WHAT DIGITALIZATION CAN DO TO ALLEVIATE

The Energy Crisis

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Introduction

As we experience an energy crisis that is fueling inflation with severe impact on households and businesses all over Europe and forcing factories to curtail their production or even to shut down, citizens are asked to reduce their energy consumption while governments scramble to secure alternative fuel sources. These, however, are only short-term measures, and there is no doubt that this winter will prove taxing for many.

All the more reason to waste no time implementing the mid- and long-term solution to the energy crisis that has been on the table for a long time: Decarbonization – the decreased reliance on, and eventual avoidance of fossil fuels – combined with digitalization.

27 percent of the global energy demand is driven by the building sector

Indeed, the energy crisis has doubled down on the urgency to follow a stringent decarbonization pathway in all areas of human activity. This affects the industry, building, transportation, and energy sectors – the way we produce goods, the way we construct and use buildings, the way we move ourselves and all manner of goods, and the way we produce, transport, and use electricity.

Of course, these areas are by no means independent and when it comes to decarbonization, solutions in one sector will benefit another. The industry and building sectors, for instance, share the massive challenge of decarbonizing cement production. The transportation and energy sectors are interlinked when it comes to stabilizing energy grids during peak EV loading times.

Yet, in the context of the energy crisis, we would like to focus on two sectors that stand out for their impact on keeping us sheltered and safe, and for their readily available solutions: The building sector, which accounts for 40 percent of the global energy usage; and the energy grid, which has to simultaneously cope with a huge surge in demand – energy consumption is set to double in the next 20 years, peak demand will triple – as well as increasing volatility due to stochastic renewable energy generation.

The transition to a decarbonized urban infrastructure and a decentralized, renewable energy system, however, simply cannot be achieved without digitalization. It is impossible to manage the complexity of buildings, grids, and cities reliably and efficiently without smart, automated solutions. As a welcome side effect, putting digital solutions at the core of the energy transition will also reduce the need for costly hardware investment.

Smart buildings: A substantial impact on decarbonization

Buildings account for 40 percent of global energy usage, of which one-quarter accrue in the construction phase and three-quarters in building operation. Accordingly, the way we manage and operate our buildings causes 27 percent of global carbon emissions. As if this was not reason enough to decouple the building sector from fossil fuels, consider that the impact of buildings will only continue to grow: By 2060, the global building floor area is expected to double. However, infrastructure is lagging behind other sectors when it comes to digitalization.

The aim will be to build sustainable communities – scalable from single buildings to, e.g., university and industrial campuses, office complexes, or hospitals – that improve the energy efficiency as well as the overall health of buildings while adapting to the no longer reversible effects of climate change. After all, we spend on average 90 percent of our time in buildings, in increasingly challenging conditions, yet around three-quarters of commercial buildings are not energy efficient.

By installing simple IoT solutions and using the collected data for optimization measures, Siemens has experienced that in most buildings, 30 to 40 percent of the energy consumption can be saved. Indeed, IoT solutions now offer a low threshold to digitize building management, using a modular approach that is scalable. Full-scale digital solutions will encompass energy and performance services with generation and storage, microgrid control and EV charging solutions, or holistic asset performance management with digital twin technologies to implement the optimal solution and ensure lifecycle performance. Digitalization also opens the door to substantial efficiency gains through automation and AI. Independent of the size of the solution, building operators can benefit from the outset by using accurate sustainability data for data-driven optimization strategies that improve energy use, save costs, and drive the decarbonization effort.

Historically, one of the main barriers to digitalization in the building sector has been cost and the unwillingness of organizations to take responsibility for the infrastructure required. Technology development – with advancement in IoT and data analytics as well as cheaper sensors – has brought down the cost. Meanwhile, new X-as-a-Service business models, where businesses pay for a specific, guaranteed outcome, typically a defined energy reduction, rather than a technology, are now enabling better, even cost-neutral access to digitalization for building operators by shifting CAPEX to OPEX.

By 2050 more than 85 percent of the building stock should be zero-carbon-ready.

Crucially, for maximum impact, any digital solution installed today will need to be open and modular, support legacy systems, safeguard against cyber threats, and foster an ecosystem approach with strong partnerships. Thus, the software solutions will be equipped to harness the full innovation potential available.

