Turning Electrification into Growth:

How Subnational Governments Can Lead the Clean Electrification Boom

Electro Economy White paper

Under2 Coalition

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Turning Electrification into Growth:

How Subnational Governments Can Lead the Clean Electrification Boom

Clean electrification: the backbone of a net zero economy and a strategic necessity.

Since 2020, the world has experienced three major fossil fuel shocks which have triggered price rises, shortages and had enormous knock-on impacts on the global economy. Policymakers have faced staggering costs to shield households and economies from energy price volatility triggered by the COVID-19 pandemic, Russia's invasion of Ukraine, and recent geopolitical tensions involving Iran, Israel and the United States. In 2024 alone, at a time of relatively low fossil fuel prices, explicit fiscal subsidies for fossil fuels globally ran to US $725 billion – or 0.6% of global GDP according to an IMF working paper.[1] When you factor in the environmental and climate impacts of policy choices which underprice air pollution and climate change, this figure rises to US $6.7 trillion – 5.8% of global GDP[2]. For subnational governments, who often have to pick up the costs of fossil fuel dependence without having access to the resources they provide, the imperative of moving away from fossil fuels is clear.

Reduce fossil fuel dependence, strengthen energy security, and unlock economic competitiveness.

Analysis suggests that up to 77% of final energy demand could ultimately be met through the direct use of electricity[3], yet fossil fuels still account for roughly 80% of primary energy consumption worldwide[4]. Electricity represented just 21% of final energy consumption in 2024[5], yet the share of electricity in energy demand will need to increase by around 4% per year to align with net zero scenarios[6], illustrating both the scale of the remaining gap and the urgency of accelerating electrification.

Closing this gap requires electrifying fossil fuel dependent sectors, primarily transport, buildings, and industry, while rapidly scaling renewable generation and modernising electricity networks.

Demand for advanced manufacturing, electrified industrial processes, electric vehicles, heating and cooling, and data centres is making electricity a central driver of growth. As economies shift from fossil fuels to clean electricity, access to affordable and competitively priced power is becoming a key determinant of investment, industrial activity, and competitiveness. Electrification is therefore both an energy transition and an economic strategy, but unlocking its benefits now depends on moving from ambition to delivery through faster investment, infrastructure buildout, and policy aligned with implementation realities.

National and global initiatives are accelerating electrification, effective delivery will be shaped at the subnational level

Subnational governments influence key levers including planning, permitting, infrastructure investment, transport systems, and building standards, making them critical to scaling electrification across sectors. States, regions, and cities also control and influence key infrastructure, public budget flows, and the rollout of regulatory frameworks, strengthening their capacity for local implementation and positioning them as essential partners to national governments and businesses. Electrification is no longer primarily a question of national ambition or technological readiness. It is a question of delivery at scale, and delivery is overwhelmingly shaped by subnational governments. Subnational authorities therefore represent the critical bridge between electrification ambition and deployment.

Strategic electrification pathways for subnational governments

This white paper presents and establishes a foundation for bottom-up policy action to scale clean electrification while capturing its economic opportunities. At this stage, the pathways do not prescribe specific policy recommendations. Instead, they identify deployment priorities, sequencing needs, and enabling conditions across buildings, transport, and industry. By defining these knowledge targets, the pathways provide a structured framework for aligning future policy recommendations within coherent sector strategies. The white paper therefore serves as a starting point for structured dialogue and evidence-based alignment, supporting the development of a final policy position grounded in practical implementation.

1 Underpriced and Overused: Fossil Fuel Subsidies Data 2025 Update www.imf.org/en/publications/wp/issues/2025/12/20/underpriced-and-overused-fossil-fuel-subsidies-data-2025-update-572729

2 Underpriced and Overused: Fossil Fuel Subsidies Data 2025 Update www.imf.org/en/publications/wp/issues/2025/12/20/underpriced-and-overused-fossil-fuel-subsidies-data-2025-update-572729

3 Energy Transitions Commission, Making Clean Electrification Possible www.energy-transitions.org/publications/making-clean-electricity-possible/

4 Statista, Fossil Fuel Dependency Worldwide www.statista.com/topics/12792/fossil-fuel-dependency-worldwide/

5 Enerdata, Share of Electricity in Final Energy Consumption yearbook.enerdata.net/electricity/share-electricity-final-consumption.html

6 International Energy Agency, Electrification Tracking www.iea.org/energy-system/electricity/electrification#tracking

What is this piece of work?

With growing momentum across national governments and the multiple benefits of electrification becoming clearer, there is increasing recognition that electrification should be elevated as a global priority, complementing and reinforcing existing global and national commitments[7]. Delivering the transition from ambition to implementation increasingly depends on action at the subnational level. Subnational governments can accelerate local implementation by sending clear signals, such as adopting shared electrification goals or demonstrating commitments to electrification within their jurisdictions.

These place-based actions help translate national ambition into deployable projects and investment opportunities. Because infrastructure is built locally, demand emerges regionally, and investment decisions are shaped by place-based conditions, subnational delivery plays a critical role in scaling electrification. This positions subnational governments as a bridge between national ambition and real-world implementation, aligning policy, infrastructure planning, and investment with regional conditions while accelerating progress toward national and global objectives.

Working with Under2 members, this work convenes subnational governments through structured dialogue, peer-to-peer exchange, and engagement with relevant demand- and supply-side stakeholders across fossil fuel–dependent sectors where subnational authorities hold strong levers, including heavy industry, transport, and the built environment. This process aims to strengthen subnational leadership and co-develop practical recommendations that enable effective implementation, accelerate electrification, and support progress toward national ambition.

Throughout 2026, Under2 members will gather to identify, prioritise and design region-specific policy recommendations across four priority areas of the economy: transport, heavy industry, the built environment, and energy infrastructure. This bottom-up approach complements national and global frameworks by aligning policy with regional readiness, infrastructure constraints, economic structures, and energy security priorities. Grounding recommendations in local conditions and implementation capacity enables practical delivery and accelerates electrification at scale.

Subnational Pathways to electrification

Scaling clean electrification requires a systems-level approach that addresses both demand and supply. This work moves beyond high-level ambition to identify the specific levers available to subnational governments to enable a coordinated shift. It examines how sector-focused levers can be sequenced effectively, and how policy, infrastructure, and investment decisions can be aligned to accelerate delivery. To structure this approach, four pathways to electrification are identified:

- **Pathway 1 –** Electrifying Mobility Systems
- **Pathway 2 –** Decarbonising Industrial Production
- **Pathway 3 –** Electrifying Buildings and Construction
- **Pathway 4 –** Building a Resilient Clean Power Backbone

7 We Mean Business Coalition, Electric Advantage: The Business Case for an Electrified Economy www.wemeanbusinesscoalition.org/electric-advantage-the-business-case-for-an-electrified-economy/

Together, these pathways focus on priority fossil fuel–dependent sectors that are central to shifting energy demand toward an electrified economy. Decisions across mobility, industry, buildings, and power infrastructure shape investment flows, infrastructure requirements, and market signals that determine the pace of electrification. Because these transitions involve distinct barriers, infrastructure needs, and investment requirements, implementation requires a structured approach that aligns policy, infrastructure, and financing across sectors.

