Carbon neutrality by 2030

Development of a new
Carbon Neutrality Strategy for the
Government of Jersey

Prepared for
Government of Jersey

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Contents

Oxera Consulting LLP is a limited liability partnership registered in England no. OC392464, registered office: Park Central, 40/41 Park End Street, Oxford OX1 1JD, UK; in Belgium, no. 0651 990 151, branch office address: Avenue Louise 81, 1050 Brussels, Belgium; and in Italy, REA no. RM - 1530473, registered office: Via delle Quattro Fontane 15, 00184 Rome, Italy. Oxera Consulting GmbH is registered in Germany, no. HRB 148781 B (Local Court of Charlottenburg), registered office: Rahel-Hirsch-Straße 10, Berlin 10557, Germany. Oxera Consulting (France) LLP is registered in Neuilly-sur-Seine, SIRET 844 900 407 00025, registered office: 60 Avenue Charles de Gaulle, CS 60016, 92573 Neuilly-sur-Seine, France. Oxera Consulting (Netherlands) LLP is registered in Amsterdam, KvK no. 72446218, registered office: Strawinskylaan 3051, 1077 ZX Amsterdam, The Netherlands.

Boxes, figures and tables

Executive summary

In light of the States Assembly's vote to achieve carbon neutrality by 2030, the Government of Jersey commissioned Oxera to:

- review best practices of international decarbonisation policy with the aim of identifying a set of policies that would enable the Government of Jersey to achieve its decarbonisation agenda, building on the 2014 Energy Plan; and
- determine which policies to prioritise in future analysis, for example in assessing the value for money of various policy options.

Accordingly, this report undertakes the initial research that is needed to inform the development of a new Carbon Neutrality Strategy for the Government of Jersey. This is expected to be followed by more detailed scoping analysis in developing specific policies, to deliver the Government's decarbonisation agenda.

The review of current data on emission sources in Jersey, as well as past work conducted by the Government of Jersey and its advisers, highlights the two main priority areas as the transport and heating sectors. In our review of case studies from other jurisdictions we have therefore focused on decarbonisation strategies in the power generation, transport and heating sectors. As the power generation sector in Jersey is almost entirely decarbonised due to interconnection to France, we have considered, in particular, how low-carbon electricity can be used in the decarbonisation of the transport and heating sectors.

In selecting the most relevant jurisdictions for case studies, we focused on jurisdictions that exhibit:

- internationally recognised, progressive decarbonisation policies;
- a high level of domestic carbon prices (as one indicator of the strength of national decarbonisation ambitions);
- similar drivers of emission to those in Jersey (i.e. high emissions from transport and heating, and relatively low emissions from power generation);
- challenges similar to those faced by Jersey as an island economy.

Based on these considerations, we selected the following seven jurisdictions:

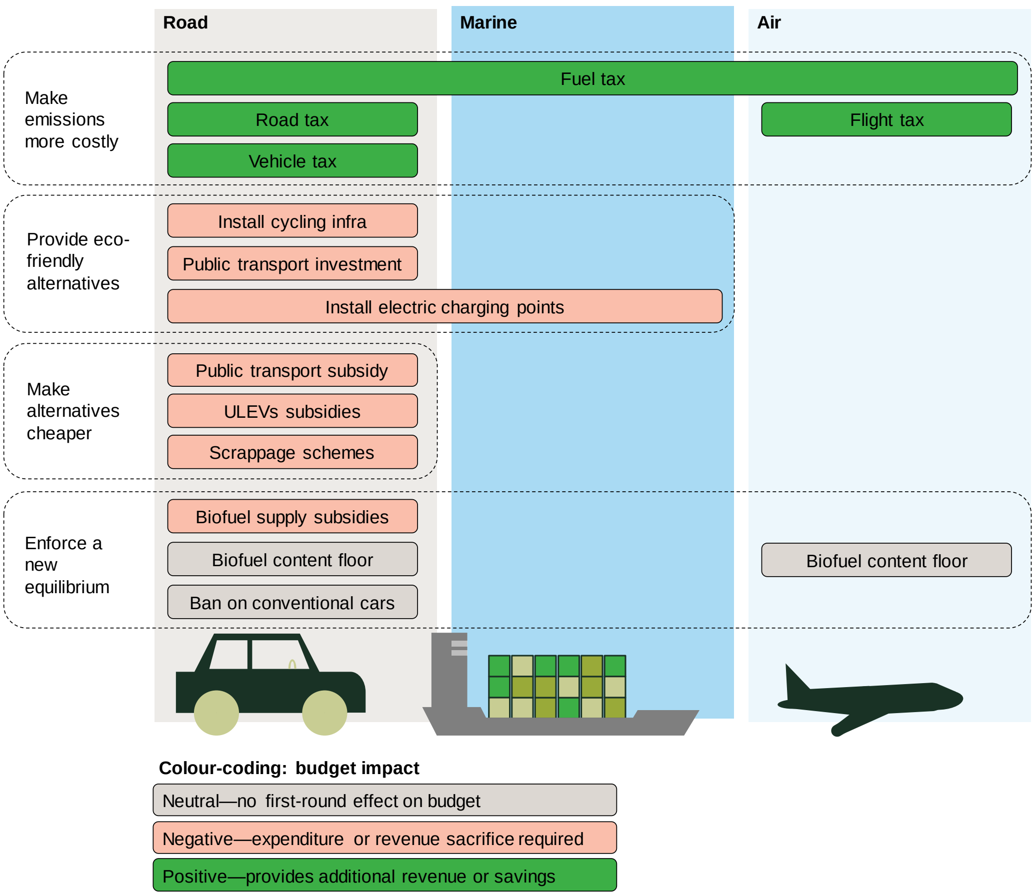
- France;

- Iceland;
- Malta;
- the Netherlands;
- Norway;
- Sweden;
- the UK.

The policy case studies presented in this report are not intended to provide an exhaustive review of decarbonisation policies around the world. Rather, our assessment focuses on identifying a range of relevant policy options for delivering carbon neutrality from a diverse set of jurisdictions, then analysing them from the perspective of the Island of Jersey.

The two figures below provide a visual summary of various decarbonisation measures that we have identified from our international case studies, in the transport and heating sectors respectively.

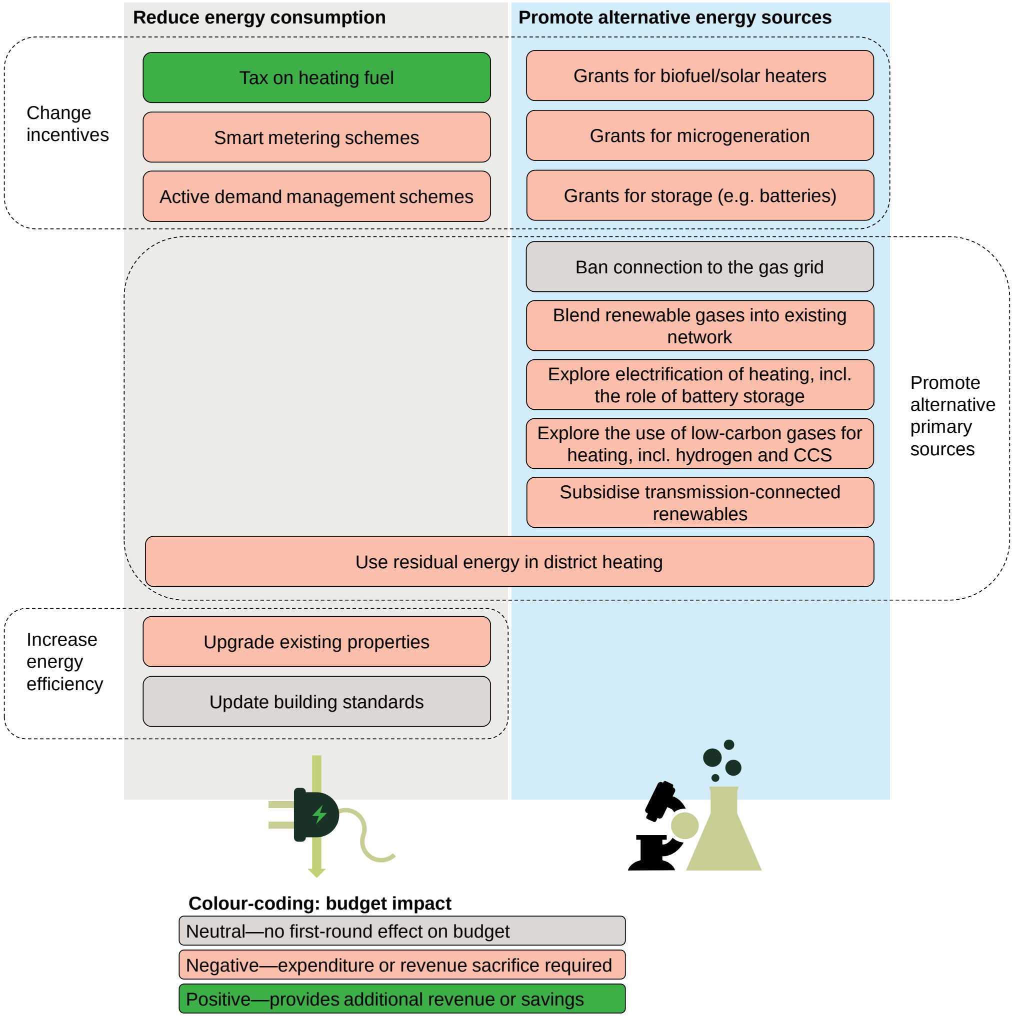
Overview of decarbonisation policies in transport



Note: EVs, electric vehicles; ULEVs, ultra-low emission vehicles; infra, infrastructure.

Source: Oxera analysis based on various policy documents.

Overview of decarbonisation policies in heating



Note: Although grey hydrogen is not a renewable gas, it could in theory be successfully employed in decarbonisation of heat, if the greenhouse gas emissions from its production are contained through the employment of CCS. For convenience, we use the term 'renewable gas' in the context of heat decarbonisation. See Olczak, M. and Piebalgs, A. (2018), 'What is renewable gas?', 14 March, available at https://fsr.eui.eu/what-is-renewable-gas/#_ftn1 and GasTerra (2018), 'Hydrogen and CCS: a smart combination', 1 February, available at https://www.gasterra.nl/en/news/hydrogen-and-ccs-a-smart-combination.

Source: Oxera analysis based on various policy documents.

Applying the insights from our case studies to Jersey-specific circumstances, we have shortlisted several policies for decarbonising the transport and heating sectors. As alluded to above, our focus for shortlisting policies was not on the power generation segment, which is largely decarbonised due to Jersey's reliance on interconnection to France.[1]

[1] We understand that the Government of Jersey is undertaking analysis of the (indirect) emissions associated with the production in France of electricity that is exported to Jersey. The French power is supplied to Jersey with certification of origin, specifying that all electricity exported to Jersey has been sourced from low-carbon facilities—either hydro or nuclear.

In addition to the policies described in the 2014 Energy Plan, we have identified four further policies in the transport sector, which we recommend for detailed quantitative assessment:

- instating a ban on registration of conventional vehicles;
- increasing the focus on fuel taxation in achieving emission reductions;
- facilitating the uptake of electric vehicles (EVs);
- facilitating a higher content of biofuels in petrol and diesel throughout Jersey.

Working in combination, these four policies will provide a comprehensive set of incentives to move Jersey towards an EV-focused transport system.

Banning the registration of conventional vehicles in Jersey would act as a barrier to an increase in the fleet of fossil-fuelled vehicles. The timing of the ban, however, needs to be carefully considered in order to balance the decarbonisation objectives with the impact on quality of life of Jersey citizens. Increasing the taxation on vehicle fuel would provide incentives to reduce car travel in the short term and accelerate the switch to ultra-low emission vehicles (ULEVs) in the medium to long term. Facilitating the uptake of EVs would allow the Island of Jersey to take advantage of its access to a reliable source of low-carbon electricity. The uptake could be facilitated by financial support for the acquisition of EVs on the one hand and for the scrappage of old conventional vehicles on the other hand. As the citizens of Jersey switch from older models of conventional vehicles, increasing the minimum content of biofuel sold at filling stations could provide an immediate reduction in emissions from the existing vehicle fleet. The resulting fuel price increase (to the extent that biofuel is more expensive than fossil fuel) would further strengthen consumers' incentives to decrease car travel and switch to EVs.

The box below summarises our recommendations for decarbonisation policy in the transport sector.

Summary of shortlisted policies in the transport sector

Relevant 2014 Energy Plan policies

- Increase in the number of ULEVs
- Improved EU emissions standards for cars and vans
- Improved international operating standards for aircraft
- Sustainable Transport Policy

Further recommended policies

- Instate a ban on registration of conventional vehicles
- Increase the focus on fuel taxation in achieving emission reductions
- Support a large-scale roll-out of EVs—subject to quantification results
- Facilitate a higher content of biofuels in petrol and diesel throughout Jersey

Recommended quantification next steps, to assess feasibility and value for money

- Identify the maximum feasible biofuel content for the vehicle fleet registered on the Island of Jersey
- Analyse the expected evolution in the vehicle fleet, to determine the fastest feasible rate of increase of biofuel content over time
- Estimate the decrease in consumption of fuel (e.g. driven by the higher cost of biofuels blended in existing sources, as well as by various fuel tax scenarios)
- Develop scenarios for the annual rate of switching from conventional vehicles to ULEVs

Source: Oxera analysis.

For the heating sector, the 2014 Energy Plan prescribes a number of policies around investing in insulation and higher energy efficiency. Of these policies, we recommend shortlisting the upgrade measures to pre-1997 properties for a quantitative assessment, as this policy was originally expected to deliver the most significant decarbonisation impact in the heating sector. The analysis should aim to establish the fastest feasible rate of upgrades and assess to what extent it is possible to complete the upgrades by 2030 (as opposed to 2050, as envisaged in the 2014 Energy Plan).

In addition, we have identified that another key task for quantitative analysis in the next phase is to assess the feasibility and timelines for full electrification of heating. For the Island of Jersey, electrification appears to have the most significant potential to deliver the medium-to-long-term decarbonisation ambitions of the Government. This is underpinned by high levels of installed interconnection capacity with access to low-carbon imported electricity, relatively high penetration rates for electricity in the heating sector, and the potential synergies with the uptake of EVs.[2] Focusing on electrification also allows the Government to avoid potential challenges that might arise in fully decarbonising the gas supply chain for an island jurisdiction.

However, blending renewable gases into the existing gas network might also be a policy option, to the extent that it is technically feasible. Similar to the blending of biofuels in the petrol or diesel supply on the island for the transport sector, increasing the content of biogas in the existing gas network could provide a short-term reduction in emissions from heating. With a longer-term outlook, achieving net zero would require using carbon-neutral energy sources for heating.

In case the subsequent quantitative analysis shows that it is not feasible to continue electrification of heating at a sufficiently fast rate to meet the Government's targets, then medium-to-long-term alternative solution(s) would need to be considered. Such alternative options would include a full decarbonisation of the gas supply (e.g. by using renewable gases) or the development of district heat networks. The box below summarises our recommendations for the decarbonisation policy in the heating sector.

Summary of shortlisted policies in the heating sector

Relevant 2014 Energy Plan policies

- Apply energy efficiency measures to the pre-1997 stock of properties
- Energy efficiency improvements in the private sector
- Energy efficiency improvements in the public sector
- Implement micro-renewables in the domestic sector
- Implement anaerobic digestion systems for waste management
- Introduce a 'low-carbon' standard for new homes through building bye-laws
- Improve energy efficiency through a behaviour change programme

Further recommended policies

- Roll-out electrification of heating—subject to quantification results
- Blend renewable gas into the existing gas network to the extent that is technically feasible in the short-term
- Potentially develop supply chains over the medium-to-long-term for transport of renewable gases and, if necessary, alternatives such as district heating. This may also require developing / upgrading heating infrastructure (e.g. in homes) to enable utilisation of energy-from-waste, waste heat, and renewable gases

[2] To the extent that the batteries in EVs could be used to discharge electricity, an EV battery could serve as a domestic storage device that could complement other technologies such as micro-renewables, heat pumps, and solar heat collectors.

Recommended quantification next steps, to assess feasibility and value for money

- Update and plan the roll-out of the pre-1997 properties upgrade measures
- Assess the timeline for a potential full electrification of heating
- Subject to the above, assess the feasibility of the use of renewable gases in existing gas infrastructure and the costs of other infrastructure upgrades

Note: We understand from the Government of Jersey that the funding for the implementation of micro-renewables in the domestic sector has subsequently been withdrawn.

Source: Oxera analysis.

The case studies provide limited evidence on how individual economies are financing specific decarbonisation policies. Taxation (e.g. fuel taxation) can point to specific line items in national budgets, and levies may be used to fund specific subsidy schemes (e.g. renewable energy). However, the majority of subsidy schemes and costs of infrastructure investment appear to be part of the state or municipal budgets without identifying specific fiscal measures for financing the cost of delivering specific decarbonisation policies. In considering their application to Jersey, to the extent that certain policies involve a combination of measures requiring expenditure and generating revenue, it should be possible to calibrate the roll-out of such policies in a way that minimises the strain on the government budget. For example, the electrification of domestic use road transport can combine revenue-enhancing measures (e.g. fuel tax) with revenue-neutral (e.g. a ban on the registration of conventional vehicles) and revenue-negative policies (e.g. subsidies for ULEV uptake), from the perspective of the Government.

As part of this process, the cost of offsets can be used to some extent as a benchmark to assess the budget efficiency of carbon abatement policies. However, it is important to factor in the risk associated with potentially significant movements in the prices of offsets. Moreover, in the last few years, the EU has been restricting the scope for using offsets. Therefore, to be seen as a leader in the net zero race, the Government of Jersey will have to put an increasingly greater weight on domestic carbon abatement initiatives.

To design an efficient package of carbon abatement policies, it is necessary to conduct an impact assessment, quantifying the cost and revenue-generating potential of the policy package, as well as its expected effect on Jersey's carbon footprint. This analysis will allow the Government of Jersey to design the optimal roll-out of decarbonisation policies, maximising the value for money for the citizens of Jersey. The boxes above list the quantification tasks that we recommend for prioritisation in the next phase.[3]

[3] Appendix A1 lists the data requirements for this quantification.

1 Background

1A Purpose of this report

In light of the States Assembly's vote to achieve net zero carbon emissions by 2030,[4] the Government of Jersey commissioned Oxera to review international decarbonisation policy best practice with the aim of identifying a set of policies that would enable the achievement of the Government's decarbonisation agenda, building on the 2014 Energy Plan.[5] Another objective of the study is to determine which policies to prioritise in future analysis, including the value for money of various policy options.

This report is structured as follows:

- section 1B summarises the evolution of the climate change policy of the Island of Jersey;
- section 1C provides an overview of the current state of transport and energy sectors in Jersey from the perspective of decarbonisation policy;
- section 2 describes the process that we followed in identifying jurisdictions for further case study analysis to supplement the options being considered by the Government of Jersey;
- section 3 presents case studies for the jurisdictions identified in section 2 and concludes with a summary of different policy levers that are available to the Government of Jersey;
- section 4 discusses the carbon offset market and its implications for Jersey's decarbonisation policy;
- section 5 provides recommendations on which policies are most likely to be applicable in achieving the Government's aims, in the context of the Island of Jersey, and describes the next steps towards the implementation of these policies.

[4] Government of Jersey (2019), 'Official report', 1 May, p. 52.
[5] Government of Jersey (2014), 'Pathway 2050: An Energy Plan for Jersey. Summary', March, available at https://www.gov.je/Government/Pages/StatesReports.aspx?ReportID=1039

1B Timeline of the climate change strategy of the Government of Jersey

In March 2007, the Government of Jersey officially committed to the Kyoto Protocol.[6] The protocol requires Jersey to reduce its carbon emissions by 80% by 2050, relative to 1990 levels.[7] By 2012, Jersey had managed to achieve a 28% reduction in carbon emissions relative to 1990 levels, primarily through relying on imported electricity. However, quantitative analysis showed that this measure alone would not be sufficient to hit the target.[8] Therefore, in 2014, the Government of Jersey put forward a new energy plan, detailing a set of policies designed to help Jersey achieve the 80% emission reduction target by 2050 ('the 2014 Energy Plan').

The plan proposed 27 targeted policies across three categories:[9]

- demand management;
- energy security and resilience;
- fuel poverty and affordability of energy.

Nearly 70% of the total reduction in greenhouse gas emissions was predicted to come from the following four policies:

- 22% from applying energy efficient measures to houses built pre-1997;[10]
- 22% as an effect of increasing the number of ULEVs;[11]
- 12% from improved EU emissions standards for cars;[12]
- 10% from energy efficiency improvements in the private sector.[13]

A more detailed breakdown of the impact of different policies is presented in Table 1.1 below.

[6] United Nations (2019), 'Kyoto Protocol to the United Nations Framework Convention on Climate Change', footnote 8, status as at: 26-08-2019 05:01:22 EDT, available at https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-a&chapter=27&lang=en
[7] Government of Jersey (2014), 'Pathway 2050: An Energy Plan for Jersey. Summary', p. 5, available at https://www.gov.je/Government/Pages/StatesReports.aspx?ReportID=1039
[8] Government of Jersey (2014), 'Pathway 2050: An Energy Plan for Jersey. Summary', available at https://www.gov.je/Government/Pages/StatesReports.aspx?ReportID=1039
[9] Ibid., p. 27.
[10] Ibid., p. 41.
[11] Ibid., p. 65.
[12] Ibid., p. 62.
[13] Ibid., p. 53.

Table 1.1 Summary of the 2014 Energy Plan

Policy	Proportion of planned emission reduction
Energy efficiency measures to the pre-1997 stock of properties	22%
Increase in the number of ULEVs	22%
Improved EU emissions standards for cars	12%
Energy efficiency improvements in the private sector	10%
Energy efficiency improvements in the public sector	6%
Implementation of micro-renewables in the domestic sector	4%
Implementation of anaerobic digestion systems for waste management of livestock slurry by 2020	4%
Improved international operating standards for aircraft	4%
Other policies	~16%

Note: We understand from the Government of Jersey that the funding for the implementation of micro-renewables in the domestic sector has subsequently been withdrawn.

Source: Government of Jersey (2014), 'Pathway 2050: An Energy Plan for Jersey'.

In December 2015, the Paris Agreement was adopted, proposing a set of stricter carbon reduction targets. The agreement featured a long list of signatories, thus raising the global benchmark for best practice in international climate change policy.[14] By that time, Jersey had already made progress in the implementation of the 2014 Energy Plan—emissions had already been reduced by 47% relative to the levels in 1990.[15] However, this figure bounced back to 36% a year later, reflecting a rise in vehicle registrations and higher emissions in the domestic energy sector.[16]

In May 2019, the States Assembly approved a proposition to declare a state of climate emergency and recommended amending the 2014 Energy Plan to set a new net zero target by 2030:[17]

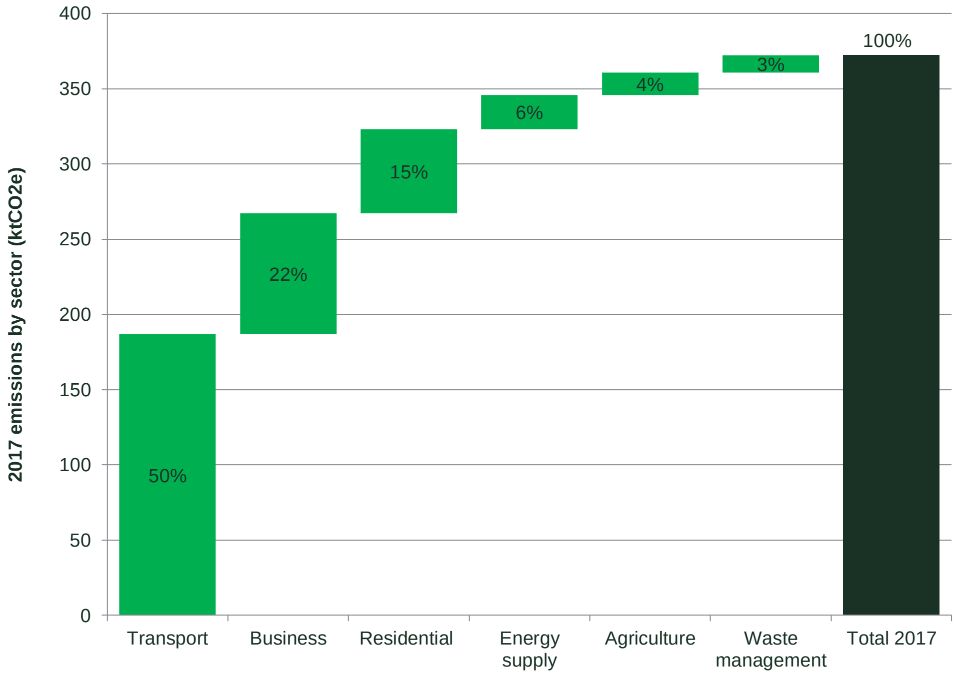
> Jersey should aim to be carbon neutral by 2030 and the Council of Ministers is accordingly requested to draw up a plan to achieve this, for presentation to the States by the end of 2019.

