June 2023

Progress in reducing emissions

2023 Report to Parliament

Climate Change Committee

Executive summary

For many in the UK, 2022 was the year that climate change arrived, with the UK's first ever 40°C day.* It was the UK's warmest recorded year and one of the six warmest years on record globally. The record-breaking temperatures seen in the UK in summer 2022 brought unprecedented numbers of heat-related deaths, wildfire incidents and significant infrastructure disruption. Human activities are causing our climate to change. Only decisive action will slow further changes.

The UK has lost its clear global leadership position on climate action. We are no longer COP President; no longer a member of the EU negotiating bloc. Our response to the recent fossil fuel price crisis did not embrace the rapid steps that could have been taken to reduce energy demand and grow renewable generation. We have backtracked on fossil fuel commitments, with the consenting of a new coal mine and support for new UK oil and gas production – despite the strong wording of the Glasgow Climate Pact. And we have been slow to react to the US Inflation Reduction Act and the EU's proposed Green Deal Industrial Plan, which are now a strong pull for green investment away from the UK. It is critical that the UK re-establishes its climate leadership with a clearer strategy to develop Net Zero industries and technologies in the UK and capture the economic benefits of Net Zero, with actions that create demand-pull for the critical technologies that will shape the UK's progress over the next decade.

This year saw the release of new detail on the Government's plans for Net Zero with the publication of the Carbon Budget Delivery Plan (CBDP) prompted by last year's High Court judgement. But policy development continues to be too slow and our assessment of the CBDP has raised new concerns. Despite new detail from Government, our confidence in the UK meeting its medium-term targets has decreased in the past year. The increased transparency embodied in the CBDP is welcome, but a key opportunity to raise the overall pace of delivery has been missed.

At COP26, the UK made stretching 2030 commitments in its Nationally Determined Contribution (NDC) – now only seven years away. To achieve the NDC goal of at least a 68% fall in territorial emissions from 1990 levels, the rate of emissions reduction outside the power sector must almost quadruple. Continued delays in policy development and implementation mean that the NDC's achievement is increasingly challenging. Some of the key planks of the UK Net Zero Strategy have substantial lead-times (e.g. hydrogen storage, greenhouse gas removals and carbon capture and storage (CCS) more generally). Progress in other areas is also too slow, including tree planting and the roll-out of low-carbon heating. There continues to be an overly narrow approach to solutions, which crucially does not embrace the need to reduce demand for high-carbon activities. A more realistic approach to delivery is needed. This cannot wait until after the next General Election.

* Without human activity, the 40°C heatwave would have been extremely unlikely. World Weather Attribution (2022) *Without human-caused climate change temperatures of 40°C in the UK would have been extremely unlikely.*

The key messages in this report are:

- **A lack of urgency.** While the policy framework has continued to develop over the past year, this is not happening at the required pace for future targets. The Net Zero target was legislated in 2019, but there remains a lack of urgency over its delivery. The Net Zero transition is scheduled to take around three decades, but to do so requires a sustained high-intensity of action. This is required all the more, due to the slow start to policy development so far. Pace should be prioritised over perfection.