Subnational governments play a critical role in coordinating these elements. They link electrified demand with clean electricity supply, support infrastructure deployment, and align planning with economic development. By addressing demand electrification and clean power supply simultaneously, the pathways provide a coordinated framework for scaling electrification while strengthening energy security, competitiveness, affordability, and economic growth. Together, the pathways strengthen subnational government leadership in moving from ambition to systemic deployment and accelerating delivery at scale.

The role of subnational governments as enablers of electrification

Electrification will not scale through national targets alone. Delivery is ultimately determined by where infrastructure is built, where demand emerges, and where investment decisions are made, all of which are shaped at the subnational level. As economies become more electricity intensive, access to clean and competitively priced electricity is increasingly defining competitiveness, resilience, and growth. Capturing this opportunity requires coordinated action across policy, business, infrastructure, and investment, aligning electrified demand with clean power supply and grid expansion.

However, many governments, policymakers, and decision makers are struggling to translate electrification ambition into practical progress. Fragmented regulation, grid constraints, infrastructure readiness gaps, and misaligned investment signals continue to slow deployment. Without coordinated action, electrification risks being delayed by infrastructure bottlenecks, investment gaps, and competing policy priorities. Subnational governments sit at the intersection of these challenges and opportunities, linking place-based demand with infrastructure planning and investment decisions.

Subnational governments influence emissions across transport, buildings, and regional industry, and are responsible for planning and permitting much of the infrastructure required for electrification. Industrial production is concentrated in regional clusters, while electrification of mobility and buildings is delivered through place-based policy levers. By leveraging policy mechanisms that drive electrification demand at the point of use, enable clean electricity supply, de-risk investment, coordinate grid upgrades, and align infrastructure with economic development, subnational governments can translate high-level commitments into scalable actions and accelerate delivery on the ground.

They are uniquely important because of their control over the last mile of delivery, particularly:

- Planning and permitting systems that determine the speed of infrastructure deployment
- Public procurement that can create lead markets for new technologies
- Regulatory frameworks that shape demand, including building codes and transport systems
- Place based economic strategies that link electrification to jobs and investment

Subnational governments are therefore not supporting actors in the transition; they are determinants of electrification speed. Regions that move faster to align demand, supply, and infrastructure will attract investment, strengthen competitiveness, and capture the economic benefits of the electrified economy.

Evidence of subnational leadership in electrification

Experience across regions demonstrates that subnational governments can accelerate electrification when planning, infrastructure, and investment are aligned. Their ability to shape local markets, coordinate stakeholders, and de risk deployment has already enabled rapid progress in clean electricity supply and electrified demand. These examples highlight how subnational leadership can translate ambition into delivery and provide a track record of success that can be replicated across regions.

In the United Kingdom, recent reforms enabling plug in and balcony solar illustrate the growing importance of decentralised electrification[8]. As distributed generation expands, subnational authorities play a key role in permitting, building standards, and local grid coordination. This enables households and businesses to electrify demand while contributing to local clean electricity supply, strengthening resilience and supporting decentralised power systems.

Germany's North Rhine Westphalia community energy fund demonstrates how coordinated action across levels of government can accelerate electrification[9]. National reforms created an enabling framework, while regional authorities helped de risk projects and mobilise investment for community owned renewable generation. This approach expanded clean electricity supply and strengthened local participation in the energy transition.

8 UK Government, Government to make 'plug-in solar' available within months www.gov.uk/government/news/government-to-make-plug-in-solar-available-within-months

9 Climate Group, Community Energy Fund: How North Rhine-Westphalia is unlocking community energy projects www.theclimategroup.org/article/community-energy-fund-how-north-rhine-westphalia-unlocking-community-energy-projects

South Australia provides a leading example of subnational leadership at scale. The state increased renewable electricity generation from around 1% to approximately 74% in just over 16 years, with a target of reaching 100% by 2027[10]. This transition was enabled by proactive planning, grid integration, large scale battery deployment, and market reforms, creating the foundation for electrification across transport, buildings, and industry.

Taken together, these examples show that subnational governments are not only implementers of national ambition, but proven market shapers capable of accelerating deployment when policy, infrastructure, and investment are aligned.

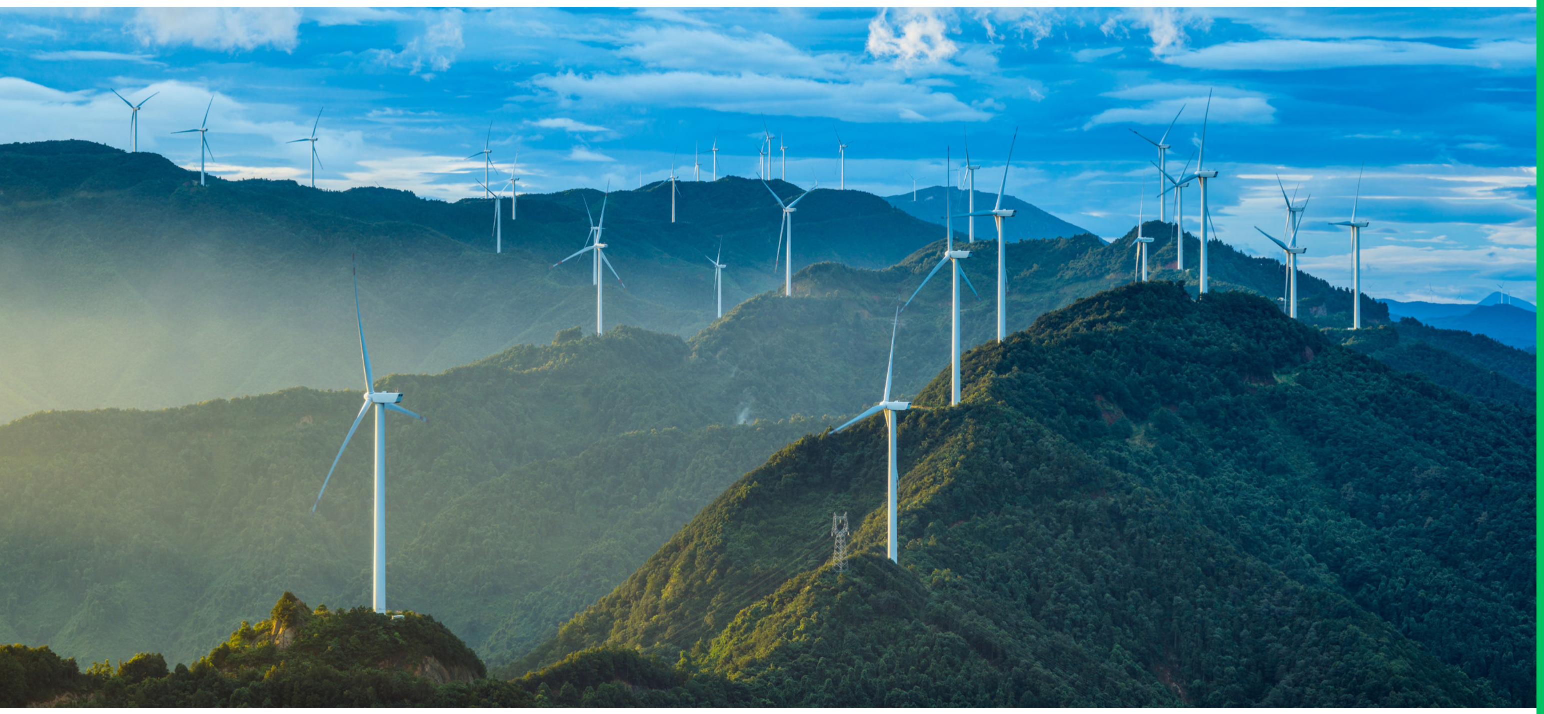
Developing Under2 Coalition's work on electrification during 2026

