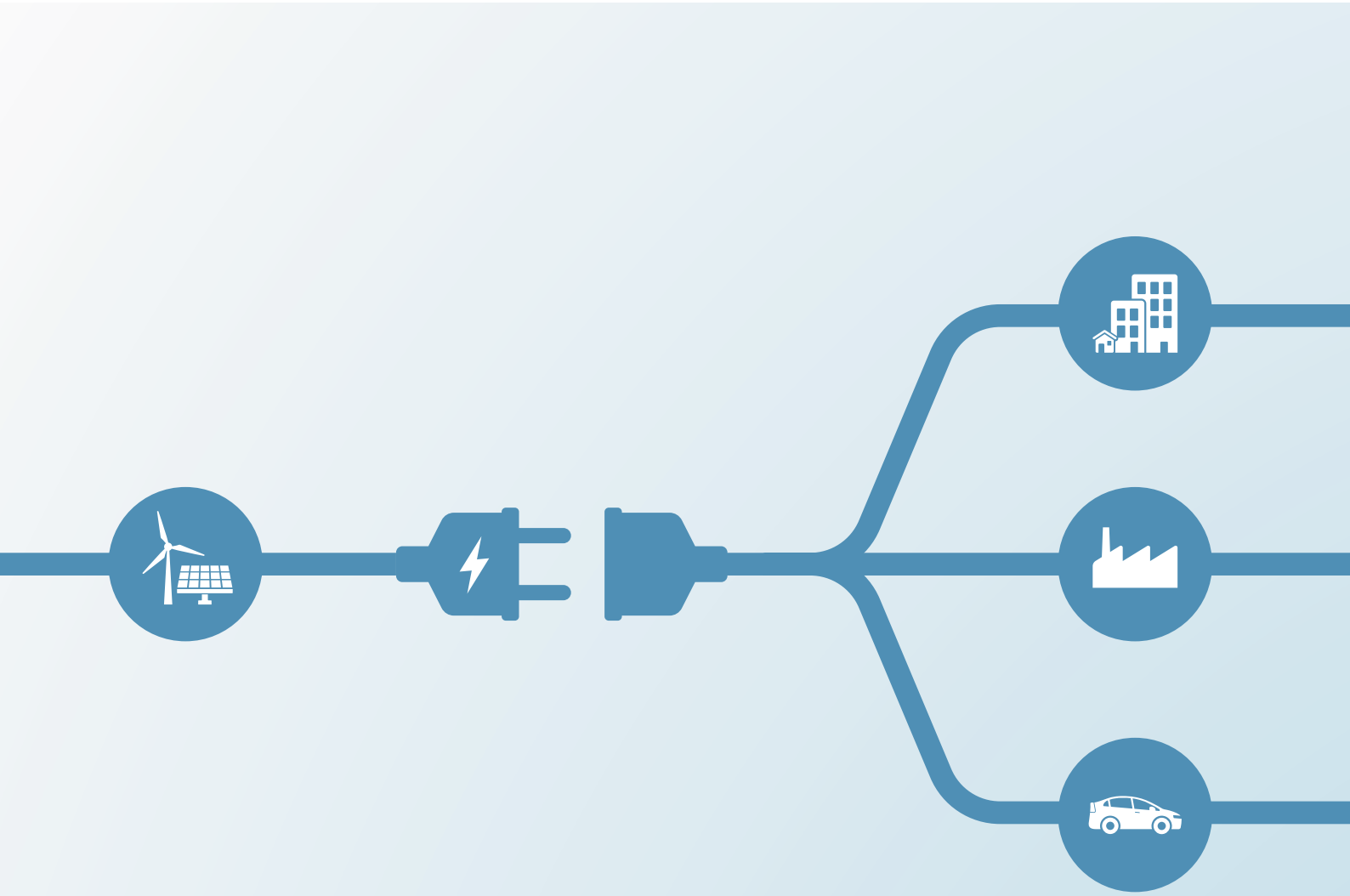
Climate Action Tracker



Climate Action Tracker

Unpacking electrification for a 1.5°C-aligned world

November 2026

CLIMATE ANALYTICS

NEW CLIMATE INSTITUTE

Summary

This report unpacks electrification to build a common understanding of what it means, how it is measured and the role it will play across the key end-use sectors: transport, buildings and industry in a 1.5°C-aligned future. Decades of insufficient mitigation action means that pursuing the Paris temperature goal requires rapid emissions reductions to minimise the magnitude and duration of overshoot, to achieve net zero greenhouse gas emissions by the second half of the century and to return warming significantly below 1.5°C by 2100. Replacing fossil fuel combustion in transport, buildings and industry with electricity from renewable sources is one of the main ways to deliver those reductions.

The goal of achieving 35% electrification by 2035 emerged this year from a campaign initiative and was adopted by the twin COP31 presidency alongside the existing goals of doubling energy efficiency and tripling renewables. Together, these three pillars support a transition aligned with 1.5°C where electrification replaces fossil fuel use, renewables provide clean electricity, and efficiency reduces the amount of electricity needed. However, a single headline share of electricity in final energy figure does not capture all dimensions of the electrification process. Translating global ambition into concrete sectoral and national targets is therefore critical to support policy development and implementation.

This report demonstrates how meaningful electrification benchmarks can be developed to guide these policy decisions. The report covers key considerations to understand, interpret and assess electrification by clarifying key concepts, technical terms and the choices that affect its measurement, and analyses what electrification means across sectors and countries. It uses these considerations to inform the design of a framework for deriving meaningful sector- and country-level electrification benchmarks, which provide the additional information needed to make headline electrification targets relevant for policy and implementation.

Understanding electrification and the energy transition in a 1.5°C-aligned world:

- **Renewable generation must expand alongside growing electricity demand while fossil generation and direct fossil-fuel use must decline.** Reaching an electrification target alone does not establish Paris alignment, because the electrification metric only tracks the 'type of energy used' – it doesn't show how clean that electricity is or how much fossil fuels it actually replaces. Electrification and renewables build-out must therefore be planned together.
- **Direct electrification and renewables can deliver the same services with less primary energy than a fossil fuel energy system.** Direct electrification changes both the energy carrier and the efficiency of converting energy into services; for example, a battery-electric car converts around 90% of its energy input into motion, compared with 25% in a gasoline car. Renewables replacing fossil fuel-thermal generation avoids large conversion losses, accounting to one-half to two-thirds of the primary energy input. As a consequence, direct electrification with renewables changes both the energy carrier and the efficiency of converting energy into services, meaning fossil energy does not require one-for-one replacement.
- **Energy efficiency is an essential part of the combination of actions needed to decarbonise the energy system.** In addition to the efficiency inherent in the adoption of electrification and renewables, measures such as building insulation, a shift from private to public transport, and material efficiency reduce the energy that needs to be supplied, including the electricity required to run an electrified economy. Combining these measures with electrification and renewable power enables the decarbonisation of the energy system with less additional generation and infrastructure.
- **Delivering this transition requires complementary action on grids, storage and flexibility and a just transition.** Without these, infrastructure constraints, upfront costs and unequal access can delay deployment and limit its benefits.

Understanding the "35 by 35" target in a 1.5°C-aligned world:

- **"35 by 35" is an important milestone, not the destination.** Paris-aligned pathways show direct electrification reaching 34-41% in 2035. Electrification continues to rise substantially beyond 2035 reaching 54-68% by 2050. Near-term targets and investment decisions therefore need to support the longer transition away from fossil fuels.
- **Reaching the "35 by 35" goal would require current electrification rates to accelerate almost four times compared to historical progress.** With a global electrification share of almost 24% in 2023, an average increase of approximately 1 percentage point per year is required to achieve the "35 by 35" goal. Based on current policies, the world is set to achieve an electrification share of 28% in 2035, leaving a gap of around 7 percentage points to the milestone.
- **An electricity share of 35% does not mean that 35% of services are electrified.** Due to the efficiency gains from electrification, in cases such as electric vehicles and heat pumps, an electricity share of 35% means that roughly two thirds of technologies or energy services are electrified.

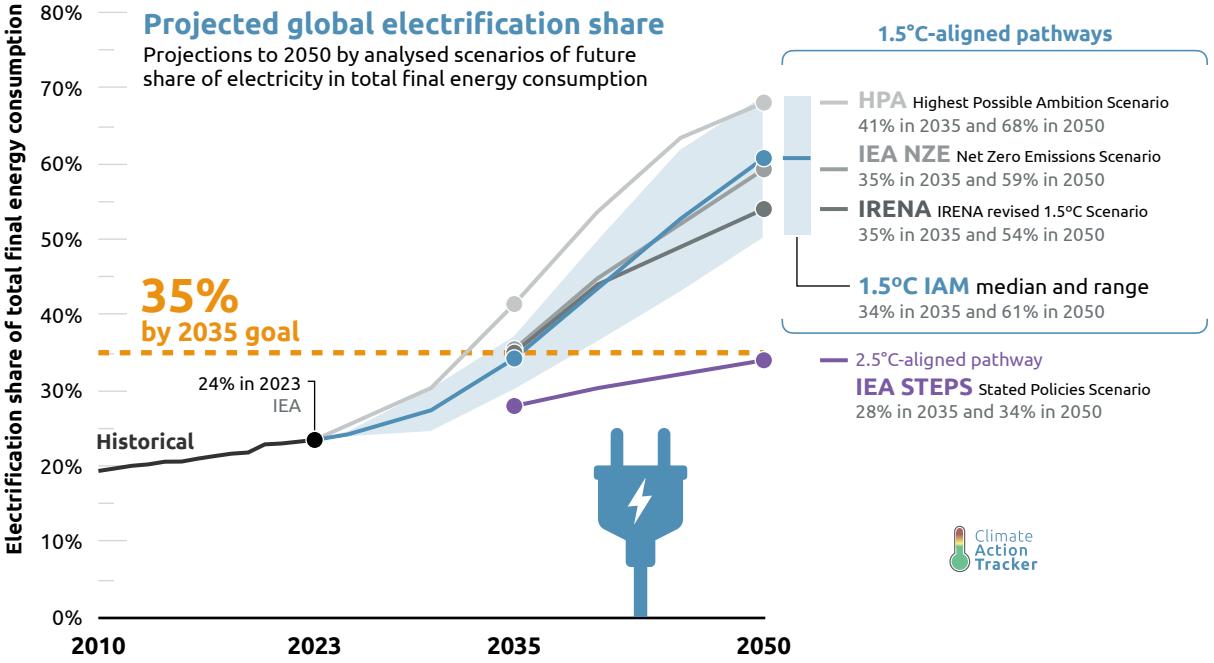


Figure ES 1 Historical and projected global direct electrification share under selected 1.5°C-aligned and current-policy pathways, 2010–2050. The dashed horizontal line marks the "35 by 35" goal, while the shaded area represents the P10–P90 range of the ScenarioMIP-CMIP7 Very Low pathways. TFEC excludes non-energy use and includes international bunkers.

Understanding what affects the electrification metric:

- **Clear definitions and boundaries are essential to interpreting electrification figures.** Some differences arise from accounting boundaries, including international aviation and shipping, industrial feedstocks and the treatment of electricity-derived fuels. Others reflect assumptions and choices about demand, technologies and reliance on complementary mitigation options. Looking into these differences helps explain why electrification develops at different scales and speeds, and what those electricity shares imply for the wider transition.
- **Growing electricity use does not necessarily mean fossil fuels are being displaced.** Meeting new demand with electricity or improving electricity access both increase electrification, but the electricity share alone does not show whether these changes contribute to the ultimate

goal of decarbonising the energy system. Expanding access is essential but does not necessarily displace fossil-fuel use. For instance, new demand such as data centres can actually increase electrification rates without displacing fossil fuels. True decarbonisation only occurs when fossil-fuel technologies are actively replaced by electric alternatives, driving a direct reduction in end-use emissions.

Understanding what electrification means across sectors and countries:

- **A common global target does not mean this should be applied equally to each sector,** and sectoral shares need to be connected to the technologies and activities driving these changes. Table ES 1 below depicts current electrification level and future scenarios, drivers and challenges of each sector.
- **Common global targets should not be applied equally to each country.** Structural conditions, such as technology stocks, the size and configuration of the power sector, industrial composition, climate and infrastructure, shape starting points and opportunities for electrification. Demand growth and unmet energy needs influence the scale of electricity required, while access, affordability and capacity considerations shape implementation and support needs. These differences must inform nationally relevant benchmarks. As a consequence, the "35 by 35" goal should not be applied as a one-size-fits-all national target.

Table ES 1 Current and future electrification share, drivers and challenges for electrification and future electrification scenarios for transport, buildings and industry sectors.

Transport	Buildings	Industry
Current electrification level		
Almost 2% Lowest of the three sectors	**Around 35%** Highest of the three sectors	**Almost 30%** Heat accounts for three quarters of the sector's energy consumption
Paris-aligned scenarios		
11–17% in 2035; **45–57%** in 2050	**50–57%** in 2035; **74–83%** in 2050	**34–46%** in 2035; **42–62%** in 2050
Key drivers		
Electrification of road vehicles	Electrification of heating and cooking, maturity and availability of technologies	Electrification of low- and medium-temperature industrial heat
Challenges		
Deployment of charging infrastructure, constraints for aviation and shipping	Policy and investment, growing cooling and data-centre demand	Electrification of high-temperature processes, technology readiness, policy and investment
Future electrification: what scenarios say		
Likely the largest increase in electrification among the sectors due to road electrification	Electrification of heating and cooking drives the share up	Need for novel technologies and new production routes, need for complimentary indirect electrification

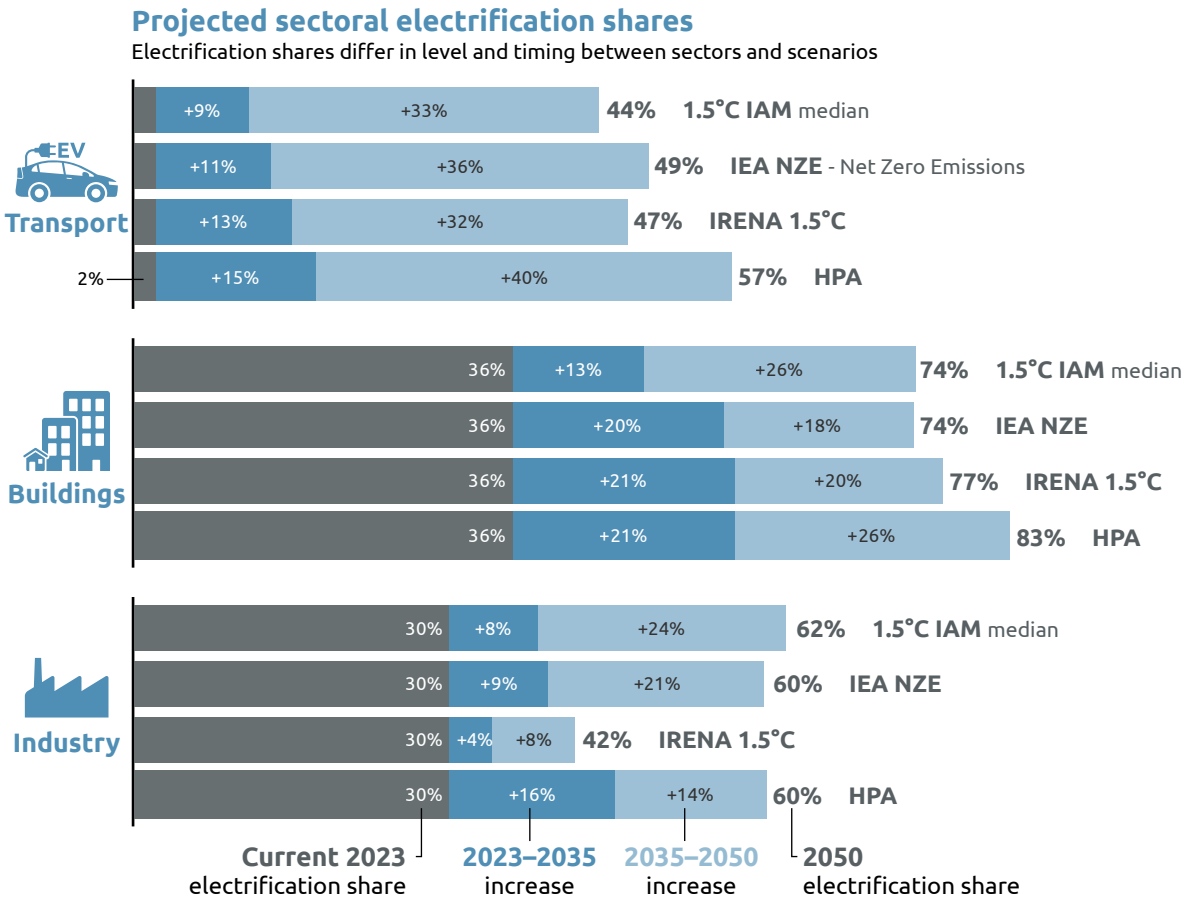


Figure ES 2 Current and future sectoral electrification shares across transport, buildings, and industry in 2035 and 2050 under selected 1.5°C-aligned pathways. HPA stands for the Highest Possible Ambition scenario, IEA NZE stands for the Net Zero Emission scenario, IRENA 1.5°C stands for the revised 1.5°C scenario and the 1.5°C IAM median is the median of an ensemble containing the very low scenario set from ScenarioMIP-CMIP7.

