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AFRY Insights

Energy transition

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Interviews

Francesco Venturini (Enel X)
Roland Lorenz (AFRY Management Consulting)

Topics

E-mobility and impact on cities
100% renewable energy system
Transformation of electricity grids

Imprint

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Editorial

Dear reader,

Digitalisation affects all areas of life and business, from mobility to urban development, from manufacturing to construction and from energy production to energy management. Amid the unprecedented challenges these sectors are facing, smart and intelligent solutions have never paid off as much as they do today.
This is why in this issue of AFRY Insights our colleagues share their most recent insights on the latest questions regarding digitalisation. How can an energy system based on 100% renewable energy work? What does electromobility mean for us and our cities? To what extent does digitalisation help us to manage, build and work more sustainably and efficiently?

Expect to read both inspiring and meaningful interviews with Francesco Venturini, CEO of Enel X and Roland Lorenz, Head of AFRY Management Consulting. We asked Roland about his view on how the pandemic has changed the world of work and how clients benefit from AFRY's bold strategy focusing on sustainability and digitalisation. Only a few have managed to be as successful as Francesco in the development of new business models and products for their industry. In a conversation with AFRY Insights, he shares his ideas about Enel X's collaboration with Volkswagen and the contexts in which players like Google and Apple can be competitors, customers or, in other cases, interesting studies.

We hope you find enjoyment and value in our selection of topics! We welcome feedback and comments so we can improve the next issue.

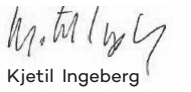
As always, we remain curious and make it our mission to bring you new ideas, perspectives and insights in order to support you for what is coming next. As we say at AFRY:
We don't care about making history.
We care about making future.

Enjoy reading!

AFRY Management Consulting


Antonio Nodari


Matt Brown


Kjetil Ingeberg

Contents

Electro pop

Electric mobility will be the next stage of automobility. This message is now generally accepted as truth. But how does e-mobility become more popular and mainstream and what role do digital technologies and standards have to play? Our experts Steffen Schaefer and Benedikt Unger dare to look into the near future.

Electric vehicles (EV) appear to have finally made the move from niche toy to mainstream products. In 2020 alone, electromobility has experienced a veritable boom. Automakers around the world are outdoing each other with announcements about when their vehicles will be exclusively electric. Subsidies and grants are available, the choice of models is expanding, charging infrastructure is rising, and the awareness within the population about climate change and air quality issues is growing.

How do digital technologies impact user experience in the context of electromobility, and how is digitalisation changing business models and value chains? What might electric mobility look like at the end of this decade?

Looking forward, we expect further acceleration. Before the decade is over, Europe will surpass 30 million electric vehicles on the road – up from around 3 million at the end of 2020. That is, if the required infrastructure, both from a physical and digital perspective, can keep up with this growth.

Most EV owners will charge their vehicles at home (68% of all charging activities, according to the German National Centre for Charging Infrastructure). But as EVs become more widespread, not everyone will have access to a parking space with a personal charger. Workplace charging, super-fast charging at charging hubs, destination and curb charging will all see very significant growth.

Digital technologies such as smartphones and mobile internet, industrial IoT, cloud computing, or machine learning have been around and they have contributed strongly to a boom of the electric-mobility market, being at the intersection of the energy and mobility sectors.

However, EV drivers voice their frustration about the lack of reliability and usability of the charging infrastructure. Generally speaking, user experience in electric mobility is far from perfect. Two issues that are frequently mentioned are interoperability – the need for several cards and apps for different charging networks – and reliability – turning up at a charger only to find it to be out of order.

Electricity providers and network operators should be concerned about potential network-load issues. From a total volume perspective, resulting changes to the electricity market will be limited. But providing the energy at the right time and place will be a challenge, especially if adoption of super-fast charging happens too quickly. A joint objective for electricity providers, network operators, and eventually the users who pay for it must be levelling spikes in energy demand and supply – which is increasingly intermittent – in order to avoid costly infrastructure upgrades.

Digital technologies can without doubt address such issues. But their use must just be coordinated and governed more strictly than is the case today. Open standards and protocols must be leveraged,in order to unlock the full potential.

The most relevant standards and protocols that can address the above mentioned usability and network load management issues include the following:

- **ISO 11158 is a communication standard between an EV and the charging point. Users are authenticated just by connecting the plug to their vehicle – a feature often described as 'Plug & Charge'.**

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- **The Open Charge Point Interface (OCPI) submits location, accessibility and pricing data. It also forwards transaction details from the Charge Point Operator to the Mobility Service Provider of the user. This feature is called 'roaming' and unlocks any charging point for any users that have had themselves registered. With those two standards, users can do away with the set of smartphone apps and RFID cards they are dealing with today.**
- **The Open Charge Point Protocol (OCPP) communicates between EV charging stations and central management systems. It allows the remote starting and stopping of charging processes, an essential piece of functionality for balancing network loads.**
- **And lastly, the Open Smart Charging Protocol (OSCP) enables communication between energy management systems and charging infrastructure about physical network capacity, including 24-hour predictions. This is key for a flourishing smart grid ecosystem.**

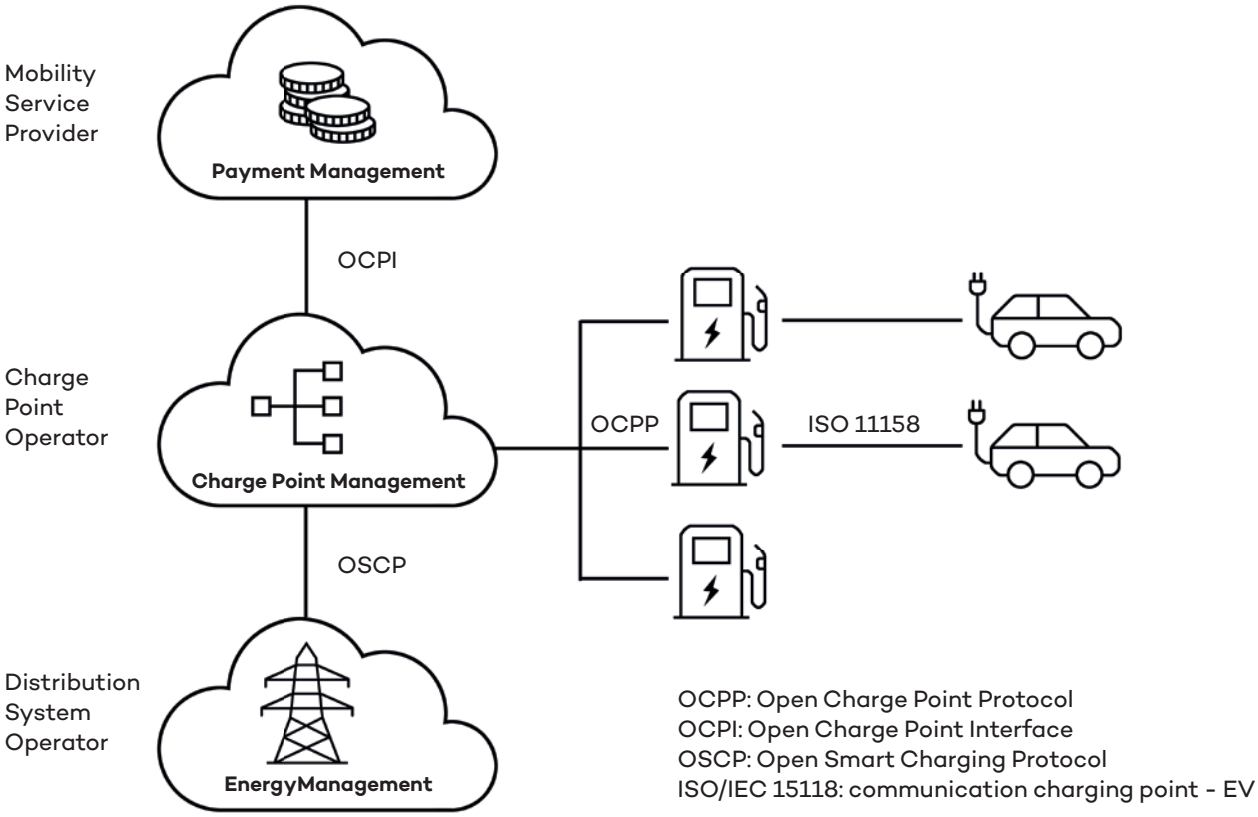

Figure 1: OCPP, OSCP, and ISO 11158 for Smart Charging

On the back of these open protocols and industry standards it is possible to control charging processes so that they become 'intelligent'. This may mean starting to charge when prices are low and stopping the charging process at times of high load for the network.

These standards do not only significantly improve user experience and support grid balancing. They even enable new roles and business models:

Flexibility Providers control a set of resources that generate or consume energy flexibly, such as electric vehicles, solar PV with stationary batteries, or heat pumps. It is the Flexibility Provider's decision at what time which amount of energy shall be generated or consumed.

An EV owner (or a charging operator, perhaps operating a collection of home chargers) can be such a Flexibility Provider. If users can provide a certain flexibility – for instance because they are using their vehicle only for short distances every day but connects it to the electricity grid as much as possible – the battery becomes part of the network and can be leveraged by the operator for balancing the network. This can result in a financial incentive for end users, when they are charged at low cost in off-peak times, and at a later point get compensated when they provide power to the grid at times of high demand.

Capacity Providers are network operators who manage a part of the smart grid and impose boundaries to the Flexibility Providers by setting incentives. They coordinate production and consumption, so both provide more value within the physical boundaries of the power grid.

To allow for a smart optimisation, there is a need for transparent and efficient markets. Pricing signals should be time- and location-dependent and take the charging speed into account. It must be possible to control individual vehicles to optimise the grid but still respect each user's preferences. If these roles are developed effectively, we can all charge our electric cars without needing to pay extra for the set-up of a high-performance grid.