Building on the evidence of subnational leadership and successful deployment highlighted above, this work aims to translate proven approaches into scalable action across the Under2 network. Outcomes from this work will support the global push to elevate electrification as a priority, while strengthening aligned action across national and subnational governments. Structured through the strategic electrification pathways, this work will inform the Under2 energy transition workstream throughout 2026. By aligning implementation priorities, sharing lessons from leading regions, and identifying common challenges, this process will support subnational governments in moving from ambition to delivery and help translate electrification goals into scalable, investable opportunities.

To help unlock opportunities and address barriers, Under2 members will be convened throughout 2026 to facilitate:

- Peer learning exchanges focused on implementation challenges and practical solutions
- Identification and scaling of pilot initiatives aligned with the electrification pathways
- Development of credible and implementation ready electrification commitments
- Joint corporate and government initiatives to unlock investment and accelerate delivery

10 NB -- not published yet, but to be added when published on CG website- Under2 - Data 2026 - All Documents



1.0 Subnational Electrification Pathways: Identifying barriers and opportunities to scale clean electrification and growth

Moving from ambition to effective implementation requires electrification to be approached as a coordinated system transformation across sectors.

To translate the role of subnational governments into actionable implementation, this white paper structures electrification across four strategic pathways that capture the core components required to scale clean electrification: electrifying demand in transport, industry, and buildings, while simultaneously expanding clean electricity supply and enabling infrastructure. These pathways reflect where subnational governments hold strong levers, where electrification can deliver economic and emissions benefits, and where coordinated action across demand and supply is required. Together, they provide a structured approach to assess readiness, identify barriers, and unlock opportunities to accelerate deployment at scale.

Each pathway examines opportunities to increase demand-side electrification, scale clean electricity supply, and enable the infrastructure required for delivery. This includes identifying implementation gaps, investment needs, and coordination challenges, while also assessing how electrification can strengthen energy security, improve competitiveness, and support affordability. By structuring analysis across pathways, this work supports a coordinated transition toward an electrification-based economy.

The four pathways are not intended to be mutually exclusive, and there are significant overlaps between transport, industry, buildings, and clean power systems. Activities across the pathways therefore focus on identifying shared barriers, highlighting scalable opportunities, and strengthening coordination between stakeholders. This includes generating practical insights, identifying pilot initiatives, and supporting collaboration with businesses and investors to unlock implementation. Together, the pathways provide a foundation for advancing subnational leadership and accelerating delivery of an electrified economy.

To ensure consistency across all pathways, knowledge targets are grouped into four common areas: mapping electrification readiness and barriers for scale, identifying opportunities for energy security, affordability, and competitiveness, understanding investment requirements, and defining the coordination role of subnational governments. This structured approach supports comparable insights across sectors and helps inform pathway-specific policy recommendations.

Pathway 1
Electrifying Mobility Systems

Pathway 2
Decarbonising Industrial Production

Pathway 3
Electrifying Buildings and Construction

Pathway 4
Building a Resilient Clean Power Backbone

1.1 Pathway 1 – Electrifying Mobility Systems

Transport is one of the largest and fastest growing sources of energy demand, accounting for around 30% of global energy use[11] and remaining heavily reliant on fossil fuels, particularly in road transport. As economies electrify, mobility is emerging as a major new source of electricity demand, driven by rapid growth in electric vehicles, electrified public transport, and electric two- and three-wheelers. Falling battery costs, expanding model availability, and stronger policy support are accelerating adoption, with global electric vehicle sales continuing to rise and representing a growing share of new vehicle markets. However, deployment remains highly uneven across regions. The majority of electric vehicle sales are concentrated in a small number of markets, with China accounting for roughly two thirds of global EV sales, followed by Europe at roughly 17%, and the United States at around 7%[12], while adoption in many emerging and developing economies remains limited. Charging infrastructure, grid readiness, manufacturing capacity, and affordability barriers continue to slow uptake in many regions, creating the risk that regions with weaker infrastructure and industrial readiness fall behind in the transition.

Despite growing momentum, current deployment remains below what is required to align with net zero pathways. Transport remains heavily dependent on fossil fuel vehicles, and delays in electrifying mobility risk locking in long-lived emissions. Globally, there is still a deficit of around 500 million electric passenger vehicles, 380 million electric two- and three-wheelers, and 78 million electric and fuel cell trucks and buses between current trends and net zero aligned pathways by 2050[13]. This gap highlights the scale of acceleration required across both light-duty and heavy-duty transport.

11 International Energy Agency, Energy Efficiency 2025 – Transport www.iea.org/reports/energy-efficiency-2025/transport

12 BloombergNEF, Electric Vehicle Outlook 2025 – Executive Summary assets.bbhub.io/professional/sites/24/202506-EVO2025-Executive-Summary.pdf

13 IEA Net Zero Scenario EV gap numbers www.iea.org/reports/global-ev-outlook-2024

Without faster adoption, transport emissions will remain difficult to reduce, undermining broader decarbonisation efforts and prolonging reliance on imported fossil fuels.