Turning this understanding into guidance for action:

- **An economy-wide target needs to be complemented by sectoral, technology-deployment and enabling indicators.** A headline electricity target alone offers limited guidance on which technologies need to be deployed, at what pace, and which supporting conditions must be developed. Complementing the electrification share with benchmarks that make these requirements explicit can inform sectoral targets, deployment policies and infrastructure planning.
- **A layered benchmark framework brings these requirements together.** Economy-wide and sectoral benchmarks establish the pace and scale of change required to be Paris-aligned, technology-deployment indicators translate broad goals into specific deployment needs that can directly inform policymaking and enabling indicators track the supporting conditions. Together, they can guide target-setting and inform deployment policies and coordinated planning for clean electricity and infrastructure.

Table of Contents

Summary i

1 Understanding electrification in a 1.5°C-aligned world 1

1.1 The role of electrification in the energy transition 1

1.2 "35 by 35" goal is a milestone, not the destination 2

1.3 Measuring electrification 3

1.4 Understanding changes in electrification rates 4

2 Global pathways 7

2.1 Historical trajectory and implementation gap 7

2.2 Paris-aligned pathways and electrification 8

2.3 Electrification rates in Paris-aligned pathways 9

2.4 Energy demand 10

2.5 Fossil fuel phase-out: coal, oil and fossil gas trajectories 12

3 Sectoral analysis 14

3.1 General overview 15

3.2 Transport 16

3.3 Buildings 18

3.4 Industry 21

4 From pathways to implementation and benchmarks 25

4.1 Role of benchmarks 25

4.2 A framework for scaling up electrification 25

4.3 Country context implications for the proposed framework 26

4.4 Way forward 27

Bibliography 28

1 Understanding electrification in a 1.5°C-aligned world

The idea of the "35 by 35" goal for achieving 35% electrification by 2035 emerged this year from a campaign initiative seeking to bring electrification to the forefront of the energy transition alongside the existing goals of doubling energy efficiency and tripling renewables. The twin COP31 Presidencies (Türkiye and Australia) adopted this goal, creating a global reference point for accelerating electrification (UNFCCC, 2026). Pursuing the Paris temperature goal now requires rapid emissions reductions to minimise the magnitude and duration of overshoot, reaching net-zero greenhouse gas (GHG) emissions by the second half of the century, and return warming significantly below 1.5°C by 2100 (UNEP, 2026a, 2026c). Replacing fossil fuel combustion in transport, buildings and industry with electricity from renewable sources is one of the main ways to deliver those reductions.

Electrification targets and benchmarks can help inform target-setting, raise ambition in policymaking by highlighting the scale and pace of change needed and help assess progress towards achieving these goals. However, their meaning depends on how electrification is defined and measured, what is included within its boundaries and whether rising electricity use is accompanied by a switch to clean power and declining fossil fuel use.

This report guides readers through key considerations needed to understand, interpret and assess electrification by clarifying key concepts, technical terms and the choices that affect its measurement. At the same time, the report uses these considerations to inform the design of a framework for deriving meaningful electrification benchmarks.

Section 1 examines the role of electrification in the energy transition and its alignment with 1.5°C, the importance of looking beyond 2035 and what the electrification headline target captures and misses. Sections 2 and 3 examine economy-wide and sectoral mitigation pathways, comparing different available scenarios and identifying the core assumptions that explain variations between studies and directly impact how electrification is measured. Building on the analysis done, Section 4 presents a framework for electrification benchmarks, identifying which indicators should sit alongside the headline share and how they should be differentiated across sectors, technologies and countries.

This is essential for translating the "35 by 35" goal and longer-term electrification benchmarks from a global headline into actionable guidance for climate ambition, sectoral transformation, technology deployment and national planning.

1.1 The role of electrification in the energy transition

Renewable power is scaling rapidly (Ember, 2025). To maximise the climate benefits of electrification, renewable supply must expand fast enough to meet new electricity demand while fossil generation and direct fossil-fuel use fall. Electrification and clean power progress must work together and therefore be planned and assessed jointly (Climate Analytics and PIK, 2025; IEA, 2025f).

This report focuses on direct electrification: electricity delivered to final users to provide mobility, heat or productive services. Indirect electrification refers to the conversion of electricity into green hydrogen or hydrogen-derived synthetic fuels. Direct electrification should generally be prioritised where it is technically feasible because it avoids conversion losses and often provides the same service with much less final energy. Indirect electrification remains important for applications that are difficult to electrify directly, including some industrial processes and long-distance aviation and maritime transport (Climate Analytics and PIK, 2025), but it is tracked separately in this report (Section 3).

The combination of direct electrification and renewable power displaces fossil fuels in energy use and improves efficiency at two distinct points in the energy system. First, replacing fossil-fuelled thermal generation with non-combustion renewables avoids large conversion losses, which typically amount to one-half to two-thirds of the primary energy input (IEA, 2026b). Second, at the point of use,

electric technologies convert final energy into useful services much more efficiently than combustion technologies. A battery-electric car, for example, converts around 90% of its energy input into motion, compared with around 25% for a gasoline car (IEA, 2026b).

Together, these gains allow the same mobility, heat and productive services to be delivered with less total energy. Compared with less efficient pathways, this reduces the scale of renewable generation and supporting infrastructure required. This in turn lowers the clean energy supply that must be deployed across the system while also providing additional benefits such as reducing fossil fuel-import exposure and air pollution.

1.2 "35 by 35" goal is a milestone, not the destination

35% by 2035

A global economy-wide milestone: electricity supplies 35% of total final energy consumption by 2035. It is a collective global direction, not a uniform national or sectoral target or a Paris-aligned end point.

First put forward by the incoming COP31 Co-Presidency (Türkiye and Australia) in June 2026, the "35 by 35" global electrification pledge aims to raise electricity's share of total global final energy consumption from just almost 24% in 2023 to 35% in 2035(UNFCCC, 2026). While the Presidency linked this target to International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA) analyses of the level needed to keep 1.5°C within reach (IEA, 2026b; IRENA, 2026a), its formal role is evolving. Initially launched as a collective global waypoint under the voluntary Action Agenda track (UNFCCC, 2026), the twin Presidencies are now actively attempting to push the target into the formal COP31 Cover Decision.

As mentioned in Section 1, any pathway claiming Paris-alignment needs to limit peak warming as close as possible to 1.5°C, reach net-zero GHG emissions in the second half of the century, and return warming significantly below 1.5°C by the end of the century. Global Paris-aligned pathways consistently show that electrification must accelerate markedly by 2035, although their results differ according to underlying assumptions and system boundary choices (Section 2 and 3). Against this background, "35 by 35" provides a simple and ambitious global milestone: soon enough to guide current infrastructure and investment decisions, and demanding enough to signal a clear break from historical progress (IEA, 2026b; IRENA, 2026a).

However, 2035 does not mark the end of the transition: Paris-aligned pathways show electrification continuing to rise substantially after 2035 to around 54-68% of final energy by 2050 (Section 2).

Finally, "35 by 35" is a global number. National pathways will differ according to starting points, sectoral structures, climates, development needs, access gaps, resources and infrastructure. Section 4 considers how national benchmarks can reflect these differences while contributing to a common global direction. Clean electrification requires system-wide change.

To ensure Paris alignment, global electrification must be powered by clean energy. Measuring electrification purely as a share of final energy consumption tracks the energy carrier itself, rather than its carbon intensity or the volume of fossil fuels displaced. Consequently, a headline electricity share benchmark fails to indicate whether the underlying power mix is clean. For example, reaching 35% with a coal- or fossil gas-heavy grid would fundamentally conflict with Paris Agreement targets. Nor does the observed share, by itself, indicate whether grids are prepared for further demand growth or whether the cost of electric technologies will enable continued and widespread adoption. High electrification can coexist with coal dependence, while a rapidly decarbonising power system can leave oil and fossil gas largely untouched in end uses. Ultimately, Paris alignment requires both transitions to reinforce one another (NewClimate Institute and Climate Analytics, 2024; Climate Analytics and PIK, 2025).

The following are important aspects to consider alongside the headline share when developing national benchmarks:

- **Clean supply and fossil-fuel phase-out.** Renewables must expand fast enough to meet growing electricity demand while displacing existing fossil generation. Efficient electric technologies can reduce energy use and emissions even before the power system is fully decarbonised. However, if clean generation, grids and flexibility do not keep pace with electrification, rising electricity demand may extend the operation of existing coal plants or be used to justify new coal- and fossil gas-fired capacity. This would erode the emissions benefit achievable with renewable electricity, prolong fossil fuel dependence and create new risks of fossil fuel lock-in. Electrification must therefore be planned and delivered alongside clean power expansion and the phase-out of fossil generation.
- **Grids, storage and flexibility.** Transmission and distribution networks, interconnection, short- and long-duration storage (incl. hydrogen for seasonal storage), demand response and flexible operation must expand ahead of, or at least alongside, electricity demand. These need to be regarded as enabling investments for electrification and not as mere secondary additions after electric technologies have been deployed.
- **Efficiency and demand-side action.** Efficient electric technologies reduce energy requirements, but other complementary actions like insulation, compact urban form, public transport and material efficiency remain indispensable. Electrification works best as part of a comprehensive portfolio that delivers more and better services with less energy. This will be especially important in light of increased demand from additional energy uses, including air conditioning use due to rising heat and the expansion of AI and data centres.
- **Affordability, access and a just transition.** Lower lifetime costs do not remove upfront investment barriers. Finance, consumer protection, social policy, workforce planning and safeguards for critical mineral supply chains shape who benefits and who bears the costs. These conditions determine the feasibility, speed and legitimacy of the transition and therefore need to be considered alongside technical feasibility.

1.3 Measuring electrification

1.3.1 The headline metric

Economy-wide electrification share = **Final electricity consumption** ÷ **Total final energy consumption**

Electricity's share of total final energy consumption (TFEC) is the headline economy-wide metric underpinning the "35 by 35" objective. This metric is practical because final-energy data are comparatively widely available, the calculation is transparent and it can be applied across countries and sectors.

The value and meaning of an electrification share depend on what is included in its numerator and denominator. Three key elements here are whether the metric focuses on direct electrification only, the treatment of non-energy use and the inclusion (or exclusion) of international aviation and shipping.

BOX 1. Which denominator?

Sources used in this report present data in several closely related terms for the denominator. Total final consumption (TFC), used in IEA energy balances, covers all energy delivered to end users, including non-energy use of fuels such as petrochemical feedstocks. Total final energy consumption (TFEC), the main metric used in this report, excludes non-energy use and includes international bunkers at world level. Gross final energy consumption (GFEC), used by IRENA and in EU statistics, adds network losses and the energy sector's own use of electricity and heat.

1.3.2 Non-energy use

For this report, total final energy consumption (TFEC) covers energy consumed for energy purposes; it excludes non-energy uses such as petrochemical feedstocks and includes international bunkers at world level. When a source uses total final consumption (TFC) or gross final energy consumption (GFEC), we check the source definition rather than assuming terms are treated interchangeably with TFEC (Box 1).

1.3.3 Direct vs indirect electrification

The headline indicator (electricity's share of total final energy consumption) counts direct electricity delivered to final users. It excludes indirect electrification, that is, electricity-derived fuels such as hydrogen or synthetic e-fuels[1]. Indirect electrification should therefore be reported as a separate and complementary indicator and read alongside it, with direct use prioritised where feasible.

1.3.4 International aviation and shipping

Including international aviation and shipping captures two major and difficult transition challenges but lowers the apparent transport electrification share compared with assessments that exclude them. Any assessment, including national benchmarks, must state the allocation rule because alternative conventions can materially change results.

The "35 by 35" goal put forward by the twin COP Presidencies does not give any clear methodological decision on these important aspects, which can have major impacts on what the target means.

1.4 Understanding changes in electrification rates

1.4.1 Efficiency gains

The efficiency advantage of electric technologies complicates interpretation. When combustion is replaced by a more efficient electric technology, electricity in the numerator rises while TFEC in the denominator can fall more sharply. The ratio can therefore move only modestly relative to the share of technologies or services electrified, making substantial deployment appear slow at first, as shown in Figure 1. To understand how quickly energy services are actually being electrified, the indicator should ideally be read alongside absolute electricity demand, activity or service demand and technology adoption metrics (Liebreich, 2026).