This new goal means that a greater reduction in absolute emissions is necessary, and at a faster rate than proposed in the 2014 Energy Plan. This report provides an overview of policies employed in other jurisdictions, to aid the Government of Jersey in developing a carbon neutrality strategy by the end of 2019.

[14] We understand from the Government of Jersey that the Island of Jersey could not sign the Paris Agreement in its own right.
[15] Government of Jersey (2017), 'Pathway 2050 Energy Plan Year 2 Summary', p. 3.
[16] Government of Jersey (2018), 'Pathway 2050 Energy Plan Year 3 Summary', p. 2.
[17] Government of Jersey (2019), 'Official report', 1 May, p. 52.

To establish the priorities for the development of the carbon neutrality strategy, it is helpful at the outset to examine the present sources of Jersey's greenhouse gas emissions. This is to ensure that our selection of decarbonisation policies is well targeted to address Jersey-specific drivers of carbon emissions. According to the latest emissions data—from 2017, compiled by Aether—the island achieved a 12% total reduction in greenhouse gas emissions following the publication of Jersey's 2014 Energy Plan.[18] Figure 1.1 illustrates the breakdown of Jersey's emissions, by sector, as at 2017.

Figure 1.1 Composition of Jersey's 2017 greenhouse gas emissions

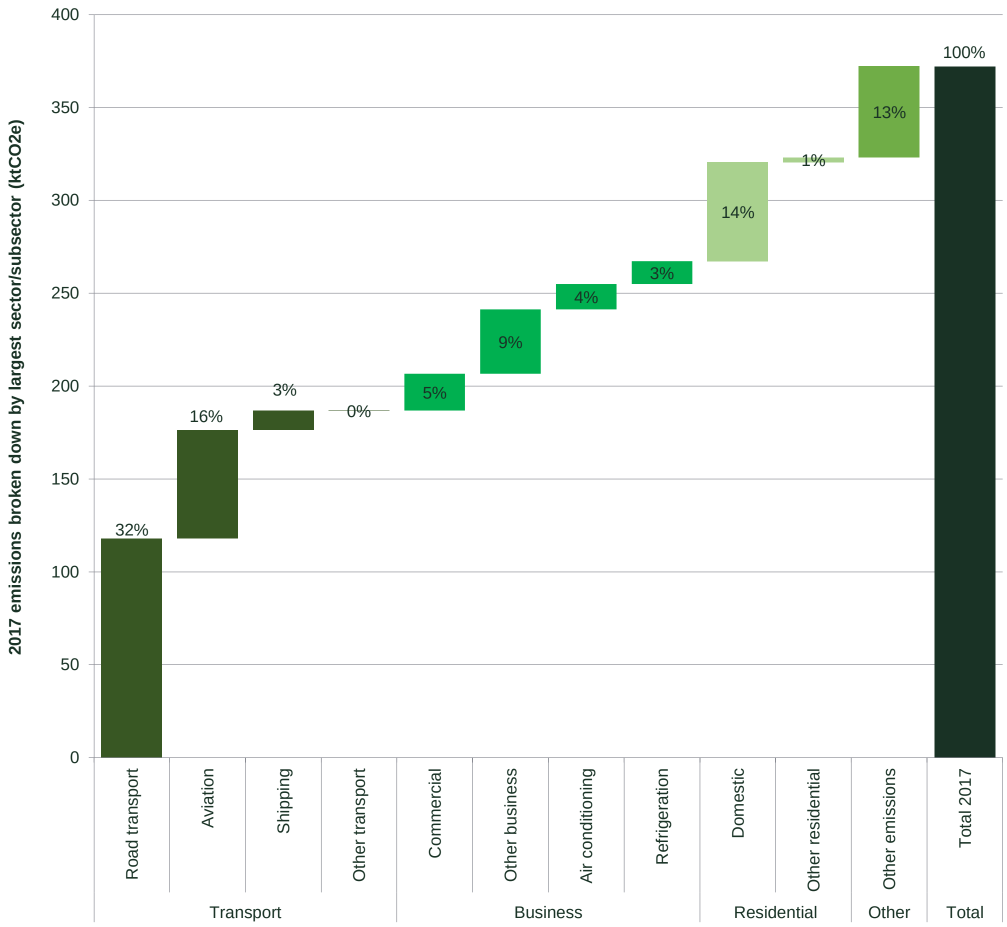


Source: Oxera analysis based on data from Aether.

The figure offers two main insights. First, the vast majority of emissions (nearly 90%) originate from three sources: transport (encompassing land, air and marine transport), business, and residential. Second, transport represents by far the largest source of emissions, accounting for 50% of the total. Figure 1.2 provides a more detailed breakdown of the three main sources of emissions in Jersey.

[18] The emissions in 2014 and 2017 amounted to 417.1 ktCO2 and 365.6 ktCO2 respectively. See Aether website, 'Jersey Greenhouse Gas Emissions 1990-2017', available at https://www.aether-uk.com/Resources/Jersey-Infographic.

Figure 1.2 Breakdown of Jersey's top three emission sources



Note: The sum of individual numbers does not reconcile to Figure 1.1 due to rounding.

Source: Oxera analysis based on data from Aether.

It can be seen that most of the transport emissions (32% of total) originate from road transport. While the names of most subcategories reported under 'Business' and 'Residential' categories do not in themselves explain what drives the emissions in these segments, the underlying source data suggests that the vast majority of these emissions relates to heating.[19] This mix of emissions—mainly originating from transport and heating—is consistent with the findings outlined in the 2014 Energy Plan,[20] as well as the interim response to the Declaration of a Climate Emergency.[21]

[19] For instance, table 7 in the 2018 'Jersey Energy Trends' publication illustrates that the household energy consumption consists of petroleum products, manufactured gas and electricity. Since electricity in Jersey is largely carbon-natural (see section 1C.1), this implies that 'domestic' carbon emissions originate from petroleum products and manufactured gas. Figure 5 further suggests that the consumption of petroleum products does not include road transport. This in turn suggests that the emissions in the reported domestic category largely originate from heating. See Government of Jersey (2018), 'Jersey Energy Trends'.
[20] Government of Jersey (2014), 'Pathway 2050: An Energy Plan for Jersey', March, p. 22, table 1.
[21] Council of Ministers' Interim Response to the Declaration of a Climate Emergency (P.27/2019), p. 7.

In conclusion, the latest profile of Jersey's emissions suggests that—in identifying priority policy actions for the island—the two most significant sources of emissions to focus on are: road transport and heating of buildings. Therefore, in undertaking our case study analysis in this report, we focus on those two areas in particular, as well as on the power generation sector, since policies in power generation could be linked to the decarbonisation of both transport and heating via electrification. The next section provides an overview of the current state of these three sectors in Jersey from the perspective of decarbonisation policy.

1C Current outlook for Jersey's electricity, transport and heating sectors

1C.1 Electricity sector

Jersey has been importing electricity from France since 1984, and in 2017–18 94.9% of Jersey's electricity came from France through a contract with EDF that is valid until December 2027.[22] This agreement stipulates that the electricity flowing into Jersey must have been generated from low-carbon facilities, with 65% originating from nuclear sources and the remaining 35% from hydro-electric sources.[23]

The combined capacity of the three interconnectors through which Jersey imports electricity from France amounts to 263 MW.[24] However, some of that capacity is reserved for a 60 MW interconnector between Jersey and Guernsey.[25] GF1, a 100 MW interconnector between Guernsey and France, is currently in the early planning stages. This could possibly make Guernsey less reliant on electricity imported through Jersey and thus make extra capacity available within Jersey's interconnectors to France.[26]

Of the remaining 5.1% of electricity consumed, 4.9% came from the local energy from waste plant. Finally, the remaining 0.2% was generated on the island at La Collette Power Station, which predominantly generates electricity from conventional technologies including diesel generators.[27] In June 2019, the roofs

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[22] Based on discussions with Jersey Electricity Company. Note that this does not account for the electricity generated from distributed sources, such as small-scale residential solar panels and batteries.
[23] Jersey Electricity Company (2019), 'Jersey: a low carbon island', 10 January, available at https://www.jec.co.uk/energy-hub/jersey-a-low-carbon-island/
[24] Links N1, N2 and N3 have capacities of 100 MW, 90 MW and 100 MW respectively but are limited to 263MW in total by the connections to the French Grid. Based on the information provided by Jersey Electricity Company and https://www.jec.co.uk/about-us/our-business/energy-business/grid-connections/
[25] Ibid.
[26] 4 C Offshore website, 'Channel Islands: Guernsey-France (GF1) Interconnector', available at https://www.4coffshore.com/transmission/interconnector-channel-islands—guernsey-france-(gf1)-icid82.html
[27] Jersey Electricity Company (2018), 'Turning the tide for a low carbon island, report and accounts 2018', p. 14, available at https://www.jec.co.uk/energy-hub/la-collette-power-station/

of La Collette Power Station were fitted with the largest solar photovoltaic (PV) array in Jersey, which is expected to generate over 90,000 kWh of electricity per year. Further large-scale PV projects are currently being planned.[28]

Jersey Electricity Company has estimated that the carbon emissions associated with electricity it supplied for the last three years were 24, 36 and 47 gCO2e/kWh respectively. These figures include an assessment of the emissions contribution from the island's energy from waste plant.[29]

Overall, Jersey Electricity Company expects that over the next 15 years, the island will have sufficient capacity to cover the anticipated demand for electricity.

1C.2 Transport sector

In the transport sector, EVs are expected to strongly contribute to Jersey's decarbonisation targets as shown by the 2014 Energy Plan. According to the 2014 Energy Plan, 22% of the reduction in greenhouse gas emissions is expected to be driven by the uptake of ULEVs.[30] The charging infrastructure for EVs has already been partly developed, with 25 charging stations already installed. The roll-out of a further 25 smart fast-charge spaces is currently under discussion.[31] In addition, some households, businesses and government departments choose to install private charging points for their own use. Limitations of the mileage range of EVs are of less concern in Jersey than in larger jurisdictions, where longer journeys between charging ports may be required. According to Jersey Electricity Company, no subsidies exist in Jersey for either the roll-out of charging infrastructure or the purchase of EVs.[32]

While there are no financial incentives in the form of subsidies for new EV purchases currently in place, we note that the Government of Jersey is encouraging the adoption of EVs through exemption from the Vehicle Emissions Duty (VED).[33]

[28] Jersey Electricity Company (2019), 'Power station roof array to generate 90,000 kWhs a year', 27 June, available at https://www.jec.co.uk/energy-hub/largest-solar-array-in-the-island-starts-generating-power-on-to-jersey-grid/
[29] Based on the information provided by Jersey Electricity Company.
[30] Government of Jersey (2014), 'Pathway 2050: An Energy Plan for Jersey, March, p. 65.
[31] Includes 24 smart fast-charging stations and one smart rapid charger currently in place at Queen Road. Fast chargers have a capacity between 7kW and 22kW, while rapid chargers have a capacity of 43kW with alternating current (AC) and 50kW with direct current (DC). Source: Information provided by Jersey Electricity Company.
[32] https://www.energysage.com/electric-vehicles/costs-and-benefits-evs/electric-car-cost/
[33] See Jersey Electricity Company's website, 'Breaking the myths: electric cars', available at https://www.jec.co.uk/energy-hub/breaking-the-myths-electric-cars%E2%80%8B/ and Government of Jersey website, 'Vehicle Emissions Duty (VED)', available at https://www.gov.je/Travel/Motoring/BuyingSellingVehicle/Pages/VehicleEmissionsDuty.aspx.

Electrification of public vehicles is also being trialled in Jersey. Currently, LibertyBus (the operator of public transport in Jersey) is running a six-week trial on the use of electric buses.[34] Jersey Electricity Company estimates that a full roll-out of electric buses would contribute approximately 2% to the electricity consumption of the Island.[35]

While the electrification of marine transport is theoretically possible, we understand from the Government and industry that the practicalities of this measure are yet to be considered in Jersey.[36]

1C.3 Heating sector

Currently, between 40% and 50% of domestic heating in Jersey is powered by electricity, with gas and oil being the other primary heating sources.

Jersey Electricity Company uses twin element meters[37] to separately control heating circuits from the general lighting and power parts of the electrical services infrastructure.

Presently, almost every home and business on the island is using a smart meter. The combination of a smart meter with an online portal allows customers to gain insights into their energy usage, which may equip them with information to make more informed energy consumption decisions. On the supply side, the technology may also allow monitoring of loads and control of peak energy demand to some extent. If economically feasible, in the future, the existence of smart grid and metering infrastructure in Jersey should also provide the option of calibrating tariff and pricing signals to manage demand.[38]

We note that there is a wide range of heating technologies that are utilised at the residential level in Jersey, including all-electric flow boilers. On the one hand, a diversity of heating technologies may imply challenges in investing in a particular technology at scale. On the other hand, if multiple technologies are utilised for heating purposes, this could allow for greater convenience to households in selecting the right option for them. Specifically, we understand from discussion with industry that heating technologies being utilised in Jersey include the

[34] In particular, a model Metrodecker EV is being considered. See Taylor, E. (2019), 'Electric bus trial in Jersey', *Jersey Evening Post*, available at https://jerseyeveningpost.com/news/2019/08/23/electric-bus-trial-in-jersey/
[35] Based on the information provided by Jersey Electricity Company.
[36] Based on the information provided by Jersey Electricity Company.
[37] These enable heating to be controlled separately from general lighting and power.
[38] Based on the information provided by Jersey Electricity Company and Jersey Electricity Company's website, 'Jersey gets 'smarter' in the power game', available at https://www.jec.co.uk/energy-hub/jersey-gets-%E2%80%98smarter%E2%80%99-in-the-power-game/

following. Firstly, storage heaters consume energy at night when off-peak electricity is available at a lower cost and then discharge energy during the day.[39] Secondly, all-electric flow boilers and storage heaters utilise off-peak tariffs controlled via twin element meters.[40] Thirdly, heat pumps absorb heat from either the air or the ground and transfer this heat into the house.[41] Of these three technologies, heat pumps provide the most efficient way to reduce the carbon footprint. However, this technology has a relatively high upfront cost.[42]

In Jersey, energy consumption for the purposes of heating is fairly flat, with regular small peaks around 12:30 and 21:30. Off-peak tariffs are in usage in Jersey. We understand that an increased penetration of electricity in heating has not led to a proportionate increase in the levels of electricity consumed. This is attributed to 'behind the meter' efficiency, with households becoming more conservative in their energy use, particularly with the roll-out of smart meters.[43]

[39] Which? Website, 'Storage heaters', available at https://www.which.co.uk/reviews/home-heating-systems/article/home-heating-systems/storage-heaters
[40] Based on the information provided by Jersey Electricity Company.
[41] Greenmatch website, 'Heat Pumps', available at https://www.greenmatch.co.uk/heat-pump
[42] Based on the information provided by Jersey Electricity Company.
[43] Based on the information provided by Jersey Electricity Company.

2 Selecting jurisdictions for case study analysis

2A Overarching principles of jurisdiction shortlisting

The purpose of this analysis is to identify relevant and feasible policy options for achieving Jersey's decarbonisation objectives, in part by examining international best practice in the form of case studies that focus on a representative selection of jurisdictions. These representative jurisdictions are intended to inform policy options in each of the areas of the Jersey economy identified as priority sectors for the carbon neutrality strategy, i.e. transport and heat (see section 1B).

We focused our review on seven jurisdictions, basing our selection on two fundamental principles:

- our case study jurisdictions must exhibit a strong commitment to decarbonisation. Although awareness of the need for climate action has amplified in recent years, only a handful of countries have committed to significantly reducing their carbon emissions over the next few decades. Therefore, in the global context, Jersey's objective to become carbon neutral by 2030 appears highly ambitious. Jurisdictions with a high degree of decarbonisation ambition and commitment are likely to provide relevant precedents to inform our assessment for the Government of Jersey;
- the emissions profile of the selected jurisdictions needs to reflect the challenges facing the Island of Jersey, specifically, high emissions from road transport and heating.

We applied these two overarching principles in the following way.

- First, we conducted an overview of the landscape of national decarbonisation policies worldwide. This allowed us to form a preliminary view on which regions and countries had embraced more advanced decarbonisation policies (see section 2B).
- Next, we cross-checked our preliminary view against the national carbon price levels published by the World Bank, thus accounting for the fact that higher carbon prices can indicate higher levels of commitment in decarbonisation policies (see section 2C).
- Finally, we examined the main sources of carbon emissions for each shortlisted jurisdiction, to ensure that assessing how the reduction of the

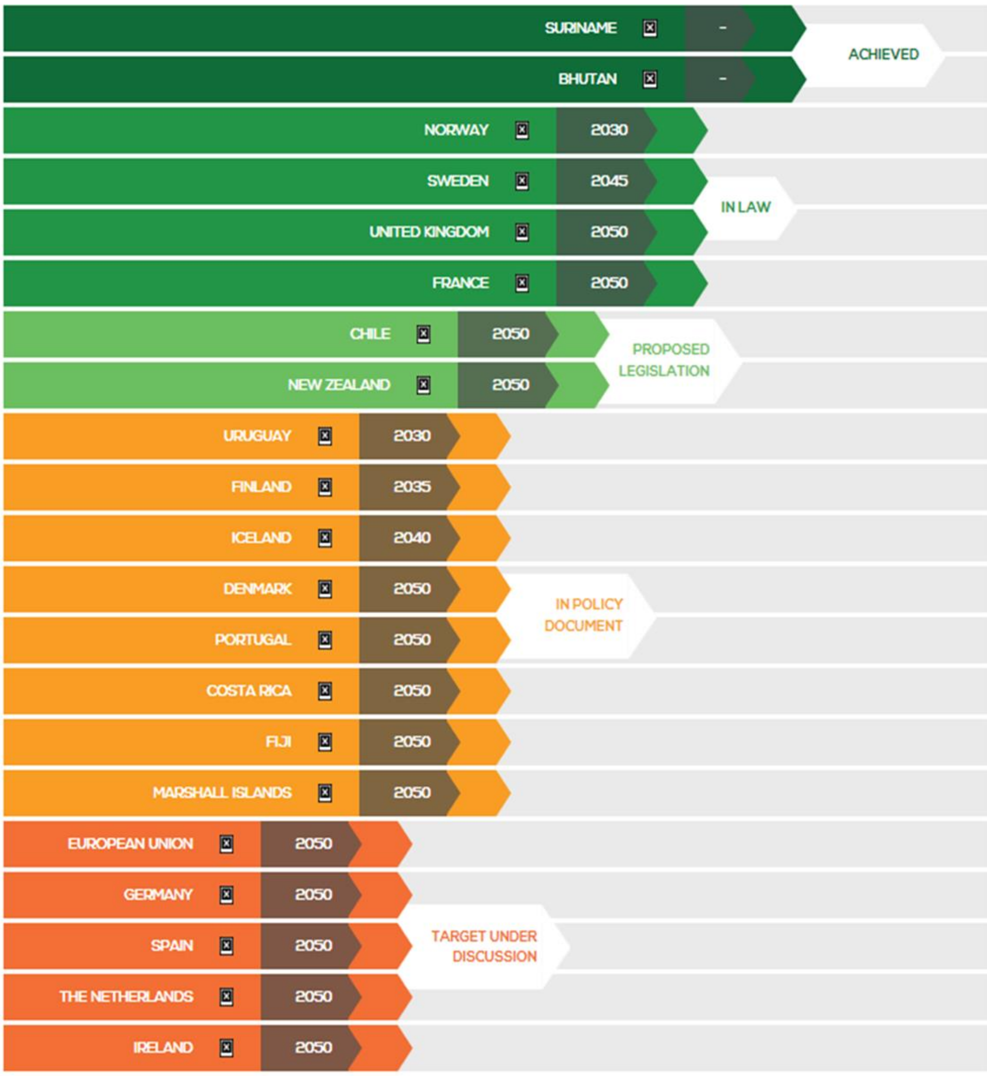
major sources of emission is being undertaken in the shortlisted jurisdictions would be relevant to the Jersey context (see section 2D).

2B Overview of global decarbonisation policy rankings

As a first step, we considered the Energy & Climate Intelligence Unit's (ECIU) recent 'Countdown to zero' report, which the Government of Jersey referred to in its draft interim response to the Declaration of a Climate Emergency.[44]

Figure 2.1 illustrates the global ranking of countries according to their decarbonisation ambitions, as published by ECIU.

Figure 2.1 Global overview of decarbonisation policies



Source: ECIU (2019), 'Net zero tracker', available at https://eciu.net/netzerotracker.

The figure above shows that most countries with an ambitious decarbonisation schedule are located in Europe and have a target, or are developing a target,

[44] Council of Ministers' Interim Response to the Declaration of a Climate Emergency (P.27/2019).

towards achieving net zero by 2050 or earlier. Two notable exceptions to this are Suriname and Bhutan, whose economies already operate at net zero. These particular precedents, however, are not applicable to the Island of Jersey, since the countries in question have arrived at carbon neutrality due to their low levels of economic activity and substantial forest resources.[45]

Among the European countries, Norway and Sweden stand out, as their carbon targets are not only explicitly embedded in law but are also subject to a shorter timeline (2030 and 2045 respectively) than those of most other countries.

In the context of the Island of Jersey, France and the UK also represent relevant jurisdictions. Not only because they are among the few countries that have embedded decarbonisation targets in law, but also because of their geographical proximity to and policy and economic ties with the Island of Jersey. Moreover, France provides most of Jersey's electricity through the Normandy interconnectors.[46]

With regard to small island jurisdictions, only three are located within the EU and/or the EEA:[47]

- Cyprus;
- Iceland;
- Malta.

As can be seen from Figure 2.1, of these economies only Iceland features on the list of policy rankings. The evidence therefore suggests that Iceland would make a valuable addition to the sample, while the value of examining Cyprus and Malta is less clear. In this report, we include Malta in our small island sample, but not Cyprus. Malta's inclusion is informed by further evidence (see section 2E).