Advances in technology have accelerated change across the global automotive market. In countries where policy support and infrastructure are in place, adoption has grown rapidly. In Norway, battery electric vehicles accounted for more than 90% of new car sales in 2024[14], while in China, electric cars accounted for around 50% of new car sales in recent years[15], making it the world's largest market and a major driver of global electrified mobility. These examples demonstrate how coordinated policy, infrastructure deployment, and market incentives can rapidly scale electrified mobility. However, the transition also raises economic and industrial challenges, particularly in regions with established automotive manufacturing bases. For subnational governments with significant automotive industries, electrification introduces risks related to supply chain shifts, workforce transitions, and regional competitiveness. Ensuring a just and managed transition therefore becomes a critical priority, requiring policies that support industrial transformation, workforce reskilling, and new investment opportunities alongside the scale-up of electrified mobility.

Subnational governments are already deploying a range of policy tools to accelerate electrified mobility, including zero-emission zones, public procurement of electric buses and fleets, toll incentives, transport electrification corridors, public-private charging infrastructure partnerships, and right-to-charge legislation. These place-based interventions highlight the role of subnational governments in shaping demand, enabling infrastructure deployment, and coordinating stakeholders across the mobility ecosystem.

Electrifying mobility systems is therefore identified as a priority pathway because it offers one of the most immediate and scalable opportunities to reduce fossil fuel dependence while stimulating electricity demand aligned with clean power expansion. Delivering this transition requires coordinated action across vehicle adoption, charging infrastructure deployment, grid readiness, battery technology, and manufacturing supply chains. Subnational governments play a critical role in enabling this shift through transport planning, public procurement, infrastructure deployment, permitting, and demand-shaping policies. By aligning vehicle adoption with charging networks, grid upgrades, and local industrial opportunities, subnational governments can accelerate electrified mobility while ensuring the transition is inclusive, regionally balanced, and economically competitive. This pathway therefore focuses on identifying opportunities and barriers to scaling electrified mobility systems and the actions required to support deployment at pace.

14 Reuters — Norway EV sales "In Norway, nearly all new cars sold in 2024 were fully electric" www.reuters.com/world/europe/norway-electric-cars-2024

15 Oxford Institute for Energy Studies — China EV share China New Energy Vehicle update www.oxfordenergy.org/wpcms/wp-content/uploads/2024/China-new-energy-vehicle-NEV-update.pdf

Knowledge targets

Mapping electrification readiness and barriers for scale

- How are subnational governments shaping and inputting into national electromobility strategies and targets?
- What are the key barriers to scaling electrified mobility across passenger vehicles, freight, and public transport?
- How can subnational governments support the scale up of charging infrastructure across urban, regional, and rural contexts?
- What policy options are available to support electricity supply, grid upgrades, and integration of transport electrification demand?
- How are governments addressing workforce and skills requirements to support the transition to electrified mobility systems?

Opportunities for energy security, affordability, and competitiveness

- How can electrified mobility reduce fossil fuel dependence and improve energy security at the regional level?
- What opportunities exist to lower transport costs and improve affordability through electrification?
- How can subnational governments support local manufacturing, supply chains, and economic transition in regions with automotive and transport industries?
- What role can public sector fleet electrification play in accelerating market adoption and reducing costs?

Investment and financing requirements

- What investment is required to scale charging infrastructure, fleet electrification, and supporting grid upgrades?
- How can public private partnerships accelerate deployment of charging networks and electrified fleets?
- What mechanisms can help de risk investment in emerging markets and regions with lower adoption?
- What market design mechanisms are needed to support investable charging infrastructure and fleet electrification?

Coordination gaps and the role of subnational governments

- How can subnational governments align transport planning with charging infrastructure and grid development?
- What coordination mechanisms are needed between subnational governments, utilities, and private sector investors?
- How can subnational governments coordinate across the value chain to accelerate deployment at scale?
- What role can subnational governments play in shaping local charging and flexibility markets?

1.2 Pathway 2 – Decarbonising Industrial Production

Heavy industry is one of the most important sectors to decarbonise. Industry accounts for around 37% of global energy use[16] and contributes roughly one third of global energy-related CO_2 emissions[17]. A large share of this demand comes from industrial heat used in industrial processes, accounting for more than 20% of global energy consumption[18]. This makes industrial heat one of the most significant opportunities for reducing emissions, yet around 85% of industrial heat is still generated from fossil fuels[19]. Approximately 850 TWh of current process heating demand takes place at temperatures below 500°C, implying that around 48% of total heat demand can be electrified using mature technologies such as heat pumps and electric boilers[20].

Industrial electrification therefore offers a direct pathway to lower emissions by up to 30% while improving energy security and long-term competitiveness[21]. Without stronger action, rising demand for industrial materials risks locking in carbon-intensive production and putting net zero pathways further out of reach.

16 IRENA – Industry energy use www.irena.org/Energy-Transition/Technology/Industry

17 Eurelectric – Industrial competitiveness electrification powersummit2025.eurelectric.org/wp-content/uploads/2025/06/Eurelectric-Industrial-Competitiveness-Policy-Recommendations.pdf

18 McKinsey – industrial heat share www.mckinsey.com/industries/industrials/our-insights/tackling-heat-electrification-to-decarbonize-industry

19 McKinsey – fossil share of industrial heat www.mckinsey.com/industries/industrials/our-insights/tackling-heat-electrification-to-decarbonize-industry

20 ABB / McKinsey low-temp electrification potential www.abb.com/global/en/areas/motion/sustainability/decarbonization

21 Iberdrola – emissions reduction potential electrification www.iberdrola.com/about-us/our-sector/electrification/industrial-electrification

In Europe alone, analysis suggests that 60–90% of industrial energy demand could be directly electrified by 2035[22], yet only around 4% of industrial heat is electrified today[23]. Solutions such as electric boilers, resistance heating, induction heating, and industrial heat pumps are already deployable, while higher temperature options including electric arc furnaces, plasma heating, and electrified chemical processes are progressing.

The opportunity is significant, but electrification will only deliver at scale if clean electricity supply and grid infrastructure expand in parallel with industrial demand. Otherwise, the constraint simply shifts from fossil fuel dependence to power system bottlenecks. Cost competitiveness, grid capacity, capital intensity, and regulatory uncertainty remain major barriers, particularly for high-temperature applications and long-lived industrial assets.

The steel sector illustrates both the urgency and the opportunity. Steel is the largest emitting manufacturing sector, responsible for around 7–8% of global emissions[24], and most primary steel is still produced through blast furnace–basic oxygen furnace routes that rely heavily on coal, which accounts for roughly 89% of energy input in primary steel production[25]. Secondary steel production using scrap in electric arc furnaces is far less emissions intensive and can approach near-zero emissions when powered by low-carbon electricity, but primary steel will still be needed at scale.

The age profile of existing assets also matters. Much of the blast furnace fleet in Europe and the United States is older, creating a window for replacement with lower-emission production routes, while China's blast furnace fleet is relatively young, making early retirement more difficult and increasing the importance of strategies such as greater scrap use, incremental electrification, and low-carbon power integration. Because blast furnaces operate for decades, investment decisions taken now will shape industrial emissions and competitiveness for a generation.