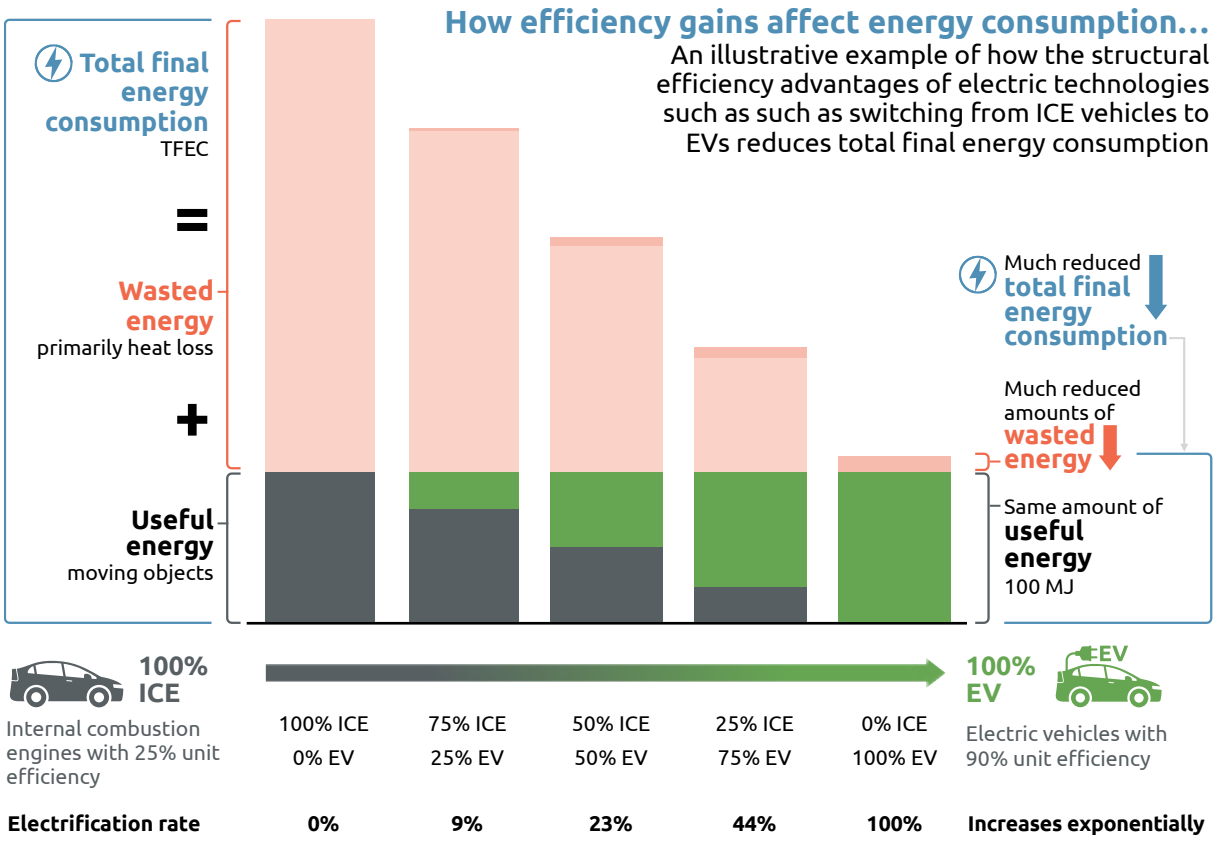
The TFEC share therefore needs to be complemented by additional measures. Electricity as a share of useful energy, for instance, more directly captures the mobility, heat and productive services delivered electrically. Technology uptake indicators, such as electric vehicles' share of the vehicle stock or heat pumps' share of the installed heating stock, show how quickly specific solutions are entering markets. Yet useful energy accounts depend on conversion assumptions and are not reported consistently or recently enough for a global benchmark. Technology metrics are highly actionable within individual sectors but cannot be aggregated cleanly into a meaningful economy-wide electrification metric.

The same accounting logic explains why electrification can make primary- and final-energy totals fall while mobility, heating and production are maintained or grow: electric technologies avoid many of the losses inherent in combustion. Lower energy totals therefore do not necessarily imply lower levels of energy service. While TFEC remains a practical headline metric, it must be interpreted alongside efficiency, absolute demand, technology deployment and fossil fuel displacement.

1.4.2 New demand and sufficiency

Electricity demand can grow through fossil-fuel substitution, but also through population growth and economic development and associated structural changes including the expansion of grids to cover previously unserved communities, industrialisation, growing cooling needs due to urbanisation and also as a means of adaptation from extreme heat, expansion of digitalisation and data centres. Added electric demand is not itself evidence of fossil displacement. Changes in the electrification share therefore need to be assessed alongside absolute electricity demand, non-electric energy demand and the underlying drivers of new consumption.

1 We note that district heating raises two accounting questions: first, whether the heat is included as a separate final energy in the TFEC and second, whether the electricity or fuel used upstream to produce that heat is attributed to the end-use sector or to the transformation sector.



… and changes the electrification share over time

These efficiency gains change the equation to calculate electrification and fossil fuel shares

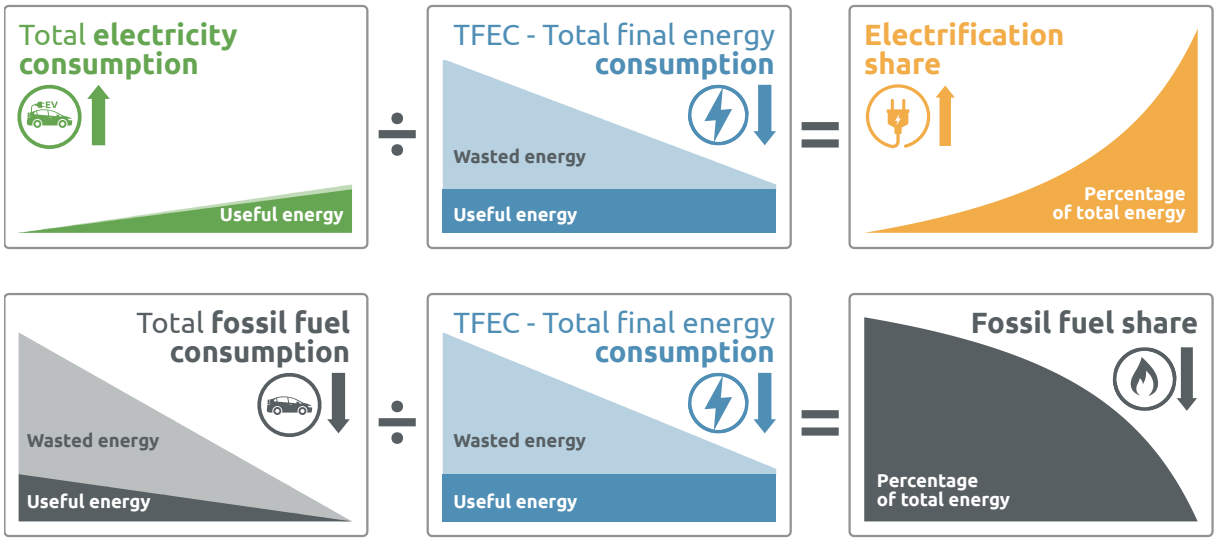


Figure 1 Illustrative effect of electric-vehicle efficiency on the electricity share of final energy consumption. EVs are assumed to require approximately one-third as much final energy as internal-combustion vehicles; consequently, the electricity share of TFEC rises more slowly than the EV share of the vehicle stock.

1.4.3 Electrification and electricity access

In many countries, rising electricity demand reflects first-time access, improved reliability or increasing access to energy services. Such increases in electricity demand do not necessarily ensure replacement of existing use of fossil fuels and established fossil fuel technologies and appliances. Universal, reliable and affordable access to energy is essential. However, measuring access alone is not enough. We also need indicators of the energy services people receive and the wider socio-economic benefits of clean electrification.

BOX 2. Electricity access

IEA's Stated Policies scenario (STEPS), a fossil-fuel intensive scenario projecting a warming outcome of around 2.5°C by 2100, globally reaches only 28% of electrification by 2035, with around 710 million people projected to remain without electricity access in 2030 and around 650 million in 2050 (IEA, 2025f). By contrast IEA's NZE scenario, which limits warming close to 1.5°C and achieves 35% electrification by 2035 shows how to overcome electricity access issue with about ~1% of energy investment. The IEA ACCESS Scenario reinforces that universal electricity access could be achieved within a decade, provided that around 80 million people gain access annually through to 2035 via the rapid, parallel deployment of national grids, mini-grids, and stand-alone systems (IEA, 2026a). Consequently, electrification benchmarks should distinguish between two distinct drivers: power sector growth that displaces existing fossil fuel use, and expansion that satisfies new or previously unmet energy service demand.

Expanding access also needs to be consistent with the wider purpose of electrification. New electricity demand should be met predominantly through renewable generation, storage and demand-side flexibility rather than becoming a justification for new fossil fuel infrastructure. Distributed and community-based renewable energy, including mini-grids and stand-alone systems, can be particularly important for reaching unserved communities, while affordability and reliability determine whether access translates into meaningful energy services. National benchmark assessments should therefore read electricity access alongside the carbon intensity of new supply, fossil-fuel displacement, reliability and affordability.

These considerations inform the enabling layer of the framework for developing electrification benchmarks that we introduce in Section 4. Across much of the Global South, the principal constraints to faster electrification may include underdeveloped grids, high financing costs, limited fiscal space and insufficient institutional and technical capacity. Benchmarks should make these delivery constraints visible rather than interpreting slower deployment solely as lower ambition. International public and concessional finance, technology transfer and capacity building are therefore part of the means of implementation required to translate a common global direction into equitable national pathways.

2 Global pathways

This section applies the measurement principles set out in Section 1 to global electrification pathways. It compares historical progress with the "35 by 35" goal, then examines where different 1.5°C aligned scenarios agree and differ and how they compare with current policy trajectories. Electricity shares are assessed alongside differences in total final energy demand and primary energy demand, clarifying how these studies model these dimensions and how electrification contributes to the wider transition.

2.1 Historical trajectory and implementation gap

Global economy-wide electrification has advanced steadily over the past two decades, growing from approximately 17% in 2000 to about 24% in 2023 of TFEC (IEA, 2025f). To reach the "35 by 35" goal, the pace of electrification needs to increase.

Reaching 35% in 2035 requires an average increase almost four times bigger than the historical average pace since 2000. If the historical growth rate were maintained until 2035, global electrification would reach 26%. Based on current policies, the world is set to achieve an electrification share of 28% in 2035, leaving a gap of around 7 percentage points to the milestone, as shown in Figure 2. Closing that gap requires faster deployment of electric technologies and the clean electricity and infrastructure needed to support them.

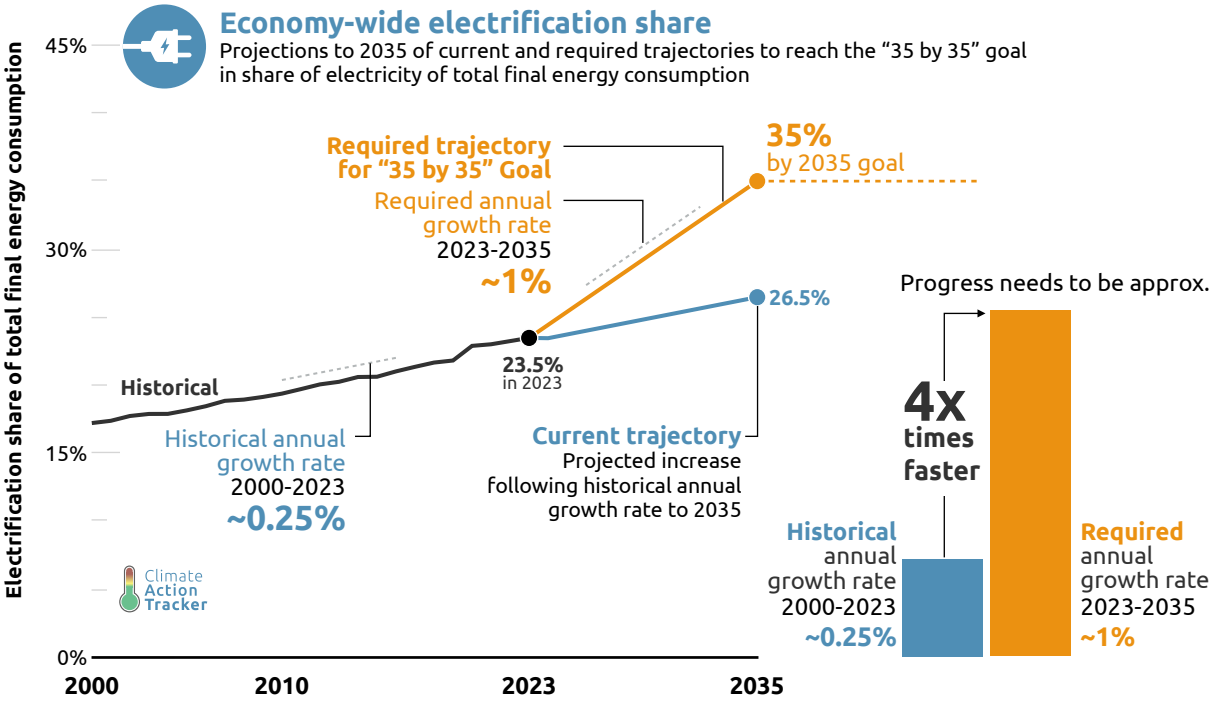


Figure 2 Historical and projected electrification rates for 2035. Current trajectory is based on historical annual growth rates since 2000. Required trajectory is based on interpolated values between current electrification shares and the "35 by 35" goal. Historical global economy-wide direct electrification share, 2000–2023, based on TFEC which excludes non-energy use and includes international bunkers

2.2 Paris-aligned pathways and electrification

To assess how the "35 by 35" electrification target compares with Paris-aligned pathways we draw evidence from four key studies that explore how to limit the magnitude and duration of overshoot and get temperatures back below 1.5°C well before 2100.

Comparing these different modelling frameworks allows us to identify areas of convergence and divergence across the literature and assess whether differences in electrification rates can be explained by underlying assumptions, definitions or other factors in each study.

Four sources of information are used:

- **IRENA revised 1.5°C pathway** (IRENA, 2026a, 2026b) models the required transformation to align the energy system to a 1.5°C pathway. The study follows a limited and temporary overshoot owing to delayed action, and it is equivalent to an IPCC AR6 C2 pathway. IRENA's report does not provide explicit detail on the peak and end-of-century temperatures in this roadmap, but the AR6 C2 pathways on average peak warming at 1.7°C and bring this down to 1.4°C in 2100. At the heart of the roadmap are renewables, electrification and grid enhancement.
- **IEA Net Zero Emissions (NZE) scenario** (IEA, 2023, 2025f), taken from the World Energy Outlook 2025. The NZE Scenario maps out a global pathway for the energy sector to reach net zero CO_2 emissions by 2050, translating the Paris Agreement's 1.5°C limit into an energy-sector pathway built on four pillars: clean energy electrification, energy efficiency, low-emissions fuels and methane abatement. Warming exceeds 1.5°C around 2030, peaks at about 1.65°C around 2050, and falls back below 1.5°C by 2100.
- **The Highest Possible Ambition (HPA) scenario** produced by Climate Analytics and the Potsdam Institute for Climate Impact Research (Climate Analytics and PIK, 2025), is a scenario that halts warming within 15–20 years, peaks at approximately 1.7°C, and returns to approximately 1.2°C by 2100, with net-zero CO_2 before 2050. The HPA scenario is built around four levers: rapid renewable electrification (more than two-thirds of the energy system directly powered by renewable electricity by 2050), a rapid fossil fuel phase-out (coal phased out by the 2040s, fossil gas by the 2050s, oil by the 2060s), cutting methane emissions (which fall by around 20% by 2030), and carbon dioxide removal scaling to 8 $GtCO_2$/yr by 2050.
- **1.5°C IAM pathways (Very Low scenario set, ScenarioMIP-CMIP7)** representing the latest multi-model set of near-Paris-aligned pathways (Box 3), drawn from ScenarioMIP-CMIP7, the newest generation of IPCC-cycle scenario intercomparison. The median across this set peaks at approximately 1.68°C and reaches net-zero GHG emissions by around 2071, with a median 2100 temperature of approximately 1.34°C. ScenarioMIP-CMIP7's Very Low scenario is designed to keep peak warming "as low as can still be plausibly achieved" and return warming below 1.5°C by the end of the century, through rapid CO_2 and methane reductions followed by sustained net-negative CO_2 emissions (Van Vuuren *et al.*, 2026).