The adoption of industry standards and open protocols to provide such essential system functionality must be driven by market players and regulators. The key for unlocking the full potential of electric mobility lies in the industry-wide use of such standards for building user-friendly solutions. Experts are needed to figure out a way to optimise the integration of EV charging into the power grid while maintaining the best possible user experience.

The physical and the digital city

What does digital transformation mean for a city? Under the Paris Agreement, CO_2 emissions must be reduced by 50% globally by 2030 and reach net 0 by 2050. Some countries have even more ambitious plans for reductions by 2030.

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The climate crisis will be solved in our cities: Urban areas occupy 5% of the planet's surface, but account for 70% of all CO_2 emissions. By 2050, 68% of the world's population will live in cities, up from 55% in 2018. As city populations grow, demand for resources like space, energy, and water will significantly increase, as will the need for mobility. This puts a strain on many services that are essential to a city's prosperity, sustainability, and safety.

Globally, the total surface covered by buildings will double by 2060; they will be responsible for about 40% of all energy consumption. Digital technologies are fundamental to address challenges in cities. They can help for example with generating and optimising the heating and cooling of buildings with districts, thus reduce CO_2 footprint.

When zooming into CO_2 emissions in Europe, it becomes clear that the transport sector is one of the largest emitter and the only sector in which GHG emissions are still rising. Today, more than 95% of all vehicles use fossil fuel. This is why it is crucial that our transport systems become electrified, using renewable energies that will be coordinated through digital technologies in a smart grid.

Within this environment, digital technologies will be essential for citizens individually, the economy, and the society as a whole. The reason for this is that changes in the physical world take a long time: buildings can last for many decades. Two thirds of the building stock that exists today will still exist in 2050. And passenger cars have an average lifetime of 15 years. Digital technologies, in contrast, come at much lower cost and evolve much faster. The average lifetime of a smartphone, for example, is just above 2 years. Software or machine learning algorithms can change daily. Therefore, combining urban infrastructure, buildings or vehicles, with digital technologies can make a city digitally connected and intelligent. Like any industry sector, cities are currently going through a digital transformation to adapt and prepare for their future.

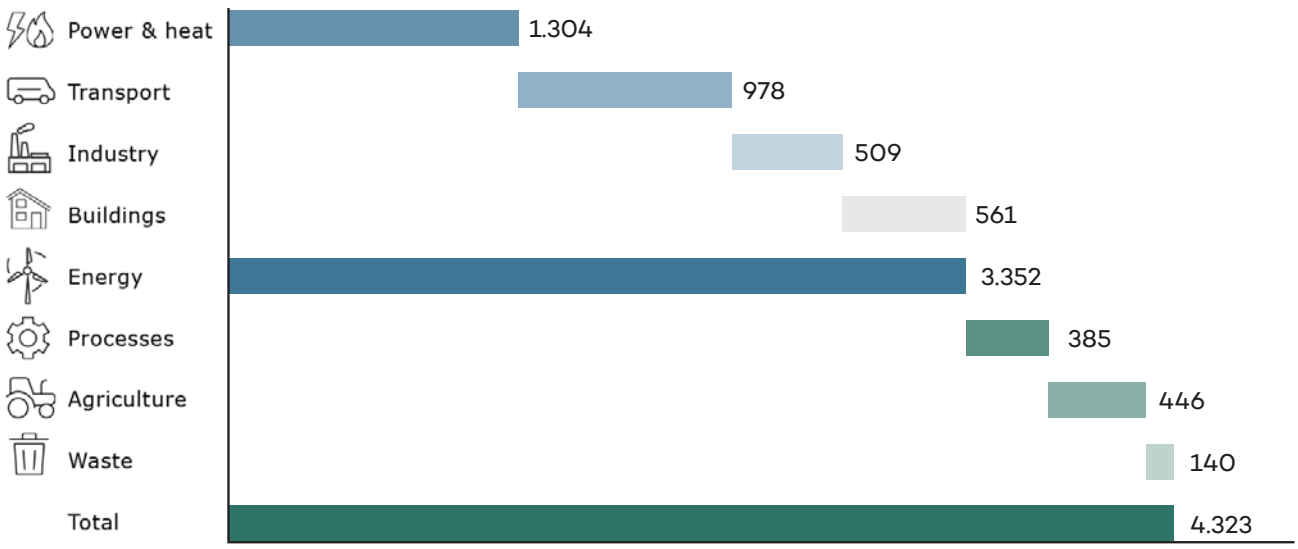
Digital technologies for the city of the future

Several digital technologies have turned out to be relevant in the context of cities (and this is not an exhaustive list):

Smartphones have become the standard interface for interactions between users and their environment. Apps allow the location of nearby bus stops or sharing vehicles and paying for them. They are used for booking a desk in the office or controlling individual light and indoor climate. They can also collect and provide a vast array of anonymised data, say for building or city operations, and thus create a feedback loop.

Wireless networks have become key for connecting people and objects ubiquitously. 5G will make a difference for many applications, however other network technologies like 4G, LTE, and WiFi will also remain important for many tasks. And there is a 'new' breed of low-power wide-area network protocols that are ideal for many sensor-based or smart metering applications.

2015, million tons of CO_2eq ($MtCO_2$eq)



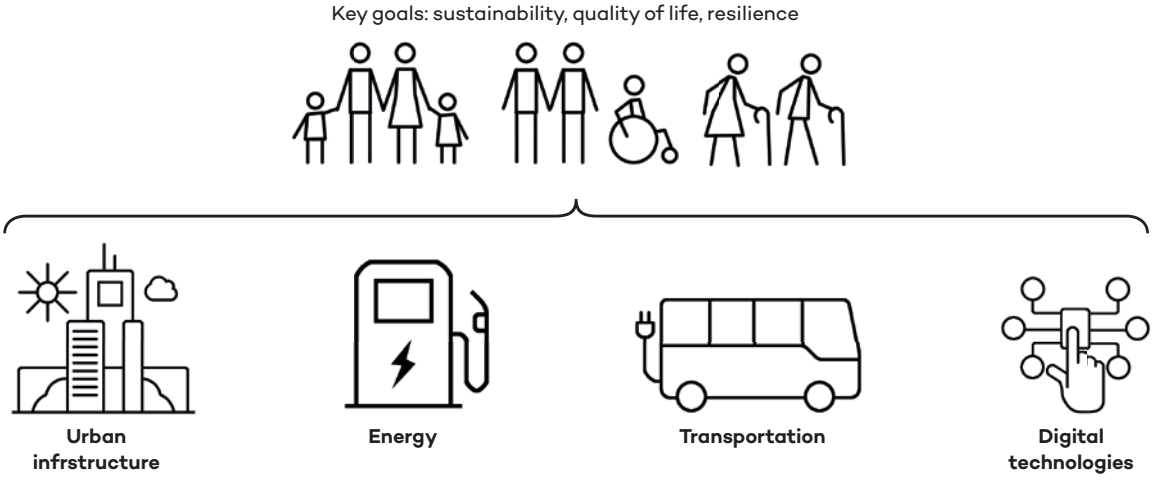
Cloud computing allows for fast and inexpensive scalability, by providing endless computing resources and storage capabilities in centralised data centres, while edge computing enables local processing close to where data is captured. Combining both will be important for many applications.

The term **Industrial Internet of Things (IoT)** subsumes a set of technologies as well as hints at solutions that integrate sensors (or cameras) and actuators that are built into objects like roads, bridges or buildings, vehicles, or the power grid, making captured data available to back-end services as well as enabling the implementation of interdependencies.

Finally, **machine learning** analyses large amounts of data to learn patterns, which are then used to detect incidents, identify the need for maintenance, or anticipate future behaviour. Forecasting energy demands, air quality issues, or road congestion are some examples.

A sample solution: autonomous shuttles

Let's take a specific example: an easy-to-use mobility service, for which users, vehicles, transport systems, and energy systems interact to move people physically from A to B (see figure above). Digital technologies are deeply embedded in all this, controlling 'things' locally and connecting them with each other, building the Industrial IoT. Through initial small-scale deployments and trials of autonomous shuttles



we have learned much about the complexity of the integration in these fields. This includes selecting suitable road space, integrating traffic signalling, or connectivity using stable and secure wireless networks.

Digital technologies are only a means to an end

Digital technologies are certainly essential and required in solutions like the above, but not sufficient on their own. The real impact happens in the physical world, in the above example by transporting physical goods or people.

It is important that all elements are well understood and integrated: urban infrastructure, energy, transportation, and digital technologies. All of them are very complex, separate disciplines. Understanding them individually, as well as their combination is a key point for success. Integration is about enhancing more traditional disciplines with digital technologies, across different sectors. This is not easy, and the primary reason why some of the early 'smart city' initiatives have failed.

The single most important point for success, though, is to understand that technologies are only a means to an end – and that for some problems 'high tech' is not even required. Putting the citizen or user first is, therefore, the key feature of the future city. As a very first step it must be properly understood what problem needs to be solved and for whom.

With human-centred design or other design-thinking techniques, it is fundamental to explore the 'low-tech' options, as well as consider long-term impact and unintended consequences; and whenever possible a series of prototypes to learn quickly. With these learning processes and incremental adaptations, the result will be an user-friendly, efficient, and sustainable solution that increases the citizens' quality of life. Regulations and business models need to support the overall purpose.

AFRY, as an expert in urban infrastructure, energy, automotive, and digital technologies, can bring all these things together. We help to build sustainable, liveable, and resilient cities. Starting with the user experience, AFRY designs sustainable, resilient, and efficient solutions that work.

Roland Lorenz
Head of AFRY
Management Consulting

Seeing the big picture

Current pressure to change the way industries operate is higher than I have ever seen at any time. The combination of the myriads of possibilities opened up through digital capability and the non-negotiable necessity driven by climate change is causing a rethink of fundamental aspects, even in industries that have had a very long history of doing things a certain way.

In early 2020, AFRY started enabling its employees to have greater flexibility between office and home office, to accommodate to the pandemic as well as to support a better work-life balance. What are your learnings from this initiative?

