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D4.4 Analytical report on employment effects

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Deliverable No. 4.4 Analytical report on employment effects

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Executive summary

Connected, Cooperative and Automated Mobility (CCAM) deployment is expected to lead to socio-economic transformation within the EU economy. It affects how mobility services are organised, and how labour markets evolve. Understanding these impacts would ensure that policymakers can address them early in the deployment phase for a socially sustainable transition to CCAM. This deliverable examines the estimated impact of CCAM deployment on employment by Member State, sector and occupation across three use cases—warehousing, road freight transport and road passenger transport—and under alternative CCAM uptake scenarios.

The methodology used in this deliverable is scenario analysis using Cambridge Econometrics' E3ME model to perform the quantification of employment effects of different scenarios. The basis of the scenario analysis is a baseline (business-as-usual scenario). The other scenarios are then measured as differences from this baseline.

Employment and GDP impacts are assessed relative to this baseline scenario that already incorporates an uptake of CCAM adoption reflecting current and expected deployment pathways. Alternative low, medium and high CCAM uptake scenarios are defined for each use case and are evaluated as deviations from this baseline over the period 2025–2050. This approach allows for a consistent comparison of labour-market outcomes across scenarios, sectors, occupations and country adopter groups.

The scenario framework has three core sets of assumptions: CCAM uptake trajectories, the additional investment required to enable deployment, and associated cost savings and productivity gains. Uptake pathways differ across use cases and by country adopter group, distinguishing between early, mid and late adopters to reflect heterogeneous enabling conditions and regulatory readiness across Member States. Investment costs are allocated to relevant supply-chain sectors, while productivity gains and cost savings primarily affect labour demand in the transport and logistics activities most directly impacted by automation. Occupational impacts are derived by combining sectoral employment changes with adjustments to occupational structures, informed by historical trends from the EU Labour Force Survey and qualitative skills foresight evidence from Deliverable 4.5 of CCAM-ERAS project.

In the warehousing use case, CCAM deployment is associated with the largest employment effects among the scenarios analysed. Rapid adoption under high CCAM uptake leads to substantial employment losses in the land transport and warehousing sector compared to the baseline, as productivity gains and labour-cost reductions outweigh the positive effects of investment. These losses are only partly offset by indirect and induced employment gains in other sectors. By contrast, slower CCAM uptake limits direct job displacement and allows investment-driven effects to dominate, resulting in net employment gains relative to the baseline by 2050. Employment impacts in this use case are highly concentrated among drivers and mobile plant operators, labourers and clerical occupations, with early-adopter Member States experiencing the largest absolute effects due to faster and more extensive deployment.

For road freight transport, the results indicate relatively modest employment effects at the EU level across both medium and high CCAM uptake scenarios. Employment losses relative to the baseline remain limited and are largely concentrated in the land transport sector and among driving occupations. While investments in CCAM technologies generate additional demand in

upstream sectors such as electronics and computing services, these indirect and induced effects are generally insufficient to fully offset productivity-driven reductions in labour demand within freight transport activities. Early-adopter Member States account for a high share of employment losses, reflecting both higher adoption rates, while late-adopter Member States are impacted through the relatively large size of the freight transport sector within their national labour markets.

In contrast, the road passenger transport scenarios exhibit a more differentiated employment response depending on the pace of CCAM uptake. Under high CCAM uptake, EU employment increases relative to the baseline by 2050, driven by higher investment, increased demand for passenger transport services and positive indirect and induced effects along the CCAM supply chain. These dynamics translate into substantial employment gains in sectors such as computing services, electronics and land transport, alongside rising demand for ICT-related occupations. Under medium CCAM uptake, however, positive investment-driven effects are largely offset by employment losses in driving occupations, resulting in employment outcomes that remain close to or slightly below baseline levels.

Across all use cases, employment impacts vary substantially by country adopter group. Early adopters tend to experience stronger and earlier employment effects—both positive and negative—due to faster deployment trajectories, while mid- and late-adopter Member States face more gradual adjustments but may still be subject to substantial absolute impacts where transport and logistics account for a large share of total employment. From an occupational perspective, CCAM deployment consistently reduces demand for driving and routine transport-related jobs, while increasing demand for ICT professionals, technicians and higher-skilled support roles, particularly in scenarios characterised by higher uptake rates.

Overall, the findings underline that the employment implications of CCAM are highly context-specific, depending on the use case, speed of adoption and national labour-market structures. While CCAM deployment can generate net employment gains under certain conditions—most notably in road passenger transport with sufficiently high uptake—it also poses substantial transition challenges, particularly in warehousing and freight transport. These results emphasise the importance of forward-looking skills policies, targeted transition and reskilling measures, and differentiated policy responses aligned with national CCAM deployment pathways.

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Table of abbreviations

Abbreviation	Full Form
AV	automated vehicles
CAPEX	capital expenditure
CCAM	Cooperative, Connected and Automated Mobility
CGE	Computable General Equilibrium
EU-27	European Union (27 Member States)
MaaS	Mobility as a Service
NACE	Statistical Classification of Economic Activities in the European Community
ISCO	International Standard Classification of Occupations
OPEX	operating expenditure
TCO	total cost of ownership
L1, L2, L3, L4, L5	SAE automation levels
SAE	Society of Automotive Engineers

1 Introduction

The Horizon Europe CCAM-ERAS project develops evidence-based methods to anticipate the labour market challenges resulting from the deployment of Cooperative, Connected and Automated Mobility (CCAM), supporting strategic planning through scenario analysis and impact evaluation. This deliverable is part of the project's fourth work package (WP).

The objectives of WP4 are threefold:

- A. to study the impact of CCAM on employment by sector and employment in occupations and provide a short, medium- and long-term employment forecast (from aggregate of direct, indirect, and induced effects) of different investment and adoption pathways of CCAM;
- B. to provide improved understanding of the short, medium and long-term effects of CCAM on the demand for new and updated skills; and
- C. to analyse employment effects of CCAM across the full value-chain.

The main outcome of WP4A is the quantification of short-, medium-, and long-term employment effects resulting from CCAM deployment, by combining labour market data with estimates of technology adoption rates. This quantification for both transport sector and the entire economy is presented in this report. The assumed changes in the occupational structure give an indication on the future workforce, shifts in responsibilities and future roles. It builds on the work presented in the Deliverables 4.1 and 4.2.

Cambridge Econometrics' E3ME model¹ was used to perform scenario analysis to obtain the employment effects quantification of different CCAM technologies uptake. E3ME is a computer-based model integrating the global economy, energy systems, and the environment. Originally developed under the European Commission's research framework programmes, it is now widely applied across Europe and internationally for policy assessment, forecasting, and academic research. E3ME is frequently employed to evaluate the economic, labour market, and environmental impacts of policy interventions. Its structure explicitly links economic activity with the energy system, ensuring internal consistency across all domains. Unlike CGE models, E3ME is demand-driven and does not assume that markets always clear through price adjustments. This fundamental difference has significant practical implications: regulation and other policies can lead to increased output where spare economic capacity exists.

Future scenarios of deployment of the CCAM technologies consider assumptions on the investment required for different levels of speed of adoption and supply chain changes. These assumptions are summarised in Section 2 of this report and described in detail in Deliverable 4.2 (Arsénio et al., 2025a). The results show the impact up to 2050 and consider that the European Green Deal and Digital Europe targets since these are considered approved policies. The scenario analysis acts as an early information sign on the evolution of employment in the warehousing, freight and passenger transport.

In this deliverable, the quantitative outcomes of the scenarios are analysed. The projections are linked to other WP regarding changing skill needs (work performed in WP4B) and lessons from the use case studies (WP3). The adoption rates of CCAM are differentiated by three types of adopting

¹ For more information about the E3ME model, please visit: <https://www.camecon.com/e3me>

Member States, imposing, for example, differential speeds of adoption across adopting groups to model their impacts on the national and EU-wide economy and its labour markets.

The deliverable is structured as follows. Next chapter summarises the assumptions used in the scenario analysis, while third to fifth chapters presents the assumptions for the five scenarios that were modelled. The last two chapters summarise the common results. All the scenarios' results are also published in a Power BI dashboard².

2 Summary of the assumptions

Deliverable 4.2 (Arsénio et al., 2025a) presented in detail the assumptions used to construct the E3ME employment forecast for CCAM deployment for road freight transport, passenger transport (public and private), and warehousing. Broadly, the assumptions can be split into three categories: the uptake of CCAM in each use case, the investment required to achieve the level of uptake, and resulting externalities (e.g., productivity gains, cost savings, sectoral output). Moreover, it is assumed that uptake of CCAM differs by country adopter groups, which were split into early, mid, late adopters. The next sections present a summary of these assumptions.

Three use cases (warehousing, road freight and passenger transport) are represented in the E3ME model as separate scenarios, with scenario specific CCAM uptake trajectories.

2.1 CCAM uptake rates

The multiple CCAM uptake rates were selected for each of the five use cases based on desk research and feedback from industry experts and consortium partners. Table 1 summarises these rates for the different scenarios. As CCAM technology is already being deployed, the baseline scenario takes this into account by assuming a certain level of deployment. For different use cases, industry experts agreed that the baseline scenario would reflect varying levels of uptake as indicated in Table 1.

Table 1: CCAM uptake by use case

Scenarios (CCAM use cases)	Year	Low uptake	Medium uptake	High uptake
Warehousing	2024	25%	25% (baseline)	25%
Warehousing	2050	60%	75% (baseline)	100%
L1/L2 road freight	2025	50.32% (baseline)	51.46%	53.21%
L1/L2 road freight	2050	90% (baseline)	85%	80%
L4/L5 road freight	2025	0.25% (baseline)	0.25%	0.25%
L4/L5 road freight	2050	10% (baseline)	15%	20%

²

<https://app.powerbi.com/view?r=eyJrljoiZGM5MzY5MjctNDgyMS00NzRmLWl1MmQtZjM1YWRhM2FhZDdiliwidCI6IjE1YWQxMGU2LWJlNWYtNDY3ZS05MDZjLWQ4MmRlMzQ1ZDM3ZiIsImMiOiJh9>

Scenarios (CCAM use cases)	Year	Low uptake	Medium uptake	High uptake
Public transport	2027	1% (baseline)	1%	1%
Public transport	2050	10% (baseline)	15%	20%
Private transport	2027	0.50% (baseline)	0.50%	0.50%
Private transport	2050	5% (baseline)	5%	10%

The adoption of CCAM technologies in the freight sector is expected to advance steadily, particularly for the long and medium-haul transport, where automation is projected to begin as early as 2025. Labour union resistance is likely to be low in this sector given existing labour shortages (European Labour Authority, 2025), reducing social friction and enabling smoother integration of automated systems. Moreover, the L1/L2 vehicles represent just over 50% of the current vehicle fleet. As such, based on available data and expert opinion, a low adoption rate of 10% by 2050 was assumed in the baseline for highly automated (L4/L5) vehicles. For the sensitivity analysis, adoption rates of 15% and 20% were considered in medium and high CCAM uptake scenarios, respectively.

The timeline for deploying CCAM technologies in road passenger transport remains less defined compared to other sectors, primarily due to persistent concerns around passenger safety, public trust, and regulatory complexity. Insights from industry stakeholders suggest that growth in this market will vary across different segments. Public transport is expected to be the main beneficiary of CCAM in this use case, whereas private transport is expected to be restricted. To reflect the current regulatory environment towards public transport, a low adoption rate of 10% was set for 2050, whereas that figure stands at 5% for private commercial passenger transport in the baseline. The medium CCAM uptake scenario expects an adoption rate for public transport increase to 15% by 2050, and that of private transport to 5%. The high CCAM adoption case sees the adoption rate for public transport increase to 20%, and that of private transport to 10%.

