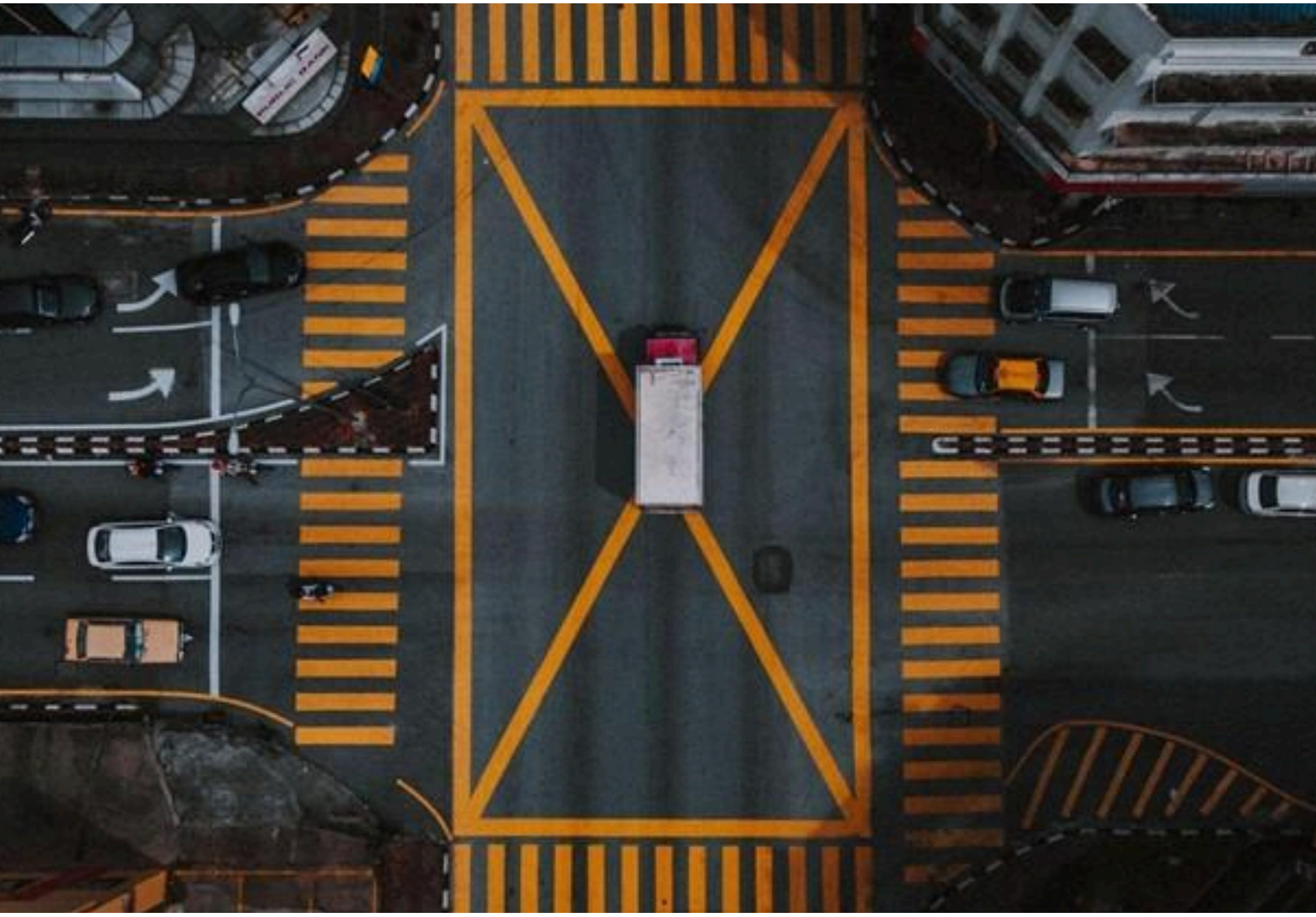

REPORT - November 2024

Financing transport decarbonisation

Study on investments for sustainable transport in the EU

Transport & Environment

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Table of contents

Executive summary

Europe needs €310 billion annually by 2030 to scale up manufacturing of clean technologies for transport

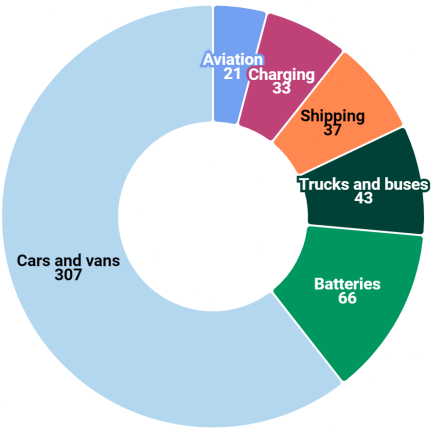
Reaching net zero by 2050 will require significant investments in cleantech, as explained in the Draghi report. Ursula von der Leyen announced her Commission will be an "investment Commission" and has committed to a Competitiveness Fund as part of its future Clean Industrial Deal to help industry achieve the EU's green goals.

This study assesses EU level investment needs - public and private - for critical transport sectors to reach net zero in 2050. It covers aviation, shipping, electric cars, buses and trucks, batteries, road charging stations.

- **Total investment needs in a net zero scenario are:**
    - **€310 billion annually by 2030** (total of €1.8 trillion).
    - **€507 billion annually by 2040** (total of €7.6 trillion).

€507 billion per year by 2040 for green transport technologies

Required investment per transport sector (data in billion €)



The bulk of the investment – 87% by 2030 – will come from private investors, including manufacturers, banks, and institutional investors.

- **Public finance (EU and national) would need to contribute €235 billion by 2030 – €39 billion annually** – mainly to catalyse these private investments. The required public investments are only slightly higher than the annual €34 billion fossil fuel subsidies to transport.

These figures assume most manufacturing of clean transport technology happens in Europe. If that is not the case, e.g. it happens in China, investment needs decline sharply but so do the economic opportunities.

- **E-fuels for planes and ships require capital investments worth €86 billion by 2030.** As the sector is still at an early stage of development and investors are reluctant to take necessary risks, two thirds of this amount should come from public funding to kickstart the production and uptake of e-fuels across Europe and de-risk private investments.
- **Electrification of road transport:** to develop a resilient EU battery value chain and get electric vehicles and zero-emission trucks on European roads, a **€250 billion investment is needed each year by 2030**. Public funding can help catalyse this.

1 Support the production and scale up of clean e-fuels for aviation and shipping

EU Innovation Fund: grants, auctions and Contracts for Difference

Public banks and InvestEU: loans and guarantees

2 Accelerate the electrification of road transport

A €25 bn EU Battery Fund under the EU Innovation Fund by 2030

An EU Platform for a **€26 bn EV social leasing scheme** under the Social Climate Fund

Loans and guarantees for manufacturing and purchase of zero-emissions HDV's: €95 bn mobilised by 2030 by the EIB and public banks

Expand the AFIF to fill gaps in public charging, public banks to support the installation of depot and home chargers

- **A competing priority** – and distraction for scarce public resources – **is the financing of expensive transport infrastructure**. EU funding should re-focus on:
    - **Boosting grids' support**, doubling current investments to reach €67 billion per year until 2050. Increased financing for energy under the Connecting Europe Facility is crucial, together with a higher share of cohesion funding, mobilising public banks and financial instruments under the future European Competitiveness Fund.
    - **Limiting funding to road expansion:** in 2021, total support for building and expanding highways in the EU reached €61 billion. **Halving such funding can save around €30 billion a year – enough to match extra needs for grids**.
    - **Rail investments** under the future EU budget should focus on network **maintenance**, **upgrade** and completion of key parts of the network, cross-border connections, **digitalisation** to increase capacity without building new tracks and **rolling stocks**.

- The future **Sustainable Transport Investment Plan** should support these flagship initiatives – making the most with existing EU funds by simplifying criteria, streamlining approvals and expanding the EU Innovation Fund and InvestEU fund.

- **The EU should revamp the EU Sustainable Finance strategy to effectively mobilise private capital in support of the green transition.** This includes developing ambitious criteria in the EU Taxonomy aimed at zero-emission technologies to avoid fossil lock-ins.

Introduction

The European Green Deal has established ambitious climate policies, targets and regulations. However, a lack of financing at the EU and national level endangers its implementation and success.

For companies, high interest rates are restricting access to finance for clean investments. Additionally, the new EU Growth and Stability Pact is unlikely to offer **fiscal space** for Member States to invest adequately in their green transition [1]. Next years will be critical, as the end of the Recovery and Resilience Facility in 2026 will create a **major public investment gap**.

At the same time, the **need for investments is greater than ever.** The European Commission estimates that €620 billion in annual extra investment is required by 2030 to fulfil the EU's climate goals. By 2050, the Commission projects total energy system investment needs will average €1.5 trillion a year [2].

The Institut Rousseau calculates that a staggering €40 trillion is needed by 2050 to decarbonise the EU economy - 10% of the EU GDP. This means additional public investment of €260 billion per year, more than doubling current investments [3]. The think tank I4CE identifies a yearly €406 billion investment deficit by 2030 in the EU's transport, buildings and energy systems, compared to current investment [4].

Transport decarbonisation as a key challenge

According to the Commission, transport represents the lion's share of these investment needs, requiring approximately **€870 billion in annual investments to meet the EU's 2050 targets** [2]. This is unsurprising as transport is the largest source of greenhouse gas (GHG) emissions in the EU, accounting for 29% of all EU emissions in 2022, which is projected to rise up to 44% by 2030 under current Green Deal regulations (Figure 1). Moreover, while transport emissions have grown by a quarter since 1990 and now exceed 1 Gigaton, non-transport emissions have decreased by 38% within the same period.

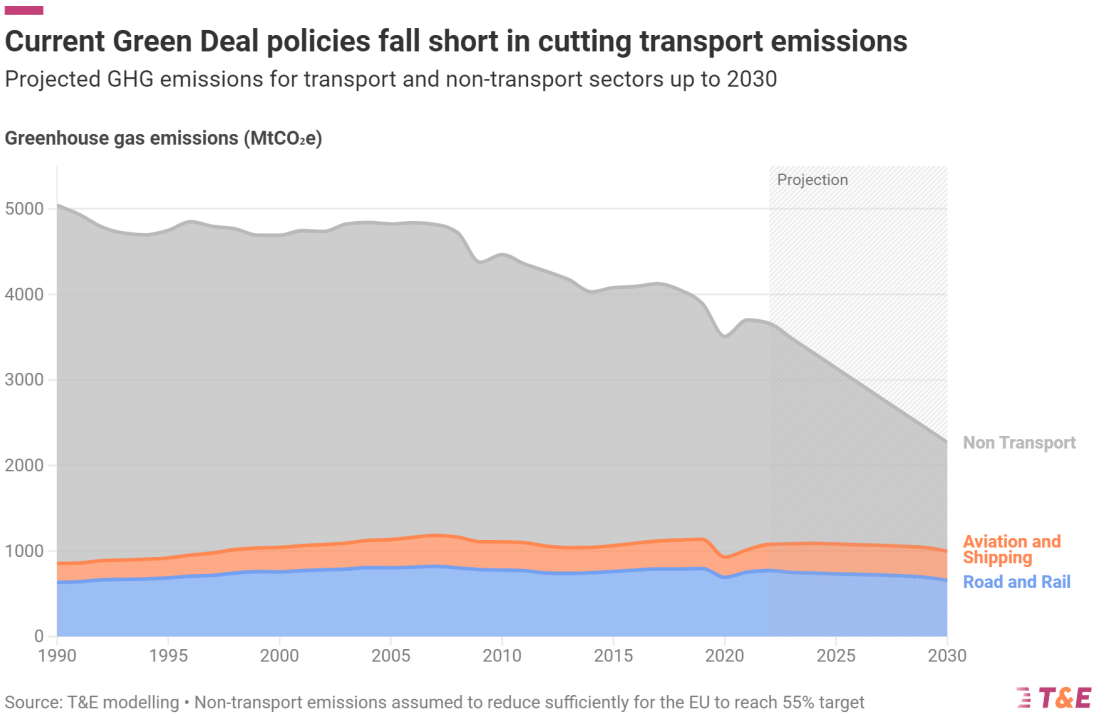


Figure 1. Projected GHG emissions for transport and non-transport sectors by 2030.

Road transport, primarily cars and trucks, contributes 70% of transport emissions, while aviation emissions more than doubled until the COVID-19 pandemic and shipping is projected to reach one-third of total transport emissions by mid-century [5]. This makes decarbonising transport one of the most pressing challenges of our time. To meet our 2050 climate targets, the sector will need to undergo one of the steepest transitions towards carbon neutrality.

T&E has developed roadmaps outlining key steps to decarbonise and calling for swift and strategic action [6, 7]. **An EU-level investment strategy must be urgently deployed to decisively support transport decarbonisation and enhance the sector's competitive sustainability**. The creation of a **Sustainable Transport Investment Plan** by the new European Commission represents a major opportunity.

A granular analysis of investment needs

Unlike the economy-wide investment gap at the EU level, the specific needs in the transport sector are poorly documented. This study aims to fill this knowledge gap by providing **a detailed assessment of six critical areas within aviation, shipping and e-mobility**: sustainable fuels for aviation and shipping, road charging infrastructure, domestic battery production, electric vehicle (EV) production and uptake, and electrification of heavy-duty vehicles. For each sector, the study offers a comprehensive cost breakdown and suggests a financing model leveraging private and public financing. The final chapter also formulates proposals to raise the efficiency of the EU financing landscape for transport infrastructure.

1. Transport decarbonisation: an investment challenge

1.1 €310 billion each year by 2030 to deploy clean technologies

For the six sectors and technologies on scope, we estimate that **a total of €7.6 trillion is required by 2040** (Figure 2) to align with a net zero trajectory by 2050.

The initial expenditure between 2025 and 2030 should reach a level of €1.86 trillion, of which the capital expenditure (Cap-Ex) is around €500 billion.

We estimate that the **annual needs will be €310 billion for the 2025-2030 period**, rising to €560 billion for 2031-2035, and €590 billion for 2036-2040. This represents respectively around 1.9%, 3.5%, and 3.7% of the EU GDP in 2022. This increase is primarily attributed to the necessity of fully deploying sustainable solutions at scale during the 2030s.

These costs pale in comparison to the cost of inaction, which could knock 7% off the EU GDP by 2100, [8] while economic losses from coastal floods alone could exceed €1 trillion per year [8, 9].

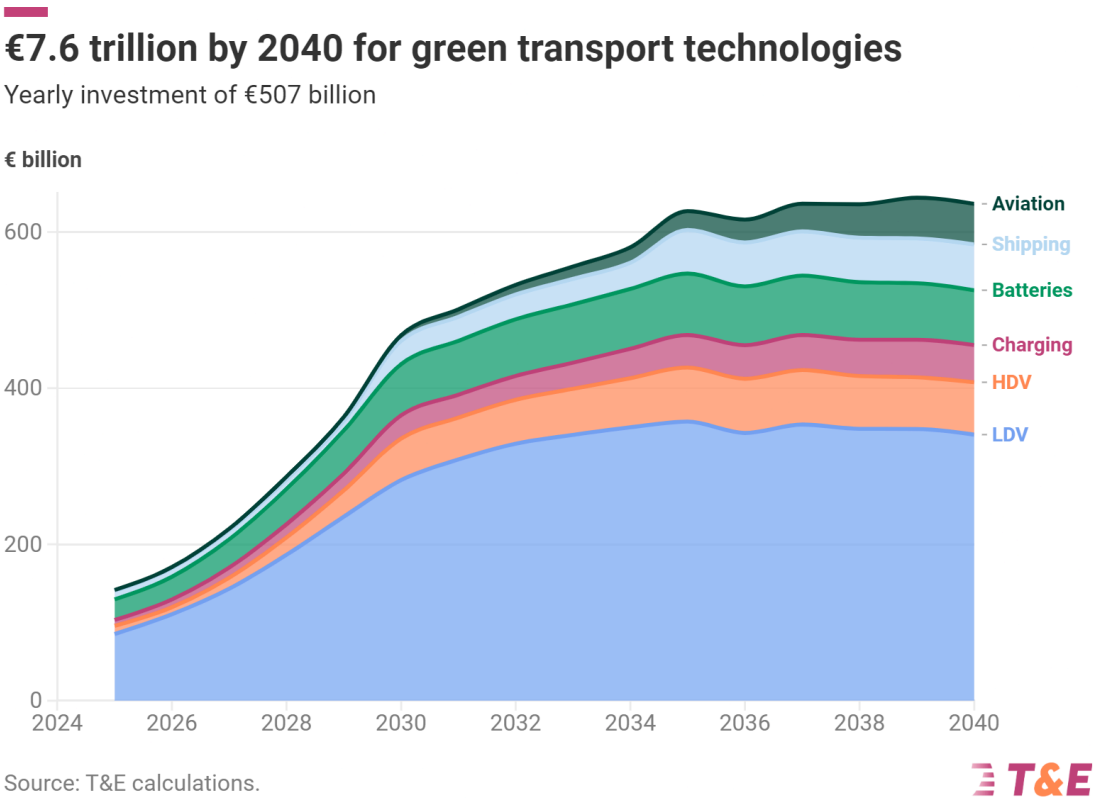


Figure 2. Total decarbonisation investment in the EU, 2025-2040.

Achieving these investment targets is feasible. **Transport decarbonisation is an economic opportunity for European businesses and should be backed by a robust investment strategy**. The future EU investment agenda should contribute to a "Made-in-Europe" strategy for clean technologies, ensuring the creation of quality green jobs, efficiently mobilising public resources to accelerate the scale-up and market uptake of clean technologies, crowding-in private financing, and putting the transition on track, in support of innovative technologies, non-bankable infrastructure and vulnerable households.

A **stable regulatory environment** is crucial to underpin an investment strategy and ensure that investments facilitate, rather than impede, the green industrial strategy we advocate for. Decarbonisation policies must place the onus on polluters, while rewarding best-in-class projects and supporting vulnerable stakeholders. Drawing upon the **polluter pays principle**, **carbon pricing** should play a central role in expediting decarbonisation efforts. Incentivised through smart regulation and carbon pricing, **private finance should then provide the bulk of the resources required for the mobility transition**.

Public subsidies are only a small part of what is required, and they are pointless without investment certainty provided by regulations and genuine commitment from private capital. Still, **public finance schemes at both national and EU levels** should serve as catalysts for private finance, especially in areas where private capital alone is inadequate to drive the green transition.

The bulk of public resources needed to back and accelerate the green transition will be allocated at the national level. However, given the constraints of national budgets, not all EU countries will have the fiscal capacity to invest adequately in the decarbonisation of the transport sector. Therefore, public funding at the EU level will play a crucial role: we estimate a **total of €235 billion in public support needed by 2030, or €39 billion annually**. Figure 3 shows how this amount is split between transport sectors.

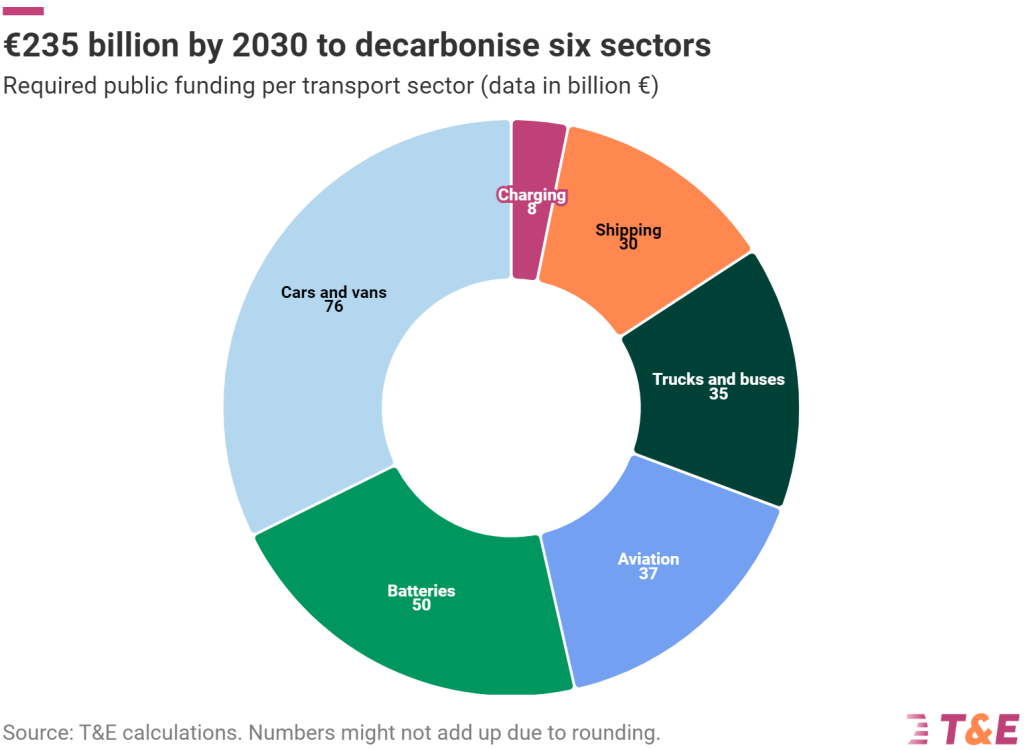


Figure 3. Public funding for the six sectors, 2025-2030.

Public funding for the 2025-2030 period could cover around 13% of the total investment needs. As we argue in section 1.2, these resources should come from already existing financial instruments at EU and national level - EU Innovation Fund, InvestEU, EIB, etc. To maximise their impact, the financial firepower of these instruments and institutions should be scaled in the coming years. The creation of the EU Clean Industrial Deal offers a window of opportunity to match an EU green industrial strategy with a solid investments' agenda.