National governments are increasingly embedding industrial electrification into broader industrial, energy, and climate strategies. The European Union's Clean Industrial Deal positions industrial decarbonisation and electrification as part of its competitiveness agenda. But turning national ambition into investable projects depends heavily on subnational delivery. Industrial production is concentrated in regional clusters, which places subnational governments at the centre of permitting, infrastructure planning, grid expansion, workforce transition, and coordination with utilities and industry.

Accelerating the shift from fossil fuel technologies to electric alternatives therefore requires a coordinated approach that combines regulation, targeted financial support, and strategic planning. Decarbonising industrial production is therefore a priority pathway because it addresses a major source of emissions while creating opportunities to strengthen industrial competitiveness, reduce exposure to fossil fuel volatility, and position regions to lead in the electrified economy.

22 Eurelectric — electrification potential Europe powersummit2025.eurelectric.org/industrial-competitiveness/

23 McKinsey / Eurelectric — current electrified heat share powersummit2025.eurelectric.org/industrial-competitiveness/

24 World Economic Forum — steel emissions share www.weforum.org/publications/the-net-zero-industry-tracker/in-full/steel-industry/

25 World Steel Association — coal energy share worldsteel.org/wp-content/uploads/Fact-sheet-Energy-use-in-the-steel-industry.pdf

Knowledge targets

Mapping electrification readiness and barriers for scale

- What share of industrial energy demand in regional clusters can be electrified using mature technologies today?
- What infrastructure constraints, including grid capacity, connection timelines, and electricity availability, are limiting industrial electrification?
- Which industrial processes present the most immediate opportunities for electrification at scale?
- What regulatory, permitting, and planning barriers are slowing deployment of electrified industrial technologies?
- How can subnational governments support industrial electrification in energy intensive sectors?
- What workforce, skills, and supply chain gaps must be addressed to support electrified industrial production?

Opportunities for energy security, affordability, and competitiveness

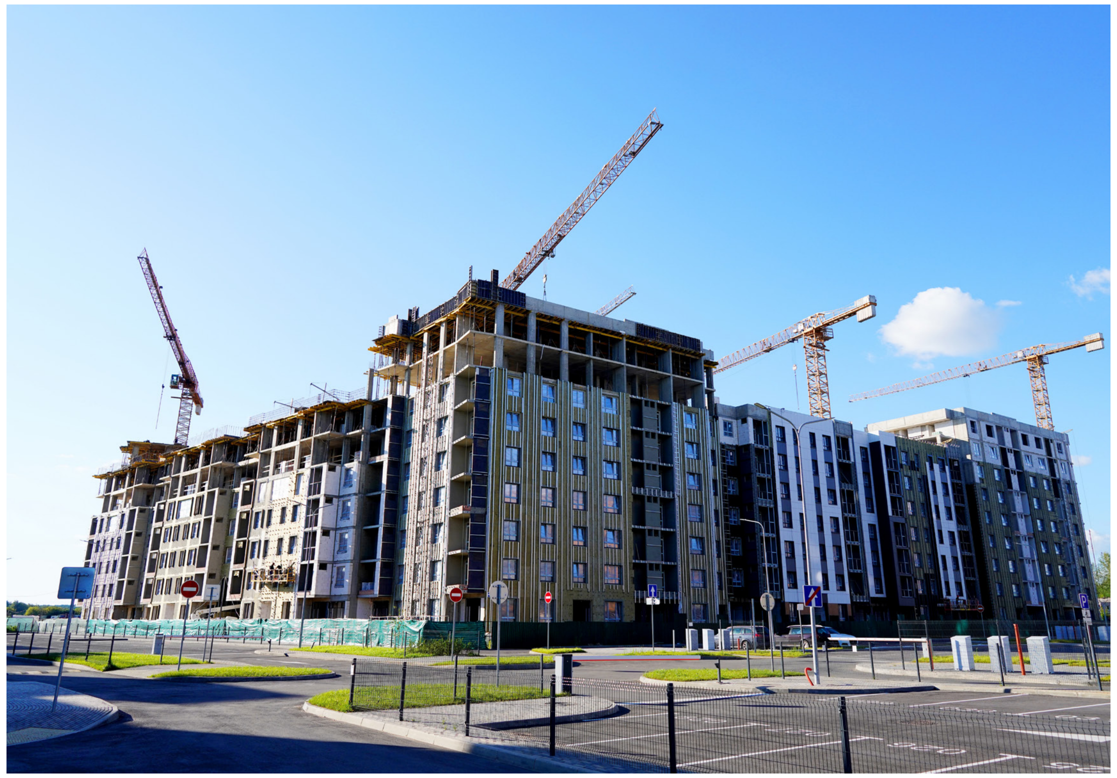
- How can industrial electrification reduce exposure to fossil fuel price volatility and strengthen regional energy security?
- What competitiveness opportunities emerge from electrified industrial clusters powered by clean electricity?
- How can electrified industrial processes improve efficiency, productivity, and innovation?
- Can embodied carbon building regulations support the transition to lower-emission industrial products?
- How can subnational governments link industrial electrification with economic development and job creation?
- What role can demand-side policies play in accelerating markets for low-emission industrial products?

Investment and financing requirements

- What investment is required to electrify industrial processes and supporting infrastructure at scale?
- Can public procurement support the affordable uptake of new technologies and low-emission industrial products?
- What financing mechanisms can help de-risk industrial electrification projects?
- How are regional carbon pricing schemes helping to finance the transition to lower-carbon production?
- What electricity pricing and market design changes are needed to improve the competitiveness of electrified industrial processes?
- How can subnational governments support investment in industrial electrification through infrastructure planning and coordination?

Coordination gaps and the role of subnational governments

- How can subnational governments coordinate industrial demand with clean electricity supply and grid expansion?
- What role can regional industrial clusters play in accelerating electrification?
- How are subnational governments working with utilities, industry, and investors to plan electrified industrial development?
- What coordination mechanisms are needed between national industrial strategies and subnational implementation?
- What measures are needed to support the transition of existing workforces towards low-carbon production models?
- How can subnational governments align industrial policy, infrastructure, and energy planning to accelerate electrification?



1.3 Pathway 3 - Electrifying Buildings and Construction

Buildings represent one of the largest and most immediate opportunities to accelerate clean electrification. The buildings sector accounts for around 30% of global final energy demand[26], with space and water heating responsible for roughly 50% of total building energy consumption[27]. Heating demand remains heavily reliant on fossil fuels, with the majority of building heat still provided through direct combustion of gas, oil, and coal. In Europe, heating accounts for around 80% of energy use in buildings[28], with most systems still dependent on fossil fuel boilers. At the same time, global building floor area is projected to more than double by 2050, particularly in emerging and developing economies, increasing demand for heating, cooling, and electricity[29]. Without accelerated electrification, growing building demand risks locking in long-lived fossil fuel infrastructure and prolonging exposure to volatile fuel markets.