Automated warehousing solutions are expected to experience important growth over the next few years. Based on available literature, the baseline assumes a medium CCAM uptake scenarios which follows a linear path of adoption defined by the historical trends recorded by the literature (Meteor Space, 2024; Schraner & Fischer, 2025). Recognising that the growth projections may not fully account for potential adoption barriers, such as regulatory measures within the EU or opposition from organised labour, the low CCAM uptake scenario assumes a lower adoption rate of CCAM in the warehousing use case of 60% in 2050. To account for upward differences in CCAM uptake, the high CCAM uptake assumes a faster adoption of the technology on the market, which would reach saturation in 2039.

To differentiate between Member States that are early, mid, and late adopters, adoption growth rates for CCAM technologies are adjusted to reflect each group's level of uptake. Early adopters are assumed to experience the unaltered growth paths (as shown in Table 1), reflecting more favourable conditions for deployment than in the other Member States. In contrast, the growth rates of late-adopter Member States are devalued due to less developed enabling conditions. Mid-adopter Member States see their growth rates reduced, but to a lesser extent than late

adopters. The country groupings and values are summarised in Table 2 and they were discussed with industry exporters during the Stakeholder Validation Workshop (November 2025).

Table 2: Member States by adoption stage

Adoption stage	Growth adjustment	Member States
Early adopters	0%	Austria, Germany, France, Netherlands, Sweden, Belgium, Denmark, Hungary, Lithuania, Malta, Slovenia
Mid adopters	-5%	Italy, Croatia, Cyprus, Czechia, Estonia, Finland, Luxembourg
Late adopters	-10%	Greece, Poland, Romania, Bulgaria, Ireland, Latvia, Portugal, Slovakia, Spain

2.2 Investment costs

Assumptions in this section focused principally on identifying the additional investment costs of automation in the three use cases. Specifically, the unit cost of automation was identified for each use case before being scaled up to the entire population (vehicles, warehouses) based on the CCAM adoption rate and mapped to input sectors. The key investment costs findings are summarised in Table 3 and more details on the sources of these assumptions can be found in Arsénio et al. (2025a).

Table 3: Investment cost assumptions summary

Use case	Type	Value
Warehousing	Cost of automating the average warehouse	EUR 10 000 000
Warehousing	Additional cost of automating the average warehouse relative to baseline	62.26%
Road freight / Public transport	Total additional automation cost per vehicle	EUR 100 000
Road freight	Total additional automation cost per vehicle relative to baseline	90.9%
Road freight / Public transport	Share of hardware in automation cost	15%
Road freight / Public transport	Share of software in automation cost	85%
Road freight / Public transport	Profile of incremental automation costs by Society of Automotive Engineers (SAE) level (1 / 2 / 3 / 4 / 5)	7.69% / 21.79% / 26.5% / 25.21% / 18.8%
Public transport	Additional cost of automation relative to the baseline	40.4%
Private transport	Estimated vehicle price	USD 167 000
Private transport	Automation cost (not including base vehicle)	USD 92 000
Private transport	Additional automation cost relative to baseline	55.09%

Use case	Type	Value
Public transport	Current system operating costs (non-automated)	83,265
Public transport	Difference in yearly operating costs (EUR/year)	28,677
Public transport	Difference in yearly operating costs (%)	34.44%
Public transport	Amortisation costs of automation per year (EUR/year)	13,857
Public transport	Difference in yearly costs (EUR/year)	14,819
Public transport	Difference in yearly costs (%)	17.80%

2.3 Cost savings and productivity gains

The CCAM deployment is expected to negatively impact employment through productivity gains and increase overall efficiency through costs savings. Therefore, assumptions on productivity and cost savings were collected from the literature (see Arsénio et al., 2025). Table 4 provides an overview of assumptions for cost savings and productivity gains by use case. These cost savings and productivity gains were applied proportionally to the CCAM uptake assumptions over the projection period.

Table 4: Cost savings and productivity gains summary

Use case	Savings type	Value
Warehousing	Productivity gains from automation	45%
Warehousing	Total labour cost after automation	-65%
Road freight	Total labour cost at L3	-10%
Road freight	Total labour cost at L4	-79%
Road freight	Total labour cost at L5	-90%
Road freight	Total insurance at L4	-5%
Road freight	Total insurance at L5	-5%
Road freight	TCO savings at L4 (>1500 miles)	-42%
Road freight	TCO savings at L4 (≤250 miles)	-13%
Road freight	TCO savings at L4 (≤100 miles)	>0%
Road freight	Labour cost share in TCO	35%
Road freight	Fuel costs	-10%
Passenger transport	Total energy and fuel cost	-20%
Public transport	Labour cost share in TCO	45%

2.4 Occupational distribution

The occupational distribution within economic sectors is based on the continuation of trends that were observed in the EU Labour Force Survey from 2014 until 2023 (Eurostat, 2024). The

starting point assumes past trends continue until 2030 and no further changes are observed until 2050³.

Since the baseline scenario assumes some level of adoption of CCAM (see Table 1), changes to the occupational distribution were derived from Deliverable 4.5. The changes were made only to the share of occupations within sectors that are either directly or indirectly covered by the skills foresight. For all other occupations, other work performed under WP4B does not provide much evidence that CCAM deployment would materially affect their employment shares beyond existing trends.

From the qualitative assessments based on Deliverable 4.5, the following quantitative assumptions were made to increase or decrease in the share of the occupation within transport sector compared to trend in the absence of CCAM:

- Stable: 0%, i.e. no change;
- Small change: 5%;
- Gradual/Moderate change: 10%;
- Strong/Clear change: 25%
- Values were defined for 2031, 2041, 2050, with interpolation being used in between.

Ultimately, occupation shares must total one, so other occupations are adjusted as needed to maintain this sum.

3 Scenarios for CCAM in warehousing

3.1 Overview

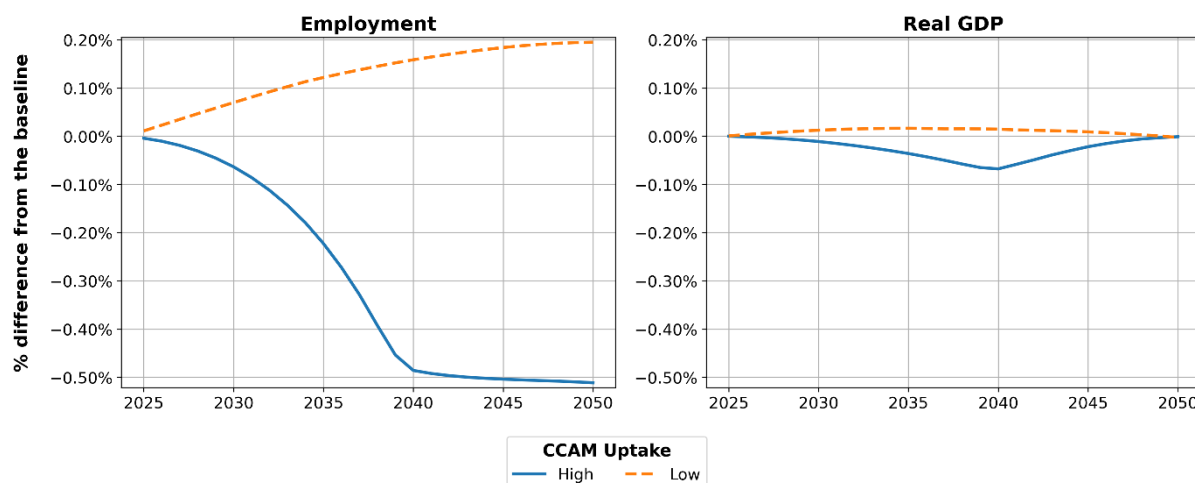
This scenario considered CCAM uptake paths in warehousing sector. The baseline case, i.e. medium uptake column in Table 1, assumes that the adoption rate of CCAM in this sector starts from 25% in 2024 and reaches 75% in 2050. The warehousing sector has the potential to experience the most significant uptake of automation out of the three use cases, reaching 100% CCAM adoption in 2039 in the high uptake scenario. This level of uptake is possible largely because warehousing automation occurs on private land, and thus it avoids the complex legislative hurdles associated with public space technologies. However, labour union resistance should be expected in this sector; therefore, the low uptake scenario reflects this resistance by assuming a CCAM uptake of 60% in 2050.

The deployment of CCAM technology in warehousing predates the projection period since the uptake rates in all scenarios start from 25%. CCAM uptake in this sector has a small impact on GDP compared to the baseline, with the largest relative difference being 0.068% in the high CCAM uptake scenario in 2040 (Figure 1) when all warehouses are automated. The decline in GDP can be explained by the fact that the employment impacts compared to the baseline are greater than the economic benefits associated with CCAM deployment. This means that investments associated with the deployment of the technology up to 2039 do not offset the impact of decline in consumer spending driven by lower employment. However, as EU employment declines less from 2040 onwards reaching around 1 million workers in 2050 compared to the baseline, GDP

³ This simplistic assumption was made considering the low number of historical observations (around nine) that would not produce reliable projections 30 years into the future.

recovers to baseline levels by the end of the forecast period, when employment loss and the increase in investment reach their peak in the baseline.

Figure 1: EU-27 employment and GDP impacts by warehousing scenarios, 2025-2050



Note: Medium CCAM uptake is assumed to be the baseline.

Source: Cambridge Econometrics' E3ME model.

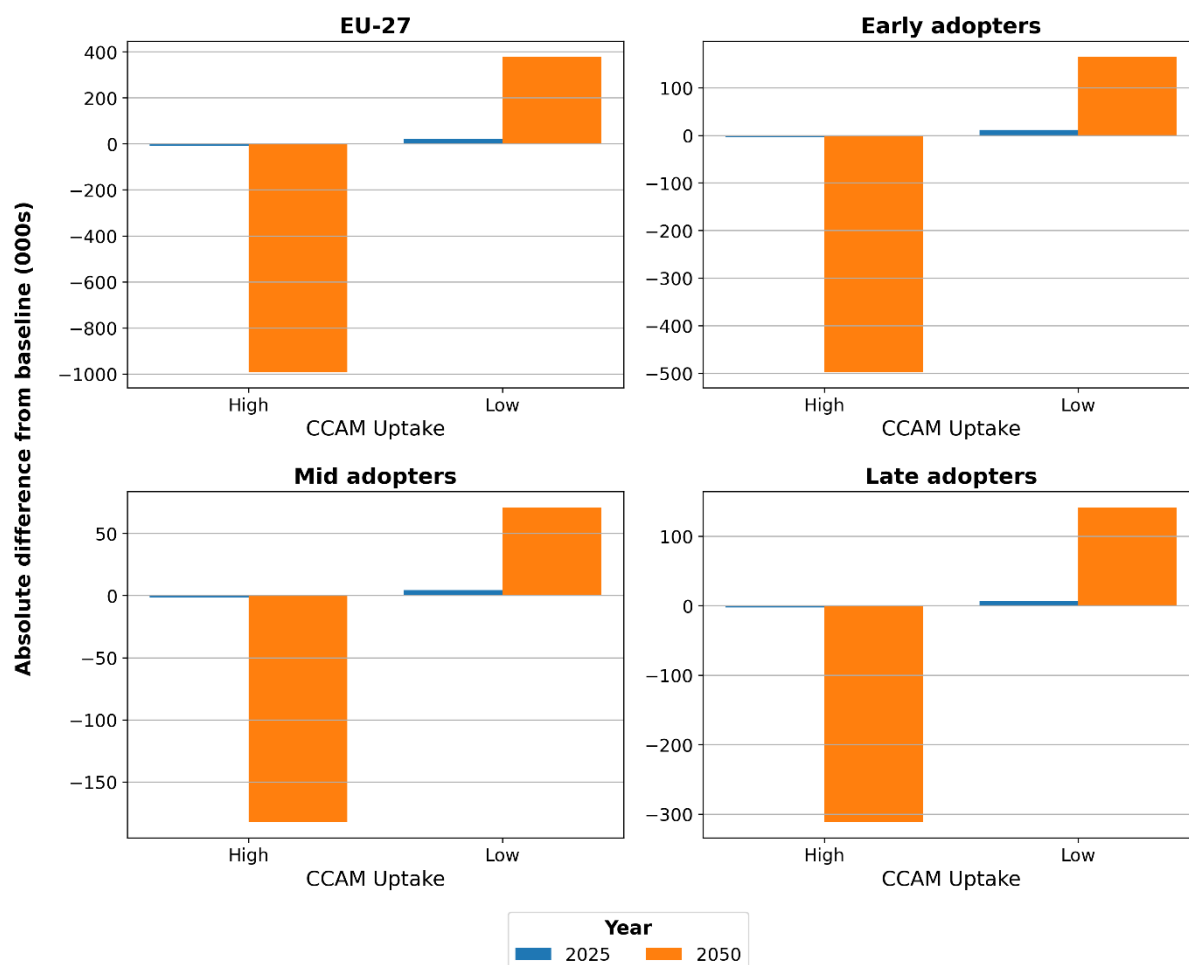
In the low CCAM uptake, lower employment losses compared to the baseline ensure a small positive relative difference in GDP, which is in line with 15 percentage points difference between uptake rates in 2050. The low CCAM uptake scenario shows an increase of around 377.3 thousand workers (0.19%) in 2050 compared to the baseline. The observed employment gain can be explained by the fact that investment CCAM generates employment elsewhere in the economy which is not offset by the gradual employment loss in warehousing.