Investment needs identified in our study range from 2% of the EU GDP in 2022 for 2025-2030 to 3.8% for 2035-2040. This proportion of GDP needed to profoundly transform a vibrant sector of the European economy is not exceptional in historical terms. The economy-wide ratio between investments (gross fixed capital formation) and GDP in the EU has fluctuated between 20-23% since the mid-90s, dropping to 20% in the 2010s before bouncing back to 22% in the 2020s [2]. Given the urgency to achieve EU climate objectives and reinforce its competitiveness, allocating between 10% and 20% of investments at the EU level to transport is both realistic and desirable. Still, this effort will need to be sustained at least until 2040 in T&E's Net-Zero Scenario. **The earlier investments will take place, the cheaper the transition bill will be**. This message is also central to the Draghi report on European Competitiveness, which calls for minimum annual additional investment of €750 to €800 billion needed for the EU to compete globally – doubling current investments by an extra 5% of EU GDP per year.

The investment needs we identify are largely aligned with reference studies by the European Commission and think tanks I4CE and Institut Rousseau in 2024. For 2031-2050, the Commission estimates that 4.2% of the EU GDP - €870 billion per year - is necessary for transport. Institut Rousseau provides a lower estimation of €689 billion per year until 2050, while I4CE anticipates lower needs – €253 billion per year by 2030 and a gap of €147 billion – although shipping and aviation are not covered by their analysis.

1.2 The opportunity of higher ambition

Achieving the goals of the Fit For 55 package requires €6 trillion by 2040 - hereafter FF55 scenario. The annual costs are projected at €187 billion by 2030, €406 billion in 2031-2035 and €548 billion thereafter.

Total expenditure in the Net-Zero Scenario - hereafter NZ Scenario - exceeds that of the FF55 Scenario by €1.7 trillion (29%). This reflects the higher value of increasing decarbonisation ambitions and shows the potential synergy between environmental health and societal prosperity. The higher figures in the NZ Scenario benefit the EU economy by circulating investment locally, creating green jobs, and building vital infrastructure. Additionally, it allows the EU industry to gain market share in strategic decarbonisation assets, positioning Europe as a future leader in the global green economy. More information on the design of our scenarios can be found in the Annex.

Figure 4 illustrates the reduced market value of green technologies under the FF55 Scenario. This is evident in sectors like shipping, where the limited scope of the FuelEU Maritime regulation fails to provide sufficient incentives for achieving full decarbonisation by 2050. Similarly, in the aviation sector, the e-fuel industry requires robust demand projections to scale production within the EU. Only a steadfast commitment to full decarbonisation can create the conditions for a sustainable future.

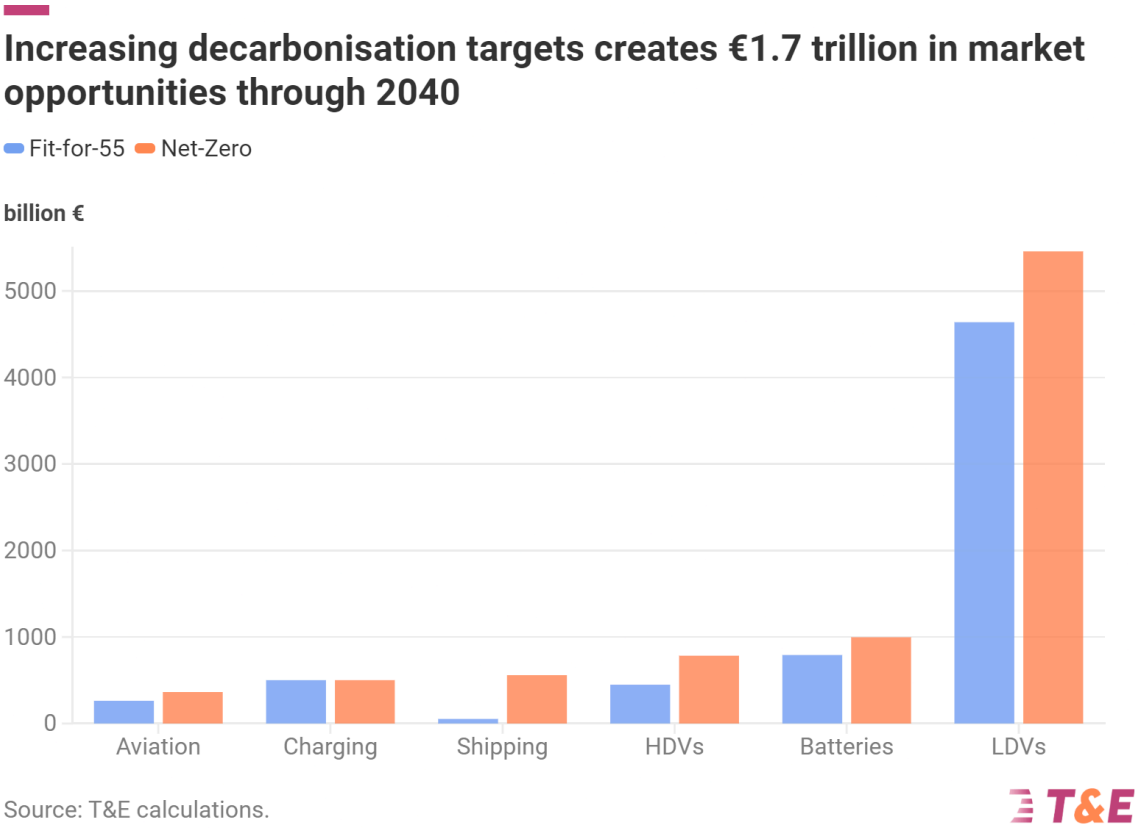


Figure 4. total expenditure under different scenarios.

1.3 Scope

This study covers six sectors: light-duty (cars and vans) and heavy-duty (trucks and buses) EVs, road charging infrastructure, sustainable fuels for aviation and shipping, and EV batteries (Figure 5).

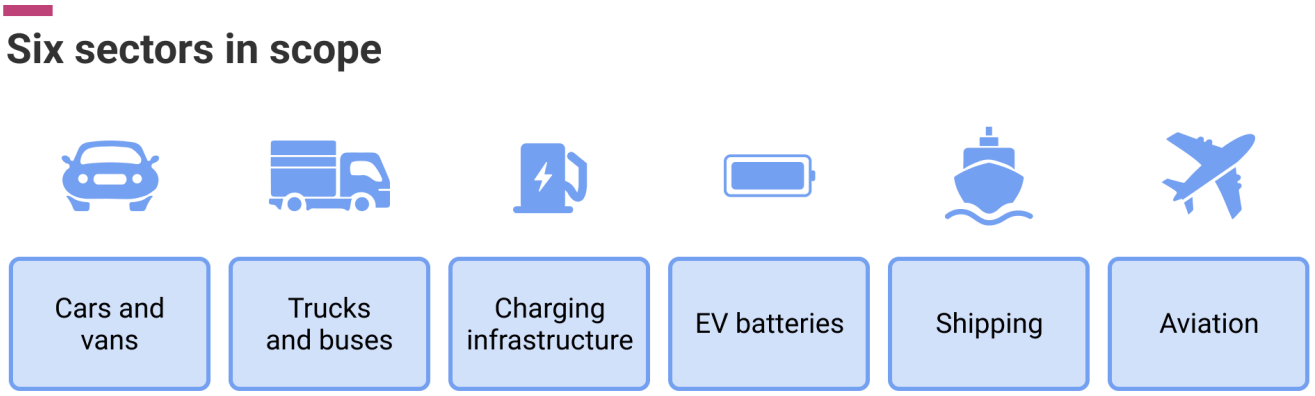


Figure 5. sectors in scope.

We quantify investments needed by 2040 to achieve T&E's Net-Zero Scenario – leading to a net zero mobility system by 2050 – with milestones in 2030, 2035 and 2040. We have also compared our NZ Scenario with the investments needed to fulfil the Fit For 55 (FF55) package up to 2030, as well as the targets set in relevant European regulations for the following years - such as cars or heavy-duty vehicles CO_2 standards, FuelEU maritime, RefuelEU aviation, etc.

This study uses "investment" and "expenditure" interchangeably to refer to total spending on sustainable goods and technologies or the total revenue from companies producing them, that are equal to the unit price of a good - an electric car, one Megajoule of e-kerosene - multiplied by its yearly demand. Financially, this includes capital expenditure (Cap-Ex), operational expenses (Op-Ex), and profit.

Investment definition

Cap-Ex

Long-term investments in assets for green technologies, such as building hydrogen production plants or purchasing patents.

Op-Ex

Recurring costs for operation and maintenance, like raw materials and salaries.

Profit

The remaining revenue after accounting for Cap-Ex and Op-Ex, generated from investments and operations.

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Thus, "investment" refers to total expenditure, not just direct Cap-Ex. Considering total revenue instead of only Cap-Ex allows for assessing the full market opportunity of the transition – and not just its costs – stressing potential economic and social benefits through increased salaries and resource redistribution.

Designing a financing model

Our study assesses how to finance these investments and how risks should be shared. Our focus is on the 2025-2030 period, given the greater certainty around the economic framework, commodity prices, and budgetary instruments. We anticipate that most sectors will decarbonise primarily through private investment, driven by regulation and attractive actual or potential returns.

T&E

However, some sectors are still in early stages, are not yet profitable, or face challenges developing in the EU – especially given the large subsidies available for companies in countries like China and the US. For instance, ramping up e-fuel production for aviation and shipping requires significant upfront capital investment, exceeding revenues generated. Likewise, switching to 100% EU battery cell production means increased investments and higher prices. In such cases, we refer to an *investment gap,* i.e. the difference between the industry size and the capital it needs to develop. **The extra investment needed to both fill the investment gap and reach a Net Zero Scenario following a "Made-in-Europe" strategy is referred to in the report as the "extra investment for strategic autonomy"**.

Public intervention is therefore crucial to rapidly fill this gap and scale up clean technologies across the Union. We set the time horizon to fill this early investment gap in 2030. We selected key EU - e.g. the Innovation Fund, InvestEU, the European Investment Bank (EIB) and national - support under the EU State Aid rules, national public banks - funding instruments and calculated how much they can support sustainable transport solutions. Finally, extra resources will come from the carbon market (ETS and ETS2) and fair taxation. When analysing transport infrastructure – roads, rail and energy grids – we focus particularly on instruments like the Connecting Europe Facility and cohesion funds.

Public intervention in the short term is needed to help infant European industries. This does not necessarily mean that the public will need to keep a high level of intervention as markets mature, particularly when decarbonised goods become cheaper. To quote the Draghi report, "*the private sector is unlikely to be able to finance the lion's share of this investment without public sector support*".

The study does not call for the creation of new funds, but rather for a more focused and optimised use of public funding and smart financial instruments, ensuring that transport decarbonisation will not require extra taxpayers' money.

2. Aviation: Clean fuels need to take off

Decarbonising the aviation sector must begin with stringent regulation, effective carbon pricing mechanisms, and taxation policies. Targeted public support is also essential for developing alternative fuels – particularly e-kerosene, which is pivotal for the sector's decarbonisation.

According to a recent T&E study on e-kerosene production, the final investment decision (FID) for the 25 large-scale projects in Europe is still pending [10]. These projects have a potential production capacity of 1.7 Mt in 2030, significantly exceeding the ReFuelEU target of 0.6 Mt for that year and the 1.0 Mt target for 2032, and can allow the EU to increase its decarbonisation ambitions while being self-sufficient in a strategic asset.

In the short term, limited public support can be crucial in addressing market failures and initiating several of these projects. As stressed in the Draghi report, the "*EU needs to start building a supply chain for alternative fuels*".

Once initial hurdles are overcome and uncertainties over profitability are solved, private finance should sustain further developments. The polluter-pays principle is fundamental, making revenues from the Emissions Trading System (ETS) a key resource for supporting the sector's decarbonisation efforts.

It is also important to highlight the uncertainty surrounding future fuel prices, as they could exceed our current estimates and consequently increase the decarbonisation's bill.

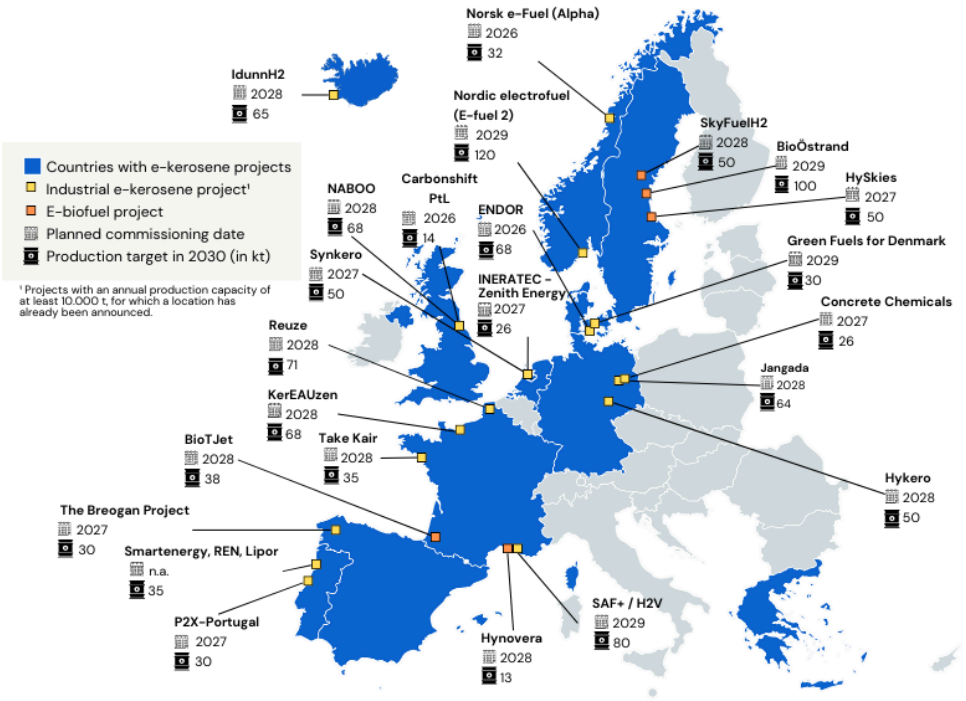


Figure 6. aviation e-fuel projects as of January 24, 2024.

2.1 Findings

Putting the aviation sector on track to reach net zero in 2050 will require €313 billion by 2040.

Given the nascent state of the clean fuels industry, early revenues generated from aviation fuels are low until 2030 and amount to €20 billion. However, the early capital investments needed in the same period for building production facilities to secure the announced e-kerosene production capacity will reach up to €51 billion. This brings the total investment required by 2030 to €71 billion – as highlighted in Figure 7. The yearly gap is €8.5 billion.

Aviation	2025-2030	2031-2035	2036-2040
Total needs (€bn)	70.9	81.3	160.4
Yearly needs (€bn)	11.8	16.3	32.1
Extra investment for strategic autonomy (€bn)	51.0		
Total public investment (€bn)	37.1		
Share of public investment	73%		

These figures underscore the high price associated with Power to Liquid (PtL) deployment. However, the transition's cost appears more manageable when considering annual investment needs: the extra yearly investment required by 2030 represents around 5.5% of the European airlines' 2023 revenues.

On top of e-kerosene, €6.8 billion will be needed for other Sustainable Aviation Fuels (SAF) between 2025 and 2030, with a total of €86.7 billion required by 2040.

Hydrogen planes will only begin to play a role from 2035 onward, with associated fuel costs estimated at €1 billion through 2040.

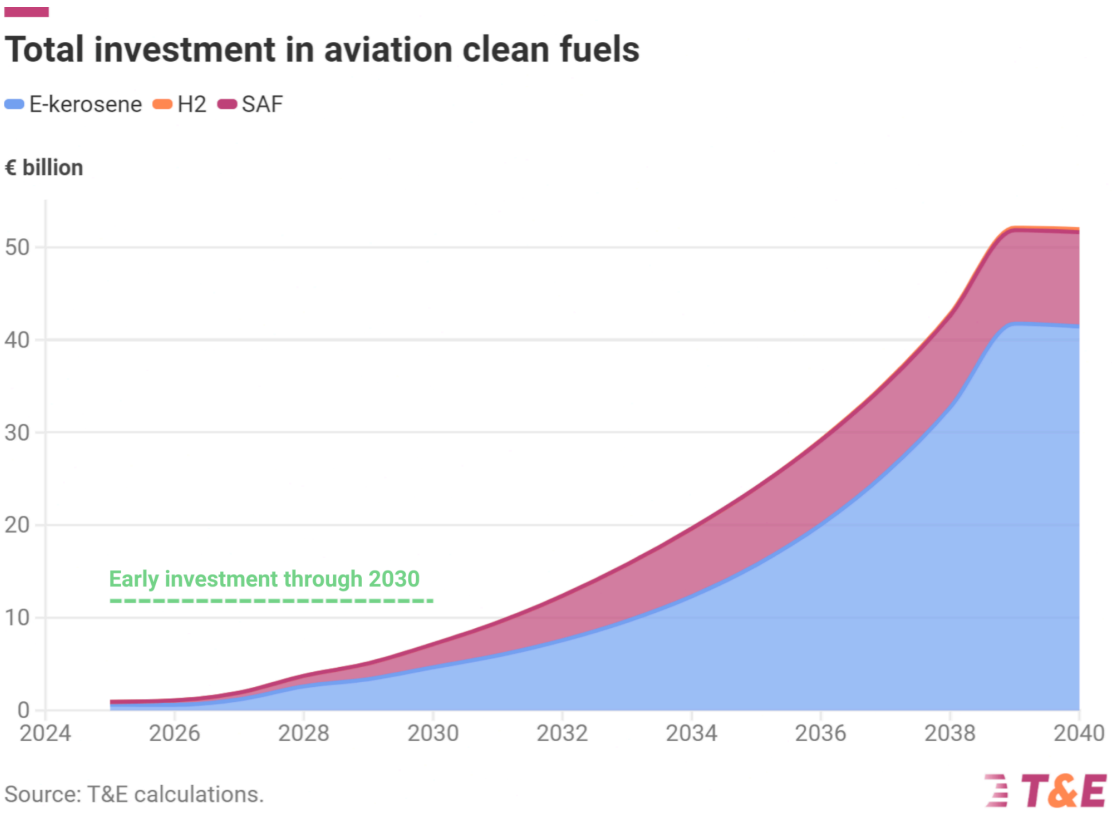


Figure 7. Clean fuels for aviation, 2025-2040.

2.2 Recommendations

Public and private funding should prioritise **decarbonising the aviation sector** due to its rapid emission growth. Between 1990 and 2019, aviation emissions more than doubled, growing faster than any other mode of transport - from 1.5% to 4.7% of total European emissions. If unmitigated, these emissions could double again by 2050, consuming over 10% of the remaining carbon budget to limit global warming to 1.5°C.

Closing the €51 billion gap must become a priority for public institutions. **The financing solutions proposed below could cover 73% of this gap through EU and national funding alone**, with the remainder sourced from companies and private financial institutions.

2.2.1 Public finance

Targeted EU instruments to support e-fuel production

A mix of public and private investments is crucial to support the build-up of e-kerosene industrial production capacity. Despite the regulatory certainty provided by the ReFuelEU regulation, e-kerosene start-ups face challenges in attracting investment from funds, especially at early stages, e.g. for funding feasibility studies. Banks also appear hesitant to finance these projects – even when potential offtakers have expressed interest – as the high capital expenditure associated with these projects increases the financial risk for lenders.

Therefore, public financing or guarantees are key at these early stages. Several instruments are already available for the EU to support e-kerosene production, or should be further developed.

The EU Innovation Fund (IF) should expand its direct support for e-kerosene production. So far, IF's support to e-kerosene projects has been scarce. Out of the 41 projects awarded grants in July 2023, only two were e-kerosene projects [11].

Firstly, the IF should dedicate part of its calls for proposals to the aviation sector. Allocating €9.8 billion to the aviation sector would channel sufficient grants to reduce upfront costs. These should come partly in the form of **Contracts for Difference (CfDs) for e-kerosene to bring costs down**. Using ETS revenues channelled through the IF to fund the mechanism will ensure that polluters finance their own decarbonisation efforts.

CfDs are funding mechanisms through which public support is awarded to producers who can produce green hydrogen or e-fuel at the lowest cost, to cover part of their operational expenses. Under a CfD, a public entity compensates the difference between the auction-winning price - the strike price - and the renewable hydrogen market price - the reference price. This approach has been successfully employed in the UK to drive down costs in offshore wind projects. Similarly, the European Commission is implementing a competitive bidding scheme for the production of renewable hydrogen through the Hydrogen Bank under the IF.

European Public banks, notably the European Investment Bank (EIB) Group, should increase their support to clean fuels, by offering affordable loans and project development assistance (PDA) to help structure viable projects. The EIB Group should also further develop its venture debt support as well as its direct and indirect equity support via the European Investment Fund (EIF).

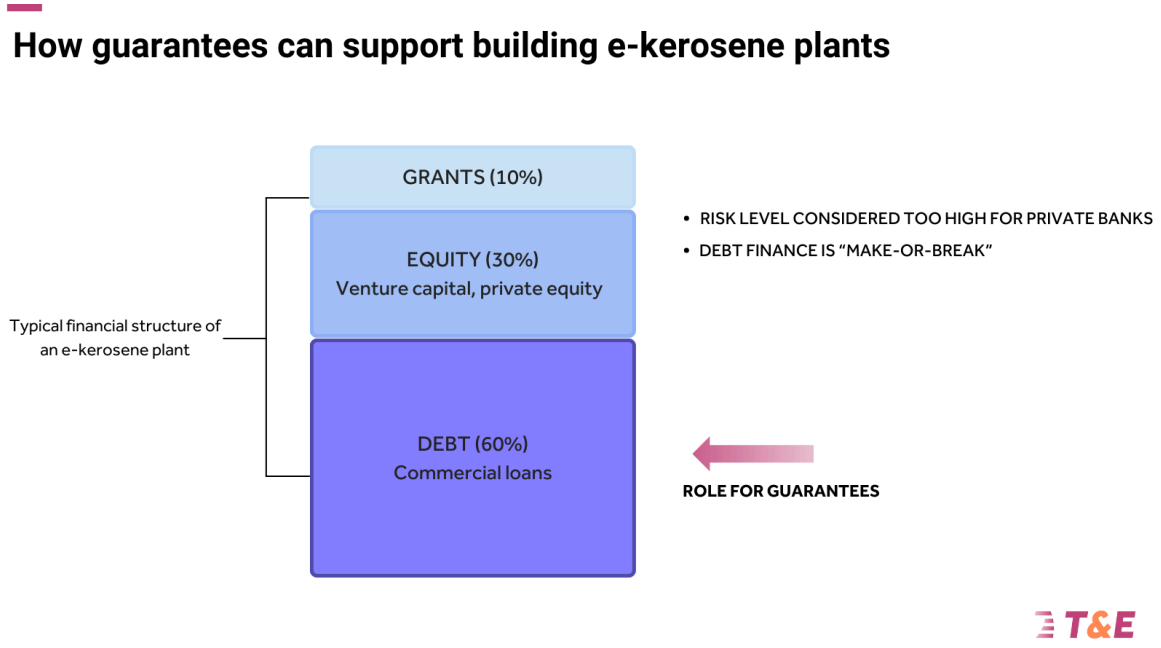


Figure 8. How guarantees can make a difference for a large-scale e-kerosene plant.