Electrifying buildings through heat pumps, electric heating systems, and smart energy management offers a scalable pathway to reduce emissions while improving efficiency and affordability. Heat pumps can deliver three to five units of heat for every unit of electricity[30], significantly reducing energy demand compared with conventional fossil fuel boilers. District heating and cooling networks also provide an important solution, particularly in dense urban areas, enabling large-scale deployment of electric heat pumps, waste heat recovery, and renewable heat sources. These systems can aggregate demand across neighbourhoods, reduce installation complexity, and improve efficiency. However, deployment remains below what is required to align with net zero pathways. Rollout is constrained by installation capacity, permitting timelines, workforce shortages,

26 IEA — buildings energy demand www.iea.org/reports/buildings
27 IEA — heating share in buildings www.iea.org/reports/tracking-buildings-2023
28 European Commission — heating share Europe energy.ec.europa.eu/topics/energy-efficiency/heating-and-cooling_en
29 IEA — floor area doubling by 2050 www.iea.org/reports/buildings
30 IEA heat pump efficiency (3–5 COP) www.iea.org/reports/the-future-of-heat-pumps

and the need for distribution grid upgrades. Slow permitting pipelines, limited installer availability, and insufficient planning for electrified heat networks continue to delay adoption in many regions.

Buildings also provide a major opportunity to scale distributed clean electricity supply. Rooftop solar across residential, commercial, and public buildings represents a significant untapped resource. Analysis from the European Commission's Joint Research Centre finds that rooftop solar could supply around 40% of Europe's electricity demand by 2050[31], highlighting the scale of generation potential embedded within the building stock. Public buildings, commercial rooftops, and residential housing represent large available surfaces for rapid deployment. When combined with electrified heating and smart demand management, rooftop solar can reduce peak demand, lower energy costs, and improve system resilience. Unlocking this opportunity requires streamlined permitting, supportive incentives, and integration with building codes and urban planning frameworks.

Subnational governments are central to delivering this transition. They control building codes, zoning rules, retrofit programmes, public housing, permitting systems, and local energy planning. They are also responsible for planning district heating networks, coordinating building retrofits, and enabling rooftop solar deployment. These levers directly determine whether fossil fuel heating is replaced with electrified systems, whether distributed generation is deployed at scale, and whether electricity and heat networks are prepared for rising demand. Because buildings have long asset lifetimes, often 20 to 30 years for heating systems, decisions made today will shape energy demand and emissions for decades. Electrifying buildings and construction are therefore identified as a priority pathway because it reduces fossil fuel dependence at scale, supports distributed clean electricity generation, strengthens energy security, and creates flexible electricity demand that supports the broader electrified economy. The pace of building electrification will ultimately be determined by subnational policy, planning, and implementation.

Knowledge targets

Mapping electrification readiness and barriers for scale

- What share of building heat demand can be electrified using heat pumps, electric heating systems, and district heating networks?
- What infrastructure constraints, including grid capacity and connection timelines, are limiting electrification of buildings?
- What barriers are slowing deployment of rooftop solar across residential, commercial, and public buildings?
- What workforce and installation capacity challenges are limiting deployment of heat pumps, district heating, and distributed solar?
- What regulatory, planning, and permitting barriers are slowing electrification of buildings and construction?

31 European Commission Joint Research Centre Rooftop solar could meet 40% of EU electricity demand joint-research-centre.ec.europa.eu/jrc-news-and-updates/rooftop-solar-could-meet-40-eus-long-term-electricity-demand-2026-01-21_en

Opportunities for energy security, affordability, and competitiveness

- How can building electrification reduce reliance on imported fossil fuels for heating and cooling?
- What opportunities exist to lower energy costs for households and businesses through electrified heating and rooftop solar deployment?
- How can electrified buildings provide flexible demand to support renewable integration and grid stability?
- How can subnational governments align building electrification with affordability and regional economic development goals?
- How can electrified buildings improve resilience to energy price volatility and energy security?

Investment and financing requirements

- What investment is required to scale heat pump deployment and district heating infrastructure?
- What financing mechanisms can support electrification of existing building stock, including residential and public buildings?
- How can incentives support rapid deployment of rooftop solar across residential, commercial, and public buildings?
- What policy options can improve the business case for electrified heating compared with fossil fuel systems?
- How should policymakers plan for rising electricity demand from large buildings, including data centres, while maintaining equitable and affordable access to electricity?
- How can subnational governments use public procurement to accelerate electrified construction and retrofit programmes?

Coordination gaps and the role of subnational governments

- How can subnational governments ensure alignment between building electrification policies and wider goals in industry and transport?
- What role can subnational governments play in coordinating building electrification with grid upgrades and distributed generation?
- How can subnational governments integrate rooftop solar, electrified heating, and district heating into local energy planning?
- What coordination is required between utilities, housing authorities, and local governments to accelerate retrofit deployment?
- How can subnational governments align planning rules, building codes, and infrastructure deployment to support electrification?
- How can subnational governments coordinate growing electricity demand from buildings with clean power supply expansion?

1.4 Pathway 4 – Building a Resilient Clean Power Backbone: Grids and Infrastructure

There is no energy transition without transmission. Electrification across transport, industry, and buildings depends on electricity grids capable of delivering clean power where and when it is needed. Yet grid infrastructure is not expanding or modernising fast enough to match rising demand. In many advanced economies such as Europe and North America, electricity networks average around 40 years old[32], with large portions approaching or exceeding their design lifetimes. Many grid systems were originally designed for centralised fossil fuel generation and are increasingly poorly suited to two-way power flows from distributed renewables, electrified heating, and electric mobility.

At the same time, global electricity demand is projected to grow at around 3.6% annually between 2026 and 2030, roughly 50% faster than the previous decade and at least 2.5 times faster than overall energy demand[33]. This growth is driven by rising electrified demand from transport, buildings, industry, and data centres. Without expansion and modernisation of transmission and distribution networks, grids risk becoming the primary bottleneck to electrification. Around $5.8 trillion in investment is needed for grid upgrades between 2026 and 2035[34].