A major difference in employment is observed in early-adopter Member States for the different CCAM uptakes. In the high CCAM uptake scenario, employment losses compared to the baseline accelerate up to 2039, before employment stabilises at around 497.2 thousand fewer workers than the baseline. The sudden stabilisation can be explained by the automation market reaching saturation at this time. In the low CCAM uptake scenario, slower adoption leads to gradual employment losses compared to the baseline, resulting in a comparative gain of 164.7 thousand workers by 2050 elsewhere in the economy (Figure 2).

Mid-adopter Member States exhibit similar dynamics to early-adopter Member States in employment. In the high CCAM uptake scenario, the absolute difference to the employment baseline declines to 182.3 thousand fewer workers compared to the baseline by 2050. In contrast, mid-adopter Member States experience a growing positive absolute difference to the employment baseline in the low CCAM uptake scenario, which culminates at 71 thousand workers in 2050.

Late-adopter Member States experience an important, consistent decrease in employment compared to the baseline in the high CCAM uptake scenario, which reaches a negative absolute difference of around 312 thousand in 2050. Conversely, in the low CCAM uptake scenario, a positive absolute difference in employment is observed throughout the forecast period, which culminates in 2050 at 142 thousand more workers than in the baseline.

Figure 2: Employment by country groups and warehousing scenarios, 2025 and 2050



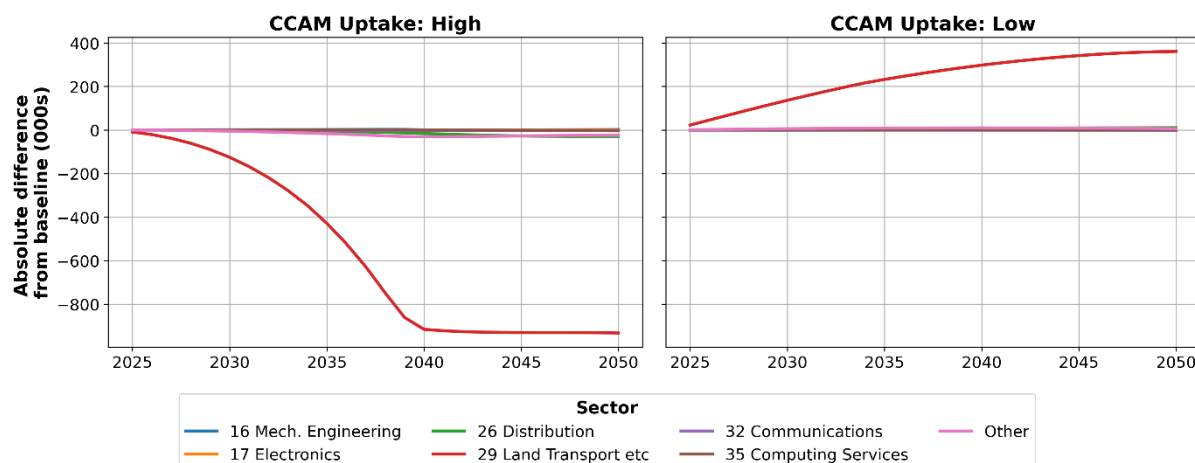
Note: Medium CCAM uptake is assumed to be the baseline.

Source: Cambridge Econometrics' E3ME model.

3.2 Employment by sector

For the warehousing scenarios, employment changes are concentrated in a handful of sectors, namely: Mechanical Engineering, Electronics, Distribution, Land Transport (including warehousing), Communications, and Computing Services. These sectors correspond to the supply chain of CCAM presented in Deliverable 4.1(Arsénio et al., 2025b).

Figure 3: Employment by sectors and warehousing scenarios, 2025-2050



Note: Medium CCAM uptake is assumed to be the baseline.

Source: Cambridge Econometrics’ E3ME model.

In the high CCAM uptake scenario, employment losses at the EU level are largely concentrated in the land transport (including warehousing) sector, which is expected to be around 932 thousand workers compared to the baseline by 2050. Specifically, a gradually accelerating upward difference from the baseline levels is observed up to 2040, coinciding all warehouses being automated (left panel of Figure 3). By 2050, all the other sectors are experiencing employment losses or gains compared to the baseline either through indirect effects, i.e. within the supply chain of CCAM, or induced effects from lower consumer spending from disposable income losses.

In the high CCAM uptake scenario, early-adopter Member States account half of the employment loss compared baseline observed in the land transport (including warehousing) sector. This result assumes that 100% of the warehouses will be automated by 2039. In contrast, mid-adopter Member States will account for 20% of the employment loss in the land transport sector, compared to the baseline. Although they will reach 100% automation of warehouses the latest, late-adopter Member States account for 32% fewer workers in the land transport sector by 2050 compared to the baseline. Compared to the other two groups, this country group also concentrates the most of the additional employment losses in other sectors compared to the baseline, given the relative higher share of the impacted sector in total employment.

In the low CCAM uptake scenario, different employment dynamics are observed at sector level. The land transport (including warehousing) sector is expected to have 361 thousand additional workers compared to the baseline in 2050. Most other sectors benefit through indirect and induced effect with moderate employment gains. By 2050, the communications and computing services sectors are expected to see an increase of over thousand workers compared to the baseline, from the indirect demand for their services in CCAM deployment. Conversely, the mechanical engineering sector is expected to lose 1.1 thousand workers compared to baseline levels by 2050, probably through indirect effects linked to less need of this sector for CCAM technology.

Like in the case of high CCAM uptake, early adopters concentrate the employment gains in the land transport (including warehousing) sector in the low CCAM uptake scenario, accounting for

40% of thousand additional workers compared to baseline levels in 2050. Similarly, early adopters account for most additional workers in the sectors compared to the baseline from indirect and induced effects of CCAM low uptake. Mid adopters account for around 20% of additional workers compared from the baseline in the land transport sector in 2050. The other highlighted sector in this country group remain close to baseline levels. Late-adopter Member States as a group account for 140 out of the 361 thousand additional workers compared to the baseline in the land transport (including warehousing) sector.

Therefore, the benefits of slow adoption of CCAM in warehousing can lead to indirect benefits in the same sector as a result of investment in CCAM. While faster adoption of this technology can offset the benefits generated through indirect and induced effects of the investment, especially if the share of land transport (including warehousing) is high within total employment.

3.3 Employment by occupation

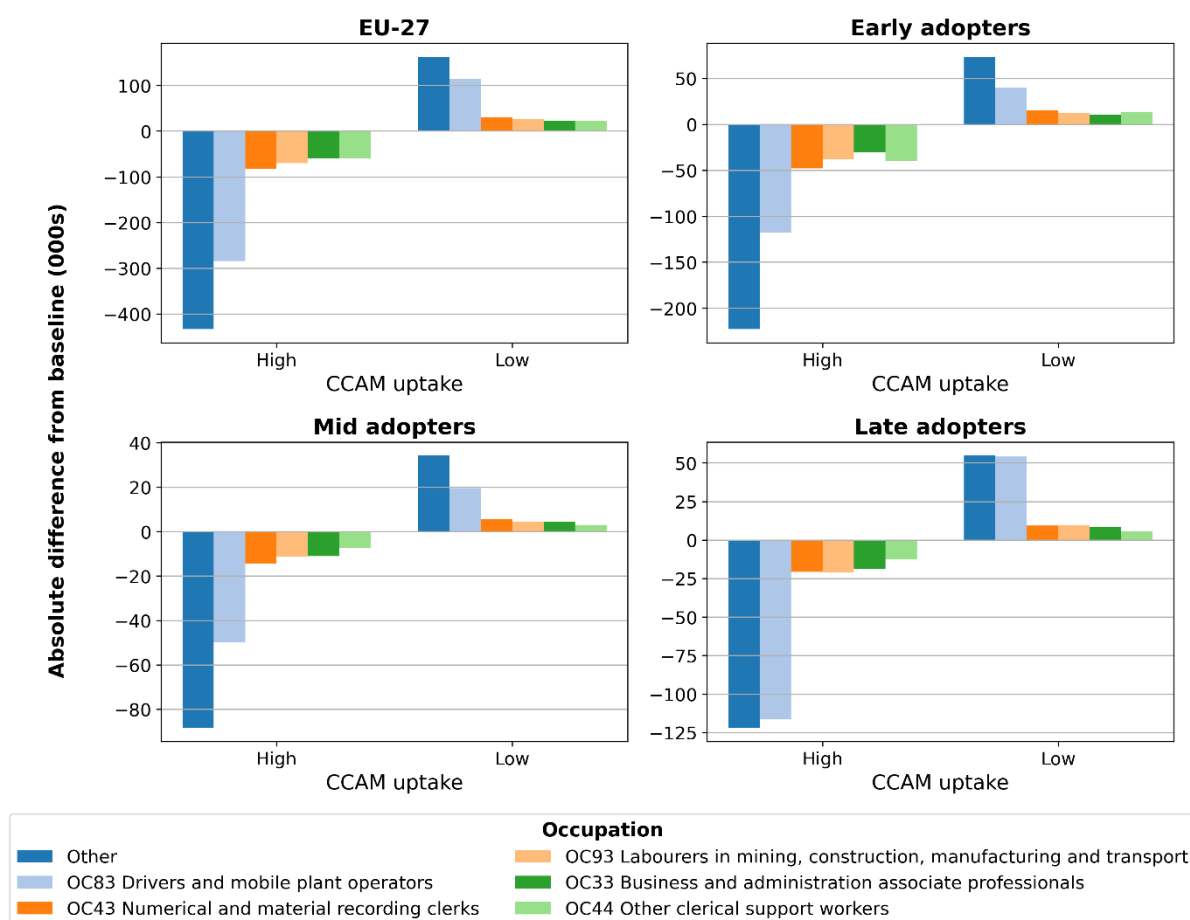
In 2025, the five occupation groups representing at least 70% of employment in the transport sector, which includes warehousing operations, include Labourers in mining, construction, manufacturing and transport, Drivers and mobile plant operators, Other clerical support workers, Numerical and material recording clerks and Business and administration associate professionals.