Guarantees are key to de-risk and unlock private investments into new production plants. They hold the potential to de-risk projects and enable senior lenders to provide project finance, ultimately leading e-kerosene projects to reach final investment decision. Therefore we recommend **allocating €5 billion from the InvestEU programme and €2.5 billion from the EIB to guarantee both public and private investments in clean fuels by 2030**. This should include providing counter-guarantees and first-loss

guarantees to private investors when necessary. Figure 8 illustrates the typical financial structure of an e-kerosene plant and the role that guarantees can play in unlocking debt financing.

National funding for the aviation sector

While public intervention is crucial to deliver the transition, citizens should not bear the entire financial burden. EU institutions and national governments can leverage taxation and carbon markets to ensure that the bulk of funding is sourced from the industry itself.

In 2023, T&E estimated the "tax gap" for the aviation sector: how much European air passenger travel benefits from tax and emission pricing exemptions, by calculating what the sector paid versus what it should have paid if these exemptions were removed [12]. This **tax gap** represents the lost public revenues from poor taxation of the sector in Europe. **In 2022, governments lost out on €34.2 billion. T&E proposes that 25% of this potential revenue is used to support e-kerosene projects - a total of €8.6 billion by 2030, enabling €1.4 billion additional yearly financing**.

Carbon markets will also be a fundamental contributor to the aviation decarbonisation pot. T&E estimates that revenues from the ETS in the aviation industry will total €45 billion in the 2025-2030 period. **We recommend earmarking 25% of these national revenues for aviation for Member States to support the production of green hydrogen and derived e-fuels** through grants, low-interest loans, state guarantees, subsidies, **on the condition of direct offtake of the produced fuels by the aviation sector**. This would channel €11.2 billion from national ETS revenues up to 2030.

Together, redirecting a quarter of fair taxation of the aviation sector and revenues from the aviation ETS can amount to €19.8 billion by 2030. These revenue sources can become the lion's share of the public funding needed for the sector's green transition.

Ending support to unsustainable projects

Focused and targeted support for the decarbonisation of the aviation sector needs to run in parallel to the end of public support for projects that do not align with the Paris Agreement objectives. **EU and national budgets should stop supporting the building of new airports or their expansion**, as it drives the growth of an unsustainable sector. A notable precedent is the EIB Climate Bank Roadmap 2021-2025 under which the EIB has decided to cease financing the expansion of airports: the bank will "*pull back from financing airport capacity expansion and concentrate support for airports on safety, security and decarbonisation projects. Conventionally fuelled aircraft will also no longer be supported*".

To better align national funding with the EU climate goals, T&E supports **more stringent criteria in State Aid support within the aviation sector through sectoral guidelines** [13, 14]. EU State Aid rules should adopt a robust, science-based approach to mainstream climate considerations in its support schemes.

2.2.2 Private finance

Commercial banks and institutional investors

Among existing barriers to finance, e-kerosene plants struggle to attract project finance due to the high risks they entail - ranging from market to creditworthiness and technology risks - and the limited track record of lenders in the field [15]. Securing commercial agreements for long-term offtake remains particularly delicate at this stage.

But with the EU institutions and public banks at work to de-risk e-fuels production, commercial banks should be incentivised to enhance their lending to the sector. Likewise, institutional investors and equity funds may identify investment opportunities, coupling competitive returns with supporting the green transition. Once a robust business case is in place, bolstered by long-term offtake and supply agreements, the reliance on public funding for e-kerosene should transition to private bank financing and equity investments. This is especially important for smaller project developers which will not be able to fund their development phases on their own, unlike larger companies.

Getting the rules of green finance right

Environmentally aware investors need robust metrics to effectively channel their investments towards sustainable options. While the EU Taxonomy is an important framework, its Technical Screening Criteria (TSC) for the aviation sector are currently too lenient to properly define sustainable investments in the aviation sector. The aviation TSC adopted in 2023 allow investments in more 'efficient' planes to be considered sustainable, regardless of whether they still run on fossil fuels [16]. Planes qualify for the criteria if they meet weak fuel efficiency standards, while continuing to operate on fossil fuels. T&E estimates that under these criteria, over 90% of Airbus' order book could be considered green, while nearly a third of low-cost giant Ryanair's future fleet would pass the threshold. Therefore, **it is urgent for the EU to strengthen the Taxonomy criteria for aviation to focus on truly disruptive solutions only – sustainable fuels or zero-emission aircrafts**.

Another promising area is the use of monetary policy to stimulate green investments. **Dual interest rates** – whereby green projects are financed at a lower interest rate than other investments – can help reduce the cost of capital for green projects. In the aviation sector, this could reduce the cost of capital for building a sustainable supply of clean e-fuels. The European Central Bank (ECB) and national central banks should create a dual rate policy that differentiates between sustainable and unsustainable activities and ensures that the cost of capital reflects all externalities of those investments.

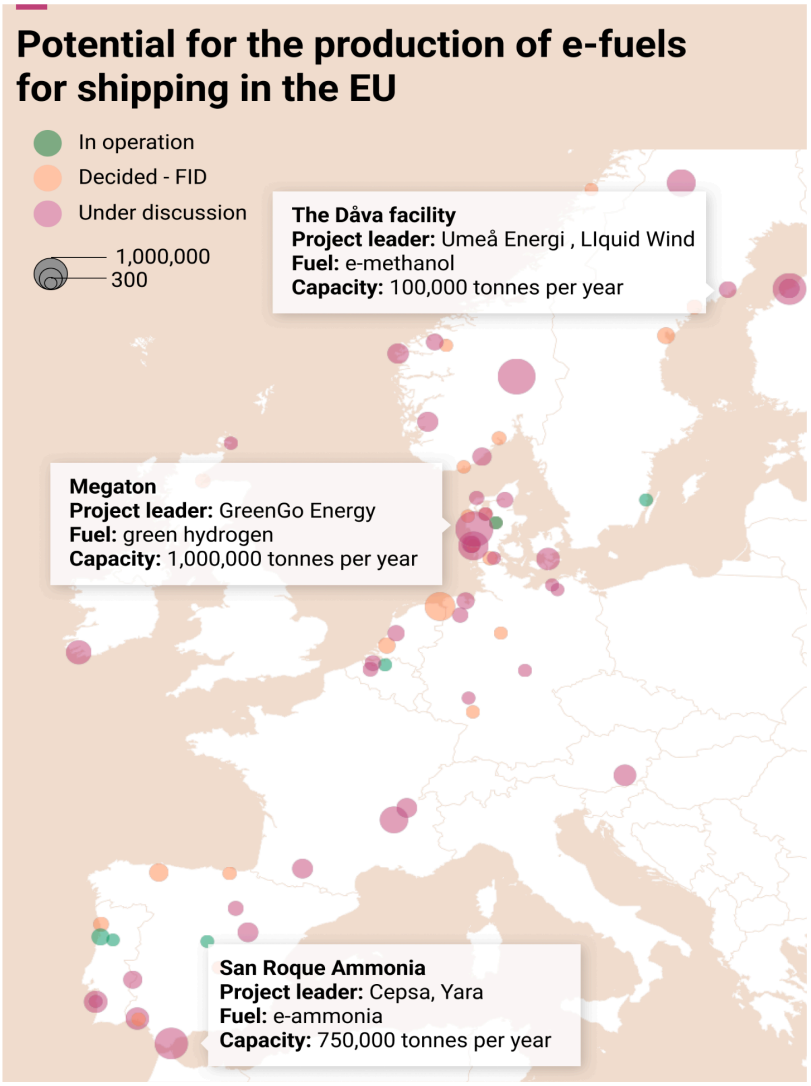
3. Green e-fuels for shipping decarbonisation

If all other sectors of the economy reduce their emissions in line with the 2°C temperature goal but the maritime sector continues to grow at its current pace, shipping emissions could represent 10% of global GHG emissions by 2050. Ships currently use some of the world's dirtiest fuels. The only sustainable alternatives to these fuels are energy carriers produced from renewable electricity such as hydrogen, e-diesel and e-ammonia. They represent the most promising way to decarbonise a sector that has long been reluctant to change.

T&E's mapping of green hydrogen projects across Europe shows that nearly 4% of European shipping could run on green e-fuels by 2030. There is a relatively strong e-fuel production pipeline in Europe, but only a sixth of the announced capacity has reached the final investment decision [17]. Fuel suppliers are hesitant to commit financially to projects without more guarantees that there will be demand for these fuels in the near future.

Shipping e-fuel projects with funding to date comprise only 0.24% of the projected European marine energy demand. This financial stalemate risks preventing EU production from matching the demand of 0.11 Mt in 2030 and 1.65 Mt in 2035 – the current capacity is 0.01 Mt.

Due to a lack of regulatory obligations on both the demand and supply, the e-fuels industry is stuck in a chicken and egg situation: e-fuels producers are expecting clearer demand signals and financial commitment from the shipping industry before making large investments. Shipping companies, on the other hand, are waiting for these fuels to scale up and get cheaper before ordering new vessels or retrofitting existing ones. Investment security is needed for more projects to become operational and supply fuels for the maritime sector. This means that **dedicated financial incentives are necessary to kickstart the production of e-fuels**, including targeted public support at least until 2030.



Still, **Europe currently lacks a well-designed investment system and tools to drive private and public investments in clean energy for shipping**. An investment strategy to decarbonise shipping should be central to the future EU maritime strategy the European Commission will develop following the call from European governments in May 2024 [18].

Regulation has a key role in the sector's transition. Public policy, rather than public financial aid, will need to drive the long-term uptake of zero-carbon e-fuels.

3.1 Findings

The path to decarbonising Europe's shipping fuels will require €559 billion by 2040. The associated yearly investment is €21 billion by 2030, €37 billion in 2031-2035 and €50 billion until 2040.

Shipping	2025-2030	2031-2035	2036-2040
Total needs (€bn)	122.6	184.8	251.5
Yearly needs (€bn)	20.4	37.0	50.3
Extra investment for strategic autonomy (€bn)	34.6		
Total public investment (€bn)	29.7		
Share of public investment	86%		

Ships already have limited access to biofuels such as methanol, diesel and LNG produced from biomass and waste. Our decarbonisation roadmap foresees using these fuels at an early stage only, with e-fuels replacing them as of 2035. This early purchase of biofuels is worth €88 billion until 2030 - this also includes hydrogen as a fuel. In the same period, e-fuel production plants construction and set-up will start. The **extra investment**

needed to kickstart these projects ranges between €25 and €35 billion by 2030 - figure 9. This amounts to less than €6 billion annually, or 4.3% of 2023 European shipping revenues in the worst price scenario.

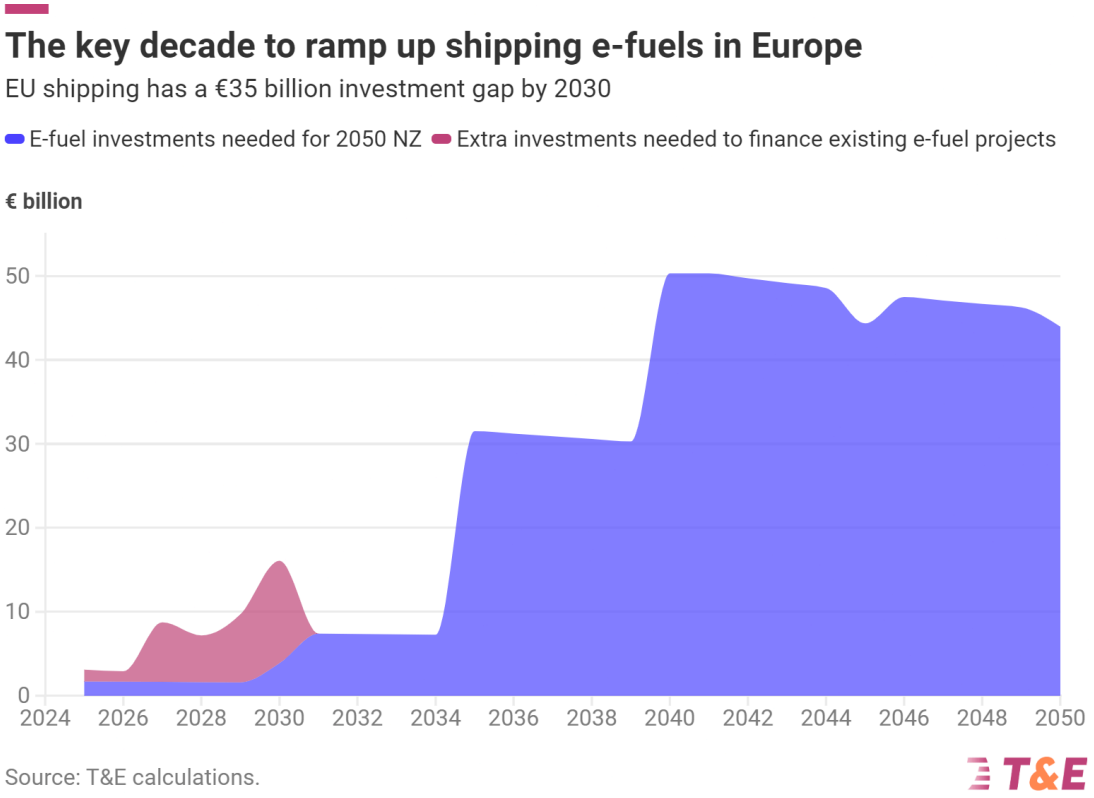


Figure 9. Clean fuels for shipping, 2025-2040.

3.2 Recommendations

It is crucial for existing shipping e-fuel production plans to attain final investment decision. This requires sufficient early-stage funding from EU institutions and national governments to complement or guarantee private investments.

Although the majority of investment needs should be paid by the private sector, we estimate that public funding could cover nearly €30 billion, or 86% of the investment gap by 2030. Most would come from ETS revenues and the Innovation Fund.

3.2.1 Public finance

The landscape of public funding for the shipping sector is fragmented across various national support schemes and EU-level instruments - like the Investment Fund, Connecting Europe Facility, Horizon Europe, etc. However, public funding still facilitates investment in fossil fuels. The EIB, for instance, allows financing for LNG ships. Therefore, beyond financing decarbonisation, EU investment in natural gas infrastructure for shipping must end as research shows that gas can produce more GHG emissions than conventional marine fuels.

Scaling up support from the EU Innovation Fund

We estimate that around €9.5 billion from the Innovation Fund (IF) must be dedicated to green e-fuels for shipping by 2030. Support should take place via dedicated calls for proposals – grants and auctions – by directing green hydrogen to the shipping sector.

The Commission already plans to allocate roughly €1.7 billion for shipping through the IF, including through the Hydrogen Bank which awards fixed premium subsidies for green hydrogen production. Following a successful first auction involving some maritime off-takers, the Commission has announced provisional terms for a second auction, scheduled for launch by the end of 2024. This round is expected to feature a €200 million dedicated basket for projects with off-takers in the maritime sector, aimed at kickstarting e-fuel deployment for shipping.

As a temporary fix, the EU should also explore setting up a European Hydrogen Clearing House, as an upgrade to the Hydrogen Bank. The Clearing House would act as an intermediary between e-fuels and green hydrogen producers on one side, and shipping and aviation off-takers on the other. Among its functions, it would aggregate hydrogen demand to ensure predictability for producers on the committed offtake volumes. Providing contract length visibility would give producers long-term clarity while allowing the flexibility of short-term purchase contracts for end-users in the maritime and aviation sectors. Ultimately, it would facilitate the accessibility and distribution of green e-fuels across the EU.

Contracts for Difference (CFDs) for the maritime sector

The transition to zero-emission shipping will necessitate additional capital and operational costs for ship operators. To help the maritime industry weather these costs during the transition period, an operational subsidy scheme could be implemented, such as contracts for difference (CfDs). CfDs are subsidy schemes that pay part of the price difference between clean fuels and fossil fuels. This could incentivise shipowners to increase their adoption of green fuels by ensuring a business case for clean fuels competitive with conventional ones.

Support in the form of supply-side CfDs - i.e. the subsidy is awarded to e-fuels producers - is an effective form of public support. Supply-side support is appropriate in shipping as it facilitates the deployment of renewable fuels in a select number of ports, where the lion's share of bunkering takes place. Policy-makers should also consider bridging only a part of the price gap between e-fuels and conventional fuels so that the market absorbs some of the cost in the form of green premiums.

The IF should develop such a scheme from its existing fixed premiums programme under the Hydrogen Bank to bridge the cost gap for pioneering projects and mitigate the volatility of energy prices.

De-risking e-fuels production and uptake

To kickstart the use of e-fuels by 2030 and achieve decarbonisation by 2050, the construction of e-fuels compatible ships must accelerate as early as possible. Investments in scaling up supply, deploying zero-emission ships and refuelling infrastructure would improve the cost-attractiveness of e-fuels, and stimulate demand. Public de-risking and leveraging of private financing will be key to make this happen.

A **guarantee instrument of €5 billion under the InvestEU program** must be set to back concessional loans. It should provide public guarantees and counter-guarantees, including first-loss guarantees, to private banks and investors to offer loans and equity to cleantech projects. We estimate this could

trigger up to €35 billion in private investment, using a leverage ratio of 1 to 7 – i.e. €1 of EU guarantee mobilising €7 of total investments. Figure 10 illustrates how public guarantees work in practice.

Public banks should also increase their support for green shipping finance. In particular, the EIB should develop a new initiative drawing lessons from the previous EIB Green Shipping Guarantee programme [19], which supported only three projects back in 2017 and 2018. One objective of a future EIB instrument should be to de-risk loans from commercial banks to companies operating best-in-class vessels powered by e-fuels – see figure 10. Additionally, the EIB should consider investing in R&D projects focused on energy efficiency technologies and battery technologies for shipping.

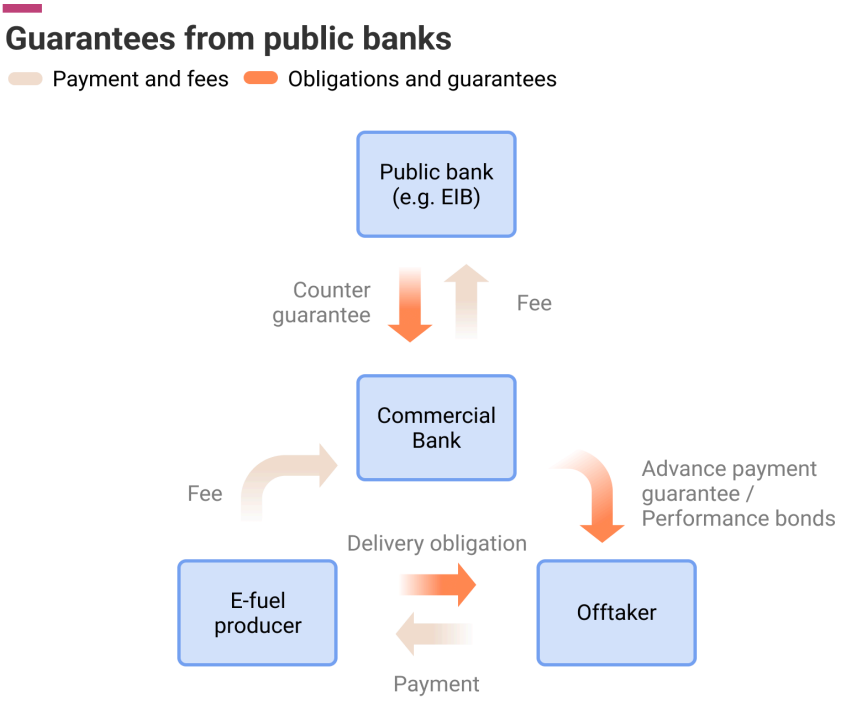


Figure 10. Guarantee schemes from public banks to de-risk e-fuel production and uptake.

Clean vessels face higher financing costs as they are more pricey to purchase and operate. Their lack of historic credit risk data and perceived technological uncertainty leads to a higher cost of capital. Therefore, target support from national public banks and Export Credit Agencies - especially in maritime countries - should enhance shipping decarbonisation, including via InvestEU as mentioned above.

Incentivise e-fuel production using maritime ETS revenues at national level

The Maritime ETS is projected to generate up to €10 billion in annual revenues by 2030. Part of this could effectively kickstart the production of e-fuels in Europe, particularly for projects lacking sufficient financing through targeted support to narrow the cost gap with fossil fuels. Therefore, **governments should invest 25% of these revenues – €15.2 billion by 2030 – into the decarbonisation of the sector.** This can be done by investing in e-fuels projects via the auction-as-a-service program under the Hydrogen Bank. Targeted financing is crucial for reducing the supply-side costs of e-fuels and enhancing investment certainty for e-fuels projects. New projects will be needed to meet increasing demand for affordable clean e-fuels and surpass the 1.2% ambition set by RED III, aligning with long-term decarbonisation goals beyond 2030.