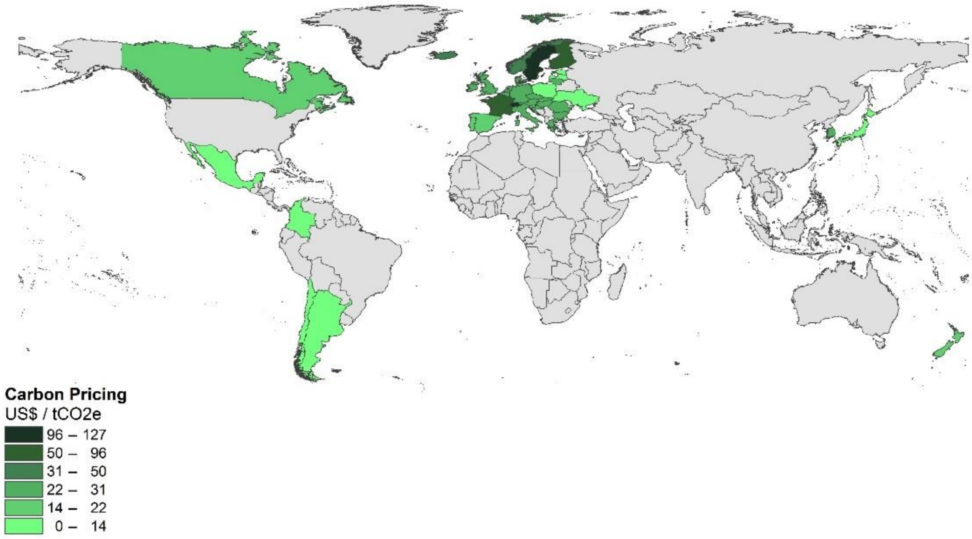
[45] Forest cover in Bhutan and Suriname amount to 71% and 93% respectively. See Department of Forests and Park Services (2017), 'National Forest Inventory Report', volume 1, p. 13, available at http://www.dofps.gov.bt/wp-content/uploads/2017/07/National-Forest-Inventory-Report-Vol1.pdf and Republic of Suriname (2019), 'The sixth national report to the United Nations Convention on biological diversity', April, p.14, available at https://www.cbd.int/doc/nr/nr-06/sr-nr-06-en.pdf.
[46] See Jersey Electricity Company's website, 'Key Facts', available at https://www.jec.co.uk/about-us/about-us/key-facts/
[47] Cyprus and Malta are members of the EU and Iceland is a member of the EEA. Eurostat statistics explained (2019), 'Glossary: European Economic Area (EEA)', available at https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:European_Economic_Area_(EEA)

Finally, as regards the countries that are listed with targets ‘under discussion’, we note that the Netherlands could prove to be a useful source of evidence, due to its ambitious heat decarbonisation programme.[48]

2C Overview of national carbon prices

To supplement the insights above, we also reviewed the difference in levels of national carbon prices across the world. National carbon prices serve as a useful cross-check, because a higher carbon price can indicate higher taxes on emissions, a lower level of emission quotas relative to the size of the country’s economy, or a country-specific carbon price floor (such as that imposed in the UK).[49] Figure 2.2 illustrates a global heatmap of national carbon prices, based on data published by the World Bank.

Figure 2.2 Global heatmap of national carbon prices

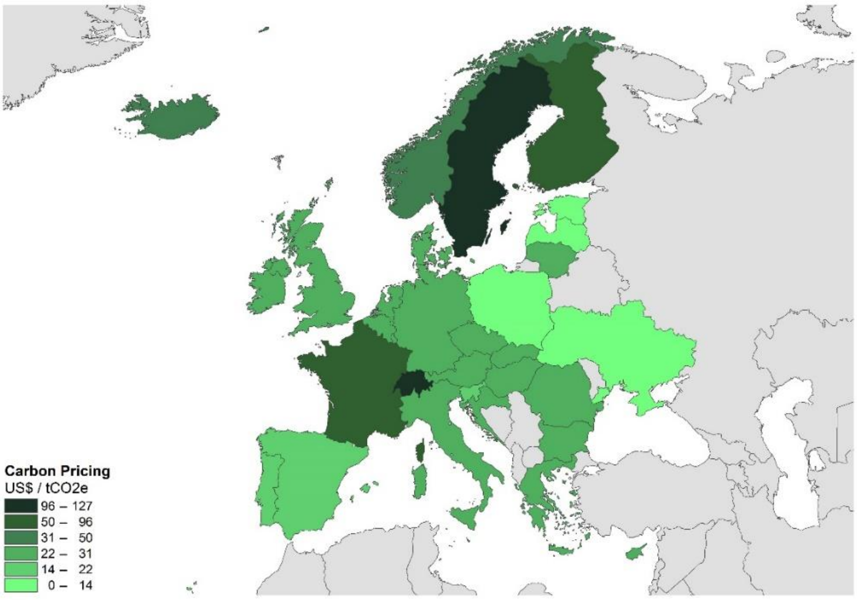


Source: Oxera analysis based on data from the World Bank carbon pricing dashboard.

Similar to the ranking presented in Figure 2.1, the heatmap suggests that Europe is more advanced in its decarbonisation policies relative to other regions of the world. Figure 2.3 illustrates the national carbon price heatmap for Europe in particular.

[48] For an overview of the Dutch government’s climate change-related policy priorities to 2030 see Government of Netherlands (2019), ‘Climate deal makes halving carbon emissions feasible and affordable’, 28 June, available at https://www.government.nl/topics/climate-change/news/2019/06/28/climate-deal-makes-halving-carbon-emissions-feasible-and-affordable. For detailed information on the Dutch ‘Climate Agreement’ (Klimaatakkoord) for the built environment see Klimaatakkoord website, ‘Afspraken voor Gebouwde omgeving’, available at https://www.klimaatakkoord.nl/gebouwde-omgeving.
[49] House of Commons Library (2018), ‘Carbon Price Floor and the price support mechanism’.

Figure 2.3 European heatmap of national carbon prices



Source: Oxera analysis based on data from the World Bank, carbon pricing dashboard.

The insights from the figure above are broadly consistent with the international decarbonisation policy ranking presented in Figure 2.1. With the exception of the UK, the countries that have embedded the carbon targets in law exhibit a relatively high level of domestic carbon price. This supports our observation that Sweden, Norway and France would be useful inclusions in the sample of jurisdictions. In addition, we include the UK in our sample; despite the fact that the domestic carbon price in the UK appears lower than that of other jurisdictions in the group, we consider that it is important to include the UK in our case studies, given its geographic proximity to and economic ties with Jersey. Similarly, the domestic carbon price in the Netherlands is in line with most of the EU countries, but we include it in our sample to cover the evidence on its heating sector reforms.

It is also noteworthy that Iceland exhibits a relatively high level of carbon price. As an island state with a largely decarbonised electricity generation sector (and therefore analogous to Jersey's low emission intensity in power generation due to interconnection),[50] Iceland presents a particularly relevant case study for Jersey.

As regards Cyprus and Malta, both jurisdictions exhibit a relatively low level of domestic carbon price, so this particular evidence does not shed light on which

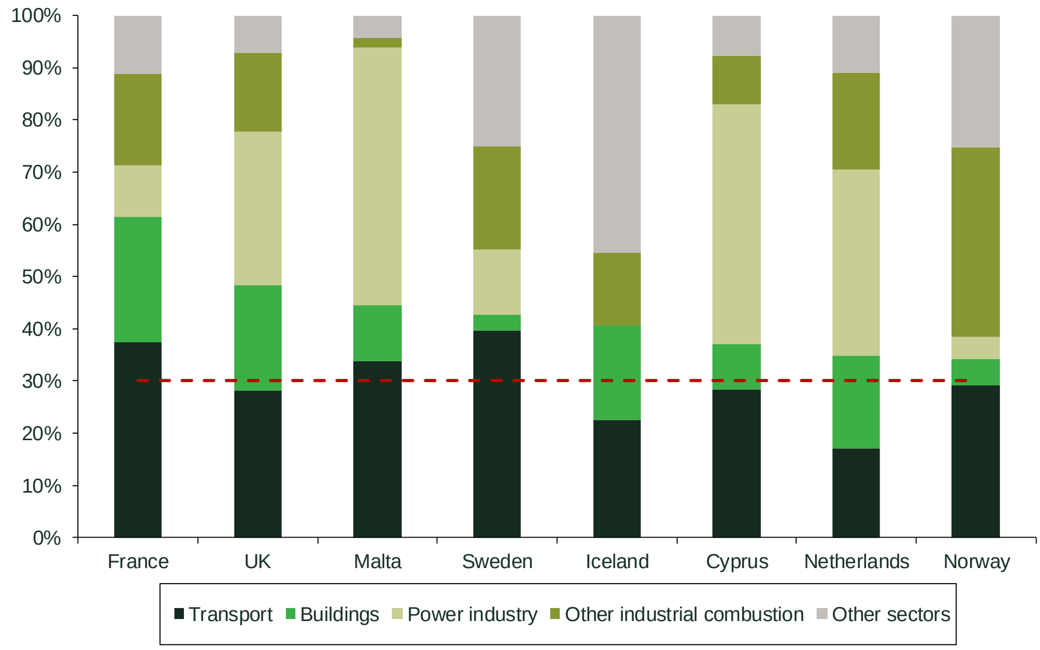
[50] Ministry of Industries and Innovation (2014), 'The Icelandic National Renewable Energy Action Plan', p. 41.

jurisdiction would be more appropriate to include as an island comparator for Jersey.

2D Overview of the major sources of carbon emissions

Finally, to ensure that our selected jurisdictions face similar decarbonisation challenges to those of Jersey, and therefore are likely to have introduced relevant policies, we considered the sources of emissions for the countries identified above, as illustrated in Figure 2.4.

Figure 2.4 Sources of carbon emission in different jurisdictions (%)



Note: France includes Monaco.

Source: Oxera analysis based on data from the EDGAR.

In selecting the relevant jurisdictions, we prioritised the countries where heating and transport form two major sources of emissions.[51] The figure presents the countries in descending order of emissions from transport and building—in line with priorities identified for the Island of Jersey.[52]

It can be seen that for all of the shortlisted countries, the proportion of emissions from transport and buildings amounts to at least 30%.

[51] See section 1B.
[52] The EDGAR database does not cover the Island of Jersey. However, the database description suggests that the 'buildings' category in EDGAR could be compared with the 'commercial' and 'residential' categories in EDGAR data. See European Commission (2018), 'Fossil CO2 emissions of all world countries 2018 Report', p. 20, available at https://publications.europa.eu/en/publication-detail/-/publication/41811494-f131-11e8-9982-01aa75ed71a1/language-en.

2E Selected sample of jurisdictions

The evidence presented above suggested that we should examine France, Iceland, the Netherlands, Norway, Sweden and the UK, with Cyprus and Malta being marginal candidates in terms of their policy and emissions profile, but relevant as island economies. In selecting between Cyprus and Malta, we decided to focus on Malta, as it is more comparable to the Island of Jersey in terms of area and population size.[53]

Based on these considerations, we shortlisted the following jurisdictions for examination.

Table 2.1 Sample of shortlisted jurisdictions

Country	Net zero target year	Target in law?	Island economy?
France	2050	✔	
Iceland	2040		✔
Malta	2050		✔
Netherlands	2050		
Norway	2030	✔	
Sweden	2045	✔	
UK	2050	✔	✔

Note: Although the UK is technically an island economy, its size and the scale of its economic activity differentiates it considerably from the other island economy comparators.

Source: Oxera analysis.

[53] The populations of Cyprus, Malta and the Island of Jersey are 854,802, 460,297 and 105,500 respectively. See European Commission (2018), 'Statistical Factsheet European Union', available at https://ec.europa.eu/agriculture/sites/agriculture/files/statistics/factsheets/pdf/eu_en.pdf and Government of Jersey, 'Population estimates', available at https://www.gov.je/Government/JerseyInFigures/Population/Pages/Population.aspx

3 Case studies

This section presents decarbonisation policy case studies for each of the jurisdictions identified in section 2E, i.e. France, Iceland, Malta, the Netherlands, Norway, Sweden and the UK. For each jurisdiction, we investigated what decarbonisation policies have been considered or implemented in the spheres of power generation, transport and heating. We also collected available information on the mechanisms for financing these policy options; where such information was not explicitly available, we drew inferences from the available information.

3A Decarbonisation policy case studies

3A.1 France

France’s 2017 Climate Plan set out the French government’s target to achieve carbon neutrality by 2050.[54] In June 2019, the target was set in law, putting France among the first of the large economies to adopt legally binding requirements to achieve carbon neutrality.[55]

In addition to the 2050 target, in 2019 France voted into law short-term targets such as a 40% reduction in fossil fuel consumption by 2030, where previously the target was 30%.[56] Furthermore, the law grants increased legal power for the government to force through policies such as the closure of the four remaining coal-fired power plants by the target year of 2022.[57]

The French National Renewable Energy Action Plan specifies 2005 as the base year for France’s final gross energy consumption. It separates its energy consumption into heating and cooling, electricity, transport and aviation.[58] As France has a significantly low-carbon electricity mix,[59] its priority, similar to Jersey, lies in decarbonisation of its heating and transport sectors.[60]

Table 3.1 provides an overview of the main statistics about the jurisdiction.

[54] Government of France (2017), ‘Climate Plan’, 6 July, available at https://www.gouvernement.fr/en/climate-plan
[55] Reuters (2019), ‘France sets 2050 carbon-neutral target with new law’, available at https://www.reuters.com/article/us-france-energy/france-sets-2050-carbon-neutral-target-with-new-law-idUSKCN1TS30B
[56] Ibid.
[57] Reuters (2019), ‘French government sticks to targets for closing coal power plants’, available at https://uk.reuters.com/article/us-france-electricity-coal/french-government-sticks-to-targets-for-closing-coal-power-plants-idUKKCN1RF19N
[58] Ministry of Ecology, Energy and Sustainable Development (2010), ‘National Renewable Energy Action Plan’, p. 7.
[59] IEA, ‘Global Engagement: France’, available at https://www.iea.org/countries/France/
[60] Ministry of Ecology, Energy and Sustainable Development (2010), ‘National Renewable Energy Action Plan’, p. 7.

Table 3.1 France—basic facts

Statistic	Units	Value
Population	100,000	669
Real GDP	€m	22,084
Real GDP per capita	€	32,998
Area	100 sq km	6,404
Population density	person/sq km	105
Car ownership	100,000	320
Car ownership per capita	vehicle per 1,000	479
Greenhouse gas emissions	100,000 tonnes	4,327
Greenhouse gas emissions	tonnes per capita	6.5
Power generation	TWh	561
Proportion of renewable power	%	17%

Note: The base year of the real GDP is 2010. All data is provided as at 2017—the latest observation available in the database. In addition to 17% of power originating from renewables, 72% of France's power originates from nuclear plants.

Source: Oxera analysis, based on Eurostat.

In the remainder of this section we describe individual decarbonisation policies adopted for the power generation, heating and transport sectors in France.

Power generation sector

- France's power generation sector is largely decarbonised due to a large share of its electricity production coming from nuclear power. In 2016 this figure was 72%, with hydro making up 12%, coal and gas 8%, and 6% from solar and wind.[61] France's four coal-fired power plants generate a small proportion of its electricity. In 2017, this amounted to less than 2% of the national energy production. However, in relative terms, these plants have a significant impact, since they accounted for 35% of greenhouse gas emissions in the sector.[62] Therefore, in accordance with the 2017 Climate Plan all coal-only power plants will be shut down by 2022.[63]

- France is also a member of the EU Emissions Trading System (EU ETS) which operates as a 'cap and trade' system for greenhouse gas emissions for heavy energy-using installations and airlines operating in the participating countries, which are the EU-28 plus Iceland, Liechtenstein and Norway.[64]

[61] World Nuclear Association (2019), 'Nuclear Power in France', available at https://www.world-nuclear.org/information-library/country-profiles/countries-a-f/france.aspx.
[62] Ministry for the Ecological and Inclusive Transition of France (2018), 'French strategy for energy and climate', p. 131.
[63] Ibid., p. 132.
[64] European Commission, 'EU Emissions Trading System (EU ETS)', available at https://ec.europa.eu/clima/policies/ets_en

Transport sector

French policies for delivering decarbonisation in the transport sector are wide-ranging. Improvements in cargo transport mechanisms and taxes levied on outbound and domestic flights are two examples. Additionally, initiatives to increase the uptake of ULEVs are working in tandem with an active mobility fund, which primarily focuses on encouraging French citizens to switch their cars for cycling. Specifically:

- Abstraction of cargo from road to more eco-friendly modes of transport is promoted through renovation of river channels and developments of port and rail facilities.[65] The funding for such projects is proposed to come from an 'eco-tax' levied on those using the road network.[66]
- To accelerate the switch to more eco-friendly cars, a scrappage scheme was introduced where people can benefit from a €3,700 subsidy towards a new EV or a €2,500 subsidy towards a new plug-in hybrid if they also scrap a diesel vehicle that is at least 13 years old. This scheme is financed by the government, but recently several French car manufacturers such as Renault have agreed to help fund the programme.[67]
- France has set up a €350m fund allocated to a cycling and active mobility plan; the first projects to receive funding from this were publicised in 2019. There have also been a number of proposed initiatives to increase the uptake of cycling, the first of which allows cyclists to ignore red lights and travel in the 'wrong' direction down one-way streets.[68] Other projects include expanding the cycle path network, building secure parking lots to combat theft, and providing support for purchasing electric bikes.[69]
- There are two notable initiatives in the area of air transport. First, an eco-tax on airfares is set to come into force in 2021. The tax applies to all domestic and outbound flights from France and varies based on the type of ticket being bought, with the tax being higher for business class tickets than

[65] Ministry of Ecology, Energy and Sustainable Development (2010), 'National Renewable Energy Action Plan', p. 74.
[66] Ibid.
[67] The Economist Intelligence Unit (2018), 'France expands diesel car scrappage scheme'.
[68] Forbes (2019), 'Signage allowing cyclists to run red among projects allocated $50 million from French active mobility fund', available at https://www.forbes.com/sites/carltonreid/2019/09/16/signage-allowing-cyclists-to-run-reds-among-projects-allocated-47-million-from-350-million-french-active-mobility-fund/#66e6e32742c0
[69] Ministry for the Ecological and Inclusive Transition of France (2018), 'French strategy for energy and climate', p. 325.

economy class. The revenue raised by this tax is intended for investments into less-polluting transport alternatives.[70] A second notable policy involves imposing a floor on the proportion of biofuel used in aircraft fuels.[71] Current biofuel content targets in aviation are set at 2% for 2025 and 5% for 2030. However, French authorities have recently indicated their intention to accelerate the process of switching to biofuels in the aviation sector.[72]

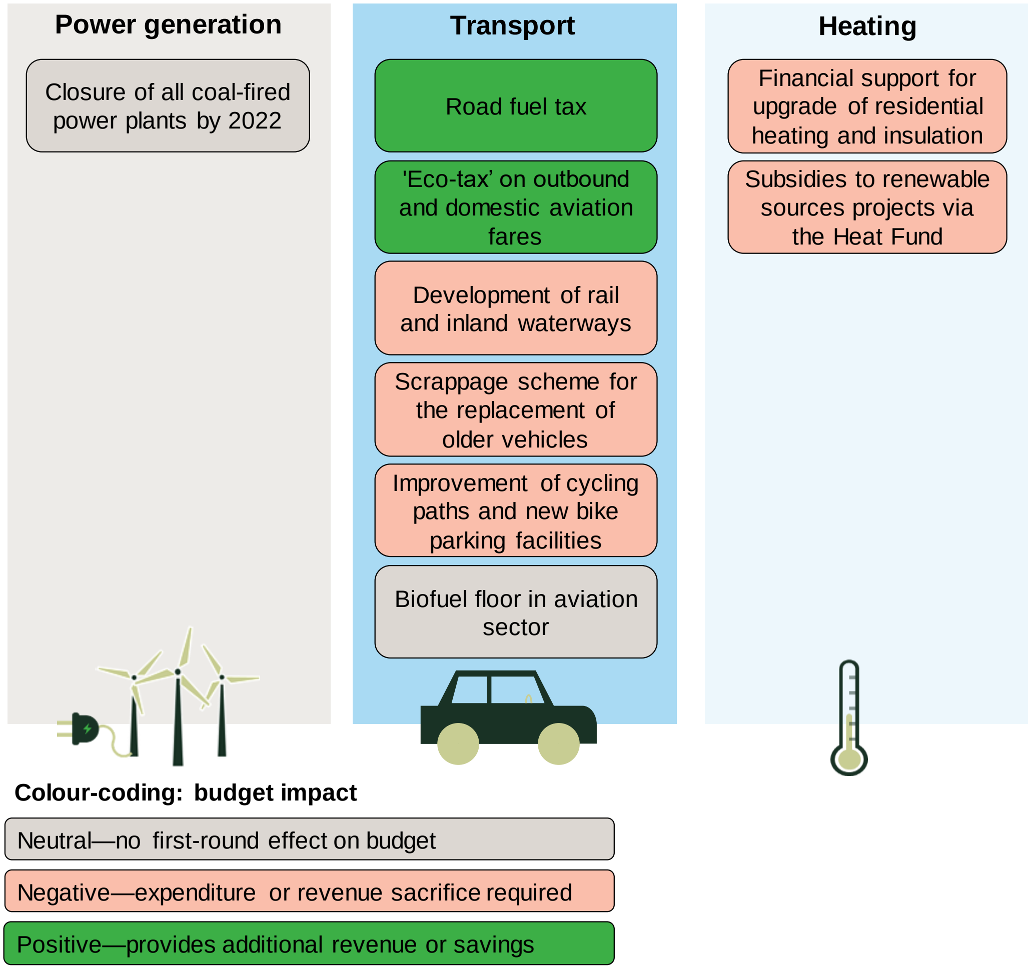
Heating sector

- The French Heat Fund has benefited from approximately €1.6bn in funding from 2009 to 2015.[73] The Heat Fund supports the production of heat through renewable energy by seeking submissions for national and regional projects every year, while ADEME (the French Agency for Environment and Energy Management) selects the most promising energy-efficient project to subsidise.[74]
- Sustainable Development Income tax credits promote switching to more eco-friendly heating technologies by covering the cost of equipment, such as heat pumps, biomass boilers and materials for insulation, of up to €8,000 per individual.[75]
- To encourage homeowners to undertake energy efficiency improvements, households with a low energy performance ranking and a modest income are offered a full compensation of the energy audit costs.[76]

Figure 3.1 provides a graphical overview of decarbonisation policies in France.

[70] BBC (2019), ‘France plans ‘eco-tax’ for air fares’, available at https://www.bbc.co.uk/news/business-48922049
[71] Ministry for the Ecological and Inclusive Transition of France (2018), ‘French strategy for energy and climate’, p. 40.
[72] La Tribune (2019), ‘La France envisage d'obliger les compagnies aériennes à utiliser des biocarburants’, 21 June.
[73] IEA (2017), ‘Heat fund’, available at https://www.iea.org/policiesandmeasures/pams/france/name-30673-en.php
[74] DHC News (2014), ‘What is the French heat fund?’, available at https://www.dhcnews.co.uk/what-is-the-french-heat-fund/
[75] IEA (2015), ‘Tax credit for sustainable development’, available at https://www.iea.org/policiesandmeasures/pams/france/name-30680-en.php
[76] Ministry for the Ecological and Inclusive Transition of France (2018), ‘French strategy for energy and climate’, p. 34.

Figure 3.1 Summary of decarbonisation policies in France



Source: Oxera analysis based on data from policy documents.

3A.2 Iceland

Iceland's target of achieving net carbon neutrality by 2040 was announced in 2017 at the One Planet Summit in Paris.[77]

A separate target was stated in Iceland's National Renewable Energy Action Plan, namely to increase the percentage of renewable energy consumption by 8.6% between 2005 and 2020. By 2014, Iceland had successfully outperformed this target by around 3%.[78] This decarbonisation success may largely be due to an abundance of hydroelectric and geothermal energy.

[77] Iceland Review (2017), 'Prime Minister Announces Plan for Carbon-Neutral Iceland by 2040', 13 December, available at https://www.icelandreview.com/news/prime-minister-announces-plan-carbon-neutral-iceland-2040/#targetText=Katr%C3%ADn%20wrote%20in%20a%20Facebook,national%20leaders%20in%20Paris%20today.

[78] Ministry of Industries and Innovation (2014), 'The Icelandic National Renewable Energy Action Plan', 19 March, p. 11.

According to Iceland's Ministry for the Environment and Natural Resources, the country's present decarbonisation policy as of September 2019 has two priorities: to phase out fossil fuels in transport and to increase carbon sequestration in land use.[79] Iceland's transport policies are extensive and cover a range of avenues such as promoting alternatives to private car travel, incentivising the uptake of low-emission vehicles and discouraging the use of older, fossil-fuelled cars.

Iceland's offsetting activities mainly span from natural measures in restoration of national woodlands and wetlands to revegetation and afforestation.[80]

The government has recently demonstrated its commitment to fighting climate change with a nearly 7bn Icelandic krona (ISK) (around £45m) increase in government funding for climate mitigation measures between 2019 and 2023.[81] This builds on the 210m ISK (around £1.35m) funding that was allocated by the government between 2016 and 2018 to support the development of charging stations for electric cars.[82]

These increased government expenditures were accompanied by high carbon tax rates introduced in 2010.[83]

Table 3.2 provides an overview of the main statistics about the jurisdiction.