Grid infrastructure is already struggling to keep pace. Around 3,000 GW of renewable power projects, including approximately 1,500 GW in advanced stages of development, were awaiting grid connections in 2024[35]. Connection delays are also affecting electrified demand, with heat pumps, EV charging infrastructure, and industrial electrification

32 Nexans — grid age and infrastructure modernisation www.nexans.com/perspective/bringing-power-grids-back-to-life-a-key-lever-for-the-energy-transition/

33 IEA electricity demand growth www.iea.org/reports/electricity-2024

34 BloombergNEF / IEA grid investment needs www.iea.org/reports/electricity-grids-and-secure-energy-transitions

35 IEA — renewable projects waiting for grid connection www.iea.org/reports/electricity-grids-and-secure-energy-transitions

projects increasingly facing long waiting times due to limited grid capacity. In many European markets, businesses report grid connection timelines of five to seven years, despite assets such as data centres, electrified industrial equipment, or large heat pump systems being deployable within two to three years.

Permitting also remains a primary cause of delays for transmission infrastructure, often extending project timelines to eight to ten years[36] and significantly delaying the integration of both new generation and electrified demand. Supply chain constraints are further slowing deployment. An IEA survey of industry players finds that it now takes two to three years to procure cables and up to four years to secure large power transformers, with lead times for key components having almost doubled since 2021[37]. Some specialised equipment is even more constrained, with waiting times for direct current cables extending beyond five years, while rising demand has also significantly increased costs. These combined delays across permitting, connection queues, and supply chains are slowing electrification projects and increasing uncertainty for businesses.

These constraints are not purely technical. Grid expansion is often slowed by planning approvals, stakeholder negotiations, land use constraints, and uncertainty around financing and cost recovery. Utilities face challenges investing ahead of demand without regulatory certainty, while private developers face delays connecting renewable energy, electrified heating, and industrial loads. At the same time, large volumes of electrification demand are emerging across buildings, transport, and industry, including heat pumps, EV charging infrastructure, and distributed renewable generation.

Without anticipatory investment, congestion and curtailment increase, reducing the efficient use of clean electricity and limiting flexibility across electrified sectors. Addressing these barriers requires coordinated planning, streamlined permitting, long-term procurement strategies, and regulatory frameworks that enable investment in grid expansion ahead of demand.

Subnational governments are central to delivering this clean power backbone. Electrified demand emerges locally through transport systems, building electrification, and industrial clusters, placing subnational authorities at the centre of grid planning, permitting, land-use decisions, and stakeholder coordination. They play a critical role in accelerating infrastructure approvals, aligning demand forecasts with utilities, enabling distributed generation such as rooftop solar, and supporting deployment of district energy and flexibility solutions.

Subnational governments can also help unlock investment through policy signals, incentives, and coordination mechanisms that reduce uncertainty for utilities and private investors. Building a resilient clean power backbone is therefore foundational to all other electrification pathways. Without expanded and modernised grids, electrification of mobility, industry, and buildings cannot scale. The pace of the energy transition will ultimately be determined by how quickly subnational governments enable grid infrastructure to move from planning to deployment.

36 IEA — transmission permitting timelines www.iea.org/reports/building-the-future-transmission-grid

37 IEA supply chain constraints transformers and cables www.iea.org/reports/electricity-grids-and-secure-energy-transitions

Knowledge targets

Mapping electrification readiness and barriers for scale

- Where are grid capacity constraints limiting electrification of transport, buildings, and industry?
- What share of grid infrastructure requires modernisation to support electrified demand and distributed generation?
- What permitting and planning barriers are delaying grid expansion and connection timelines?
- How long are connection timelines for renewables, heat pumps, EV charging, and industrial electrification?
- Where are congestion and curtailment limiting the integration of clean electricity?
- How are supply chain constraints, including cables and transformers, affecting grid deployment timelines?
- What role can energy efficiency policies play in reducing peak demand and limiting the need for new infrastructure?
- How can subnational governments assess readiness for integrating distributed generation such as rooftop solar?

Opportunities for energy security, affordability, and competitiveness

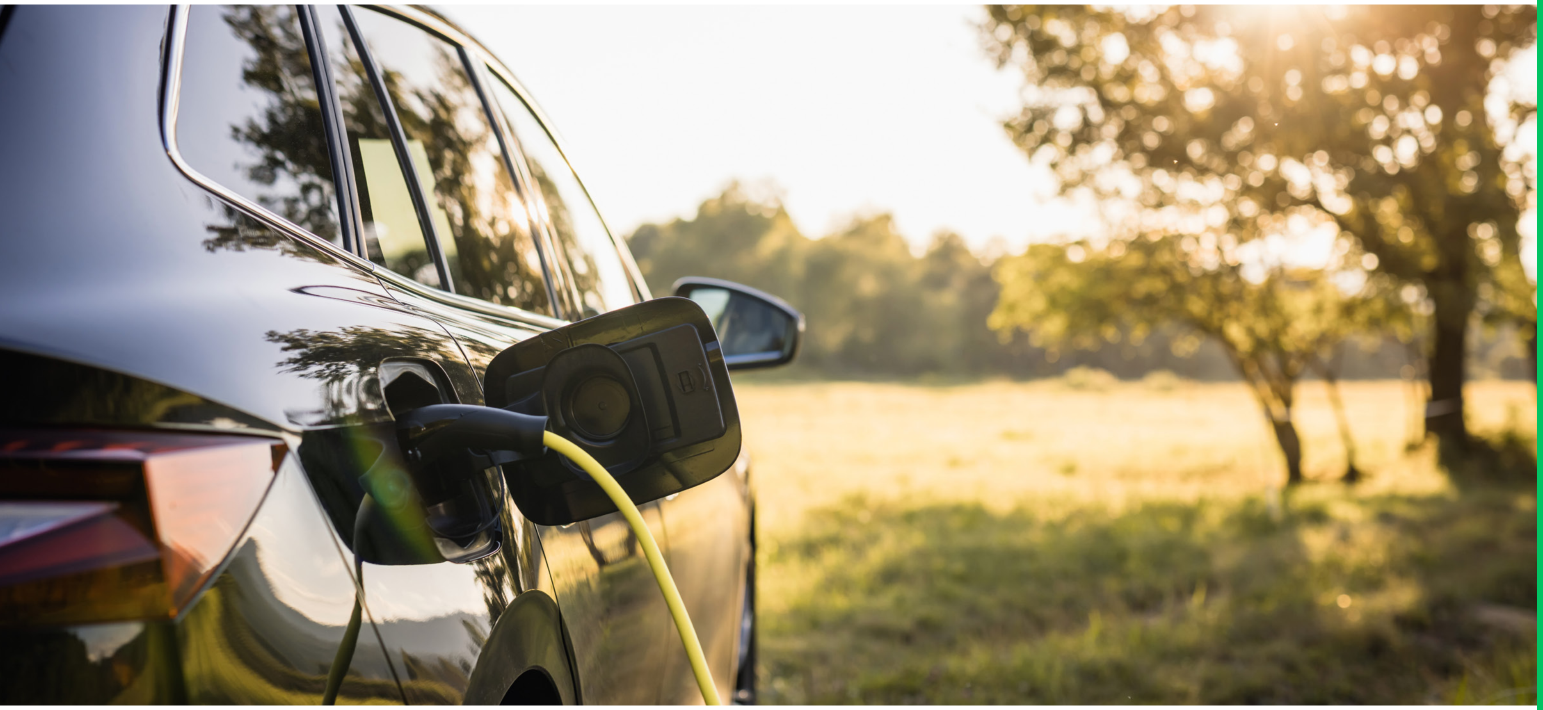
- How can grid expansion improve energy security by enabling domestic clean electricity supply?
- What opportunities exist to reduce electricity costs through improved grid flexibility and integration of renewables?
- How can distributed energy resources reduce infrastructure costs while improving affordability and resilience at the regional level?
- What role can subnational governments play in encouraging private sector uptake of renewable energy?
- How can grid modernisation support regional competitiveness and industrial development?
- What opportunities exist to improve reliability and resilience against climate and physical risks?
- How can local flexibility, storage, and demand response reduce the need for costly grid expansion?