The big realisation for me during the last year has been that the old set-up, which we left behind in a rush when the pandemic unfolded, is now history. We are entering a new era, where success is measured differently and where work communities are taking on a new shape. It is not fully clear yet what shape this will be in the long term, and actually that is in fact another thing to learn: arriving at the future workplace is a change process that will take a longer time. Thinking retrospectively, as a leader who has been in the business environment for a couple of decades, it was important for me to see full remote working in action to be fully convinced that it can deliver the same results, from both a technological point of view and from a people perspective.

My experience of people's drive, motivation, time-management, sense of community and productivity in the remote-work setup has been extremely positive. Even with quite big challenges, such as children at home, the worries about the pandemic and full travel restrictions, there is no question that people have delivered excellent work that is equal to, if not better than, before. This is good news for the long term outlook and it will be exciting to see how people flourish professionally when it is possible to operate in the new hybrid working model without significant challenges and uncertainties. The big questions for me as we look to the future are not about productivity, as there is no question that full flexibility is a win-win for everyone, but rather about what framework needs to be provided to support individuals' mental and physical health and what level of travel and face-to-face time will be appropriate, both from a human and from an environmental perspective.

Climate change and digitalisation are putting companies worldwide under enormous pressure to transform. As a group, AFRY is putting itself at the forefront of this transformation movement. How do you, as management consultants, help your clients to cope with these changes?

At AFRY Management Consulting we find ourselves well-positioned to support our customers through the transformation that is taking place across industries, which is led by digitalisation and climate change mitigation targets. The current pressure to change the way industries operate is higher than I have ever seen at any time. The combination of the myriads of possibilities opened up through digital capability and the non-negotiable necessity driven by climate change is causing a rethink of fundamental aspects, even in industries that have had a very long history of doing things a certain way. It is an exciting time when we look at all the possibilities to improve, but it can also be a daunting time for our clients owing to the sheer scale of the change that is required.

This need provides our people at AFRY Management Consulting with a strong objective and our overall offering very much corresponds to the needs we see emerging among our clients, as they take steps towards renewable energy and the circular bioeconomy. Looking at AFRY holistically, we see a similar dynamic and we also see how the many different fields of expertise that AFRY offers join up to make a bigger picture. For example, I see strong interplay between future cities, clean energy, industry, circular solutions, new materials, automotive and transport – just to name a few. In all of these different fields, AFRY Management Consulting's focus areas – strategic advice, forward-looking market analysis, operational excellence and transaction services – can make a meaningful difference to our clients' progress.

You describe AFRY Management Consulting as a "People Business". At the same time, however, you have launched a digitalisation offensive at AFRY this year. Isn't that a contradiction?

This is another shift from a rather outdated perspective to a new perspective. In contrast to a couple of decades ago, digitalisation in our business does not mean that people are redundant but rather that people are essential to enable our clients to understand digital solutions, opportunities and results. People will always be central to delivering the services that we provide in a management consultancy and digital tools are simply an enabler. It is a very exciting time to see how our people leverage a whole array of technology, from AI to drone monitoring, to augment and add depth to their work. And this development is exciting to observe across AFRY: Through our focus on digitalisation we have an impressive set of tools and competence at our disposal.

While listed companies worldwide struggle with formulating sustainability targets, AFRY is quite proactive in this regard. Increasing the proportion of female leaders to 40% by 2030, halving CO_2 emissions per employee by 2030 and achieving net-zero emissions by 2040. Will your clients benefit from this sustainability strategy and if so, how?

Yes, AFRY has understood the importance of being future oriented in the areas of diversity and climate change mitigation. It is crystal clear for us that this is morally the right approach and at the same time the only feasible route for companies to take if they want to remain relevant in the long term. We are proud to be able to take bold steps in this area and find out what works, so that we can accompany our clients on their own journey towards meeting sustainability targets and shaping their business in a way that will yield results for decades to come. Success in the new business world involves a whole array of elements, from ensuring that operations are as effective as possible and understanding the market, up to embracing innovation and ensuring that the people at the core of the business are as diverse as possible, so that the right perspective is there to stay relevant in the long term. And it is important for us at AFRY to be brave and make sure that we are at the forefront, gathering these experiences in our own organisation to allow us to provide the best possible service to clients that have to progress along the same change curve.

In this spirit, it has been very helpful to join up with NGOs and initiatives that advocate for progress, such as the Gapminder Foundation, which has helped us to develop our fact-based approach to challenging topics and to understand how the expertise we have at AFRY relates to the UN's 17 Sustainable Development Goals. Our partnership with the Norrsken Foundation gives us access to fresh perspectives, via their own ultra-modern approach as well as via the start-ups in their network, which are coming up with new ideas that leverage digitalisation to get better results for our planet.

It has been almost two years since ÅF and Pöyry became AFRY and you were appointed EVP and Head of AFRY Management Consulting. How have AFRY as a whole and AFRY Management Consulting developed since then?

In these two years we have understood much better how to sustain and implement the ambitions of the company, in terms of growth, market position and what we stand for. From the perspective of AFRY as a whole, we have gained a holistic view of the sustainability transition, how things are interconnected and the role we can play with our unique set of competences. This is an exciting perspective and seeing the difference AFRY can make in action as a brave, progressive and modern company is very motivating and keeps us aiming high. We can see this development reflected in our position in employer rankings and it is excellent that we can attract top talents to come and contribute to meaningful projects that make a real difference for our clients and for society as a whole.

In terms of the development of AFRY Management Consulting over the last two years, we have noted a high demand for our services and have experienced strong collaboration with the other divisions, which has allowed us to leverage the combined experience that we have across AFRY to add value for our customers. Our position, as leading advisor for the transition of the energy and bioindustry sectors, fits perfectly into AFRY's "Making Future" vision and into our ambitions in the clean energy and bioindustry sectors. Over the last two years, AFRY Management Consulting has become well-established and is ready for growth on our core markets in all respects, both in geographical terms and in the digital and sustainable transition.

AFRY has a culture of brave leadership. What does it mean for you personally and how does this approach shape the company?

By brave leadership at AFRY, we mean endorsing diversity, being clear in the way we communicate, ensuring our people get a feeling of belonging, maintaining the highest standards of integrity, trusting and supporting our people and building a collaborative and innovative environment. These points are all highly relevant for my own understanding of brave leadership. I personally think that growth needs brave leadership and that brave leadership starts from the top. Fortunately, these values are reflected in the bold commitments made by our CEO Jonas Gustavsson in the areas of sustainability, diversity and inclusion, as well as the ramp-up of Digital X. These decisions and the brave leadership approach give us permission within AFRY Management Consulting to pursue meaningful work and take a point of view on challenging topics. For me personally, the brave leadership philosophy harmonises well with my own leadership, that puts our experts at the forefront and empowers them to make a meaningful impact and pursue innovation in fields that are important for them personally as well as for our clients and future generations. Ultimately, as a modern leader, it is all about empowering people to use their individual talent and purpose to drive meaningful progress for clients, for our company and for society as a whole.

By brave leadership at AFRY, we mean endorsing diversity, ensuring our people feel a sense of belonging, maintaining the highest standards of integrity, trusting and supporting our people and building a collaborative and innovative environment.

Ten years into the future

Restrictions imposed as a result of the pandemic catapulted Italian corporate society into the future, forcing a ten year fast-forward in digital skill development and sudden full adoption of remote working technology, on both an individual and corporate level. Just over a year ago, such rapid acceleration seemed impossible. Our author Massimiliano Mandarini reflects on how we will work in the future, what our offices of the future will look like and, last but not least, what smart working really means.

As the first Western country overwhelmed by the pandemic, Italy enforced a national lockdown that left corporates with no option than rapid implementation of technology and ramp up of remote working. Connectivity became of vital and strategic importance, not only for companies to survive, but also for the country. It was a leap of faith for employers, which provided a much needed opportunity to test the technology as well as prove that employee productivity is related to an array of factors that much more relevant than office presence, such as trust, empowerment and purpose. Now smart working is a reality for 33%, of Italian workers. In January-February 2020 it was at 5%.

Fluid companies, flexible organisations, remote work for new services and ways of communicating: our brave new society consists of a number of factors that increase the complexity of the management of our digital assets. If the business sector remembers 2020 as the year of video conferences, message applications and improvised work stations, the next twelve months must be remembered for a second leap forward, as we embed new collaboration tools, establish ways to secure our digital assets and organise ourselves around a new professional daily routine that is sustainable in the long term.

The widespread adoption of the virtual workplace has certainly shifted our understanding of productivity and has fundamentally reshaped what it means to be a good employee and employer. The world of work is changing right before our eyes and the ripple effect can be felt widely, even by our own children. It is impossible to say now which pattern we will ultimately see emerging as standard, but it is likely to be a hybrid one. What we can say with certainty is that this change will affect, or better, has also already inevitably affected, both home and office spaces – as well as the surrounding local infrastructure.

A contamination of sorts took place within the usually private sphere of employees, which has occurred without anyone realising it. Some people flourished working autonomously and others instead found it difficult to stay concentrated, often due to challenging emergency setups such as working in small or unsuitable spaces or alongside children at home due to school closures.

Now places of work are undergoing the same process. Imagine new apartment buildings, designed with internal co-working spaces, or the new offices with nursery, or with pet friendly floors. This hybridisation of spaces, which is increasingly becoming an option, is leading us to rethink the concept of office and home as separate entities. If many companies continue on the smart working path, the office will become crucial as a sharing and aggregation space, whose primary function is to be a hangout for creating and collaborating together.

We already talk about “workations” and developing villages that enable remote working, with large focus on sustainability and mobility. It is certain that something will shift in this space, perhaps enabling less congestion on public transport as people are enabled to work in various locations outside of cities. More generally, there will be a radical evolution of the spaces and boundaries in which we can work, which become less and less defined and more and more transient with time. The office of the future is made up of new spaces, new ways of moving, seeing the city, and of new quick leaders.