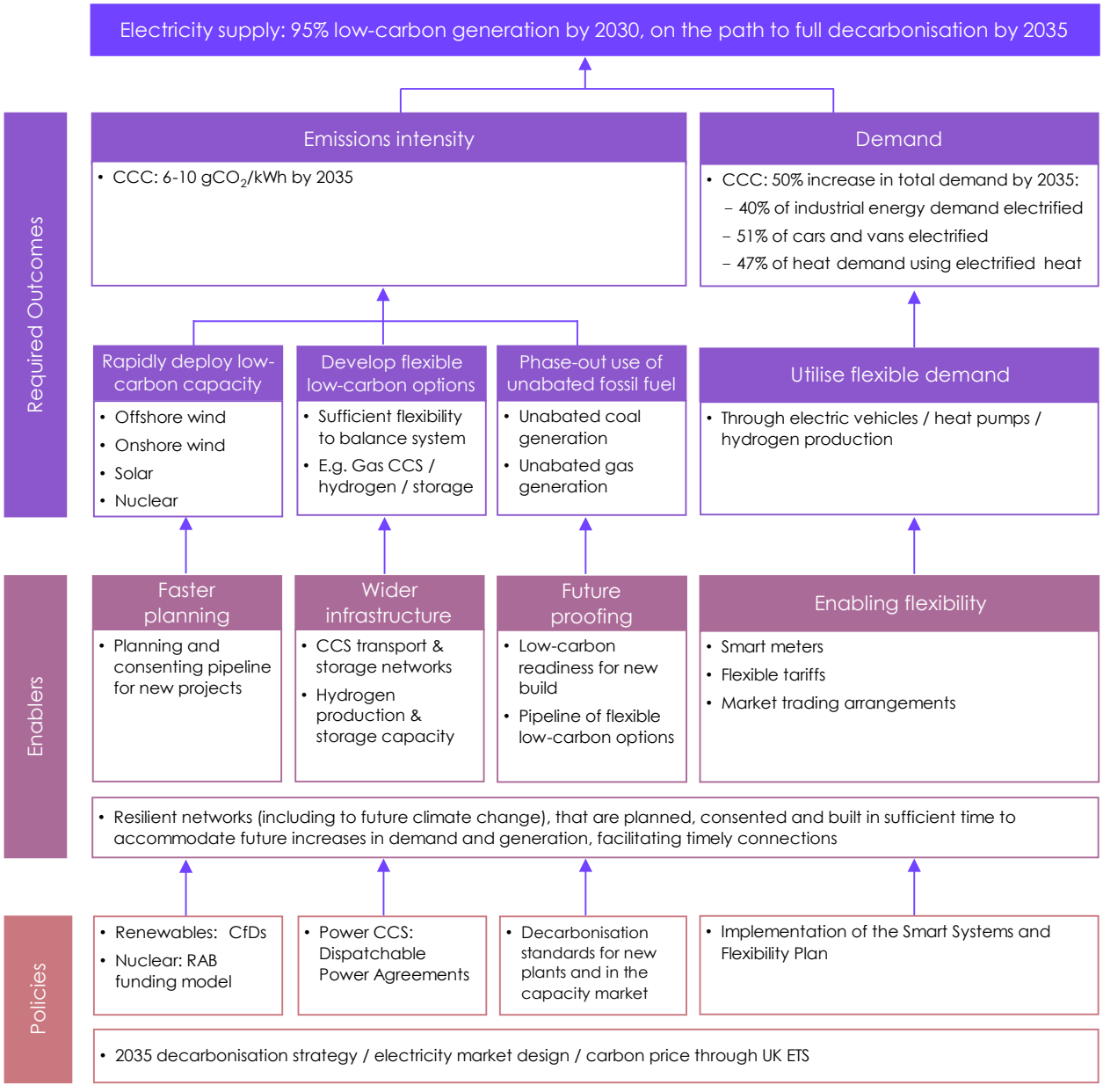
- **Stay firm on existing commitments and move to delivery.** The Government has made a number of strong commitments, notably on the 2030 fossil fuel vehicle phase-out, the 2035 decarbonisation of the electricity system, the commitment to install 600,000 heat pumps per year by 2028, and the deployment at scale of new industries such as hydrogen and greenhouse gas removals. These must be restated and moved as swiftly as possible towards delivery, including by ensuring the UK has the skills base it needs to deliver on its commitments and building on its promising plans to guide private sector action and investment. The recent announcement of up to £20 billion funding for CCS is welcome – we look forward to the detail and implementation of these spending plans.

- **Retake a clear leadership role internationally.** The UK will need to regain its international climate leadership. This means taking urgent action to reduce emissions in line with delivering the UK's ambitious NDC for 2030 and fulfilling other pledges made in international climate negotiations, ensuring that decisions on UK fossil fuel production and infrastructure are consistent with Net Zero and the UK's expectations of others, and putting climate back at the front and centre of UK diplomacy from the highest level.

