PORTUGAL

Country Factsheet: 1.5°C Pathways for Europe

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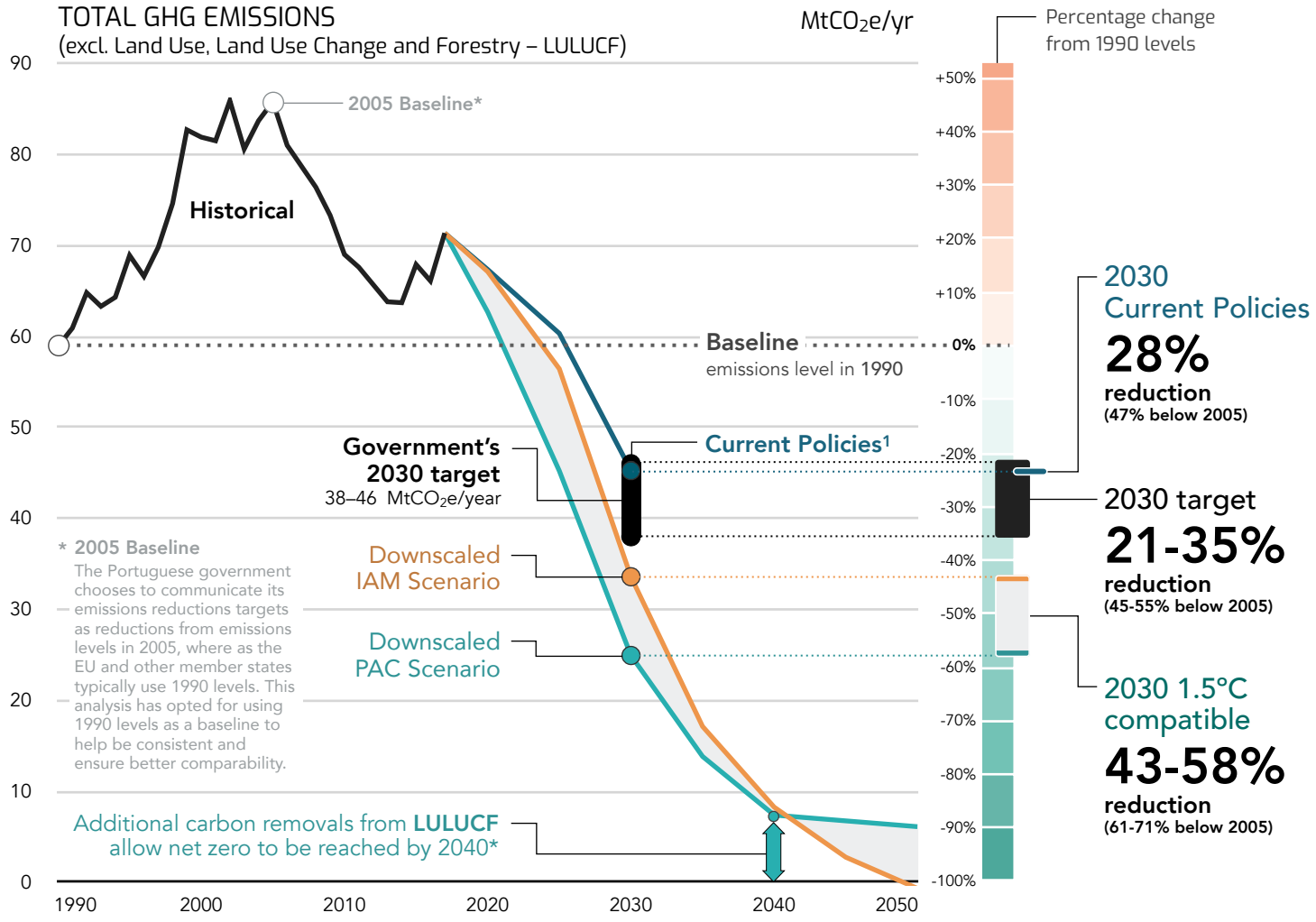
Portugal's current 2030 emissions target is not 1.5°C compatible



*To achieve the net zero emission target, emissions from LULUCF need to be reduced while increasing the capacity of forests, wetlands, grasslands and farmlands to remove carbon. These carbon removals are not equal to emissions in other sectors and the two cannot simply be considered fungible.