Nowadays, digital and smart-working means well-being, as individuals are increasingly enabled to manage the spaces in which they move. Digital and sustainability are becoming core to a new cultural and managerial approach within an extremely fluid organisational model, which at the beginning may struggle to be put into practice, and is not the solution to all evils, but it is surely a solution that has the potential to create much greater balance than before. In parallel, it has become necessary to lead people to continuously innovate and learn. In terms of thought leadership and innovation, the pandemic has been a catalyst for a multitude of changes and has slowed down the traditional business process in its orientation towards the current day. It has led us to think in perspective.

True smart working is not a change that happens overnight and it is not simply a set of rules and regulations. It is a deep change process that reaches through the mindset, training and education of people working in companies and living spaces. We have been forced to begin at a speed which is not suited to change processes. Design, digital and sustainable technologies as well as hybrid new living will increase awareness of the importance of sharing ideas, spaces and people in a process of adaptation to new models of society that hold the person at the centre, in balance between nature and technology.

Massimiliano Mandarini
The author is an architect, biophilic designer, sustainabilty advisor and green building coach. Mandarini deals with research, resilient innovation, strategic consulting and integrated planning in the fields of design and creativity, sustainability, circular economy and smart cities. He is Chief Creative Officer and Co-Founder of Green Smart Living an innovative start-up in Milan created to spread a culture of sustainable and digital innovation.


Unlocking
new value . . .
by
becoming
invisible
How to set up
a flexible electricity retail

Andy Houston
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Electricity end-users are overwhelmingly passive and unengaged

End-users consume electricity largely without thinking about it, and typically without paying at the point of use. Occasionally, they may switch their supplier to save relatively modest amounts of money or because of poor customer service. For many years, there has been talk about consumers taking a more active role in the market. But real-world changes have generally been limited to either very large consumers or small market sub-segments with higher levels of engagement (e.g. prosumers or early adopters of new technology).

Electricity retail today is primarily a billing and debt collection business. The vast majority of consumers simply do not wish to engage actively in energy markets. Consequently, electricity supply remains commoditised and retailers' profit margins are small.

The status quo is changing

We now see three parallel trends that will disrupt the 'passive consumer' business model and have the potential to de-commoditise electricity supply. Firstly, new value pools: The need for demand-side flexibility has been driven up an ever-increasing penetration of renewable energies, which has in turn led to a larger value pool.

Secondly, increased volumes of flexible demand: The convergence of distributed electricity, smart-home, heat and mobility sectors is creating a rapidly growing pool of flexible demand from onsite generation to appliances and heating to electric vehicles. Finally, enabling technology: Digital technology has advanced to the point where it can enable previously locked-up sources of flexibility and allow them to be managed together to offer a 'dispatchable' block of power to help balance the system. We can now envisage a world where a virtually unlimited number of individual sub-premises level demand sources can be monitored and managed actively in real-time as part of an aggregated portfolio.

A range of new 'flexible retail' business models are emerging

At the simpler end of the spectrum, and most widespread, we see time-of-use tariffs proliferating on many markets. These allow consumers to change their consumption in response to simple price signals, but most offerings are still relatively static and do not reflect real-time value. Most importantly, the success of these products requires consumers to engage – which most still do not wish to do. At the more innovative end of the spectrum, we are beginning to see the emergence of truly new business models, where retailers take active control of their customers' energy use. This could be through subtle short-term changes to the temperature of heating, through smart EV charging, or even through smart appliances. The attraction of these models is that consumers can remain unengaged on a day-to-day basis whilst still extracting value from the flexibility embedded in their demand.

How should the flexible retail business of the future be created?

The market for flexible retail services is young and winning and losing business models are not yet clear. Most offerings so far have been bolt-ons to existing retail models, and the true disruptors have yet to emerge. Ultimately, deep change must be consumer led, but in a world of unengaged consumers, the winners will be the ones that can make the 'boring details' invisible.

We make four recommendations:

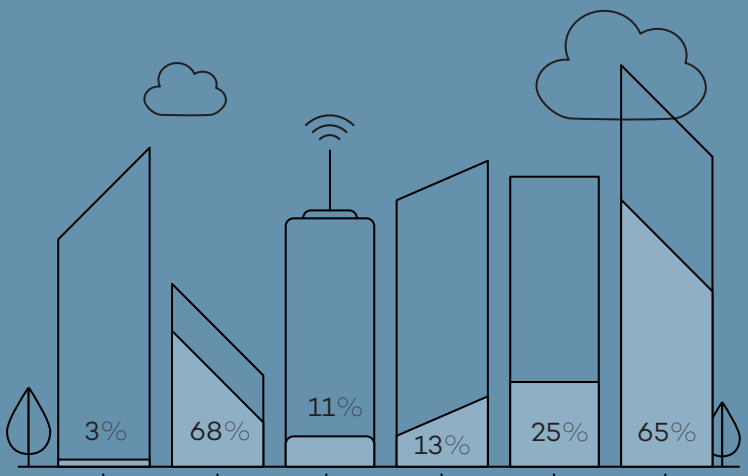
1. Increase capability to forecast and monetise the value of flexibility. Retailers will need a deep understanding of all aspects of the markets in which they operate, especially national and local flexibility markets. The ability to forecast accurately and trade effectively in order to monetise transient value in near real-time will be a key differentiator.

2. Build flexible customer volumes fast. Building a customer portfolio that has high inherent levels of flexibility embedded within smart homes, flexible heating and EV charging (and non-household demand flexibility). Early movers will have a competitive advantage, and retailers should seek to cross-sell relevant technologies, whether directly or through partners.

3. Make enabling technology invisible. Most consumers want to remain unengaged, so technology should be seamless and 'just work'. With this mindset, customer contact should be minimised, since it generally means something has gone wrong. As the market matures, invisibility will become a threshold criterion for flexible retail; if consumers must spend time and effort to make the model work, they will simply not bother.

4. Do not forget the basics. Compliance. Risk management. Accurate and timely billing. Cash collection.

The future of downstream power is uncertain. But the direction of travel is clear. Winning business models will make managing complexity a competitive advantage. The rest will be disrupted.



Urban areas occupy only 3% of the planet's surface, but are responsible for 70% of CO^2 emissions.

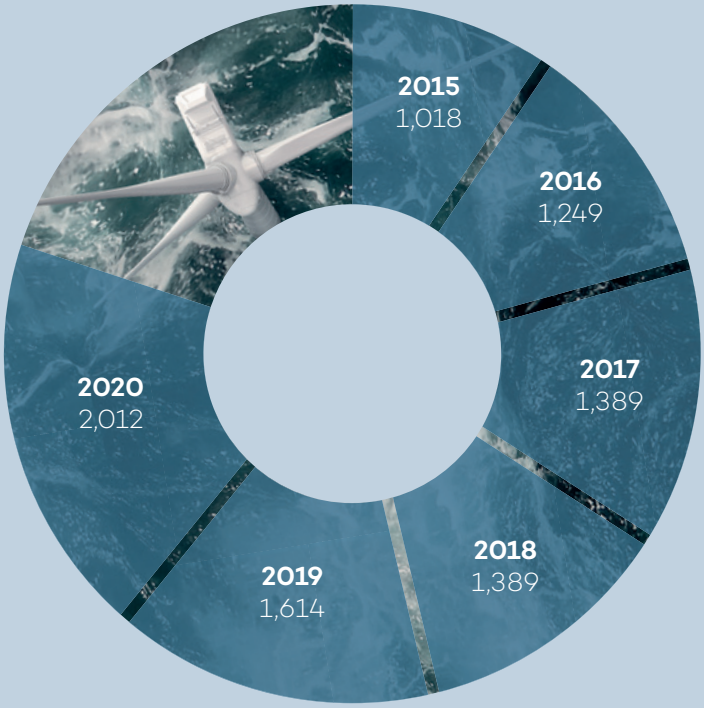
68% of the world's population will live in cities by 2050 (up from 55% in 2018).

11% of emissions in EU28+EEA countries come from buildings.

13% of emissions in EU28+EEA countries come from industry.

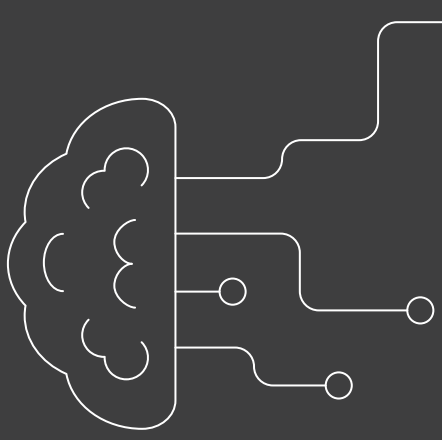
25% of emissions in EU28+EEA countries come from transport.

Europe has 280,000 electric buses of which 65% (180,000) have to be decarbonised by 2030.



There has been an **80% increase** in the number of companies planning or using an internal carbon price in just five years.

To reach net-zero as efficiently as possible, digital tools to track and price carbon emissions are a prerequisite.



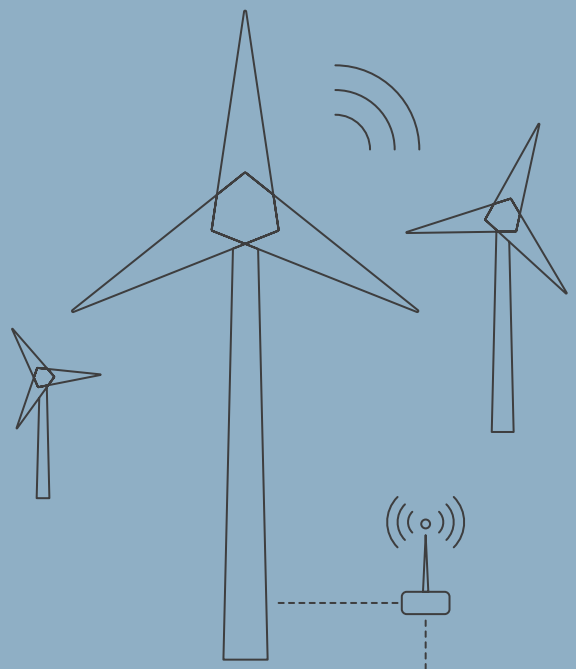
How can digitalisation accelerate the sustainable transition?