- **Immediate priority actions and policies.** Action is needed in a range of areas to deliver on the Government's emissions pathway. New policies are urgently needed in industry, especially in the steel sector where the Government has high ambitions for decarbonisation but no policy to deliver it, as well as wider incentives for electrification of industry. Policies are required to step up the rates of tree planting and peatland restoration. The Government needs to overcome the uncertainty being caused by its planned 2026 decision on the role of hydrogen in heating, to accelerate deployment of electric heating and press ahead with low-regret energy infrastructure decisions. We welcome the commitment to rebalance electricity and gas prices by spring 2024, which will support electrification.

- **Develop demand-side and land use policies.** The Government's current strategy has considerable delivery risks due to its over-reliance on specific technological solutions, some of which have not yet been deployed at scale. This lack of balance carries considerable and increasing risks to meeting the emissions targets. Recent experience on societal changes (e.g. to travel patterns) following the pandemic has shown that substantial changes to behaviours are possible, although these have not been due to climate policy. It is essential that policies to empower and support people to make low-carbon lifestyle choices are implemented now, especially on home energy use, shifting to healthier and more sustainable diets, and reducing air and car travel. Further strengthening of policy in these areas may be required subsequently given risks of shortfalls in delivery elsewhere.

Figure 7.1 Monitoring map for electricity supply



Source: CCC analysis.

The CCC's monitoring map for electricity supply (Figure 7.1) sets out the policies, enablers and required outcomes for a successful transition. This report focuses on ten key indicators, with additional indicators available in the supplementary material presented alongside this report. Our Monitoring Framework documents the indicators we track and our approach for assessing progress.[7]

Emissions in the electricity supply sector fell slightly in 2022, down 1% since 2021 to 48 $MtCO_2e$.

Emissions. Electricity supply emissions fell slightly in 2022, down 1% since 2021 to 48 $MtCO_2e$ (Figure 7.2a and 7.3), despite a rise in total UK electricity generation. The UK was a net exporter of electricity for the first time in recent history.

UK electricity demand fell in 2022 compared to 2021, due to lower consumption in industry and residential buildings.

Electricity demand. Demand within the UK fell to 273 TWh in 2022,* a decrease of 4% compared to 2021, due to lower consumption in industry and residential buildings (Figure 7.4).

- Both residential and industrial demand, including iron and steel, fell by around 6% relative to 2021 levels. Demand from other final users, including commercial demand, increased by 1% compared to 2021 levels.

- This decrease in electricity demand likely reflects the impact of increased electricity prices as a result of the spikes in fossil fuel prices following Russia's invasion of Ukraine, incentivising consumers to reduce consumption.

Emissions-intensity of UK generation decreased by 7% in 2022. 56% of electricity generated came from low-carbon sources.

Emissions-intensity. The emissions-intensity of UK generation decreased by 7% to 167 gCO_2/kWh. Although generation from fossil fuels increased slightly compared to 2021, low-carbon generation increased its share of the generation mix. Overall, 56% of electricity generated in 2022 came from low-carbon sources, with the majority of the remaining production coming from gas (Figure 7.5).

- **Low-carbon generation.** Electricity generation from low-carbon sources was 9% higher in 2022 than in 2021, largely due to record levels of wind generation.

  – Wind generation increased to a record 80 TWh, up 24% on 2021. This was due to a 3 GW increase in capacity (up 12%) and wind speeds returning to more normal levels following unusually low wind speeds in 2021 (Figure 7.6).

  – Solar generation increased to 14 TWh, up 15% compared to 2021, due to an increase in the number of hours of sunshine (up 19%) and a 0.7 GW increase in capacity (up 5%).

  – Nuclear generation increased by 4%, despite operational nuclear capacity reducing by 25% by the end of 2022, due to the closures of Hunterston B and Hinkley Point B.[2]

- **Generation from fossil fuels.** There was a fall in overall emissions-intensity, despite generation from fossil fuels increasing by 1% in 2022 compared to 2021.

  – Gas generation rose by 2 TWh to 125 TWh, an increase of 2% compared to 2021.

  – Coal generation fell by 1 TWh to 6 TWh, a decrease of 14% compared to 2021. Coal now provides less than 2% of electricity generation (Figure 7.5).

The UK became a net exporter of electricity for the first time in more than 40 years.

