

Abstract

Can future energy needs be met through more integrated infrastructures? Nebojsa Nakicenovic

Fundamental, game-changing transformations are needed for a shift toward more sustainable development paths. By significant investment in new technologies and decarbonization multiple co-benefits can be achieved – from provision of affordable access to modern energy and creation of new business and economic opportunities to addressing the threat of climate change. Global energy perspectives will be presented that addresses these paradigm-changing, multiple energy challenges toward more sustainable futures. More integrated energy, mobility and information infrastructures are needed for achieving this transformational change.

Decarbonization of the global economy toward a carbon-free future is such a paradigm-changing transformation. In the energy area, this implies a shift from traditional energy sources, in the case of those who are excluded from access, to clean fossils and modern renewable energy, and in the more developed parts of the world a shift from fossil energy sources to carbon-free and carbon neutral energy services. In all cases this means a vigorous improvement of energy efficiencies, from supply to end use, expanding shares of renewables, more natural gas and less coal, vigorous deployment of carbon capture and storage, and in some cases (where it is socially acceptable and economically viable) also nuclear energy. All of these energy supply technologies need to mesh with emerging innovations in energy networks and end use in direction of smart integration. This would occur at a number of levels, from local and distributed to centralized generation. The very nature of energy end use is undergoing fundamental transformation as well toward more self-organization and internet-like structures and integration. At the same time, the increasing complexity from energy supply to end use poses high demands for new and more integrated infrastructures for energy, mobility and information. Energy infrastructures are becoming ever more outdated for the current needs of increasing energy trade, more intermittent sources and higher and higher demands from energy end use. They are fundamentally inadequate for the emerging future needs to decarbonize energy and integrate different systems locally and across the continents.

The emerging new energy systems and infrastructures require two complementary co-evolutions – one is technological and the other institutional. With new technologies and systems, new business models and institutional arrangements will emerge. All of these complementary and co-evolving transformations will require market, regulatory and behavioral changes.

The cumulative nature of technological and associated institutional changes, all compounded by deep uncertainties, require innovations to be adopted as early as possible in order to lead through experimentation and evolutionary changes to lower costs and wider diffusion in the following decades. The longer we wait to introduce these advanced technologies, the higher the required costs and emissions reduction will be as well as the “lock-in” into the old structures. The transformational change toward more sustainable futures requires enhanced research, development and deployment (public and private) efforts as well as early investments to achieve accelerated diffusion and adoption of advanced energy technologies and systems.

The ever more evident crisis of the “old” development patterns is an opportunity for the “new” ones to emerge.