Digital technologies and processes are the most powerful and universal tool for tackling climate change and reducing global emissions. Within the energy sector, connected sensors, smart meters and machine learning are driving operational efficiency and thus improving flexibility and quality. Digitalisation is now expected by customers, as it can significantly improve their experience and enable a data-driven approach for managing a business.

AFRY
ÅF PÖYRY

The global Internet of Things (IoT) in the energy market is expected to grow at a compound annual growth rate (CAGR) of 25.1% from 2019 to 2026, from USD 16.5 Billion to an estimated USD 75.3 Billion.

IoT in in the energy market covers hardware, software, services, cellular, satellite and radio networks as well as applications for energy management, power distribution, mobile workforce management, asset and equipment monitoring, field surveillance and others.



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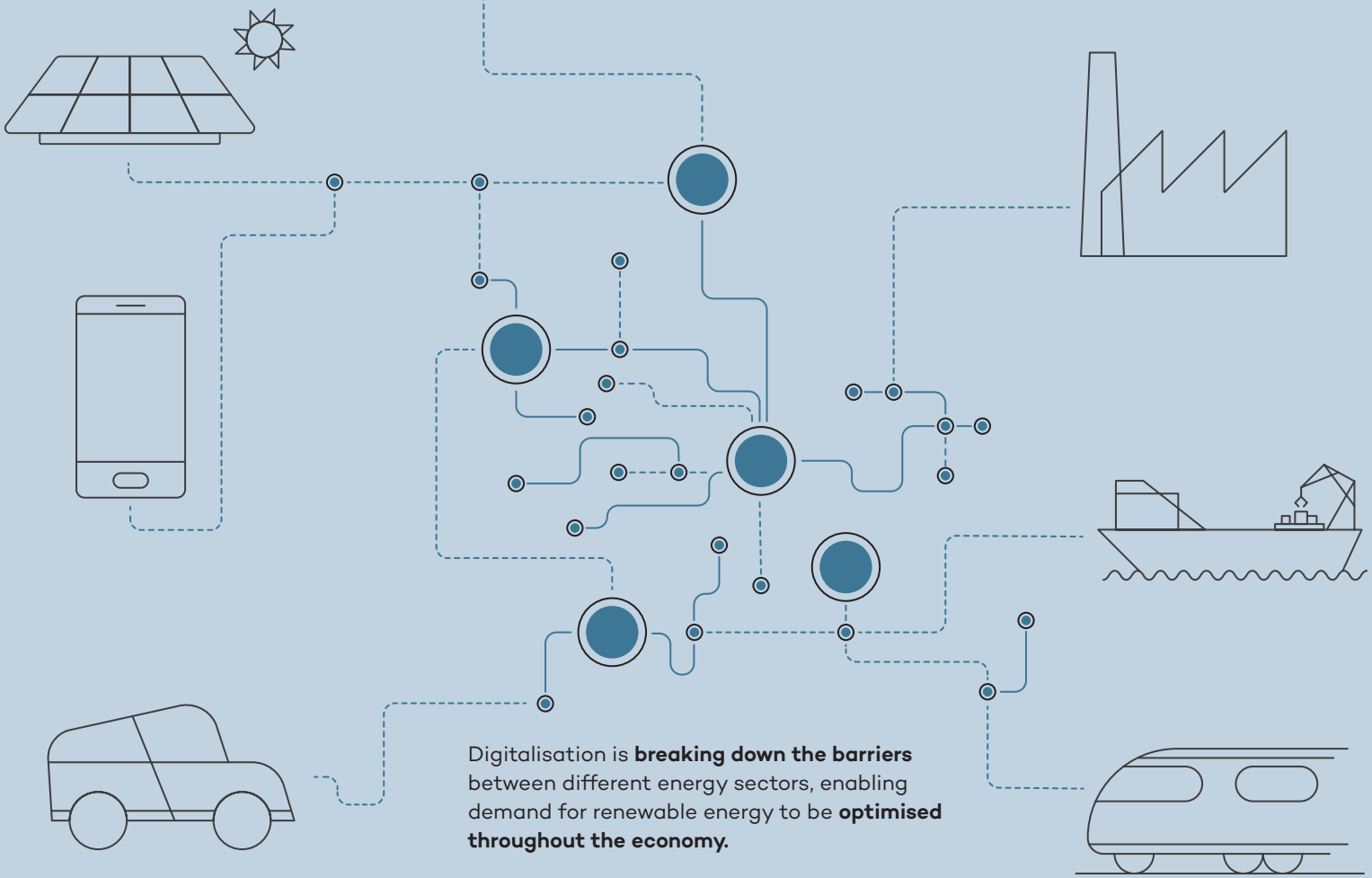
Nearly a third of the 50% carbon emissions reductions the UK needs to make by 2030 could be achieved through existing digital technology – from sensors to large scale modelling.

+470%

AI software revenue will grow from USD 22bn to USD 126bn by 2026.



Digitalisation is **breaking down the barriers** between different energy sectors, enabling demand for renewable energy to be **optimised throughout the economy.**

Francesco Venturini
CEO EnelX

Fully electric

Our innovation already represents an important business paradigm within the definition of innovability: it is a perfect fusion between innovation and sustainability.

Enel X was founded in 2017 and already contributes to the revenue and ebitda of Enel. Can you reveal how you achieved this in such a short time and how much of your original motivation and goals are still left?

Since 2017, Enel X has always shown a constant growth with an annual EBITDA increase of more than 33%. In fact, from the beginning we had an immediate and clear vision of the financial goals to reach, rationalising the most important businesses and understanding where there could be profitable opportunities in the future. Furthermore, the common thread that always contributes to enthusiasm comes from two pillars on which our businesses are based: sustainability and digitalisation. These are important topics at global level with an exponential growth every day. That is why there are various investments from several governments around the world which offer strong business opportunities for the markets. In conclusion, being drivers in the energy transition by helping customers understand the best ways of using energy is definitely the best motivation and goal to pursue.

At first glance, renewing an existing business model and making it fit for the future seems more difficult from the outside than completely reinventing something. How is Enel X positioned in the Group and how is innovation exchanged with Enel's other divisions?

Surely reinventing a business has a different difficulty than creating one from scratch. During these four years we have done both. When we were born, Enel X had the aim of giving value to all those non-core Enel Group businesses that were incapable of getting off the ground. We rationalised more than 200 similar products, almost 300 commercial offers with different IT systems and a huge number of contracts with external suppliers. We isolated each company and tried to understand its priorities, potentiality, and future developments. Enel X's position in the group is in fact being the first point of contact for the customer.

Enel X wants to offer people, industries and cities the support they need to live in a smarter and more sustainable way through innovative solutions that respond to ever-changing needs. The key to success was studying customer needs and changing business paradigms that seemed inaccessible. Our innovation already represents an important business paradigm within the definition of innovability: it is a perfect fusion between innovation and sustainability.

The latter is structured in a transversal way among Enel, and its objectives are to:

1) stay focused on the business;
2) be ready for any unexpected event;
3) always be one step ahead of future business needs.

A business success story was City Analytics: a very interesting tool adapted to the Covid emergency. In detail, it is a digital solution based on Big Data processing and specifically designed to support public administrations in planning services and optimising urban infrastructures. During the pandemic, Enel X developed a new version, to facilitate the management of the Covid-19 epidemic thanks to the anonymised and aggregated data the tool can elaborate, coming from connected vehicles, maps and navigation systems, as well as geo-location data from mobile applications and open data from the public administration.

Recently you teamed up with Volkswagen to push electric mobility in Italy. How do you evaluate such joint ventures and would such initiatives also be conceivable for Enel as a global player in other countries?

We share with Volkswagen a joint vision on global electrification of transport, so a partnership with them came naturally for us: the energy transition requires teamwork.

The EU's automotive industry and the energy sector have the required expertise and means to make the energy transition happen as quickly as possible, with the electrification of transportation as one of its main avenues. To obtain this aim, we are joining forces with Volkswagen and the overall auto sector in the design and implementation of electric-mobility solutions that are accessible and convenient for all drivers, as well as being safe and sustainable.

We started in Italy, but Enel X e-Mobility is present worldwide, from China to the US passing through Europe. So, after learning from this experience, we will soon start this type of initiative in other countries.

Talking about digitising the energy business we are already talking about the corresponding technologies, such as AI, IoT or AR or VR. But these technologies are not per se the innovation, the improvement or reinvention! How do you deal with these technologies at Enel X to identify use cases that are relevant for your clients?

Enel X does not look at technology to understand business needs, it first looks at the customers' needs and then inserts the technology into them.

Some of the main examples that involve AI are:

- Adaptive Lighting: thanks to video cameras equipped with processing capabilities and computer vision software, we are able to monitor real-time traffic, weather and luminance conditions in order to automatically adjust the power of public lighting to the road conditions - all this allows us to increase energy savings and the resilience of our cities. The solution was included by the World Economic Forum in the innovation paper that celebrates the most impactful innovations in the Energy world of the last 10 years.

- Satellite analysis for the census of urban assets, with particular attention to public lighting: After the collection of satellite images through machine-learning algorithms, we are now able to extract fundamental information for the census of light points. This project was particularly important during the Covid emergency because it allowed us to proceed with the public lighting census plan even in a phase in which for safety reasons it was not possible to carry out physical inspections in the field.

- EMS (Energy Management System): Enel X EMS is a cloud-based application that enables the unified overview of all the measures sent by a customer premise. Each monitored asset is integrated with an hardware agnostic approach through the Enel X IoT platform. Once integrated, the EMS application packs capabilities to monitor, analyse and predict the energy consumption and energy efficiency of the customer premise.

Some examples from the IoT side are:

- City Analytics (B2G): Data-driven administrations to increase safety, reduce pollution and traffic, improve services, make the city more liveable for residents and tourists.

- Homix (B2C): IoT and Big Data in the home, to reduce costs and consumption and improve the quality of life.

Referring to a recent Enel X presentation you say that nowadays sustainability can be reconciled with economic convenience , something that should not be associated with low quality. Can you give us some example how Enel X is achieving this?