Electricity exports. Total UK generation increased by 6% in 2022 compared to 2021, despite falling demand within the UK, as electricity exports rose to record levels. The UK became a net exporter of electricity for the first time in more than 40 years (Box 7.1).

* As measured by final consumption.

- Total exports rose to a record 21 TWh, an increase of 400% compared to 2021. This increase was likely driven by lower gas prices in the UK compared to mainland Europe and by French nuclear outages.

- In particular, the UK's capacity to import liquefied natural gas (LNG) meant that it was able to act as a 'land bridge', importing gas and re-exporting some of this energy through interconnectors both as fossil gas and electricity (i.e. generated using UK gas-fired capacity).

Box 7.1
UK electricity exports in 2022

Change in UK electricity exports in 2022. In 2022, the UK became a net exporter of electricity for the first time in more than 40 years, with net electricity transfers changing from 25 TWh imported into the UK to an export of 5 TWh (Figure B7.1).

- Total electricity exports from the UK rose to record levels of 21 TWh, an increase of 400% compared to 2021.
- The biggest change was seen on interconnectors connecting to France, with net imports to the UK changing from 14 TWh in 2021 to -10 TWh in 2022.

Drivers. The UK's shift to a net electricity exporter in 2022 was likely due to lower wholesale gas and electricity prices in the UK relative to mainland Europe, and outages in the French nuclear fleet.

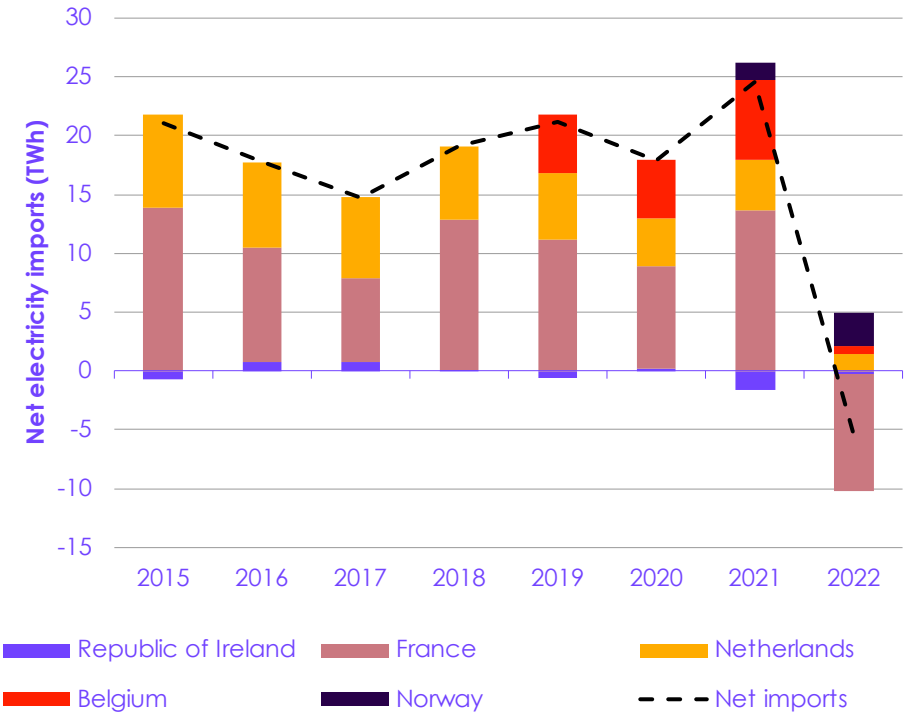
- Lower gas prices in the UK relative to mainland Europe:
  - Following Russia's invasion of Ukraine, European countries have moved to reduce their pipeline imports of Russian natural gas. As a result, European demand for LNG surged, leading to high global gas prices.
  - As the UK is less dependent on pipeline imports of Russian natural gas and had capacity to receive LNG imports in excess of UK demand, the UK had lower wholesale gas prices relative to those in mainland Europe. This meant that the UK was able to act as a 'land bridge', importing gas and re-exporting some of this energy through interconnectors both as fossil gas and electricity (i.e. generated using UK gas-fired capacity).
- Outages in the French nuclear fleet:
  - French nuclear generation fell by 82 TWh in 2022 compared with 2021, a decrease of 23%, leaving mainland Europe short on generation capacity.[8] The average unavailability rate of French nuclear reactors was around 46% in 2022, as a result of maintenance delayed due to the COVID-19 pandemic and corrosion stress problems in some reactors.[9]
  - High river temperatures during the summer heatwave also restricted EDF's access to river water for cooling, leading to a further temporary reduction of output.[10]

