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The Road to Energy Security

Electrification, Efficiency and Clean Energy as One System

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EXECUTIVE SUMMARY

Europe's recurring energy crises share a single root cause: structural dependence on fossil fuel imports. Each shock – Russia's invasion of Ukraine, the Covid-19 disruption, the Iran conflict – triggers a supply-side scramble. Each time, the scramble fails to address the underlying vulnerability. That vulnerability has two faces: not only dependence on fossil fuel imports, but the structural energy waste that decades of relatively cheap fossil fuels allowed Europe to keep prolonging – a gap no shock, not even the war in Ukraine, has yet closed.

Energy efficiency, electrification and clean energy are one coherent system, not three separate policy tracks. Efficiency reduces the energy that must be supplied. Electrification shifts remaining demand onto a grid that can run on clean power. Renewables and nuclear make that grid clean and domestically controlled. Each lever amplifies the others, including by freeing up electricity for new demands such as data centres and industrial expansion.

Energy efficiency has avoided 249 Mtoe of EU energy demand since 2000, equivalent to 29% of 2024 consumption. Deeper integration of all three levers could cut EU gas demand from 340 bcm in 2025 to 101 bcm by 2040 (a 70% reduction) and oil demand from 350 Mtoe to 98 Mtoe (a 72% reduction)[1], delivering between €1.4 trillion (at pre-Hormuz crisis prices) and €2 trillion (at current prices) in avoided gas and oil import costs[2]. The technologies are ready and EU industries hold a competitive advantage. A coherent carbon price signal spanning both ETS1 and ETS2 is the foundation on which private investment decisions are made. What Europe needs now is to follow-through on its policy goals, not dilute them.

29%

or 249 Mtoe of EU energy demand avoided by efficiency measures implemented since 2000

239 bcm

gas, plus 252 Mtoe oil — potential gas and oil demand reduction by 2040

€1.4–2tn

potential avoided gas and oil import costs through 2040 (pre-Hormuz to current prices)

One strategy

Electrification, energy efficiency and renewable energy are often treated as three parallel tracks competing for political attention and funding. But the three form a single integrated system. Like a three-legged stool, treating them as separable, or trading one off against another in the name of political compromise, destroys the compounding benefits that make the approach work.

Capital allocation decisions that will shape Europe's industrial competitiveness over the coming decade are being made now. They depend on the confidence that the policy framework will hold. This brief provides the evidence base for why it should.

What efficiency has already delivered

EU final energy consumption in 2024 stood at 854 Mtoe.[3] Without the efficiency improvements made since 2000, it would have reached approximately 1,103 Mtoe. That gap (249 Mtoe, or 29% of 2024 demand) represents energy that Europe did not have to generate, import or pay for. It is the accumulated effect of better-insulated buildings, more efficient industrial processes and technologies, improved appliances, vastly improved lighting technologies and more efficient vehicles across 27 member states over two and a half decades.

At any given energy price, Europe pays roughly 29% less than it would have without these gains. The protection holds regardless of whether the next supply shock comes from the Middle East, Russia, or anywhere else. Every percentage point of efficiency progress made now reduces future exposure in the same way. And because the 29% counts only the energy Europe no longer consumes, it understates the additional benefits in terms of avoided generation, network and infrastructure costs.

Europe already pays 29% less for energy than it would have

EU-27 final energy consumption (Mtoe), actual vs. no-efficiency-savings counterfactual