In the high CCAM uptake scenario, the highlighted occupations account for a loss in EU employment compared to the baseline of around 558 thousand workers by 2050. Most of the employment losses are concentrated in drivers and mobile plant operators, who account for half of the workers compared to the baseline in 2050. Correspondingly, labourers in mining, construction, manufacturing and transport account for a loss of around 70 thousand workers, other clerical support workers account for a loss of 60 thousand, numerical and material recording clerks and business for around 83 thousand fewer workers, and business and administration associate professionals for a loss of 60 thousand, compared to the baseline by 2050. Cumulative employment in all other occupations accounts for a loss of employment of roughly 433.3 thousand workers in 2050 compared to baseline.

In the high CCAM uptake scenario, early-adopter Member States account for a substantial portion of the employment difference compared to the occupational employment baseline (Figure 4), driven by other occupations and drivers. Mid-adopter Member States contribute to a comparatively smaller portion of the overall employment difference to the baseline, also driven by other occupations and drivers. Late-adopter Member States are expected to employ 117 thousand fewer drivers and mobile plant operators than in the employment baseline, mid-range between early and mid adopting Member States.

When a low CCAM uptake is assumed, a positive absolute difference from the employment baseline is observed in all occupation groups. Most of the employment change at the EU level is concentrated in drivers and mobile plant operators, which now account for more than 114 thousand extra workers compared to the baseline by 2050. Early-adopter Member States account for 35% of the 114 thousand additional drivers and mobile plant operators compared to the baseline by 2050. Further positive differences are observed for numerical and material recording clerks, and for labourers in mining, construction, manufacturing and transport. Lastly, employment among business and administration associate professionals and other clerical support workers are expected to increase by over 10 thousand compared to the baseline.

Figure 4: Employment difference from the baseline in selected occupations by CCAM uptake and country adopter group in the warehousing scenario, 2050



Note: Medium CCAM uptake is assumed to be the baseline.
 Source: Cambridge Econometrics' E3ME model.

Mid-adopter Member States account for a smaller share of the difference compared to the baseline, i.e. 20 thousand of the 114 thousand additional drivers and mobile plant operators by 2050. Late-adopter Member States capture the largest share of the additional employment among drivers and mobile plant operators, i.e. 54 thousand of the 114 thousand compared to the baseline by 2050.

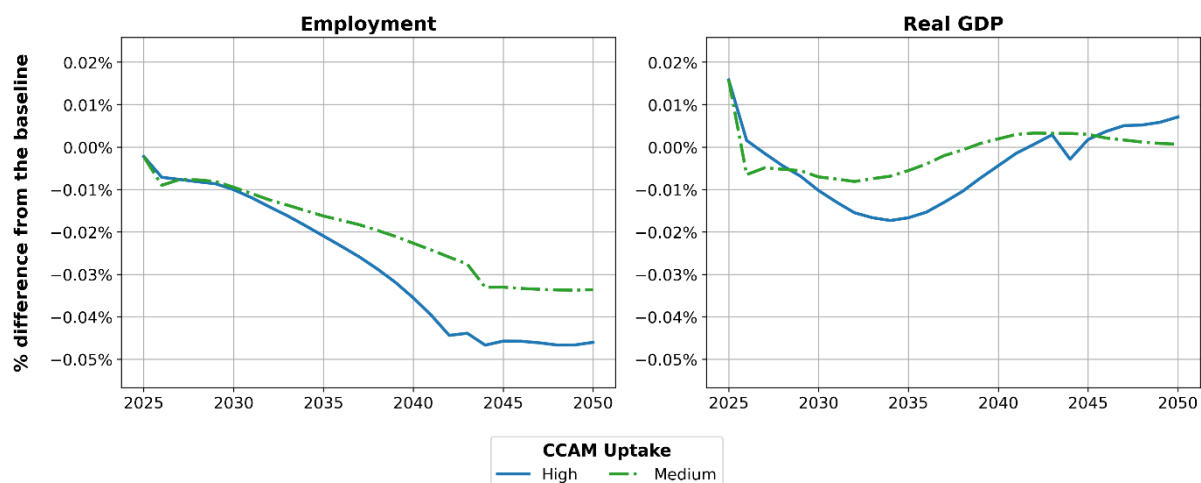
4 Scenarios for CCAM in road freight transport

4.1 Overview

The scenarios focusing on road freight transport sector assume higher CCAM uptake rates than in the baseline. The baseline case, i.e. low CCAM uptake column in Table 1, assumes a low adoption rate of CCAM in road freight transport sector, which starts from 0.25% for L4/L5 automation level and 50% for L1/L2 in 2025 and reaches 10% for L4/L5 and 90% for L1/L2 in 2050. In the high uptake scenario, the L4/L5 and L1/L2 reach the 20% and 80%, respectively, in 2050. In the medium uptake scenario, the L4/L5 and L1/L2 reach 15% and 85%, respectively, in 2050. No

information was identified in the literature about the L3 automation level; therefore, it was excluded from the analysis.

Figure 5: EU-27 employment and real GDP by road freight scenarios, 2025-2050



Note: Low CCAM uptake is assumed to be the baseline.

Source: Cambridge Econometrics' E3ME model.

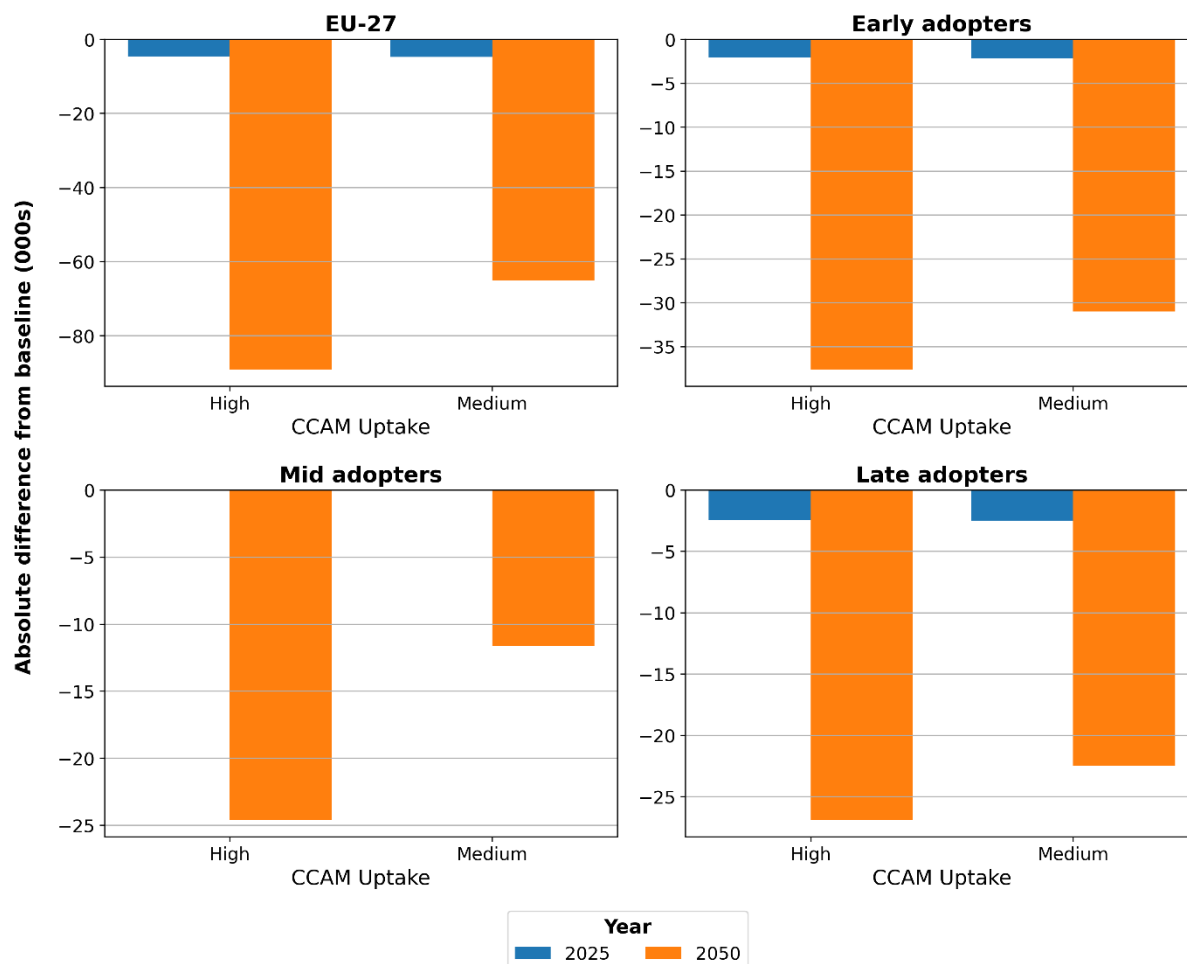
When considering CCAM uptake paths, by 2050 the GDP shows the small impact of the expected CCAM deployment in the road freight transport. EU GDP is expected to reach the largest relative difference from the baseline of 0.016% in both the high and medium CCAM uptake scenarios in 2025, corresponding to the initial investment at the start of the deployment period (Figure 5). The decline compared to the baseline by 2035 shows that the employment impacts on GDP are greater than the economic benefits associated investment in technology. However, as the CCAM uptake starts to accelerate, the economy adjusts to the new technology and GDP is above the baseline from 2045 to 2050.

Overall, for the high CCAM uptake scenario, the results indicate a total loss in EU employment of around 89 thousand in 2050 compared to the baseline (see top left panel of Figure 6), which corresponds to decline of 0.046% relative to the baseline (see Figure 5). This decline from the baseline up to the early 2040s is driven mostly by employment losses due to the rise in the adoption of L4/L5 vehicles and productivity increases from L1/L2 widespread. The increase in demand for goods and services needed for the production of CCAM in freight transport is not enough to offset this decline in employment caused by the deployment of the technology, as can be seen in the sectoral breakdown of employment in Figure 7. In comparison, the medium uptake scenario shows decline of around 65 thousand (-0.034%) in 2050 compared to the baseline. The smaller employment loss in medium uptake scenario than in the high uptake scenario is in line with the difference in CCAM uptake rates between the scenarios in the transport sector.

In both scenarios, the employment losses compared to the baseline are concentrated in the early-adopter Member States. In the high CCAM uptake scenario, the early-adopter Member States account for 38 thousand of employment loss, the mid-adopter Member States for 25 thousand, and the late-adopter Member States for 27 thousand. In the medium CCAM uptake scenario, the early-adopter Member States account for 31 thousand of the additional employment losses compared to the baseline, the mid-adopter Member States account for

around an additional 12 thousand, and the late-adopter Member States account for around 23 thousand.