It is unclear whether 2023 will bring a return of the long-term trend of net electricity imports to the UK. While the availability of France's nuclear fleet is slowly increasing, which may see capacity shortages ease on the continent, it is less clear whether the differential in gas prices between the UK and mainland Europe will be a significant driver in the longer-term.

Emissions impact of increased electricity exports. It is difficult to determine the impact of increased electricity exports on the UK's emissions in 2022. It is impossible to directly attribute electricity exports to a particular generation source and the counterfactual scenario, in the absence of the invasion of Ukraine, is uncertain. However, it is likely that UK territorial electricity supply emissions would have fallen further in 2022 if exports had been in line with historical levels. This is supported by both the overall reduction in UK electricity demand and the decrease in the emissions-intensity of generation in 2022.

We estimate that around 3 $MtCO_2e$ (6%) of the UK's electricity supply emissions in 2022 might be attributable to the increase in electricity exports based on the change in generating patterns.

Figure B7.1 UK net electricity imports by country (2015-2022)



Source: DESNZ (2023) *Energy Trends*; CCC analysis.
Notes: Figure shows net imports (i.e. total imports minus total exports).

Source: CCC analysis.

Indicators. For the electricity supply sector, we use a range of indicators in our progress monitoring of renewables, low-carbon flexibility and utilisation of flexible demand (Figure 7.2). These have been updated relative to last year to reflect new analysis undertaken for, and subsequent to, our recent report on Delivering a reliable decarbonised power system.[11]

Renewable energy generation capacity continued to grow in 2022, but below the rate required to meet the Government's stretching targets.

- **Deployment of renewable energy.** Renewable energy generation capacity continued to grow in 2022 but below the rate required to meet the Government's stretching targets.
  - A further 2.7 GW of offshore wind was deployed in 2022 (Figure 7.2b), which is slightly off track for the Government's ambitious target to reach up to 50 GW by 2030.[12] An average annual deployment rate of 4.5 GW is required to deliver 50 GW of offshore wind by 2030.
  - Both onshore wind and solar deployment are progressing more slowly than offshore wind, in part due to barriers in the planning system, despite being among the cheapest forms of electricity generation.
    - Only 0.3 GW of onshore wind was deployed in 2022 (Figure 7.2c). The Government does not have a target for onshore wind capacity, but current deployment rates are slightly off track relative to the Balanced Pathway from our Sixth Carbon Budget analysis.

- In 2022, 0.7 GW of solar was deployed (Figure 7.2d). The deployment of solar capacity is significantly off track to meet the Government's target of 70 GW by 2035.[12] An average annual deployment rate of 4.3 GW is required to deliver 70 GW of solar by 2035.

The share of unabated gas in electricity generation remains high at 38% in 2022, which we consider to be slightly off track.

- **Phase-out of unabated gas.** The share of unabated gas remains high at 38% in 2022, which we consider to be slightly off track (Figure 7.2e).
  - Generation from unabated gas is expected to fall as low-carbon capacity continues to grow and needs to be almost completely phased-out by the mid-2030s. It is a high-level indicator of whether progress in decarbonising the sector is on track.
  - The unabated gas share of generation in a given year will depend on a wide range of factors, including: the overall level of electricity demand; the amount of installed low-carbon capacity and flexible resources on the system; weather conditions; availability of network capacity; requirements for ancillary services; the degree of interconnector usage and whether the UK is a net importer or exporter of electricity (which was one driver of unabated gas use in 2022).
  - As illustrated in our March 2023 report on Delivering a reliable decarbonised power system, the share of unabated gas in electricity generation will need to approximately halve from 2022 to 2025. We therefore consider this indicator to be slightly off track, noting that all of our above renewables deployment indicators are currently off track.