Table 3.2 Iceland—basic facts

Statistic	Units	Value
Population	100,000	3
Real GDP	€m	139
Real GDP per capita	€	39,763
Area	100 sq km	1,003
Population density	person/sq km	3
Car ownership	100,000	3
Car ownership per capita	vehicle per 1,000	760
Greenhouse gas emissions	100,000 tonnes	141
Greenhouse gas emissions	tonnes per capita	40.4
Power generation	TWh	19
Proportion of renewable power	%	100%

Note: The base year of the real GDP is 2010. All data is provided as at 2017—the latest observation available in the database.

Source: Oxera analysis, based on Eurostat.

[79] Ministry for the Environment and Natural Resources (2018), 'Iceland's Climate Action Plan for 2018-2030', p. 4.
[80] Ibid., p. 4.
[81] Ibid., p. 4.
[82] Ibid., p. 5.
[83] Ministry for the Environment and Natural Resources (2018), 'Iceland's 7th National Communication and 3rd Biennial Report', p. 69.

In the remainder of this section, we describe individual decarbonisation policies adopted for the power generation, transport and heating sectors in Iceland.

Power generation sector

- Almost all of Iceland's electricity comes from domestic renewable sources (approximately 27% geothermal and 73% hydropower),[84] enabling Iceland's electricity supply to be entirely isolated.[85] This makes Iceland a particularly relevant case study for the Island of Jersey, since both islands' electricity generation sectors are largely decarbonised—in Jersey's case due to reliance on imported energy from France.[86]
- Iceland also participates in the EU ETS, despite not being a member of the EU-28, as a tool for reducing greenhouse gas emissions.[87]

Transport sector

- A general carbon tax is in place, covering all fossil fuels, and was increased by 50% in 2018, with a further 10% increase scheduled for 2019 and 2020.[88] In 2018 this translated into 12.6 ISK (around 9p) per litre of petrol and 11 ISK (around 8p) per litre of diesel.[89]
- A number of measures are in place to encourage the uptake of low-emission vehicles. Financial incentives include VAT exemptions on the purchase of zero-emission vehicles (including hybrid vehicles) and free parking for low-emission vehicles.[90] In addition to financial incentives, there are policies in place that aim to make EV usage more convenient. A set of charging ports installed along Iceland's main motorway now allows EV travel around the whole country.[91] As indicated by Norway's experience (see section 3A.5), the ability to travel throughout the country, as opposed to just within the boundaries of a city appears to be an important factor in

[84] *Iceland Magazine* (2018), 'Carbon taxes raised, those on environmentally friendly vehicles lowered to reduce CO_2 emissions'.
[85] There are plans to build an interconnector, IceLink, to Great Britain. See Landsvirkjun website, 'Overview of IceLink', available at https://www.landsvirkjun.com/researchdevelopment/research/submarinecabletoeurope
[86] See section 1C.1.
[87] European Commission, 'EU Emissions Trading System (EU ETS)', available at https://ec.europa.eu/clima/policies/ets_en
[88] Ministry for the Environment and Natural Resources (2018), 'Iceland's Climate Action Plan for 2018-2030', p. 5.
[89] *Iceland Magazine* (2018), 'Carbon taxes raised, those on environmentally friendly vehicles lowered to reduce CO_2 emissions'.
[90] Ministry of Industries and Innovation (2014), 'The Icelandic National Renewable Energy Action Plan', 19 March, pp. 27 and 47.
[91] Ministry for the Environment and Natural Resources (2018), 'Iceland's Climate Action Plan for 2018-2030', p. 5.

EV uptake. The government itself is leading by example by buying non-emitting vehicles for state enterprises.[92] Such government-led initiatives can have several advantages: they are likely to yield immediate and reliable results in terms of achieved carbon reductions and can act as a prompt to the general public, akin to an information campaign.

- Working in conjunction with the measures promoting the use of low-emission vehicles, there are also a number of measures discouraging the use of cars powered by fossil fuels. Biannual road tax and excise duty on passenger cars are levied based on the estimated CO2 emissions of the vehicle. These charges are lowered for vehicles using methane,[93] which is mainly collected from Iceland's largest landfill.[94] In addition, registration of new petrol and diesel vehicles in Iceland is scheduled to be banned after 2030.[95] In September 2018 the government also announced a feasibility study for a potential scrappage scheme for replacing older, high-polluting cars.[96]
- To encourage a further switch away from fossil-fuelled cars, the government is working on promoting alternative means of travel through infrastructure developments such as priority lanes for selected vehicles, support for public transport and creation of walking and cycling routes.[97]
- With regard to marine transport, Iceland has begun with efforts to bring electricity to ships in harbours, so that combustion engines are not used for electricity needs while docked. The government is looking to introduce more electrical infrastructure into harbours, such as high voltage charging stations for cruise ships, with the aim of enabling most ships to use electricity by 2025.[98]

Heating sector

- Similar to its power generation sector, heating is not a major area of focus for Iceland, due to the abundance of geothermal resources. Iceland was

[92] Ministry for the Environment and Natural Resources (2018), 'Iceland's Climate Action Plan for 2018-2030', p. 6.
[93] Ministry of Industries and Innovation (2014), 'The Icelandic National Renewable Energy Action Plan', 19 March, p. 48.
[94] Ministry for the Environment and Natural Resources (2018), 'Iceland's 7th National Communication and 3rd Biannual Report', p.3.
[95] Ministry for the Environment and Natural Resources (2018), 'Iceland's Climate Action Plan for 2018-2030', p. 5.
[96] Ibid., p. 5.
[97] Ibid., p. 6.
[98] Ibid., p. 6.

granted derogation from Directive 2002/91/EC on energy performance of buildings due to the special circumstances of Iceland's energy system. There are, however, national building codes that ensure high levels of efficiency are attained.[99] Policies aimed at locating new areas for geothermal heat, known as 'cold areas', are also in place.[100]

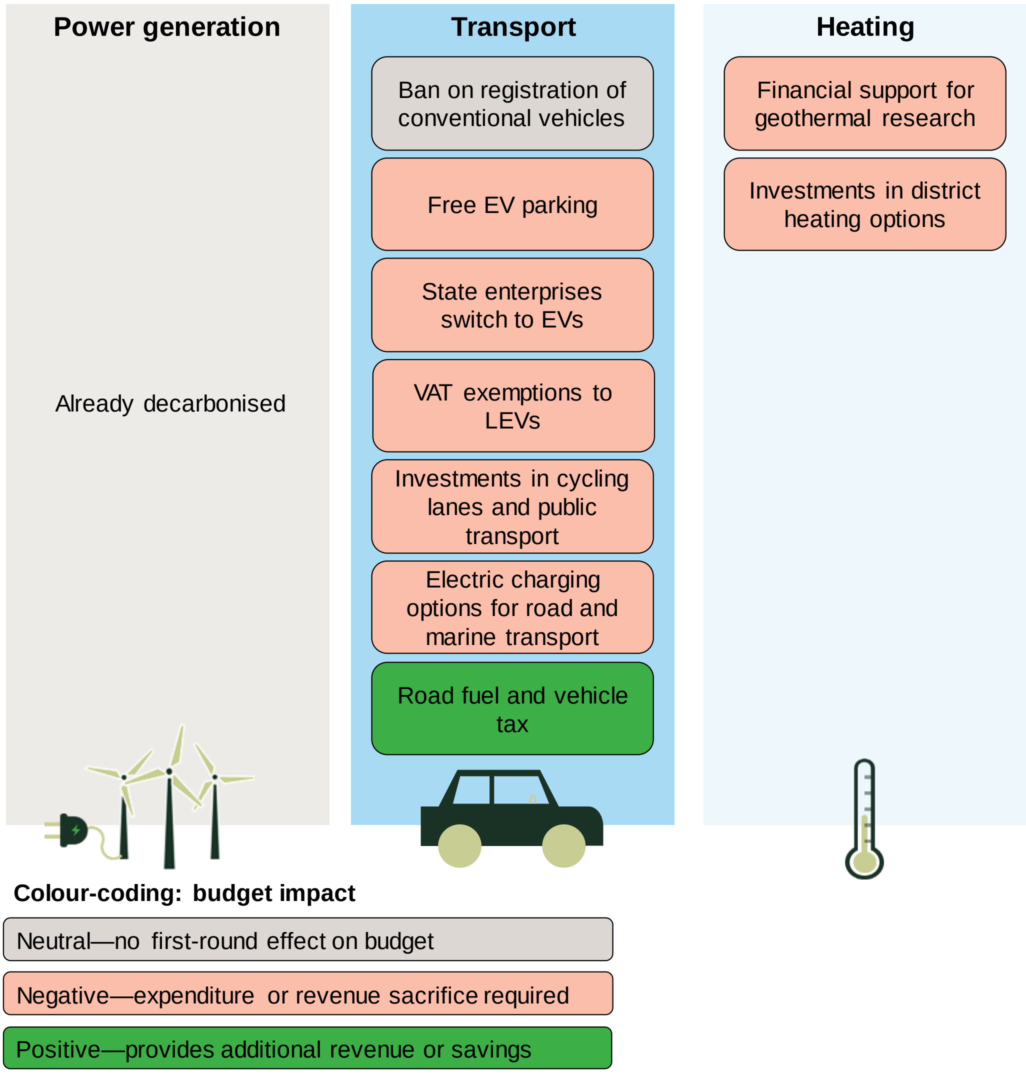
- Support and loans for geological/geothermal research and drilling for geothermal heat/hot water are in place. Specifically, 50% of the estimated cost in each case is financially supported.[101]

- Special loans are offered from the National Energy Fund for exploration of geothermal heat in areas where a district heating system could reduce domestic heating costs.[102]

Figure 3.2 provides a graphical overview of the decarbonisation policies in Iceland.

[99] Ministry of Industries and Innovation (2014), 'The Icelandic National Renewable Energy Action Plan', 19 March, p. 7.
[100] Ministry of Industries and Innovation (2014), 'The Icelandic National Renewable Energy Action Plan', 19 March, p. 47.
[101] Ibid., p. 43.
[102] Ibid., p. 43.

Figure 3.2 Summary of decarbonisation policies in Iceland



Note: LEVs, low emission vehicles.

Source: Oxera analysis based on data from policy documents.

3A.3 Malta

Malta committed to reaching a net zero target by 2050 as a part of signing the Paris Agreement.

In addition to the Paris Agreement, Malta's National Renewable Energy Action Plan mandates that by 2020 at least 10% of Malta's gross final energy consumption should come from renewable energy sources.[103] Given Malta's ample amount of year-round sunshine, the Plan places a strong emphasis on the development of PV systems, which are expected to yield 47% of the overall target emission reduction.[104] In addition to the overall target, there is a goal to

[103] The Energy and Water Agency (2017), 'The National Renewable Energy Action Plan 2015-2020', p. 14.
[104] Ibid., p. 35.

achieve at least a 10% share of renewables in the final consumption of energy, specifically in the transport sector.[105]

In the heating sector, grants, incentives and the provision of information are all used as tools for stimulating domestic and industrial adoption of heat pumps and solar water heating, which, together, are expected to provide 25% of the overall target carbon reduction.[106]

As part of Malta's offsetting efforts, Malta's Energy and Water Agency is working to identify joint investment opportunities for Maltese businesses in large-scale renewable energy projects in the rest of the EU and the rest of the world, with specific focus on solar energy projects in North Africa. Although technically not a government project, the TuNur solar export presents an example of a cross-border energy project. The project will generate renewable energy from a CSP (concentrated solar power) tower located in Tunisia. The energy is then transported to Malta to be redistributed to other parts of Europe.[107]

The plans for the financing of Malta's energy policies do not appear to have been fully determined yet. However, it is expected that a portion of expenditure will be covered by EU funding.[108] This is particularly true of Malta's R&D efforts—for example, the University of Malta has made use of EU funding through its Institute for Sustainable Energy, establishing a solar research lab that has contributed to shaping Malta's PV roll-out strategy. The University of Malta's Institute for Sustainable Energy has benefitted from EU funding through the European Regional Development Fund (ERDF). A grant of €4.2m combined with some funding from the University of Malta resulted in almost €5m to invest in a new Solar Research Lab that has contributed to shaping Malta's PV roll-out strategy.[109] However, acknowledging the scarcity of resources available for domestic R&D, the Maltese government actively monitors the technological development of renewable power generation sources globally, with the aim of embracing new technologies that have already demonstrated their effectiveness.[110]

Table 3.3 provides an overview of the main statistics about the jurisdiction.

[105] The Energy and Water Agency (2017), 'The National Renewable Energy Action Plan 2015-2020', p. 14.
[106] Ibid., p. 35.
[107] Nur Energie, 'TuNur Overview', available at http://www.nurenergie.com/tunur/index.php/english/project/overview
[108] Ibid., p. 44.
[109] THINK, 'Harnessing the power of the sun', available at https://www.um.edu.mt/think/harnessing-the-power-of-the-sun/
[110] Ibid., p. 145.

Table 3.3 Malta—basic facts

Statistic	Units	Value
Population	100,000	5
Real GDP	€m	104
Real GDP per capita	€	21,924
Area	100 sq km	3
Population density	person/sq km	1,505
Car ownership	100,000	3
Car ownership per capita	vehicle per 1,000	634
Greenhouse gas emissions	100,000 tonnes	22
Greenhouse gas emissions	tonnes per capita	4.5
Power generation	TWh	2
Proportion of renewable power	%	10%

Note: The base year of the real GDP is 2010. All data is provided as at 2017—the latest observation available in the database.

Source: Oxera analysis, based on Eurostat.

In the remainder of this section, we describe individual decarbonisation policies adopted for the power generation, transport and heating sectors in Malta.

Power generation sector

- Malta's decarbonisation policy in the power generation sector primarily focuses on the roll-out of PV systems and the adoption of biofuels. While the option of offshore wind farms was previously explored, subsequent feasibility studies showed this option to be ineffective.[111]
  - To promote the roll-out of PV systems, the government offers grant schemes for domestic PV installations for electricity production.[112] For households with no roof access or limited space, communal medium-scale PV projects are organised.[113] The government itself is leading by example by deploying PV panels on the roofs of public buildings.[114] Furthermore, the government has committed to identify brownfield sites that could be used for PV farms, such as abandoned landfills and grounds within the perimeter of Malta International Airport.[115]
  - To promote the production of biogas, facilities for converting animal manure into fuel are being constructed at farm sites.[116] Malta is reliant on

[111] The Energy and Water Agency (2017), 'The National Renewable Energy Action Plan 2015-2020', p. 115.
[112] Ibid., p. 137.
[113] Ibid., p. 138.
[114] Ibid., p. 138.
[115] Ibid., p. 138.
[116] Ibid., p. 140.

cooperation between numerous livestock farms in order to make the use of biogas through anaerobic digesters economically efficient.[117] It is worth noting that Malta's scope to benefit from biogas is significantly greater than Jersey's as in 2015 Maltese livestock amounted to 74,667 heads.[118] This is more than double the 35,560 that Jersey had in 2017.[119]

- The use of biofuel is also encouraged through exemption from excise duty.[120] It should be noted, however, that although the use of waste in power generation or in heating systems displaces the use of fossil fuels, the technology in itself produces harmful emissions.[121] Therefore, this measure tends to be a stepping stone or has a complementary role in a more fundamental medium-to-long-term decarbonisation agenda.
- As a member of the EU-28, the EU ETS operates in Malta, cutting emissions and promoting investment in new, low-carbon technologies.[122]

Transport sector

- Transport decarbonisation measures in Malta are centred on reducing road transport emissions, for instance by promoting the use of more eco-friendly vehicles or public transport. Malta's policies focus on decarbonising road transport as follows:
  - the use of auto-gas (LPG) in private vehicles is promoted through a subsidy on the conversion of vehicles from petrol to LPG.[123] This measure is implemented in conjunction with an information programme, advertising LPG as a cleaner vehicle fuel option;[124]
  - there are various schemes that incentivise the uptake of EVs, such as grants of up to €7,000 towards the initial cost when a 10-year-old

[117] The Energy and Water Agency (2017), 'The National Renewable Energy Action Plan 2015-2020', p. 72.
[118] Malta Independent (2017), 'Pigs account for 60% of livestock in Malta', available at https://www.independent.com.mt/articles/2017-08-14/local-news/Pigs-account-for-60-of-livestock-in-Malta-6736177792
[119] Government of Jersey, 'Agriculture and fisheries statistics', available at https://www.gov.je/Government/JerseyInFigures/BusinessEconomy/pages/agriculturefisheries.aspx
[120] Government of Malta (2011), 'Response to the European Commission's Template for National Renewable Energy Action Plans (NREAPs)', 24 May, p. 65.
[121] Towie, N. (2019), 'Burning issue: are waste-to-energy plants a good idea?', *The Guardian*, available at https://www.theguardian.com/environment/2019/feb/28/burning-issue-are-waste-to-energy-plants-a-good-idea
[122] European Commission, 'EU Emissions Trading System (EU ETS)', available at https://ec.europa.eu/clima/policies/ets_en.
[123] *Times of Malta* (2018), 'Encouraging LPG-powered vehicles', 14 April, available at https://timesofmalta.com/articles/view/Encouraging-LPG-powered-vehicles.676432
[124] World LPG Association, 'Clean', available at https://www.wlpga.org/about-lpg/why-use-lpg/clean/

combustion engine vehicle is scrapped and €6,000 without scrapping another vehicle.[125] Reductions to registration fees and excise duties, and a roll-out of electric charging stations are also in place;[126]

- the government has put in place regulatory requirements to increase the use of biofuel in transport. The biofuel content level in imported fuels is set at the maximum allowed by European Standards,[127] which is 7% for Fatty Acid Methyl Ester (FAME) and 10% for ethanol as of 2013.[128] Given that all fuel in Malta is imported,[129] this measure effectively imposes a maximum use of low-emission fuels in road transport that is feasible with the present vehicle fleet.

Heating sector

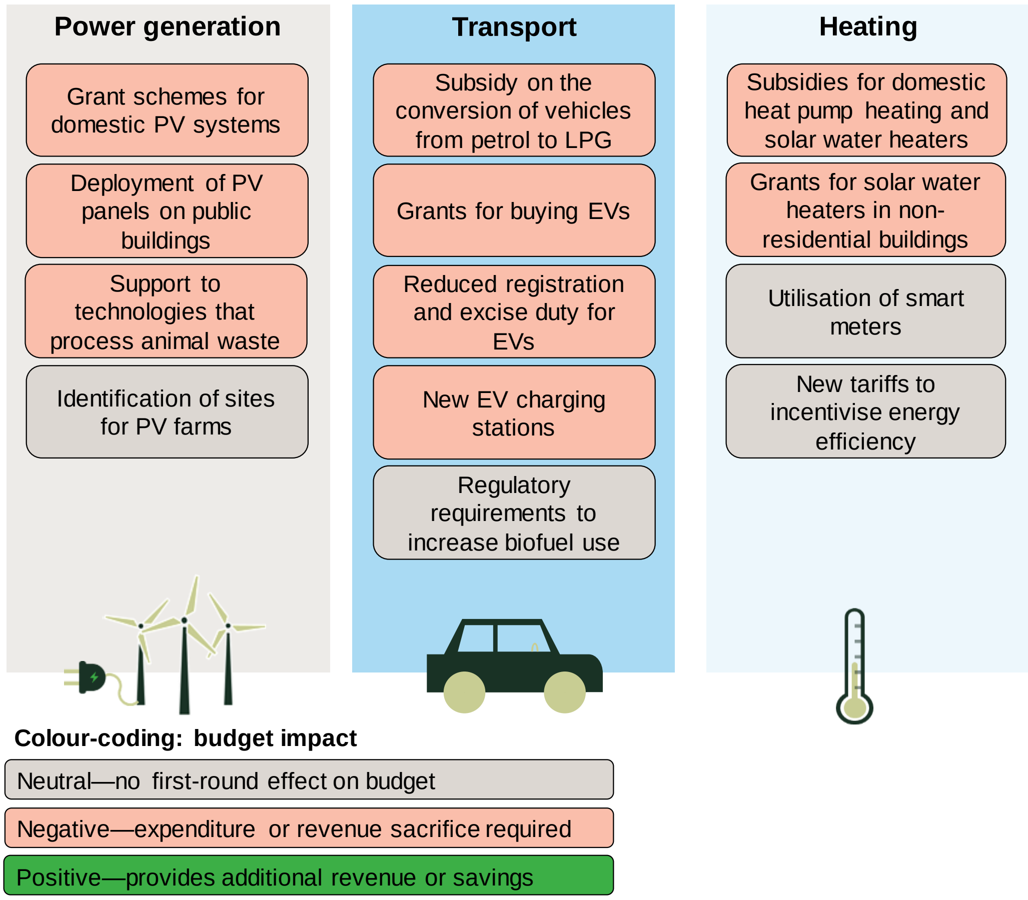
- Malta's policies focus on introducing efficient technologies such as heat pumps and solar water heaters, as well as encouraging behavioural changes in energy consumption. Individual policies include the following.
    - The state covers part of the cost of heat pump systems and solar water heaters for domestic consumers. This is also supported through environmental information campaigns.[130]
    - For non-residential buildings, various capital grant schemes for the installation of solar water heaters are also available.[131]
    - Smart meters are used to optimise the management of distributed renewable energy sources through a tariff system such as dynamic time-of-use tariffs, which shift the price of energy consumption depending on the level of supply and demand.[132]

[125] Transport Malta (2018), 'Schemes for greener vehicles', available at https://news.transport.gov.mt/schemes-for-greener-vehicles/
[126] In Malta, excise duty is referred to as 'circulation tax'. See The Energy and Water Agency (2017), 'The National Renewable Energy Action Plan 2015-2020', p. 86.
[127] The Energy and Water Agency (2017), 'The National Renewable Energy Action Plan 2015-2020', p. 141.
[128] The Energy and Water Agency (2017), 'The National Renewable Energy Action Plan 2015-2020', p. 141. Kampman, B., Verbeek, R., van Grinsven, A., van Mensch, P., Croezen, H. and Patuleia, A. (2013), 'Bringing biofuels on the market: Options to increase EU biofuels volumes beyond the current blending limits', July.
[129] Lexology (2018), 'Oil and Gas in Malta', 1 November.
[130] The Energy and Water Agency (2017), 'The National Renewable Energy Action Plan 2015-2020', p. 60.
[131] Ibid., p. 58.
[132] Maugham, C. (2017), 'Smart meters the way to a new age of clean energy', *The Ecologist*, 3 April.

- Research into the heating habits of Maltese households is being conducted to determine the most effective means to promote the switch to sustainable heating.[133]

Figure 3.3 provides a graphical overview of the decarbonisation policies in Malta.

Figure 3.3 Summary of decarbonisation policies in Malta



Source: Oxera analysis based on data from policy documents.

3A.4 The Netherlands

In 2015, the Netherlands co-signed the Paris Agreement and committed to a 2050 carbon emissions reduction target of 85–95% relative to 1990 levels. This agreement was passed by national lawmakers in December 2018.[134]

Subsequently, in 2019, the National Climate Agreement was signed, committing representatives of various sectors to concrete climate change goals. The participating sectors are: electricity, industry, built environment, traffic and

[133] The Energy and Water Agency (2017), 'The National Renewable Energy Action Plan 2015-2020', p. 143.
[134] Corder, M. (2018), 'Dutch lawmakers pass ambitious law to reduce emissions', Phys.org, available at https://phys.org/news/2018-12-dutch-lawmakers-ambitious-law-emissions.html

transport and agriculture.[135] The Climate Agreement follows on from the Paris targets and commits to reducing greenhouse gas emissions by 49% and 95% by 2030 and 2050 respectively.

Looking more specifically into the energy sector, the Energy Agreement for Sustainable Growth mandates that the proportion of sustainable energy in the Netherlands needs to reach at least 14%, 16% and nearly 100% in 2020, 2023, and 2050 respectively.[136] Decarbonisation of heating in particular is an important part of the Netherlands' emission reduction plan.[137] Natural gas used within domestic houses (for heating and cooking) constitutes 80% of natural gas consumption in the Netherlands; thus, efforts have focused on providing alternatives to natural gas, including low-carbon district heating, heat pumps and biomass boilers.