3.2.2 Private finance

Taxonomy rules

Most ship financing comes from private financiers through loans, equity or bonds. Shipping is a capital-intensive industry requiring regular access to capital to replace vessels and reduce fleet emissions. As the green transition accelerates, this need will be even more acute in the future. Therefore, it is crucial to develop **clear criteria for sustainable shipping investments and direct private capital towards the sector's decarbonisation**.

The EU taxonomy criteria for sustainable investments mistakenly include LNG-powered ships, despite their significant methane emissions, which often make them worse for the climate than traditional fuels[20]. This undermines efforts to promote truly sustainable shipping practices. Hence, the EU Taxonomy should be revised to take the sustainable label off of all LNG-related activities.

Commercial banks and institutional investors

Public investment and guarantees will be crucial to de-risk the shipping sector and make sure companies can access adequate financing – from banking finance to covered bonds and equity investments. Given shipping companies' dependence on bank debt, the European banking sector should offer specialised loans for maritime projects that demonstrate positive environmental impact and alignment with sustainability goals. Due to the cyclicality of the shipping industry, flexible repayment terms including grace periods should be considered. Extra support from European banks is of paramount importance, as European shipping firms increasingly rely on Chinese state-backed banks and financial institutions for competitive financing.

To enhance industry visibility on financing options and streamline access to public and private funding, the European Commission should establish a digital Single Access Portal with a simplified application process. Additionally, it will enable public institutions such as the Commission, the EIB and national public banks to provide project development support, bolstering the technical and financial viability of decarbonisation initiatives.

4. Rolling out charging infrastructure in Europe

Charging infrastructure is a key enabling condition to the rollout of EVs and the electrification of road transport. At the EU level, the Alternative Fuels Infrastructure Regulation (AFIR) mandates member states to build public charging capacity for both light duty vehicles (LDVs) and heavy duty vehicles (HDVs) on main roads. Additionally, the Energy Performance of Buildings Directive addresses private charging infrastructure in buildings. With these regulations in place, the focus should now shift to implementation. Creating a framework to sustain the current growth of the charging network is crucial. This involves removing barriers to deployment - such as regulatory and space requirements - and ensuring the grid connections are fast and flexible to support market-based network growth.

Central to this agenda are adequate and smart investments. While most investments will be private, the public sector must step in to address market failures in the short term.

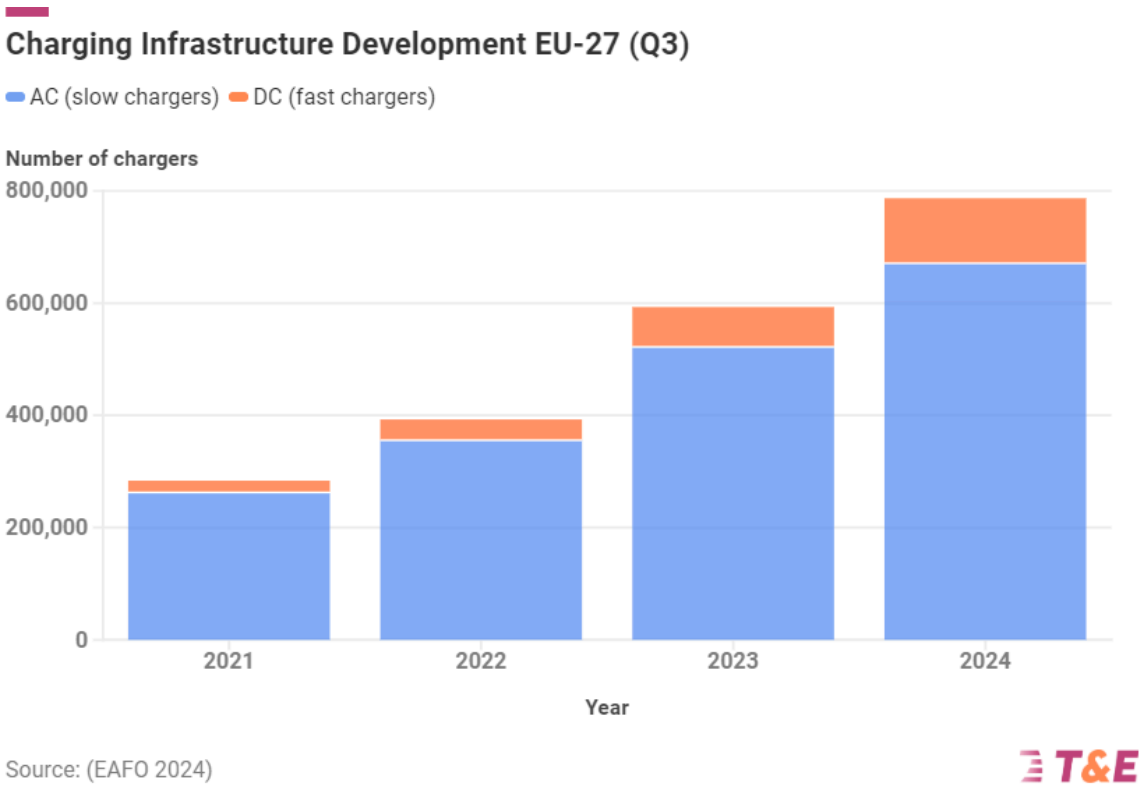


Figure 11. Charging Infrastructure Development EU-27.

4.1 Findings

To support cars and vans - light-duty vehicles - Europe will need around 58 GW of installed capacity for public chargers and around 37 million private chargers in homes, offices and commercial properties such as shops and hotels by 2030. This infrastructure will be sufficient to charge the electric fleet necessary to align with the EU Green Deal and climate neutrality goals. **The overall investment required for light vehicle charging infrastructure will be €300 billion by 2040.** By 2030, at least €15.8 billion should be spent on installing public chargers, and an additional €68.7 billion should be invested in private chargers across Europe - €84.5 billion in total.

For freight, our analysis shows that EU-wide infrastructure for zero-emission trucks and buses - chargers and refuelling stations - will cost approximately €197 billion by 2040. About 82% of this cost is for private charging, with the remaining funds dedicated to public infrastructure. The early investment by 2030 is estimated at around €13.9 billion.

Charging	2025-2030	2031-2035	2036-2040
Total needs (€bn)	98.4	172.3	230.0
Yearly needs (€bn)	16.4	34.5	46.0
Direct Cap-Ex (€bn)	84.7	148.2	197.9
Total public investment (€bn)	7.5		
Share of public investment	8%		

Overall, **an investment of €98 billion – €16.4 billion a year – is required to provide sufficient infrastructure across Europe by 2030.** It would represent only 13% of the annual spending in fossil fuel subsidies in the EU, estimated at €123 billion in 2022 by the European Commission. These projects should be streamlined and receive fast-tracked permits to minimise costs and time losses associated with administrative burdens. The Commission estimates a similar level of €15 billion per year for recharging and refuelling infrastructure by 2040[2].

Figure 12 shows how the investment in LDV public charging decreases over time. The AFIR regulation tows massive investments until 2030 – more than 40% of the total amount – that are needed to develop the backbone of the European charging network.

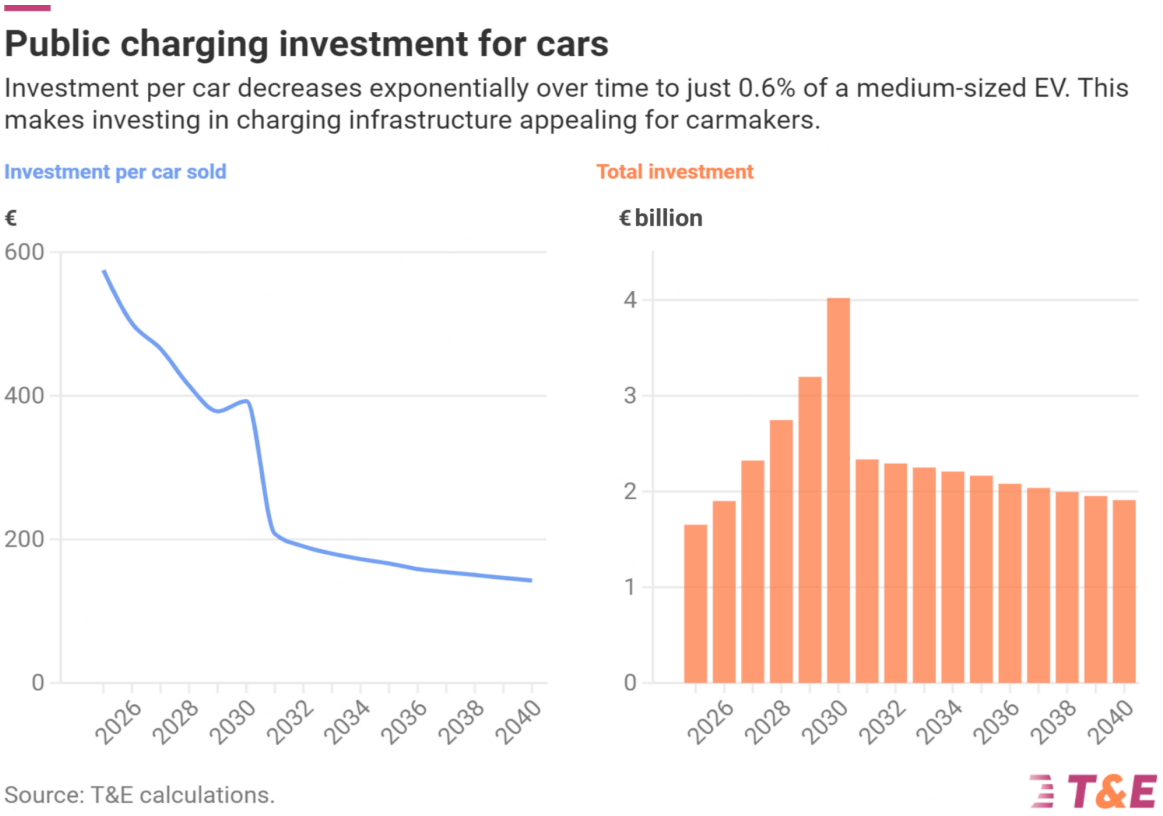


Figure 12: Public charging infrastructure cost, absolute vs per car.

4.2 Recommendations

Public charging stations for light and heavy-duty vehicles situated on main European roads offer solid returns and are attractive for company investments. A large part of the required investments will be driven by the private market, as companies are already seizing market opportunities and investing solely with their own means.

Hence, **public funding should prioritise deploying minimum basic network coverage and compensating for market failures**. This includes low-traffic locations where charging infrastructure is needed to ensure a continuous network but where the business case for private operators is not yet viable.

Focus should also be on leveraging bidirectional charging (V2X) to integrate EVs smoothly into the energy system. This will have wider benefits of allowing higher renewable energy penetration and benefiting both drivers and the energy market.

Member states should ensure that public funding stimulates competition and counterbalances monopolistic and oligopolistic tendencies in the charging markets. After establishing the initial network, further charger deployment should primarily be left to the market, with robust safeguards to ensure transparency on tariffs, value for money for consumers, etc.

4.2.1 Public finance

Public charging

Substantial public charging infrastructure investments are needed to serve the growing EV market and remove charging anxiety. National governments should be responsible for assessing whether and where market failures exist in their territories and intervene to install additional public charging capacity where necessary. To help plug the gaps, T&E supports **simple funding schemes to develop backbone networks for public charging**, at locations where the AFIR targets are not met along the TEN-T network. Key options to be explored are unit contribution - simple lump-sum funding per charger - or **output-based financing,** which creates clarity and simplicity.

The funding schemes should also encourage charging companies to deploy chargers in areas with low traffic, and thus low charging demand - reduced or no funding for more profitable locations, increased funding for less profitable locations. **The EU should make use of existing EU-funding mechanisms, building primarily on the Alternative Fuels Infrastructure Facility (AFIF – blending grants and loans)** and further mobilising the InvestEU, Connecting Europe Facility, Just Transition Fund and structural and regional funds to provide sufficient public funding.

Private charging

Regarding support for home - including collective charging in shared buildings for cars - and depot charging - for vans and trucks - targeted EU and national funding schemes are necessary. **The EIB and national public banks have a role to play to decrease upfront costs for households and companies**. Public support should preferably take place through investment loans and guarantees to overcome the high Cap-Ex costs of starting a charge point, as charging will be a profitable business activity after the initial investment costs are retrieved. At the EU level, we recommend the EIB to mobilise up to €7.5 billion in loans for households and companies by 2030, with a specific focus on low-income households and neighbourhoods where there is a gap, ensuring true additionality of public support.

HDV charging

For heavy-duty chargers, building upon the €1 billion already available under the AFIF is an efficient tool. A toolbox of EU and national funding should be further deployed to support connection to grids and Charging Point Operators (CPOs) via cheap loans and guarantees. In a context of high interest rates and tanking stock valuations, these key actors are currently facing barriers to access finance. An incomplete network could deter hauliers from investing in zero-emission trucks.

4.2.2 Private finance

Simpler, coherent and harmonised administrative and funding requirements

Member states should strive for simplified and faster administrative and permitting procedures. No disproportionate reporting obligations would help the rapid deployment of charging infrastructure.

Project finance and balance sheet finance

The cash flow generated from public charging infrastructure projects is attractive to both corporations and financial institutions. These entities should take the lead in facilitating access to finance for CPOs.

Companies providing charging infrastructure services for EVs should pool resources and issue **green bonds** to accelerate the development of widespread charging networks, driving the transition to electric mobility. By pooling resources, these companies can leverage shared expertise and economies of scale, reducing costs and increasing efficiency. Issuing green bonds helps access capital dedicated to sustainable projects, attracting environmentally conscious investors.

Innovative financing models

Innovative financing models where businesses make upfront investments and recoup their investment through service payments should be encouraged. For example, in private charging infrastructure for buildings, companies can finance the entire collective installation, manage connections to the network, and maintain all installations. This cost can then be allocated to EV users and, over time, allow new EV owners to have new individual charging stations installed, see the example of Logivolt [21].

5. Scaling up affordable electric car production

As European regulation has set a target of 100% zero emission new car sales by 2035, a crucial challenge now lies in scaling up investments in electric vehicle (EV) production. To stay on track for full decarbonisation by 2050, the EU needs to entirely substitute its old polluting car fleet – which is responsible for 56% of transport CO_2 emissions – with new zero-emission cars.

Carmakers are primarily responsible for the transition to electric vehicles. They need to adapt their investment strategies and actively promote EVs to customers.

However, the high purchase price of EVs still hinders their mass market adoption. To democratise access to EVs, companies and public institutions must ensure that purchasing and running an electric car is affordable for everyone. Support to lower-income households and to the social component of the transition will be of paramount importance.

5.1 Findings

Investment in electric cars and vans (LDVs) will amount to €5.45 trillion by 2040 in the NZ Scenario, accounting for 61% of the total needs identified in our study. This substantial investment aligns with the significant contribution of diesel and petrol engines to CO_2 emissions.

Around €1.3 trillion is needed by 2030 – equivalent to €216 billion per year – while an additional €2 trillion will be required over the

Electric vehicles	2025-2030	2031-2035	2036-2040
Total needs (€bn)	1,301.3	2,056.6	2,099.9
Yearly needs (€bn)	216.9	411.3	420.0
Direct Cap-Ex (€bn)	136.6	215.9	220.5
Total public investment (€bn)	76.0		
Share of public investment	6%		

following five years, amounting to €400 billion annually from 2030 to 2035. While this may seem like an enormous amount of money, the total investment is only 15% higher than under the current regulation standards – i.e.the FF55 Scenario.

The bulk of these costs stem from the private purchase of Battery Electric Vehicles (BEVs), meaning a significant portion of the transition falls on consumers' shoulders. As EV prices are by far the main barrier to EV adoption, the transition will not occur if consumers cannot afford electric cars.

As BEVs still bear a substantial price gap compared to their fossil-fuel powered counterparts, carmakers are seeking solutions for widespread clean vehicle adoption. T&E proposes focusing on the **production of compact, affordable and sustainable cars**. This strategy would enhance road safety, reduce pressure on scarce raw materials, and potentially **lower the transition cost by up to €480 billion**, or 10% of the total investment needed by 2040, compared to the current production setting (Figure 13). The EU economy would benefit for two reasons: European carmakers could gain market share over foreign competitors, and cost savings would result from using fewer materials, which are mostly imported.

This significant cost reduction underscores that smaller electric cars are a better fit for Europe: socially, as they are more affordable, environmentally, as they require fewer minerals and have a lower environmental impact during the production and use phase, and industrially, as smaller segments are where the sales volumes are higher both in Europe and globally.

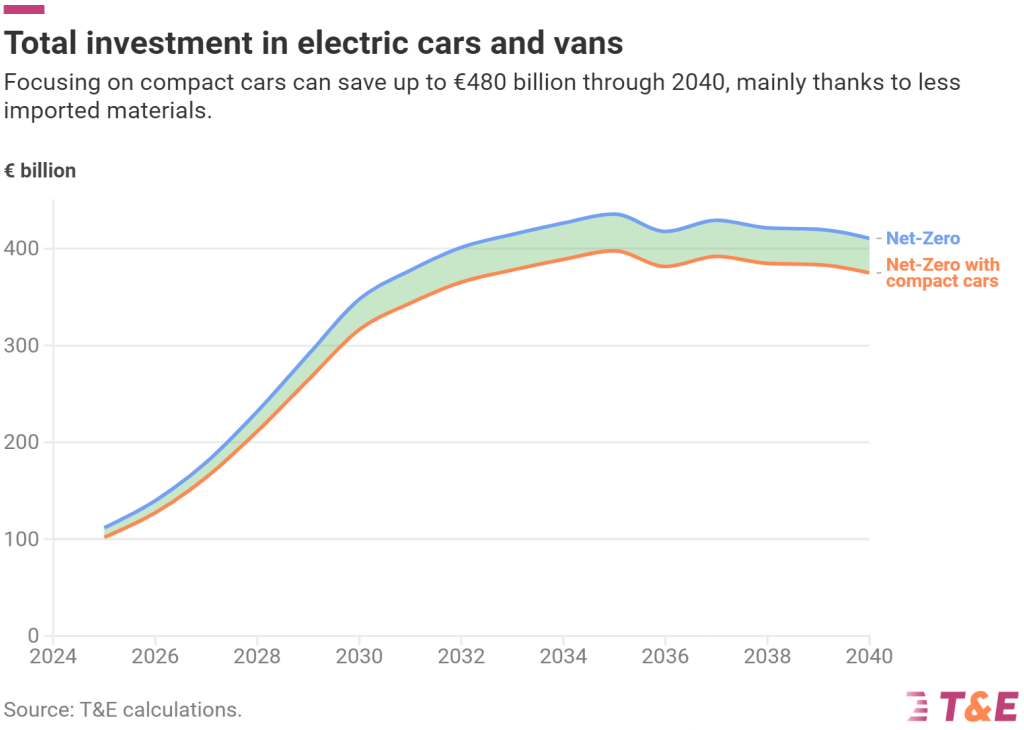


Figure 13: LDV investment scenario analysis.

5.2 Recommendations

While EV adoption is already substantial in some EU countries, it is clear that residents in lower-income areas face challenges affording the higher price associated with EVs. Affordability remains the primary barrier to achieving mass-market adoption and needs prompt resolution. This requires a joint effort from carmakers and the financial community. Additionally, the public sector must ensure adequate financial instruments are accessible to all stakeholders, with particular support for lower-income households.

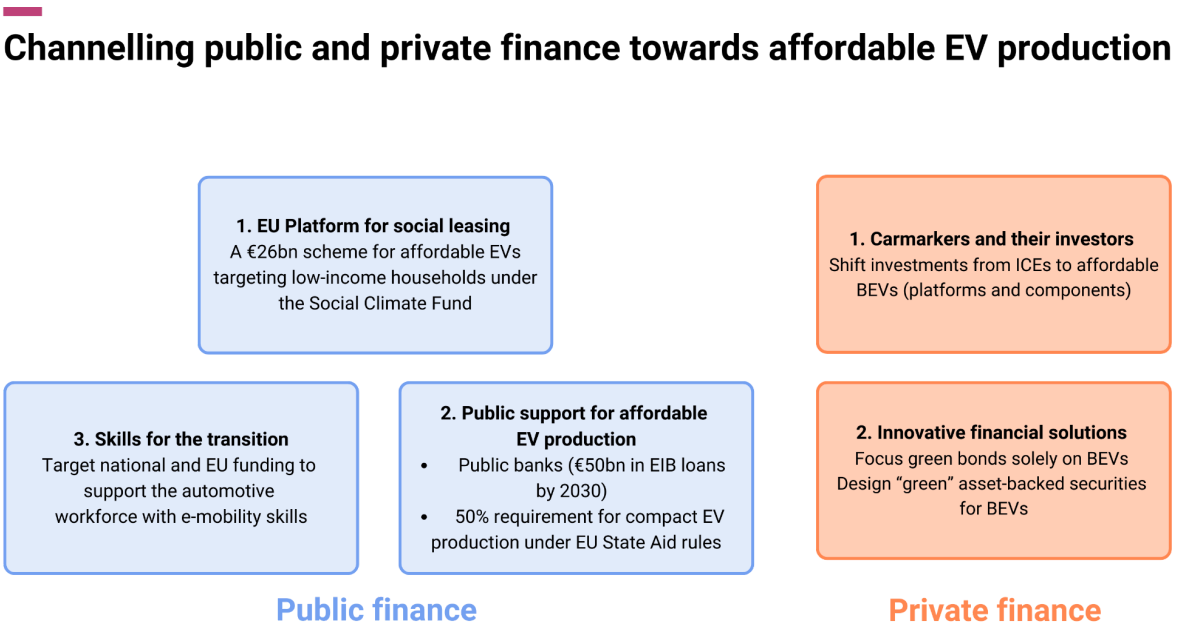


Figure 14: Channelling public and private finance towards affordable EV production.