BOX 3. Paris-compatible vs. Paris-aligned scenarios

In previous analysis, the CAT has used a set of pathways which are fully compatible with the temperature goal of the Paris Agreement. This means that they limited warming to 1.5°C with low overshoot (<0.1°C), achieved net zero GHGs in the 2nd half of the century and brought 2100 temperatures down to ~1.2°C in 2100 (Riahi *et al.*, 2022).

However, these pathways have become increasingly outdated, as they assumed rapid emissions cuts began in 2020 – whereas in reality emissions have continued to grow through the 2020s. As a result, a larger degree of overshoot of 1.5°C is now inevitable (Climate Analytics and PIK, 2025; UNEP, 2026a).

However, this does not mean that the Paris Agreement is dead. The legal, scientific and moral

imperatives remain to limit overshoot and get warming back below 1.5°C remain, even as we overshoot (Rogelj and Rajamani, 2025).

To show how we can do this, the CAT will now use pathways which still align with the goals of the Paris Agreement (even if they do not fully achieve the goals), and still use the Paris Agreement's architecture (limiting peak warming, achieving net zero GHGs, and thereby getting temperatures on a declining path back to below 1.5°C).

While they are not fully compatible with the Paris Agreement, these pathways are still "aligned" with it. Paris-aligned pathways peak warming ≤1.7°C, reach net zero GHG emissions in the second half of the century and bring 2100 temperatures down to ~1.3°C or lower. All the pathways assessed in this report are either fully consistent with this definition or could be with only minor changes (for example, the IEA and IRENA roadmaps focus on 2050 and do not provide explicit details on the 2050-2100 period in these scenarios. Different scenario assumptions in the latter half of the century could lead to further reductions in end of century temperatures, without changing the near-term electrification rates which we use from these scenarios for this analysis).

Specific scenarios used in CAT analysis may evolve over time as new pathways are developed, released and assessed. While the set of scenarios may be updated in the future, all selected pathways will continue to be evaluated against the criteria described above.

As shown in Figure 3 below, these scenarios are also compared against a current policy trajectory, represented by the IEA Stated Policies Scenario (STEPS) from the World Energy Outlook 2025 (IEA, 2025f). This reflects the effect of policies already adopted or announced without assuming additional action, taking into account specific energy, climate and related industrial policies adopted or intended but not yet codified into law (IEA, 2025c).

2.3 Electrification rates in Paris-aligned pathways

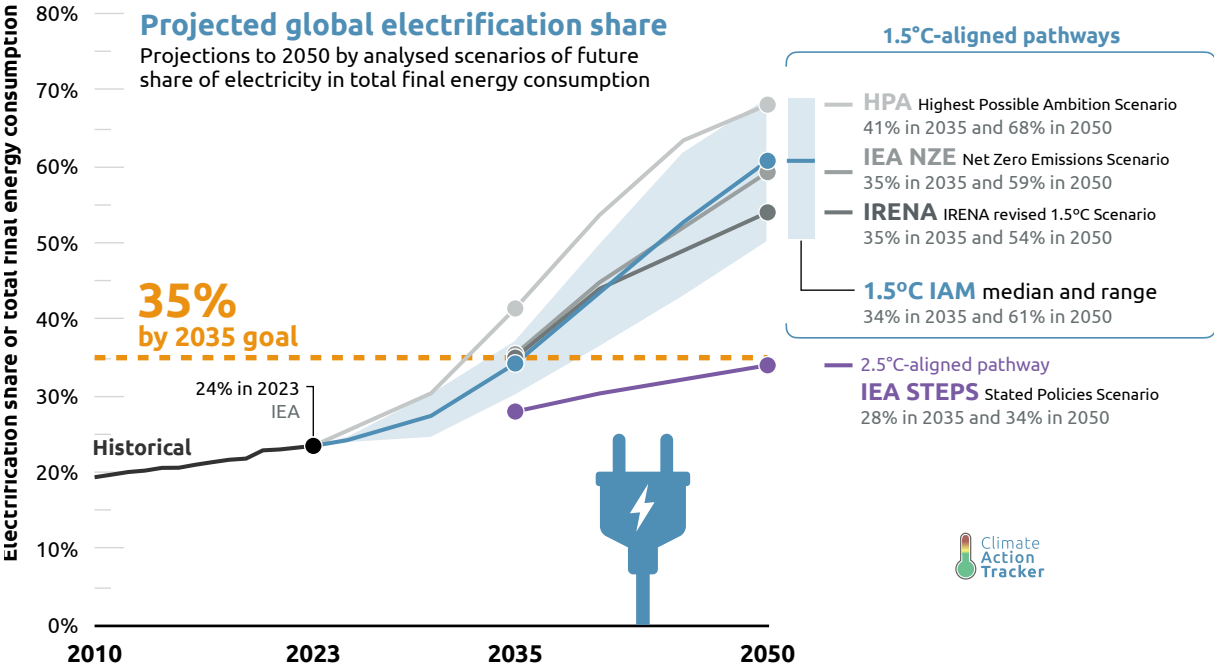


Figure 3 Historical and projected global direct electrification share under selected 1.5°C-aligned and current-policy pathways, 2010–2050. The horizontal line marks the 35 by 35 benchmark, while the shaded area represents the P10–P90 range of the ScenarioMIP-CMIP7 Very Low pathways. TFEC excludes non-energy use and includes international bunkers.

Across the scenarios reviewed, electrification reaches 34–41% by 2035 and 54–68% by 2050. IRENA and IEA both reach around 35%, while HPA goes further and reaches more than 40% electrification rate by 2035. Under the 1.5°C IAM ensemble, the latest multi-model set of low-overshoot scenarios from the IPCC, the median electrification rate reaches 34% in 2035. This shows that the "35 by 35" goal is the right target but should not be seen as an ambition ceiling. There are pathways which go beyond 35%, which can help accelerate a fossil phase-out while reducing reliance on other options like biofuels.

At the same time, "35 by 35" is not the goal, but a milestone on the way to the end goal: a highly electrified economy. Electrification rates grow to above 50% by 2050 in these Paris-aligned scenarios and reach 70% in the most ambitious scenario, the HPA. Although data after 2050 is not available for all the explored scenarios, HPA and the 1.5°C IAM median, both reach a maximum level of approximately 75% electrification rate in 2100, although the HPA reaches that target before.

The STEPS scenario estimates that under stated policies, we may only reach 34% electrification by mid-century, indicating that stronger policy action is needed to close the ambition gap. Under the STEPS scenario, temperatures are projected to reach 2.5°C by 2100 (IEA, 2025f).

Differences between the assessed scenarios can be explained by several factors that can be grouped into system-wide differences and sectoral-level discrepancies. Some of these system-wide differences are highlighted in this section whereas key sector-specific differences are examined in Section 3 of this report.

2.4 Energy demand

Historically growth in TFEC has been closely linked to rising fossil fuel use. As shown in Figure 4, increases in electricity consumption between 1990 and 2023 occurred alongside, rather than instead of, continued growth in fossil fuel consumption. Throughout this process electricity has played a complementary role to fossil fuels, covering parts of the overall demand increase together with fossil fuels.

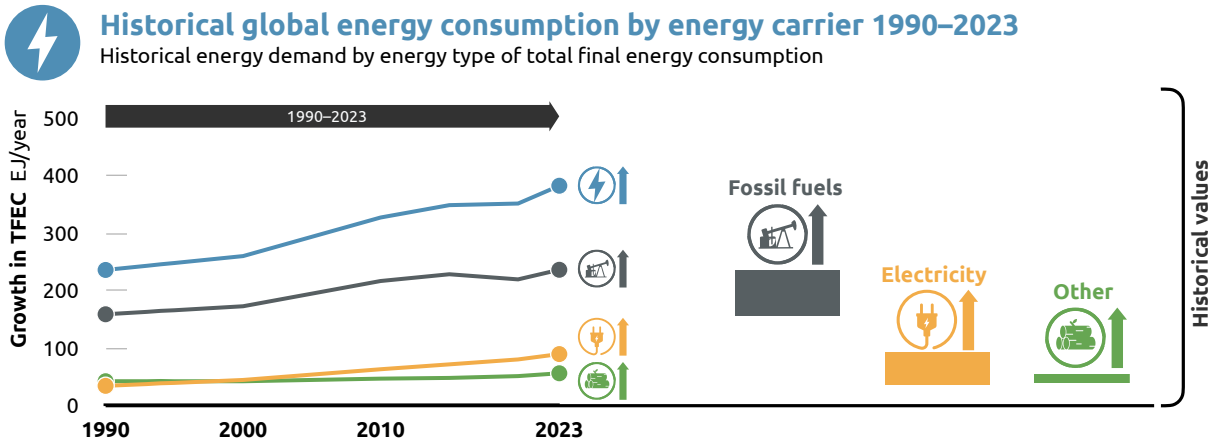


Figure 4 Historical global final energy consumption by energy carrier. The panels compare TFEC and its electricity, fossil-fuel and other energy components. Other category includes hydrogen and biomass.

All future scenarios show a continued growth in electricity demand. However, the fundamental split between current policy trajectories, like IEA STEPS, and 1.5°C-aligned scenarios lies in whether new electricity replaces fossil fuels or simply builds on top of them. As shown in Figure 5, under STEPS, rising electricity use acts as an addition to the energy system, continuing with an almost flat fossil fuel TFEC. Consequently, overall energy demand surges while fossil fuel use fails to decline meaningfully.

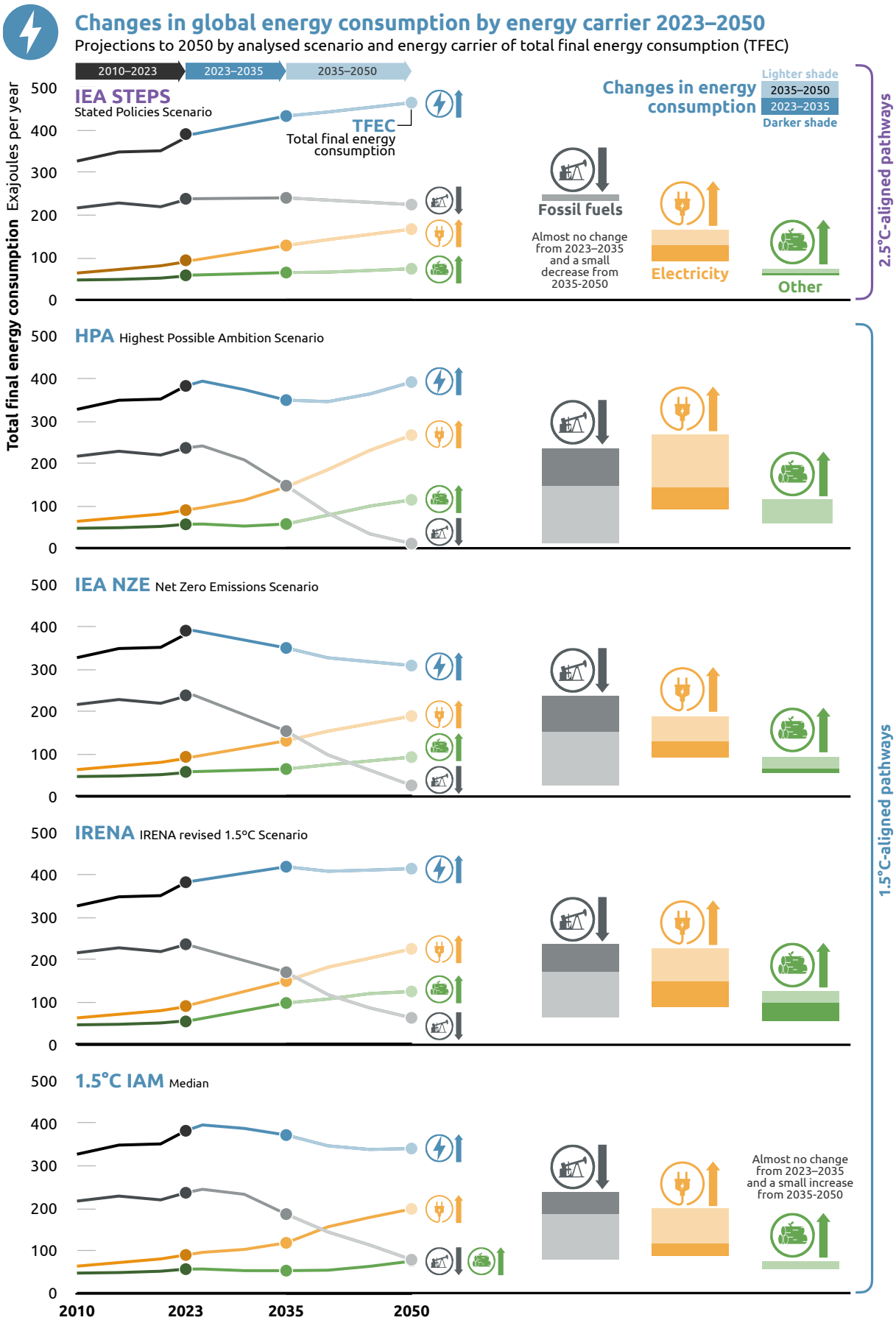


Figure 5 Historical and projected global final energy consumption by energy carrier under selected scenarios. The panels compare TFEC and its electricity, fossil-fuel and other energy components under selected 1.5°C-aligned and current-policy pathways. Other category includes hydrogen and biomass.

By contrast, all 1.5°C-aligned pathways combine increased electricity consumption with declining fossil fuel use. This behaviour depicts the role of electrification in the energy system transition, driving a decline in fossil fuel use. Electricity increasingly substitutes fossil consumption in end-use sectors and non-electric fossil consumption declines sharply. At the same time, more efficient electric technologies, as discussed in Section 1.4.1, reduce the amount of final energy required, delivering the same or greater energy services. Consequently, several 1.5°C-aligned pathways show TFEC stabilising or declining, although actual energy services delivered to society would increase or expand.

The primary divergence among 1.5°C pathways lies in their strategy to phase-out fossil fuels. Scenarios reaching the highest levels of electrification, such as the HPA, project a sharper decline in fossil fuels, dropping nearly to zero by 2050, driven by a near-tripling of electricity demand relative to current levels. Conversely, other scenarios, such as the IRENA 's revised 1.5°C scenario, IEA NZE and the 1.5°C IAM ensemble project a higher share of fossil fuels by 2050 and some, such as the IRENA revised 1.5°C scenario rely more significantly on other non-electric alternatives, such as biofuels and green hydrogen to achieve the energy transition.