Figure 6: Employment by country groups and road freight scenarios, 2025 and 2050

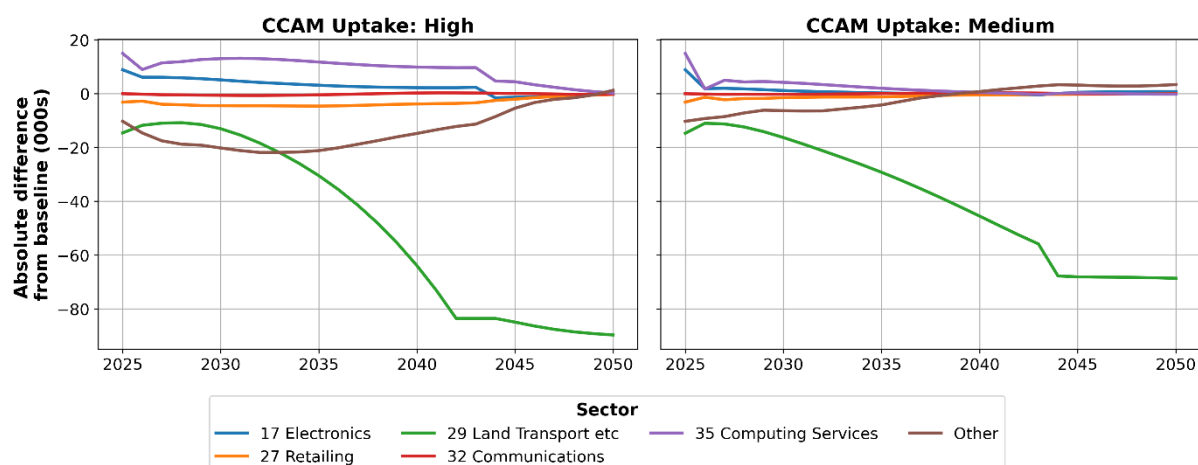


Note: Low CCAM uptake is assumed to be the baseline.
 Source: Cambridge Econometrics' E3ME model.

4.2 Employment by sector

For the freight-related scenarios, employment changes are concentrated in a handful of key sectors, namely: Electronics, Retailing, Land Transport, Communications, and Computing Services sectors. These sectors correspond to the supply chain of CCAM technology for this use case which was described in Deliverable 4.1 (Arsénio et al., 2025b).

Figure 7: EU-27 employment by sector and road freight scenarios, 2025-2050



Note: Low CCAM uptake is assumed to be the baseline.

Source: Cambridge Econometrics' E3ME model.

In the high CCAM uptake scenario, employment losses in the EU-27 are concentrated in the Land transport sector, which is expected to experience a loss of around 90 thousand workers compared to the baseline in 2050. Specifically, the decline in employment in the Land transport sector compared to the baseline accelerates before abruptly slowing down from 2042 onwards. The slowdown corresponds to the moment at which automated vehicles (both L1/L2 and L4/L5) are assumed to reach their peak of deployment. Once the economy adjusts, the subsequent employment developments are thus more driven by the substitution effects from L1/L2 to L4/L5 vehicles. After an initial decline, Electronics sector is expected to recover from a loss compared to the baseline of around four thousand in 2044 to a loss of around one thousand workers by 2050. The other identified sectors follow similar trends, although with smaller employment effects, with their end-of-period additional losses being estimated at under one thousand workers each compared to the baseline. The exception is Computing Services sector, which is expected to experience high demand early in the forecast period before reaching baseline levels from 2044 onwards. Employment in all other sectors through indirect and induced effects declines compared to the baseline up to around 2032, 22 thousand less workers compared to the baseline. Thereafter, indirect and induced effects of CCAM uptake are expected to bring three thousand additional employees compared to the baseline by 2050.

In early-adopter Member States, by 2050, the employment losses compared to the baseline for the land transport sector amount to 37 thousand workers in the high CCAM uptake scenario, mainly driven by the adoption rates and the share of this sector in total employment within the countries. The other sectors remain close to baseline levels because indirect and induced effects of this adoption are not expected to produce substantial changes from the baseline.

Mid-adopter Member States are expected to experience in high CCAM uptake scenario a decline of around 25 thousand workers compared to the baseline in 2050. Late-adopter Member States are also expected to see a decline in employment in the land transport sector compared to the baseline, although at a lower level, accounting for only 28 thousand of the 90 thousand EU workers. From indirect and induced effects, the other economic sectors converge in 2050 to levels close to the baseline employment.

In the medium CCAM uptake scenario, EU employment losses remain concentrated in the land transport sector, with an additional loss in employment of around 69 thousand compared to the baseline in 2050. All other sectors have employment changes from the baseline quantified under one thousand each since the indirect and induced effects are small.

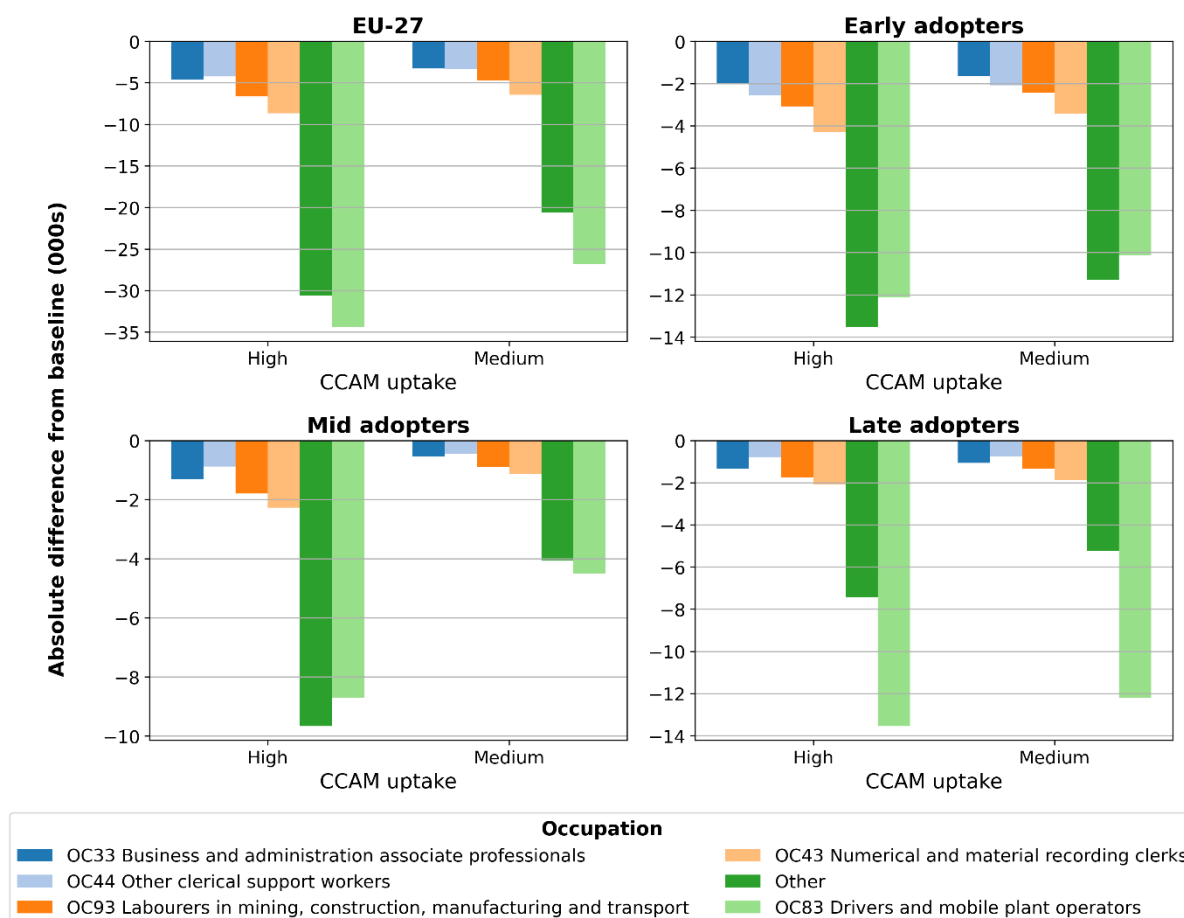
For early-adopter Member States, the employment in the land transport sector experiences a marginally smaller negative difference from the employment baseline than in the high uptake, reaching 31 thousand workers in 2050. In line with lower uptakes rates, also indirect and induced effects in all other sectors continue to experience at most minor differences to the baseline over the forecast period. The medium-adopter Member States concentrate their employment changes in this CCAM uptake scenarios in the land transport sector, with a decline from the employment baseline of around 13 thousand. Similarly, the late-adopter Member States see a similar decline in the land transport sector, with 25 thousand fewer workers in 2050 than in the baseline employment. Given the small impacts following the direct impacts, the indirect and induced effects in all other sectors are expected to see minimal differences from the baseline over the forecast period.

4.3 Employment by occupation

The forecast and scenario assumptions are implemented from 2025 onwards, with over 70% of transport sector jobs expected to be held by 2-digit ISCO occupations such as labourers, drivers and mobile plant operators, clerical support workers, recording clerks, and business and administration associate professionals⁴. Figure 8 shows how these occupations are impacted by country adopter group and scenario.

⁴ For detailed information what these occupations, please check the https://esco.ec.europa.eu/en/classification/occupation_main

Figure 8: Employment by occupations, country adopter group and road freight scenarios, 2050



Note: Low CCAM uptake is assumed to be the baseline.
 Source: Cambridge Econometrics' E3ME model.

In the high CCAM uptake scenario of road freight transport, the main occupations in the EU land transport sector are expected to experience a loss around 59 thousand workers compared to the baseline in 2050. The occupational employment compared to the baseline shrinks in line with the sectoral employment up to 2042, after which it stagnates. A considerable proportion of employment losses compared to the baseline are expected among Drivers and mobile plant operators, a decline of approximately 34 thousand by 2050 since this occupation is the main occupation in land transport sector in the baseline. Similarly, labourer roles are also affected, with a loss of around 7 thousand in 2050 compared to the baseline. The other occupations compared to the baseline in 2050 decline in line with occupational distribution within impacted sectors by the direct, indirect and induced effects assumed in the scenarios.

In early-adopter Member States and high CCAM uptake scenario, employment among drivers and mobile plant operators is expected to decline by around 12 thousand by 2050 compared to the baseline (see Figure 9). The other occupations decline in line with their shares in the affected sectors through direct, indirect and induced effects.

Mid-adopter Member States account for a smaller share of the employment loss observed for drivers and mobile plant operators, around 9 thousand of the 34 thousand fewer workers expected in EU employment compared to the baseline. Numerical and material recording clerks

are expected to fall by approximately 2 thousand workers compared to the baseline. For the remaining occupations, differences from the baseline are small over the projected period in line with the occupational distribution within sectors impacted by direct, indirect and induced effects.

Late-adopter Member States are expected to see a decline in employment of drivers and mobile plant operators compared to the baseline, with 14 thousand of the 34 thousand fewer workers expected for the EU results. Romania and Poland are major employers of freight transport drivers in Europe, which explains this result. Any other job losses at the occupational level align with predicted sector shrinkage based on CCAM adoption assumptions and occupational distribution of sectors impacted by direct, indirect and induced effects.

In the medium CCAM uptake scenario, drivers and mobile plant operators experience a loss of 27 thousand workers compared to the baseline by 2050. The other occupations shrink proportionally to their share in sectors impacted by direct, indirect and induced effects, as well as total economy. The early-adopter Member States concentrate a sizeable share of the expected employment difference compared to the occupational employment baseline. Employment among drivers and mobile plant operators is expected to experience a loss of around 10 thousand by 2050 compared with the baseline. In mid-adopter Member States, only drivers and mobile plant operators and other occupations are expected shrink the most compared to the baseline by 2050 (Figure 8). Late-adopter Member States accounts for 12 thousand of the 27 thousand fewer drivers and mobile plant operators compared to the baseline. Employment in other occupations declines in line with their shares within declining sectors.