Also in this case, the first thing we did was try to figure out what the customer is looking for when buying a product or service, especially for the home. The first aspect is convenience, accompanied by the needs of comfort and therefore safety at home.

Trying to satisfy these needs, we have dispelled the paradigm according to which sustainability is not synonymous with convenience and product quality. Today we can say that sustainability is accessible to everyone and customers choose us because we are able to offer them a product / service of excellent quality at a competitive price.

An example of sustainability coinciding with value and quality is the fact that we sell a photovoltaic system at a price 10 times lower than the market price of 10 years ago, with the installation included in the price. The most innovative and accessible solution for everyone this year was our PV Plug and Play: ideal for those who want a photovoltaic system but live in an apartment. Simple and quick to install on your balcony, it connects to the mains via an electric plug with a dedicated socket.

Reinventing yourself in the digital world means meeting players from this field at the same time. Apple has already made a name for itself in the smart home sector and is cooperating with numerous smaller companies; Google has similar strategies. How relevant is the competition with the tech giants for your work and where do you see its advantages?

The main difference between players like Google, Apple, and us consists in the fact that they were born digital while companies from the utility sector have only recently been faced with digital conversion.

The interesting thing in this type of market is how things change rapidly in a very flexible way: in a specific context these players can be competitors, in other customers, or in other cases, interesting studies to pursue in order to improve business strategies. Digitalisation is at the basis of Enel X, helping it to achieve its objectives. We have invested in a cultural and technological transformation, to ensure a continuous development of the platforms in a global key to always improve our ecosystem, to digitise the relationship with our customer and to be a data driven company, in order to extract useful information about our business, predict what will happen in the future, have a competitive advantage and better understand our customer by anticipating their needs.

An example of sustainability coinciding with value and quality is the fact that we sell a photovoltaic system at a price 10 times lower than the market price of 10 years ago, with the installation included in the price.


Change

Energy markets must undergo a paradigm shift – moving beyond flexing supply to match demand, and onto addressing where redundancy in the energy system should be located and used.

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Brave new energy world

A 100% renewable energy system requires a shift in market design principles. Renewable electricity can power the new net-zero economy but is already facing limits due to its non-dispatchable nature. Flexibility and redundancy will be key system components going forward.

Energy market design in the transition to 100% renewable energy

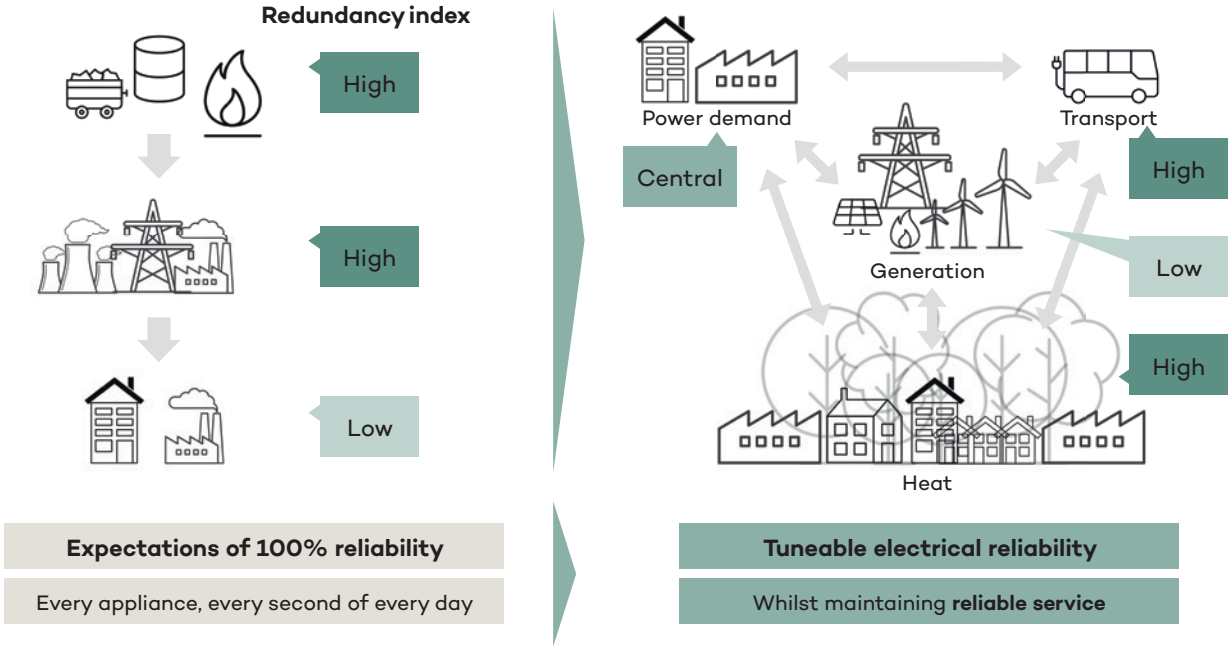
Emissions have been rising year-on-year, decreasing only when the global economy splutters e.g. from coronavirus or the 2009 financial crash. Yet to stop temperatures from rising further, we need to drive emissions down to net-zero i.e. whereby emissions equal carbon sinks. Fortunately, the groundswell of state and non-state actors committing to net-zero targets is reaching a tipping point for global action.

Renewable electricity can power the new net-zero economy but is already facing limits due to its non-dispatchable nature e.g. curtailment and redispatch costs arising from the lack of flexibility in the wider energy system. Today's world places redundancy in the power sector to meet the needs of customers. In a 100% renewable energy system, we need to move (to some extent) towards flexing demand to match renewable production, making use of the inherent storage in the new sectors to be electrified (thermal storage for space and water heating and cooling, battery storage for transport). This means that the future world of sector coupling needs to address where in the wider system the redundancy should be placed.

Redundancy in modern day energy infrastructure is all around us and will be a key system component going forward. Coal and gas power stations operate at a fraction of baseload, private cars are used less than 5% of the time, networks are designed to provide demand at a few peak hours throughout the whole year, and so on. This redundancy is cheap, has become a social norm, and is essential – system reliability requires redundancy. A smart energy system will not remove the need for redundancy, it will merely shift it to other sectors.

A smart energy system will not remove the need for redundancy – it will merely shift it to other sectors

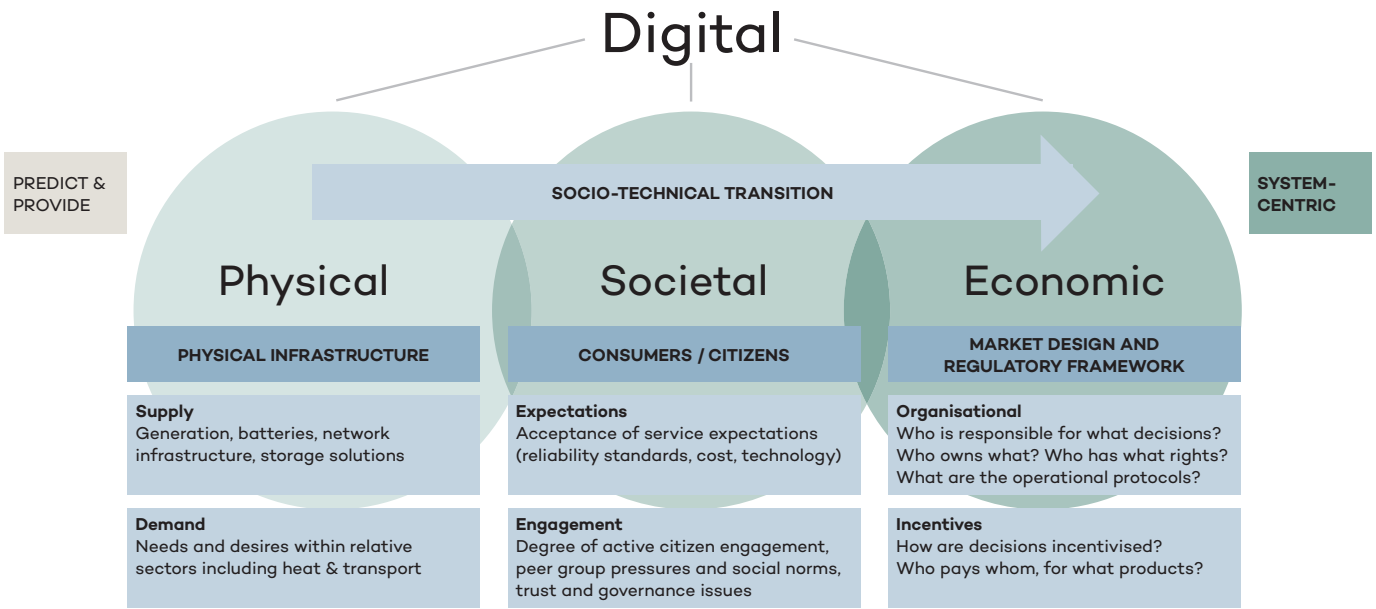
The future energy system can be viewed in a number of layers: physical, societal and economic (which in turn comprises organisational and incentive layers). The underpinning digital layer provides the interlinking interactions to make it possible. Reaching a 100% renewable energy system requires us to move from a 'predict and provide' to a 'system-centric' approach where the customer is at the heart.



The future energy system can be viewed in three layers: physical, societal and economic

Decarbonisation and technological advances are transforming our electricity system, driving growth in distributed flexibility, but there are risks if not managed properly. For instance, electrification of transport results in high capacity, low energy loads at the lowest voltage levels, which will lead to bottlenecks if firm access is provided on a first-come-first-serve basis. A successful transition will depend on the development of the human part of the energy system, at least as much as the technical part. Obligations and incentives must be structured to allow innovative solutions such as selling bundled/interruptible energy and energy as a service.

To conclude, a 100% renewable energy system requires a shift in market design principles from just 'minimising cost' to 'maximising value within environmental constraints'. Regulatory reforms must support the new economics, with new product definitions and new buyers and sellers. Flexibility and redundancy will be the invisible unsung features of successful market design going forward.