Table 3.4 provides an overview of the main statistics about the jurisdiction.

Table 3.4 The Netherlands—basic facts

Statistic	Units	Value
Population	100,000	172
Real GDP	€m	7,159
Real GDP per capita	€	41,666
Area	100 sq km	339
Population density	person/sq km	507
Car ownership	100,000	84
Car ownership per capita	vehicle per 1,000	490
Greenhouse gas emissions	100,000 tonnes	1,989
Greenhouse gas emissions	tonnes per capita	11.6
Power generation	TWh	117
Proportion of renewable power	%	15%

Note: The base year of the real GDP is 2010. All data is provided as at 2017—the latest observation available in the database.

Source: Oxera analysis, based on Eurostat.

In the remainder of this section, we describe the individual decarbonisation policies adopted for the power generation, transport and heating sectors in the Netherlands.

[135] Government of the Netherlands, 'Climate policy', available at https://www.government.nl/topics/climate-change/climate-policy
[136] Government of the Netherlands, 'Central government encourages sustainable energy', available at https://www.government.nl/topics/renewable-energy/central-government-encourages-sustainable-energy
[137] Klimaatakkoord (2019), Chapter C1, available at Klimaatakkoord.nl.

Power generation

- In 2017, the government announced plans to close all five Dutch coal plants by 2030.[138] The policy was revised in March 2019, mandating that one plant would be closed in 2020, one in 2024 and the remaining three in 2030.[139]
- In addition to being a member of the EU ETS trading scheme, the Netherlands has imposed a carbon price floor of €12.30/tCO2e from 2020, increasing to €31.90/tCO2e in 2030.[140] This will come into effect whenever the spot market price falls below the minimum price, although it is not expected that this will occur in the near future, with European emission allowances currently trading at a price above €20/tCO2e.[141]
- In 2011, the government introduced a feed-in premium scheme—the SDE+ scheme (to be replaced by the SDE++ in 2020). Under this scheme, an operating grant is paid to producers of renewable energy if their cost of production is higher than the market price of that commodity. The grant subsidises the production of renewable electricity, renewable gas and renewable heat (including CHP). The scheme is funded through a surcharge on the combined (i.e. including both electricity and gas) energy bill (ODE).[142]
- In addition to the SDE+ scheme, which supports only the operations of existing renewable energy producers, there is an ISDE (Investeringssubidie Duurzame Energie) scheme. ISDE, in turn, helps to increase the number of assets producing renewable energy, by assisting with the financing of the installation and construction costs.[143]

[138] Darby, M. (2017), 'Netherlands to end coal power by 2030, closing down new plants', Climate Home News, available at https://www.climatechangenews.com/2017/10/11/netherlands-agrees-coal-phase-calls-stronger-2030-eu-emissions-target/
[139] Meijer, B. (2019), 'Dutch to close Amsterdam coal-fired power plant four years early', Reuters, available at https://www.reuters.com/article/us-netherlands-energy/dutch-to-close-amsterdam-coal-fired-power-plant-four-years-early-rtl-idUSKCN1QO1JE
[140] Government of the Netherlands (2019), 'Bill submitted on minimum carbon price in electricity production', available at https://www.government.nl/latest/news/2019/06/04/bill-submitted-on-minimum-carbon-price-in-electricity-production, Sterling, T. (2019), 'Dutch government proposes minimum price for CO2 emissions from 2020', Reuters, available at https://www.reuters.com/article/us-netherlands-carbon-emissions/dutch-government-proposes-minimum-price-for-co2-emissions-from-2020-idUSKCN1T5219
[141] See Figure 4.2.
[142] The terms 'biomethane' and 'biogas' are often used interchangeably. However, technically speaking, the two have different properties. Biogas can be used on CHP plants, but it cannot be mixed with natural gas. To be injected into the gas grid, biogas needs to be purified to obtain biomethane, which then can be blended with natural gas. The Official Information Portal on Anaerobic Digestion, 'Biogas', available at http://www.biogas-info.co.uk/about/biogas/
[143] Government of the Netherlands, 'Stimulating the growth of solar energy', available at https://www.government.nl/topics/renewable-energy/stimulating-the-growth-of-solar-energy

Transport

- In 2018, the Dutch government pledged to invest €345m in new ultrafast cycling routes and additional parking facilities for bikes.[144] This is intended to encourage people to switch from travelling by car to bicycle, a change that is estimated to reduce around 150g of CO2 per kilometre.[145]

- Financial subsidies to petrol stations for increasing the proportion of biofuel sales have been put in place. This is funded by the Dutch government and was given a total budget of €50m in 2006.[146]

- Financial incentives are in place for EV drivers, such as reduced tax rates for zero-emission company vehicles. There has also been investment in relevant infrastructure to facilitate EV uptake. In the period 2009 to 2011, there was a government budget of €65m for these types of policies.[147]

Heating sector

- As mentioned above, in 2011, the government introduced the SDE+ scheme to support the production of a wide range of renewable energy.[148] With regard to heating in particular, the scheme promotes the use of biomethane (sourced mostly from agriculture) [149] in the natural gas grid.

- The Gas Act 2018 prohibits newly built houses from being connected to the gas grid (which is currently the most popular source of domestic heating) and instead requires households to choose an alternative sustainable heating option.[150] The ultimate goal is for housing to be completely free of natural gas by 2050.[151] A similar measure was introduced in the UK at roughly the same time (see section 3A.7).

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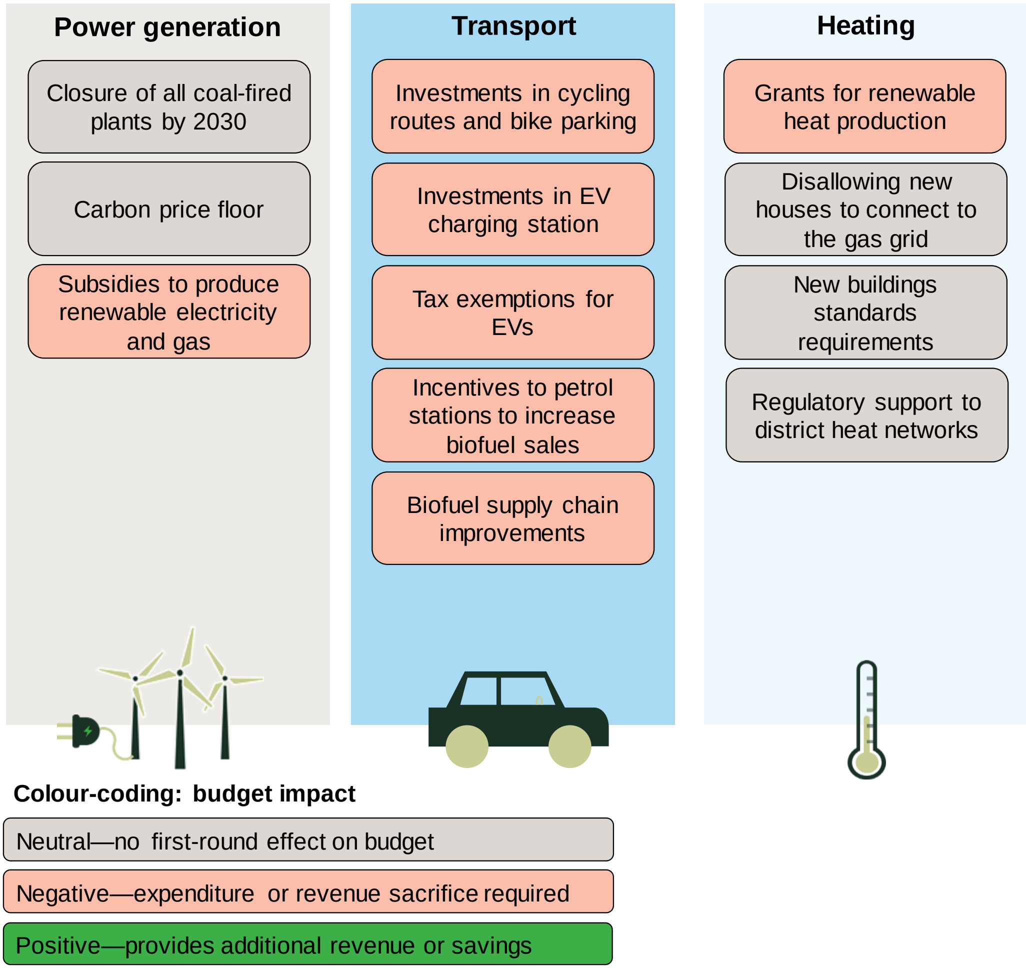
[144] Government of the Netherlands (2018), 'Hundreds of millions of euros to boost cycling in the Netherlands', news item, available at https://www.government.nl/latest/news/2018/11/23/hundreds-of-millions-of-euros-to-boost-cycling-in-the-netherlands
[145] Ministry of Infrastructure and Water management (2018), 'Cycling Facts, Netherlands Institute for Transport Policy Analysis', p. 13.
[146] Government of the Netherlands (2010), 'National renewable energy action plan, Directive 2009/28/EC', p. 98.
[147] Ibid.
[148] Government of the Netherlands, available at Netherlands Enterprise Agency, 'Stimulation of Sustainable Energy Production (SDE+)', available at https://english.rvo.nl/subsidies-programmes/sde
[149] Government of the Netherlands (2018), 'Anaerobic Digestion Market Report', pp. 2–3, available at http://www.worldbiogasassociation.org/wp-content/uploads/2018/07/The-Netherlands-International-Market-Report.pdf.
[150] Ministry of Economic Affairs and Climate Policy (2018), 'Energy transition in the Netherlands – phasing out of gas', p. 6.
[151] Dutch News (2018), 'Two million Dutch homes to be gas free by 2030, as energy transition takes shape', 26 March, available at https://www.dutchnews.nl/news/2018/03/two-million-dutch-homes-to-be-gas-free-by-2030-as-energy-transition-takes-shape/

- In 2019, new standards for the assessment of building energy efficiency, BENG, were introduced. The standards mandate that all new buildings are 'nearly energy-neutral'.[152]
- There is also regulatory support for the roll-out of district heat networks to replace gas-fired domestic boilers since district heating can be an efficient way to decarbonise heating at the local level. Assuming that the area is sufficiently densely populated to have an annual heat demand density of at least 4 MWh/sq m,[153] a district heating system exhibits better thermal efficiency, relative to gas-fired domestic boilers. District heating can also be powered by sustainable fuels such as biomass.[154]
- To ensure that consumers are incentivised to make a switch from the gas grid, the tariffs on district heating are price-regulated such that the district heating tariff cannot exceed the tariff charged by the gas grid.

Figure 3.4 provides a graphical overview of the decarbonisation policies in the Netherlands.

[152] Netherlands Enterprise Agency, 'BENG-indicatoren', https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/wetten-en-regels-gebouwen/nieuwbouw/beng-indicatoren
[153] Heat Network Partnership (2017), 'District Heating Strategy Factsheet', available at districtheatingscotland.com/wp-content/uploads/2017/10/Module-5-Infrastructure.pdf
[154] The Green Age (2017), 'What is district heating?', 29 August, available at https://www.thegreenage.co.uk/what-is-district-heating/

Figure 3.4 Summary of decarbonisation policies in the Netherlands



Source: Oxera analysis based on data from policy documents.

3A.5 Norway

In 2015, as part of the Paris Agreement, the Norwegian Ministry of Climate and Environment made a legally binding commitment to reduce greenhouse gas emissions to at least 40% below 1990 by 2030, and 80–95% by 2050.

Norway is uniquely positioned as regards renewable energy: nearly all of its domestic electricity production is based on hydropower, yet the country’s biggest export industries are oil and gas. Domestically, the share of renewable energy is higher than that of EU countries,[155] and there are extensive policy efforts to carry out grid upgrades to allow for a widespread integration of renewables into the transmission network. Most large initiatives are centred on the diversification of energy sources in particular sectors.

[155] Ministry of Petroleum and Energy (2012), ‘Norway National Renewable Energy Action Plan (NREAP) under directive 2009/28/EC’, September, p. 5.

Norway is also participant to the EU ETS, despite not being a member of the EU-28, and is therefore equally committed to the EU ETS scheme, aiming to reduce greenhouse gas emissions across Europe.[156]

Table 3.5 provides an overview of the main statistics about the jurisdiction.

Table 3.5 Norway—basic facts

Statistic	Units	Value
Population	100,000	53
Real GDP	€m	3,695
Real GDP per capita	€	69,775
Area	100 sq km	3,043
Population density	person/sq km	17
Car ownership	100,000	27
Car ownership per capita	vehicle per 1,000	517
Greenhouse gas emissions	100,000 tonnes	277
Greenhouse gas emissions	tonnes per capita	5.2
Power generation	TWh	149
Proportion of renewable power	%	98%

Note: The base year of the real GDP is 2010. All data is provided as at 2017—the latest observation available in the database.

Source: Oxera analysis, based on Eurostat.

In the remainder of this section, we describe individual decarbonisation policies adopted for the power generation, transport and heating sectors in Norway.

Power generation sector

- In 2012, Norway and Sweden implemented a joint Norwegian–Swedish electricity certificate market to pursue the goal of increasing their electricity production from renewable energy sources by 28.4 TWh by 2020, of which 13.2 TWh would be financed by Norway. Putting this in context, in 2012 the electricity consumption in Norway and Sweden was 120.69 TWh and 136.03 TWh respectively.[157] The scheme is managed by the Norwegian Water Resources and Energy Directorate (NVE) and the Swedish Energy Agency.[158]
- Enova SF, a Norwegian government enterprise founded in 2001, offers investment aid to private sector projects across Norway, in order to

[156] European Commission, 'EU Emissions Trading System (EU ETS)', available at https://ec.europa.eu/clima/policies/ets_en
[157] IEA, 'Global engagement: Sweden', available at https://www.iea.org/countries/Sweden/ and IEA, 'Global engagement: Norway', available at https://www.iea.org/countries/Norway/
[158] Norwegian Water Resources and Energy Directorate, Swedish Energy Agency (2015), 'The Norwegian-Swedish Electricity Certificate Market', Annual Report 2015, p. 6.

contribute to reduced greenhouse gas emissions, increased innovation in energy technology, and increased security of energy supply.[159] These subsidies are financed partly through the government budget and partly through a designated tariff imposed on electricity consumers in Norway.

- In terms of the further development of the national electricity grid to accommodate renewable electricity, as of 2012, Norwegian legislation requires that operational reporting as well as schedules for major repairs related to the power grid are published regularly by grid operators. This is aimed at increasing the transparency of energy transmission and the predictability of repairs or outages.
- National guidelines for the planning, placement and use of wind and hydropower plants have been continuously updated since 2007, encouraging the widespread adoption and efficiency enhancement of renewable energy sources.[160]
- In addition to policy measures aimed at adopting new technologies, the Norwegian government has been actively involved in supporting the development of new technologies. Norway's RENERGI and ENERGIX schemes, from 2004 onwards, have led to increased R&D for renewable energy and alternative fuels through state funding. Indeed, the government provided a budget of over 1bn Norwegian krone (NOK) (£90.2m)[161] for grants towards renewable energy in 2019, to complement a series of previous research initiatives.[162] For example, the Offshore Energy Act 2010 financially supports research projects and prototypes for offshore resources exploration.[163]

[159] IEA (2017), 'Investment aid and conditional loans to support development and deployment of energy and climate efficient technologies and measures through Enova SF', available at https://www.iea.org/policiesandmeasures/pams/norway/name-24957-en.php
[160] Karagiannopoulos, L. (2019), 'Norway identifies 13 preferred areas for new wind power projects', Reuters, available at https://www.reuters.com/article/us-norway-wind/norway-identifies-13-preferred-areas-for-new-wind-power-projects-idUSKCN1RD27H
[161] Using Bank of England exchange rate as at 31 December 2018, available at https://www.bankofengland.co.uk/boeapps/database/Rates.asp?TD=31&TM=Dec&TY=2018&into=GBP&rateview=D
[162] Government of Norway (2018), 'More than a billion kroner for renewable energy', available at https://www.regjeringen.no/en/aktuelt/renewable_energy/id2613723/
[163] International Energy Agency (2015), 'Act on Offshore Renewable Energy Production', available at https://www.iea.org/policiesandmeasures/pams/norway/name-24981-en.php?s=dHlwZT1yZSZzdGF0dXM9T2s,&return=PG5hdiBpZD0iYnJlYWRjcnVtYiI-PGEgaHJlZj0iLyI-SG9tZTwvYT4gJnJhcXVvOyA8YSBocmVmPSIvcG9saWNpZXNhbmRtZWFzdXJlcy8iPlBvbGljaWVzIGFuZCBNZWFzdXJlczwvYT4gJnJhcXVvOyA8YSBocmVmPSIvcG9saWNpZXNhbmRtZWFzdXJlcy9yZW5ld2FibGVlbmVyZ3kvIj5SZW5ld2FibGUgRW5lcmd5PC9hPjwvbmF2Pg,,

Transport sector

- Policies in the transport sector focus on providing financial incentives for the reduction of fossil fuel consumption, through taxation regimes, subsidies, and a series of tax exemptions for ULEVs. These benefits cost the Norwegian government almost $1bn (£1.2bn)[164] in 2018 and will be phased out in 2021 to be replaced by higher taxes on combustion engine vehicles.[165]
    - In the early 2000s, a series of tax exemptions were applied to electric, hydrogen and biodiesel-powered cars, as well as exemptions for the use of sustainable marine fuels, biodiesel blends and mineral oils.[166]
    - Since then, further exemptions have been introduced to motivate the uptake of EVs. These include full exemption from VAT and registration fees, as well as partial exemption from annual ownership fees and road tax upon purchase of EVs.[167]
    - Additionally, electric car drivers are allowed to use bus lanes, are given exemptions from ferryboat fees, and benefit from designated free parking areas.[168] The government also provides financial support for the development of charging infrastructure. From 2010 to 2014, the government spent NOK 50m (£4.5m)[169] on subsidies for the installation of fast charging stations. Following that, in 2015, Enova introduced a new support scheme with the objective of ensuring that fast charging stations are available within every 50 km along all the main roads of Norway.[170]

[164] Using Bank of England exchange rate as at 31 December 2018, available at https://www.bankofengland.co.uk/boeapps/database/Rates.asp?TD=31&TM=Dec&TY=2018&into=GBP&rateview=D
[165] Lewis, M. (2018), 'With government incentives, Norway sees electric car sales boom', The Christian Science Monitor, available at https://www.csmonitor.com/Environment/2018/1219/With-government-incentives-Norway-sees-electric-car-sales-boom
[166] Ministry of Petroleum and Energy (2012), 'Norway National Renewable Energy Action Plan (NREAP) under directive 2009/28/EC', September, p. 24.
[167] Ibid., p. 24.
[168] Ibid., p. 114.
[169] Using Bank of England exchange rate as at 31 December 2018, available at https://www.bankofengland.co.uk/boeapps/database/Rates.asp?TD=31&TM=Dec&TY=2018&into=GBP&rateview=D
[170] EVS30 Symposium (2017), 'Charging infrastructure experiences in Norway – the world's most advanced EV market', October, pp. 3-4.

- The government has imposed mandatory sale requirements for biofuels since 2009. This biofuel quota obligation enforces a minimum required proportion of biofuels in annual sales of road traffic fuels.[171]

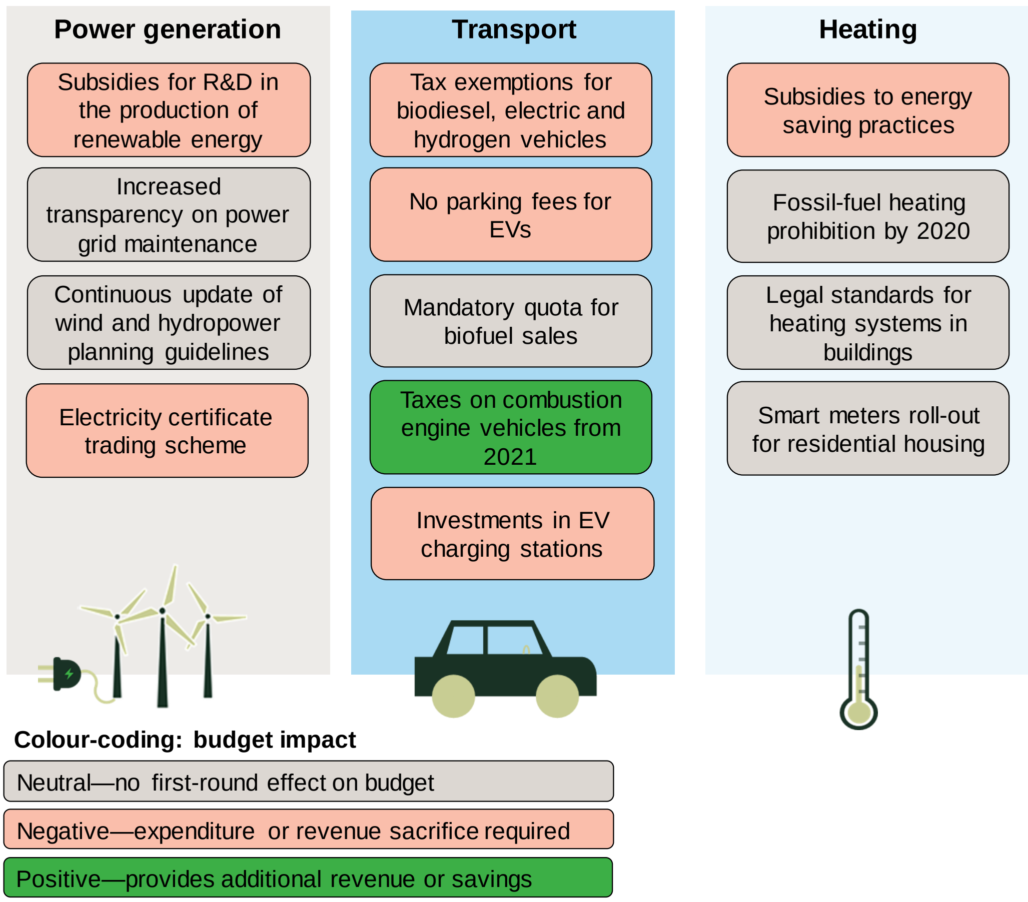
Heating sector

- Enova SF, Norwegian state-owned enterprise, also grants subsidies for households, industry buildings and district heating systems to encourage the adoption of energy-saving practices. The 'Enova Subsidy' works in conjunction with more stringent government regulation, which now aims to prohibit fossil-fuel heating in Norway by 2020.[172]
- A series of legal standards for heating systems in buildings have been implemented by the Norwegian government over the last two decades. This includes the Planning and Building Act 2008 (due to be updated in 2020), which ensures that building projects are carried out in compliance with a number of sustainability laws; and the Energy Act, updated in 2010, which applies to apartment regulations, energy ratings systems and the assessment of technical facilities in buildings.[173]
- Smart-metering schemes in households were introduced in 2010 and smart meters were subsequently made compulsory in 2017.[174] Smart meters provide advanced information about electricity usage to households, encouraging more efficient energy use in residential housing.

Figure 3.5 provides a graphical overview of the decarbonisation policies in Norway.

[171] Ibid., p. 24.
[172] Enova (2018), 'Annual Report 2018'.
[173] Ministry of Petroleum and Energy (2012), 'Norway National Renewable Energy Action Plan (NREAP) under directive 2009/28/EC', September, p. 45.
[174] Norwegian Water Resources and Energy Directorate (2018), 'Smart metering AMS', available at https://www.nve.no/energy-market-and-regulation/retail-market/smart-metering-ams/

Figure 3.5 Summary of decarbonisation policies in Norway



Source: Oxera analysis based on data from policy documents.

3A.6 Sweden

In 2017 Sweden passed the new Climate Act, which legally binds the country to reaching net zero emissions by 2045—five years earlier than agreed under the Paris Agreement in 2015, which Sweden also signed.[175] The Swedish government has developed targeted initiatives focusing on sustainable power generation, heating and transport, particularly within cities.

The general focus is on achieving a sustainable and resource-efficient energy supply, particularly directing efforts to promote renewable energy in order to reduce dependency on oil and fossil fuels.