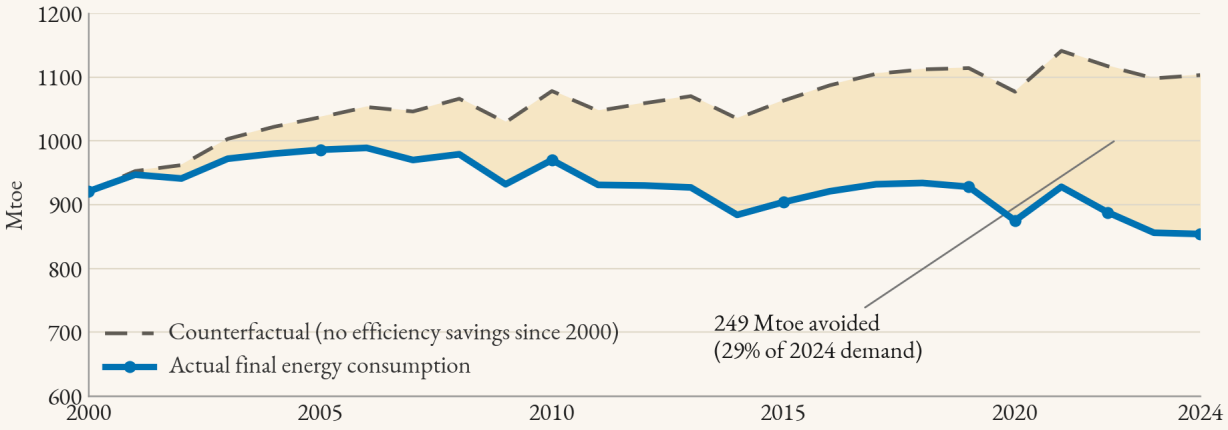

Chart: Jan Rosenow
Source: Odyssee-MURE decomposition of EU-27 final energy consumption.
Counterfactual adds back cumulative technical energy savings of final consumers.

Good progress in electricity, less elsewhere

The electricity sector has decarbonised substantially: the fossil fuel share of power generation fell from 53% in 2005 to below 30% by 2024.[4] But electricity accounts for only 23% of total EU final energy use. Transport remains 92% fossil-dependent. Buildings are at 71%. Industry is at 61%.[5] The electricity sector shows what the trajectory looks like when the policy conditions are right. Decarbonising the remaining sectors is harder: it means transforming whole ecosystems, including new clean electricity production capacity, grid optimisation and build-out, and aligning the pace of change across supply, demand and the supporting tools of finance, incentives and technical assistance. That calls for at least the same level of political commitment, not less.

Power has decarbonised. The rest of the economy can follow.

Fossil fuel share of final energy by sector, EU-27 (%, latest year)

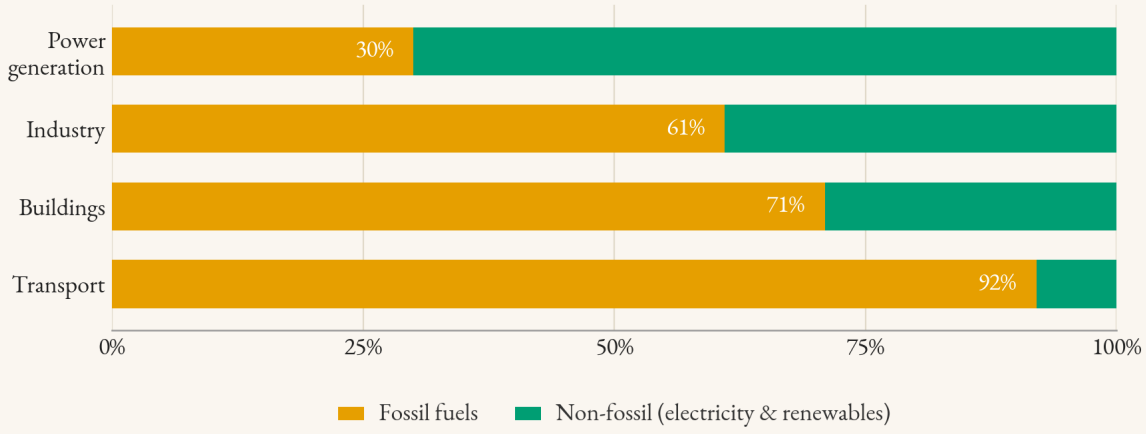

Chart: Jan Rosenow
Source: Eurostat energy balances 2024; Ember European Electricity Review 2025. Power = fossil share of electricity generated.

Why the three levers are one system

Efficiency, electrification and renewables are interdependent. Each is also a direct lever on energy security, reducing Europe's structural exposure to fossil fuel imports.

Efficiency reduces the total energy that must be supplied, which means a smaller and cheaper grid for any given level of renewable deployment and a smaller fossil import bill at every price level. Without efficiency, the EU would need substantially more electricity from low carbon sources, putting further pressure on the grid and making it harder to decarbonise electricity. More efficiency also means that in energy crisis situations countries are less dependent on fuel switching to carbon intensive forms of energy such as coal.

