GERMANY

Country Factsheet: 1.5°C Pathways for Europe

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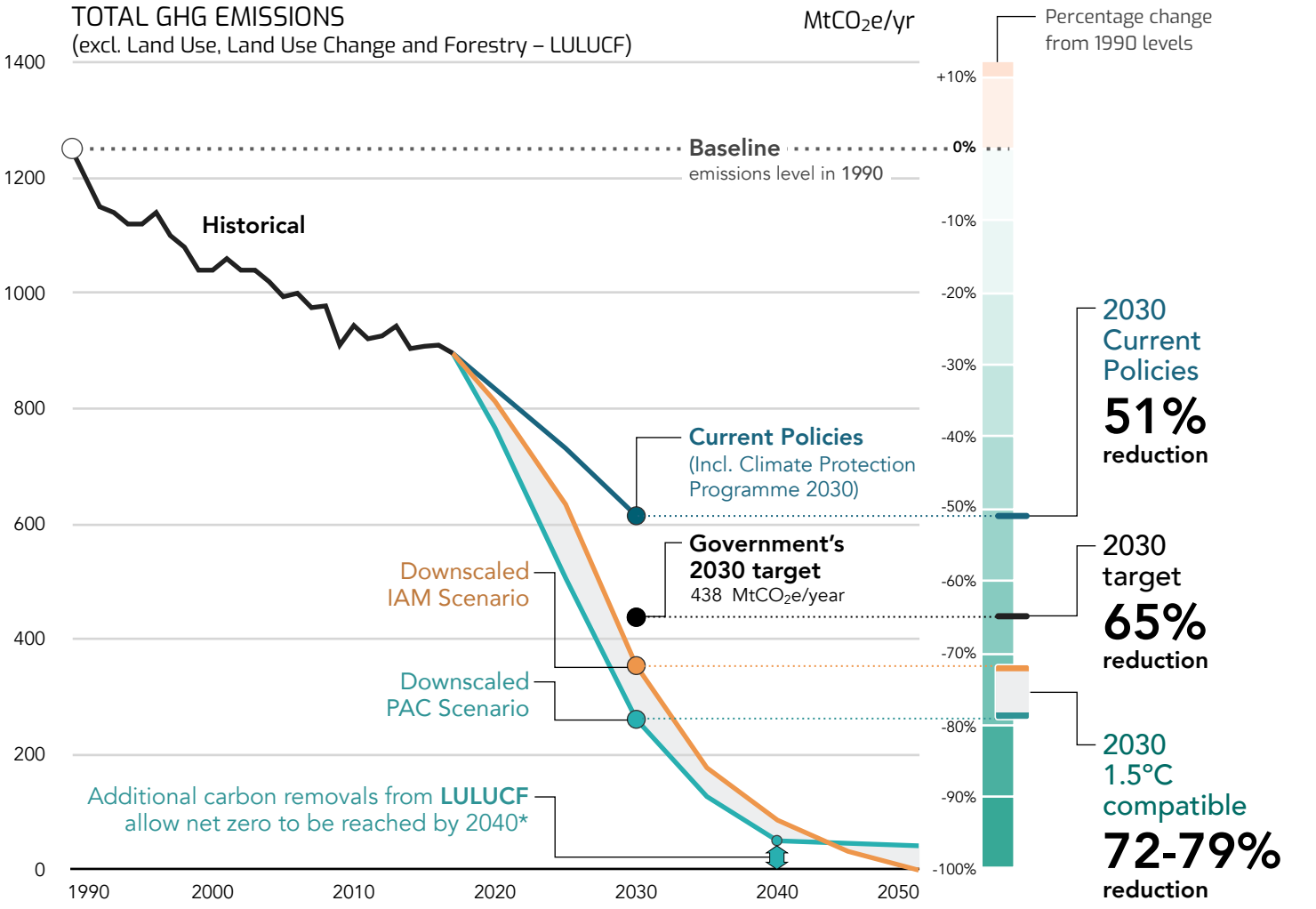
Germany's current 2030 emissions target is not 1.5°C compatible



*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.

