Box A[4]

Major challenges in the energy transition

Decarbonisation is a huge endeavour. Replacing fossil fuels will require investments in renewable plants, grids and pipelines, storage facilities, carbon-free fuel alternatives, as well as the rehabilitation of buildings, efficient industrial processes and appliances, new transportation technologies and smart systems. The envisioned transition is a tremendous opportunity for technology-driven, new economic growth, as long as Europe is in a position to produce this equipment domestically and implement investment in a cost-effective manner. Financing conditions, stable conditions for future markets and policy coordination, including effective regulation, are all necessary to implement new technologies and move along their steep learning curves.

Market coordination failure is a common problem when restructuring markets and technological innovations depend on many actors. The role of policymaking is to enable the coordination of investment decisions by infrastructure developers, technology developers, manufacturers, financing institutions and, most importantly, final consumers in the uptake of new technologies. In this way, market coordination will bring positive benefits such as cost reductions and improved performance.

The quantitative assessment of the European Commission's decarbonisation strategy, performed using the PRIMES energy system model, among others, illustrates that irrespective of the technologies used all scenarios achieving decarbonisation imply a significant increase in investment in energy. The largest portion of that investment, 60-65%, would need to go to energy consumers for building rehabilitation, improved industrial processes, efficient equipment and new transportation technologies. About 35-40% would need to go to energy suppliers to develop and reinforce energy infrastructure, to build plants using renewable sources and new facilities for storing energy, and to factories for producing carbon-free hydrogen and synthetic fuels.

The majority of energy sector projects have long lead times and operation lifetimes. The projects are typically irreversible economic decisions and present high risks of locking in particular technologies or approaches if not well planned. The learning process behind technology development and the achievement of economies of scale in industry are also long-term processes. Therefore, investment plans, cautiously designed with clear priorities in mind, should be moved to the top of the European Union's agenda as early as possible. Besides, economic analysis has shown that failure to invest in technology and infrastructure in 2020-2030 will result in higher costs and emissions in the future, rendering the next decade as a "lost decade".

The emergence of carbon neutral gaseous fuels, whose carbon footprint is very low or even zero, would make it possible to continue using the extensive European gas transmission and distribution network. However, gas infrastructure should be adapted to accommodate a paradigm shift in which the majority of gas is no longer imported into Europe Union via pipeline or liquefied natural gas (LNG) terminals, but is rather produced domestically. The new gas infrastructure will have to accommodate multiple energy generation points at its core rather than its periphery, and be able to transport gases towards regions that cannot produce this type of energy.

Furthermore, the grid infrastructure for electricity transmission will have to be extended considerably to access renewable energy produced in remote areas, supply electricity to centralised facilities producing hydrogen and carbon neutral fuels, and fully integrate the markets to balance resources effectively. At the same time, the electricity distribution system will have to expand significantly to integrate battery-recharging networks, be able to respond to demand and highly dispersed generation and reap the full benefits of digitalisation.

4 The text in this box was provided by Pantelis CAPROS, Professor of Energy Economics, Head of E3MLab/National Technical University of Athens.

It is worth noting that the final consumers, households and firms, will have to take on the biggest part of the investment needed. However, most individuals are highly risk-averse, and their investment decisions depend on their disposable income. Uncertainty about the future of certain technologies and imperfect information dampen consumers' willingness to invest in new energy infrastructure. Moreover, lower-income households are unlikely to have the cash available to invest in building rehabilitation and the purchasing of more efficient appliances or vehicles. The result is a new type of "technology poverty" that can further exacerbate the conditions of people already living in energy poverty.

The common approach of financial institutions to energy investment must be revisited. Certain issues that need to be tackled are methods for assessing infrastructure projects, the funding conditions required for the rapid industrialisation of proven but not yet fully mature alternative fuels and technologies, the promotion of platform business models to help integrate renewable production and, most importantly, effective ways to facilitate fundraising by individuals. A model-based macroeconomic assessment of the European Commission's long-term strategy, based on the GEM-E3 general equilibrium model, has shown that the financing conditions available determine the impact the energy transition has on the European Union's GDP. Under certain conditions, adequate financing could support new growth and jobs created by the replacement of imported fossil fuels.

The consumer's role in the energy transition

The energy transition is more than a gradual switch to low carbon power generation. It requires a step change in how people live, work and spend time together. Consumers determine energy consumption when they buy a house, a vehicle, electronics or groceries. A successful energy transition will require consumers to be aware of their impact on energy consumption and to play their role in moving towards a low carbon economy.

Consumption levels in the developed world will need to account for the economic growth of developing countries. Mitigating the impacts of climate change requires the combined efforts of developed as well as developing countries. However, it is particularly important for a globally just transition that consumption in the developed world factors in the growing demand for energy from developing countries. These countries have rapidly expanding economies and corresponding living standards, and they need to meet the basic needs of their population for food, water and electricity. Technological progress can reduce the developed world's climate impact, but the transition will also require more conscientious consumer choices. Balancing these more conscious consumption patterns with social well-being and sustainable economic growth will be key to a successful energy transition.

Consumers will play an active role in the energy transition by adjusting their electricity demand and supplying energy to the grid. In addition to changing consumption patterns, the energy transition will gradually turn consumers into "prosumers", where they are able to sell electricity back to the grid. Most EU countries already have the regulatory framework in place for this to happen. This will be increasingly important as our society further electrifies, which will require a better matching of energy supply and demand due to greater volatility. Consumers will be able to participate in this process not only by providing electricity, but also by adjusting their electricity demand (e.g. appliances, vehicles, heating) to the available supply.

Impact of the energy transition – economic growth, employment and equality

The energy transition can lead to increased economic growth and additional jobs, particularly if Europe can leverage the domestic production of low carbon technologies. The model-based