Electrification shifts final energy demand onto electricity, the only energy carrier that can be produced domestically from clean sources. Every electrified vehicle, heat pump or industrial process is one less unit of imported oil or gas that Europe has to source from international markets exposed to geopolitical shocks. Without electrification much less efficient and more expensive modes of decarbonisation would be required.

Renewables clean the grid that electrification depends on and remove the underlying fuel-import dependency that gas generation has long embodied. Without additional renewables, low carbon electricity will not be available in sufficient quantities – which in turn means electrification delivers less carbon reduction and less security benefit. Efficiency, in turn, smooths the imperfect match between where and when electricity is needed and how much is available, easing the integration of variable renewables.

Remove or weaken any one leg and the system loses its compounding benefits. The canonical example is a heat pump installed in a well-insulated building running on renewable electricity. That single investment cuts fossil fuel exposure across all three dimensions simultaneously: it reduces total energy demand, eliminates the direct fossil fuel combustion in the building, and delivers its full climate benefit with a decarbonised grid. The same investment also removes that building from the gas import chain entirely, insulating it from the next price shock and improving indoor environmental quality and resilience to extreme weather. Efficient buildings also cut peak demand, lowering the cost of the energy system as a whole.[6] The same logic applies at industrial scale: An efficient electrified industrial process powered by a long-term power purchase agreement with a wind developer, with on or off-site waste-heat recovery, combines all three levers in a single project.

Prioritising the integrated approach (efficiency, electrification, and predictable carbon pricing across ETS1 and ETS2) could reduce EU gas demand from 340 bcm in 2025 to 101 bcm by 2040, a 70% cut, and oil demand from 350 Mtoe to 98 Mtoe, a 72% cut. Combined, this delivers between €1.4 trillion (at pre-Hormuz crisis prices) and €2 trillion (at current prices) in avoided gas and oil import costs over 2025–2040, while improving living conditions across the continent.

How the EU can cut gas demand by 2040

EU-27 gas demand by reduction lever (bcm), 2025–2040

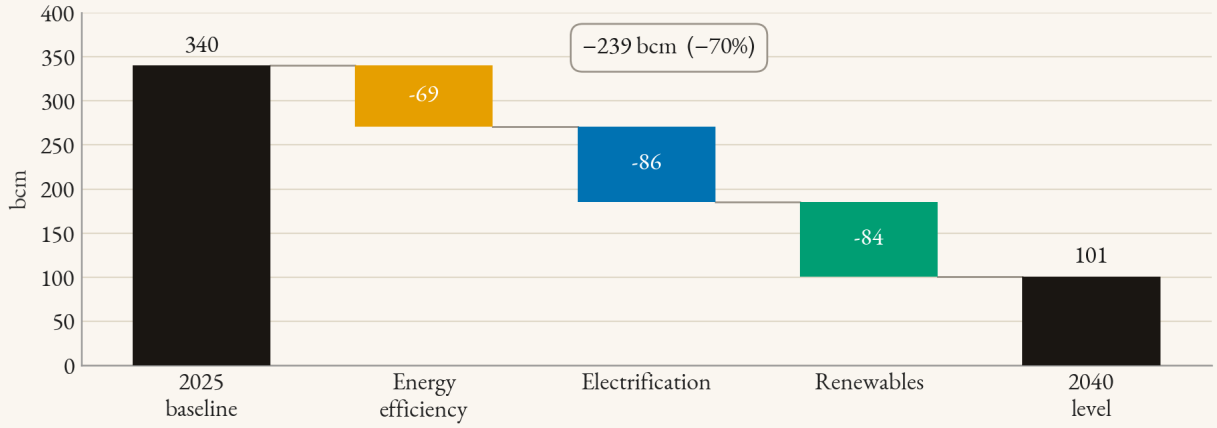

Chart: Jan Rosenow
Source: EC 2040 Climate Target Impact Assessment, Annex 8 (PRIMES S3); author's attribution to the three pillars (see methodology annex).