Investment and financing requirements

- What investment is required to expand and modernise transmission and distribution networks?
- How can regulatory frameworks support anticipatory grid investment ahead of demand?
- What incentives are needed to unlock private finance for grid expansion and digital infrastructure?
- How can subnational governments support financing for distributed energy and local grid upgrades?
- What procurement strategies can reduce supply chain bottlenecks for cables, transformers, and equipment?
- How can public private partnerships accelerate deployment of grid infrastructure?
- What mechanisms can ensure cost recovery while maintaining affordability for consumers?

Coordination gaps and the role of subnational governments

- How are subnational governments working with energy utilities and customers to identify challenges and opportunities?
- What coordination mechanisms are needed between subnational governments, utilities, and system operators?
- How can subnational governments align grid expansion with electrification demand from transport, buildings, and industry?
- What role can subnational governments play in accelerating permitting and siting of grid infrastructure?
- How can subnational governments coordinate distributed generation, storage, and demand response deployment?
- How can subnational governments support anticipatory grid planning to avoid future bottlenecks?
- What role can subnational governments play in building stakeholder consensus for new transmission infrastructure?



2.0 Capturing Economic Value and Resilience Through Subnational Electrification Pathways

The four electrification pathways provide more than a framework for implementation. They define how subnational governments can capture the economic value of the electrified economy. By coordinating demand electrification across transport, industry, and buildings, while simultaneously scaling clean power supply and enabling grid infrastructure, subnational governments can strengthen energy security, improve affordability, enhance competitiveness, and support job creation. Electrification therefore becomes not only a decarbonisation strategy, but a pathway to economic growth and long-term resilience.

Electrification strengthens energy security by reducing exposure to volatile fossil fuel markets and shifting energy demand toward domestically generated electricity. Around three quarters of the global population live in countries that are net importers of fossil fuels, exposing economies to price volatility and supply disruption[38]. The European Union alone imported €375.9 billion worth of energy products in 2024[39], illustrating the scale of exposure to external fuel markets. Accelerating electrification supported by domestic renewable energy reduces reliance on imported fuels, stabilises energy costs, and improves long-term affordability while strengthening resilience to geopolitical shocks.

At the same time, electrification is reshaping competitiveness and economic growth. Electrified technologies are typically more energy efficient than fossil fuel alternatives, reducing overall energy demand and lowering operating costs over time. Scaling clean electricity supply and electrified demand also creates new opportunities for investment,

38 Energy Transitions Commission, Making Clean Electrification Possible www.energy-transitions.org/publications/making-clean-electricity-possible/

39 Eurostat, EU imports of energy products, 2024 ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20250321-1

industrial development, and supply chain growth. Renewable energy deployment generates around three times more jobs per dollar invested than fossil fuels[40], while global manufacturing capacity for key electrification technologies such as electric vehicles and heat pumps currently covers only around 20–30% of expected demand[41]. Much of the supply chain, installation capacity, and enabling infrastructure still needs to be built, creating opportunities for regions that move early to capture investment, jobs, and industrial development.

In many parts of the Global South, where electricity access remains limited or supply capacity is insufficient to meet growing demand, electrification also supports energy access and inclusive economic development. The International Energy Agency estimates that around 730 million people lacked access to electricity in 2024, the majority in sub-Saharan Africa[42]. Expanding clean electricity systems improves reliability, supports industrial growth, and strengthens economic resilience.

Each electrification pathway provides a distinct route to capturing this value. Electrifying mobility systems reduces fuel imports, lowers transport costs, and stimulates investment in charging infrastructure and supply chains. Electrifying industrial production improves competitiveness, reduces exposure to fossil fuel price volatility, and supports the development of low-carbon industrial clusters. Electrifying buildings reduces energy demand, lowers household and business energy costs, and enables distributed generation and flexibility. Building a resilient clean power backbone strengthens energy security, enables investment, and supports the expansion of electrified demand across sectors. Together, these pathways align demand electrification with clean power supply and enabling infrastructure, providing subnational governments with a structured approach to capture economic value while accelerating the transition to an electrified economy.

40 UK Energy Research Centre, Green job creation, quality, and skills: A review of the evidence on low carbon energy ukerc.ac.uk/publications/green-job-creation-quality-and-skills/

41 Eurelectric, Industrial Competitiveness and Electrification powersummit2025.eurelectric.org/industrial-competitiveness/

42 International Energy Agency, SDG7 Data and Projections www.iea.org/reports/sdg7-data-and-projections

3.0 Conclusion

The four electrification pathways provide a structured foundation for translating ambition into implementation. They identify priority fossil fuel dependent sectors where subnational governments can accelerate deployment at scale and capture economic value, while addressing pathway specific challenges and opportunities. By assessing readiness, identifying barriers, mobilising investment, and strengthening coordination across mobility, industry, buildings, and clean power infrastructure, the pathways help prioritise action. Together with the common knowledge targets, the pathways link electrified demand with clean power supply and enabling infrastructure. This enables subnational governments to align stakeholders, move from planning to delivery, and scale electrification. Advancing these pathways positions regions to strengthen energy security, improve affordability, enhance competitiveness, and capture the growth opportunities of the electrified economy.

Building on this foundation, the next phase of this work will focus on co-creating implementation-focused policy actions with Under2 members and relevant stakeholders. Together, this provides a framework for a bottom-up approach that accelerates local implementation, creates investable opportunities, and supports scaling electrification from subnational action to national ambition. Through structured dialogue, peer exchange, and engagement across demand- and supply-side actors, the pathways and knowledge targets will inform joint commitments that send clear signals for scaling electrification. By strengthening coordination across subnational governments, stakeholders, and sectors, the pathways translate electrification into systemic deployment at scale, reinforce national strategies, and help elevate electrification as a global priority.

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