Portugal's 2030 emissions target is not within the derived 1.5°C compatible range

Portugal's 2030 domestic emissions reduction target of a 21–35% reduction below 1990 levels excluding LULUCF (45-55% below 2005), does not align with the 1.5°C compatible emissions range derived in this project.† This range suggests Portugal would **need to increase its target to at least 43% below 1990 levels, and would then need additional policies to ensure such a target is met.** Under current policies, Portugal's existing 2030 emissions target is projected to be met.[1]

The downscaling approach used in this project does not incorporate considerations of emissions reduction burden sharing as is the case with EU climate obligations whereby Portugal has been exempted from stricter climate action than is required from wealthier EU countries. Ensuring Portugal contributes its fair share to global climate mitigation efforts, however, requires additional emission reduction activities to be supported in developing countries as is required by all developed countries under the UN Framework Convention on Climate Change.[2,3]

† **Scope and limitations of downscaled emissions and energy mix pathways:**

- Pathways were downscaled using the SIAMESE model developed by Climate Analytics. See 1.5°C Pathways for Europe Report[3] for details
- Land use, land use change and forestry (LULUCF), and international aviation and shipping emissions are not covered by this assessment
- Detailed macro-economic modelling was not conducted as part of this assessment
- Historical and future energy imports and exports were not considered

CURRENT SITUATION
Snapshot of Portugal's emissions and energy system

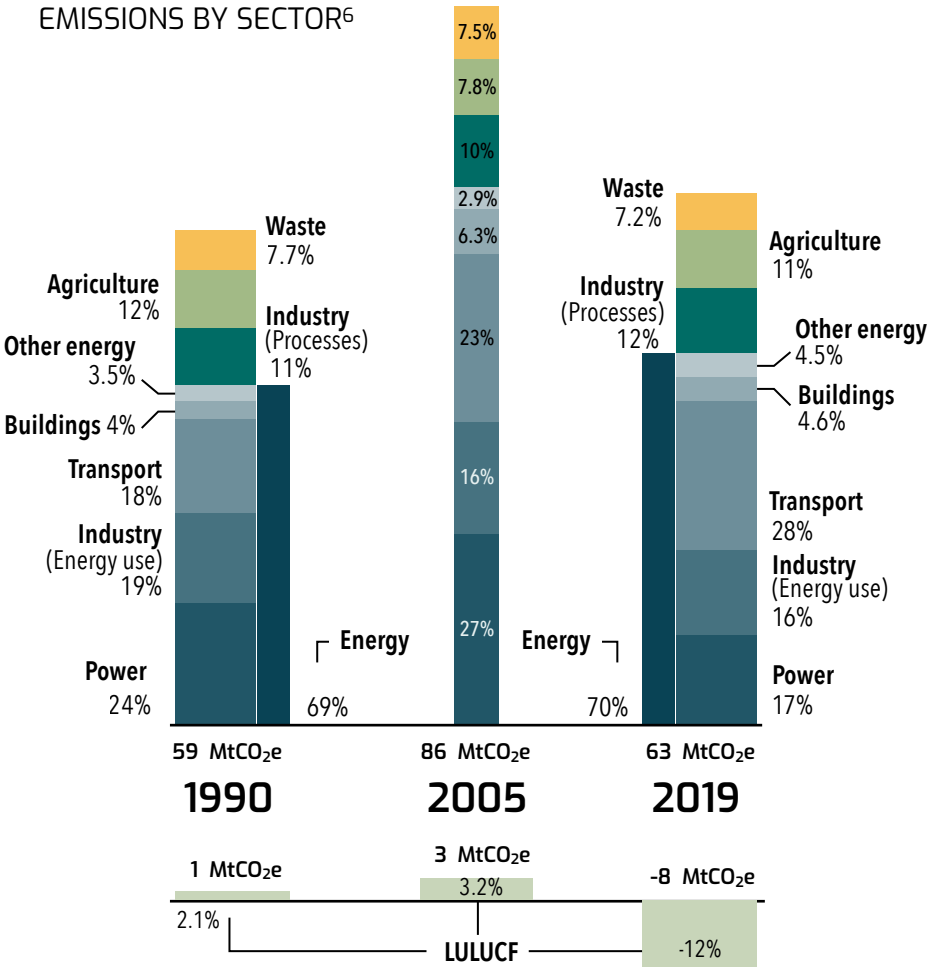
Emissions profile

After peaking in 2005, Portuguese emissions fell rapidly until 2014 to reach 24% below the peak of ten years earlier.[4] Emissions have since risen to be 8% higher than 1990 levels in 2019, one of only a handful of European countries where emissions have not fallen relative to 1990 levels.