Buildings are where the integrated approach delivers some of its most immediate social and economic benefits. Human health is among the most important co-benefits of energy efficiency. Europeans spend around 90% of their time indoors, yet more than 30 million live in homes with insufficient daylight, and some 163 million – nearly a third of the population – are exposed to at least one serious indoor-climate risk such as damp, mould, excess cold, poor daylight or noise. Poor indoor environments are linked to respiratory and cardiovascular disease and to lower mental wellbeing, particularly among low-income households. Building improvements could generate socio-economic gains exceeding €600 billion by 2050 through higher productivity and lower healthcare costs.[7][8]

Industrial efficiency also remains a major untapped opportunity and an enabler of electrification. In the EU27, electric motors account for more than half of total electricity consumption[9], much of it from systems operating below current efficiency standards. Equipment upgrades and system optimization can deliver significant savings, reduce costs and ease pressure on the grid.

The same logic applies to oil. Under the same scenario, EU petroleum demand can fall from 350 Mtoe in 2025 to 98 Mtoe by 2040, a 72% reduction dominated by electrification of road transport, with efficiency gains and renewable fuels (advanced biofuels and e-fuels) closing the gap in aviation, shipping and heavy freight where direct electrification is not yet feasible.

How the EU can cut oil demand by 2040

EU-27 petroleum products demand by reduction lever (Mtoe), 2025–2040

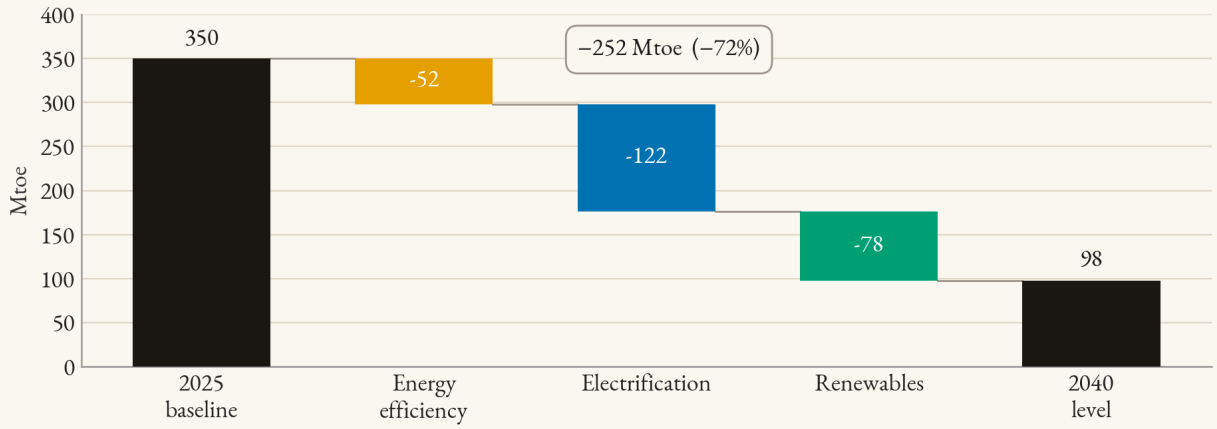

Chart: Jan Rosenow
Source: EC 2040 Climate Target Impact Assessment, Annex 8 (PRIMES S3); author's attribution to the three pillars (see methodology annex).

The compounding effect of combining strategies consistently exceeds the sum of individual interventions.

The case for policy stability

The technologies are mature and ready to be deployed (heat pumps, energy efficient technologies, grid and electrical equipment). The supply chains are being built and EU industrial leadership in these technologies is a key competitive advantage. Europe does not need a new strategy. It needs the confidence to hold the strategy it already has and build on it. Above all it needs to implement and finance what it has already committed to. Stable, integrated policy is itself an enabler – it lets European industrial value chains invest, attract private finance, boost skills, and deploy at scale. The energy transition is both a security agenda and an industrial one, and one that creates local, non-offshorable jobs in renovation, installation and planning.

Electrification, efficiency and renewables are not three separate bets on the future of European energy. They are one integrated approach that only delivers its full economic, security, climate and public health value when pursued together and at scale. Maintaining momentum requires ambitious targets for each for 2040. And a coherent carbon price spanning ETS1 and ETS2, combined with strong demand-side directives and clear electrification and energy-efficiency targets, provides the foundation. Investment follows stability.

