

Electrification is the main road to decarbonization

Context

The world could cover a large proportion of its energy needs by electrifying demand and supplying it with renewable generation. This strategy not only brings significant economic savings and improved air quality: it is an imperative for our survival on Earth.

- **Climate emergency.** To avoid the most damaging effects of global warming, the temperature rise must be limited to 1.5°C by the end of the century.
- **Urgency to decarbonize.** To achieve 1.5°C the world must, not only reach net zero emissions by 2050, but also halve current emissions by 2030: half of the journey toward net-zero must be accomplished within the coming decade.

There is a **clear route for halving emissions in the 2020s: clean electrification**. Electrified end-uses generate no emissions, but electricity generation must also be decarbonized. Yet, renewable energies have now clearly demonstrated their commercial viability: solar photovoltaic and offshore wind are now the cheapest forms of electricity. These are proven technologies ready to be massively deployed.

Where to make the first cut in emissions?

Some sectors are harder to decarbonize than others (agriculture, specific heavy industries such as steel or cement). However, three energy uses could already be subject to rapid transformations:

- **Mobility:** electrification of road transport would reduce current equivalent CO₂ emissions by ~12%.
- **Buildings:** electrification of heating would cut down ~6% of equivalent CO₂ emissions.
- **Industry:** all processes with industrial heat requirements below 1,000°C could be electrified with technologies available today, eliminating ~6% of equivalent CO₂ emissions.

Direct electrification is the obvious winner in these three sectors for speed, scale and cost. This is because on the one hand technologies already exist to decarbonize them at scale and, on the other hand, because they are easier to access for retrofit due to shorter lifespans.

In addition, accelerating the decarbonization of the power sector (on current uses) would further reduce emissions by ~30%. Finally, the displacement of fossil fuels would have a positive impact on the ~6% fugitive emissions from the oil and gas industry.

In total, 60% of current emissions would be cut down by electrifying road transport, buildings and low-temperature industrial processes, in combination with renewable power generation.

The key benefit: electrification is efficiency

One of the key benefits of electrification, particularly electrification powered by renewables, is the **enormous efficiency gain** that can be realized: this approach will **halve the primary energy requirements of most economies**.

The current energy system is wasteful. In the US alone approximately 70% of primary energy is “rejected energy”. An electric car uses around one third of the energy than a car with a diesel or petrol engine. A heat pump powered by clean electricity provides 2 to 4 times as much heat to a home as a boiler powered by natural gas. Similarly, on the supply side, renewable power plants are far more efficient than their fossil fuel counterparts, as coal and gas power plants lose almost half of their energy as heat. A typically underappreciated benefit of clean electrification is also the elimination of supply chains for mining and moving the fossil fuels across the globe.

Pathways to electrification

Scaling up must happen now

Governments must take action to unlock clean electrification, which will have major economic and environmental benefits in the long run. Clean electrified technology has reached maturity, but there are important bottlenecks that limit massive deployment.

Strategies for operationalizing this pathway include:

- **Focus on critical industries.** We need to scale up ten-fold the critical industries: electric vehicle production, heat pump production, battery production, wind, and solar production.
- **Train the workforce.** We need unprecedented levels of workforce training to enable a transition, including, critically, retraining and incentives for the fossil fuel industry workforce to transition.

Enabling electrification by empowering demand

The electricity grid was designed for consistent, predictable power generation, while large amounts of variable renewables will be needed for decarbonization. However, we can incorporate new digital technologies that can **make the demand flexible enough** to accommodate the fluctuations in generation.

Strategies for operationalizing this pathway include:

- **Focus on deployment.** Technology is ready to meet that challenge. Both hardware and software technologies are readily available: distributed energy resources, vehicle-to-grid charging, and smart meters are just some examples. What is missing now are the market mechanisms to allow those technologies to be deployed at large scale.

For the [Global Future Council on Clean Electrification](#), World Economic Forum

- **Promote new business models.** New business models should transfer capital expenditures and risk from smaller players to financial providers, and empower all stakeholders to become active contributors to a decarbonised power grid. A promising model is ‘Energy as a Service’, which shifts the cost and responsibility of the design, installation, maintenance and even management of distributed energy resources from consumers to service providers. Those service providers, in turn, reach agreements with insurers, energy companies and institutional investors ready to take over both capital for retrofitting and even operational expenses, in exchange for reasonable performance paybacks.

Economic policy needs to evolve

Current policies in most countries are still adapted to a fossil-fuel based energy system. This situation must change to unlock clean energy technologies.

Strategies for operationalizing this pathway include:

- **Align fiscal tools with decarbonization goals.** Clean technologies typically have higher up-front capital costs and lower ongoing fuel and maintenance costs than the polluting alternatives. This is a challenge that needs to be met with financing that makes the future more affordable, not less.
- **Remove subsidies to fossil fuels.** Subsidies and tax incentives to fossil fuels are still present in many countries. Due to this market distortion, a residential customer typically has no economic incentive to change their heating system from fossil fuels to cleaner alternatives, and it also negatively impacts the economics of electric vehicles vis-à-vis petrol cars.

References

Figures are based on a compilation of data from the following sources:

McKinsey (on Industry, 2020): <https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/plugging-in-what-electrification-can-do-for-industry>

Climate Watch (World Resources Institute, 2018): <https://www.climatewatchdata.org/key-visualizations?visualization=5>

IEA (World Energy Outlook, 2021)