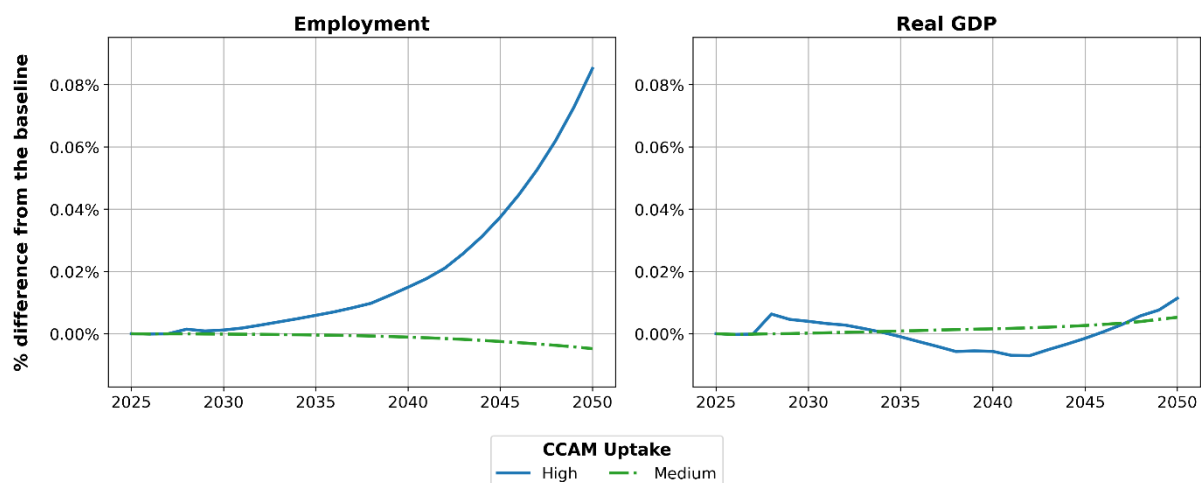
5 Scenarios for CCAM in road passenger transport

5.1 Overview

This chapter describes the impact of CCAM uptake in road passenger transport (which is NACE Rev2 sector H49.3). The baseline case, i.e. the low uptake column in Table 1, assumes that the uptake of CCAM in this sub-sector starts from 2027 with a low uptake of 1% for public transport and 0.5% for private transport. In 2050, the uptake remains low, i.e. 10% and 5% for public and private transport, respectively. In the high uptake scenario, in 2050 the public CCAM transport will reach about 25%, while the private will remain at around 10%. In the medium uptake scenario, in 2050 the public CCAM transport is assumed to reach about 15%, while private transport remains at around 5%.

The GDP results for different CCAM uptake scenarios for real GDP reflect slight differences from the baseline. EU GDP is expected to have the largest relative difference observed amounting to 0.011% in the high CCAM uptake scenario in 2050 (Figure 9). The increase in GDP by 2027 can be explained by the investment at the start of the deployment phase for the road passenger scenario. After 2034, the negative employment impacts on GDP are greater than the economic benefits associated with CCAM deployment. However, as the CCAM uptake increase by the late 2040s, the economy adjusts to the new technology and real GDP starts to grow relative to the baseline. This might be explained also by the decline in the EU working age population which would increase the need for passenger transport at the same time as the supply of available drivers declines.

Figure 9: EU-27 employment and GDP by road passenger scenarios, 2025-2050



Note: Low uptake is the baseline scenario in this use case.
 Source: Cambridge Econometrics' E3ME model.

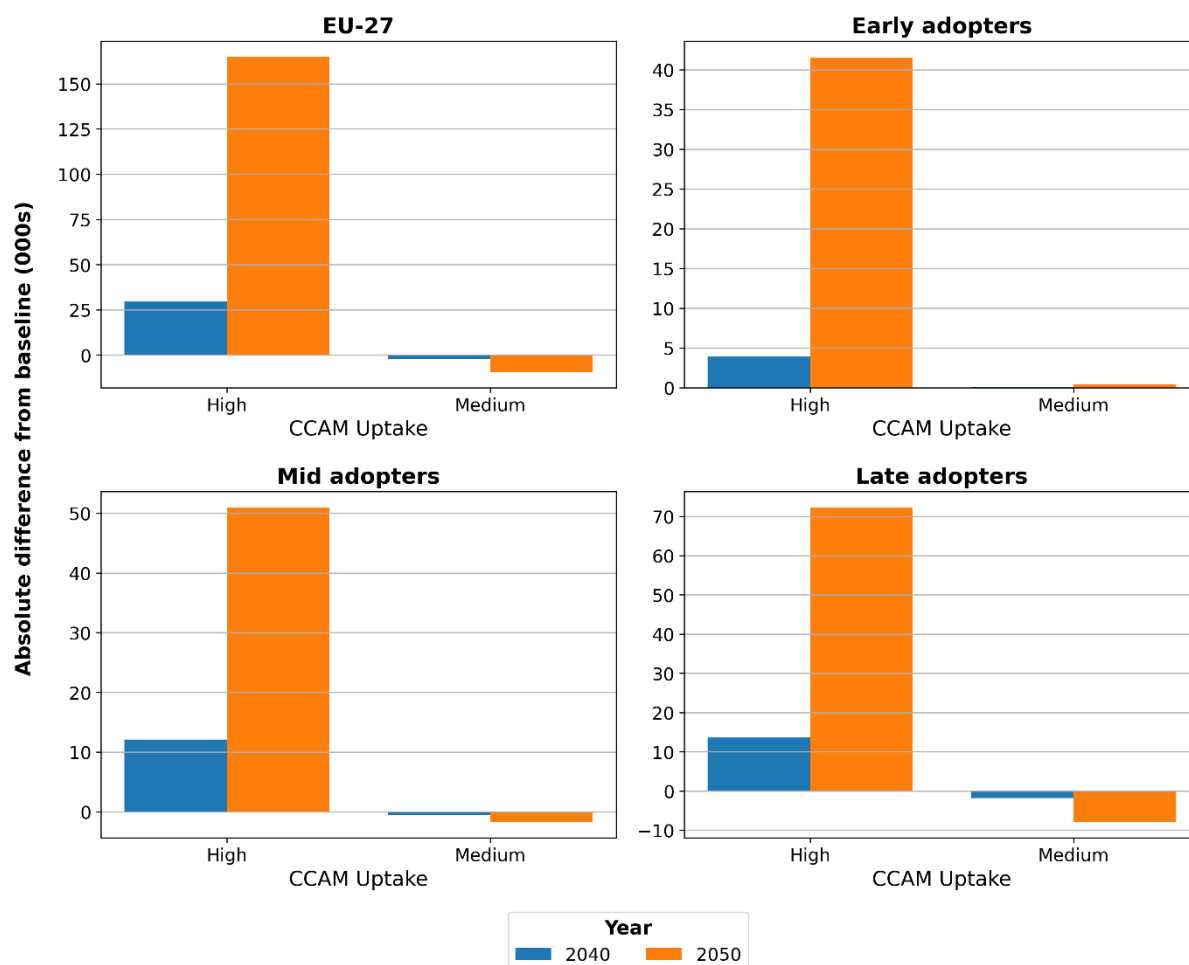
Overall, the employment results for the high CCAM uptake scenario indicate a total increase in EU employment of around 165 thousand workers in 2050 compared to the baseline (see top left panel of Figure 10), which corresponds to a relative difference of 0.085%. This increase follows an accelerating dynamic after the 2030s based on the increase in demand for goods and services needed to produce CCAM in passenger transport and the increase in demand for passenger transport in general. This increase is likely to offset any decline in employment caused by the deployment of the technology, as can be seen in the sectoral breakdown of employment in Figure 11. In comparison, the medium uptake scenario leads to a decline of around 9 thousand workers in 2050 compared to the baseline. In this case, the impact of employment demand in other sectors seems to be balanced out by employment losses in occupations associated with road passenger transport (e.g., drivers and mobile plant operators), as can be seen in Figure 12.

EU employment gains in the high CCAM uptake scenario for early-adopter Member States account for 42 thousand out of the 165 thousand additional employees compared to the baseline in 2050. In the medium CCAM uptake scenario, employment in early-adopter Member States remains close to the baseline levels throughout the forecast period.

For mid-adopter Member States and high CCAM uptake scenario, 51 thousand additional workers are expected in 2050. However, in the medium CCAM uptake scenario, mid-adopter Member States are expected to see fewer workers in 2050 than in the baseline given the indirect and induced effects of employment decline in land transport related to CCAM uptake.

Late-adopter Member States are expected to benefit from high CCAM adoption with 72 thousand workers above the baseline by 2050 and lose around 8 thousand workers compared the baseline, for medium uptake. These dynamics are explained by the indirect and induced effects which tend to be higher than the job replacement of drivers if the CCAM uptake is high enough to generate decline in prices and thus increase in demand for road passenger transport.

Figure 10: Employment by country groups and road passenger scenarios, 2040 and 2050



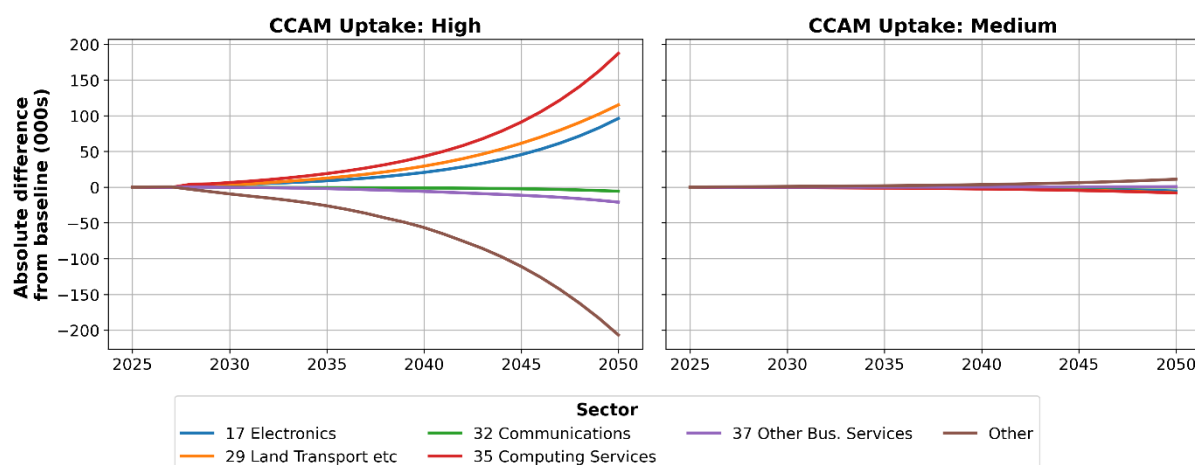
Note: Low uptake is the baseline scenario in this use case.

Source: Cambridge Econometrics' E3ME model.

5.2 Employment by sector

For the road passenger transport, employment changes compared to the baseline are concentrated in a few sectors, namely the Electronics, Land Transport, Communications, Computing Services, and Other Business Services sectors. These sectors correspond to the supply chain of CCAM presented in Deliverable 4.1 (Arsénio et al., 2025b).

Figure 11: EU-27 employment by sectors and road passenger scenarios, 2025-2050



Note: Low uptake is the baseline scenario in this use case.
 Source: Cambridge Econometrics’ E3ME model.

In the high CCAM uptake scenario, EU employment gains compared to the baseline are largely concentrated in the Computing services sector, up to 187 thousand additional workers compared to the baseline in 2050, a sector which benefits from the indirect effects of investment in CCAM. The Land transport sector, i.e. the main beneficiary of direct investments in CCAM, is expected to gain an additional 115 thousand workers compared to the baseline in 2050, while the Electronics sector is expected to gain 96 thousand additional workers from indirect effects of CCAM uptake. The increase in employment in these three sectors is indicative of the increase in demand from the road passenger sector that generates indirect effects, but also of induced effects in the economy from increase in employment. In contrast, the communications and other business services sectors are expected not to benefit much compared to the baseline. All the other sectors are expected to see a decline in employment driven by a reduction in demand from households for government goods since the CCAM investment in public transport is paid through higher transport price. The indirect and induced effects of higher prices for public transport leads to further decline in the sectors that benefited from lower prices in the baseline.