Trading away ambition for short-term political purposes is costly. The cost of that trade (paid in continued fossil fuel import bills, foregone industrial competitiveness, and a more difficult transition later) is far higher than the cost of holding the line now. It is the cost of inefficiency – the mirror image of the 29% saving Europe has already banked – and it grows the longer the synergies between efficiency, electrification and clean energy go unrealised.

Priority actions (next 12 months)

PRIORITY ACTION	WHAT IT INVOLVES	LEVER
Maintain the 2030 efficiency target	Resist rollback of the Energy Efficiency Directive's binding 2030 target, and accelerate delivery mechanisms for SMEs and households.	EFFICIENCY
Drive implementation, not just targets	Deliver the EED and EPBD on the ground, alongside the electricity market-design flexibility provisions that a more electrified system depends on.	CROSS-CUTTING
Lock in 2040 sectoral targets	Set 2040 targets for efficiency, electrification and renewables consistent with the EC's 90% GHG scenario, to give investors a stable long-run signal.	CROSS-CUTTING
Close the financing gap	Direct a larger share of EU funding (the next MFF, cohesion policy, the Innovation Fund and the Industrial Decarbonisation Bank) to efficiency and electrification, and earmark ETS1 and ETS2 revenues for the same, treating efficiency as fiscal and industrial policy.	CROSS-CUTTING
Deliver a credible carbon price	A coherent price across ETS1 and ETS2, with no exemptions or delays that hollow out either system.	CROSS-CUTTING
Push renovation of the existing building stock	Support renovation of buildings as one of Europe's faster energy and housing wins, and treat efficiency as an affordability measure, pairing fabric improvements with electrification.	EFFICIENCY ELECTRIFICATION
Hold the heat-pump market signal	No weakening of the fossil-boiler phase-out trajectory; extend financial support to reduce upfront cost barriers across income groups. Align building-fabric programmes such as insulation with heat-pump support schemes so the two reinforce one another.	EFFICIENCY ELECTRIFICATION
Fast-track industrial electrification	Speed up permits and grid connections for electrothermal, industrial heat pumps and direct electrification at industrial sites, support on-site generation, storage and digital controls.	ELECTRIFICATION
Accelerate efficiency upgrades of motor-driven systems	Promote replacement and optimization of inefficient motor-driven systems through standards, incentives and public procurement, reducing electricity demand and operating costs.	EFFICIENCY ELECTRIFICATION
Streamline waste-heat rules and price signals for electricity	Streamline the definition of waste heat across the EED and RED (on-site and off-site) to unlock its use, and address the electricity-to-gas price ratio so electrification is the rational choice for households and industry.	CROSS-CUTTING
Unlock existing grid capacity	Use digitalisation, smart metering and demand-side flexibility alongside passive solutions so industry, buildings, storage and e-mobility can cut peak demand and defer new infrastructure.	ELECTRIFICATION EFFICIENCY
Lead from the public sector	Scale efficiency investment in public buildings and infrastructure, mandate lifecycle-cost assessment / total cost of ownership in public procurement, and use public demand aggregation to drive down costs.	EFFICIENCY

Annex: methodology for gas and oil demand reduction

The 2025–2040 gas and oil demand reduction figures in this brief are derived from PRIMES model output published in Annex 8 of the European Commission's 2040 Climate Target Impact Assessment (COM(2024) 63 final). All 2040 values use scenario S3, corresponding to the EU's 90% domestic greenhouse gas reduction target. This brief does not present new modelling. The 2040 endpoint figures are taken directly from the EC's published outputs; the decomposition of each reduction across efficiency, electrification, and renewables (or, for oil, biofuels and e-fuels) is an indicative analytical attribution to the three pillars, not a separate modelling exercise.

Key figures. Gas. 2025 baseline of 340 bcm, from the EC Quarterly Report on European Gas Markets Q2 2025 (confirmed 2024 EU-27 consumption of 332 bcm plus approximately 4% growth in H1 2025). 2040 level of 101 bcm, from PRIMES S3 scenario, Annex 8 Fig 29 (alternative scenarios: S1 80% = 148 bcm, S2 85% = 117 bcm). Total reduction of 239 bcm, equivalent to a 70% cut. Oil. 2025 baseline of 350 Mtoe, estimated from Eurostat energy balances trend (2019 PRIMES calibration of 387 Mtoe adjusted for the 2022–2024 price-driven demand reduction). 2040 level of 98 Mtoe, from PRIMES S3 scenario, Annex 8 Fig 32 (S1 80% = 111 Mtoe, S2 85% = 104 Mtoe). Total reduction of 252 Mtoe, equivalent to a 72% cut.