To facilitate progress in research, grants are provided to universities and research institutes, covering a broad range of topics in the area of sustainable energy, such as large-scale renewable electricity generation and its integration into the grid; electric and hybrid vehicle propulsion systems; waste refineries;

[175] United Nations (2017), 'Sweden plans to be carbon neutral by 2045', available at https://unfccc.int/news/sweden-plans-to-be-carbon-neutral-by-2045

biofuels; renewable materials; new nuclear technology and carbon capture storage.

The Swedish Rural Development Programme, which is an EU Structural and Investment (ESI) Fund programme with a total budget of €4.3bn, attributes around 60% of its budget to environmental and climate targets.[176] The emphasis of the programme lies on compensation for agri-environmental commitments.[177] This, for instance, translates into investment support for planting energy forests on arable land or aid provided to investments for the production, storage and processing of biogas.[178] This thereby incentivises initiatives that lead to carbon offset.

Table 3.6 provides an overview of the main statistics about the jurisdiction.

Table 3.6 Sweden—basic facts

Statistic	Units	Value
Population	100,000	101
Real GDP	€m	4,462
Real GDP per capita	€	44,087
Area	100 sq km	4,103
Population density	person/sq km	25
Car ownership	100,000	48
Car ownership per capita	vehicle per 1,000	485
Greenhouse gas emissions	100,000 tonnes	89
Greenhouse gas emissions	tonnes per capita	0.9
Power generation	TWh	164
Proportion of renewable power	%	58%

Note: The base year of the real GDP is 2010. All data is provided as at 2017—the latest observation available in the database.

Source: Oxera analysis, based on Eurostat.

In the remainder of this section, we describe individual decarbonisation policies adopted for the power generation, transport and heating sectors in Sweden.

Power generation

- A key instrument of Sweden's long-term energy policy is CO2 taxation. The tax strengthens the effect of the EU ETS, in which Sweden takes part as an EU member state.

[176] European Network for Rural Development, (2015), '2014-2020 Rural Development Programme: Key facts & figure Sweden', pp. 4–5, available at https://enrd.ec.europa.eu/sites/enrd/files/se_rdp_qnt_summary_v1.pdf
[177] Ministry of Enterprise and innovation (2015), 'A rural development programme for Sweden'.
[178] Energy forestry is a form of forestry in which a fast-growing species of tree is grown specifically to provide biomass or biofuel for heating or power generation.

- A number of policies are in place to promote renewable electricity generation. The Swedish Parliament has implemented a national planning framework for wind power that is expected to deliver 30 TWh of wind energy by 2020. Of that generation, the majority (20 TWh) is expected to come from onshore wind.[179] Investment aid for PV cells connected to the electricity grid is also offered.[180]

- As mentioned in section 3A.5, Sweden, in cooperation with Norway, has been operating an electricity certificate scheme since 2012,[181] which pursues the goal of increasing electricity production from renewable energy sources by 28.4 TWh by 2020, with 15.2 TWh financed by Sweden. Electricity certificates, both Swedish and Norwegian, are traded on the Nord Pool exchange with the price agreed between purchasers and sellers.[182]

- On top of this, Sweden has an individual target of increasing electricity production based on renewable energy sources by a further 18 TWh by 2030.[183]

Transport sector

- The government has announced an ambition to have a vehicle fleet completely independent of fossil fuels by 2030.[184] The government's action plan envisages both tax proposals and targeted initiatives to achieve this. It believes that a prerequisite for quickly increasing the use of biofuels, and at lower costs, is to increase the opportunities to blend biofuels with petrol and diesel. Implementing the EU's new Fuel Quality Directive, which will allow up to 10% ethanol to be blended with petrol and 7% FAME to be blended with diesel oil, is therefore a priority.[185]

[179] Government of Sweden (2010), 'The Swedish National Action Plan for the promotion of the use of renewable energy in accordance with Directive 2009/28/EC and the Commission Decision of 30.06.2009', p. 4.
[180] Ibid., p. 18.
[181] See Bellini, E. (2017), 'Sweden and Norway extend joint electricity certificate system for renewables to 2030', pv magazine,19 April, available at https://www.pv-magazine.com/2017/04/19/sweden-and-norway-extend-joint-electricity-certificate-system-for-renewables-to-2030/
[182] Norwegian Water Resources and Energy Directorate, Swedish Energy Agency (2015), 'The Norwegian-Swedish Electricity Certificate Market', Annual Report 2015, p. 6.
[183] The Local SE (2018), 'Sweden to reach 2030 renewable energy goal in 2018', 16 July, available at https://www.thelocal.se/20180716/sweden-to-reach-2030-renewable-energy-goal-in-2018
[184] Government of Sweden (2010), 'The Swedish National Action Plan for the promotion of the use of renewable energy in accordance with Directive 2009/28/EC and the Commission Decision of 30.06.2009', p. 4.
[185] Government of Sweden (2010), 'The Swedish National Action Plan for the promotion of the use of renewable energy in accordance with Directive 2009/28/EC and the Commission Decision of 30.06.2009', p. 4.

- A bonus-malus system for new vehicles was also introduced in July 2018, with the ultimate goal of encouraging a higher proportion of new car purchasers to opt for low-emission vehicles.[186] The scheme offers bonuses to those buying low-emission vehicles while new vehicles with high CO2 emissions will be taxed at a greater rate for the first three years.[187]

- Other policies include the requirement in law for certain petrol stations to offer at least one renewable fuel in addition to petrol.[188] Historically in Sweden this has been the 'E85' product (i.e. an 85% blend of ethanol with petrol).[189] This is supplemented by state-funded grants to enable petrol stations to offer further alternative fuels.[190]

Heating sector

- Aid is available for conversion from direct-acting heating (the use of domestic heaters that rely on non-intermittent energy sources such as gas or oil) to district heating, solar heating, biofuels (such as biomethane) and heat pumps.[191]

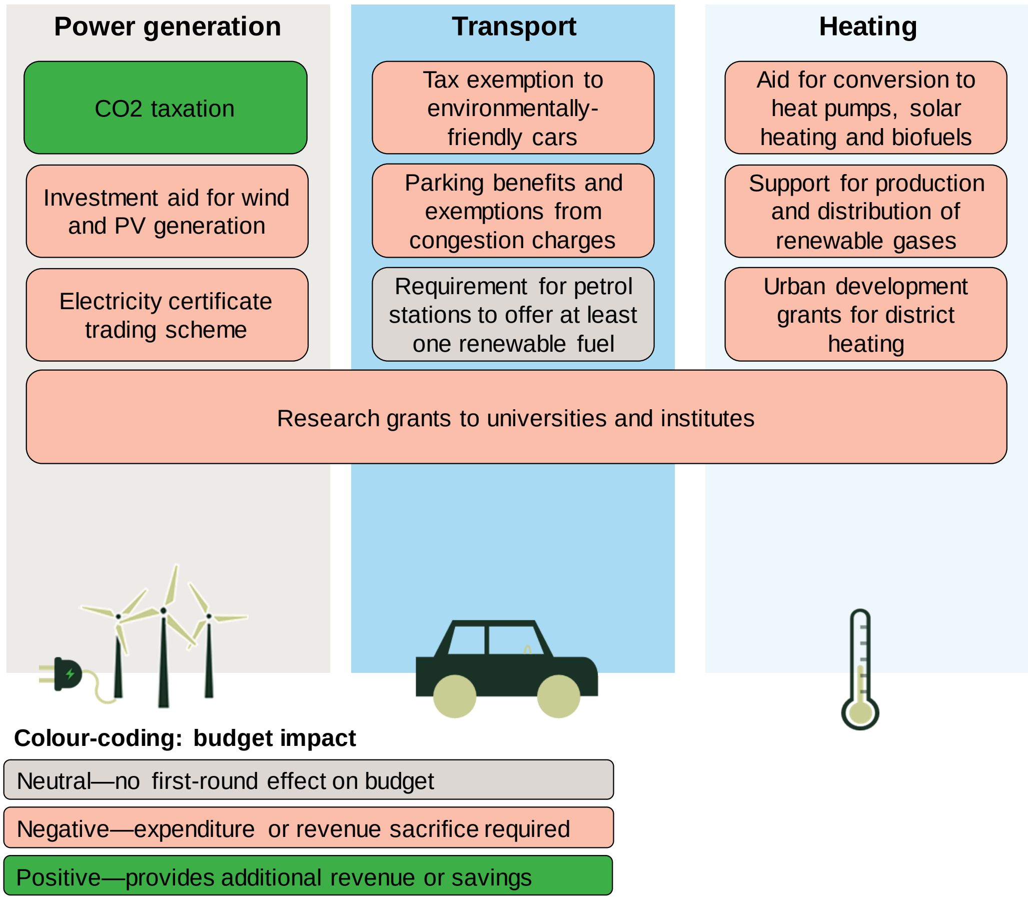
- The grants for sustainable urban development, mentioned in the power generation section, also cover district heating.[192]

- Investment support is also available for projects that increase the generation, distribution and use of renewable gases. Various forms of investment support are available to production centres, distributors and consumers.[193]

Figure 3.6 provides a graphical overview of the decarbonisation policies in Sweden.

[186] IEA (2018), '"Bonus-malus" for new passenger vehicles', available at https://www.iea.org/policiesandmeasures/pams/sweden/name-167633-en.php
[187] Government Offices of Sweden (2017), 'Bonus-malus system for new vehicles', available at https://www.government.se/press-releases/2017/05/bonusmalus-system-for-new-vehicles/
[188] Government of Sweden (2010), 'The Swedish National Action Plan for the promotion of the use of renewable energy in accordance with Directive 2009/28/EC and the Commission Decision of 30.06.2009', p. 18.
[189] Sekab website, 'E85: how Sweden got the most biofuel in Europe', available at http://www.sekab.com/sustainability/what-weve-done/e85-how-sweden-got-the-most-biofuel-in-europe/
[190] Government of Sweden (2010), 'The Swedish National Action Plan for the promotion of the use of renewable energy in accordance with Directive 2009/28/EC and the Commission Decision of 30.06.2009', p. 18.
[191] Ibid., p. 185.
[192] Ibid., p. 18.
[193] Government of Sweden (2010), 'The Swedish National Action Plan for the promotion of the use of renewable energy in accordance with Directive 2009/28/EC and the Commission Decision of 30.06.2009', p. 19.

Figure 3.6 Summary of decarbonisation policies in Sweden



Source: Oxera analysis based on data from policy documents.

3A.7 The United Kingdom

In 2008 the UK government adopted the Climate Change Act, which legally committed the UK to reducing its carbon emissions by at least 80% from 1990 levels.[194] As part of the Act, a designated body—the Committee on Climate Change (CCC)—was set up to advise the UK government on the national decarbonisation policy.

Subsequently, the Department of Energy & Climate Change (now part of the Department for Business, Energy & Industrial Strategy) issued an Overarching National Policy Statement for Energy (EN-1),[195] which included a number of

[194] Department for Business, Energy & Industrial Strategy (2019), 'UK becomes first major economy to pass net zero emissions law', 27 June.
[195] Department of Energy & Climate Change (2011), 'Overarching National Policy Statement for Energy (EN-1)', July.

initiatives to promote decarbonisation, including support for a series of nuclear new build projects.[196]

In May 2019, the CCC published an updated report with recommendations as to what measures could be taken to achieve full carbon neutrality by 2050. Subsequently, in June 2019, the UK government updated its 2050 target to a net zero target.[197]

Table 3.7 provides an overview of the main statistics about the jurisdiction.

Table 3.7 UK—basic facts

Statistic	Units	Value
Population	100,000	663
Real GDP	€m	21,562
Real GDP per capita	€	32,535
Area	100 sq km	2,419
Population density	person/sq km	274
Car ownership	100,000	312
Car ownership per capita	vehicle per 1,000	474
Greenhouse gas emissions	100,000 tonnes	4,606
Greenhouse gas emissions	tonnes per capita	7.0
Power generation	TWh	338
Proportion of renewable power	%	30%

Note: The base year of the real GDP is 2010. All data is provided as at 2017—the latest observation available in the database.

Source: Oxera analysis, based on Eurostat.

In the remainder of this section, we describe individual decarbonisation policies adopted for the power generation, transport and heating sectors in the UK.

Power generation sector

- The UK government has set out plans to ensure that all its coal power plants will be forced to close by October 2025 due to new pollution standards.[198] Currently, there are six plants open in the UK, with this number set to fall to five by March 2020.[199]

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196 EN-1 states that '[Nuclear generation is] anticipated to play an increasingly important role as we move to diversify and decarbonise our sources of electricity'. See Department of Energy & Climate Change (2011), 'Overarching National Policy Statement for Energy (EN-1)', July, para. 3.5.1.

197 Department for Business, Energy & Industrial Strategy (2019), 'UK becomes first major economy to pass net zero emissions law', 27 June.

198 Vaughan, A. (2018), 'UK government spells out plan to shut down coal plants', *The Guardian*, 5 January, available at https://www.theguardian.com/business/2018/jan/05/uk-coal-fired-power-plants-close-2025

199 Ambrose, J. (2019), 'UK to be left with five coal power stations after latest closure', *The Guardian*, 13 June, available at https://www.theguardian.com/environment/2019/jun/13/mild-but-windy-winter-was-greenest-ever-for-uk-energy-use

- The carbon price floor was set in the UK in 2013 to 'underpin the price of carbon at a level that drives low carbon investment which the EU ETS has not achieved'.[200] While originally, the floor was expected to rise every year, reaching £30/tCO2 in 2020, in 2014 the government announced that the carbon support price (i.e. the top-up over and above the ETS price) will be capped at £18/tCO2 until 2021.[201]

- The Renewables Obligation (RO) is a regulatory scheme, implemented in 2002, aimed at increasing the generation of renewable electricity for large-scale installations. The RO placed an obligation on licensed electricity suppliers to source an increasing amount of their supply from renewable resources, or to pay a penalty.[202] The RO closed to all new generating capacity on 31 March 2017.[203] Instead, the Contracts for Difference (CfDs) scheme was introduced.

- CfDs are aimed at incentivising investments in renewable energy by ensuring protection from volatile wholesale prices to developers of projects involving high upfront sunk costs.[204] Contracts are assigned through auctions. Under the contract, over a period of 15 years, developers receive the difference between the 'strike price' (reflecting the costs of the investment) and the 'reference price' (the average market price in the UK electricity market).[205]

- Financial support to small-scale renewable installations (up to 5 MW) is given by the Feed-in Tariff (FITs) scheme, introduced in 2010. Through the FITs, individuals, householders, organisations, businesses and communities are paid a tariff for the electricity their installations produced and exported.[206] The scheme closed to new applicants on 1 April 2019.[207]

[200] Hirst, D. (2018), 'Carbon Price Floor (CPF) and the price support mechanism', p. 6, available at https://researchbriefings.parliament.uk/ResearchBriefing/Summary/SN05927#fullreport

[201] Ibid, p. 3.
[202] UK government (2009), 'National Renewable Energy Action Plan for the United Kingdom: Article 4 of the renewable energy directive 2009/28/EC', p. 15.
[203] Ofgem, 'RO closure', available at https://www.ofgem.gov.uk/environmental-programmes/ro/about-ro/ro-closure
[204] Department for Business, Energy & Industrial Strategy (2019), 'Contracts for Difference', policy paper, 11 January, available at https://www.gov.uk/government/publications/contracts-for-difference/contract-for-difference
[205] Department for Business, Energy & Industrial Strategy (2019), 'Contracts for Difference', policy paper, 11 January, available at https://www.gov.uk/government/publications/contracts-for-difference/contract-for-difference
[206] UK government (2009), 'National Renewable Energy Action Plan for the United Kingdom: Article 4 of the renewable energy directive 2009/28/EC', p. 15.
[207] Ofgem, 'About the FIT scheme', available at https://www.ofgem.gov.uk/environmental-programmes/fit/about-fit-scheme

- As a member of the EU, the UK has participated in the EU ETS 'cap and trade' scheme, which covers around 45% of the EU's greenhouse gas emissions.[208]

Transport sector

- The UK's transport decarbonisation policies can largely be aggregated into two groups: measures aimed at promoting EV uptake and usage, and measures aimed at introducing more eco-friendly fuels.
- As part of the promotion of EVs, the UK government has announced a £400m investment, half state-funded and half privately funded, to be invested in EV charging infrastructure. The first £70m of this investment will be spent on building 3,000 new rapid charging points.[209]
- According to the latest report from the CCC, the net zero targets require that EV sales constitute 100% of all new car sales by 2035 at the latest.[210] Currently, the UK government supports the uptake of EVs by providing a grant of up to £3,500 per EV sold to vehicle dealers.[211] A plug-in motorcycle grant, covering 20% of the purchase price is also available.[212]
- With regard to measures targeting the carbon footprint from fuel, in 2012 the UK government introduced an obligation on all fuel suppliers with annual sales exceeding 450,000 litres of fuel to ensure that at least 4.75% of the fuel they supply comes from renewable and sustainable sources.[213] This requirement is mostly met by blending bioethanol and biodiesel with petrol and diesel respectively.[214]

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[208] European Commission, 'EU Emissions Trading System (EU ETS)', available at https://ec.europa.eu/clima/policies/ets_en
[209] Fossdyke, J. (2019), 'Government invests £400 million in electric car infrastructure', motor1.com, 13 September, available at https://uk.motor1.com/news/370388/government-invests-400-million-in-electric-car-infrastructure/ and Paton, G. (2019), 'Electric car rapid-charging points to double by 2024', *The Times*, 10 September, available at https://www.thetimes.co.uk/article/electric-car-rapid-charging-points-to-double-by-2024-qttwx993j
[210] Committee on Climate Change (2019), 'Net zero—the UK's contribution to stopping global warming', May, p. 34.
[211] UK government website, 'Low-emission vehicles eligible for a plug-in grant', available at https://www.gov.uk/plug-in-car-van-grants and Nissan website, 'Government grants for electric cars and vans', available at https://www.nissan.co.uk/experience-nissan/electric-vehicle-leadership/subsidies.html?cid=psmtndoMXQt_dc|U|pgrid|53578586783|ptaid|dsa-368938189436|pcrid|336313499913|slid||intent=EV&gclid=EAIaIQobChMIm8uyr8-W5AIVibPtCh3VNwodEAAYASAAEgJ3gPD_BwE
[212] Committee on Climate Change (2019), 'Net zero—the UK's contribution to stopping global warming', May, p. 148.
[213] Note, the UK's standards will also affect any fuel that Jersey imports from suppliers meeting the specified criteria. See UK government website, 'Renewable transport fuel obligation', available at https://www.gov.uk/guidance/renewable-transport-fuels-obligation
[214] Department for Transport (2019), 'Renewable Transport Fuel Obligation Annual Report 2017-18'.

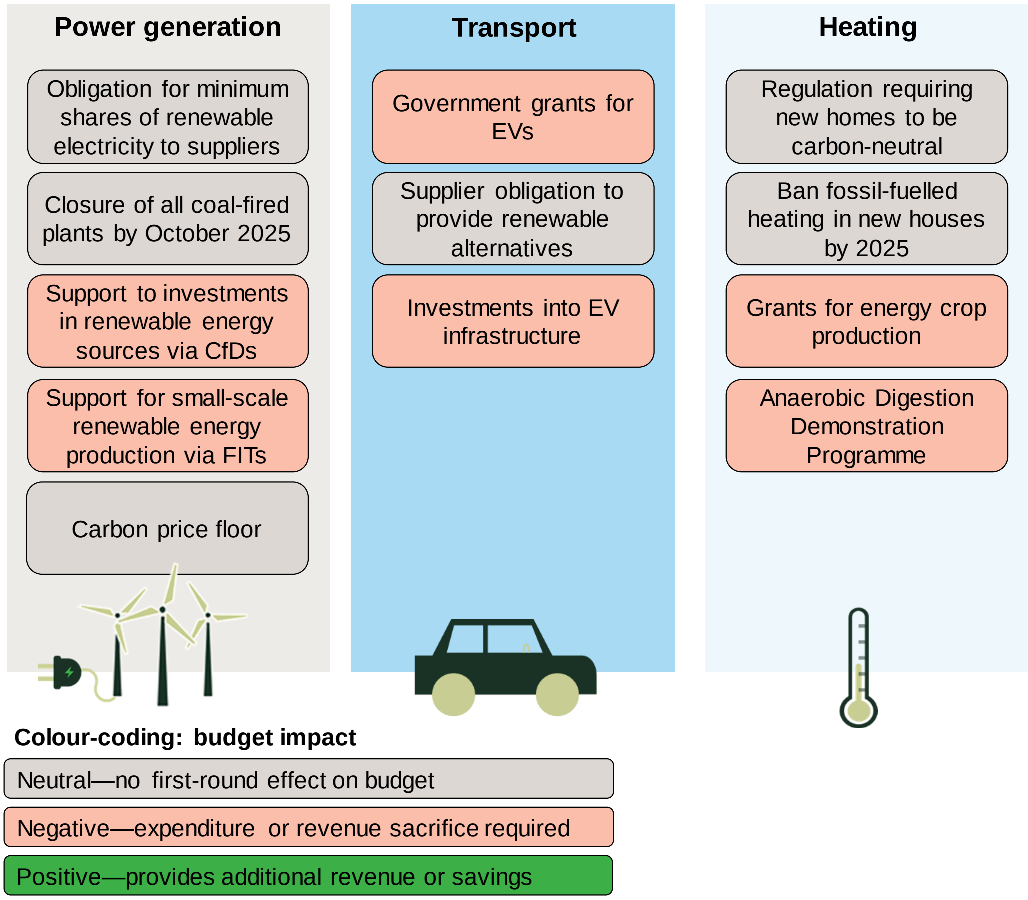
Heating sector

- The UK's decarbonisation policy in the heating sector over the last few years has focused on reducing energy consumption required for heating. In 2010, the UK government adopted a series of regulations, requiring new homes to be carbon-neutral. The regulation was set to take effect from 2016 for new private homes, 2018 for public buildings, and 2019 for other non-domestic buildings.[215]
- To support the supply of biofuels, the Energy Crops Scheme (ECS) was set up to provide grants to farmers and landowners for cultivating energy crops, such as corn, for heat and electricity generation.[216]
- The Anaerobic Digestion Demonstration Programme was created with the aim of increasing production of biogas through anaerobic digestion using food waste, agricultural waste and sewage. The programme benefited from a £10m grant to build five projects by March 2011 that demonstrated 'state of the art' use of anaerobic digestion.[217]
- More recently, the UK government has signalled its intention to further promote the use of alternative sources of energy. In particular, former Chancellor of the Exchequer, Philip Hammond, claimed in his 2019 Spring Statement that 'we will introduce a Future Homes Standard, mandating the end of fossil-fuel heating systems in all new houses from 2025.'[218]

Figure 3.7 provides a graphical overview of the decarbonisation policies in the UK.

[215] UK government (2009), 'National Renewable Energy Action Plan for the United Kingdom: Article 4 of the renewable energy directive 2009/28/EC', pp. 23 and 69.
[216] ibid., p. 18.
[217] Department of Energy and Climate Change (2010), 'National Renewable Energy Action Plan for the UK', p. 144.
[218] UK government (2019), 'Spring Statement 2019: Philip Hammond's speech', available at https://www.gov.uk/government/speeches/spring-statement-2019-philip-hammonds-speech

Figure 3.7 Summary of decarbonisation policies in UK



Source: Oxera analysis based on data from policy documents.

3B Summary of case studies

This section provides a more general overview of the various policy measures in the areas of transport and heating, as described in the case studies in section 3A.