Compared to 2005 levels, emissions from all sectors have fallen considerably except for those from transport, which declined by just 11%. Transport sector emissions overtook those from the power sector in 2006 to become the largest source of emissions, and have seen a 64% increase since 1990.

Total electricity generation in 2019 is almost double 1990 levels, but due to an 89% and 40% drop in oil and coal combustion respectively, emissions are 26% lower.[4] This coal and oil demand has been displaced by natural gas and biomass, while total renewable generation has increased threefold.

PORTUGAL
EMISSIONS BY SECTOR[6]



Energy overview and main policy gaps

While power generation in Portugal has almost doubled since 1990, total energy supply in 2019 was 30% higher, driven primarily by a 83% increase in transport energy use.[5] Coal demand has roughly halved over this time, while demand for natural gas, which was zero in 1990 reached 24% of the total energy supply in 2019 due to its extensive use in the power, industry, and building sectors. In a welcome development, the government's previously set 2023 coal phase out target has been brought forward to the end of 2021. Despite the increased transport sector demand, total oil consumption fell between 1990 and 2019 due the precipitous fall in its use in the power sector. This removal of oil from the power sector is a positive, as is the fall in coal use, but the dramatic rise in natural gas demand, which remains near its 2017 peak, must be addressed moving forward. Rising transport sector emissions need to be targeted with strong investments in public transport, bicycle and walking infrastructure, and vehicle electrification.

Civil Society & Global Integrated Assessment Models
1.5°C energy and climate scenarios for Europe

The aim of the 1.5°C Pathways for Europe Project is to derive Paris Agreement compatible emissions and energy mix pathways for key European countries. The project seeks to highlight existing scenarios that demonstrate that a **very high level of ambition on climate and energy policy *is possible* for the European Union and its Member States.** To reflect the varied methodologies employed to construct such scenarios, we assess the Paris Agreement Compatible (PAC) energy scenario, and a scenario from the global REMIND integrated assessment model (IAM), both embodying high levels of 2030 climate ambition in the European Union region. We use the SIAMESE model developed by Climate Analytics to create country level pathways, using the PAC/REMIND scenario results for the European Union as input and downscaling them based on demographic, economic, energy system, and policy heterogeneity between countries.[7] We outline key differences between the two scenarios used as input for the SIAMESE downscaling process below.

PAC [8]
Paris Agreement Compatible Energy Scenario

The PAC scenario for the EU28 was developed through a bottom-up collective research exercise involving energy and climate experts and incorporating findings from relevant scientific literature.

Around 150 stakeholders from member organisations of the European Environmental Bureau (EEB) and Climate Action Network (CAN) Europe, and from science and industry were involved in the scenario building process.

The PAC scenario is an attempt to construct a European-wide energy scenario which is aligned with the Paris Agreement's objective to limit global warming to 1.5°C and which embodies the demands of civil society.

In doing this it suggests a trajectory with:

- **100%** renewable energy supply by 2040
- **At least 65% GHG** emissions reduction below 1990 levels by 2030
- Net zero emissions by **2040**

Carbon Capture and Storage (CCS):

A key assumption underpinning the PAC scenario is that carbon capture and storage **will not be required** to achieve net zero emissions for the European Union.

Global IAM [9,10]
Integrated Assessment Model Scenario

We assess the global REMIND 1.7 CEMICS-1.5-CDR8 scenario as an additional line of evidence for pathways for the European Union to achieve the 1.5°C long-term temperature goal of the Paris Agreement. REMIND is a global energy-economy-climate model that maximises inter-temporal welfare. It contains macro-economic, energy system, and climate modules that are integrated to attain exogenously prescribed climate targets.[11]

Population and GDP growth are key drivers of future energy demand and, thus, GHG emissions in IAMs. In our SIAMESE-based downscaling approach, we therefore take growth rates from the shared socio-economic pathway (SSP) scenarios, specifically SSP2, a middle of the road scenario, in order to assess what the EU-region results of this scenario imply for country-specific energy system transformation.