Our modelling suggests that we will need to significantly ramp up deployment of dispatchable low-carbon capacity this decade.

- **Dispatchable low-carbon capacity.** While it is too early to say whether current progress in this area is on track overall, our modelling suggests that these solutions will need to ramp up significantly this decade (Figure 7.2f and 7.2g).
  - A portfolio of dispatchable low-carbon capacity (e.g. gas with carbon capture and storage (CCS) and hydrogen-fired gas plants) is essential for a resilient, low-carbon electricity system and will need to be deployed rapidly and at scale. The next three years will be critical in delivering the planning and infrastructure changes necessary for the deployment of these technologies, as well as commercialising new business models.
  - The capacity of dispatchable low-carbon generation in operation will need to reach 3-6 GW by 2028 (Figure 7.2f). To achieve this, projects need to be in development several years prior. Our modelling suggests that 4-11 GW of dispatchable low-carbon capacity needs to be in development by 2025. Our analysis indicates that there is currently at least 7 GW of dispatchable low-carbon capacity in development based on eligible power CCS projects in the Government's Cluster sequencing Phase-2 process and known hydrogen power plant projects.[13] We consider this to be on track to meet requirements for 2025 (Figure 7.2g).

Grid storage capacity is growing, with a considerable pipeline of battery storage in development.

- **Grid storage and active demand response.** We consider grid storage to be on track due to a considerable pipeline of grid-scale battery storage in development, assuming these are able to gain network connections. It is

too early to say whether current progress on active demand response is on track, but we expect to see tangible progress by 2025.

  - The power output capacity of grid storage is currently around 2 GW.[14] This will need to rise to 7 GW by 2025 and 8-9 GW by 2028 (Figure 7.2h). Grid storage capacity in Great Britain will more than double by next winter, as 2.3 GW of new-build battery storage won contracts for delivery in 2023/24 in the recent T-1 Capacity Market auction.[15] A further 5.0 GW of new-build battery storage won contracts for delivery in 2026/27 in the recent T-4 auction.[16] Overall, there is around 50 GW of capacity in the pipeline.[17] Based on this considerable pipeline, we judge this indicator to be on track.

  - Our modelling suggests that active demand response will need to reach 2-3% of total demand by 2028 (Figure 7.2i).

  - However, a full picture of the extent to which peaks in demand for electricity are reduced by flexibility (time-shifting of demand or reduction) is difficult to determine at present due to data gaps. As a result, we consider it is too early to say whether progress on active demand response is on track.

The roll-out of smart meters is slightly off track, with smart meters making up 55% of total electricity meters in 2022.

- **Smart meter uptake.** The roll-out of smart meters is slightly off track, with smart meters making up 55% of total electricity meters in 2022 (Figure 7.2j).

  - Smart meters are a critical enabler for delivery of a decarbonised power system by 2035 as they are needed to measure the use of electricity on a half-hourly basis and reward flexibility. The Government has set out a firm commitment and policy framework to drive a market-wide roll-out of smart meters by 2025.[18]

  - In 2022, 50% of domestic and non-domestic electricity meters were smart meters operating in smart or advanced mode.* This does not include an additional three million smart meters which have been installed but are currently operating in traditional mode. Overall, 55% of domestic and non-domestic electricity meters were smart meters in 2022. Although there is a clear policy framework in place, we currently judge this to be slightly off track as uptake needs to accelerate out to 2025 and there is a risk remaining domestic and non-domestic customers may have lower appetite or face other barriers to installation.

  - Delivering on a market-wide roll-out of smart meters will not deliver demand flexibility benefits on its own. It also needs to be ensured that all smart meters have adequate communication performance in practice, so that network and system operators can use the data they collect. This is covered in more detail in Section 2.

* Smart meters operating with smart functionality are referred to as 'operating in smart or advanced mode'. Advanced mode refers to advanced meters, which are a subset of smart meters that are available to non-domestic customers and must, at a minimum, be able to store half-hourly electricity and hourly gas data, to which the non-domestic customer has timely access, and the supplier has remote access. Smart meters that have temporarily lost smart functionality (e.g. due to a switch of energy supplier) are referred to as 'operating in traditional mode'.