5.2.1 Public finance

Social leasing schemes

The most decisive short-term measure for the EU to support affordable electric car adoption is to implement a social leasing scheme targeting low-income households. As part of the EU's Social Climate Fund (SCF), EU Member States should support affordable social leasing of BEVs in their national Social Climate Plans. This should be done under clear multi-year planning, whereby authorities plan the gradual shift towards socially targeted support and avoid abruptly removing subsidies.

The EU should launch an "Affordable EU EV" platform to support member states to set up national social leasing policies based on France's model, using SCF and ETS2 revenue. The platform would provide guidance and templates for easy policy set-up, aggregate pan-EU demand for small made-in-EU models and pre-design projects - criteria, vehicle selection - for smaller member states to join easily.

Dedicating €26 billion from the SCF, including via Member States' co-financing, can be the backbone of this initiative to make EVs affordable for those who need them most. This scheme would not only reduce GHG emissions but also foster social inclusivity and economic mobility. Financing through the SCF enables advancing towards a greener future while addressing social disparities.

Strong environmental and social criteria should be attached to social leasing schemes, for instance clauses favouring EVs manufactured in the EU and those with best sustainability performance - e.g. excluding SUVs and large cars. When leasing companies are involved, they should disclose to public authorities all information on how they calculate the leasing rate and other key financial parameters, in order to avoid windfall profits.

National and EU support to affordable EV production

Moreover, **Member States supporting national car production under EU State Aid rules should include a requirement to produce compact EVs** – at least 50% of BEV models in segments A-C, non-SUV. Criteria under EU funding programmes should mirror these requirements.

At the EU level, the EIB and national public banks could play a pivotal role by providing up to €50 billion in loans until 2030, in support of a fair transition and compact EVs.

In the longer term, implementing scrappage schemes will be essential to accelerate the cleaning up of the European vehicle fleet. These policies can become a successful instrument for facilitating EV adoption among low-income households, who typically own the oldest and most polluting cars. Further resources from the SCF and the EIB should back such schemes after 2030.

Skills for the transition

Transitioning from predominantly producing ICE cars to going 100% electric will entail a profound transformation of the automotive industry, its supply chains and the workers involved. Ensuring Europe's automotive competitiveness and accelerating the supply of BEVs will require **preparing the future automotive workforce with essential skills for emerging industries**, such as electronic engineering, electrochemistry, and IT.

It is crucial to enhance and reform vocational training and technical education across Europe to align with the needs of e-mobility. All funding options at national and EU levels - including the EIB, national public banks, the Social Climate Fund, and national subsidies - should incorporate initiatives for up-skilling and reskilling workforces into their financing tools.

5.2.2 Private finance

Carmakers and their investors

To drive the private sector towards sustainability, car manufacturers should prioritise the production of small, affordable BEVs and phase out investments in ICEs. Essentially private investment has to shift from ICE to BEVs, with minimal extra cost involved. This strategic shift will broaden access to clean EVs among consumers, thereby accelerating the transition to environmentally friendly transportation.

Private investors also play a crucial role in the electrification of the automotive industry. They should leverage their influence to direct investments towards transforming existing production lines into dedicated EV platforms. Financing should also support the production of essential EV components such as motors, converters, and battery packs. By doing so, the industry can increase its capacity to produce EVs and their components more efficiently, driving costs down and boosting market penetration.

Innovative financial solutions

Implementing innovative financial mechanisms is key to supporting the EV transition. For instance, green bonds should be redesigned to exclude plug-in hybrid vehicles (PHEVs) and focus solely on BEVs. This can ensure that funds raised through green bonds are used exclusively for the most sustainable vehicle technologies, maximising their environmental impact.

Furthermore, EV Asset-Backed Securities (ABS) can attract substantial investment by offering a secure return based on the assets of EVs. ABS linked to auto loans are a key area of the securitisation market, in particular in the USA, where it is worth $250 billion. As recent studies highlight [22, 23], these auto loans' securities bear significant risks since the underlying loans focusing mostly on ICEs can become stranded assets. Indeed the green transition will reduce the residual value of ICEs and subsequently raise the level of risk to bond investors. Distinguishing securities linked to loans for ICEs and those linked to loans for BEVs can alleviate this risk, by enabling investment firms to prioritise support to BEV-linked ABS. Greening auto ABS can ultimately improve the funding conditions of firms accelerating the electrification of their production, and help develop a sustainable asset class.

Info Box. Public transport and clean cities

While not covered in this study, public transport plays a pivotal role in accelerating the decarbonisation of the transport sector. Investing in public transport will facilitate modal shift, ultimately reducing the number of vehicles on the road and the resources required for vehicle manufacturing. With almost 3 in 4 Europeans living in urban areas, cities are central to this transition[24].

Cities face mounting pressure to address mobility challenges, prompting many to adopt measures that promote alternatives to cars, vans and trucks while freeing up road space for cyclists and pedestrians. This can be achieved by revising urban planning policies and investment plans, to prioritise investments in cycling and walking infrastructure, public and shared transport (e.g. metros, e-buses – both BEVs and trolley buses –, trams, shared micromobility, etc.), promoting the use of cargo bikes or establishing logistics hubs [25].

However, responsibility should not solely rest at the city level. Bringing the budget closer to EU citizens is crucial. Funding for such projects could be sourced from the Connecting Europe Facility, the European Regional Development Fund (ERDF), or the Cohesion Fund (CF).

National governments and the EU must support and consolidate decarbonisation efforts by investing in public transport infrastructure and strengthening a regulatory framework that sets binding climate targets for cities and facilitates the adoption of Sustainable Urban Mobility Plans for all urban nodes of the Trans-European Transport Network (TEN-T) before the 2027 deadline [26].

Additionally, the EU should implement the 'EU Mission for 100 climate-neutral and smart cities by 2030' by increasing earmarked funds for this initiative under Horizon Europe, and reinforcing the monitoring of climate plans and commitments at the city level. Grants for public transport should prioritise cities and regions with inadequate public transport services, particularly in Member States struggling to finance such improvements independently. To meaningfully assist cities in reducing emissions and improving air quality, the ERDF and CF could allocate extra funding for zero-emission urban public transport for the future budgetary period 2028-2034.

A recent study from the EIT Urban Mobility estimates that at least additional €1.5 trillion are needed by 2050 to meet the Green Deal objectives for the transport sector in European cities - €500 billion in investments generating about €300 billion in revenues, and €1.3 trillion in user costs. The study concludes that benefits outweigh costs in two out of three scenarios [27].

6. Developing the EU EV battery value chain

As Europe moves towards decarbonising its economy, batteries and the materials required for their production are crucial for cleaning up cars, trucks, and buses. Recent research by T&E [28] highlights the significant potential to establish a local and sustainable battery supply chain, though numerous risks remain. Without political leadership, robust policies, and a strong investment agenda, Europe may struggle to compete on a global scale.

Europe has the potential to achieve self-sufficiency in battery cell manufacturing as early as 2026 and meet much of its demand for key components – such as cathodes – and materials like lithium by 2030, provided all announced projects come to fruition. However, many of these projects are still uncertain. Given the nascent stage of this industry in Europe, they are unlikely to proceed without stronger government intervention and adequate investments.

In particular, going further mid- and up-stream reveals more risks. While plans to build cathode active material facilities across Europe exist, these have experienced less development than cells, with the region facing critical gaps in terms of project development. Their production is almost exclusively concentrated in China today. This highlights the urgency of establishing domestic capabilities to allow Europe to capture the full value chain.

T&E proposes an industrial blueprint for European governments, which includes maintaining investment certainty through the 2035 car phase-out, providing EU-level investment support, and enforcing stronger Made-in-EU provisions for best-in-class projects.

6.1 Findings

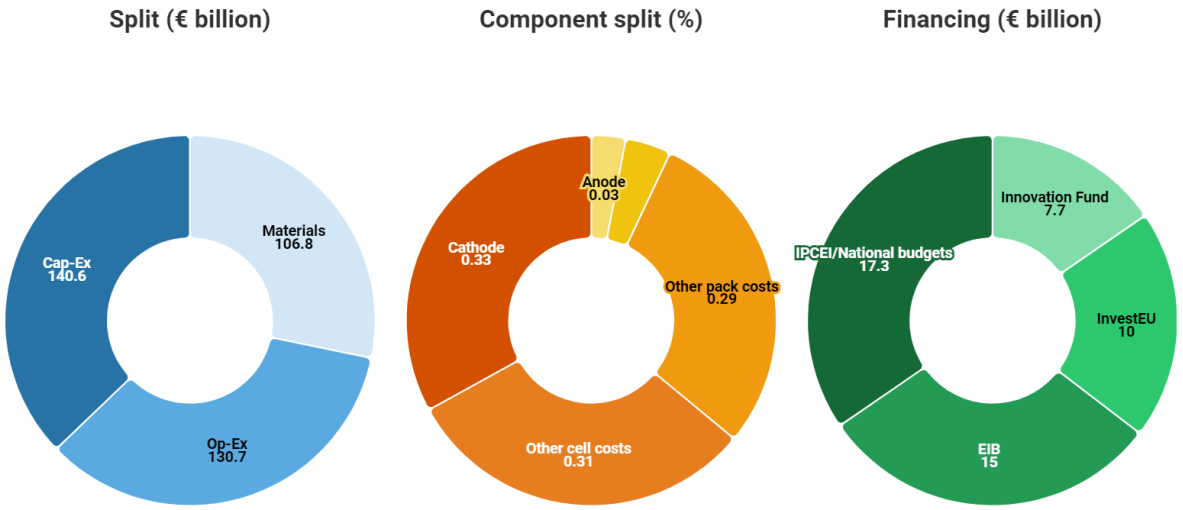
Around €1 trillion is needed by 2040 to produce enough batteries to support the transition to a fully electric, zero-emission fleet by 2050. Given the urgency of shifting to 100% European production, **significant investments are needed already by 2030 – €378 billion, or €63 billion annually**. This would ensure the EU's independence in this strategic sector and allow car and truck manufacturers to decarbonise on time and resiliently. Compared to the current industrial setup of the battery value chain - with significant imports from third countries including China, a trend also reflected in our FF55 Scenario - where most production occurs outside Europe, **the additional investment needed by 2030 amounts to €120 billion**.

Batteries	2025-2030	2031-2035	2036-2040
Total needs (€bn)	378.0	371.6	247.1
Yearly needs (€bn)	63.0	74.3	49.4
Extra investment for strategic autonomy (€bn)	120.4		
Total public investment (€bn)	50.0		
Share of public investment	42%		

Scaling up production along the battery value chain demands significant investments in both Cap-Ex, which cover upfront costs for infrastructure and equipment, and Op-Ex, which may include costs related to energy, labour, water, chemicals and raw materials. Given China's lead in both technology and knowhow to scale factories on the one hand, and higher input costs in Europe on the other, onshoring the battery value chain into Europe comes at a cost. Figure 15 details the battery cost and investment split and the financing instruments that could be mobilised to address investment needs.

Battery investment, cost and financing

The investment split based on Cap-Ex needed to reach the announced installed capacity by 2030, while Op-Ex and materials cost is based on the yearly battery demand. Cost split is presented for a battery built in Europe. Financing cost refer to the extra-investment needed through 2030 to reach a 100% European production.



Source: T&E calculations.

Figure 15: Breaking down battery investment.

6.2 Recommendations

Given the substantial support from China over the past decade and the financial incentives of the US IRA, there is currently no viable business case for investing in battery cells and components in Europe. While much of this can be sourced from private capital, public investments will also be essential. **T&E estimates that at least €50 billion in public support will be required across Europe, which means financing 42% of the extra cost associated with the 100% European production goal**. EU-level funding should prioritise expanding midstream and upstream supply chain manufacturing locally, focusing particularly on minerals processing, notably cathodes, anodes and precursors.

6.2.1 Public finance

Comprehensive investment support will be critical to build the supply chain across Europe, including enhanced and targeted efforts from the European Investment Bank and the prompt operationalisation of the EU Battery Fund. We recommend a **blend of public finance instruments that covers almost 50% of the cost gap through 2030. Unlike more mature sectors of the economy, the nascent EU battery value chain needs targeted public support amid fierce global competition.**

As part of its proposal for a €1 trillion investment package at the EU level [29], T&E recommends establishing a €400 billion Green Industry Fund from 2025 to 2034, with priority investment to de-risk and scale manufacturing of clean battery value chain technologies, notably cathode active material and battery recycling. The Fund should bolster existing and scalable EU financing instruments: the EU Innovation Fund and the InvestEU Fund - potentially under the the future EU Competitiveness Fund.

Beyond increasing and sharpening support for scaling up the battery value chain, EU research and innovation funding under programs like Horizon Europe should prioritise backing affordable, scalable and sustainable alternatives to batteries, e.g. resource-light chemistries.

Developing a robust EU Battery Fund

The EU should **swiftly operationalise the EU Battery Fund under the Innovation Fund (IF)** to enhance its strategic support for battery production within Europe. This new instrument aims to allocate up to €3 billion by 2026 to European manufacturers of the most sustainable batteries. To maximise positive impacts across the entire European battery value chain, notably its upstream segment, as well as support the assembly of electric vehicles in Europe, additional funding is essential in the future. The EU Battery Fund should be extended over a longer period and cover the entire battery value chain, addressing critical gaps and bottlenecks. This approach will ensure robust support for best-in-class clean projects and facilitate substantial spillover effects throughout Europe's battery ecosystem.

We estimate that the **IF should allocate at least €7.7 billion to the EU Battery Fund by 2030**, with a focus on both Cap-Ex and Op-Ex (basically the yearly cost of running a factory) to bridge the cost gap with the market and the midstream of the battery supply chain. This budget should primarily stem from revenues generated under the ETS. We identify two other ways to increase the resources under the Battery Fund to reach a total pot of €25 billion by 2030. Firstly, the EU should use the 75% of the revenue raised from recently announced tariffs on Chinese EVs – the portion that gets back to the EU budget – to beef up the EU Battery Fund. Secondly, the Battery Fund should **establish a functional system for Member States to co-finance projects**. One option is to allow **governments to directly channel national ETS allowances towards the Battery Fund**. This could mirror the "Member States compartment" under InvestEU, which allows Member States to use a limited portion of EU shared management funds towards the InvestEU objectives. A second option is to **merge the Important Projects of Common European Interest (IPCEIs) for batteries into the EU Battery Fund**. This can channel national support in a single direct support instrument connected to the EU industrial priorities – making use for example of the auctions-as-a-service platform under the IF. Auctions-as-a-service can simplify access to national funding and create economies of scale by avoiding fragmentation and saving administrative costs.

Any support under EU State Aid rules should be linked to strong environmental and social conditions – e.g. on local employment, intellectual property via joint ventures, etc – for subsidies in Europe to better benefit local skills and jobs and contribute to EU climate objectives.

The Battery Fund should become **a hub for financing the EV batteries value chain** for Member States and project developers - coordinating and blending funds with other public and private funding.

Altogether, **the EU Battery Fund could reach a financial firepower of €25 billion by 2030**. This could in turn directly leverage **up to €42 billion from private investors and cover together 18% of the investments needs at EU level by 2030**.

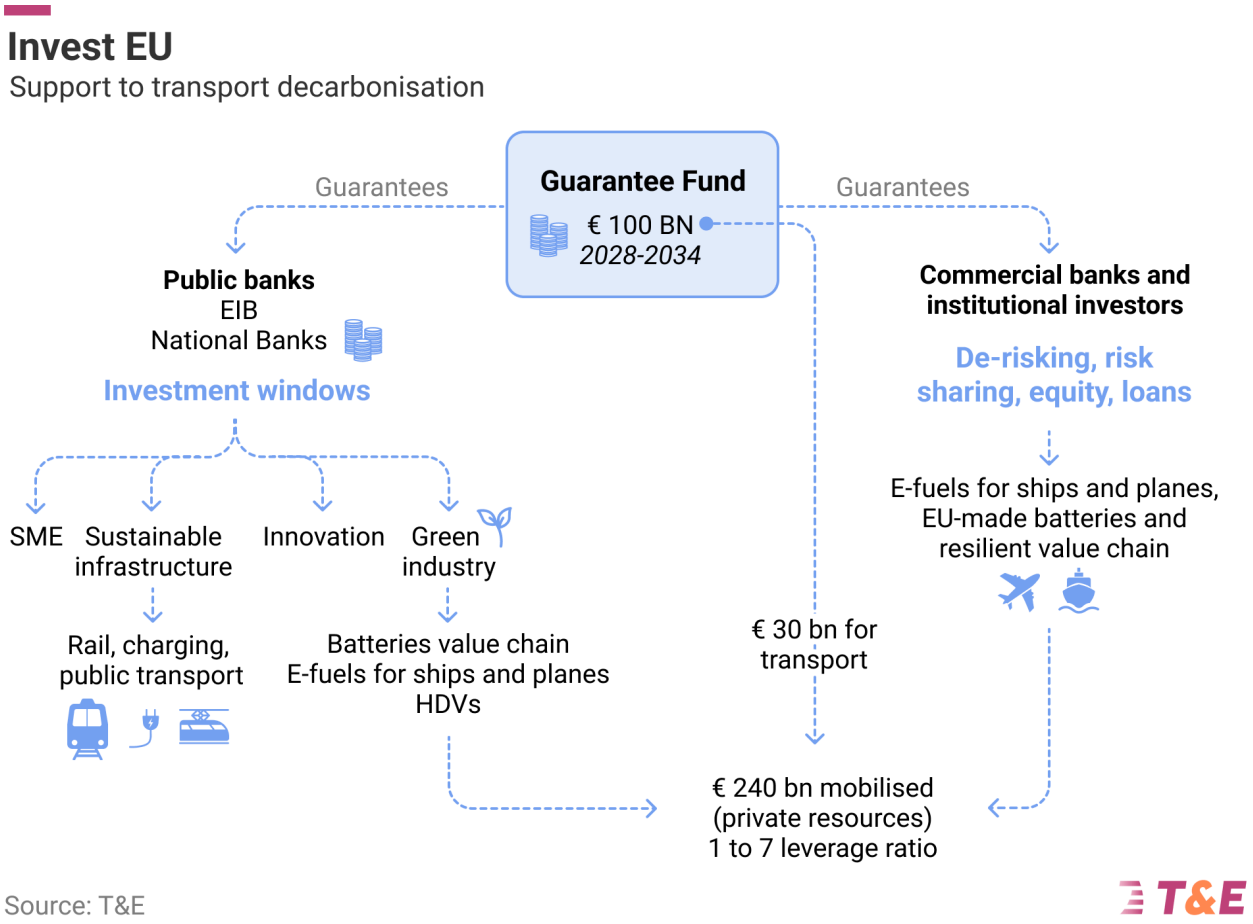


Figure 16: Guarantee scheme under InvestEU

The **InvestEU Fund** can crowd in public and private investment into the battery value chain through a system of guarantees to de-risk investments into the sector. InvestEU should focus on projects facing economic or technological risks, enabling public banks (National Promotional Banks and the EIB Group) to take higher risks and scale up the manufacturing of battery cells and key components. This should include support to both Cap-Ex and Op-Ex with predictable and upfront support via production loans. InvestEU should also crowd in private investments and guarantee investments from commercial banks, similar to the recent support scheme to Northvolt [30]. Using a leverage ratio of 1 to 7 – lower than the current leverage ratio of 1 to 14 assumed by the Commission – **a dedicated loan guarantee facility under InvestEU worth €10 billion allocated to battery projects can secure up to €70 billion investment from public banks and private investors by 2030**.

The EIB should enhance its support to best-in-class projects in the EV batteries value chain, including backing refining and recycling of critical raw materials. Ensuring complementarity with national funds set up in France (Critical Metals Fund) and Germany to support raw materials is key in order to provide co-financing and risk-sharing instruments like first loss guarantees to mitigate the risks for investors under the national schemes. The EIB Group should provide guarantees and counter-guarantees to commercial banks for investments across the EV value chain to de-risk private investments contributing to the green industrialisation of the EU. **We estimate that €12.5 billion should be allocated to projects in the batteries value chain by 2030. Additionally, €2.5 billion for guarantees can attract additional private investment.**

6.2.2 Private finance

A major barrier to private capital supporting the EU battery value chain is the high-risk profile that battery and components projects carry in the eyes of commercial banks and investors alike. Therefore, **de-risking investments is instrumental to channel private financial flows in support of this critical sector**. Counter-guarantees for commercial banks are a pivotal intersection of public and private financing. By de-risking investments, these guarantees encourage broader private-sector participation and ensure that capital flows more readily into projects that align with EU policy objectives.

Venture capital and private equity

Venture capital (VC) and private equity (PE) funds are essential to drive innovation and growth in the EV value chain. These firms play a crucial role in funding early-stage startups and scaling up emerging technologies for advancing sustainable transportation solutions across Europe. VC and PE funds are typically more risk prone than banks and other large financial institutions. Still, the VC and PE markets are under-developed in the EU, especially compared to the United States. Therefore, the EU should put conditions in place to boost these critical markets, including via support to VC and PE funds focusing on clean technologies. The European Investment Fund (EIF) plays a central role in this regard, acting as a "fund of fund". The EIF should further invest in funds that incorporate the battery value chain as a key investment theme within their broader fund strategy. Subsequently, when the sector has further matured, dedicated battery value chain funds should be established, in which the EIF would cooperate with private equity and infrastructure funds specialised in cleantech finance.

To increase sustainable investment in the sector, high ESG criteria should be built into the European private investment framework to give local manufacturers an upper hand, e.g. via smart taxonomy rules around minerals processing and refining. Some critical economic activities, like raw materials processing, refining and recycling for the EV battery value chain, are currently left out of the classification. On the one hand, these activities can result in potentially adverse impacts on people and the planet - including emissions, waste management and biodiversity issues. On the other hand, they can become more sustainable if guided by strong environmental and human rights standards and due diligence. A recent T&E paper analysing the global and European market for nickel, a critical material for batteries, concludes that setting a maximum threshold of 10 kg CO_2e/kg nickel by 2030 could define nickel as "low emissions" [31]. To stimulate investments and commercialisation of technologies relying on the best environmental techniques available, the future EU Taxonomy requirements should set a clear CO_2 threshold and mirror this approach for other critical materials at the heart of the green transition.