Key outputs for the EU region from this scenario are:

- **90%** renewable energy supply by 2040
- **62% GHG** emissions reduction below 1990 levels by 2030 (excl. LULUCF)
- Net zero emissions between **2045-2050**

Carbon Capture and Storage (CCS):

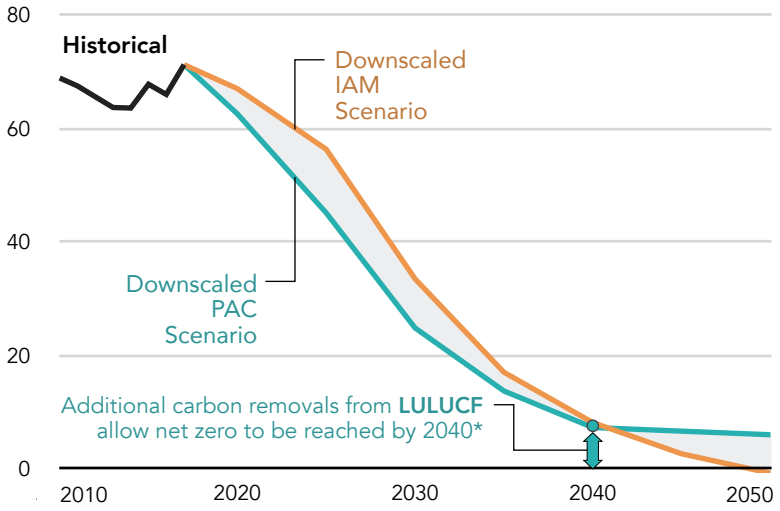
This IAM scenario envisages some **natural gas and biomass** combustion with carbon capture and storage.

Economy-Wide 1.5°C Pathways

According to the analysis undertaken in this project, achieving a 1.5°C compatible economy for Portugal requires a 43-58% reduction in total GHG emissions (excluding LULUCF) by 2030 and reaching net zero emissions between 2040 and 2050.

There are numerous different pathways to reaching net zero emissions in this timeframe. In the scenarios downscaled, a LULUCF sink of between 7-8 $MtCO_2e$ would achieve net zero by 2050, while under the PAC scenario, a LULUCF sink of 6 $MtCO_2e$ would achieve net zero emissions in 2040.

PORTUGAL TOTAL GHG EMISSIONS (excl. LULUCF) $MtCO_2e/yr$



*To achieve the net zero emission target, emissions from LULUCF need to be reduced while increasing the capacity of forests, wetlands, grasslands and farmlands to remove carbon. These carbon removals are not equal to emissions in other sectors and the two cannot simply be considered fungible.

1.5°C Compatible 2030 primary energy mix

	2017[5]	2030
Renewables incl. biomass	22%	**62–68%** IAM PAC
Fossil Fuels	79%	**32–38%** PAC IAM
Nuclear	0%	**0%**

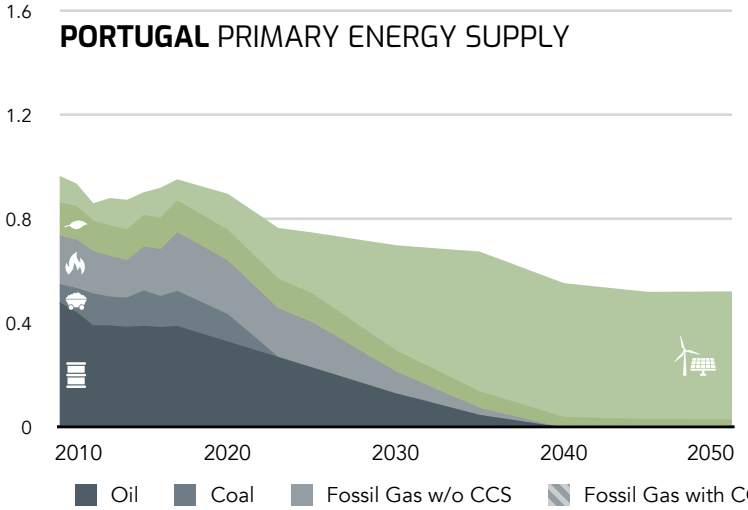
In the downscaled PAC and IAM pathways, the share of unabated fossil fuels in primary energy demand is reduced to between 30-38% by 2030, whereas the share of renewables including biomass reaches between 62-68% of primary energy by the same date.