2.5 Fossil fuel phase-out: coal, oil and fossil gas trajectories

In 1.5°C-aligned pathways, end-use electrification and clean power expansion work together to drive a primary fossil fuel phase-out, where primary fossil energy falls by much more than non-electric final energy (Figure 6). Across these scenarios, coal falls first and fastest, down by roughly 60-70% by 2035 and reaching almost 90-100% by 2050, reflecting the rapid transition to clean power generation. Oil declines more steadily, dropping by about 20% to almost 30% by 2035 as transport electrifies and vehicle stocks turn over. Fossil gas is the slowest fuel to decline, falling by around 20% to 45% by 2035 and up to approximately 80-90% by 2050, as its drop depends on the simultaneous electrification of both power generation and heat across buildings and industry.

Under current policies (IEA STEPS), rising electrification fails to deliver a comparable fossil fuel decline, demonstrating that a growing electricity share can coexist with persistent fossil dependence. Total primary fossil energy use falls only modestly to 2035, with lower coal use partly offset by higher fossil gas use, before total fossil fuel demand levels off. While coal demand peaks before 2030 and oil peaks around 2030, fossil gas demand continues to grow into the mid-2030s. Although the electricity share still reaches around 34% by 2050 under STEPS, neither the shift in end uses nor the decarbonisation of power generation is sufficient to achieve the deep fossil displacement seen across 1.5°C pathways.

The main differences among 1.5°C pathways lie in how fast non-electric demand shrinks relative to electricity growth, how fast fossil gas declines, and the role assigned to alternative energy carriers. Scenario variants like HPA achieve a faster fossil gas phaseout, because they move more aggressively on direct electrification of heat and demand reduction, thereby requiring less reliance on biomass or green hydrogen. In contrast, pathways like IEA NZE feature a slightly slower fossil gas decline due to a more gradual electrification of heat, while pathways such as IRENA's revised 1.5°C rely more heavily on bioenergy and hydrogen to decarbonize hard-to-abate sectors alongside direct electrification.



Figure 6 Historical and projected global primary fossil-energy consumption by fuel under selected 1.5°C-aligned and current-policy pathways.

3 Sectoral analysis

As discussed in Section 1, economy-wide electrification targets, such as the "35 by 35" goal are a collective global direction and not a uniform national or sectoral target. These global averages mask substantial differences in starting points and sectoral structure. Currently, electrification in industry and buildings sit at 30% and 36% respectively, while electrification of road and rail transport is almost 2% (Figure 7). Understanding these differences is key for developing comprehensive approaches to measuring electrification progress.

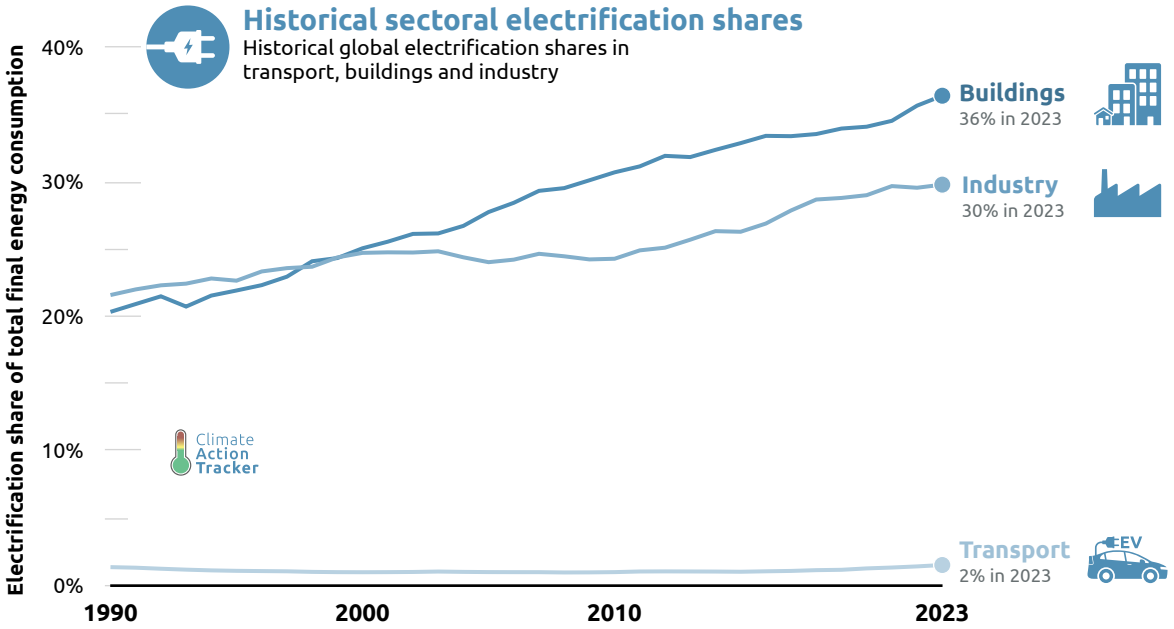


Figure 7 Historical global electrification shares in transport, buildings and industry, 1990–2023. Transport includes all modes and international bunkers; residential and commercial buildings exclude non-energy use; and industry excludes non-energy use (IEA, 2026f).

This section explores the current level of electrification across transport, buildings and industry and assesses their level of electrification in the future under the same set of scenarios analysed under Section 2. In addition, studies assessing the technical electrification potential of each sector are also reviewed to identify the technical upper limits of electrification.

Current electrification levels, future pathways, key enablers and remaining challenges are analysed across the sectors. Understanding these sector-specific characteristics is essential for determining how electrification should be measured and what indicators best capture the full scope of electrification.

3.1 General overview

Current electrification levels and what different 1.5°C-aligned scenarios estimate in the future differ across transport, buildings and industry, as shown in Figure 8. Discrepancies reflect the diverse energy requirements of each sector, technological maturity of electrification solutions, stock turnover dynamics and infrastructure needs.

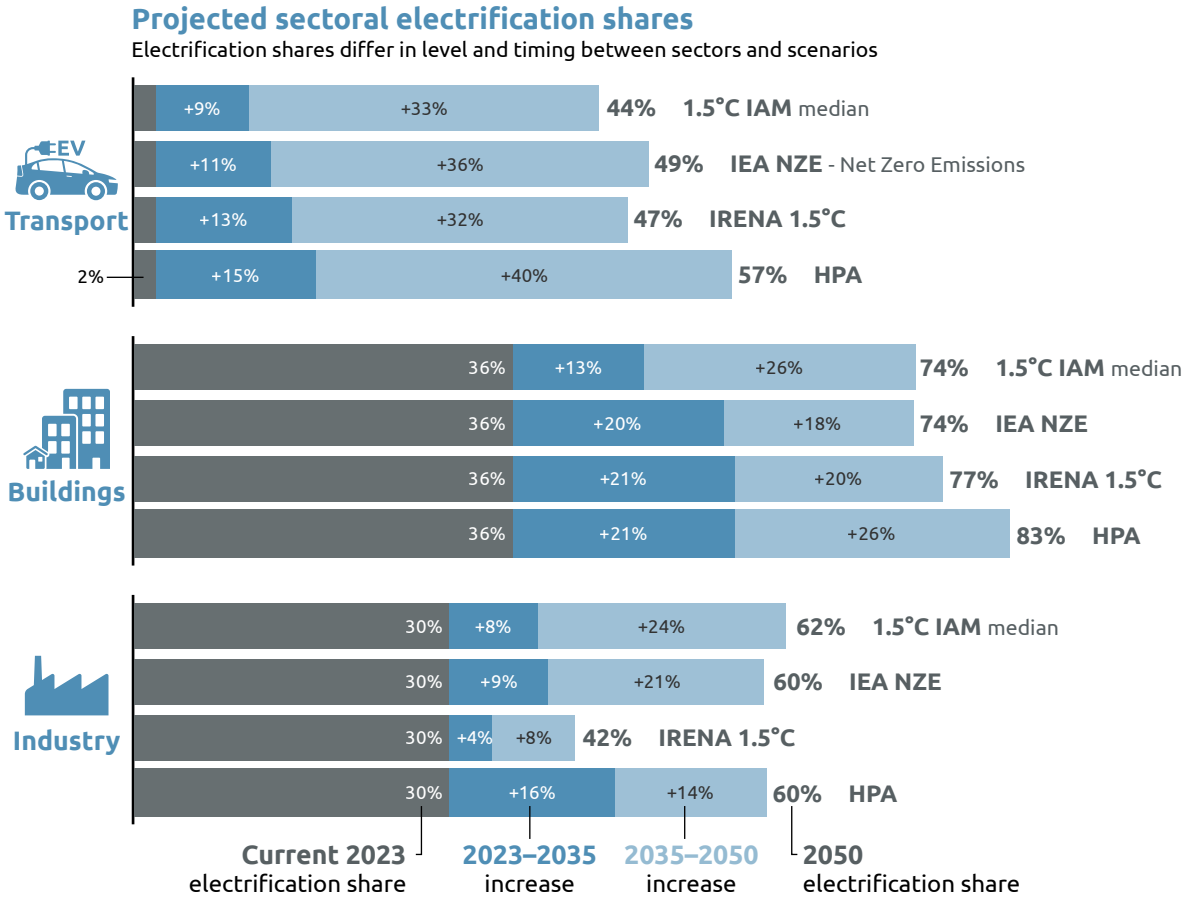


Figure 8 Current and future sectoral electrification shares across transport, buildings, and industry in 2035 and 2050 under selected 1.5°C-aligned pathways. HPA stands for the Highest Possible Ambition scenario, IEA NZE stands for the Net Zero Emission scenario, IRENA 1.5°C stands for the revised 1.5°C scenario and the 1.5°C IAM median is the median of an ensemble containing the very low scenario set from ScenarioMIP-CMIP7.

Buildings are currently the end-use sector with the highest electrification rate, with electricity accounting for around 36% of final energy consumption, compared with 30% for industry and almost 2% for transport. Despite its low starting point, transport is required to grow the fastest, based on the analysed 1.5°C-aligned scenarios, with electrification levels increasing roughly 30-40 times by 2050. Buildings and industry also see substantial increases in electrification, with the electricity share approximately doubling in buildings and increasing by around 1.5-2.5 times in industry.

The following sections contain further analysis on the pathways that could deliver these electrification levels together with the challenges that each sector faces.

3.2 Transport

3.2.1 Current electrification level

The transport sector accounts for approximately 30% of global final energy demand and remains the end-use sector with the highest dependence on fossil fuels, particularly oil (IEA, 2025f). Despite the rapid deployment in recent years of electric vehicles (EVs), with EV cars jumping from a 4% sales share in 2020 to 25% in 2025 (IEA, 2025d), transport remains the least electrified demand sector, with oil dominating passenger and freight mobility worldwide, representing 93% of the sector's final consumption at the global level (Jaramillo *et al.*, 2022; IEA, 2025f).

Transport electrification, measured as the share of electricity in TFEC, is estimated at around 2% globally in 2023, including international maritime and aviation (IEA, 2025f; IRENA, 2026b). Although electrification through battery electric vehicles (BEVs) has seen major advances, current electrification remains low, with battery electric cars representing approximately only 3% of the global stock (IEA, 2026b). The large existing stock of combustion engine vehicles and slow turnover of vehicle fleets further constrain the pace of electrification. The modal split varies across countries for passenger and freight transport; however, private passenger vehicles are generally the main means of transport and largest source of transport emissions (Jaramillo *et al.*, 2022).

BOX 4. Electric Vehicles

EVs are classified in three different categories of vehicles, which include hybrid electric (HEV), plug-in hybrid electric (PHEV) and battery electric vehicles (BEVs). HEVs bring the lowest emissions reduction compared to internal combustion engine vehicles (ICEVs), followed by PHEVs. BEVs can have the highest abatement potential from all the EV categories analysed. However, these are also highly dependent on how the electricity used for charging is generated (Jaramillo *et al.*, 2022).

3.2.2 Electrification of transport: drivers and challenges

Transport electrification is expected to be driven by the direct electrification of road transport, primarily through BEVs increasingly replacing internal combustion engine vehicles (ICEVs). Modal shifts from passenger transport to lower energy intensity transport modes, such as public transport and shared mobility, will also have an impact on the future of mobility and will need to play a role for the overall transition towards a zero-carbon economy. However, whether these shifts are translated into higher electrification rates depends on the electrification of these means of transport, such as electric trains or shared BEVs.

Direct electrification through BEVs is highly suitable for light-duty vehicles (LDVs) such as passenger cars and two- and three- wheelers, and heavy-duty vehicles (HDVs) such as urban buses. Trends show that electrifying these segments is crucial for transforming global transport (IEA, 2026b). BEV sales continue to grow globally and are expected to accelerate further due to the declining cost of batteries and production, which will increase price competitiveness against ICEVs, favouring affordability (IEA, 2025d; IRENA, 2025). The transition could be slowed down by protectionism measures such as regional tariffs and trade barriers risking fracturing supply chains (IEA, 2025d).

Electrification of truck transport poses a challenge due to the required larger battery capacities and extensive charging infrastructure, specifically for long-haul and heavy-duty freight applications (IEA, 2026c). However, recent assessments indicate that with continued improvements in battery technology and adequate policy support, decarbonisation of long-haul and heavy freight road transport can be achieved predominantly through direct electrification (Schreyer *et al.*, 2024; Climate Analytics, 2025).

The expansion and integration of supporting infrastructure remains equally important and a potential barrier. Increasing charging coverage, expanding charging capacity, improving charging speeds and integrating charging demands are critical requirements for large-scale BEV deployment (IEA, 2025d; Lee *et al.*, 2025).

3.2.3 Future electrification: what scenarios say

Across all analysed sectors, transport emerges as the one with the biggest increase in electrification rates, with electrification levels increasing almost 2% in 2023 to 45-57% in 2050 under the analysed 1.5°C-aligned scenarios, as shown in Figure 9. Despite agreement on strong growth, differences exist in the ultimate level of electrification that needs to be achieved. As discussed previously, transport electrification is expected to occur through direct electrification with BEVs.

Comparable information on BEV deployment is not consistently available across all analysed studies. Therefore, divergences on the electrification level achieved are assessed through changes in the sector's energy carriers. Given oil's dominant role in the sector, currently accounting for 90% of transport energy consumption, the analysis focuses on this carrier (IEA, 2025f).

In 2035, all analysed scenarios have a similar share of oil in TFEC, ranging from less than 70%, in the scenarios with higher electrification levels such as the HPA, NZE and the IRENA's revised 1.5°C scenario, to more than 75%, as in the 1.5°C IAM median. Although this represents still a high share of the sector's energy consumption, some of the analysed scenarios indicate that the sales share of EVs (including BEVs and PHEVs) should be almost 100% in 2035 (IEA, 2026). This indicates the importance of vehicle stock turnover and the time needed to translate the sales share into electrification. The picture changes by 2050, when higher electrification levels are achieved and the share of oil drops to approximately 10% in the HPA, the study reaching highest electrification level; in the 1.5°C IAM median, the study reaching the lowest level of electrification by 2050, oil still accounts for almost 30%, while for the NZE and the IRENA revised 1.5°C scenario it represents around 15%.