Manufacturers and downstream equity into nascent EU based battery supply chain companies

Car and truck manufacturers are increasingly channelling equity investments into nascent European-based companies in the battery supply chain. Whether through direct equity stakes or long-term offtake agreements, these investments are essential for supporting the growth and stability of local battery manufacturing and sustainable technology development, thus bolstering Europe's strategic position in the global clean energy market. European downstream players, notably automotive, battery and renewables companies should work closer with local players in the supply chain, providing firm long-term offtake guarantees, investing and co-partnering to scale these nascent companies.

7. Accelerating road freight's electrification

The regulation on CO_2 standards for heavy-duty vehicles (HDVs) represents a major achievement of the FF55 package [32]. This groundbreaking legislation sets mandatory targets for Europe's truck and bus manufacturers to sell an increasing share of zero-emission vehicles (ZEVs) starting in 2025. This means that the industry will now swiftly steer its production towards clean vehicles.

The regulation provides clear direction, allowing manufacturers to invest in clean vehicles while providing the necessary planning and investment certainty. However, the initial cost required to buy a zero-emission truck is still significantly high, as ZEVs will remain more expensive than their diesel counterparts in the short- and medium-term. **While it can be expected that vehicle and technology costs will drop with increasing production volumes and economies of scale, financing the initial phase of the transition emerges as a key challenge**.

Firstly, it makes it crucial for environmentally aware investors to step up their role in ensuring financial resources are only allocated to credible decarbonisation projects focused on scaling ZEVs manufacturing and operations.

On the public side, further effort must ensure the enabling conditions are in place for widespread ZEV adoption by transport operators. Charging infrastructure is key in this regard - see section 5. Another central area for smart regulation is greening corporate fleets by setting mandatory zero-emission targets for large fleets, shippers and freight forwarding companies [33].

The public sector has a major role to play to ensure that innovative financial solutions are made available for the market. Targeted support can help offset the temporarily higher costs associated with producing and operating ZEVs and will help accelerate the transition of a highly carbon intensive sector - see figure 17 below - to a clean transport sector.

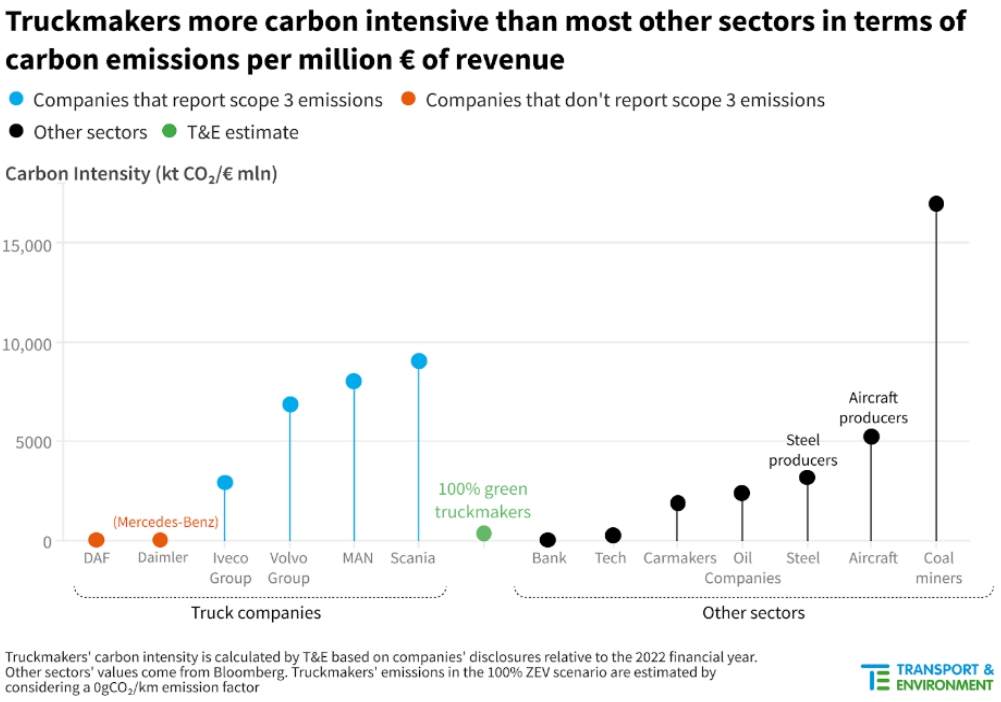


Figure 17: Truckmakers' carbon intensity.

7.1 Findings

Decarbonising the heavy-duty fleet completely by 2050 will require an overall investment of €783 billion by 2040. This is a substantial increase of €335 billion compared to the FF55 Scenario (Figure 18), which only reduces emissions from the sector by 68% by 2050. Achieving this ambitious target will demand maximum effort and collaboration from all stakeholders.

Heavy duty vehicles	2025-2030	2031-2035	2036-2040
Total needs (€bn)	142.7	301.1	339.9
Yearly needs (€bn)	23.8	60.2	68.0
Direct Cap-Ex (€bn)	15.7	33.1	37.4
Total public investment (€bn)	35.0		
Share of public investment	25%		

The bulk of the investment will occur in the 2030s – around €64 billion yearly – while the early intervention is more modest - €23.8 billion yearly by 2030 for a total of €142 billion.

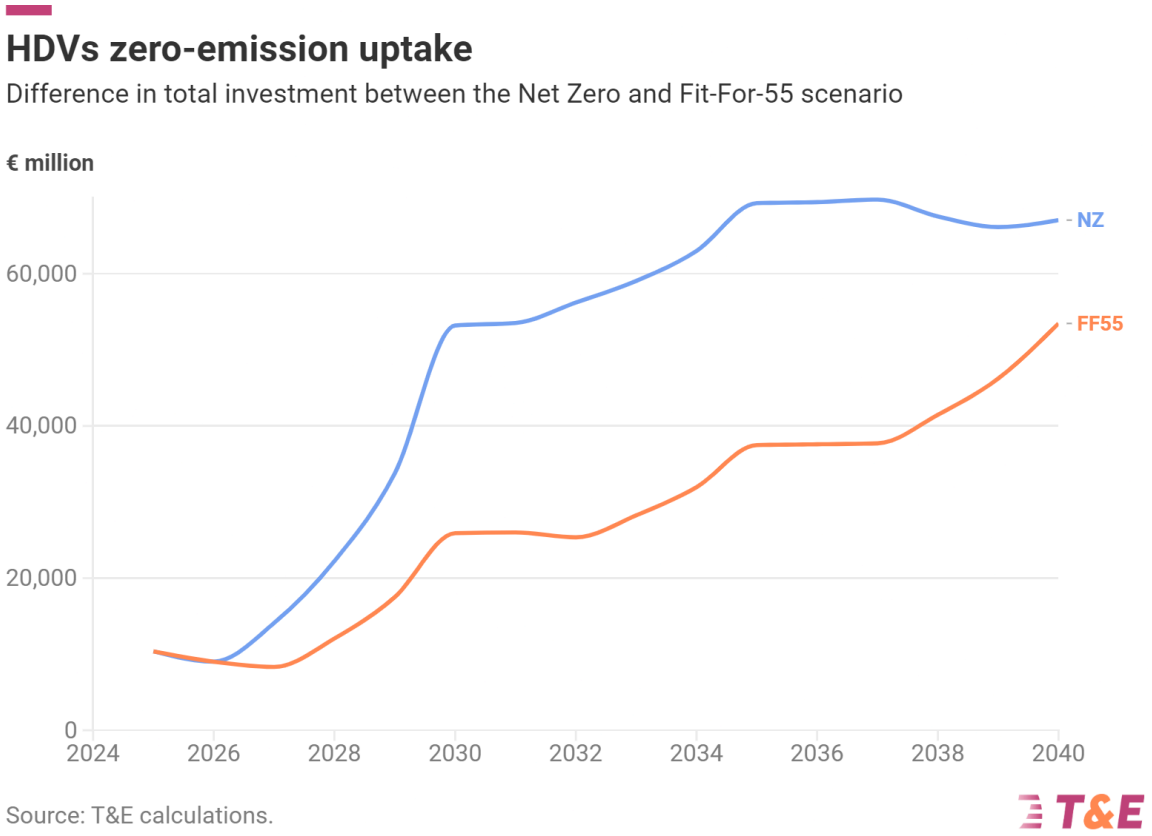


Figure 18: the market for HDVs is substantially larger in the NZ Scenario than in the FF55 Scenario.

7.2 Recommendations

Van, truck and bus manufacturers need to quickly scale their production of ZEVs. This will partially be achieved through the new HDV CO_2 standards, and will require investing in retooling production sites, marketing and internalising parts of the battery value chain to increase the share of added value. But the EU's CO_2 targets on supply are below what is needed to achieve the EU's climate objectives [34]. ZEV production will need to scale up faster, which manufacturers are unlikely to do if there's no clear demand signal. While the haulier market is made up of many very small enterprises – 79% of EU transport

operators own less than 10 trucks – who will need support to transition, just 9% of companies own 56% of all truck stock in the EU [33].

Even if the bulk of the investment will be on the private sector's shoulders, public money will be crucial in the early stage to close the gap between diesel and electric vehicles' total cost of ownership (TCO) and to roll-out a European-wide and reliable network of public charging at a sufficient speed.

7.2.1 Public finance

The toolbox of public financing should prioritise affordable loans and guarantees for transport operators and small- and medium-sized enterprises (SMEs) in particular. Enabling smaller companies to buy ZEVs is key to accelerate the uptake of clean vehicles. The road haulage industry is mainly made up of SMEs that do not yet have the access to capital for higher upfront purchase costs.

State-backed loans, guarantees or leasing schemes are crucial to overcome the obstacle. These help small companies obtain financing by reducing lender risk and borrowing costs, enhancing creditworthiness, and providing additional support and resources. The EIB can allocate €5 billion in guarantees to ease private banks conceding loans to SMEs for clean vehicle purchase. In addition, public banks should give out loans at national level for a total of €10 billion.

The EIB should also provide cheap loans worth €10 billion for zero-emission van, truck and bus manufacturing. Concessional loans with low interest rates, longer maturity and grace periods offer better conditions than loans from commercial banks, enabling all truckmakers to more quickly scale up their electrification strategies. Recent support by the EIB to the electrification of Italian truckmaker Iveco via a €450 million loan highlights the potential of public banks in supporting electrification strategies of truckmakers [35].

The total commitment needed from the EIB and public banks is €25 billion by 2030: €20 billion in loans and €5 billion in guarantees. Criteria for being eligible for a loan could be linked to the electrification strategy needed to deliver on the ambition level of the HDV CO_2 standards, supporting both compliance and stimulating manufacturers that want to scale up more quickly.

The EU budget should also be mobilised under InvestEU to provide guarantees to the EIB and other national investment banks so that they raise their support in the field and absorb risks linked to ZEV manufacturing and purchasing. Ultimately, this can help ZEV manufacturing reach an inflection point, where it becomes increasingly uneconomical to continue sales of ICE vehicles. **A scheme under InvestEU for the transport sector amounting to €5 billion to produce zero-emission vans, trucks and buses could boost the market and place Europe in a leading industrial role for such vehicles. An additional €5 billion should aim to support small operators. Using a leverage ratio of one to seven, such a scheme could mobilise €70 billion by 2030**.

7.2.2 Private finance

Industrial strategy and related investments

Although public funding is crucial to support the transition, no business model can exist based on perpetual public aid. **Vehicle manufacturers and transport operators are the main responsible for the transition and will need to adapt their business strategies accordingly**. Investors in turn can invoke pressure on the manufacturers they invest in, through public statements and engagement strategies [36]. Pension funds especially can and should align financial planning with environmental responsibility. A recent report from the European Clean Trucking Alliance (ECTA) also advances a set of proposals for innovative financial solutions that will help the sector transition with its own resources, of which we highlight three promising schemes below [37].

Trucking as a Service

In the trucking-as-a-service model, fleet operators pay a regular subscription fee for access to a service provider's fleet of zero-emission trucks (ZETs) and related infrastructure such as charging or refuelling facilities. In addition to vehicle and infrastructure access, operators can often opt to receive additional services and support to operate ZETs. Typically, the service providers are vehicle manufacturers themselves or large fleet operators. According to ECTA, this approach offers two main benefits: flexibility, allowing fleet operators to choose different service plans based on their business needs, and support in the transition to ZETs, as service providers can help reduce the learning curve associated with operating these vehicles and overcome upfront purchasing costs through the leasing model that immediately allows the reaping of TCO benefits.

Residual Value Guarantee

Residual value guarantees (RVGs) are insurance tools designed to mitigate the risks of asset depreciation. For ZEVs, where technology is rapidly evolving and the market is still developing, RVGs are essential in encouraging fleet operators and businesses to invest in these green vehicles now rather than waiting until mass-uptake and maturity has been achieved. They act as a safety net to cover residual value risks for operators. Unlike direct public spending, RVGs involve setting up a guarantee scheme that ensures a minimum residual value for a ZEV at the end of a purchase or lease term. These guarantees can be provided by companies involving all stakeholders, minimising the typical moral hazard issues found in insurance contracts. Guarantees from InvestEU and public banks - see the “public finance” section above - could back such instruments.

Collective Purchase/Pooling Demand

Collective purchasing is another de-risking strategy aimed at lowering the cost of acquiring ZEVs. This measure involves multiple prospective buyers forming a coalition to combine their orders, thereby reducing the purchase price. An aggregated order placed by a group of jointly liable partners also reduces the risk of default compared to a scenario with a single borrower.

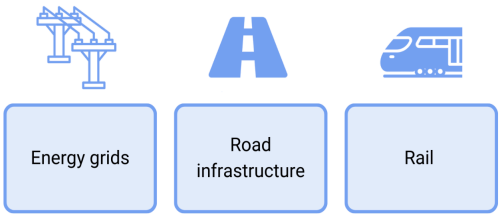
8. Re-focusing energy and transport infrastructure funding

Alongside the manufacturing and deployment of green technologies, transport and energy infrastructure will be central to the investment debate in the coming years. Both the Draghi and Letta reports

emphasise this, with Mario Draghi specifically calling for a major shift in grid deployment: "*if there is one horizontal area in the energy sector whose importance cannot be overstated, it is the EU's energy grids*".

Substantial investments are needed to modernise and expand infrastructure for safety, connectivity, and the green transition. Energy and transport infrastructure is a major challenge for the European economy and its Member States. Given the high costs of infrastructure projects – road building in the EU can cost up to €90,000 per kilometre[38] – public funding is critical to mitigate risk and uncertainty.

Three sectors in scope



This chapter outlines key considerations for energy grids, road infrastructure, and the rail sector, focusing on short-term investment needs and EU-level funding solutions such as the Connecting Europe Facility (CEF) and cohesion funds.

8.1 Connecting Europe Facility and cohesion funds: too heavy focus on road building

The CEF is a key EU funding instrument that promotes infrastructure development across Europe, focusing on transport, energy, digital and technological projects. Created in 2014, it aims to enhance connectivity between EU member states by providing grants and financial guarantees to projects that fill in missing links in the TEN-E and TEN-T networks and remove bottlenecks. A stated focus is on green infrastructure, supporting the reduction of carbon emissions and fostering renewable energy.

For the period 2021-2027, the CEF will allocate a total of €33.7 billion, with €25.81 billion focusing on transport – including €11.29 billion for cohesion countries and €5.84 to energy [39].

In the transport envelope, so far 66% has been allocated to rail infrastructure, 16% to road infrastructure, and the remaining 18% split between the aviation and shipping sectors, and developing the road charging network via the Alternative Fuels Investment Facility (AFIF).

Cohesion funds are equally important for the financing of infrastructure projects across Europe. Designed to reduce economic disparities between EU member states, they specifically target member states with a Gross National Income (GNI) per capita below 90% of the EU average.

These funds provide significant support to transport projects, in particular building transport infrastructure, and improving Trans-European Transport networks (TEN-T), railways, and roads. T&E analysis finds that out of €470 billion of cohesion funds channelled to ten Central and Eastern European (CEE) countries over the 2007-2022 period, €110 billion – or 24% – went to transport. Around 56% of this amount targeted road infrastructure, while only 24% rail. This leads to a situation where the TEN-T network's completion is more advanced for road infrastructure – 66% of the projects completed – than rail infrastructure –58%. Only in CEE countries, the EU contributed €4 billion via the CEF (2014-2024) and €62 billion via cohesion funds (2007-2022).

In 2021, EU member states spent €92 billion on road infrastructure, with two-thirds – €61 billion – backing new construction and the remainder devoted to maintenance and safety improvements [40].

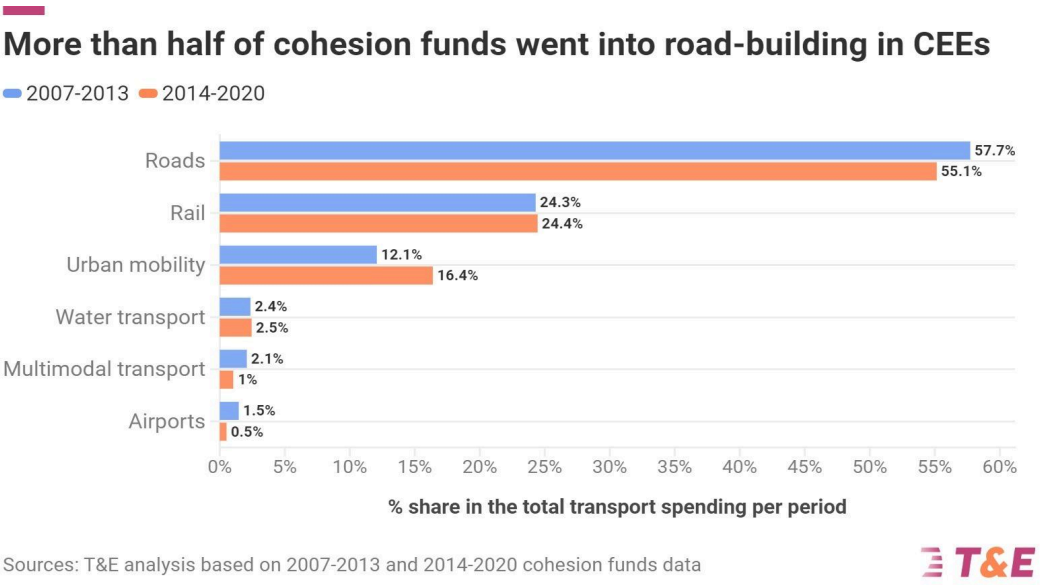


Figure 19: More than half of cohesion funds went into road-building in CEEs.

While maintaining safe, functional roads is essential, expanding road infrastructure is increasingly questionable. T&E studies in Germany indicate that the traffic generated by new road construction is consistently underestimated, and consequently is the associated CO_2 [41]. As a result, most highway and road expansion projects may have costs that outweigh their benefits and should be reconsidered.

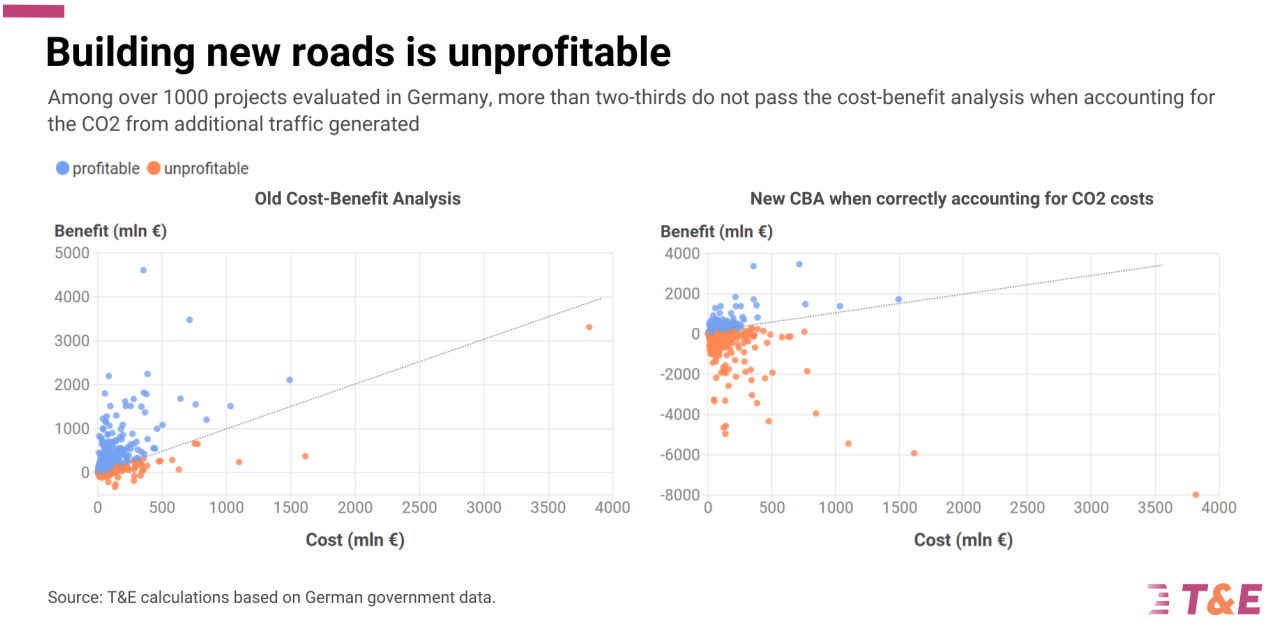


Figure 20: Building new roads is unprofitable.

8.2 Grids: a battlefield for investments

Investment figures for charging infrastructure in Chapter 4. cover hardware costs, annual operation and maintenance, and local grid connection. However, getting electricity to the charging hub through a smart and reliable distribution grid is equally critical.