Due to the significant levels of biomass consumption in the IAM scenario used to downscale primary energy to the national level in Portugal, the model has allocated an increasing share of biomass demand over time. With a limited domestic supply of biomass likely to be exacerbated by climate change, this modelled demand may need to be displaced by energy efficiency gains as envisaged under the downscaled PAC scenario.

*Primary energy supply includes losses that occur during the conversion of nuclear and fossil fuels to electricity, resulting in a higher proportion of both nuclear and fossil fuels than in total final energy demand

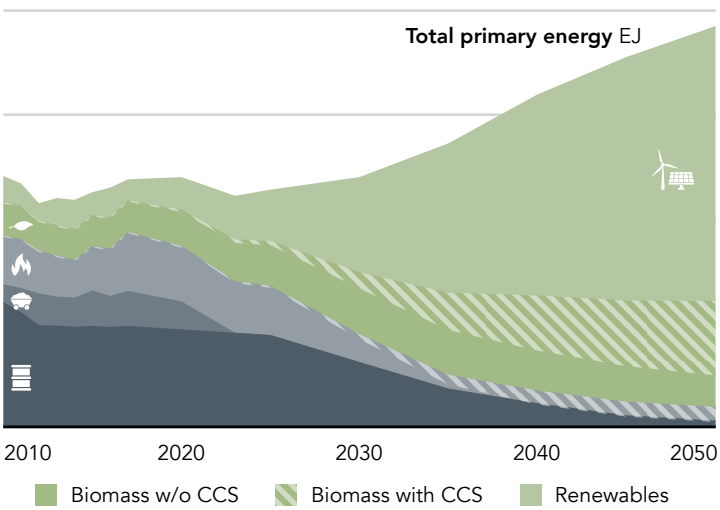
Downscaled PAC Scenario

PORTUGAL PRIMARY ENERGY SUPPLY



Downscaled IAM Scenario

Total primary energy EJ

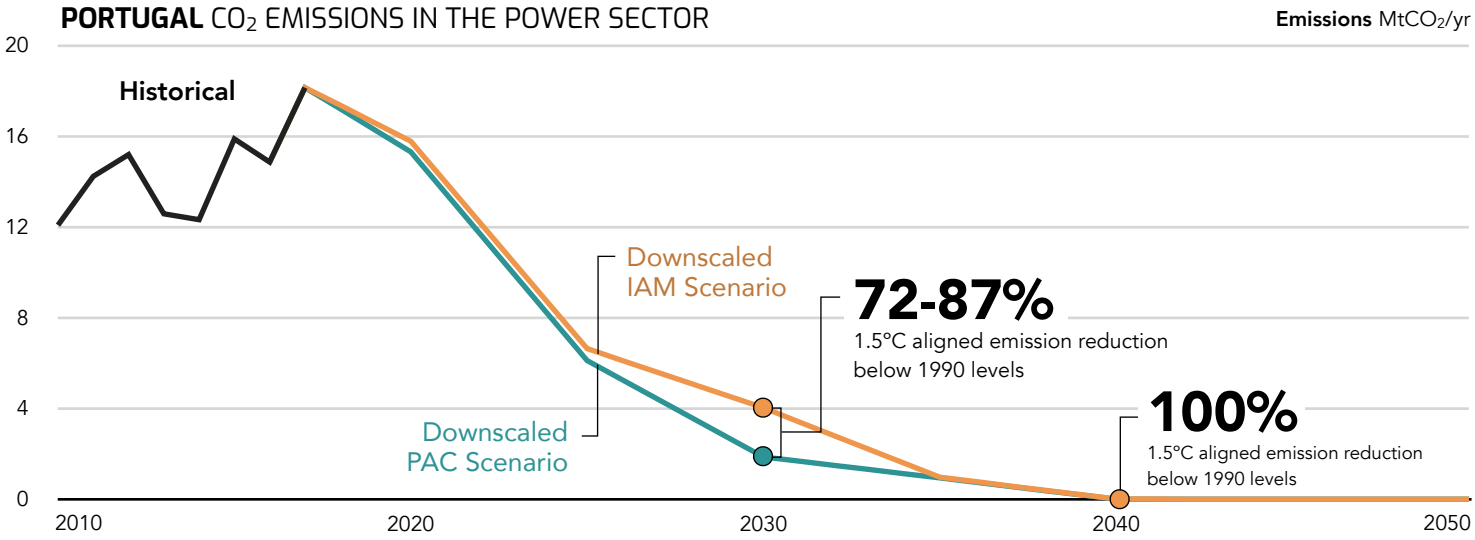


Oil | Coal | Fossil Gas w/o CCS | Fossil Gas with CCS | Biomass w/o CCS | Biomass with CCS | Renewables

The PAC scenario depicts a future where total energy use rapidly declines through efficiency gains, largely from switching fossil fuel consumption to renewables, increased rates of material reuse and recycling, and consumer demand reduction.