Driven by the wind

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With the acquisition of Finnish simulation and software development company Numerola, AFRY has gained a new family member and significantly expanded its digital-service offerings in the field of digital solutions for clean energy. AFRY will now be able to provide clients with extensive wind power services and the most advanced technologies on the market for demanding wind power projects.

The transaction is taking place in light of an increasing demand for carbon-free energy and AFRY's ambition is to be a leader in the transition towards cleaner energy. Numerola is an expert in computational fluid dynamics (CFD) based on the physics of air flows.

"We are excited to have Numerola join AFRY's group of wind power experts. Our wind analysts around the world can now benefit from Numerola's expertise, while at the same time providing Numerola's professionals with access to the rapidly expanding global wind market. Numerola is a pioneer in wind power simulation and has extensive experience in designing wind power solutions. By joining forces, we will become a stronger enabler of the energy transition", says Esa Holttinen, Global Sales Director for Wind at AFRY.

With the expertise gained, AFRY now provides digital wind condition modelling and analyses for all phases of the planning and development of wind power projects, for power grid storm damage control as well as for urban planning. Even the industrial sector can be helped with its modelling and simulation needs.

Keeping it real-time

How advanced sensors support the digital transformation of electricity grids

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The availability of ever-cheaper and better sensors, in combination with high-capacity communication platforms, opens a whole new world of opportunities for enhanced electricity grid information. While smart meters and other measuring devices have been rolled out at volume in the latest decade, we now see a new generation of advanced multi-sensors for overhead lines and cables coming to the market. The big question is – how can we create value out of more real-time grid data?

Under usual circumstances, the electricity grid is a robust and well understood technology, built to operate reliably over decades. Yet in new market conditions, the utilisation of these assets changes considerably. The green transition of the electricity grid means greater fluctuations of loads, higher utilisation of thermal capacity and a larger share of cables. This gives rise to a greater need to better understand the implications of this shift on the grid assets.

Modern electricity grid sensors allow for the registering and transmiting of real-time data on a wide range of variables. There are several sensor solutions already present in the market. The sensors may cover some or all electricity data – voltage, current, frequency, ground fault – but also environmental data, including line temperature, humidity, line inclination and sag, movement and more. This combination of different data streams provides totally new opportunities for the electricity network management.

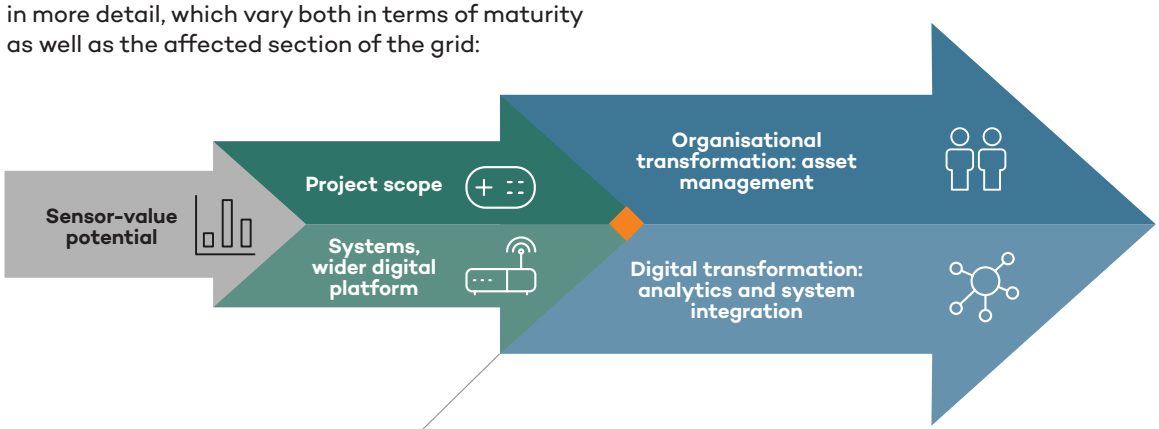
A recent study conducted by AFRY Management Consulting regarding overhead-line sensors revealed that most network operators are unaware of the specific benefits of these solutions and are often hesitant about the integration of these IoT devices into their existing IT infrastructure. Our study revealed four key use cases that grid operators are currently exploring in more detail, which vary both in terms of maturity as well as the affected section of the grid:

- **Dynamic line rating (DLR) increases available grid capacity: While an electricity line has a certain rated, static capacity, using information on real line temperature can increase useable line capacity by as much as 20-25% in certain periods.**

- **Ice detection to prevent heavy ice loads on lines: Identifying early ice build-up on electricity lines allows for implementing mitigating measures well ahead of reaching critical conditions.**

- **Fault location detection: Particularly in rural and hard-to-reach areas, sensors can help to quickly identify the fault location and to direct maintenance crews to the appropriate position.**

- **Remaining lifetime assessment (Predictive Maintenance): Some old lines require lengthy analyses, in some case even physical samples, to determine the remaining lifetime of the asset. With advanced analytics, sensors promise to better estimate the remaining lifetime of components and better direct maintenance activities to extend this lifetime.**



Feasibility study
- Value proposition, potential value from sensors
- Project scope, wider impacts
- Project concretisation
- Decision gate ◆ : Invest in sensors?

Digital transformation
- Analytics of stand-alone and of combined data sources
- Use of better information: data storage, analytics, system-integration issues
- Cyber security and integrity

Organisational transformation
- Strategic level: investment and capacity planning
- Operational level: planned / unplanned maintenance, system operations
- Work processes and procedures: adapt to reflect new information
- Risk assessment

The value of sensors thus materialises in several areas – lower costs, better quality, improved safety, and strengthening the network companies' role in the green transition. But more data alone is not sufficient to create value. The challenge grid companies face is to evaluate business cases for these sensors considering the different type of value and cost implications associated with each of these use cases.

First, it has been shown that the different applications cannot be scaled equally to the entire grid. DLR, for example, is particularly relevant for highly congested lines, ice detection for regions with a high ice-load potential, and these might not necessarily overlap.

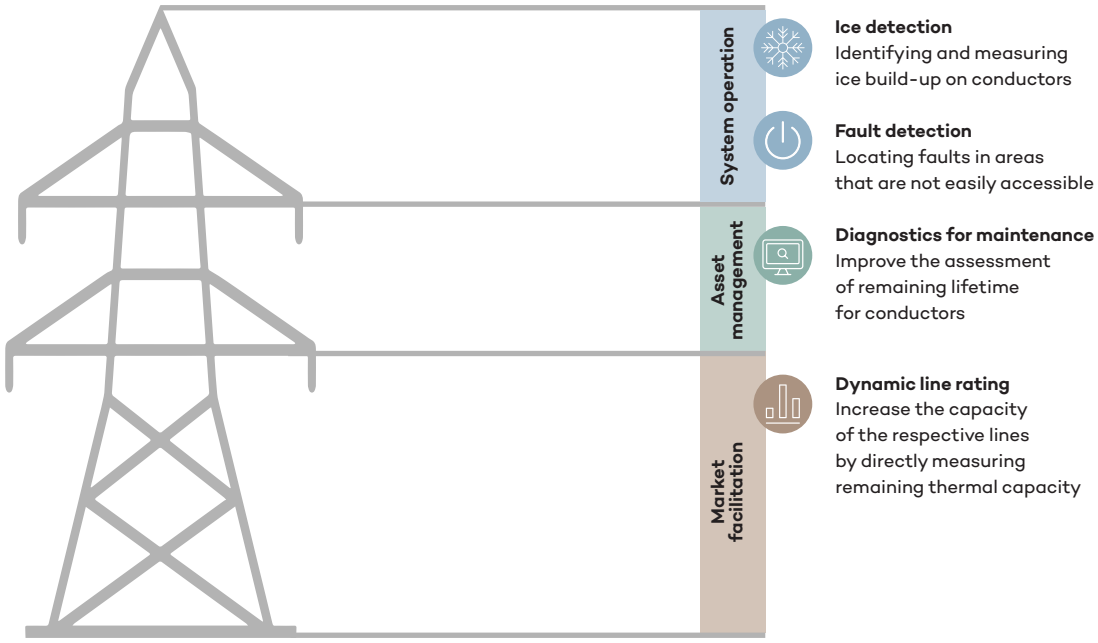
Use cases might also differ in their requirements to integrate with various IT systems. A key issue in this respect is that many manufacturers use cloud services to provide data analyses as a service that raises security concerns if integrated in the SCADA world of control room systems. A hybrid integration of cloud and SCADA systems is very uncommon in the space of network operation. Additionally, different use cases also require connecting to a range of internal as well as external data sources, such as for example substation sensors, drone footage, weather data or smart meter data.

The AFRY study also showed that the introduction of and the investment in grid sensor technologies can vary considerably owing to different regulatory regimes. Particularly the shift of regulation from CAPEX to TOTEX regimes is expected to greatly favour sensor implementation in the future.

For overcoming these challenges early movers in electricity network sensors tend to initially concentrate on a single-purpose use case, such as for example ice load, DLR, or fault detection. This approach may be useful as part of a learning process, but clearly underexploits the full, potential value this sensor data can provide.

More mature companies are using a more holistic picture to determine the future value of sensors. They see grid sensors as part of a wider long-term vision that will enable them to create a digital simulation of the grid. With immediate effect, they invest in developing the digital as well as organisational capabilities that will be required to address the technological challenges of this decade. To drive this digital transformation, they need to define the future targets for their data management, analytic and control capabilities. From an organisational perspective, they must define targets for a new asset management framework and adapt work processes and procedures in line with an updated risk profile of these assets.

So, when looking at the value of grid sensor technology initial investigations will require separate and detailed understanding of the cost-benefits of each of the envisaged use cases. This narrow focus, however, should not ignore the long-term implications that grid sensors can have in achieving the operational and digital transformation goals of network companies.



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Inbound change

Over the last decade, the energy and infrastructure sectors have undergone a paradigm shift in terms of digital transformation of their businesses, enabled through rapid growth in data collection, storage, processing capacity, sensor technology and connectivity.