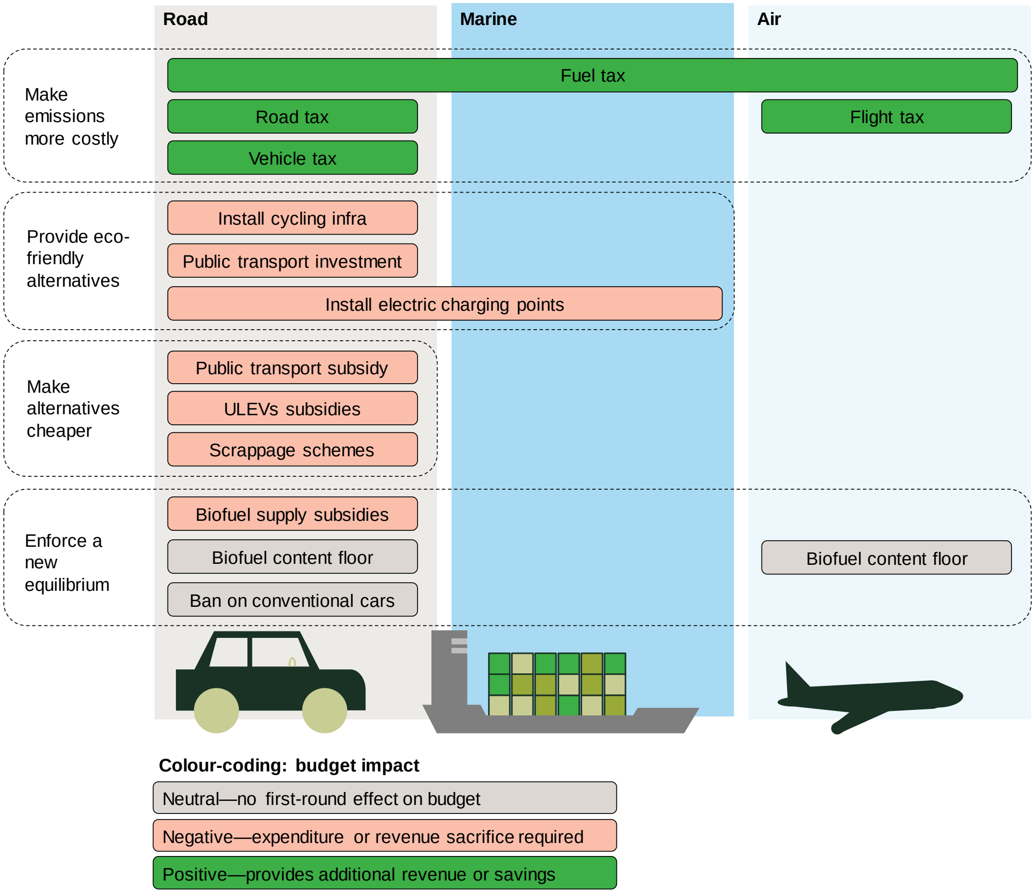
These presented policy options are not exhaustive but are designed to provide a top-down view of the major levers employed by other governments to decarbonise the transport and heating sectors, which are a focal point in Jersey's decarbonisation strategy. Please note that while we have also reviewed the power generation sector in each jurisdiction, this is primarily with a view to informing the prospect for increased electrification, using renewable sources, for heat or transport purposes. As noted at the outset of this report, the Jersey power generation sector is already largely decarbonised due to reliance on interconnection to France.

The option of offsetting greenhouse gas emissions (often referred to as 'carbon offsetting') is examined separately in section 4.

3B.1 Transport sector

Figure 3.8 summarises common themes in the decarbonisation policies of the selected jurisdictions as regards the transport sector.

Figure 3.8 Overview of decarbonisation policies in transport



Note: EVs, electric vehicles; ULEVs, ultra-low emission vehicles; infra, infrastructure.

Source: Oxera analysis based on various policy documents.

The figure offers two main insights:

- first, of the policies adopted in recent years, most have focused on reducing emissions from road transport (as opposed to marine or air transport);
- second, the policies in road transport generally aim to decrease emissions through one of the following three channels:
  - increasing the usage of renewable fuels;
  - increasing the proportion of ULEVs in the country's vehicle mix;
  - reducing car travel.

One of the implications of the second point is that some policies may have conflicting effects on behaviour when employed in combination. To illustrate, while increasing vehicle taxes is likely to decrease the number of cars acquired (and therefore car journeys), it will also negatively affect the incentive to acquire a new ULEV, unless appropriate exemptions are specified.

Similarly, while a more developed public transport system may discourage people from using their car as often as they otherwise would, it may also discourage them from acquiring a new, more efficient model. This is because with fewer journeys a large upfront cost of a new car seems less attractive since it would take longer to 'pay it off'.

The trade-offs discussed above indicate that prior to the implementation of policy interventions, it is necessary to conduct a holistic impact assessment, to ensure that the various policies work in conjunction rather than in conflict with each other, and deliver value for money. As part of the scope of this study, we shortlist which policy interventions should be quantified in the next phase when assessing value for money for the Government of Jersey.

The review of national policies within our case-study-based analysis has highlighted limited options for emission reduction from aviation. It is likely to be the case that regulations and requirements on this industry will be applied as international rather than national standards. We therefore have reviewed international efforts to target emissions from aviation. There are international and European aviation emission schemes in place, such as CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) and the EU ETS. The two schemes take different approaches to mitigating the environmental impact of air transport. The EU ETS applies to domestic and international flights within the EEA and operates as a tradeable allowance scheme. All airlines flying within the EEA must report their emissions and purchase the corresponding number of allowances to offset those emissions.[219] The CORSIA scheme, run by the International Civil Aviation Organisation (ICAO), is set to begin its pilot in 2021 and is planned to operate as an offsetting scheme for all international flights of the 81 participating states, which covers 76.63% of international aviation activity, with offsetting requirements shared among airlines.[220] Jersey is

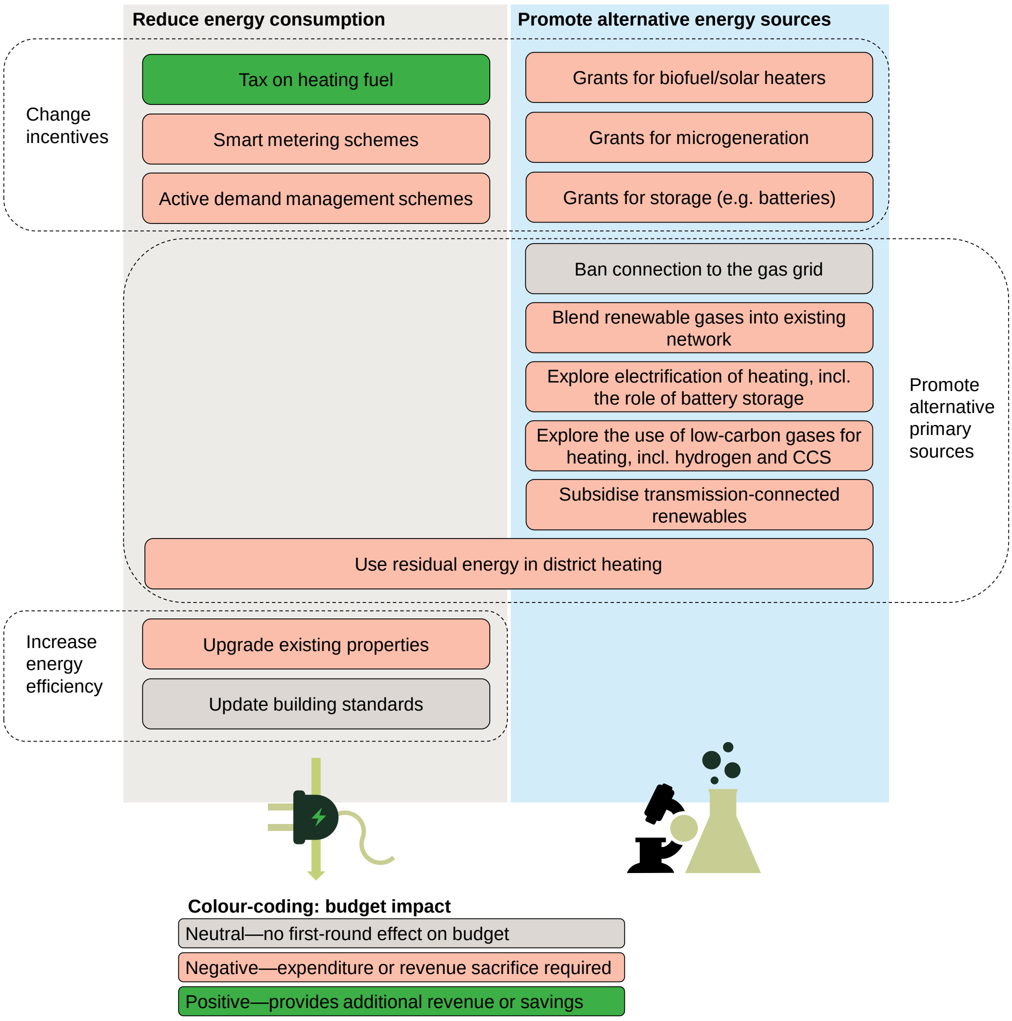
[219] European Commission, 'Reducing emissions from aviation', available at https://ec.europa.eu/clima/policies/transport/aviation_en
[220] International Civil Aviation Organisation (2019), 'CORSIA FAQs', p. 15, available at https://www.icao.int/environmental-protection/CORSIA/Documents/CORSIA_FAQs_September%202019_FINAL.PDF

not currently participating in either of these two schemes but it is clear that participation will be possible within the CORSIA scheme. If Jersey were to participate in the scheme, then 'international flights to and from' the Island of Jersey would be covered by the offsetting requirements.[221]

3B.2 Heating sector

Figure 3.9 summarises common themes in the decarbonisation policies of the selected jurisdictions as regards the heating sector.

Figure 3.9 Overview of decarbonisation policies in heating



Note: Although grey hydrogen is not a renewable gas, it could in theory be successfully employed in decarbonisation of heat, if the greenhouse gas emissions from its production are contained through the employment of CCS. For convenience, we use the term 'renewable gas' in the context of heat decarbonisation. See Olczak, M. and Piebalgs, A. (2018), 'What is renewable gas?', 14 March, available at https://fsr.eui.eu/what-is-renewable-gas/#_ftn1 and GasTerra (2018), 'Hydrogen and CCS: a smart combination', 1 February, available at https://www.gasterra.nl/en/news/hydrogen-and-ccs-a-smart-combination.

[221] International Civil Aviation Organisation (2019), 'CORSIA FAQs', p. 20, available at https://www.icao.int/environmental-protection/CORSIA/Documents/CORSIA_FAQs_September%202019_FINAL.PDF

Source: Oxera analysis based on various policy documents.

Similar to transport decarbonisation policies, heating decarbonisation can be described as generally operating through two channels:

- decreasing the amount of energy consumed for heating;
- promoting alternative, sustainable sources of energy.

To some extent, these two channels may conflict, if not appropriately coordinated. For instance, switching consumers from domestic boilers to district heating can result in a more efficient heating of households overall (as is currently developed in the Netherlands). However, the option to switch to district heating may reduce consumers' incentives to invest into more energy efficient housing, e.g. insulation improvements.

The adoption of the policies described in this section will allow the Island of Jersey to significantly reduce its carbon footprint. However, regardless of how well these policies perform, there will still be some unavoidable activities, such as air travel, for which carbon-free solutions have not yet been developed. To achieve its carbon-neutral objective, Jersey would have to acquire emission allowances against its unavoidable emissions. These are discussed in the next section.

4 Using emission allowances

This section provides an overview of the carbon offset market and examines the current and expected level of prices for carbon offsets, before drawing conclusions on how the Island of Jersey can engage with the offset market.

4A.1 The offset market

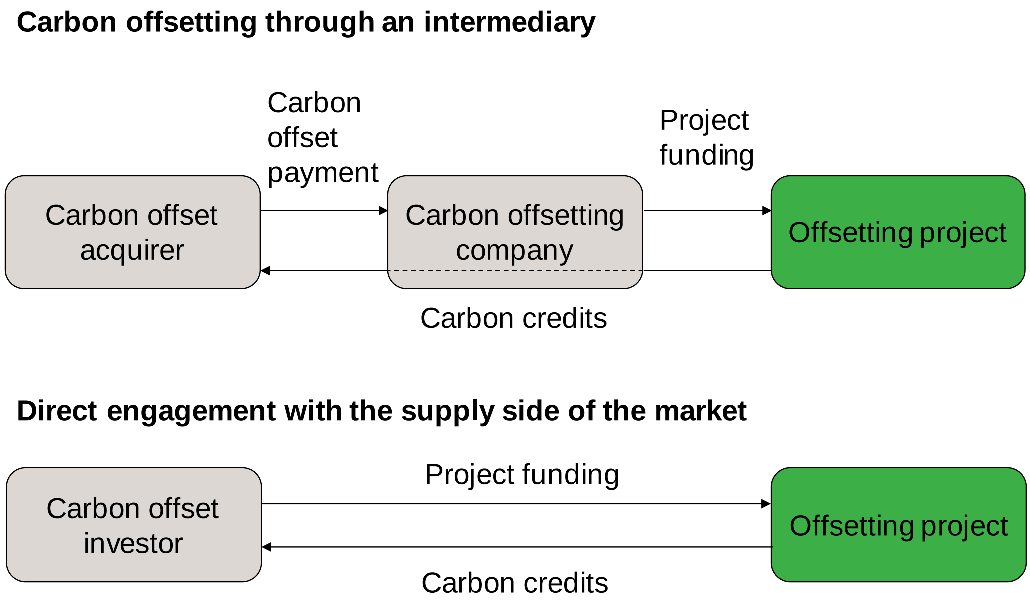
In this context, offsetting would imply compensating for domestic emissions by funding emission reduction projects elsewhere in the world, acknowledging that large-scale offset schemes (e.g. afforestation) cannot be undertaken at scale in Jersey.

The certified service of offsetting carbon emissions is provided by carbon offset companies. The companies attract funding from governments and businesses seeking to offset their emissions and redistribute these funds to emission reduction projects around the globe. A list of the top global carbon offset companies currently includes: GreenTrees, Carbon Clear, NativeEnergy, Allcot Group, 3Degrees, Aera Group, Renewable Choice, South Pole Group, Terrapass, Forest Carbon, Carbon Credit Capital, Bioassets, Biofílica, WayCarbon, CBEEX and Guangzhou Greenstone.[222]

If an institution has strong relationships with local project sponsors, it can also invest in carbon offsetting projects directly, as opposed to engaging with the market through intermediaries. Figure 4.1 illustrates the mechanics of the carbon offset market.

[222] BNP Paribas Asset Management (2019), 'THEAM Quant Europe Climate Carbon Offset Plan'.

Figure 4.1 The structure of the carbon offset market



Source: Oxera analysis.

Given that the Government of Jersey is aiming to lead in global decarbonisation efforts, it is important that any offsets used as part of its decarbonisation policy are internationally recognised. At present, there are several different international carbon offsetting standards that carbon offsetting companies can rely on. The Kyoto Protocol features two mechanisms for the creation of carbon allowances:

- the Clean Development Mechanism (CDM) governs the implementation of emission reduction projects in 'developing countries'.[223] These projects receive Certified Emissions Reductions (CERs), which are often referred to as 'carbon offsets';[224]
- the Joint Implementation (JI) mechanism, which regulates emission reduction initiatives in the countries committed to the Kyoto Protocol.[225] These schemes generate Emission Reduction Units (ERUs). The largest JI mechanism in place is the EU ETS,[226] introduced in 2005.

[223] Countries that do not have any commitments under the Kyoto Protocol.
[224] United Nations (2019), 'The Clean Development Mechanism', available at https://unfccc.int/process-and-meetings/the-kyoto-protocol/mechanisms-under-the-kyoto-protocol/the-clean-development-mechanism
[225] Annex B countries. See United Nations (2019), 'Joint Implementation', available at https://unfccc.int/process/the-kyoto-protocol/mechanisms/joint-implementation
[226] ERUs generated within the ETS scheme are called EU Allowance Unit of one tonne of CO2 (EUAs). See Kamdem J.S., Nsouadi, A. and Terraza, M. (2015), 'Time-Frequency Analysis of the Relationship between EUA and CER Carbon Markets', p. 1.

CERs and ERUs (the latter often referred to as ETS certificates in the EU context) can also be traded in the secondary market, allowing institutions, corporates or other parties instant access to carbon allowances.

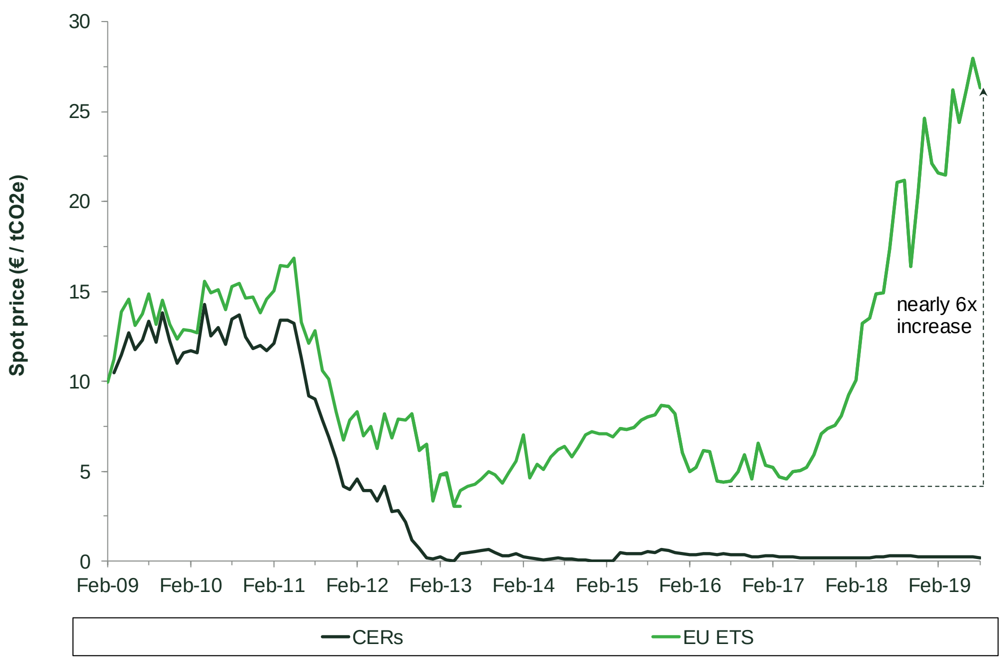
Since new CERs are also generated by the implementation of emission reduction projects, the Government of Jersey could potentially receive recognition for some of its initiatives in Africa.[227]

4A.2 Current pricing of offsets

The pricing of carbon allowances can vary significantly, depending on factors such as project type, cost, location, or type of transaction (i.e. whether allowances are bought in bulk or smaller quantities). It is reasonable to focus on the pricing of the carbon allowance certificates that are recognised by international climate change agreements, i.e. CERs and ERUs.

Figure 4.2 illustrates the evolution of the historical prices of CERs and the EU ETS; the price paths have diverged since about 2013.

Figure 4.2 Historical spot rates of emission allowances—CERs vs EU ETS certification



Source: Oxera analysis, based on data from Eikon.

Figure 4.2 shows that in spite of EU ETS prices rising steadily from 2013 onwards, the prices of CERs have plummeted, reaching a near-zero level in

[227] See, for example, Jersey Overseas Aid website, 'Where we work', available at https://www.joa.je/where-we-work/

2019. Industry and academic research suggests that the main reason for the decrease in prices is the restriction on the use of CERs within the EU ETS, the world's largest emissions trading scheme.[228] This highlights the significance of and speed with which geopolitical factors that underpin international climate change policies can influence the pricing and perceived legitimacy of carbon offsets, and the extent to which such instruments can be relied on. It therefore points to the vulnerability of a domestic climate change agenda that is overly reliant on offsets rather than abatement policies.

In particular, in recent years, EU legislation has restricted the amount of CERs that operators under the EU ETS may use for compliance, with recent legislation further restricting the use of CERs from 2020 onwards.[229] While the tight ceiling imposed on the use of CERs results in lower demand, the inertia in the generation of carbon offsetting projects prevents supply from contracting immediately. The two factors result in oversaturation of the CER market, thus depressing CER prices, as observed in Figure 4.2.

According to the recent CER market data, it costs just over €0.20 to offset a tonne of CO2e. This implies that it would cost the Government of Jersey just under €80,000 per annum to offset the entire volume of greenhouse gas emissions generated from the island in 2017.[230] Alternatively, using the EU ETS certificates, the spot price of €26 per tonne of CO2e implies a cost of €9.6m per annum. The legal feasibility of a complete offsetting of Jersey's emissions with the use of carbon offset certificates is out of scope of this report. However, even if this were possible, a primary reliance on offsets instead of abatement in decarbonisation policy has to be treated with caution for at least two reasons.

- First, it is unclear to what extent the international community will keep acknowledging offsetting projects as legitimate evidence of decarbonisation efforts, as evidenced by the ETS restrictions. Therefore, it is likely that investment in domestic carbon abatement projects by the Government of Jersey would be viewed as a stronger signal of commitment to net zero in the international community.

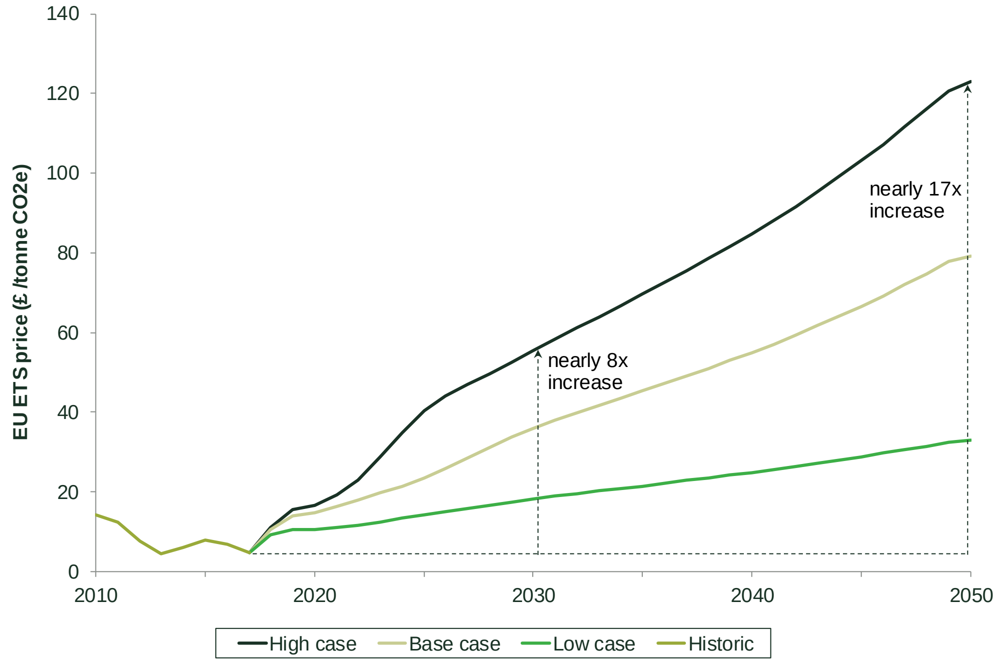
[228] See, for example, CDC Climat (2012), 'Climate Brief', May and Gronwald, M. and Hintermann, B. (2016), 'Explaining the EUA-CER spread', 19 February.
[229] European Commission website, 'Use of international credits', available at https://ec.europa.eu/clima/policies/ets/credits_en
[230] The total emission from Jersey amounted to 365.5ktCO2 in 2017. See Aether website, 'Jersey Greenhouse Gas Emissions 1990-2017', available at https://www.aether-uk.com/Resources/Jersey-Infographic.

- Second, there is a distinct possibility that the cost of carbon allowances (be they CERs or ERUs) could materially increase in the future (see subsection 4A.3). Were that risk to materialise, the Government of Jersey might no longer be able to guarantee a sufficient budget to sustain the offsetting. The next subsection describes the evidence on the possible future evolution of carbon allowances.

4A.3 Future price developments of offsets

As mentioned above, there is a distinct possibility that the cost of carbon allowances for the Government of Jersey could rise in the future. As illustrated in Figure 4.3, National Grid forecasts a significant and persistent increase in the ETS price over the next few decades. It is therefore reasonable to assume that the prices of carbon allowance schemes in general, which are recognised within the EU ETS, would face a similar upward pressure.