The IAM scenario also achieves efficiency gains, but assumes energy demand continues to rise over time in line with historical growth trends. The large increase in national total primary energy supply reflects the overall increase in the modelled Europe-wide scenario results.

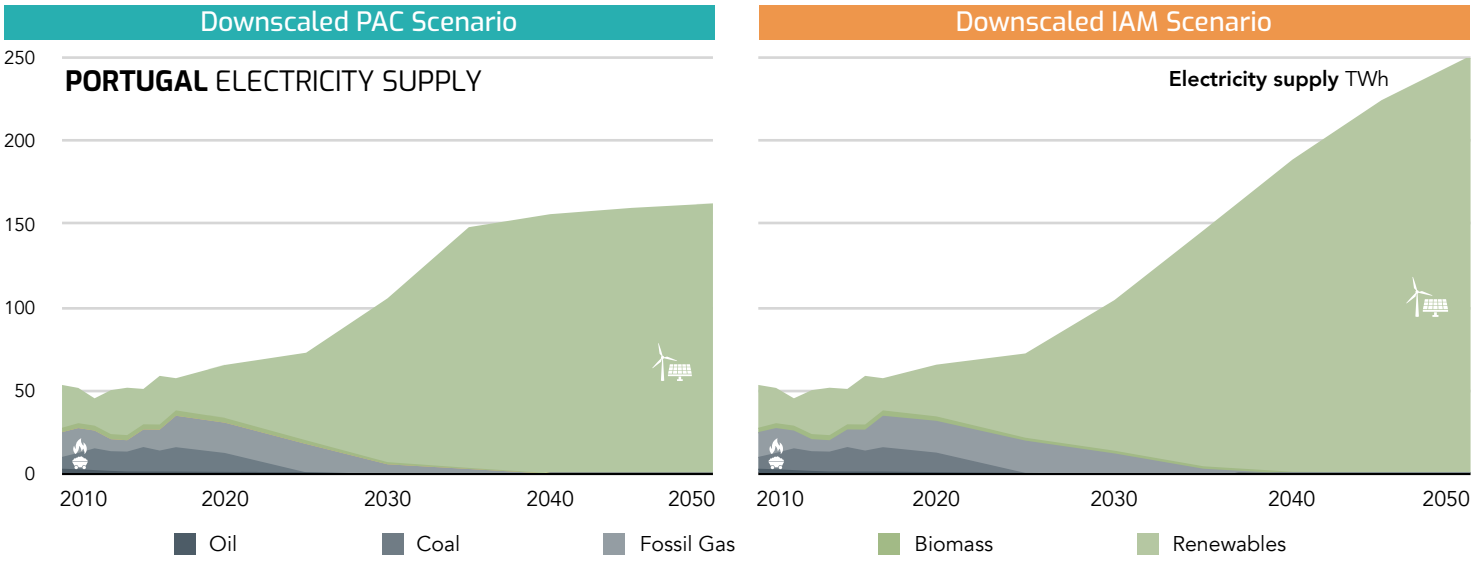
Sectoral decarbonisation: Power



1.5°C Compatible 2030 power sector fuel mix*

	Renewables incl. biomass	Coal	Fossil gas	Nuclear
2017 [5]	39%	26%	33%	0%
2030	89–95% IAM PAC	0%	5–11% PAC IAM	0%