Lever attribution. The three levers are defined to be mutually exclusive across both reductions. For gas (239 bcm total): energy efficiency (−69 bcm, 29%) is gas saved because the quantity of useful energy demanded (heat, mechanical work, process output) is lower, regardless of how it is supplied. Derived from PRIMES Fig 41 (useful heat demand per m^2), Fig 49 (industry final energy consumption by sector) and Fig 50 (industry consumption by fuel). Electrification (−86 bcm, 36%) is gas saved because the remaining useful demand, once efficiency has reduced it, is supplied by electricity rather than gas, with heat pumps replacing gas boilers and industrial electrification the dominant routes. Derived from Fig 44 (heat pump stock 2015–2050) and Fig 50. Renewables (−84 bcm, 35%) is gas displaced directly by non-electric renewable supply: wind and solar reducing dispatch of gas-fired power (approximately 70 bcm) and biomethane plus e-gas injected into the gas network (approximately 14 bcm). Derived from Figs 19, 20, 30 and 50.

The mutually-exclusive definition avoids the double-count risk in REPowerEU's headline buildings figure, which combines insulation and heat pump effects. The split here is calculated from separate PRIMES outputs rather than aggregated sectoral totals.

For oil (252 Mtoe total), the third lever is biofuels and e-fuels rather than non-electric renewables. Energy efficiency (−52 Mtoe, 21%) is oil saved because the underlying useful energy demand (vehicle-kilometres, heat, process output) is lower, regardless of fuel type. Derived from PRIMES Fig 41 (useful heat demand), Figs 49–50 (industry FEC) and Fig 64 (transport FEC by mode). Electrification (−122 Mtoe, 48%) is oil displaced because remaining useful demand is met by electricity rather than petroleum, dominated by EVs replacing internal combustion vehicles. Derived from Fig 44 (heat pump stock) and Fig 66 (transport FEC by fuel). Biofuels and e-fuels (−78 Mtoe, 31%) is fossil petroleum displaced by clean liquid or gaseous fuels (advanced biofuels, e-kerosene, e-diesel) concentrated in aviation and shipping where direct electrification is not yet feasible. Derived from Fig 66 and Fig 50.

Cost calculation. Combined avoided import costs of €1.4–2 trillion are calculated separately for gas and oil and then summed. The gas component (~€600–900 billion) applies TTF wholesale prices of €30–35/MWh (pre-Hormuz crisis baseline) and €45–50/MWh (current, June 2026) to the cumulative 2025–2040 avoided gas demand of approximately 1,790 bcm-years. The oil component (~€830 billion to €1.15 trillion) applies Brent wholesale prices of approximately €60/bbl (around $65/bbl pre-Hormuz) and €83/bbl (around $90/bbl current) to the cumulative avoided oil demand of approximately 1,890 Mtoe-years, or 13.9 billion barrels equivalent. The lower bound of each range assumes the pre-crisis price holding throughout; the upper bound reflects current wholesale prices. Both bounds are conservative because EU oil and gas import bills are paid at refined-product and final-delivered prices, not pure wholesale.

Caveats. The 2025 gas baseline is provisional pending full-year Eurostat data; the 2025 oil baseline is estimated from Eurostat trends. The efficiency/electrification split within sectors is derived analytically from separate PRIMES indicators and involves interpretation, as PRIMES does not publish an explicit decomposition.

1. European Commission (2024): 2040 Climate Target Impact Assessment, COM(2024) 63 final, Annex 8 (PRIMES S3, 90% GHG reduction scenario). Decomposition methodology detailed in the methodology annex below.
2. Calculated by applying TTF wholesale gas prices (€30–35/MWh pre-Hormuz, €45–50/MWh current) and Brent crude wholesale oil prices (approximately €60–83/bbl, or $65–90/bbl) to the cumulative 2025–2040 avoided gas and oil demand. See methodology annex.
3. Odyssee-Mure (2026): Decomposition tool. https://www.indicators.odyssee-mure.eu/decomposition.html
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