When comparing the current policy scenario (STEPS) against the 1.5°C-aligned scenarios, the gap increases with time, moving from a difference of approximately 5-10 percentage points in 2035 to 30-40 percentage points in 2050. This underscores the need to deploy transport electrification policy frameworks to close the gap with the required electrification levels achieved under the 1.5°C-aligned scenarios analysed.

The role of other energy carriers in the transport sector is relevant due to long-distance maritime and air transport. Hydrogen moves from a limited role in 2035, with shares between 0-1%, up to 0-8% in 2050. Other liquid fuels, such as synthetic fuels, achieve 10-15% shares in 2050. Although batteries offer significant efficiency advantages, long-haul applications such as aviation and shipping require considerably higher energy densities than current battery technologies can provide. Direct electrification alternatives have been developed or are under development, but they require further development and research; several challenges are foreseen for long distance solutions in the case of aviation, or with available direct electrification options limited to short distances such as maritime transport (IEA, 2026c). From the two, direct electrification of long-distance ships could be the most feasible (Kersey *et al.*, 2022).

As a consequence, some of the discrepancies on the level of electrification reached by different studies can be explained by international aviation and maritime shipping. Therefore, assumptions on the varying degrees of indirect electrification through hydrogen and synthetic fuels play a major role, reflecting the importance of technology assumptions and transparent communication of these assumptions, which can increase or decrease the role in the sector of direct or indirect electrification (Schreyer *et al.*, 2024).

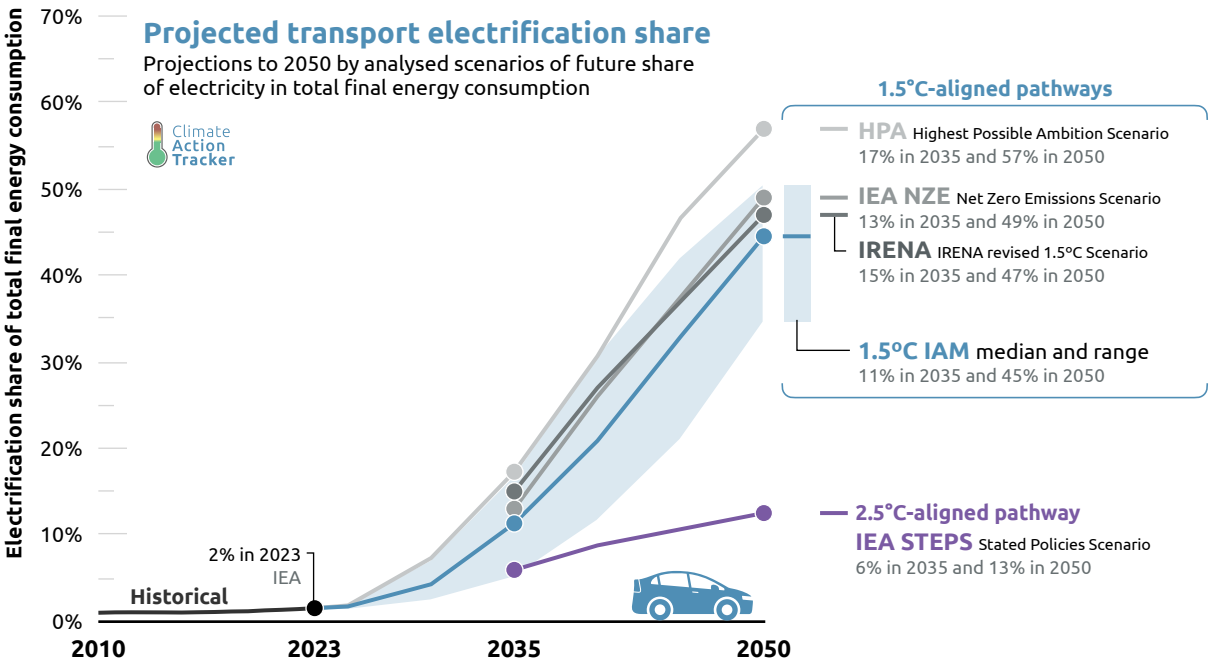


Figure 9 Historical and projected global transport electrification under selected 1.5°C-aligned and current-policy pathways, 2010–2050. The benchmarks cover direct electrification across all transport modes, including international aviation and shipping bunkers. The shaded area represents the P10–P90 range of the ScenarioMIP-CMIP7 Very Low pathways.

3.3 Buildings

3.3.1 Current electrification level

The buildings sector accounted for approximately 30% of global final energy demand in 2023, with 70% of this demand coming from residential buildings and 30% from commercial (IEA, 2025f). It is currently the most electrified end-use sector, with the share of electricity in TFEC estimated to be around 36% globally in 2023 (IEA, 2025f). Electricity is the primary energy source in buildings (IEA, 2025f; IRENA, 2026a). Buildings are a key driver of increasing economy-wide electricity demand, and in 2023 were responsible for the majority of global electricity consumption growth (UNEP, 2026b).

Residential and commercial buildings are key infrastructure, and energy consumption in buildings is driven by a variety of functions related to human activity, primarily space and water heating, cooling, cooking, using appliances and lighting. Many of these functions are already electrified, contributing to the sector's higher electrification rate compared to transport and industry. Cooling, lighting and appliances are all powered with electricity and account for roughly 30% of energy demand from residential buildings in advanced economies and 20% in emerging markets and developing economies (EMDEs) (IEA, 2025b).

The use of fossil fuels in buildings is concentrated in specific applications, namely heating and cooking. Space and water heating account for 70% of residential energy demand in advanced economies, compared to less than 40% in EMDEs, and remains primarily powered by fossil fuels (IEA, 2025b). Across geographies, fossil gas is the primary fuel used for heating, with other fossil fuels, district heating, electricity and biomass also playing a role. Cooking represents around 5% of energy demand in advanced economies, whereas this figure is closer to 10% in EMDEs, and fossil gas, LPG and increasingly electricity are the primary fuels; in EMDEs, an additional 30% of energy demand comes from the use of traditional biomass (IEA, 2025b).

3.3.2 Electrification of buildings: drivers and challenges

There are several dynamics of electricity demand to consider in the buildings sector: new electricity demand coming from direct electrification, which will primarily involve transitioning to electricity-powered technologies and increasing electricity demand from growing floor area, expanding access to electricity and introducing new sources of demand, including rising cooling needs. Data centres are emerging as an increasingly important driver of energy demand in the commercial buildings sector, particularly in regions with high concentrations of existing data centre infrastructure or that are planning large-scale expansion (IEA, 2025a). The key driver of electrification in the buildings sector is the maturity and availability of technologies for most energy uses in buildings.

Heat pumps will play an essential role in electrifying heating and additionally will lead to substantial efficiency gains. Heat pumps, which are 3-5x more efficient than fossil gas boilers, are a cornerstone technology for electrifying residential space heating and district heating networks, and multi-purpose heat pumps can also provide water heating as well as cooling services (IEA, 2026d; WGBC, 2026). Alongside heat pumps, electric resistance heaters, electric stoves and ovens are other electric technologies that can be deployed to replace fossil fuel and traditional biomass counterparts.

It is important that electrification efforts are undertaken in parallel with improving the efficiency of energy use in buildings. This includes retrofitting existing building stock and constructing new buildings to be well-insulated, employing passive heating and cooling where possible, and using the most efficient, electrified technologies like heat pumps and electric stoves. Integrating on-site renewable energy production and battery and/or thermal storage into buildings will be an important step in decarbonising buildings and can support electrification efforts by reducing burden on grids while at the same time making electricity more resilient and affordable for consumers (IEA, 2022; WGBC, 2026).

The main challenge to achieving full electrification in the buildings sector lies in the policy and investment landscape to drive and support this transition (WGBC, 2026). In geographies with mature buildings stock, governments should implement policies banning the sale of fossil gas boilers and incentivising consumers to switch to electrified technologies and make energy efficiency improvements. For some of these technologies, heat pumps in particular, barriers can include high upfront costs and the price of electricity compared to fossil gas (IEA, 2026d). Additionally, enacting strict and ambitious building codes and building performance standards will ensure new buildings and major renovations use the most efficient electric technologies and avoid fossil lock-in (CAT, 2022). This will also be key in geographies where much of the buildings stock is yet to be constructed.

Another aspect of electrification to consider in the buildings sector is additional demand for electricity, especially for data centres and cooling. Electricity demand from data centres has more than doubled over the last ten years and is expected to roughly triple from 2020 to 2035 (IEA, 2026e). Cooling demand in particular is projected to increase in response to global warming and more widespread extreme heat and is seeing the most rapid growth in energy demand of the various energy uses in buildings; air conditioner ownership, historically enjoyed by the wealthiest in society, is rising as a result of a combination of increased need alongside access and income levels (IEA, 2025b). This will require efficient technologies and strategies to mitigate the impacts of increased peak demand on grids and electricity prices.

3.3.3 Future electrification: what scenarios say

Across analysed scenarios, buildings is the end-use sector with current highest rates of electrification and is almost doubling from now to 2050. These pathways converge on high electrification of the buildings sector, with studies broadly agreeing on the level of electrification needed from now until 2050.

The HPA is the most ambitious scenario, reaching 57% electrification in 2035 and 83% in 2050. The scenarios from the IEA and IRENA have similar trajectories, reaching 56% and 57% in 2035 and 74% and 77% in 2050, respectively. The 1.5°C IAM median reaches 50% in 2035, though catches up to IEA and IRENA in 2050 at 75% share of electricity. Under current policies (STEPS), electrification of buildings is expected to reach 48% in 2035, on track with the IAM median, though lagging behind the other three scenarios and only increasing marginally to 56% in 2050, which is significantly lower than the

other scenarios. Due to the technological maturity and cost-competitiveness of direct electrification solutions, indirect electrification in the buildings sectors is expected to play a residual role (Schreyer *et al.*, 2024).

Discrepancies between the current policy scenario (STEPS) and the 1.5°C-aligned scenarios remain relatively small in 2035 but widens substantially by 2050. This initial alignment reflects that near-term electrification is already projected under current policy frameworks, although more ambitious policies could reach the highest projected electrification rates. The long-term divergence, however, underscores an urgent need for raising policy ambition over the medium- and long-term. Specific details on the electrification level reached under each study analysed are shown in Figure 10.

Comparable information on technology deployment is not consistently available across all studies, so the differences presented in Figure 10 are assessed through changes in the sector's energy mix. Currently oil, traditional biomass and fossil gas account for approximately 10%, 15% and 23% of energy consumption in buildings, respectively, including non-energy uses (WEO, 2026). Data on these carriers is not as granular for buildings as for the other end-use sectors. Where data is available, the scenarios agree on a substantial reduction of these energy sources. However, some of the discrepancies on the level of electrification reached by the different studies can be explained by differences in the contribution of these fuels to buildings' TFEC.

For fossil gas, the primary fossil fuel used in buildings, the share drops to less than 20% in 2035 and almost 0% in 2050 in the IEA NZE scenario. The HPA and IRENA's revised 1.5°C scenario show a faster decrease going down to 10% in 2035 before ultimately reaching 0% in 2050. The share of oil falls to approximately 5% in 2035 in both the IEA NZE and 1.5°C IAM median; in the HPA and IRENA's revised 1.5°C scenario, oil remains at around 10% in 2035. All of them reach similar levels in 2050 close to 0%, except the IRENA's revised 1.5°C scenario reaching almost 5% in 2050.

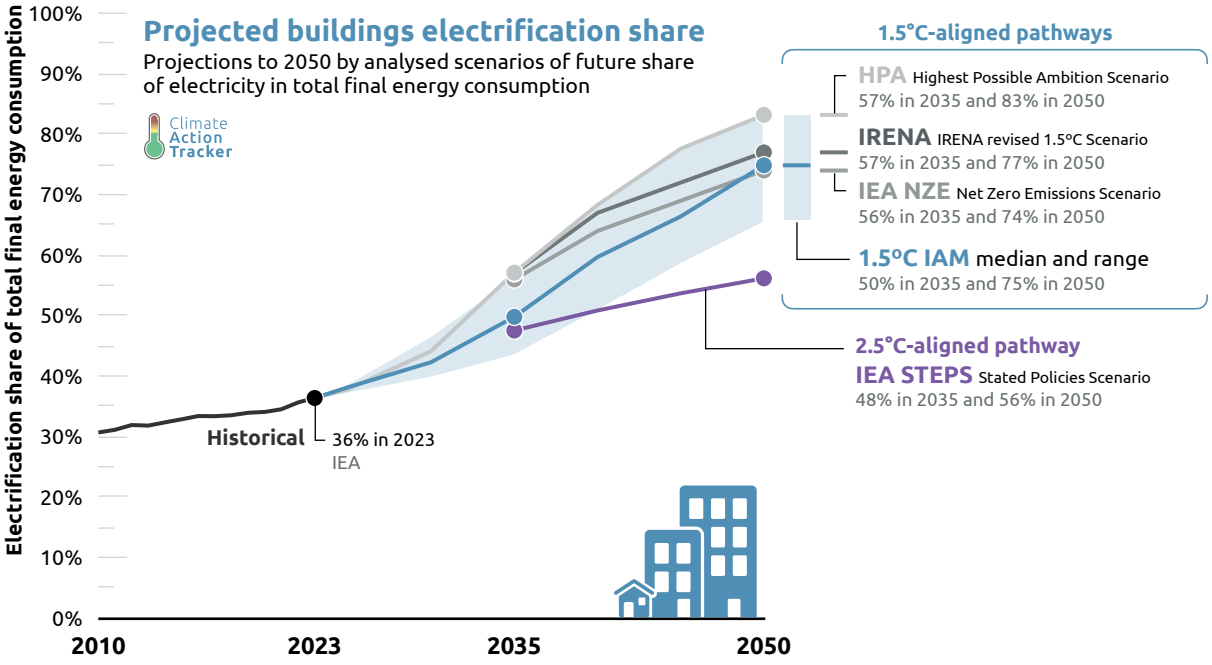


Figure 10 Historical and projected global electrification of residential and commercial buildings under selected 1.5°C-aligned and current-policy pathways, 2010–2050. The benchmarks exclude non-energy use. The shaded area represents the P10–P90 range of the ScenarioMIP-CMIP7 Very Low pathways.

3.4 Industry

3.4.1 Current electrification level

The industrial sector is the largest energy consumer of all end-use sectors globally, accounting for approximately 40% of global final energy demand in 2024 (IEA, 2025f). Energy is required across a diverse range of industrial processes, from the provision of high-temperature heat for cement production to low-temperature steam for the food and beverage industry. The main source of that energy currently comes from fossil fuels, which dominate the energy mix in the sector (IEA, 2025e). Fossil fuels also provide non-energy applications, such as feedstock for several chemical processes (IEA, 2018).

Electrification of the industrial sector, defined as the share of electricity in TFEC, is around 30% in 2023 (IEA, 2025f; IRENA, 2026b). Electricity in the sector is currently used to drive a range of industrial applications such as motor systems, pumps, compressors, cooling and lighting and fully electrified technologies, such as electric arc furnaces (EAF) for the production of steel.

The share of electricity in the industrial sector has remained largely unchanged across major economies for the last 10 years, although some regional differences are notable. At a global level, industrial electrification has slightly increased, as seen in Figure 7, driven by activity growth in electrified sectors in Asia rather than technology shifts (IEA, 2026b).