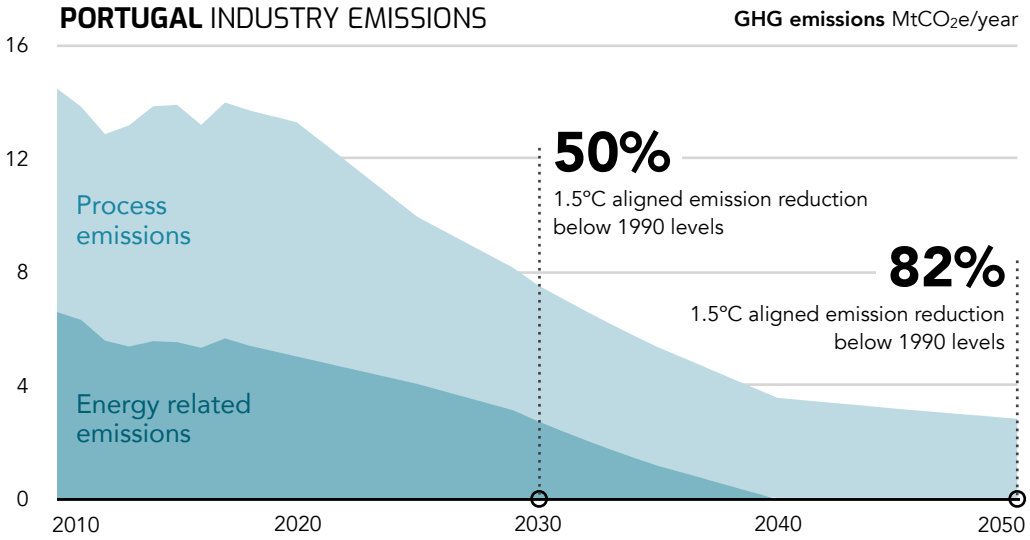
*No detailed wholesale electricity market modelling was undertaken for this assessment



Towards a fully decarbonised power sector

Portugal's power sector has undergone a transformation since 1990, when fuel combustion in the power sector was roughly half from coal and half from oil.[5] Power sector oil and coal demand since then has fallen by 89% and 40% respectively, with natural gas in 2019 making up 35% of total generation, while renewables contributed over half. With a 2021 coal phase out policy in place, focus should now turn to replacing natural gas consumption with a steep increase in renewable energy generation.[1]

Sectoral decarbonisation: Industry



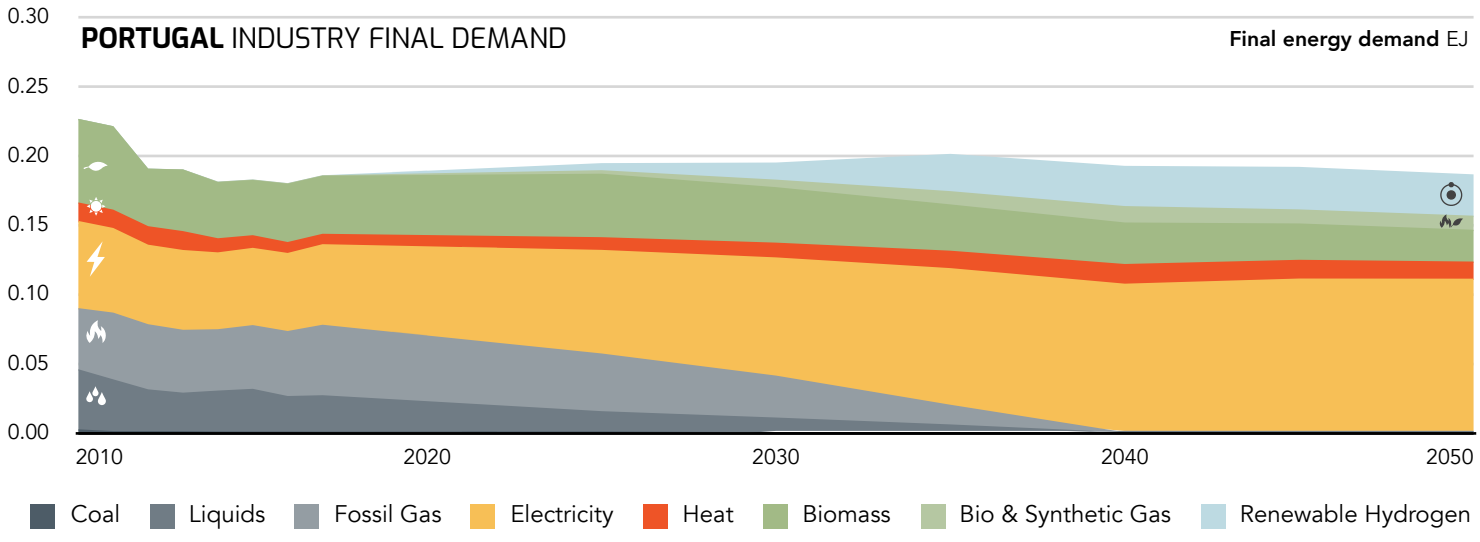
Emissions from industry decline significantly until 2040 in the pathway downscaled from the PAC scenario, whereby energy-related emissions reach zero and further reductions occur more gradually. This is due to the nature of these residual (process) emissions that are harder to mitigate than those from fuel combustion.