Germany fails to achieve its insufficient 2030 emissions target

Germany's current suite of climate policies will fail to achieve its insufficient 2030 target, reflecting the **need for greater urgency across all sectors of the economy (power, industry, buildings, transport) and a more ambitious target that guides such action**.[1] Analysis by Climate Analytics shows that a reduction of 72-79% below 1990 levels (excl. LULUCF) would be a 1.5°C compatible 2030 domestic emissions target.†

Germany's current 2038 coal phase out is not 1.5°C compatible and should be brought forward to at least 2030. Germany has not yet started discussions about the necessary phase out of fossil gas and oil from the economy. Speeding up the growth of renewable electricity to achieve a 93-97% share of total generation by 2030 is crucial to achieving this assessment's 1.5°C compatible power sector trajectory. To ensure Germany is contributing its fair share to global climate mitigation efforts, additional emission reduction activities should also be supported in developing countries.[2]

† **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

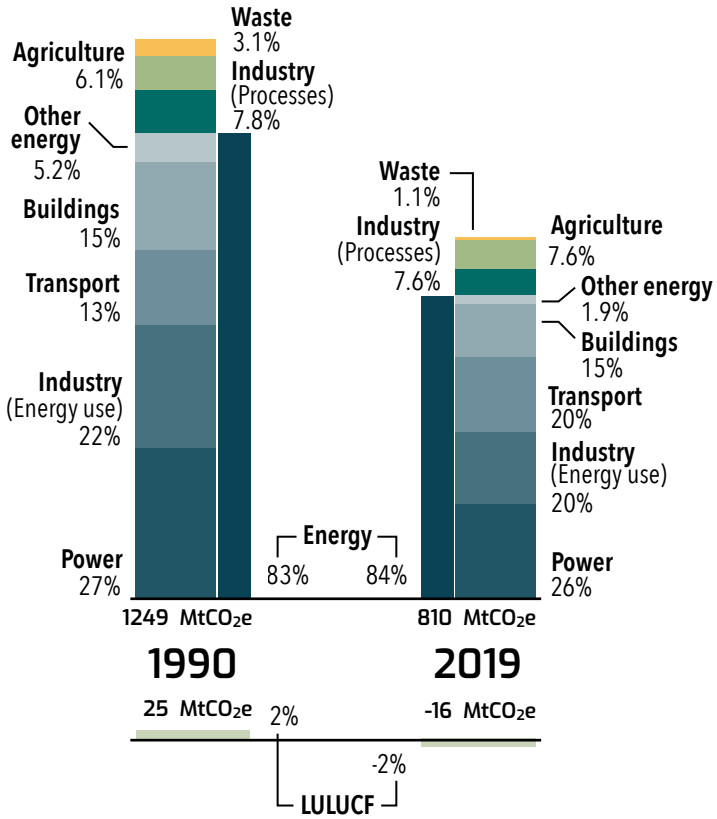
CURRENT SITUATION
Snapshot of Germany's emissions and energy system

Emissions profile

German emissions were 35% below 1990 levels in 2019, led primarily by reductions over time in the power and industry sectors.[4] Electricity production remains the largest source of emissions, though, due to its relatively high proportion of brown coal, contributing 30% of total emissions in 2020.[5] Industry and transport were the next highest emitters, contributing 24% and 20% respectively in 2020. Transport is the only sector that has not seen emissions fall since 1990, highlighting the need for strong measures to address these emissions. Agriculture emissions declined only marginally, while the buildings sector failed to achieve the sectoral 2020 target enshrined in the German Climate Law.

Under current policies (projected to 2030 taking into consideration policies included in the Climate Protection Program 2030), Germany's emissions (excl. LULUCF) would reach just 51% below 1990 levels by 2030, well below its current 2030 target.[6] This does not, however, reflect measures introduced in the framework of the post COVID-19 recovery.