Three-quarters of the energy consumed by the sector is in the form of heat (IEA, 2026b). Industrial activities such as iron and steel production, primary chemicals production and the production of cement, glass and clay require process temperature above 600°C and are commonly categorised as high-temperature heat industries. Low- to medium-temperature industries include segments of the chemical industry, food and beverage production, textiles and paper manufacturing (Madeddu *et al.*, 2020; IEA, 2025e; Etter-Wenzel and Rosenow, 2026).

3.4.2 Electrification of industry: drivers and challenges

A major driver of industrial electrification is the availability of commercially mature technologies for low- and medium-temperature applications. These can replace fossil fuels for heat production by electricity through commercially available technologies, such as industrial heat pumps and electric boilers (IEA, 2025e). While these technologies are commercially available, their deployment still requires specific adaptation and integration with existing industrial sites and complementary infrastructure investment (Madeddu *et al.*, 2020; IEA, 2026c).

Industrial heat pumps and electric boilers can also be combined with electro-thermal energy storage (ETES) technologies for supplying low- to medium- heat. This technology allows the conversion of electricity into heat to be stored in solid materials such as sand, concrete or molten salt. As a result, this solution can increase operational flexibility and the role that industry can play as a flexibility provider, shifting electricity consumption and facilitating the integration of variable renewable electricity generation (IEA, 2025e).

The main challenge to achieving full electrification of the industrial sector lies in the complexities associated with the electrification of high-temperature heat industries. These processes face barriers not only related to the temperature requirements but also on the process itself. As an example, coke in primary steelmaking fulfils both an energy and a chemical reduction function, making its substitution more complex than simply replacing fossil fuels with electricity.

The maturity of direct electrification technologies for high-temperature heat varies considerably across industrial applications. In steel production, electric arc furnaces (EAFs) represent commercially mature technologies and are already widely deployed for secondary steel production. However, other direct electrification technologies require further testing and deployment at scale, such as electric steam crackers to produce high-value chemicals and direct electrification of kilns for cement production (IEA, 2026c).

In some applications, such as the production of iron, steel, aluminium and cement, electrification may need to be accompanied by a fundamental redesign of production processes. Alternative production techniques are particularly important because process emissions can also be addressed. Cement production illustrates this transformation. Clinker production is one of the main sources of emissions for cement production, with emissions arising both from the high temperatures required during the production process and from the chemical breakdown of limestone during calcination. Several clinker substitution technologies exist at different levels of maturity. By reducing or replacing clinker content, these alternatives can avoid a significant share of process emissions that would otherwise remain even with extensive electrification of cement production (IEA, 2026c).

3.4.3 Future electrification, what scenarios say

Across all the analysed scenarios, industrial electrification increases over the coming decades. Among all the end-use sectors, as shown in Figure 11, scenarios remain equally separated throughout the whole studied period. The spread between the lowest and highest electrification estimates is approximately 10 percentage points in 2035, slightly increasing to 20 percentage points in 2050.

The final level of electrification reached by the 1.5°C-aligned scenarios is around 40-60%. Building on a large ensemble of studies exploring the technical electrification potential of the sector based on existing and emerging technologies, these indicate that a 90% share of electrification would be technically possible by 2050 (Etter-Wenzel and Rosenow, 2026), indicating that the electrification potential of the sector is high and is heavily interlinked with the capacity to develop and implement at scale the technical solutions required.

Under current policies, electrification of industry is expected to grow but only marginally, from almost 30% in 2023 to 32% in 2035 and 34% in 2050. In contrast, under 1.5°C-aligned scenarios electrification increases to 34-48% in 2035 and reaches 42-62% in 2050. Additional action and policy support will be needed to increase the share of electrification in industry.

As comparable information on specific technology deployment and the transformation of different production routes is not consistently available across all studies, differences between scenarios presented in Figure 11 are assessed through changes in the TFEC by carrier. Currently coal, oil and fossil gas account for approximately 25%, 20% and 20% of industrial energy consumption respectively, including non-energy uses (IEA, 2025f).

All scenarios analysed agree on a substantial reduction of coal use in industry. The HPA, which reaches the highest level of electrification by 2035, shows the most rapid coal decline until 2035, reducing its share of final consumption from approximately 25% to around 5% from now until 2035. IEA's NZE, the 1.5°C IAM median and IRENA's revised 1.5°C scenario also reduce coal, albeit more gradually before 2035. After 2035, coal continues declining and converges on very low levels, approximately 0-5%, by 2050, with the HPA coming closest to a complete phase-out. Oil use also declines in all scenarios, although the speed and extent of reduction differ. The HPA, IRENA's revised 1.5°C scenario and the 1.5°C IAM median reduce the share of oil to around 5% in 2050, while the NZE projects a higher share of around 15% by mid-century. Fossil gas experiences a major decrease only after 2035, reaching a share of final consumption of about 5% in 2050, except in IRENA's 1.5°C revised scenario that reaches around 10%. Availability of fossil gas data is limited, with absolute consumption values and shares available only for the HPA, NZE scenarios and IRENA's revised 1.5°C scenario.

Industrial electrification is heavily influenced by assumptions about technology readiness, electricity prices, availability and connection to clean power, industrial retrofitting and the availability of complementary technologies (Wei *et al.*, 2019; Etter-Wenzel and Rosenow, 2026). As discussed above, the treatment of high-temperature industrial processes also plays a key role in the future of electrification, together with the development of alternative production routes.

The analysis done on the energy carriers and its share here include non-energy uses. This is certainly relevant for industry and specifically for the chemical industry. Feedstock is essential for producing chemical products and is almost fully obtained from fossil fuels (WEF, 2024). For this reason and the challenges faced for direct electrification of high-temperature heat processes, the balance between direct and indirect electrification is key in modelling the sector.

The role of indirect electrification depends on the manufacturing good and the process (Schreyer *et al.*, 2024). For example, in the chemical industry electrolytic hydrogen could serve both as a feedstock to produce ammonia and methanol or as an energy carrier. In the production of iron and steel it could be used as an alternative to fossil gas and coal through the hydrogen-based reduction route. However, many of these applications remain at a prototype level or early commercial stages and require further test and technological development (IEA, 2026c).Among the studies analysed, hydrogen only reaches a share of final consumption around 5-20% in 2050. Assumptions and the reliance of different model settings on varying degrees of indirect electrification through hydrogen and synthetic fuels play a major role in sector outcomes, reflecting the importance of technology assumptions and their transparent communication, as this can increase or decrease the role of direct electrification in the sector (Schreyer *et al.*, 2024).

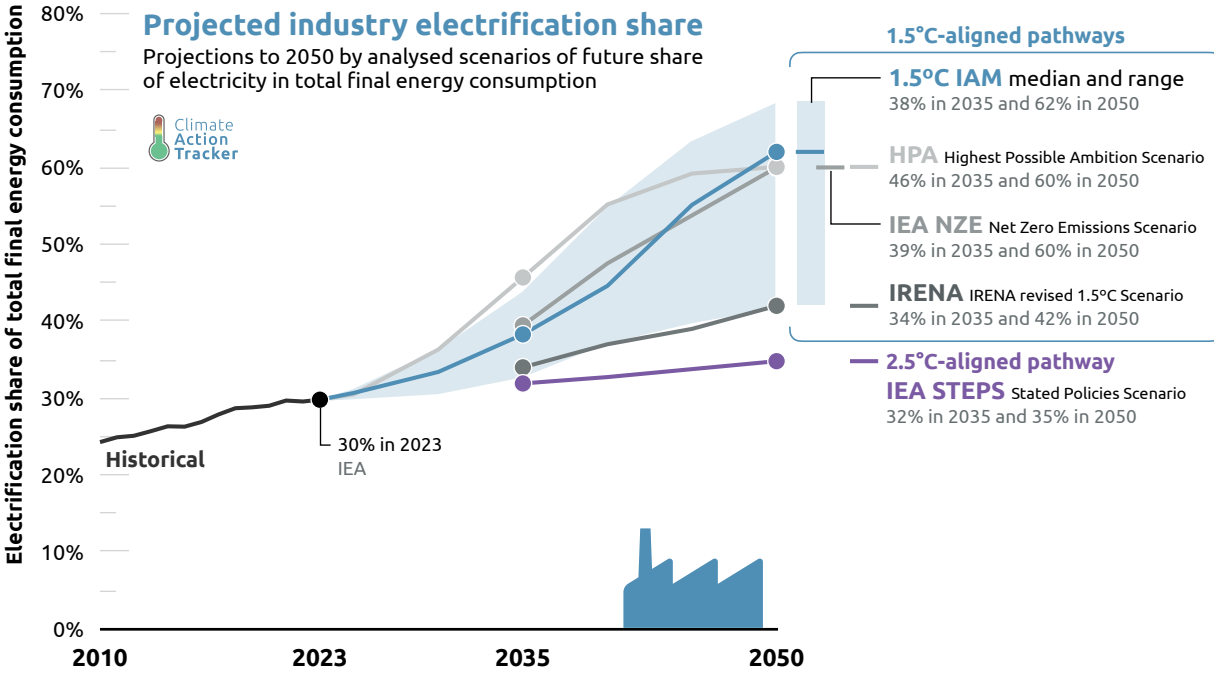


Figure 11 Historical and projected global industrial electrification under selected 1.5°C-aligned and current-policy pathways, 2010–2050. The benchmarks exclude non-energy use. The shaded area represents the P10–P90 range of the ScenarioMIP-CMIP7 Very Low pathways.

3.5 Implications of sectoral differences on benchmarks

Transport remains the least electrified sector today, but 1.5°C-aligned scenarios indicate that it requires the most rapid acceleration in electrification. This growth is expected to be driven primarily by the mainstream adoption of battery electric vehicles (BEVs), particularly in passenger road transport, which accounts for the biggest share of sectoral emissions. While BEVs are already technologically mature and cost-competitive with fossil fuel alternatives, significant technical challenges and uncertainties persist for long-distance aviation and maritime shipping.

Buildings currently have the highest level of electrification among the end-use sectors analysed primarily because part of its energy requirements only run on electricity, such as cooling and appliances. Across the 1.5°C-aligned scenarios analysed, buildings remain the most electrified sector and show the highest level of convergence among the different scenarios analysed. Electrification is primarily driven by the availability and maturity of technologies such as heat pumps, electric cooking appliances and efficient cooling systems. The main barriers are therefore less technological and more related to policy, investment and consumer adoption. At the same time, growing electricity demand from cooling, expanding access to electricity and emerging new uses such as data centres require careful consideration.

The industrial sector presents the most diverse range of energy end uses among all the analysed sectors, ranging from high-temperature heat for cement production to low-temperature steam for

food and beverage manufacturing. While direct electrification is readily viable for low- and medium-temperature processes, high-temperature applications present a far greater hurdle, requiring a combination of direct electric technologies and broader process innovation. Consequently, indirect electrification is expected to play a more substantial role in industry than in any other sector analysed.

The sectoral analysis presented in this section demonstrates that electrification cannot be understood only through a single metric or benchmark. Drivers and challenges differ substantially from sector to sector, requiring a level of granularity that reflects the specific characteristics of each one. The indicators proposed in Table 1 below are not intended as an exhaustive set of benchmarks but attempt to illustrate the type of sector specificity required to generate actionable and meaningful benchmarks. Building on the findings of Sections 1, 2 and 3, Section 4 proposes a framework for designing electrification benchmarks that capture the multiple dimensions of the electrification process paired with renewables.

Table 1 Illustrative sector-specific indicators for tracking direct electrification and enabling conditions in transport, buildings and industry.

Sector	Indicator	Calculation
Transport	Share of road BEV sales	BEV sales / Total vehicle sales [%]
	Share of road BEV stock	BEV stock / Total vehicle stock [%]
	Share of passenger transport electrified	Passenger km provided by BEV / Total passenger km [%]
	Share of freight transport activity electrified	Tonne km provided by BEV / Total tonne km [%]
	Charging infrastructure coverage	Public charging points per 100 km or per 100,000 inhabitants
Buildings	Heat pump share of heating equipment sales	Heat pump sales / Total heating equipment sales [%]
	Heat pump share of heating equipment stock	Installed heat pumps / Total heating equipment stock [%]
	Electric cooking adoption	Buildings or households using electric cooking appliances / Total buildings or households [%]
Industry	Share of low temperature industrial heat demand supplied by large-scale heat pumps	Heat supplied by industrial heat pumps / Total industrial heat demand [%]
	Share of steam cracker capacity that is electric	Electric steam cracker capacity / Total steam cracker capacity [%]
	Share of kiln capacity that is electricity	Electric kiln capacity / Total kiln capacity [%]
	Share of steel production through EAFs	Steel produced via EAFs / Total steel production [%]

4 From pathways to implementation and benchmarks

4.1 Role of benchmarks

As climate policy shifts from setting targets to implementing them, benchmarks remain important for both assessing whether planned or delivered action is actually sufficient and increasing understanding of what is needed for electrification to happen. This is particularly relevant for electrification, where political attention is growing but definitions, indicators and reference points remain uneven across sectors and countries. Renewable electricity targets alone provide limited guidance on whether clean power expansion is translating into fossil fuel phase-out in transport, buildings and industry. Electrification benchmarks can help close this gap by making visible whether clean power expansion is being matched by shifts away from fossil fuel use in end-use sectors.

Benchmarks are evidence-based reference points that indicate the scale and pace of change associated with a given objective, such as limiting warming to 1.5°C. They can be interpreted as a translation of what Paris-aligned pathways imply at a global, national, regional or sectoral level. Benchmarks are not targets in themselves, but can inform target-setting, raise ambition in policymaking by highlighting the scale and pace of change needed, and help assess progress towards achieving these goals (CAT, 2024). At the same time, benchmarks should not be interpreted as an authoritative and prescribed vision of what the future will look like. Instead, they provide reference points for assessing whether policies, targets and scenarios are broadly consistent with the direction and pace of change required to meet long-term temperature goals. As discussed throughout the report, several methodological and design choices play an essential role in how electrification benchmarks should be developed and interpreted. Three aspects are particularly important:

- **Metric:** e.g. electricity share in final energy, or useful energy
- **System boundaries:** e.g. direct vs indirect electrification, aviation/shipping, non-energy use
- **Indicator granularity:** e.g. economy-wide, sectoral or technology-specific indicators such as EV sales, heat pump deployment or industrial electrification.

Transparency regarding these methodological choices is essential to ensure meaningful comparison across studies and for ensuring that benchmarks are interpreted correctly in policy contexts. This is why electrification benchmarks are most useful when designed as a layered framework rather than as a single headline indicator.

4.2 A framework for scaling up electrification

No single electrification metric can capture all aspects of the electrification process. Economy-wide electrification provides a useful overview, but alone it is not enough to reveal where electrification is occurring, which technologies are driving the process or if the broader conditions required – including renewable implementation, flexibility needs and grid stability – are being developed. Conversely, technology-specific indicators can provide important information, but they lack the connection with wider system transformation and global temperature alignment.

To address these limitations, electrification benchmarks can be structured as a layered framework. Table 2 sets out a proposed multi-layered framework, which combines different layers of analysis, ranging from high-level electrification to technology deployment and enabling conditions that together provide a comprehensive assessment of electrification.