It was not possible to downscale the chosen IAM scenario due to a misalignment of scenario and historical energy data.

1.5°C Compatible 2030 industry sector final energy mix

	Electricity	Coal	Fossil gas	Renewable Hydrogen
2017 [5]	31%	0%	28%	0%
2030	**44%**	**0%**	**18%**	**6%**

Downscaled PAC Scenario



Towards a fully decarbonised industry sector

Portugal's industry sector consumes very little coal, making up less than 1% of total sectoral demand.[5] Industrial coal consumption has fallen 98% since 1990, when it made up 13% of demand. In 2019, natural gas made up 27% of industrial energy demand, standing in stark contrast to its total absence from industry in 1990. Its displacement of oil and coal demand over time along with rising supply from renewables has meant that energy-related emissions from this sector are lower than in 1990 despite total demand being roughly the same. Focus should now be on electrifying industry energy demand, expediting the transition away from oil and gas consumption, and deriving methods for dealing with process emissions.

Closing the Ambition Gap

Key characteristics of Portugal's 1.5°C compatible pathways

	Historical	1.5°C compatible benchmarks		Country targets	
	2017	**2030**	**2050**	**2030**	**2050** incl. LULUCF*
Total GHG excl. LULUCF	71 $MtCO_2e/yr$	25–34 $MtCO_2e/yr$	-1–6 $MtCO_2e/yr$	38–46 $MtCO_2e/yr$	0 $MtCO_2e/yr$
	20% above 1990	43–58 % below 1990	90–101 % below 1990	21-35 % below 1990	100 % below 1990
	17% below 2005	61–71 % below 2005	93–101 % below 2005	45-55 % below 2005	100 % below 2005
Emissions intensity of power generation**	316 gCO_2/kWh	18-39 gCO_2/kWh	0 gCO_2/kWh		
Share of renewable power	39 %	88–94 %	100 %	80 %	
Share of unabated fossil fuel in power	61 %	5–11 %	0 %		
Share of nuclear power	0 %	0 %	0 %		
Industry electrification rate	31 %	44 %	60 %		

* 2050 target is shown including LULUCF emissions due to the absence of government projections for these emissions to 2050

** Does not include upstream emissions

Raising Ambition

Portugal has set an ambitious renewable electricity generation target, but it is not yet aligned with the downscaled 1.5°C compatible pathways; an increase to 88% by 2030 would make it so. An increase in ambition is also required on the current 2030 emissions target, which is projected to be met with current policies.[1] This demonstrates that greater ambition is possible. In particular, policies are lacking to encourage the necessary rapid decarbonisation of the transport, industry, and buildings sectors. Investments to achieve modal shift from cars to public transport and walking or cycling are crucial moving forward, as are incentives to encourage house owners to install low carbon heating options.

Portugal's 2050 economy-wide carbon neutrality target is commendable, but the path to reaching net zero is just as critical as reaching the target itself. A 2050 net zero target cannot be 1.5°C compatible on its own without a strong medium-term target for 2030 in place. Portugal should increase its 2030 emissions reduction target to between 43-58% below 1990 levels (excl. LULUCF) to ensure it is aligned with the range implied by the two downscaled 1.5°C compatible emissions pathways.

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About the author

Supporting science-based policy to prevent dangerous climate change, enabling sustainable development.

Climate Analytics is a non-profit climate science and policy institute based in Berlin, Germany with offices in New York, USA, Lomé, Togo and Perth, Australia, which brings together interdisciplinary expertise in the scientific and policy aspects of climate change. Our mission is to synthesise and advance scientific knowledge in the area of climate change.

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Acknowledgments

We would like to acknowledge the Swedish Postcode Foundation for providing funding for this project.

Climate Action Network (CAN) Europe and AirClim provided ongoing and invaluable coordination support but do not necessarily endorse all findings from this project.

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