GERMANY
EMISSIONS BY SECTOR[4]



Energy overview and main policy gaps

Oil and petroleum products constitute the largest share of German primary energy supply at 36% in 2019.[7] Natural gas and coal are the next two largest at 25% and 18% respectively. Though renewables reached a 40% share of total electricity generation in 2019, they constituted just 15% of primary energy supply due their slow uptake in other sectors. Germany has adopted a 2038 coal phase out date, but this is well after the commitments of many of its European peers, with the UK, a historically highly coal reliant nation committing to a 2024 phase out.[1] Emissions from coal-fired power plants increased strongly in 2020, in part due to restrictive policies affecting new wind and solar PV capacity additions. A 2022 phase out of nuclear is also in place, but in the near-term Germany is increasing its dependency on natural gas by investing in new natural gas pipelines, power plants, and in liquid natural gas (LNG) terminals. A hydrogen strategy was released by the government in 2020 with a strong focus on renewable hydrogen, a commendable and necessary step to achieve the necessary decarbonisation across the economy, but particularly in the industry sector.[8] However, the hydrogen strategy does not lay out how and where to source this renewable hydrogen.

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.** 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.[9] We outline key differences between the two scenarios used as input for the SIAMESE downscaling process below.

PAC [10]
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 [11,12]
An integrated scenario reaching 1.5°C

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.[13]

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**

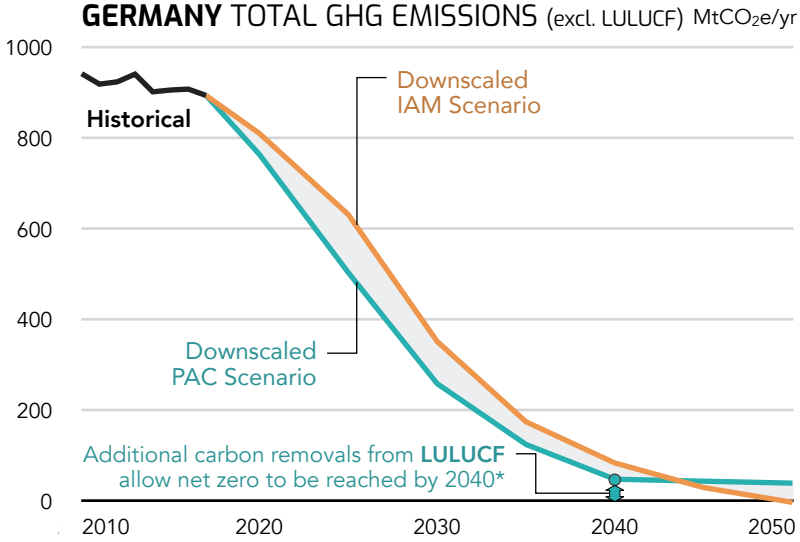
Carbon Capture and Storage (CCS):

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 Germany requires a 72-79% reduction in total GHG emissions by 2030 (excluding LULUCF), 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 0-42 $MtCO_2e$ would achieve net zero by 2050, while under the downscaled PAC scenario, a LULUCF sink of 50 $MtCO_2e$ would achieve net zero emissions in 2040.



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1.5°C Compatible 2030 primary energy mix*

	2017[7]	2030
Renewables incl. biomass	13%	**53–58%** IAM PAC
Fossil Fuels	80%	**42–47%** PAC IAM
Nuclear	7%	**0%**