Investing in grid upgrades is key to decarbonising energy and electrifying transport and should become a priority for future public funding at the EU level. Most investments are required in distribution grids to make them digital, monitored in real-time, remotely controllable and cybersecure. Approximately 40% of distribution grids in the EU are over 40 years old and have to be modernised.

In its 2023 grids Action Plan, the European Commission estimates that €584 billion is needed for electricity grids by 2030 [42]. The industry anticipates that around €375-425 billion of investment in distribution grids alone is needed by 2030, while a recent report from Ember estimates that EU member states need to invest €63 billion annually in their grids [43]. **According to Eurelectric, the EU currently invests around €36 billion in grids each year. This figure needs to almost double, to €67 billion annually until 2050** [44]**.**

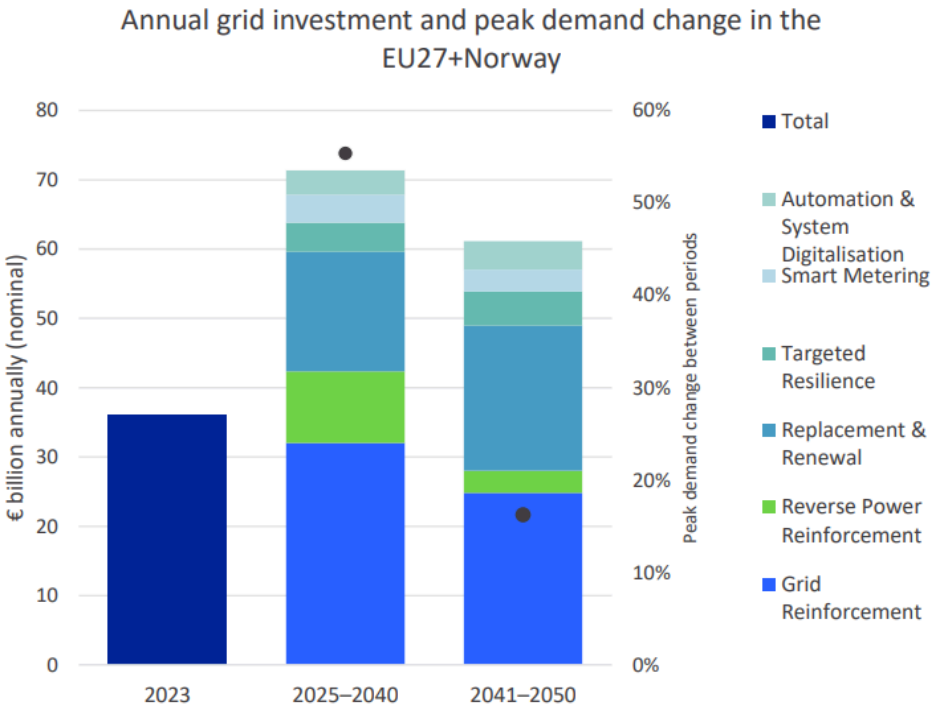


Figure 21: Annual grid investment and peak demand change in the EU27+Norway. Source: Eurelectric.

Among financing solutions proposed, in his report on the European single market, Enrico Letta suggests creating a Clean Energy Delivery Agency which would be responsible for disbursing grants for cross-border grid projects [45]. He singles out grids and energy interconnections as key sectors where EU integration has been lacking.

The Draghi report on the future of European competitiveness reinforces this demand. It stresses that a central element in accelerating decarbonisation will be unlocking the potential of clean energy through a collective EU focus on grids. To this end, the report urges the EU to mobilise public and private financing by reinforcing the CEF to finance interconnectors and to issue new EU debt to finance cross-border grids, in combination with support from the EIB.

For transport and in particular road transport, grids up to the high-voltage level are the most important networks. They are typically operated by distribution system operators (DSOs). Investments in the reinforcement and expansion of these grids is of paramount importance and anticipatory investments are critical to prevent grids becoming a bottleneck for accelerating EV uptake. Investments in grids and the energy system as a whole should also take into account the massive potential of EVs as 'batteries on wheels' which could lower the total system cost in 2040 by 8.6% or €22.2 billion[46].

In May 2024, EU energy Ministers also called upon the EIB to "*strengthen financing and de-risking initiatives*" for grid investments in the future and to further mobilise the EU budget to this end.

8.3 Use rail public money efficiently to reduce emissions

The EU already has one of the densest railway networks in the world, which plays a key role in advancing a more efficient transport system, built around dense urbanisation. In this context, it offers an alternative to road and air transport.

Still, rail currently accounts for only 7% of passenger and 17% of freight transport, while road transport accounts for 80% of passenger and 70% of freight traffic respectively. The European Commission estimates that new rail infrastructure and improved connectivity systems can boost rail coverage of passenger and freight transport to 10% and 20% by 2050 [47]. Therefore, increased rail investment can only have a limited impact on road transport emissions. Although this will save CO_2 from road traffic, cars, buses and trucks will remain by far the biggest problem to address when it comes to GHG emissions. Smart travel policies shifting intra-EU flights to rail can also curb aviation emissions substantially, but not definitely, as about two-thirds of EU aviation emissions come from extra-EU flights.

According to the European Commission, total rail infrastructure spending in Europe was €41.8 billion in 2020. Member states spent 52% on maintenance and renewals, 28% on upgrades and 20% on investments in new infrastructure. National budgets contributed to 69% of total spending, whereas EU co-financing accounted for 8% but is expected to rise significantly after 2020 via the Recovery and Resilience Facility (RRF), Connecting Europe Facility and the cohesion funds [48].

Estimates of funding needs for rail are also significant. The Community of European Railway and Infrastructure Companies (CER) anticipates that public funding of €50 billion per year is needed by 2030 to double high-speed rail for the TEN-T core network [49]. The lower bound estimate from the Rousseau Institute leads to around €36 billion per year of public funding by 2050. The European Commission's impact assessment report for the TEN-T regulation calculates total investment needs for the core network at around €18 billion per year, and this estimate is set to increase following the adoption of the updated legislation [50]. Deploying digital interoperability and safety enhancement solutions through the European Rail Traffic Management System (ERTMS) is also on member states' to-do list. For the entire TEN-T core network, the European Court of Auditors estimates the capital investment for track-side ERTMS deployment at €80 billion.

Rail funding should focus on a set of targeted projects which have proven their need through a robust cost-benefit analysis, which must demonstrate their potential for modal change.

Existing financial tools must be enhanced, boosting the CEF and ensuring a shift in cohesion funds from road building and airport expansion to rail. Priority for funding should go to maintenance and upgrades of existing lines through the ERTMS, which will allow to improve the reliability of rail services and increase the capacity on existing tracks. Co-financing rates in the CEF general envelope for ERTMS and cross-border sections could be increased from the current 50% maximum to a 60% limit to reflect the higher European interest of these investments, adapting unit contributions accordingly.

For new rail projects, funding should follow the criteria set in the revised TEN-T regulation. This means ensuring that by 2040 all passenger lines in the extended core network support speeds of 160 km/h

minimum, that ERTMS is deployed across the whole of the EU network or that airport hubs with more than 12 million passengers a year are connected to long-distance rail.

Funding should also incorporate areas beyond the TEN-T scope if they can have a significant positive impact – i.e. projects in urban areas with a high potential for modal shift. Simultaneously, increased investments in modernising or building new rolling stocks are required to cope with the need to welcome an increasing share of passengers.

Like most large-scale infrastructure projects, building new rail lines is expensive, time-consuming and results in very high construction emissions. Where new rail infrastructure is developed emissions associated with their construction must be accounted for. Emissions grow depending on the amount of tunnels and viaducts, which in many cases are unavoidable due to the geography of the terrain to be crossed. It is therefore necessary to incorporate a green steel and low-carbon cement strategy into rail construction so that it can be a key lever for emission reductions and demand for green products.

8.4 Recommendations

Connecting Europe Facility: more for grids, better for rail, less for road building

The CEF should be revamped for the 2028-2034 funding cycle. The main priority must be supporting the electrification of the EU energy and transport system by significantly increasing grids funding – from €5.7 billion for the CEF energy envelope under the 2021-2027 budget to a minimum of €50 billion for 2028-2034. This yearly investment of €7 billion would represent 10% of the total investment needs – €72 billion – identified by Eurelectric over this period. Large chunks of this funding should help modernise and digitise the network, beyond solely focusing on grid expansions.

Recommendations for future EU rail investments

1. Refocus CEF and Cohesion Funds on **maintenance, upgrade, digitalisation and rolling stocks**
2. Mobilise the EIB to support the **renewal and modernisation of rolling stocks for rail operators**

The current level of rail investments under CEF – €3 billion per year – only represents 25% of the ERTMS financing needs. A future T&E study will formulate proposals on how a revamped CEF should better and more efficiently support the rail sector.
Lastly, capping support to road infrastructure is necessary, with a funding pot of €4 billion in total – €500 million a year – for maintenance and safety.

To accommodate these strategic priorities, the total CEF pot should be raised to a minimum of €81 billion under the 2028-2034 MFF. This figure does not include an increase in rail support, which would de facto mean growing the CEF pot.

Re-focus EU funding towards grids and electrification

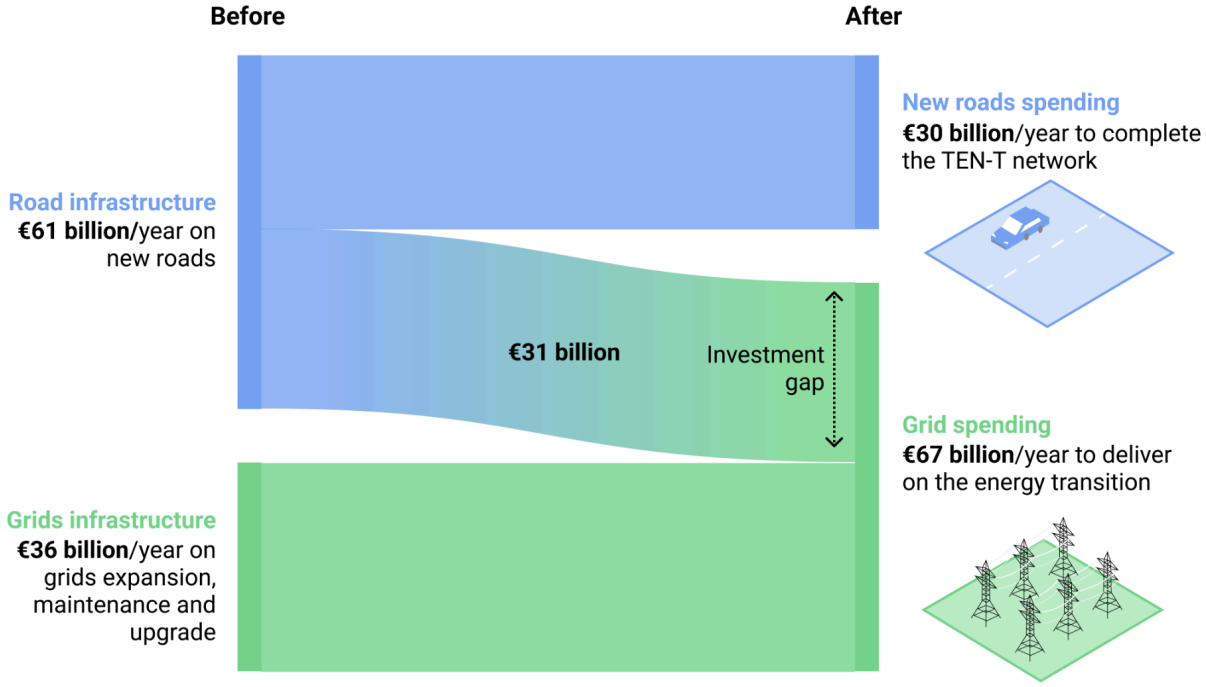
The future Clean Energy Investment Strategy for Europe, to be developed by the Energy and Housing Commissioner, **should prioritise grids' support**. On top of the augmented CEF pot, this should include:

- Pooling together funding streams under the MFF, including via a higher share of cohesion funding, in support of grids
- Mobilising public banks like the EIB and National Promotional Banks and financial instruments under the future European Competitiveness Fund to chip in with loans and guarantees
- Developing innovative financial tools – e.g. help develop bond issuance for grids

Focusing on grid modernisation, rail upgrades, and strategic road infrastructure is essential. Member States should prioritise completing the TEN-T network and de-prioritise constructing new infrastructure outside its scope. **Halving current spending on new roads could fill the grids financing gap**. Future funding for roads should focus on optimising existing infrastructure rather than unnecessary expansion.

Less asphalt, more energy

Halving expenditure on new roads can fill the investment gap for electricity grids



Source: OECD and Eurelectric. Roads infrastructure data from 2022, Grids infrastructure data from 2024

Figure 22. Halving current spending on new roads could fill the grids financing gap.

EU-level rail investments under the future EU budget like the CEF and cohesion funds – should focus on **maintenance** of the network to improve punctuality, **upgrade** and completion of key parts of the network, cross-border connections, **digitalisation** to increase capacity without building new tracks – e.g. ERTMS – and **rolling stocks** – including via a separate call under CEF.

The EIB should be mobilised to support the renewal and modernisation of rolling stocks for rail operators, including new entrants on the market, and leveraging and de-risking private investments.

Conclusions and recommendations

The total investment needed for clean technologies to decarbonise aviation, shipping, and e-mobility by 2040 is €7.6 trillion – €507 billion per year. Investments will lead to huge business opportunities and will offer the EU a chance to boost reindustrialisation, increase its competitiveness and resilience in key industrial sectors and implement a circular economy.

A large portion of transport investments will be covered by the private sector. Large industry businesses will bear a major share of the investment needs. But public spending should also play a substantial role in accelerating the transition, crowding in and leveraging private financing, compensating for market inefficiencies and supporting non-bankable projects.

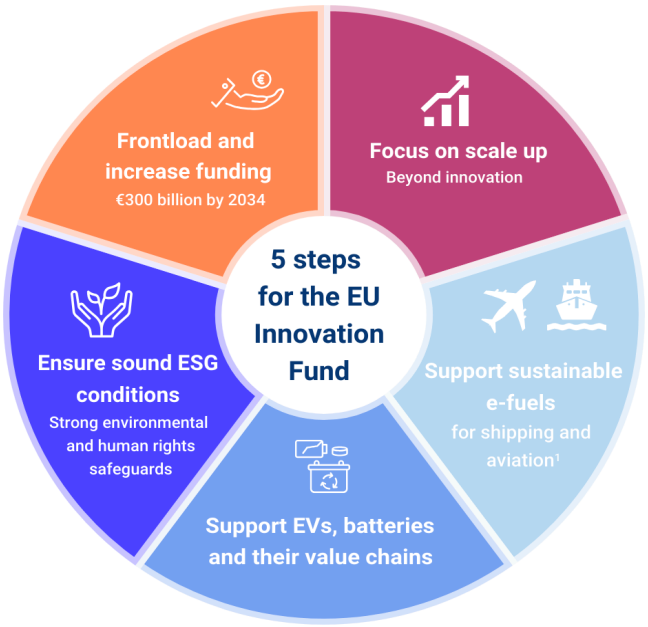
The following strategic priorities for transport investments should stand at the heart of the future **Sustainable Transport Investment Plan** under crafting at EU level:

- **Electrification of road transport**: to develop the EV battery value chain in Europe and get zero-emission cars, vans and heavy-duty vehicles on European roads, €1.5 trillion is needed by 2030 - €250 billion per year.
    - Quickly operationalising the **EU Battery Fund** under the EU Innovation Fund is essential for scaling up the EV battery value chain in Europe, providing at least €7.6 billion of direct support by 2030 (Op-Ex and Cap-Ex), and **a total of €25 billion by 2030** via Member States' co-financing and revenues generated by tariffs on EVs manufactured in China.
    - **An EU Platform for a €26 billion EV low-cost leasing scheme**, mirroring the social leasing scheme operating in France, **under the EU Social Climate Fund** to increase electric car adoption through affordable leasing options for lower income households.
    - **Low-interest rate loans and guarantees from the EIB and national public banks to help small hauliers purchase zero-emission Heavy-Duty Vehicles.** A total of €25 billion by 2030 – €20 billion in loans and €5 billion in guarantees, together with a dedicated €10 billion guarantee tool under InvestEU, could mobilise a total of €95 billion to accelerate trucks' electrification.
    - **Charging Infrastructure: the EU Alternative Fuels Infrastructure Facility should be expanded to fill gaps in the public charging network** in tandem with other EU public funding schemes. Loans from public banks should support the installation of depot (HDVs) and home (LDVs) chargers.

- **Getting clean e-fuels to planes and ships requires investments by 2030 worth €86 billion**. Two thirds of this could come from public funding to kickstart the production and uptake of e-fuels across Europe.
    - **Public Banks & InvestEU Guarantees**: De-risking private investments through guarantees and financial support.
    - **Innovation Fund and Contracts for Difference**: To support clean e-fuel production and bring costs down. To make the Innovation Fund fit to boost support for clean technologies, we suggest revamping this instrument (see Figure 23 below).
- **Re-focus EU infrastructure funding**
    - **Boost electricity grids' expansion and maintenance**, doubling current investments to reach €67 billion per year until 2050.
    - Draw resources from **divesting in road expansion**, that mostly creates more traffic and CO_2 emissions.

- **Rail investments** under the future EU budget should focus on network **maintenance**, **upgrade** and completion of key parts of the network, cross-border connections, **digitalisation** to increase capacity without building new tracks and **rolling stocks**.

The EU Innovation Fund: 5 steps to ramp up a key instrument for clean technologies in Europe



Source: T&E
1. Deployment of Renewable Fuels of Non-Biological Origin for the maritime and aviation sectors

Figure 23. Priorities for the EU Innovation Fund.

These investments can yield significant economic, social, environmental and climate benefits, crucially safeguarding our livelihoods and wellbeing. However, they are not a panacea. The financing models we propose are essential components of a broader decarbonisation effort. They must align with overarching principles guiding both public and private finance strategies. As Enrico Letta states, "*in the next legislative term, it will be necessary to direct all energy towards the financial support of the transition, channelling all necessary public and private resources towards this goal to make the transformation of the European production system possible*".

A robust pan-European investment strategy is key to achieving EU climate objectives. **The EU needs to overhaul its public finance architecture** to balance competing priorities, such as digital transformation, transport, or agriculture, while maintaining a strong focus on climate action. With 60% of climate and environmental investments required by 2030 lacking a bankable business case [51], **public investments are essential** for steering the economy towards sustainable prosperity within planetary boundaries.

Strategically mobilising EU funds can incentivise private investors to align their activities with sustainability goals, thereby enhancing the EU's sustainable competitiveness and energy security. A coordinated EU approach to investments for an industrial strategy is crucial to ensure a level playing field, running counter to intra-EU competition and a patchwork of national strategies.

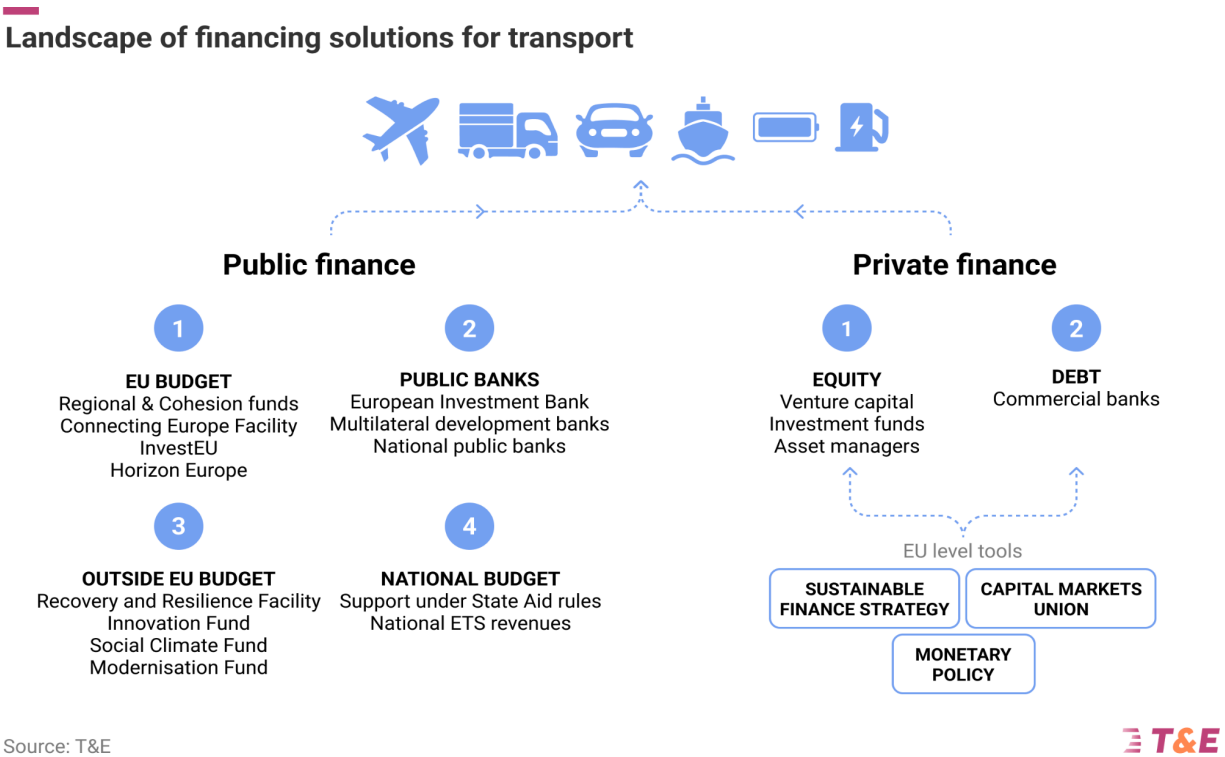


Figure 24: Landscape of financing solutions for transport.

