



SMART CITY

A View of the UK's New Energy System

Dr Ana Cortes, EBRI

The organisation of society has been and will continue to be steered by access to energy. This will not change in the future, however, resources and consumption patterns have been extremely dynamic during the 21st century and will continue to change rapidly. Driven by social, environmental, political and economic concerns, the integration of renewable sources of energy is already astonishing and the energy revolution is beginning to turn into potentially one of the most radical and accelerated technology transitions in modern history. Although fossil fuels are still the main source of energy in Europe (77% of the energy mix), the integration of renewable resources has been increasing rapidly. In 2010, solar photovoltaics (also known as solar PV) was the largest source of new installed capacity with wind installations in third place (after gas). This means that it is likely that the targeted reduction of 20% in greenhouse gas (GHG) emissions by 2020 (compared to 1990 levels) will be met¹,

which has been confirmed by data collected by the European Environmental Agency (EEA).

In the UK, fossil fuel dependency has gone down from 91 to 80%, with the largest contribution to this reduction coming from the energy generation sector. As in the rest of Europe, transport keeps being the sector with strongest dependency on petroleum derived fuels (see pie charts on next page). The progressive integration of renewable resources into energy generation already has shown astounding results, with record breaking renewable generation shares observed during the last two years. Since the introduction of the Climate Change Act in 2008, the share of low carbon energy generation increased from 19% to a record of 53% in the spring of 2017. The 21st of April 2017 was the first day since the industrial revolution where the energy system was free from coal powered generation. A new record was

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UK Power Generation Facts

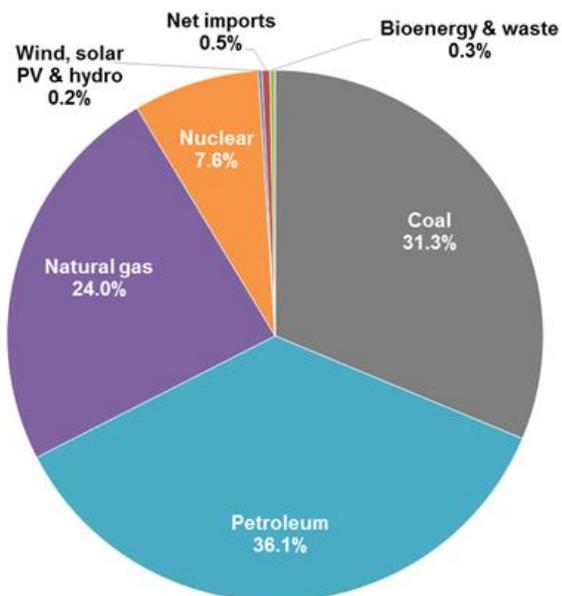
-  **57%** Total emissions from energy supply decreased 57% between 1990 and 2016, and CO₂ emissions decreased 36%.
- 53%**  Low carbon energy generation increased from 19% in 2008 to a record 53% between April and May 2017.
- 3 DAYS** For the first time after 1882, all coal-fired power plants were offline for 3 days in a row (April 2018).
-  **66%** Transmission connected capacity is now on average below 66% of the total generation capacity.

established in April 2018 when all coal-fired plants were offline for three days in a row. These changes have translated into a significant reduction in general emissions, reaching 43% in GHG and 38% in carbon dioxide during 2017 compared to 1990. Total emissions from energy generation processes were cut 57% during the same period². Most of the generation capacity available in the UK can now be classified as low carbon and transmission generated capacity is now only 55 to 66% of the total generation

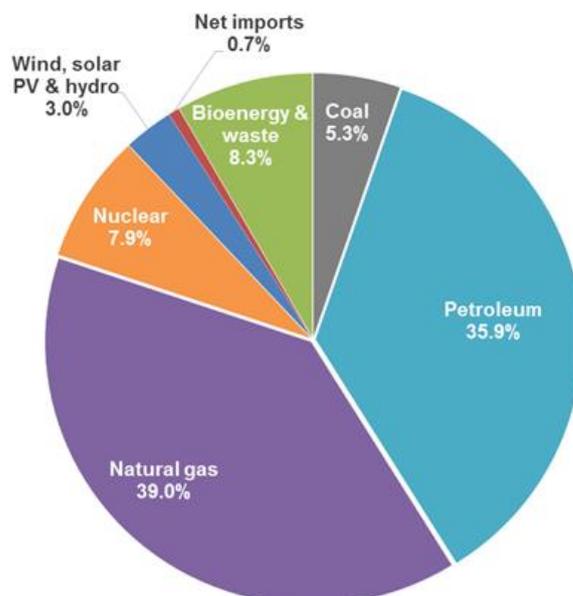
capacity, with the rest being covered by distributed or localised generation systems.

The UK's adoption of more sustainable energy resources has changed the role of the consumers, including residential consumers, businesses, organisations and district network operators. They have gradually abandoned their passive role within the energy system, evolving into generators and managers of their own

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UK primary fuel consumption in 1990



UK primary fuel consumption in 2017

Progress in UK share of primary fuels—1990 vs. 2017

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energy. Together with the uptake of distributed generation and electric vehicles, this new consumer role has resulted in new challenges for the existing energy system. The importance of local networks has grown significantly, turning distribution network operators (DNOs) into distribution system operators (DSOs) who are capable of not only maintaining the network, but also managing local electricity generation and use.

A large number of innovative smart solutions will be required as the system turns more decentralised, disaggregated and multivector, where many solutions will have to come together for the system to work and all the stakeholders benefit from it. New technical and business challenges are arising as new roles and interactions are created in the transition towards a low carbon energy system. The development and integration of innovative solutions within different levels of the energy system are an opportunity to provide technologies and services that were not required before. These solutions have to consider the system as a whole to make sure they are all compatible and synergistically improve the efficiency of the energy system.

A good example of new business opportunities arising is the smart integration and management of electric vehicles (EVs), which will not only be

“According to the EEA, registration of battery EVs went from 700 in 2010 to 97,000 in 2017. Uptake keeps increasing, with sales growing 51% between 2016 and 2017. The UK, together with France and Germany, are the countries with highest uptake in recent years.”



key in breaking transport's dependency on fossil fuels, but also represents an opportunity to provide flexibility to the energy system. Different business models are being developed so EVs can provide grid services from which owners can also get an extra income, such as demand response and active network management. The implementation of bi-directional charging, commonly referred to as vehicle-to-grid (V2G), could also provide the system with additional balancing services by enabling the use of the power in the vehicle's battery. Smart solutions will allow to charge the EVs when demand is low and there is an excess of electricity, and will discharge the battery providing support power when demand surpasses supply. The use of V2G will be more relevant as the share of intermittent renewable generation from solar PV and wind increases, with a potential flexible capacity of 370GW from all EVs on UK roads³.

References

¹ EEA Report No 16/2018. Trends and projections in Europe 2018 - Tracking progress towards Europe's climate and energy targets.

² Digest of United Kingdom Energy Statistics (DUKES) 2018.

³ EEA Report No 16/2018. Trends and projections in Europe 2018 - Tracking progress towards Europe's climate and energy targets.



Dr Ana Cortes
Business Research
Associate, Energy
Systems, EBRI