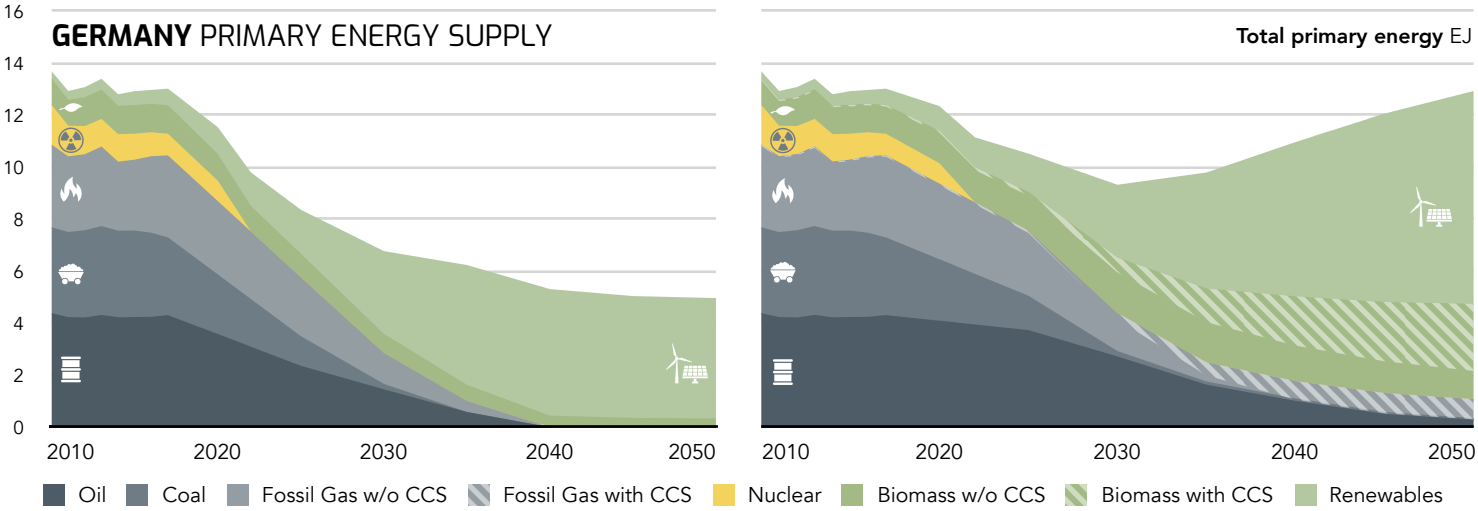
In the downscaled PAC and IAM pathways the share of unabated coal, oil, and fossil gas in primary energy demand is reduced to between 42-47% by 2030, whereas the share of renewables including biomass reaches 53-58% by the same year.

The transport and building sectors constitute a combined 47% of total GHG emissions in Germany, illustrating the need for strong policies to reduce the oil and natural gas demand that produces these sectoral emissions.