Figure 4.3 National Grid's forecast of EU ETS spot price

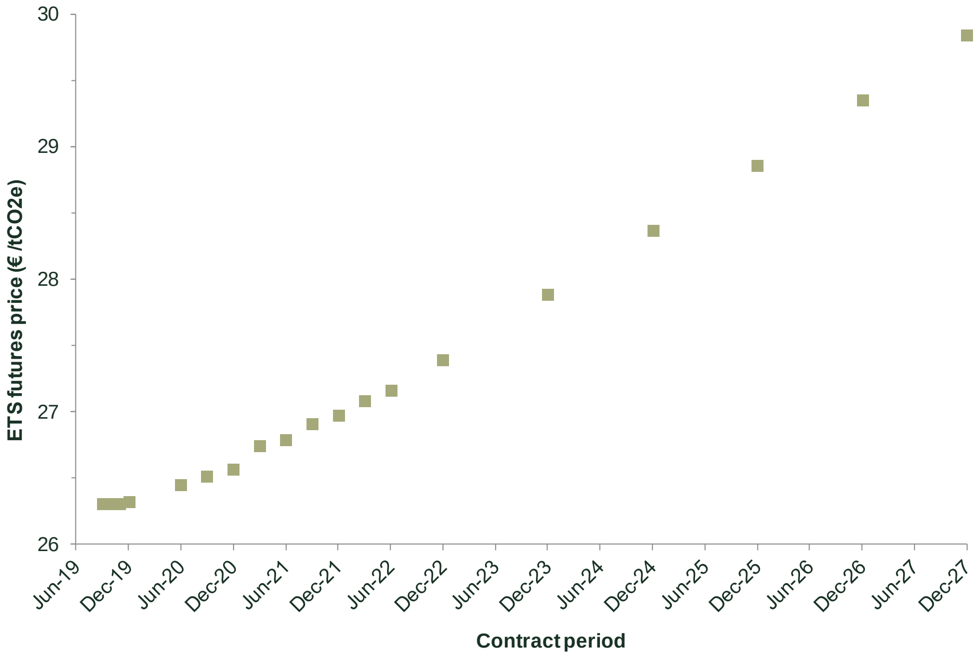


Source: National Grid (2019), 'Future Energy Scenarios'.

The market data on ETS futures prices also supports the proposition that ETS prices will increase in the future, as illustrated in Figure 4.4.[231]

[231] A futures contract involves the delivery of a specified commodity or security (in this case, ETS certificates) at a designated time in the future at a designated price. See Fabozzi, F. (2000), *The handbook of fixed income securities*, McGraw-Hill, pp. 1175–6.

Figure 4.4 ETS futures prices



Note: The forward curve is constructed using data as of 31 August 2019.

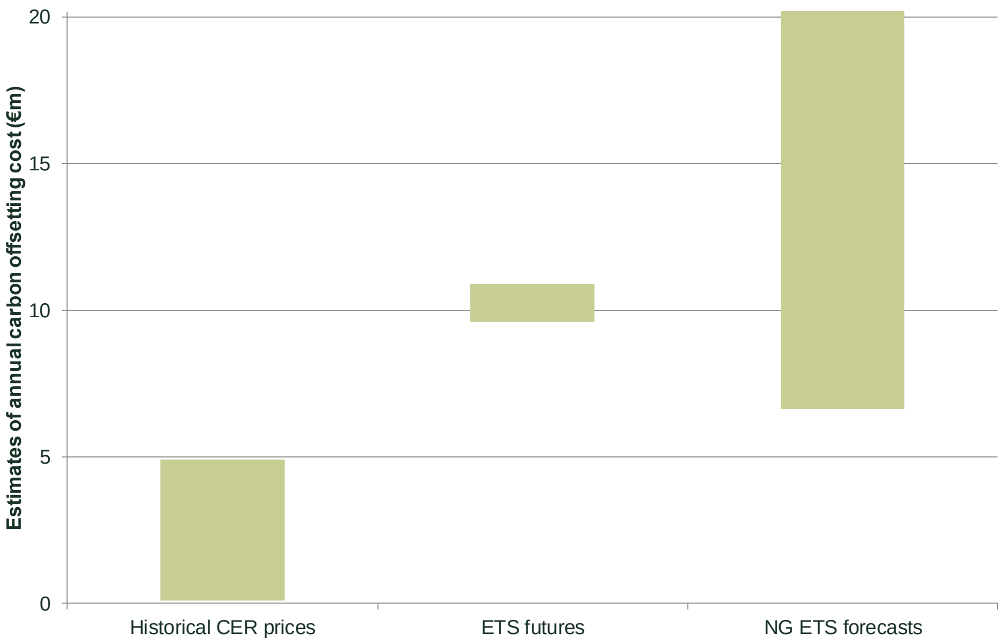
Source: Oxera analysis based on data from Eikon.

Finally, historical prices of CERs themselves exhibit a range. As illustrated in Figure 4.2, in 2011, before the market decline of 2011–12, the CER market price was around €14/tCO2e. To the extent that the CER market has the potential to bounce back, for example due to an increased demand or unexpected relaxation of regulations, the historic price volatility provides another illustration that relying on CERs or similar offsets could expose the Government of Jersey to significant risks in relation to the market pricing and perceived legitimacy of offset schemes.

4A.4 Illustrative cost of carbon offsets

Figure 4.5 illustrates the potential annual cost of offsetting total carbon emission for the Island of Jersey, under different assumptions of allowances used (CER or ETS) and their respective future costs. The first bar shows the range on the basis of historical CER prices between 2011 (before the sharp fall in the CER market) and August 2019. On this basis, the cost estimates are fairly moderate—ranging from €80,000 to less than €5m. The second bar illustrates the cost as implied by different points on the ETS forward curve. The estimates range from €9.6m (spot) to €10.9m (delivery in 2027). Finally, the last bar presents the cost of offset ranging between €6.6m and €20.3m, using National Grid's forecasts (ranging from low to high) for 2030 ETS prices as a proxy for the cost of offsets.

Figure 4.5 Illustrative cost of carbon offset under different scenarios



Note: The forward curve is constructed using data as of August 2019.

Source: Oxera analysis based on data from Eikon.

4A.5 Concluding remarks

When considering the possible reliance on carbon allowances in Jersey's decarbonisation strategy, it is important to consider the volatility of the pricing and availability of such instruments. As outlined above, calculations based on historical, futures and forecast prices place the annual offset cost to a range between €80,000 and €20m. This highlights a weakness in relying on emission allowances in the long term instead of pursuing abatement programmes. Economic and political support for abatement investments is therefore likely to provide more security and budget predictability around meeting targets in the medium to long term.

Given that CER prices have been fundamentally depressed since about 2013, there would appear to be a present opportunity to transform Jersey into a carbon-neutral state from an accounting perspective at relatively low cost. However, cost savings yielded by this policy could come at the expense of recognition of the Government of Jersey's efforts as a genuine decarbonisation policy leader in the eyes of the international community and the EU in particular. ETS prices therefore represent a more realistic cost of offset benchmark for Jersey than CER prices.

Overall, there is merit for the decarbonisation agenda of the Government of Jersey to rely heavily on abatement. The case for abatement is strengthened where offsets (direct or indirect) may not be reliably available as long-term substitutes for domestic abatement. Offsets should be used as a complement where direct full reduction of emissions is not possible (e.g. reliance on aviation transport).

5 Conclusions and recommendations for the Government of Jersey

This section provides recommendations on which policies should be prioritised by the Government of Jersey in the transport and heating sectors—based on the findings of the case studies presented in section 3. First, we provide a recap of the 2014 Energy Plan, to set the context for the policies that are already being implemented. Next, we present the policies that we have shortlisted for more detailed consideration, as well as the rationale behind this selection. Finally, we provide commentary on the implications for the funding strategy, to the extent that this has not been covered in earlier sections.

5A.1 A recap of the 2014 Energy Plan

According to the modelling conducted for the 2014 Energy Plan, nearly 70% of the planned reduction in emissions was expected to be generated by four interventions:

- applying efficiency measures to pre-1997 properties was forecast to generate 22% of the target emission reduction;
- increasing the proportion of ULEVs was expected to generate over 22% of the target reduction;
- the EU legislation on the vehicle emission standards was expected to make a contribution of 12%;
- finally, energy efficiency improvements in the private sector were expected to yield 10% of the overall planned emissions reduction.

Given that a more ambitious decarbonisation trajectory is now envisaged, to achieve carbon neutrality by 2030, this implies that further emission reductions need to be delivered more quickly, potentially also accompanied by a greater reliance on carbon offset schemes. Therefore, in identifying policies for application to Jersey, we seek to identify those that are likely to deliver faster and/or greater carbon emission reductions, building on the existing policies and Jersey-specific circumstances.

We understand from discussion with the Government that a substantial medium-to-long-term reliance on international carbon offset schemes is not a preferred policy choice, in lieu of delivering a reduction in emissions. We consider that this is a reasonable perspective in line with the likely economic constraints of investing in carbon offset schemes.[232]

The next step in the implementation of the new carbon neutrality strategy is to quantify the impact of the shortlisted policies to determine their carbon abatement potential, likely cost and the optimal roll-out path.

5A.2 Transport sector

In addition to the policies described in the 2014 Energy Plan, we have identified four further policies in the transport sector, which we recommend for detailed quantitative assessment:

- instating a ban on registration of conventional vehicles;
- increasing the focus on fuel taxation in achieving emission reductions;
- facilitating the uptake of EVs;
- facilitating a higher content of biofuels in petrol and diesel throughout Jersey.

Working in combination, these four policies would provide a comprehensive set of incentives to move Jersey towards an EV-focused transport system.

Banning the registration of conventional vehicles in Jersey would act as a barrier to an increase in the fleet of fossil-fuelled vehicles. The timing of the ban, however, needs to be carefully considered in order to balance the decarbonisation objectives with the impact on quality of life of Jersey citizens. Increasing the taxation on vehicle fuel would provide incentives to reduce car travel in the short term and accelerate the switch to ULEV in the medium to long term. Facilitating the uptake of EVs would allow the Island of Jersey to take advantage of its access to a reliable source of low-carbon electricity. The uptake could be facilitated by financial support for the acquisition of EVs on the one hand and for the scrappage of old conventional vehicles on the other. As the citizens of Jersey switch from older models of conventional vehicles, increasing the minimum content of biofuel sold at filling stations could provide an immediate reduction in emissions from the existing vehicle fleet. The feasibility of this measure depends on the ability of Jersey suppliers to flexibly switch their product mix. Existing long-term contracts for a particular type of fuel could prove to be a barrier to rapid implementation of this policy. If feasible, the resulting fuel

[232] See section 4.

price increase (to the extent that biofuel is more expensive than fossil fuel) would further strengthen consumers' incentives to decrease car travel and switch to EVs.

The advantage of decarbonising road transport through electrification is twofold. First, focusing on one source of energy (i.e. electricity) yields economies of scale or network effects—once EV charging infrastructure with adequate capacity is installed, a larger number of EV users would allow a quicker recovery of the installation expenditure. From a consumer perspective, the cost of each charging station would be spread over a larger number of users, reducing the burden per consumer. Second, as mentioned previously, with some EV charging infrastructure already in place and with Jersey's access to low-carbon electricity, decarbonisation of road transport may be potentially implemented without the need to make substantive additional investment in the supply chain for alternative sources of energy (for example, investing in facilities for the transportation of hydrogen).

The potential disadvantage of solely focusing on electrification is that the island might expose itself to supply risks. For instance, if the electricity supply were disrupted, this would threaten the stability of a transport system that is functioning largely on EVs. However, according to Jersey Electricity Company, over the next 15 years, the island will have sufficient capacity to cover the anticipated demand for electricity.[233]

It is worth noting that, to some extent, the Government of Jersey is likely to face a trade-off between fiscal savings and the achievement of decarbonisation. To illustrate, a small fixed tax levied on conventional vehicles is unlikely to change people's travel habits, but can therefore act as a predictable source of revenue. Conversely, a high tax on fossil fuels is likely to reduce the number of car journeys (and, consequently, carbon emissions), but will yield a revenue stream that declines over time and, most likely, will be less predictable several years ahead. Therefore, using behaviour-altering policies in combination with revenue-generating policies will help the Government to strike the balance between decarbonisation and fiscal sustainability.

[233] See section 1C.1. If the further electrification of Jersey's transport and / or heat does require further investment into enhanced capacity in the supply chain, e.g. investing in further centralised or decentralised measures for renewable electricity generation and/or in interconnector capacity, then these costs would have to be taken into account in impact assessment of the decarbonisation options.

To make this package of interventions most effective, we recommend conducting the following analysis:

- identify the maximum feasible biofuel content for the vehicle fleet registered in the Island of Jersey;
- analyse the expected evolution in the vehicle fleet, to determine the fastest feasible rate of increase of biofuel content over time;
- estimate the decrease in consumption of fuel (e.g. driven by the higher cost of biofuels blended in existing sources, as well as by various fuel tax scenarios);
- develop scenarios for the annual rate of switching from conventional vehicles to ULEVs.

Box 5.1 summarises our recommendations for decarbonisation policy in the transport sector.[234]

Box 5.1 Summary of shortlisted policies in the transport sector

Relevant 2014 Energy Plan policies

- Increase in the number of ULEVs
- Improved EU emissions standards for cars and vans
- Improved international operating standards for aircraft
- Sustainable Transport Policy

Further recommended policies

- Instate a ban on registration of conventional vehicles
- Increase the focus on fuel taxation in achieving emission reductions
- Support a large-scale roll-out of EVs—subject to quantification results
- Facilitate a higher content of biofuels in petrol and diesel throughout Jersey

Recommended quantification next steps, to assess feasibility and value for money

- Identify the maximum feasible biofuel content for the vehicle fleet registered on the Island of Jersey
- Analyse the expected evolution in the vehicle fleet, to determine the fastest feasible rate of increase of biofuel content over time
- Estimate the decrease in consumption of fuel (e.g. driven by the higher cost of biofuels blended in existing sources, as well as by various fuel tax scenarios)
- Develop scenarios for the annual rate of switching from conventional vehicles to ULEVs

[234] Appendix A1 lists the data requirements for this quantification.

Source: Oxera analysis.

5A.3 Heating sector

For the heating sector, the 2014 Energy Plan prescribes a number of policies around investing in insulation and higher energy efficiency. Of these policies, we recommend shortlisting the upgrade measures to pre-1997 properties for a quantitative assessment, as this policy was originally expected to deliver the most significant decarbonisation impact in the heating sector. The analysis should aim to establish the fastest feasible rate of upgrades and assess to what extent it is possible to complete the upgrades by 2030 (as opposed to 2050, as envisaged in the 2014 Energy Plan).

In addition, we have identified that another key task for quantitative analysis in the next phase, is to assess the feasibility and timelines for full electrification of heating. For the Island of Jersey, electrification appears to have the most significant potential to deliver the Government's medium-to-long-term decarbonisation ambitions. This is underpinned by high levels of installed interconnection capacity with access to low-carbon imported electricity, relatively high penetration rates for electricity in the heating sector, and the potential synergies with the uptake of EVs.[235] Focusing on electrification also allows the Government to avoid some potential challenges that might arise in decarbonising the gas supply chain for an island jurisdiction.

However, blending renewable gases into the existing gas network might also be a policy option, to the extent that it is technically feasible. Similar to the blending of biofuels in the petrol or diesel supply on the island for the transport sector, increasing the content of biogas in the existing gas network could provide an instant reduction in emissions from heating. With a longer-term outlook, achieving net zero would require using carbon-neutral energy sources for heating.

In case the subsequent quantitative analysis shows that it is not feasible to continue electrification of heating at a sufficiently fast rate to meet the Government's targets, then medium-to-long term alternative solution(s) would need to be considered. Besides prospects for further renewable electricity production, either centralised or via distributed energy resources, other industry options may be examined. Such alternative options would include a full

[235] To the extent that the batteries in EVs could be used to discharge electricity, an EV battery could serve as a domestic storage device.

decarbonisation of the gas supply (e.g. by utilising renewable gases) or the development of district heat networks. Box 5.2 summarises our recommendations for the decarbonisation policy in the heating sector.[236]

Box 5.2 Summary of shortlisted policies in the heating sector

Relevant 2014 Energy Plan policies

- Apply energy efficiency measures to the pre-1997 stock of properties
- Energy efficiency improvements in the private sector
- Energy efficiency improvements in the public sector
- Implement micro-renewables in the domestic sector
- Implement anaerobic digestion systems for waste management[237]
- Introduce a 'low-carbon' standard for new homes through building bye-laws
- Improve energy efficiency through a behaviour change programme

Further recommended policies

- Roll-out electrification of heating—subject to quantification results
- Blend renewable gas into the existing gas network to the extent that is technically feasible in the short-term
- Potentially develop supply chains over the medium-to-long-term for transport of renewable gases and, if necessary, alternatives such as district heating. This may also require developing / upgrading heating infrastructure (e.g. in homes) to enable utilisation of energy-from-waste, waste heat, and renewable gases

Recommended quantification next steps, to assess feasibility and value for money

- Update and plan the roll-out of the pre-1997 properties upgrade measures
- Assess the timeline for a potential full electrification of heating
- Subject to the above, assess the feasibility of the use of renewable gases in existing gas infrastructure and the costs of other infrastructure upgrades

Note: We understand from the Government of Jersey that the funding for the implementation of micro-renewables in the domestic sector has subsequently been withdrawn.

Source: Oxera analysis.

5A.4 Other relevant considerations for the funding strategy

The funding strategy for the carbon neutral proposal will involve judgement on the trade-off between the degree of certainty with which the Government of Jersey can expect to reach its net zero target on time and the volume of the upfront government expenditure that will need to be incurred for carbon abatement.

[236] Appendix A1 lists the data requirements for this quantification.
[237] A feasibility study found that financial returns for anaerobic digestion systems are very low relative to the capital investment required and, thus, investments for such systems are not particularly attractive to investors. Support would, therefore, be required from the Government of Jersey, which could include provision of land, low interest loans or capital grants.

The case studies provide limited evidence on how individual economies are financing specific decarbonisation policies. Taxation (e.g. fuel taxation) can point to specific line items in national budgets. However, the majority of subsidy schemes and the costs of infrastructure investment appear to be part of the state or municipal budgets without identifying specific fiscal measures for financing the cost of delivering specific decarbonisation policies.

Currently, carbon emission represents a market failure, i.e. from the perspective of financial self-interest, individuals and corporations would prefer to choose fossil fuel energy notwithstanding that the social disbenefit potentially exceeds the private benefit of these individuals' and corporations' decisions. However, as technologies develop, environmentally friendly alternatives can reasonably be expected to become increasingly financially attractive.

While it may be reasonable to assume that the environmentally friendly alternatives will eventually outcompete fossil fuel technologies, it is highly uncertain that this process will be completed by 2030 or even 2050. Therefore, in order to accelerate the adoption of environmentally friendly alternatives, governments have to incentivise individuals and firms by introducing 'distortions' to the market. From the perspective of government, these distortions could generally either generate revenue (taxes) or require expenditure (subsidies).

With regard to revenue-driven policies, it is necessary to have regard to the issue of affordability. Academic studies show that the proportion of income spent on energy is inversely related to the total income of a household.[238] Fuel taxes and duties are therefore regressive and tend to affect vulnerable customers in a disproportionate manner. In this context, the example of Sweden can provide a useful lesson. When introducing its carbon taxes, Sweden adopted a gradual incremental increase in tax rates, allowing businesses and households time to adapt to the new policy.[239] At the same time, income taxes were reduced, offsetting the additional financial burden of carbon taxes on vulnerable households.[240]

[238] Meier, Jamasb and Orea, (2014), 'Necessity or Luxury Good? Household Energy Spending and Income in Britain 1991-2007', available at https://www.jstor.org/stable/pdf/41969254.pdf?refreqid=excelsior%3Ad9a61f907fa4efefac02c2eb6c4e9f9a
[239] Ricardo Energy & Environment, (2018), 'Sweden Energy and Carbon Tax Policy: Rethinking Decarbonisation Incentives – Policy Case Studies', available at https://es.catapult.org.uk/wp-content/uploads/2018/10/Sweden-Case-Study-FINAL.pdf
[240] Anthesis Enveco AB, (2018), 'The Swedish CO2 tax – an overview', available at http://www.enveco.se/wp-content/uploads/2018/03/Anthesis-Enveco-rapport-2018-3.-The-Swedish-CO2-tax-an-overview.pdf

With regard to expenditure-driven policies, the Government of Jersey has the choice of either relying on carbon offsetting schemes internationally or carrying out domestic investment to directly deliver carbon abatement investments. This is where the trade-off between the reliability of delivering the decarbonisation plan and the budget constraint arises.

In addition, while it may be the case that current offsetting prices appear financially more attractive than domestic subsidy programmes and the amount of carbon emission offset is presently known, heavy reliance on offsets exposes the Government of Jersey to the price risk of offsetting services in the future. As climate change policies gain traction, the demand for offsetting services is likely to rise, putting upward pressure on the price of carbon offsetting services. In that scenario, the Government of Jersey may no longer be able to guarantee a sufficient budget to sustain the offsetting.

Conversely, conducting a comprehensive domestic carbon abatement programme may require a higher upfront expenditure, but would yield a more certain decarbonisation outcome in the medium to long term.

A1 Data requirements for the recommended impact assessments

This appendix lists the data required to conduct the quantitative assessment recommended in this report. The precise form of the statistics used in the quantitative assessment will inevitably depend on the depth and quality of the data points available and may be revised upon future investigation.

Policy	Data required	Purpose
Electrification of road transport	Historical time series of the number of electric, diesel and petrol vehicles registered in Jersey, if possible, classified by models or energy efficiency characteristics Historical time series and future projections for the upfront costs of diesel, petrol and electric vehicles in Jersey Historical prices and future projections of diesel, petrol and electricity prices in Jersey Historical information and future projections for other significant costs of owning and operating a vehicle (e.g. material vehicle taxes or differences in insurance premia)	The information on the types of vehicles owned and their respective costs (including acquisition and maintenance) will allow the assessment of (i) how quickly the citizens of Jersey are likely to switch to an EV; and (ii) what is likely to drive that switch. Once calibrated on historical data, the model will allow the estimation of the most efficient combination of fuel taxes and EV subsidies, required to achieve the 2030 net zero target, while minimising government expenditure, e.g. on subsidies. The analysis can be conducted at different levels of granularity, ranging from fuel type (diesel, petrol, electricity) to different types of vehicles (e.g. accounting for the different fuel consumption for different car models).
	Historical geographical distribution of EV charging points and EV registrations	To the extent that vehicle registration data is available by region, it is also possible to analyse to what extent the absence of charging stations affects consumers' decision to switch to EV.

Policy	Data required	Purpose
	Estimates of financial profitability of EV charging stations, e.g. extracts from historical business plans on costs of installing and operating charging stations	If there is concern about insufficient investment in charging infrastructure for EVs, the support for this infrastructure can also be quantified. Data on existing geographical coverage, costs and profitability of charging stations will allow the assessment of the extent to which there exists a market failure in the charging infrastructure market. It is worth noting that the first stations installed are likely to be the most profitable. Increasing penetration further is likely to prove progressively more difficult. Analysing past precedents on the financial performance of investment in charging stations will allow us to make inferences as to the potential amount of support required for potential full penetration of charging stations on the island.
Energy efficiency improvements	List of premises on the island, split by energy efficiency and, if available, region Historical time series and future projections of the cost of energy efficiency upgrades and heating bills, by region if available	This information will allow us to assess the cost of upgrades as well as future heating cost savings from consumers' point of view.
	List of premises on the island, grouped by energy efficiency status and, if available, region Future projections of the labour force available to implement the efficiency upgrades.	This will allow us to estimate the fastest feasible rate of upgrades and assess to what extent it is possible to complete the upgrades by 2030 (as opposed to 2050, as envisaged in the 2014 Energy Plan).
Assessment of timeline for the electrification of heating	Historical time series on heating energy consumption by technology Historical time series and future estimates of costs of installation of heat pumps, solar water heaters and potentially, other heating technologies that rely on carbon-neutral sources of energy	This information will allow us to assess the cost of upgrades as well as future heating cost savings from consumers' point of view.

Policy	Data required	Purpose
	Historical time series and future projections of gas, kerosene, diesel and heating oil prices	
	Scenarios on the future evolution of the peak electricity demand, accounting for the electrification of transport and heating	This will allow us to assess the feasible rate of electrification from the perspective of security of supply.
	Projections on the future capacity of the electricity system	

Source: Oxera analysis.

www.oxera.com