Tomorrow's energy: Connecting possibilities

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Energy is one of the most important prerequisites for the development of every society. Prosperity and growth depend directly on the reliability of a country's infrastructure, above all its energy system. Of course, the situation differs from country to country and from region to region. While the demand for electricity in industrialised nations is expected to remain fairly constant over the medium term, the hunger for electricity in many developing and emerging countries is soaring. Around 1.2 billion people worldwide still have no access to a regular power supply.

In order to ensure reliable, economical and climate-friendly power supplies, numerous issues have to be clarified. And there can be conclusive answers only when the search for solutions extends beyond national and regional borders, and only when one thinks in the larger context. There certainly is enough potential for improvements, and the resources as well as the required technologies are already available for sustainably realising the vision of "electricity for everyone."

If you look at the great potential of energy systems in individual countries, regions and continents theoretically available from the respective resources, you quickly get the impression of a world with an excess of energy. And in fact, there are more than enough resources to provide reliable electricity supplies to all of mankind. The problem is, the established energy systems throughout the world developed slowly and organically – that is, largely unstructured – over the last one hundred years. The consequence is that today we have a worldwide power plant fleet that converts only slightly more than one-third of the consumed primary energy resources into electricity. In other words, in large parts of the world, power supplies are primarily generated with ageing and inefficient technologies. Moreover, the development and expansion of energy infrastructures in many countries simply cannot keep up with the soaring demand.

The World Energy Congress in Daegu offers Siemens a welcome opportunity to take a closer look at the energy situation in various countries and regions. Our goal is not to focus on ways to make minor improvements here and there, but to think in a larger context. What overall opportunities does each energy system offer? What kind of savings of resources and capital could be achieved with the major restructuring of a country's power plant fleet or a major change in its current energy development plans? In a study, Siemens developed scenarios for various countries and regions – and revealed theoretical potential with impressive results.

Impressive potential

In both core areas of an energy system – power generation and distribution – one can calculate scenarios that offer high savings potential depending on the respective situation in the country or region. At the moment, these ideal calculations are only theoretical, yet nonetheless technically feasible.

Take Europe as an example. In many countries of the European Union there are development plans for renewable energies, in particular wind and solar. Considerable possibilities for optimisation would be available if one focused on the choice of locations. Around 138 gigawatts of new photovoltaic capacity alone will be installed in Europe by 2030. If solar units are built in the sunniest locations, the higher yield of electricity – thanks to better geographic conditions – would save 39 gigawatts in solar units, yet produce the same yield. This principle also applies to wind power. If one calculates the right scenario, around 45 billion euros in investments could be saved by 2030 in developing the share of renewable energies. The additional power grid expansions required by this scenario is already taken into account in the calculation.

The example of the United States demonstrates the benefits that modernisation of the power grid offers. A scenario in the study calculates that consequential costs of up to US$80 billion from blackouts could be eliminated every year with a modern system. Not only would the country's supply security be improved, but the power grid would be far more efficient and power losses would be reduced by 2 percentage points to 4.5 percent. This would translate to annual savings of 85 terawatt-hours with a market value of US$4 billion.

In China, on the other hand, the biggest lever in the energy system lies in expanding the country's renewable energies. Water, wind and solar already account for a 19 per cent share of China's energy mix. The government plans to increase this share to 27 per cent by 2030. If one developed theoretically feasible potential, a renewables share of nearly 50 per cent could be reached in the same period. As a consequence, CO_2 emissions of China's power sector would remain at today's level. Considering the enormous growth rates for the country's power consumption, the great potential available here is obvious. Similar savings in emissions, however, could also be achieved – with far lower investments – if substantially more natural gas were used rather than coal for China's fossil power generation.

One need only highlight some of these scenarios to

show the enormous savings potential that is available for a sustainable, secure – and above all, economical – energy supply. But there are two prerequisites for implementing these scenarios.

The first prerequisite is reliable investment conditions. The basis here is always a legal framework that, on the one hand, sends the right signals to investors to develop the most viable energy mix on the basis of the respective resource situation. On the other hand, all regulations should allow the greatest possible freedom for unhindered competition, since the best technologies can prevail economically only in a market-oriented environment.

As long as the energy system involves individual countries, responsibility here lies in the hands of the respective government. The situation is different in a community of states. In the European Union, for example, sovereignty for most energy legislation does not lie with the European Parliament and Council of Ministers, but rather with national governments. As a result, it is ambitious to try to create an integrated energy market in Europe. Yet exactly such conditions are necessary for creating a market for the location-optimised development of renewable energies.

Atrractive investment conditions must also allow the commodity of electricity to physically change ownership. At present, this is often impossible due to varying technical conditions among the countries, and not only in Europe. In order to turn the vision "electricity for everyone" into reality, there has to be a power grid infrastructure that securely connects and integrates countries and regions. Only then can the available energy potential be used reciprocally in the grids as well.

The second prerequisite for achieving comprehensive improvements in energy systems throughout the world is an ongoing flow of innovations. Every type of improvement is based on technical advances, whether it be shifting the power generation mix to renewables or making fossil power generation fleets more efficient. Thirty years ago, wind turbines had a maximum capacity of 300 kilowatts; today they have reached 6 megawatts. Another example is the efficiency of gas-fired power plants. While fossil plant fleets (coal and gas) worldwide operate at an average efficiency of slightly above 30 per cent, the most modern combined cycle plant from Siemens has an efficiency of over 60 per cent.

Innovations, of course, are not only necessary for increasing the performance and efficiency of energy systems, but also for making industries – such as the manufacturing of technologies for renewable energies – more economical. While the auto industry has generally optimised all of its industrial processes, the shift to industrial production for renewable technologies – such as for wind power plants – is still underway.

If a good and effective market design provides an optimal framework for investment security, the best technologies will also be used. In the end, innovative technologies for greater efficiency pay off through better climate and environmental protection as well as greater economic efficiency. And ultimately this means greater prosperity for all. ❑

Optimising renewable potential by putting more solar projects in the south and wind in the north could save €45 billion in investment costs by 2030