*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

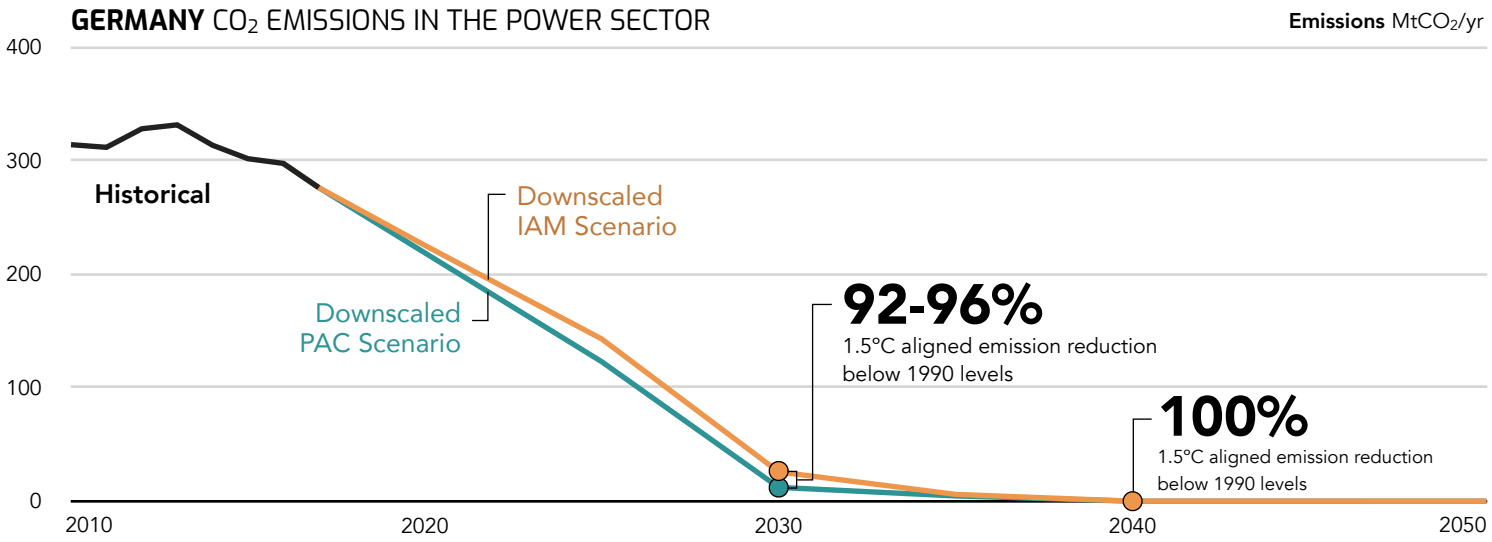
Downscaled IAM Scenario



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 regional growth trends. The large increase in national total primary energy supply reflects the overall increase in the modelled Europe-wide scenario results.

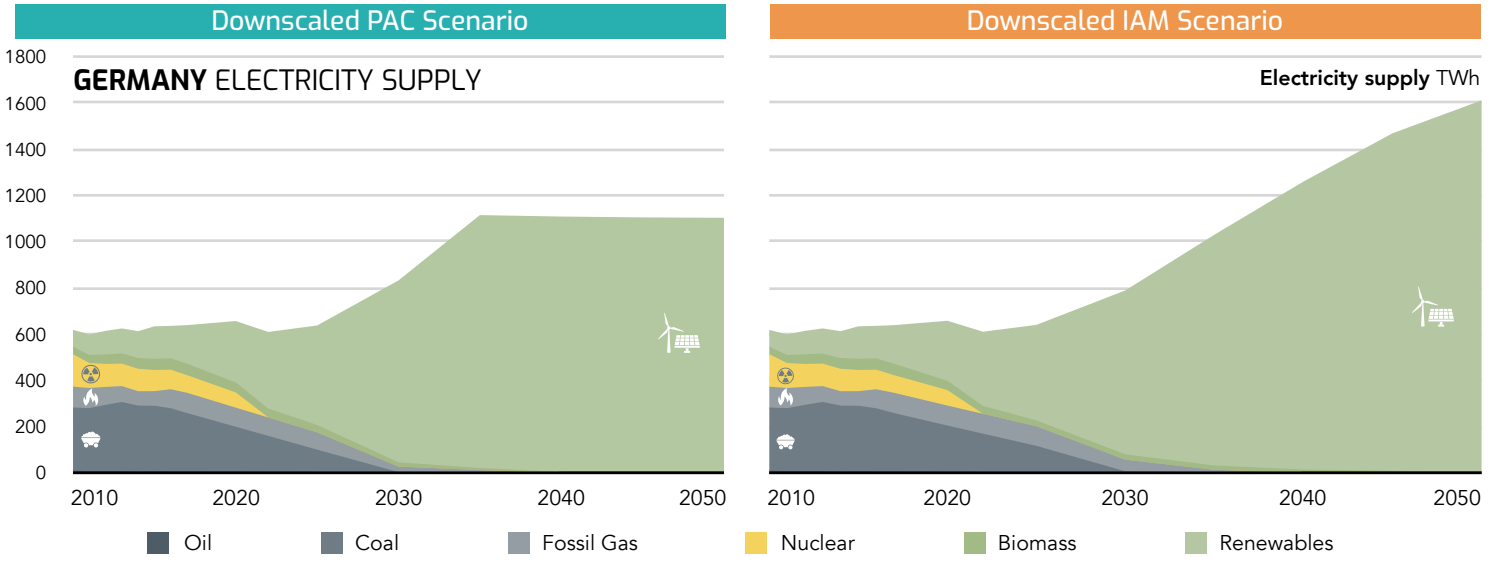
Sectoral decarbonisation: Power



1.5°C Compatible 2030 power sector fuel mix*

	Renewables incl. biomass	Coal	Fossil gas	Nuclear
2017 [7]	34%	40%	14%	11%
2030	93-97% IAM PAC	0–1% PAC IAM	3–6% PAC IAM	0%