In early-adopter Member States and the high CCAM uptake scenario, additional employment compared to the baseline is expected in two sectors that benefit from the indirect effects of investment in road passenger transport: Computing services sector with 83 thousand additional workers and the Electronics sector with around 36 thousand additional workers in 2050. The Land transport sector is expected to benefit with 29 thousand additional workers mainly through indirect and induced effects of CCAM adoption in road passenger transport.

In the high CCAM uptake scenario, mid-adopter Member States account for 45 out of the 187 thousand additional workers to the baseline in the Computing services sector in 2050. Similarly, this group of Member States accounts for 47 out of the 115 thousand additional workers to baseline observed in the Land transport sector, and 19 out of 96 thousand additional workers to baseline in the Electronics sector in 2050. While the first sectoral effect can be linked to direct investments and demand of computer services for CCAM uptake, the latter two are the net effect of direct, indirect and induced effects based on the assumptions used in the high CCAM uptake scenario.

In the high CCAM uptake scenario, late-adopter Member States are expected to also benefit with additional employment in Computing services, Land transport and Electronics sectors, with 59, 39 and 42 thousand workers, respectively, in 2050 compared to the baseline. In this scenario, the sectoral impacts in the three groups of countries can also be generated through both internal and intra-EU trade effects of the supply chain of CCAM.

In the medium CCAM uptake scenario, the Land transport, Computing services and Electronics sector sectors are expected to experience a decline in employment compared to the baseline in 2050, by 7.8, 8.1 and 5.4 thousand fewer workers, respectively. Compared to the high CCAM uptake, this scenario differs from the baseline only in the uptake rates of public transport. Therefore, also the indirect and induced effects CCAM uptake on overall employment compared to the baseline is much lower than in the baseline. The subsequent higher price for public transport services is expected to offset the benefits generated by indirect employment from CCAM investment in public transport vehicles.

In the medium CCAM uptake scenario, early-adopter and mid-adopter Member States see small changes in sectoral employment compared to the baseline. Late-adopter Member States are expected to have the most variation in sectoral employment in this scenario. The Land transport, Computing services and Electronics sector sectors are expected to reach 6, 6 and 4 thousand fewer workers, respectively, by 2050 for this Member States' group. Because direct and indirect impacts are minimal in the main sectors, the rest of the economy is unlikely to see substantial indirect or induced effects.

A full breakdown of the absolute changes in sectoral employment from the baseline for each CCAM uptake scenario and country adopter group is included in the Annex.

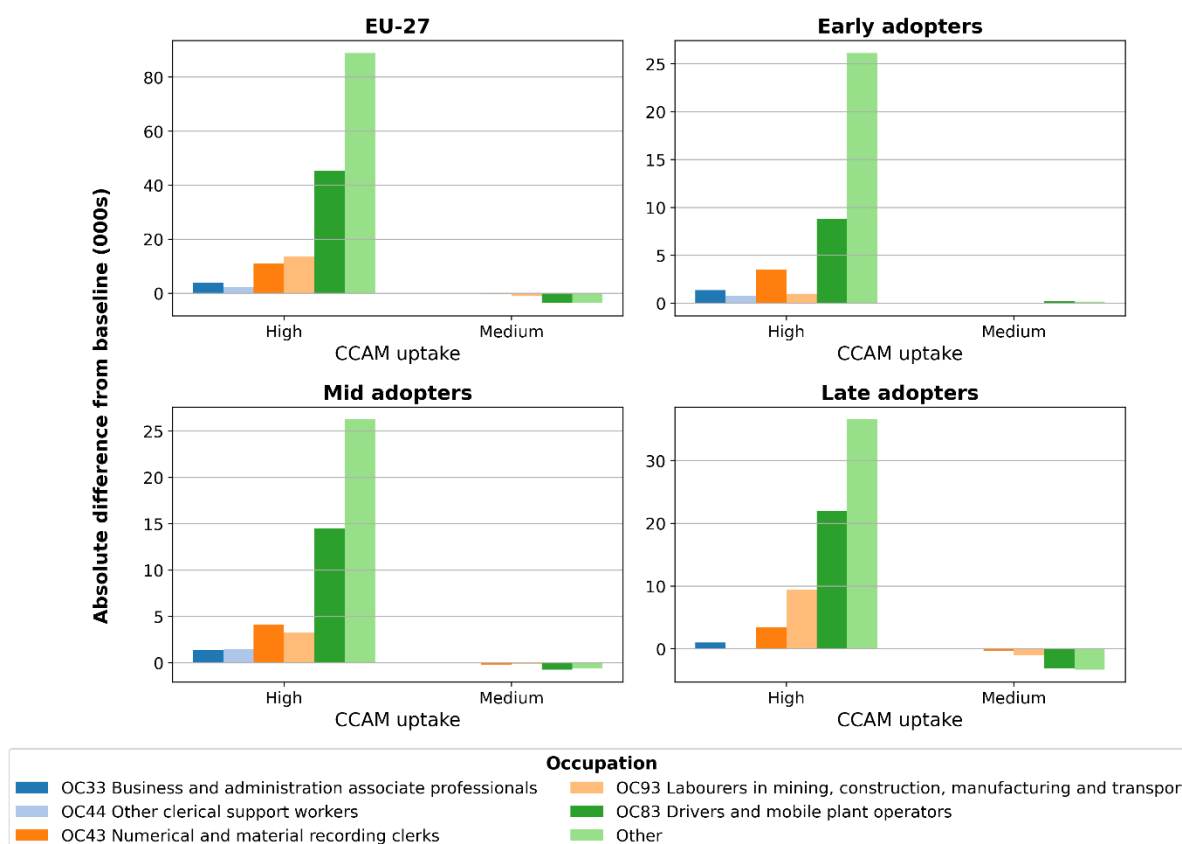
5.3 Employment by occupation

The five occupation groups representing at least 70% of employment in the land transport sector in 2025 include: Labourers in mining, construction, manufacturing and transport; Drivers and mobile plant operators; Other clerical support workers; Numerical and material recording clerks; and Business and administration associate professionals⁵.

In the high CCAM uptake scenario of road passenger transport, these five occupations account for a net positive difference from the EU employment baseline of around 80 thousand by 2050. Most of the employment difference from the baseline is concentrated in Drivers and mobile plant operators, which account for 45 thousand additional workers compared to the baseline in 2050 (upper left panel of Figure 12) and it is driven by the employment changes in land transport mentioned in the previous section. On the other hand, Information and communications technology professionals and technicians are expected to increase by 74 and 26 thousand workers, respectively, compared to the baseline in 2050, driven by the increase in employment in Computer services. All other occupations are expected to experience positive impacts resulting from direct, indirect, and induced effects, consistent with sectoral employment trends and the occupational distribution within those sectors.

⁵ These occupations were chosen based on their occupational distribution of economic sectors within the Eurostat Labour Force Survey for the year 2024. This report uses the International Standard Classification of Occupations (ISCO) from 2008. For a detailed description on what these occupations do, please check: https://esco.ec.europa.eu/en/classification/occupation_main

Figure 12: Employment by occupations, country adopter group and road passenger scenarios, 2050



Source: Cambridge Econometrics’ E3ME model.

In high CCAM uptake scenario and early-adopter Member States, Drivers and mobile plant operators are expected 9 thousand additional workers compared to the baseline, while Numerical and material recording clerks see a smaller increase of 4 thousand compared to the baseline in 2050. In the other occupations, Information and communications technology professionals are expected to increase in employment compared to the baseline, reaching 34 thousand extra workers in 2050, in line with the increase in the demand for Computer services sector.

For mid-adopter Member States, Drivers and mobile plant operators are expected to see an increase by around 15 thousand by 2050, compared to the baseline. In the other occupations, Information and communications technology professionals are also expected to increase proportional with the increase in the demand for Computer services sector in the country group.

Late-adopter Member States collectively are expected to have the largest increase in Drivers and mobile plant operators, amounting to 22 thousand additional workers to the baseline by 2050. This is expected based on the high employment number of workers in this occupation, compared with other country groups. Information and communications technology professionals are expected to reach 26 thousand additional workers in 2050 based on the demand for Computer services sector in the high CCAM uptake scenario in late-adopter Member States.

In the medium CCAM uptake scenario, a decline in Drivers and mobile plant operators over the forecast period is expected, with 4 thousand fewer workers than in the baseline by 2050. In all

other occupations, a decline compared to the baseline is expected by 2050 (see Figure 12) based on the occupational structure of the sectors affected by the CCAM uptake in road passenger transport.

Figure 12 shows that the occupational distribution follows the pattern from sectoral employment, where mid-adopter Member States seem to concentrate less of the absolute employment changes expected from the baseline than early or late adopters.

6 Conclusions

The objective of the analysis presented in this deliverable is to estimate the socio-economic impact of CCAM adoption within the EU. The focus is on the employment by sector and occupation, but estimates of GDP impact are also included.

The methodology used in the deliverable is scenario analysis of future CCAM deployment using the Cambridge Econometrics' E3ME model. The scenarios, covering the period from 2025 to 2050, account for uncertainties in technology deployment, investment costs, and policy development. Estimates were carried out across the full range of scenarios. The baseline scenario assumes low/medium CCAM uptake and is the main scenario used to explore the economic impacts. The high and low/Medium scenarios provide an indication of the economic impacts under alternative CCAM uptake scenarios. All results are presented as difference from the baseline scenario, providing a snapshot in selected years.

The **deployment of CCAM exclusively in warehousing** is expected to have a net negative impact on employment, unless barriers or delays significantly slow the anticipated uptake of the technology. Our results are based on three different CCAM uptake rates by 2050 and indicate that a slower uptake of CCAM (i.e. 60% by 2050) in this sector would be beneficial for employment.

The employment effects are projected to be concentrated in the transport sector, which includes warehousing activities, and particularly among drivers and mobile plant operators, reflecting the expected reduction in human-operated roles within warehouse environments. In the high CCAM uptake scenario, 934 thousand of the 991 thousand additional employment loss compared with the baseline occur in this sector. Similarly, in the low uptake scenario, 361 thousand of the 377 thousand additional employment gains by 2050 are concentrated in transport sector.

Among adopter groups, Member States that deploy the CCAM sooner stand to lose the most workers, with the late adopters being second in employment losses given their high relative share of impacted sectors within total employment. This means that both employment share of impacted sectors and the timeline of the deployment have a role to play in the socio-economic impact of CCAM uptake in warehousing.

Based on the scenarios' results, the **deployment of CCAM in road freight** is expected to have limited impacts on employment and GDP. As in the case of warehousing, the impacts of employment losses on disposable income outweighs the benefits of new investments in technology have on the GDP. Employment changes are concentrated in the *land transport* sector and the *drivers and mobile plant operators* occupation. The E3ME mode does not take into account the existing labour shortages identified at EU level, especially for long-haul drivers.

In both CCAM uptake scenarios (high and medium), the employment losses compared to the baseline are concentrated in the early-adopter Member States, indicating that faster adoption of the technology will bring larger employment regardless of the share of the workforce affected by technology. Moreover, the employment losses in the transport sector exceed those of the total economy, compared to the baseline. In the high CCAM uptake scenario, 91 thousand job losses in the land transport (including warehousing) are expected compared with the baseline in 2050. Similarly, in the medium CCAM uptake scenario, 70 thousand job losses compared to the baseline are concentrated in land transport (including warehousing) by 2050.