Our key recommendations:

1	A greener EU budget with streamlined access to EU funds
2	A successor to NextGenEU: a €1 trillion green and social package
3	Fostering the transformation of the EIB as the "EU Climate Bank"
4	Mobilising private finance to accelerate the green transition
5	Halting harmful subsidies

Recommendation 1: **A greener EU budget with streamlined access to EU funds**

The EU Budget (MFF) is pivotal for advancing the Union's long-term objectives. A minimum of 30% is currently dedicated to climate and environmental initiatives, totalling €360 billion. We propose **increasing climate and environmental earmarking to 50%**, thereby raising investments to at least €500 billion for 2028-2034.

These investments should provide a **substantial contribution** to at least one of the six environmental objectives identified in the EU Taxonomy. Additionally, we propose **expanding the 'Do No Significant Harm' principle** to all MFF programs. **Public support at the EU level must align with, and not hinder, the objectives of the Green Deal.** It is crucial to improve climate tracking proofing and reporting methodologies to better distinguish

1. 50% climate and environmental earmarking

2. Apply the 'Do No Significant Harm' principle to all EU funds

3. Harmonised and simplified procedures, merging funding instruments

4. Design output- and performance-based instruments

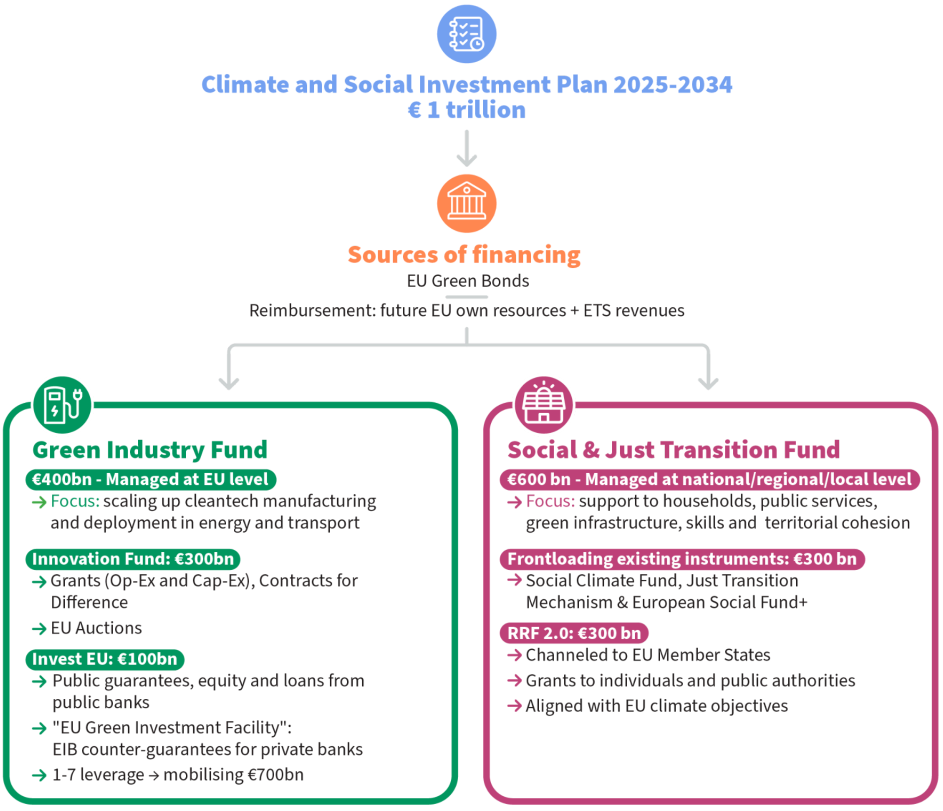
expenditures supporting climate action from those that perpetuate harmful activities. A truly sustainable investment strategy needs to reward only companies that are developing sound just transition plans and do no harm to the climate and people. Therefore, **placing sustainability conditions** for accessing EU-level public funding is necessary.

The absorption capacity of EU funds at national, regional and local levels is a major challenge, only exacerbated by the fragmented array of EU and national funding instruments with varying rules and procedures across programmes. This complexity creates significant barriers for small companies, startups, and energy communities seeking access to public funding. Therefore, **a single rulebook of simplified and harmonised procedures** should ensure easier and quicker access to EU funding [52].

The Commission should consider adopting **performance-based and output-based instruments** in the future MFF. Drawing inspiration from successful examples like the Recovery and Resilience Facility and the simplicity of the US Inflation Reduction Act, this approach would directly link EU funding to the achievement of climate, social and environmental objectives. Rationalising the fragmented landscape of EU funds should also be a priority: a **large-scale pooling of funds** can help maximise public resources. To increase its impact, **the MFF should also target production and manufacturing to scale up strategic clean technologies** - providing both Cap-Ex and Op-Ex support.

Recommendation 2: A successor to NGEU – €1 trillion for the green and social transition

The EU budget alone falls short of bridging the climate investment gap, and the forthcoming end of the RRF in 2026 suggests a notable decline in climate investments. In response, T&E has proposed **a €1 trillion Social and Climate Investment Plan** for 2025-2034 [29] – summarised in Figure 24. This off-budget instrument could cover 36% of the needs identified in this study - totalling €85.1 billion - and would reinforce the **Innovation Fund, InvestEU and the Social Climate Fund**. **The future European Competitiveness Fund is an opportunity to establish such additional investment capacity.**



The repayment of a new joint borrowing programme requires the **introduction of New EU Own Resources (NORs)**, enabling the creation of a permanent investment capacity at the EU level. Therefore, the EU should endorse and promptly implement the proposals for NORs outlined by the European Commission and Parliament. Additionally, it should develop a package of initiatives based on socially just progressive taxes and the polluter pays principle.

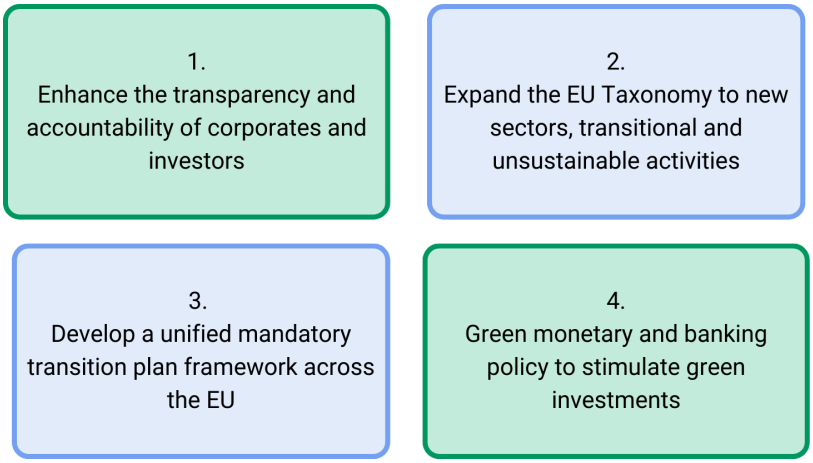
Recommendation 3: Fostering the transformation of the EIB as the "EU Climate Bank"

The EIB Group is a major financier of the transport sector, with new operations amounting to €10-15 billion annually. To further bolster the EIB's role in transforming the mobility system, the bank should provide at least €60 billion in loans and €10 billion in guarantees by 2030 to support the six sectors analysed in this report. We suggest to:

- **Reinforce support to an EU green industrial strategy, providing loans** to strategic projects, prioritising their scale up. This should cover refining and recycling of critical raw materials.
- Increase financial risk-taking by **offering guarantees and counter-guarantees** to commercial banks for investments across the EV value chain. The EIB should enhance its support to projects such as battery cell and battery component factories, and set up "Made in EU" provisions mandating a certain percentage of materials and components to originate from Europe.
- **Ramp-up support for green hydrogen and e-fuel production for aviation and shipping**, including plants to produce e-ammonia, e-methanol, e-liquid H2 and e-kerosene. This entails designing guarantees to decrease borrowing costs and reduce risks at an early project development stage, as well as de-risking agreements with offtakers.

Recommendation 4: Mobilising private finance to accelerate the green transition

The transition to climate-neutral activities requires a substantial influx of private capital. To this end, the EU must implement its sustainable finance strategy by taking the following steps:



- **Enhance corporate and investor accountability** by adopting ambitious sector-specific standards for transport under the Corporate Sustainability Reporting Directive (CSRD). This is instrumental in holding companies accountable for their impact on the outside world. In addition, the Sustainable Finance Disclosure Regulation (SFDR) should be reviewed, introducing more stringent criteria and aligning its requirements with the EU Taxonomy, thereby reducing the risk of greenwashing of funds or financial products.
- **Preserve and expand the EU Taxonomy** to accelerate the shift of private investment towards truly sustainable activities. The Taxonomy should be expanded to define transitional and unsustainable activities, and to critical economic activities such as raw materials processing, refining and recycling for the EV battery value chain [31].
- **Develop a unified mandatory transition plan framework** to support companies in decarbonising their business models. This should be grounded in both impact and financial materiality, building

upon criteria defined in the CSRD and the Corporate Sustainability Due Diligence Directive.

- **Green monetary policy to stimulate green investments.** A starting point is to integrate environmental risk assessments in Pillar 1 of the EU's collateral frameworks for banks and insurers, and strengthening EU and national programmes to reduce the cost of capital for green lending. The European Central Bank (ECB) and national central banks should implement a dual interest rate policy, distinguishing between sustainable and unsustainable practices.

Recommendation 5: Halting harmful subsidies

EU fossil fuel subsidies soared to a whopping €123 billion in 2022, more than doubling from €56 billion in 2021. Transport received the largest share – €34 billion [53]. Additionally, WWF estimates that a minimum of €34 billion – up to €48 billion – each year is spent in subsidies to activities that harm biodiversity [54]. In comparison, subsidies for renewable energy amounted to €87 billion in the same year [55]. This spending is fundamentally **incompatible with a net zero trajectory**. **Urgently phasing out harmful subsidies to the fossil fuel industry** is essential. The market and investors need a **clear signal** to shift investments away from fossil fuels and accelerate decarbonisation efforts.

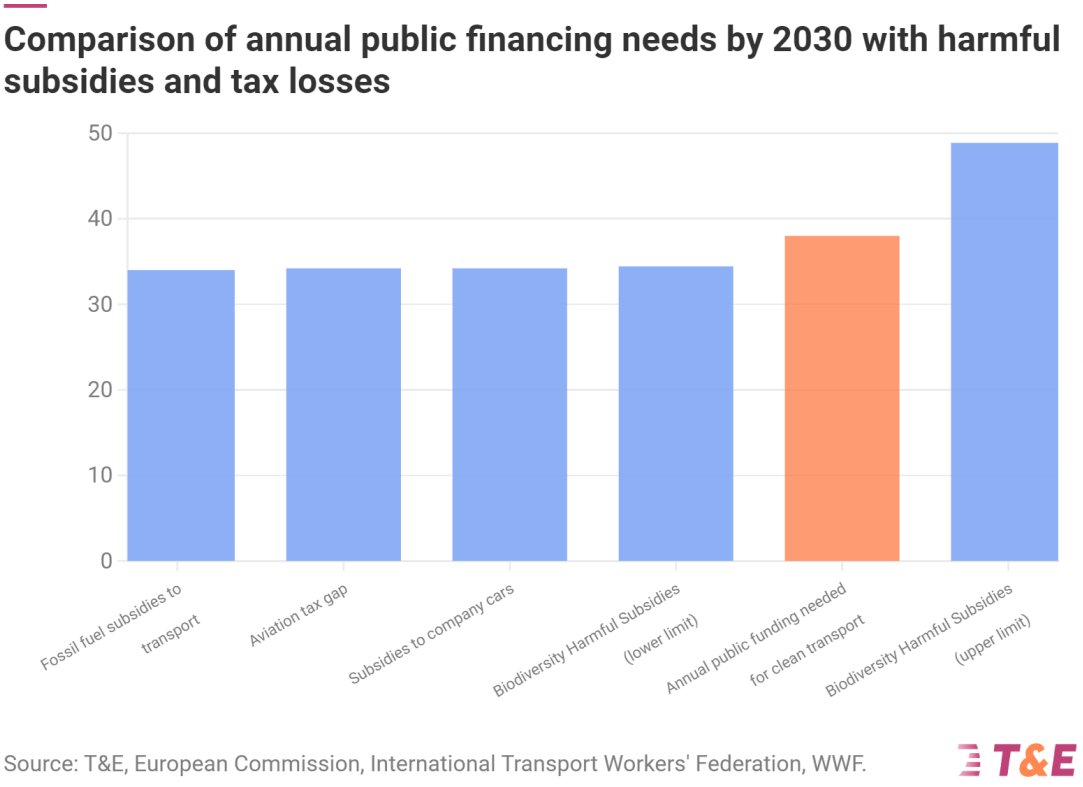


Figure 25: Comparison of annual public financing needs by 2030 with harmful subsidies and tax losses.

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Annex - Methodology

Fit for 55 and Net-Zero scenarios

The investment figures in this report refer to two scenarios: the FF55 and NZ. In recent years, T&E has closely monitored EU transport regulations to evaluate if decarbonisation measures and targets are ambitious enough. Our simulation tools show that the FF55 package falls short of achieving net-zero by 2050 in road, maritime, and air transport. In response, we proposed our own Net-Zero scenario. This is a collection of the sector-specific roadmaps developed by T&E, stating the amount of green technologies - number of EVs, amount of e-fuels - needed to reach net-zero in 2050. The single roadmaps are publicly available and can be downloaded from T&E's website.

Estimating investment needs

Our methodology follows a well-established approach in the field [4]. We determine the total yearly investment by multiplying the final price of a unit good, such as an EV or a Megajoule of energy from e-kerosene, by its demand. This is equivalent to calculating revenue in the sector. The final price includes all production and delivery costs, e.g. raw materials, labour, transportation, cost of capital, etc. This standardised method of calculating investment allows for benchmarking across different sectors.

This study identifies overall investment needs rather than "additional" needs compared to current levels. Our focus is on **gross costs**, not net costs relative to current investments in polluting technologies. For instance, introducing over 160 million light EVs onto European roads by 2040 will require a total investment of €5.46 trillion, representing the sum of EV purchase prices. This figure encompasses all investments necessary to produce the EVs and allows for distribution among various stakeholders: manufacturers, private companies, financial institutions, the public sector, and private consumers.

In mature sectors such as EVs, where most capital investments have already been made, our methodology effectively accounts for both final consumption and capital depreciation - i.e. capital investments from previous years now being recovered. However, nascent sectors like e-fuel production require further analysis. Significant upfront Cap-Ex are necessary to build infrastructure before generating revenues, often leading to initial Cap-Ex exceeding anticipated revenues.

For these sectors, we calculate the cost of building sufficient production capacity in Europe by 2030 to meet decarbonisation targets through Cap-Ex analysis. The difference between this cost and the industry revenue reveals the investment gap. We then subtract the extra investment needed by 2030 from the total expenditure for 2031-2040 to avoid double-counting, as future prices of final goods already account for capital depreciation.

The study considers only the revenue/expenditure in the six sectors in scope. For example, we calculate the revenue of the entire EV industry, but exclude revenue from a car company's leasing branch. Data sources and calculations for individual sectors are provided in the following sections.

Our analysis does not cover the entire transport sector. Investments in rail or smart urban mobility are not included in the model. For these sectors, we reviewed existing literature and public funding schemes. The economic modelling developed by T&E for this study will be expanded in the future to other mobility sectors and specific geographical areas. On the energy side, our analysis includes the production of Green Hydrogen needed for generating clean e-fuels for aviation and shipping - together with a preliminary estimate of the investment required for hydrogen production.

Finally, the study adopts an EU-wide approach and does not differentiate between specific national or regional disparities.

The next subchapters unveil more sector-specific information.

I.I Aviation

The total investment for e-kerosene, SAF and hydrogen is calculated based on the final fuel price multiplied by its anticipated demand. However, given that most production facilities are yet to be installed, significant upfront costs are required. Therefore, for e-kerosene we added the cost of installing new production capacity - i.e. the capital cost to build the projects mentioned above. This is calculated by multiplying yearly capacity by the cost of building the production plants (capital expenditures or Cap-Ex). These costs are derived from data sourced from Concawe[56] and operators' announcements. While all fuels are included in our analysis, we only calculate the extra investment for e-fuel plants, leaving biofuels out. Unless specified otherwise, our focus is on results derived from the most pessimistic assumptions, reflecting the highest registered costs.

Out of scope under this study are investments in airport infrastructure, e.g; for enhancing safety, digitising or "greening" airport infrastructure.

T&E's aviation decarbonisation roadmap includes hydrogen-powered aircrafts from 2035. However, due to the uncertainties surrounding this technology, the investment associated with developing these planes is outside the scope of this study. In a previous study[57] commissioned by the European Climate Foundation and T&E, the consultancy firm Steer conducted an economic analysis on deploying hydrogen aviation for intra-European flights by 2050. The main finding was that €299 billion would be needed between 2025 and 2050 to develop and operate the hydrogen aviation value chain in Europe, with 83% of costs allocated to hydrogen production, distribution and liquefaction.

Other costs included in our calculations are the total investment for the hydrogen needed for e-fuels (representing between 72% and 83% of total e-fuels costs) and the refuelling infrastructure (which costs are close to negligible since existing infrastructure is sufficient).

I.II Shipping

The fuel mix for the NZ Scenario is based on T&E's shipping decarbonisation roadmap [6]. Biodiesel, biomethanol and direct hydrogen are the primary fuels until 2035, after which e-ammonia and e-diesel become predominant. Our data covers all EU shipping, and not just those vessels covered by the FuelEU Maritime (FEUM) regulation.

E-fuel final costs and Cap-Ex are sourced from a study of Concawe [56], while biofuel costs are based on T&E's impact assessment of the FEUM regulation [58]. Fuel costs encompass transportation and distribution, as well as refuelling infrastructure. As for aviation, biorefineries are not included in the extra investment calculations.

The electrification of port docks is outside the scope of this research. However, it is an important aspect of the green transition, as it enables docked ships to be powered by green electricity instead of burning fuel. An upcoming T&E study will explore this area in detail.

I.III Charging

An upcoming T&E study will detail how the AFIR requirements translate into installed capacity across Europe's main roads. For private chargers, we assumed a one-to-one EV-charger ratio, meaning one charging point per EV. The cost of public charging infrastructure (in €/GW) was derived from multiple sources, including the European Commission [59], the International Council on Clean Transportation (ICCT)[60] and the Boston Consulting Group [61]. The cost of private charging (€/point) is based on a study by the Fraunhofer institute [62]. Initially calculated for Germany, this cost was normalised by GDP to scale it to the EU level. This includes equipment, installation and grid connection. In our modelling, new investments slow down in 2031-2035, to get back up slightly after 2035 once electric car sales reach their peak. However, we decided to fit the total amount in 2031-2040 to a strictly decreasing trend, assuming that investments will continue to be stimulated by AFIR. This may lead to short-term overcapacity but will enable early movers to gain market share in future years.

T&E also calculates that the public charging infrastructure mandated by the EU's highway charging law (AFIR) will be sufficient for both light and heavy fleets in a NZ Scenario. Therefore, the same inputs are used for both the NZ and FF55 scenarios.

I.IV LDVs

Our figures reflect the investment required for new electric vehicle sales between 2025 and 2040. The annual vehicle sales projections under the two scenarios are derived from T&E's internal model for road transport simulation, EUTRM. Total sales are then split per vehicle class (categories A to F) using data from GlobalData Automotive. Vehicle price projections are sourced from BloombergNEF.

To calculate the savings under the "compact BEV" scenario, we differentiated prices between SUVs and non-SUVs for vehicle categories B, C and D. We assumed the price for these categories is the non-SUV price exclusively, rather than a combination of both as in the other scenarios. Therefore, while the sales volume remains constant, the price per car is significantly lower in the affected segments.

On top of cars, we have also included light commercial vehicles (i.e. vans) in our calculations, although they constitute a minor part of the investment - €653 billion through 2040, or 14% of the total figure presented in this chapter.

In the recommendations, we ask for €20 billion to be allocated from the Social Climate Fund. This represents the majority of the €28 billion T&E is asking from the SCF to be allocated to transport, and is 29% of the Fund's total pot, if it was beefed up according to T&E's requests. Such share is equal to the share of transport greenhouse gas emissions in the EU in 2022.

I.V Batteries

Figures include batteries for cars, vans and heavy-duty vehicles.

The additional investment – i.e. the cost gap to reach a 100% European production – is calculated as follows. The Cap-Ex and Op-Ex required to build the announced gigafactory projects in Europe are derived by crossing BloombergNEF data with announcements made by the battery makers. Cap-Ex is multiplied by the yearly additional capacity, while Op-Ex is multiplied by the total battery requirement. Capacity reflects the available GWh for production by 2030, yearly demand is calculated in-house by T&E.

The business as usual scenario – i.e. Net Zero targets with the current battery production setting – is calculated by multiplying the vehicle prices by the battery cost share according to BloombergNEF data.

The additional investment required for 100% European production is obtained by the difference between this scenario and the business-as-usual production setting.

It is worth highlighting that our findings are on par with the estimates of the European Battery Alliance (EBA250) that new investments worth €380 billion will be needed in support of the battery value chain across Europe in order to create a self-sufficient battery industry by 2030 [63].

I.VI HDVs

The study covers the entire heavy-duty fleet in the EU – vehicles with a mass above 3.5 tons gross vehicle weight. The FF55 Scenario assumes strict compliance with regulation targets – i.e. meeting the minimum sales share required to avoid fines. The NZ Scenario developed in-house by T&E is modelled on the best-case scenario for HDV uptake given the current and forecasted market conditions. It includes a 100% zero-emission sales target for all vehicles from 2040 and reaches a 95% CO2 reduction by 2050. Both scenarios are modelled using the EUTRM, which provides yearly sales projections [34]. Vehicle prices, net of VAT, are obtained by crossing multiple sources from industry experts and academia [64, 65].

Modal shift has been a key part of the EU's investment strategy regarding the decarbonisation of freight transport. Although efforts to move more freight by rail are welcome, even in the most optimistic scenario – where the EU doubles the amount of freight carried by rail – 59% of freight would still be transported by road.