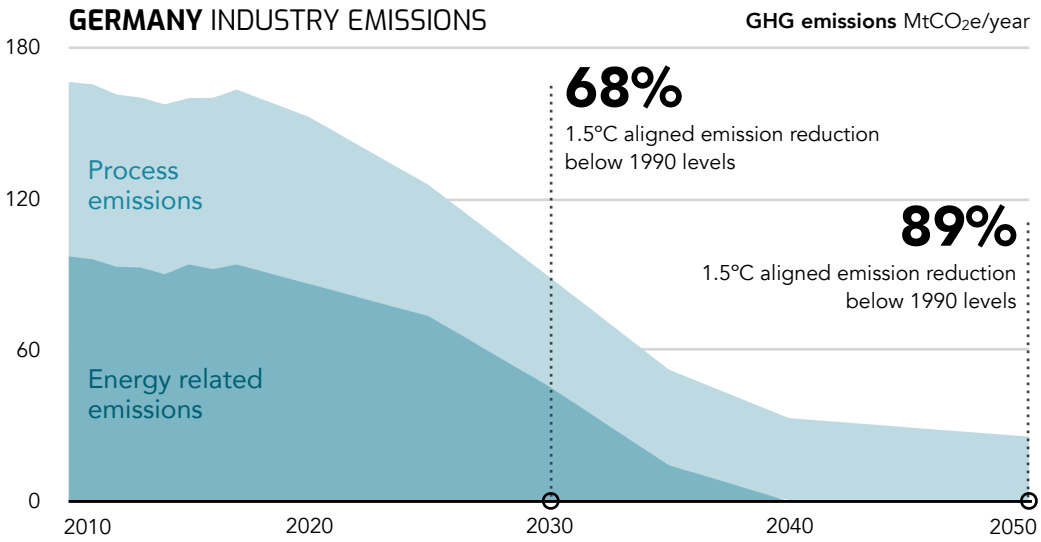
*No detailed wholesale electricity market modelling was undertaken for this assessment



Towards a fully decarbonised power sector

In both downscaled scenarios, currently high coal consumption rapidly declines and is phased out by 2030, well ahead of the current 2038 phase out date. There is no increase in gas generation in either scenario and it is phased out of the system by around 2035, when the system is fully decarbonised. The expected increase in total electricity demand due to widespread electrification across the economy is met exclusively with renewable sources, with a doubling in total electricity demand by 2035 in both scenarios.

Sectoral decarbonisation: Industry



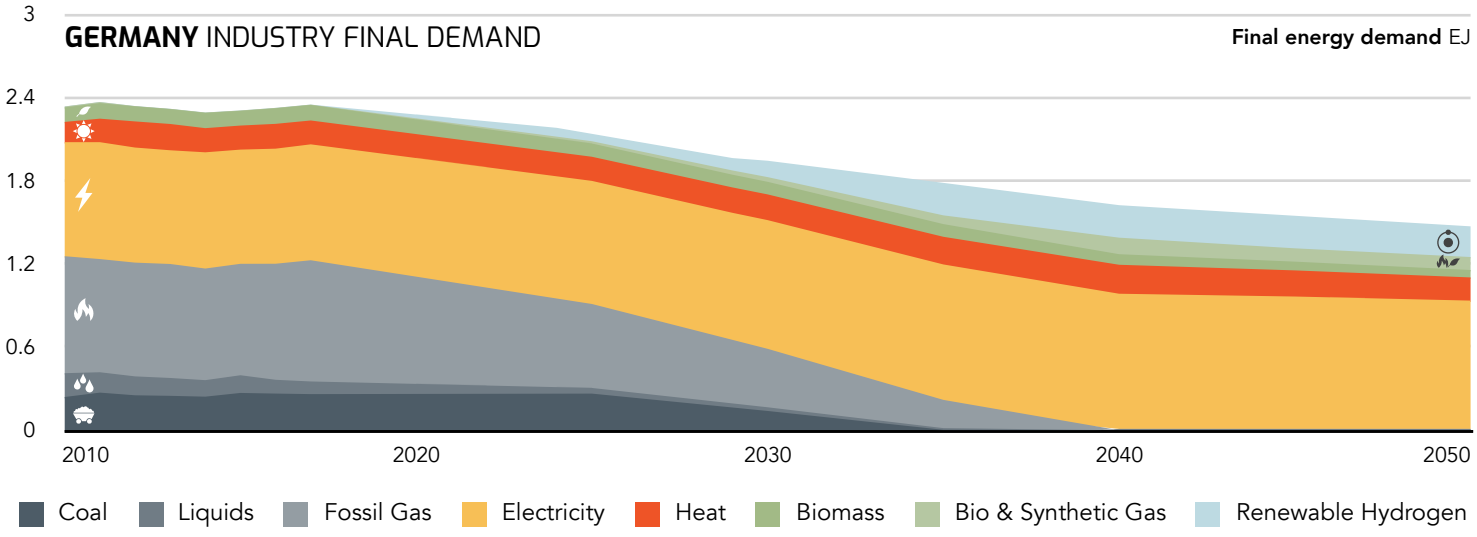
Emissions from industry decline significantly until 2040 in the pathway downscaled from the PAC scenario, whereby energy-related emissions reach zero and further reductions occur more gradually. This is due to the nature of these residual (process) emissions that are harder to mitigate than those from 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 [7]	36%	11%	37%	0%
2030	**48%**	**7%**	**24%**	**6%**