The overall concept of the multi-layered framework presented here is to develop full system coverage of what electrification means. Importantly, the layers should be read together rather than treated as substitutes. Economy-wide benchmarks establish the overall direction of travel and form the link to global temperature goals, but they may obscure whether electrification is taking place in the sectors and technologies where it is most needed. Sectoral benchmarks identify where electrification needs to occur across end-use sectors and underscore differences between them, but electricity shares alone

may not capture whether key technologies are being deployed. Technology deployment indicators translate this into more actionable deployment requirements, but they require careful interpretation because sales, additions, capacity and stock measure different variables. Finally, enabling indicators reveal two points: if the electricity system is decarbonising fast enough, and if flexibility and system stability solutions are also deployed at the pace required.

Table 2 Proposed multi-layered framework for electrification benchmarks and the principal limitation of each layer.

Layer	What it tells us	Main limitation
Economy-wide	Overall direction and pace of structural change at a global or national level	Can conceal differences in sectoral composition, efficiency improvements and technology deployment
Sectoral	Where electrification is occurring and which sectors are advancing or lagging	Electricity shares alone may still fail to reflect technology uptake and deployment
Technology deployment	Progress in deployment of the technologies required to achieve electrification	May require distinguishing between sales, additions, capacity and stock for a comprehensive understanding
Enabling indicators	Whether electricity systems and supporting infrastructure can accommodate electrification and fully decarbonise	Complement electrification benchmarks but do not explain how electricity is displacing fossil fuels in energy use

4.3 Country context implications for the proposed framework

Global benchmarks developed under the proposed multi-layered framework provide a common understanding of the direction and pace of electrification required to align with global temperature goals. However, country context also needs to be considered when looking at current electrification levels and scenarios developed to assess electrification progress in the future (IEA, 2026b; IRENA, 2026b; Opfer *et al.*, 2026). Country context therefore matters for how benchmarks are interpreted and translated into nationally relevant reference points.

Three broad dimensions can help characterise country-specific conditions that influence the pace and scale of required electrification: structural dynamics, demand dynamics and access, affordability, and implementation capacity considerations.

Structural dynamics help differentiate the starting point of the transition for each country. Existing electrification levels, technology stocks, asset age and electricity infrastructure all shape what electrification can displace and how quickly, as well as where infrastructure constraints may need to be overcome. Overall power-system readiness and sector-specific factors, such as modal mix in transport, local climate and consequent heating/cooling needs or types of dominant industries, also play a critical role.

Demand dynamics are essential to determining future electrification needs. Understanding the drivers behind demand is key to understanding its impact across the different levels of the proposed framework. Some of the drivers that need to be considered are expansion of electricity access, sectoral growth, economic development and population behaviour. Sector-specific demand is also relevant, which is influenced by factors such as mobility demand, industrial output or floor area. Furthermore, new sources of electricity demand, such as cooling needs and data centres, are becoming increasingly important. It is therefore important to distinguish between electrification that replaces existing fossil fuel use and electrification that meets new or previously unmet demand. These factors affect both the absolute scale of electricity deployment required and the rate at which electricity's share of final energy can increase.

Access, affordability and capacity considerations are critical considerations when interpreting electrification benchmarks in national context. In countries where a significant share of the population lacks reliable and affordable electricity, rising electricity demand may reflect first-time access and improved energy services rather than substitution away from existing fossil fuel use. For many developing countries, electrification therefore starts with universal access. A global benchmark such as "35 by 35" should consequently not be applied as a one-size-fits-all national target; nationally relevant reference points should be interpreted in light of different starting conditions, development priorities and capabilities while remaining consistent with a Paris-aligned transition.

In countries with lower access levels or higher unmet development needs, electrification may initially play a larger role in expanding energy services rather than replacing existing fossil fuel use, which can affect how the pace and scale of electrification are interpreted. Furthermore, affordability, capacity, support needs and the risk of fossil lock-in are also relevant. While these equity-related considerations do not reduce the need for Paris-aligned electrification, they help identify where finance, technology transfer or capacity building may be needed to support faster implementation.

Together, these three considerations provide the bridge between global benchmarks and nationally relevant reference points. Reading benchmarks alongside structural conditions, demand dynamics, access, affordability and implementation capacity can clarify how Paris-aligned electrification may differ across countries. While the framework provides a basis for using benchmarks to inform national policy priorities and implementation planning, it does not prescribe how effort or support should be allocated between countries.

4.4 Way forward

Building on the analysis presented in this report, the CAT team will develop 1.5°C-aligned electrification benchmarks at the global and national levels. The layered framework presented here will serve as the guideline for defining and calculating these benchmarks across the different dimensions of electrification. The criteria discussed throughout the report will also inform the interpretation of these benchmarks in sectoral and national contexts, recognising that appropriate electrification pathways depend on sector-specific characteristics and country-specific circumstances.

The CAT team also emphasises that data availability may limit the comprehensive assessment of all the dimensions proposed in this framework. As a result, benchmark development and assessment may need to balance conceptual completeness with the availability and quality of underlying data.

Bibliography

CAT (2022) Decarbonising buildings. Climate Action Tracker. Available at: https://climateactiontracker.org/documents/1018/CAT_2022-03-09_Report_DecarbonisingBuildings.pdf (Accessed: 15 September 2026)

CAT (2024) Methodology for 1.5°C compatible sectoral benchmarks. Climate Action Tracker. Available at: https://ca1-clm.edcdn.com/publications/CAT_2024-10-29_Methodology_1.5CompatibleBenchmarks.pdf?v=1730294897 (Accessed: 15 September 2026)

Climate Analytics (2025) Real zero: delivering a fossil free future. Climate Analytics. Available at: https://ca1-clm.edcdn.com/publications/Real-zero-delivering-a-fossil-free-future.pdf?v=1762444037 (Accessed: 15 September 2026)

Climate Analytics and PIK (2025) Rescuing 1.5°C: new evidence on the highest possible ambition to deliver the Paris Agreement. Climate Analytics. Available at: https://climateanalytics.org/publications/rescuing-1-5c (Accessed: 15 September 2026)

Ember (2025) Global Electricity Review. Ember. Available at: https://ember-energy.org/latest-insights/global-electricity-review-2025/ (Accessed: 15 September 2026)

Etter-Wenzel, C. and Rosenow, J. (2026) High voltage: the global potential for electrifying industry. Oxford. Available at: https://www.eci.ox.ac.uk/sites/default/files/2026-04/High_Voltage_April2026_FINAL.pdf (Accessed: 15 September 2026)

IEA (2018) The future of petrochemicals. International Energy Agency. Available at: https://iea.blob.core.windows.net/assets/bee4ef3a-8876-4566-98cf-7a130c013805/The_Future_of_Petrochemicals.pdf (Accessed: 15 September 2026)

IEA (2022) Unlocking the Potential of Distributed Energy Resources. International Energy Agency. Available at: https://www.iea.org/reports/unlocking-the-potential-of-distributed-energy-resources (Accessed: 15 September 2026)

IEA (2023) Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach. International Energy Agency. Available at: https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-c-goal-in-reach (Accessed: 15 September 2026)

IEA (2025a) Energy and AI. International Energy Agency. Available at: https://www.iea.org/reports/energy-and-ai (Accessed: 15 September 2026)

IEA (2025b) Energy efficiency. International Energy Agency. Available at: https://www.iea.org/reports/energy-efficiency-2025/industry (Accessed: 15 September 2026)

IEA (2025c) Global Energy and Climate Model. International Energy Agency. Available at: https://www.iea.org/reports/global-energy-and-climate-model (Accessed: 15 September 2026)

IEA (2025d) Global EV Outlook 2025. Available at: https://www.iea.org/reports/global-ev-outlook-2025 (Accessed: 15 September 2026)

IEA (2025e) Renewables for Industry. International Energy Agency. Available at: https://www.iea.org/reports/renewables-for-industry (Accessed: 15 September 2026)

IEA (2025f) World Energy Outlook. International Energy Agency. Available at: https://www.iea.org/reports/world-energy-outlook-2025 (Accessed: 15 September 2026)

IEA (2026a) Delivering electricity and clean cooking for all. International Energy Agency. Available at: https://www.iea.org/topics/access-and-affordability (Accessed: 15 September 2026)

IEA (2026b) Electrification. International Energy Agency. Available at: https://www.iea.org/reports/electrification (Accessed: 15 September 2026)

IEA (2026c) Energy Technology Perspectives. International Energy Agency. Available at: https://www.iea.org/reports/energy-technology-perspectives-2026 (Accessed: 15 September 2026)

IEA (2026d) Heat Pump Monitor. International Energy Agency. Available at: https://www.iea.org/reports/heat-pump-monitor-2026 (Accessed: 15 September 2026)

IEA (2026e) Key questions on energy and AI. International Energy Agency. Available at: https://www.iea.org/reports/key-questions-on-energy-and-ai (Accessed: 15 September 2026)

IEA (2026f) World Energy Balances. International Energy Agency. Available at: https://www.iea.org/data-and-statistics/data-product/world-energy-balances (Accessed: 15 September 2026)

IRENA (2026a) Transitioning away from fossil fuels: A roadmap based on renewables, electrification and grid enhancement. International Renewable Energy Agency. Available at: https://www.irena.org/Publications/2026/May/Transitioning-away-from-fossil-fuels (Accessed: 15 September 2026)

IRENA (2026b) World Energy Transition Outlook. International Renewable Energy Agency. Available at: https://www.irena.org/Publications/2026/Oct/World-Energy-Transitions-Outlook-2026 (Accessed: 20 October 2026)

Jaramillo, P., Ribeiro, S.K., Newman, P., *et al.* (2022) 'Transport', in Climate Change 2022: Mitigation of Climate Change. Cambridge University Press. https://doi.org/10.1017/9781009157926.012

Kersey, J., Popovich, N.D. and Phadke, A.A. (2022) 'Rapid battery cost declines accelerate the prospects of all-electric interregional container shipping', Nature Energy, 7(7), pp. 664–674. https://doi.org/10.1038/s41560-022-01065-y

Lee, Y., Bencekri, M., Kwak, J., *et al.* (2025) 'Electrification pathways toward transport decarbonization with a systematic review', Clean Technologies and Environmental Policy, 27(12), pp. 7855–7877. https://doi.org/10.1007/s10098-025-03321-7

Liebreich, M. (2026) 'Let's target 35% electrification, but of what?' Available at: https://mliebreich.substack.com/p/lets-target-35-electrification-but (Accessed: 15 September 2026)

Madeddu, S., Ueckerdt, F., Pehl, M., *et al.* (2020) 'The CO2 reduction potential for the European industry via direct electrification of heat supply (power-to-heat)', Environmental Research Letters, 15(12). https://doi.org/10.1088/1748-9326/abbd02

NewClimate Institute and Climate Analytics (2024) Setting 1.5°C compatible wind and solar targets: Guidance for key countries. Available at: https://newclimate.org/resources/publications/setting-15degc-compatible-wind-and-solar-targets-guidance-for-key-countries (Accessed: 15 September 2026)

Opfer, K., Peter, M., Adil, L., *et al.* (2026) Renewable Electrification as a Means of Transitioning Away from Fossil Fuels: From Commitment to Implementation at COP31. Germanwatch. Available at: https://www.germanwatch.org/en/node/93571 (Accessed: 9 January 2026)

Riahi, K., Schaefer, R., Arango, J., *et al.*(2022) 'Mitigation pathways compatible with long-term goals.', in Climate Change 2022: Mitigation of Climate Change. Cambridge University Press. https://doi.org/10.1017/9781009157926.005

Rogelj, J. and Rajamani, L. (2025) 'The pursuit of 1.5°C endures as a legal and ethical imperative in a changing world', Science, 389(6757), pp. 238–240. https://doi.org/10.1126/science.ady1186

Schreyer, F., Ueckerdt, F., Pietzcker, R. and Rodrigues, R. (2024) 'Distinct roles of direct and indirect electrification in pathways to a renewables-dominated European energy system', One Earth, 7(2), pp. 226–241. https://doi.org/10.1016/j.oneear.2024.01.015

UNEP (2026a) Emissions Gap Report 2026: The point of return – Urgent emissions cuts needed to come back from overshoot of 1.5°C. United Nations Environment Programme. Available at: https://doi.org/10.59117/20.500.11822/50038 (Accessed: 23 October 2026)

UNEP (2026b) Global Status Report for Buildings and Construction 2025-2026. Available at: https://www.unep.org/resources/report/global-status-report-buildings-and-construction-2025-2026 (Accessed: 15 October 2026)

UNEP (2026c) Limiting Overshoot: Navigating exceedance of 1.5°C and pathways towards return. United Nations Environment Programme. Available at: https://doi.org/10.59117/20.500.11822/49857 (Accessed: 23 October 2026)

UNFCCC (2026) COP31 Presidency announces new targets on global electrification. Available at: https://unfccc.int/news/cop31-presidency-announces-new-targets-on-global-electrification-cutting-waste-resilient-cities (Accessed: 15 September 2026)

Van Vuuren, D.P., O'Neill, B.C., Tebaldi, C. and Sanderson, B.M. (2026) 'The Scenario Model Intercomparison Project for CMIP7', Geosci. Model Dev., 19(7), pp. 2627–2656. https://doi.org/10.5194/gmd-19-2627-2026

WEF (2024) Net Zero Industry Tracker. World Economic Forum. Available at: https://reports.weforum.org/docs/WEF_Net_Zero_Industry_Tracker_2024.pdf (Accessed: 15 September 2026)

Wei, M., A. McMillan, C.A. and de la Rue du Can, S. (2019) 'Electrification of Industry: Potential, Challenges and Outlook', 6(4), pp. 140–148. https://doi.org/10.1007/s40518-019-00136-1

WGBC (2026) Powering the Transition: Building Electrification. World Green Building Council. Available at: https://worldgbc.org/wp-content/uploads/2026/02/WorldGBC-Building-Electrification-2026.pdf (Accessed: 15 September 2026)

Authors

Climate Analytics

Samuel Guéret
Neil Grant
Zarrar Khan
Danial Riaz

NewClimate Institute

Pablo Blasco Ladrero
Emily Daly
Judit Hecke
Louise Jeffery
Jan-Luka Scheewel

Editing
George Smeeton

Design
Designers For Climate Studios

Acknowledgments

We would like to thank the wider CAT team for their work on country assessments, which contributed to this briefing.

This report was made possible with the generous support of our **funders**.

Pooled fund on International Energy

CAT The Consortium

Climate Action Tracker

The Climate Action Tracker (CAT) is an independent scientific analysis produced by three research organisations tracking climate action since 2009. We track progress towards the globally agreed aim of holding warming well below 2°C, and pursuing efforts to limit warming to 1.5°C.

climateactiontracker.org

Climate Analytics is a non-profit institute leading research on climate science and policy in relation to the 1.5°C limit in the Paris Agreement. It has offices in Germany, the United States, Togo, Australia, Nepal and Trinidad and Tobago.

climateanalytics.org

NewClimate Institute is a non-profit institute established in 2014. NewClimate Institute supports research and implementation of action against climate change around the globe, covering the topics international climate negotiations, tracking climate action, climate and development, climate finance and carbon market mechanisms. NewClimate Institute aims at connecting up-to-date research with the real world decision making processes.

newclimate.org