini

A global leader in consulting, technology services and digital transformation, Capgemini is at the forefront of innovation to address the entire breadth of clients' opportunities in the evolving world of cloud, digital and platforms. Building on its strong 50-year heritage and deep industry-specific expertise, Capgemini enables organizations to realize their business ambitions through an array of services from strategy to operations. Capgemini is driven by the conviction that the business value of technology comes from and through people. It is a multicultural company of 200,000 team members in over 40 countries. The Group reported 2017 global revenues of EUR 12.8 billion.

Learn more about us at

www.capgemini.com

About
Capgemini Consulting

Capgemini Consulting is the global strategy and transformation consulting organization of the Capgemini Group, specializing in advising and supporting enterprises in significant transformation, from innovative strategy to execution and with an unstinting focus on results. With the new digital economy creating significant disruptions and opportunities, the global team of over 3,000 talented individuals work with leading companies and governments to master Digital Transformation, drawing on their understanding of the digital economy and leadership in business transformation and organizational change.

Find out more at:

www.capgemini-consulting.com

People matter, results count.