Downscaled PAC Scenario



Towards a fully decarbonised industry sector

Between 1990 and 2005, Germany achieved a significant reduction in coal demand in its industry sector, but since then consumption has remained relatively stable. To be 1.5°C compatible, this will need to change, with coal needing to be phased out of German industry by 2035. Roughly 50% of industry energy demand should be met by electricity, compared to the current 36%. The PAC scenario envisages significant energy savings through material reuse and recycling.

Closing the Ambition Gap

Key characteristics of Germany'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	896 $MtCO_2e/yr$	261–354 $MtCO_2e/yr$	-1–42 $MtCO_2e/yr$	438 $MtCO_2e/yr$	0 $MtCO_2e/yr$
	28 % below 1990	72–79 % below 1990	97–100 % below 1990	65 % below 1990	100 % below 1990
Emissions intensity of power generation**	433 gCO_2/kWh	15-33 gCO_2/kWh	0 gCO_2/kWh		
Share of renewable power	34 %	93–97 %	100 %	65 %	
Share of unabated fossil fuel in power	55 %	3–7 %	0 %		
Share of nuclear power	12 %	0 %	0 %		
Industry electrification rate	32 %	48 %	63 %		

* 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

Germany's current 2030 target falls short of the 1.5°C compatible range derived by this analysis of 72-79% below 1990 levels (excl. LULUCF). Ratcheting up its target to fall within this range and align with the 1.5°C compatible 2050 target should be a priority, as should adopting a 2030 coal phase out and raising its 2030 renewable generation target to at least 93%. Reaching net zero emissions before 2050 will require a rapid decarbonisation across all sectors including transport and buildings. To truly be aligned with the Paris Agreement's 1.5°C temperature limit, a sufficiently strong 2030 target is needed in addition to the rapid achievement of net zero emissions.

Other modelling results

Boston Consulting Group/Prognos: 95% Path[14]
- 57% GHG emissions reduction below 1990 by 2030, 95% by 2050
- 64% reduction in power sector emissions below 1990 by 2030, 48% for industry emissions
- 100% renewable energy in power sector by 2050

Fraunhofer ISE: Paths to a climate neutral energy system[15]
- Wind and solar provide 50-60% of primary energy demand by 2050
- Primary energy demand falls by 26-49% below current levels by 2050
- 100% renewable energy in power sector by 2050

Agora Energiewende: Climate Neutral Germany[16]
- 65% GHG emissions reduction below 1990 by 2030, net zero by 2050
- Coal phase out and 70% RES by 2030, 100% 2050
- 50% reduction in primary energy demand below 2018 levels by 2050, 38% RES by 2030

Ensure Project: Transformation of the Energy System by 2030[17]
- 78% 2030 emissions reduction target, net zero by 2050
- Coal phase out and 83% RES in power system by 2030
- <15% natural gas power generation by 2030 levels by 2050

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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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