Despite the fears of pandemic-induced global restrictions and economic slowdowns, the energy and infrastructure sectors' deal flows continue to grow. For green and ESG-enhancing assets, recent valuations are reaching new highs due to increasing volumes of capital availability in markets and stiffer competition amongst investors vying for quality assets. While, on the one hand, investors have to pay closer attention to the fundamentals to derive fair valuations, on the other hand, they must look beyond the traditional valuation drivers and methodologies to identify additional sources of value.

Not long ago, the availability of relevant data was limited and quality was often of inadequate granularity. The collection and subsequent analysis of data was a cumbersome exercise and led to a tendency to compromise in transactions with demanding timelines. The reliance on the 80-20 approach, complemented by expert opinion, was considered the industry standard. For energy and infrastructure transactions, there is no replacement for sound subject-matter knowledge and experience of local experts in a due diligence process. However, in addition to these mandatory qualities, advisors must be capable users of novel digital tools and technologies. Data-driven intelligence built upon ever-growing data and sophisticated algorithms enhances complex decision-making and automates several decisions during the due diligence process that previously have been reliant on traditional assessment methods. Some examples of value addition through data-driven and digital readiness of advisor are as follows:

High confidence valuation

The fundamentals of a business and the future value of its assets are influenced by factors like the future growth of the addressable markets, technological advancements, and the evolution of consumer behaviour. These factors are evolving rapidly and consequently the markets are changing at a faster pace with stark differences noticeable from one decade to the next. Adopting traditional tools and methodologies for evaluating the evolution of these factors on a macro-scale is likely to lead to a myopic estimation of future value of a business.

Ever since the onset of the digital / Internet-of-Things revolution, access to high-performance computing and prevalence of Big Data, opportunities have risen that empower the deal and advisory teams to assess the drivers of the business in a more granular fashion and develop a clearer view on the future value of business within the typical time-scales of a transaction.

For instance, in recent high-value district energy transactions, AFRY utilised the wealth of current open source geospatial-temporal data (satellite imagery high-granularity climate models, and high-resolution datasets on demographic, behavioural, technological and economic factors) to assess each potential customer of the district energy network at a very granular level. This enabled us to derive high-fidelity projections for addressable market growth, available customer profiles, demand for services, and competitiveness (market and technological). This way, data-driven assessment could reduce the uncertainty and bring transparency to the valuation.

Digital value propositions

The past few years have seen a surge in energy and infrastructure deals with growing competition amongst investors for attractive assets and a greater pressure on margins.

In order to position themselves for successful acquisition at a competitive price, investors are increasingly assessing additional upsides to the target businesses. This entails analysing the business beyond traditional fundamental value drivers and exploring the newer and innovative business value propositions that are frequently based on digital practices and solutions.

One relevant example is from traditional utilities (electricity, heat, and water), which have progressively entered the consumer-end of the value chain and are developing digital retail solutions that enable consumer participation and feedback. Such solutions range from simple mobile apps that enable consumers to track their consumption and make decisions based on their individual preferences to technically advanced home energy optimisation interfaces. These retail solutions are intended to enhance the marketability of the core business and at the same time uncover short-term and long-term cost-optimisation potentials. Furthermore, such low-cost and scalable solutions often result in stronger customer proliferation and retention, as well as sizable additional revenue streams.

Experience and understanding of digital solutions and technologies relevant to a business along with a market view on the economics, marketability, readiness and customer preferences uncovers potential revenue streams beyond the traditional business models. Advisors' knowledge and experience with digital solutions in a transaction is therefore key to derive potential upsides to the business and to support a competitive valuation for investors.

Competitive bidding – cost-gaps

The energy and infrastructure sectors are transforming themselves towards digital operations and management practices to achieve a higher efficiency resulting in lower operating costs. This entails committed efforts to digital integration and optimisation across the entire value chain of a company, from the operating model, sourcing & procurement, operations, maintenance, trading and dispatch, support functions up to the process optimisation.

Digital strategy implementation is inherently cross functional, necessitating large-scale changes in well-established operational models and employee behaviour, which can slow down the progress.

In AFRY's experience, while significant progress has been made towards digitalisation, the implementation and scaling of digital initiatives towards getting implementable decision-making systems has proven to be more challenging. These challenges lead to tangible gaps that in turn lead to cost inefficiencies and sub-optimal decision making. Our operational excellence services' diagnosis that was already performed as part of the due diligence process has identified cost gaps in range of 5-8% across a global set of recent energy and infrastructure transactions. This additional value could be gained for a target business through a well-defined implementation plan which in turn can improve the competitiveness of bids during a transaction.

Teamwork at play

Across the board, AFRY is using the digital capabilities of its teams globally. AFRY leverages it deep expertise in digital strategy implementation and optimisation. Our local teams have digital readiness, both in terms of knowledge and experience. AFRY offers a wide array of data-driven services as part of transaction-advisory service, with an aim to provide support in the development of a high-confidence valuation and the placement of winning bids.

Ramp up digitalisation

The construction industry has traditionally been seen as one of the slow adopters of digital solutions. However, AFRY engineers leverage digital tools to enable a route to deliver technical success, financial viability, customer satisfaction and sustainable development.

When it comes to digitalisation and innovation in the economy, the IT sector, the energy industry and the automotive industry are playing a leading role. According to the Harvard Business Manager magazine, the mining and construction sectors are far behind in this innovation ranking, they are just slightly more digitalised than fishermen and hunters. Why is this so? "On the one hand, this is historically conditioned and is due to the development of builders and construction companies. However, the business is also simply complicated and very individual," says Dr. Mathias Smesnik, Head of Geotechnics, Soil and Rock Mechanics at AFRY.

In light of a global market and a rapidly increasing shortage of skilled workers in the construction industry, digitalisation plays a key role in delivering cost-competitive, suitainable and safe infrastructure projects by allowing visibility of challenges in construction and operations already during planning. However, the challenges are great. Every new infrastructure project entails new conditions, new project tasks and sometimes new partners. "A construction site is a very complex environment," explains Smesnik. It can change quickly and constantly. Especially in large infrastructure projects, premises that are often difficult to access or dangerous are part of every-day business. This makes the digitalisation of construction projects a complex, often dynamic challenge.

Seen from above

One example: Whenever a road, bridge or dam is built, there is one thing that accrues in huge amounts: earth. But exactly how much of it was moved and where to plays an important role in these projects in particular. Traditionally, to answer this question accurately, numerous individual point measurements are required, which is enormously time-consuming. AFRY uses drones to simplify the process. "Camera drones use photogrammetry to map the construction site in a 3-D point cloud," explains Mathias Smesnik, a university-trained geotechnical engineer. With the data gained, the AFRY team can determine the huge masses of earth that are moved during a project. The great advantage of the aerial sensing and mapping is that many work steps can be carried out more efficiently and accurately with the help of the drone and the software, which above all saves time and money.

As with all advanced digitalisation processes, products develop their full potential through the combination of different technologies. This is what Mathias Smesnik and his team are researching. "Currently we are developing an AI-based software that uses machine learning to provide accurate data on rock-mass characteristics," Smesnik says. The software, driven by a team of AFRY Gelologists, Geotechnical Engineers and Scientists, already delivers reliable data and increases safety at work.

Hydropower in numbers

The planning, construction and operational management of hydropower plants is another example that shows how digitalisation can contribute to greater sustainability and safety. "In early project phases, it is important to identify challenges in the construction and operation of the plant and to take them into account even in the planning," explains Mathias Smesnik. This process is facilitated, for example, by the "Hydro Decision Support System" software that has also been developed especially by AFRY.

It can be used to optimise projects in terms of water and energy management (location, reservoir size, installed capacity etc.), while also taking into account the effects of climate change and other changes in the catchment area. The simulation model, which also uses AI-based optimisation algorithms, can subsequently also be used in operation to create inflow forecasts and optimise generation and power plant use in real time.

Once the preliminary planning or the early project phases have been completed, the implementation planning begins with the help of various digital approaches. The planning of hydropower plants in particular requires the joint cooperation of many trades. In order to handle the planning as efficiently as possible, the BIM method is used here. BIM stands for "Building Information Modelling" and offers advantages especially for the planning of complex structures. The BIM software is used to model, combine and capture the relevant building data so that architects, engineers, operators and maintenance technicians can access it at all stages of construction and operation.

The digital twin

In the planning phase of a project, a "digital twin" is created on which various planners and designers work simultaneously. This is not only about a 3D image, but also about enabling the linking of planning, execution and operational management through the storage of data within the image. In hydropower projects, AFRY uses digital twins and machine-learning algorithms for optimising water and energy management and defining the most suitable hydropower plant configuration.

Once the hydropower plant is in operation, the digital twin can be used to optimise power generation, water management and the power plant use in real time. "In order to further optimise projects in terms of costs, time, quality, safety and sustainability," says Mathias Smesnik, "our experts are working on further linking and implementing the methods of BIM and lean construction management which represents an integral approach to planning, design and execution."

At the forefront

As a result of the rising energy demands, many existing power plants worldwide are in need of rehabilitation and upgrading to increase energy efficiency, reliability and flexibility. For a continuous, economical operation of these plants, AFRY provides its clients with complete renewal concepts and investment planning, and with the renovation of civil works, penstocks, the optimisation of turbines and of the electro-mechanical equipment.
" The increasing need for clean energy through the greater use of hydropower is a socio-political necessity today," says Smesnik. " We are here to make it happen."

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Digital accelerator

AFRY is investing to strengthen its position as the leading digital transformation partner. AFRY X is our digital accelerator, designed to drive the rapid development of digital solutions as well as boost the broader digital transformation, for our clients and across our organisation. Every industry is evolving in response to the global digital transformation, which is accelerating its pace in AFRY's core industry sectors.

With AFRY X we are committed to staying at the forefront of the digital transformation in areas such as Infrastructure, Food & Life Science, Bioindustry and Clean Energy.

We aim to achieve a more sustainable society, together with our clients and partners, through leading digital solutions.

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