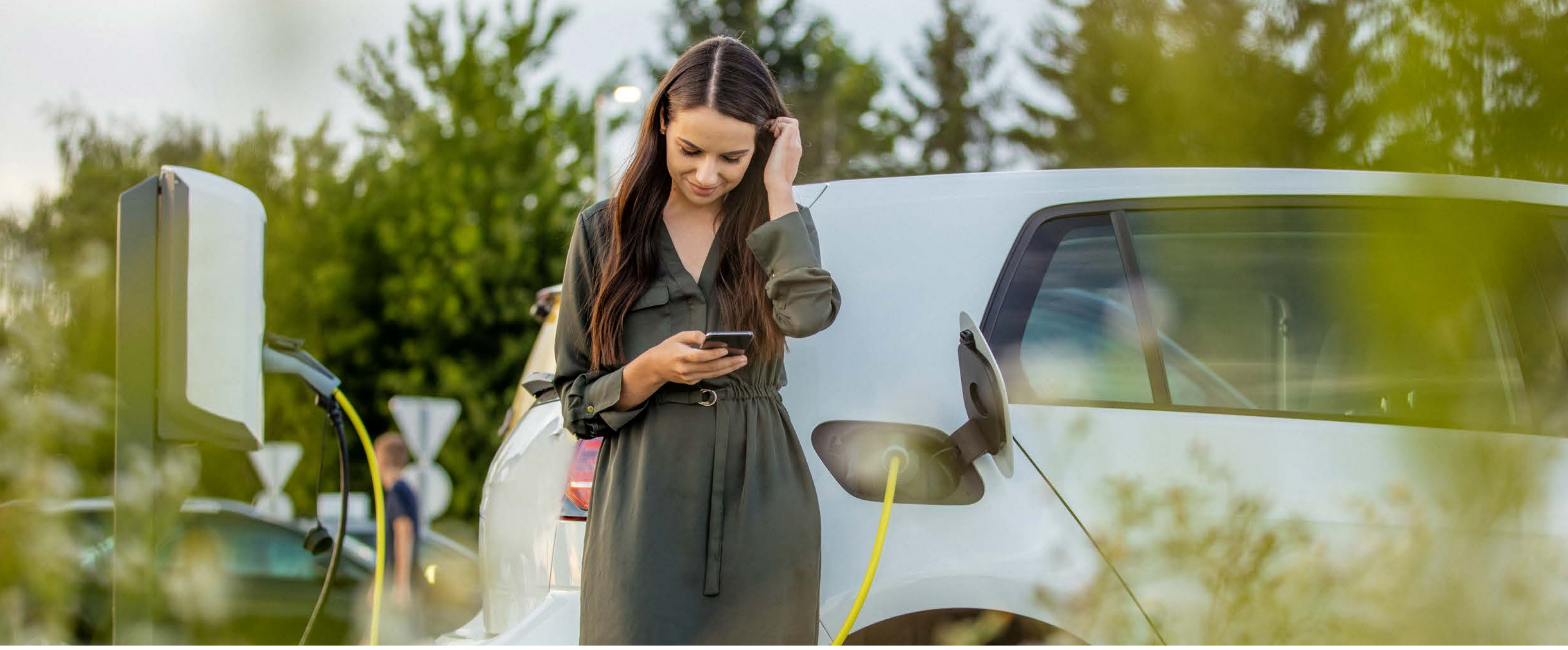
This is all the more important because time is of the essence – and not only due to the added urgency of mitigating an energy crisis. The International Energy Agency's (IEA) "Net Zero by 2050. A Roadmap for the Global Energy Sector"[1] report fleshes out the timeline for decarbonization compatible with the Paris Agreement in the buildings sector: By 2030, it stipulates, all new buildings should be zero-carbon ready, and universal energy access facilitated; by 2035 most appliances and cooling systems sold should be best in class to ensure no more energy-guzzling equipment is used; 2040 is the deadline to retrofit 50 percent of existing buildings to zero-carbon-ready levels; ultimately, by 2050 more than 85 percent of the building stock should be zero-carbon-ready.

Klinikum Bremerhaven-Reinkenheide: Cutting energy costs while addressing long-term decarbonization goals

Faced with rising energy prices, long-standing customer Klinikum Bremerhaven-Reinkenheide, a hospital near Hamburg, Germany, looked to Siemens for a solution which would decrease energy costs and reduce CO2 footprint.

A comprehensive decarbonization roadmap was proposed, with Siemens demonstrating synergies of optimized energy purchasing in combination with flexible decentralized energy generation, enabling a range of services.

With flexibility and energy purchase services, the customer has been able to save around EUR 320,000 per year in energy costs, which can be invested into core operations to continue providing world-class care and treatment to patients.



Enabling grids: Dealing with volatility and increased energy demand

It is not only the building sector that is under pressure to decarbonize. The energy sector will also have to step up significantly to meet the deadlines of the Paris Agreement – all while in the chokehold of an energy crisis. Its role is to keep energy affordable, and grids stable in uncertain times.

And the challenge will continue to grow. With the electrification of the mobility sector – by 2035, 60 percent of car and 50 percent of heavy truck sales will have to be electric – and the building sector, i.e., heating and cooling, the capacity of the electricity grid will have to increase threefold in the next 20 to 25 years.

60 percent of car sales will have to be electric by 2035

All combined, energy consumption will double in the next 20 years, while peak demand will triple. According to the IEA Roadmap for the Global Energy Sector, by 2035, the annual addition of installed solar and wind energy generating capacity will amount to 1,020 gigawatts. That is also the deadline for overall net-zero emissions from electricity generation in advanced economies.

In a cruel twist of irony, renewable energy is currently being wasted in many countries, including Germany, as the energy grid cannot support the volatility. This is why energy grids are undergoing a massive transformation to accommodate the increasing in-feed of stochastic renewable energy sources – which can only be done with the support of digitalization.

Digitalization will assist grid operators in their quest for stability in the absence of centralized generation assets. Storage solutions too are key for grid stability and digitalization is required to manage such solutions. Faced with volatility and uncertainty at the edge of the grid, operators are currently struggling to cope. Substantial conventional investments in power lines and transformers are of course still necessary, but will by themselves not solve the challenge we are facing. Grid software solutions will help to substantially diminish those costs by making the grid smart without massive investment. XaaS financing models further help to keep CAPEX down.

In addition, grid software cuts technical and non-technical losses, reduces time for troubleshooting, decreases OPEX, and increases flexibility and thus even the capacity of a grid. The flows in the network can be managed much more efficiently, and there is strong indication that digitized grids could even transport twice as much energy. Dealing with volatility becomes more feasible if there is real-time, actionable data, for example from Meter Data Management Systems, to inform contingency planning. AI will also be able to improve situational awareness by estimating future scenarios, such as the effect of the rapid growth of electric vehicles and renewable energy on a certain grid area.

Grid management with digital twin technology not only enables the sustainable integration of decentralized renewable energy resources to the grid, it also accelerates the energy transition. Approaches for the central management of corresponding data not only benefit the optimization of processes in the classic functions of grid operation and grid planning, but also support analyses in connection with renewable grid infeed, enable the efficient synchronization and thus qualitative improvement of data from different sources across all operational phases and operational units (e.g., also between TSOs and DSOs), and generally improve the transparency and controllability of the grid.

A large number of possible grid situations can thus be analyzed and evaluated even before they occur in the real grid. In addition, new digitalization approaches, such as artificial intelligence, can be made usable based on this data.

The scope is therefore vast, and let's not forget that grid transformation is also essential to ensure resilient, economical, and sustainable electrification. As we look to achieve a balanced energy mix, we mustn't underestimate the need to invest in our energy infrastructure by speeding up the electrification of existing infrastructure and by making existing assets smarter.

By 2050, the electricity grid will incorporate **90 percent renewables**

On the pathway to net zero by 2050, the energy sector will have to reach this goal early – preferably, of course, as soon as possible to decrease the detrimental dependence on fossil fuels. However, by 2040 at the latest, we should reach net-zero emissions from electricity generation on a global scale and phase out all unabated coal and oil power plants. By 2050, the electricity grid will incorporate 90 percent renewables, almost 70 percent of which from photovoltaics and wind.

Fingrid: A digital twin called Elvis

In a contract awarded to IBM by the Finnish transmission system operator Fingrid, Siemens has contributed a grid data management system for model management and a system for network analysis and simulation that enable a single digital network model (also known as a Digital Twin) of the Finnish power system. The model also goes by the name of ELVIS (Electrical Verkko Information System).

Connecting a variety of IT systems in one integrated solution, the Digital Twin allows the grid to be mapped, analyzed, and simulated in real-time, studying how the power transmission grid behaves in different operating situations and how it reacts to disturbances.

By linking asset management data as well as real-time and past measurements, the resulting big data is used to ensure the reliable and safe operation of the grid while also serving as the basis to evaluate the pros and cons of investments, resulting in savings of tens of millions of Euros.

ELVIS also turned around the ratio of automated (80 percent) to manual work (20 percent) in grid simulation. It saves resources, improves processes, and speeds up innovation through faster software development.

Conclusion

Software can undoubtedly help to solve the energy crisis – if we choose digital solutions that are open source, collaborative and modular to support our rapid transition away from fossil fuels. In this, we have to make the essential move away from corporate ego-systems to purpose-led ecosystems, building strong partner networks to ensure customers are supported unconditionally in their decarbonization journey. Partnerships are key, as collaboration will enable us to both speed up and scale the transition together.

Make no mistake, this transformation to net-zero requires serious investment: The IEA recommends a 2.8-fold increase in investments in clean energy. However, the redevelopment and digitalization of the grid will cost less than the Marshall Plan invested in Europe – 2 percent of GDP, which is of course substantial – but it means it is doable.

Essentially, while software is a vital enabler of the energy transition, it is also a means to speed it up. And at a time of energy crisis that comes on top of an ongoing climate crisis, amid great political and economic uncertainty in Europe and the rest of the world, swift solutions are what we need.

References

1. IEA (2021), Net Zero by 2050, IEA, Paris https://www.iea.org/reports/net-zero-by-2050, License: CC BY 4.0.

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