The **deployment of CCAM in road passenger transport** is expected to lead to varying gains in employment depending on the penetration of the technology. Higher levels of uptake are associated with increases in employment, whereas lower levels see small employment declines. This counterintuitive result is driven mainly by the assumption that CCAM is taken up exclusively in economic activities associated with road passenger transport. The CCAM uptake thus has two separate effects. First, there is a positive effect associated with the increased investment in the sector and increased demand for input goods to manufacture the technology. Second, there is a negative employment effect associated with the deployment of CCAM causes, most notably on driving occupations. In the medium CCAM uptake scenario, these employment effects offset any positive effects. However, in the high CCAM uptake scenario, the investment and demand effects along the supply chain are much more important, with the employment impact remaining relatively limited to the overall low uptake of the technology in absolute terms (see Table 1), leading to a net increase in overall employment being observed. It is worth highlighting here the increasing role of certain occupations tied to the information, communication and technology (ICT) sector.

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Annex

Table 5: *Employment by scenario and country adopter group, absolute employment difference from the baseline, 2050*

Scenario	Country Group	CCAM uptake	00 Total	1 Agriculture etc	2 Coal	3 Oil & Gas etc	4 Other Mining	5 Food, Drink & Tob.	6 Text., Cloth. & Leath	7 Wood & Paper	8 Printing & Publishing	9 Manuf. Fuels	10 Pharmaceuticals	11 Chemicals nes
Freight	Early	High	-37.6	0.0	0.0	0.0	0.0	0.2	-0.1	0.0	0.0	0.0	-0.1	0.0
Freight	Early	Medium	-31.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	0.0
Freight	Mid	High	-24.6	0.1	0.0	0.0	0.0	0.1	-0.4	-0.1	-0.1	0.3	0.0	0.0

Deliverable 4.4

Freight	Mid	Medium	-11.6	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	0.0	0.1	0.0	0.0
Freight	Late	High	-26.9	0.3	0.0	0.0	0.0	0.4	0.2	0.0	0.1	0.0	0.1	0.0
Freight	Late	Medium	-22.5	0.3	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0
Passenger	Early	High	41.5	-2.9	0.0	0.0	0.1	1.3	1.0	0.9	-0.1	0.0	0.0	0.7
Passenger	Early	Medium	0.4	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0
Passenger	Mid	High	51.0	-3.3	0.0	0.0	-0.3	-2.7	0.2	-1.7	-1.3	0.2	0.7	1.1
Passenger	Mid	Medium	-1.7	0.2	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0
Passenger	Late	High	72.3	-2.0	0.0	0.0	0.0	-6.2	-3.7	0.8	-2.6	0.0	-1.1	-0.2
Passenger	Late	Medium	-7.9	0.2	0.0	0.0	0.0	0.5	0.2	0.0	0.1	0.0	0.1	0.0
Warehousing	Early	High	-497.2	1.0	0.0	0.0	0.0	-0.6	-0.5	-0.9	-0.1	0.0	-0.3	-0.1
Warehousing	Early	Low	164.7	-0.4	0.0	0.0	0.0	0.3	0.2	0.3	0.1	0.0	0.1	0.1
Warehousing	Mid	High	-182.3	-1.4	0.0	0.0	0.0	-1.0	-0.3	-0.4	-0.3	0.0	-0.1	-0.5
Warehousing	Mid	Low	71.0	0.5	0.0	0.0	0.0	0.3	0.1	0.0	0.1	0.0	0.0	0.2
Warehousing	Late	High	-311.6	1.9	0.0	0.0	0.0	0.5	0.0	0.8	0.5	0.0	0.6	-0.1
Warehousing	Late	Low	141.6	-0.9	0.0	0.0	0.0	0.1	0.0	-0.4	-0.2	0.0	-0.2	0.0

Source: Cambridge Econometrics' E3ME model.

Scenario	Country Group	CCAM uptake	00 Total	12 Rubber & Plastics	13 Non-Met. Min. Prods.	14 Basic Metals	15 Metal Goods	16 Mech. Engineering	17 Electronics	18 Elec. Eng. & Instrum.	19 Motor Vehicles	20 Oth. Transp. Equip.	21 Manuf. nes	22 Electricity
Freight	Early	High	-37.6	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	0.1	0.0	0.0	0.1	-0.2
Freight	Early	Medium	-31.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.2	0.1	0.0	0.1	-0.1
Freight	Mid	High	-24.6	0.0	0.2	0.0	0.3	0.1	0.0	0.0	-0.1	0.3	-0.2	-0.1
Freight	Mid	Medium	-11.6	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.2	0.0	0.0
Freight	Late	High	-26.9	0.1	0.0	0.0	0.1	0.0	0.1	0.0	-0.2	0.2	0.9	-0.1
Freight	Late	Medium	-22.5	0.1	0.0	0.0	0.0	0.2	0.7	0.1	-0.1	0.1	0.4	0.0
Passenger	Early	High	41.5	-0.2	0.3	1.9	0.0	8.3	35.5	3.2	0.1	0.6	4.7	0.4
Passenger	Early	Medium	0.4	0.0	0.0	-0.1	0.0	-0.1	-0.2	-0.1	-0.1	0.0	-0.2	0.0
Passenger	Mid	High	51.0	-1.5	-1.6	0.1	-0.4	-0.7	18.9	2.2	0.1	-2.8	-2.2	-0.1
Passenger	Mid	Medium	-1.7	0.1	0.1	0.0	0.1	0.0	-0.8	-0.1	0.0	0.2	0.2	0.0
Passenger	Late	High	72.3	0.8	0.0	1.3	-1.7	1.9	41.7	7.8	2.1	-1.6	-5.8	0.0
Passenger	Late	Medium	-7.9	0.0	0.1	0.0	0.2	-0.1	-4.4	-0.4	-0.1	0.2	0.8	0.0
Warehousing	Early	High	-497.2	0.0	-0.6	-0.4	0.5	-1.9	-0.5	1.2	-0.5	-0.3	-1.5	-0.1
Warehousing	Early	Low	164.7	0.0	0.1	0.0	-0.2	0.5	0.2	-0.5	0.1	0.2	0.5	0.0
Warehousing	Mid	High	-182.3	0.3	0.1	0.0	1.1	1.2	-0.3	0.9	0.0	0.1	-0.7	-0.1
Warehousing	Mid	Low	71.0	-0.1	0.0	0.0	-0.2	-0.4	0.1	-0.3	0.0	0.0	0.2	0.0
Warehousing	Late	High	-311.6	0.0	0.3	-0.4	1.0	2.6	0.5	0.4	-1.3	-0.2	2.6	0.0
Warehousing	Late	Low	141.6	0.0	-0.2	0.2	-0.3	-1.2	-0.3	-0.2	0.5	-0.1	-1.1	0.0

Source: Cambridge Econometrics' E3ME model.

Scenario	Country Group	CCAM uptake	00 Total	23 Gas Supply	24 Water Supply	25 Construction	26 Distribution	27 Retailing	28 Hotels & Catering	29 Land Transport etc	30 Water Transport	31 Air Transport	32 Communications	33 Banking & Finance
Freight	Early	High	-37.6	-0.6	0.0	0.0	-1.5	0.4	0.6	-36.7	0.0	0.1	-0.4	0.2
Freight	Early	Medium	-31.0	-0.3	0.0	0.1	-0.9	0.0	0.3	-30.7	0.0	0.0	-0.1	0.2
Freight	Mid	High	-24.6	0.2	0.0	-0.4	-0.1	-0.2	0.3	-25.1	0.2	0.0	-0.2	0.0
Freight	Mid	Medium	-11.6	0.1	0.0	0.0	0.0	0.2	0.2	-12.8	0.1	0.0	-0.2	0.1
Freight	Late	High	-26.9	-0.1	0.0	-0.5	-0.7	-0.5	0.4	-28.0	0.1	0.0	0.3	0.2
Freight	Late	Medium	-22.5	-0.1	0.0	-0.1	-0.8	-0.3	0.3	-25.1	0.1	0.0	0.1	0.1
Passenger	Early	High	41.5	-0.2	0.0	-2.9	-5.0	-	-	29.0	0.0	-0.5	-3.2	-2.3
								20.2	21.4					
Passenger	Early	Medium	0.4	0.0	0.0	0.1	-0.2	0.3	0.2	0.5	0.0	0.0	0.0	0.0
Passenger	Mid	High	51.0	0.6	0.0	-2.5	-2.9	-8.3	-2.5	47.1	-0.2	-0.1	-1.2	-1.3
Passenger	Mid	Medium	-1.7	0.0	0.0	0.2	0.1	0.4	0.1	-2.5	0.0	0.0	0.1	0.1
Passenger	Late	High	72.3	0.1	0.0	2.7	25.1	-	-	39.1	-0.5	-0.9	-1.3	-4.3
								14.3	24.9					
Passenger	Late	Medium	-7.9	0.0	0.0	0.1	-1.5	1.3	1.9	-5.9	0.1	0.1	0.1	0.4
Warehousing	Early	High	-497.2	-0.1	0.0	0.7	-8.8	-4.4	-1.9	-	-0.5	0.0	-2.4	1.9
										456.1				
Warehousing	Early	Low	164.7	0.1	0.0	-0.3	2.9	1.1	0.5	153.0	0.2	0.0	0.2	-0.7
Warehousing	Mid	High	-182.3	-0.2	0.0	-1.3	-0.2	-3.1	-0.6	-	0.8	-0.1	-0.4	0.1
										175.2				
Warehousing	Mid	Low	71.0	0.1	0.0	0.5	0.1	1.1	0.2	68.1	-0.3	0.0	0.3	0.0
Warehousing	Late	High	-311.6	0.1	0.0	-3.7	-	-5.6	-4.0	-	-0.1	0.7	-0.3	1.1
							21.8			301.0				
Warehousing	Late	Low	141.6	0.0	0.0	1.6	7.5	2.5	2.3	139.7	0.0	-0.4	0.2	-0.4

Source: Cambridge Econometrics' E3ME model.

Scenario	Country Group	CCAM uptake	00 Total	34 Insurance	35 Computing Services	36 Prof. Services	37 Other Bus. Services	38 Public Admin. & Def.	39 Education	40 Health & Social Work	41 Misc. Services	42 Unallocated	43 Forestry	44 Hydrogen Supply
Freight	Early	High	-37.6	0.0	0.6	-0.6	0.0	0.2	0.1	0.2	0.4	0.0	0.1	0.0
Freight	Early	Medium	-31.0	0.0	-0.1	0.1	-0.2	0.0	0.0	0.0	0.2	0.0	0.1	0.0
Freight	Mid	High	-24.6	0.0	-0.8	0.5	0.3	0.0	0.0	0.1	0.2	0.0	0.0	0.0
Freight	Mid	Medium	-11.6	0.0	-0.1	0.5	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Freight	Late	High	-26.9	0.0	0.4	-0.4	-1.2	0.0	0.2	0.4	0.6	0.0	0.1	0.0
Freight	Late	Medium	-22.5	0.0	0.0	0.5	0.0	0.0	0.0	0.1	0.6	0.0	0.1	0.0
Passenger	Early	High	41.5	-2.8	83.3	-	-	-3.8	-4.5	-	-8.8	0.0	-0.4	0.0
						10.3	14.4			26.0				
Passenger	Early	Medium	0.4	0.0	-0.1	0.1	0.1	0.1	0.1	0.4	0.0	0.0	0.0	0.0
Passenger	Mid	High	51.0	-0.7	44.7	-5.4	-4.9	-0.6	-3.2	-6.2	-5.8	0.0	-0.4	0.0

Deliverable 4.4

Passenger	Mid	Medium	-1.7	0.0	-2.0	0.4	0.3	0.0	0.2	0.3	0.3	0.0	0.0	0.0
Passenger	Late	High	72.3	0.0	59.1	-1.3	-1.6	-2.1	-7.1	-	-9.7	0.0	-0.4	0.0
										16.8				
Passenger	Late	Medium	-7.9	0.0	-6.0	0.5	0.4	0.2	0.5	1.3	1.1	0.0	0.0	0.0
Warehousing	Early	High	-497.2	-0.1	-2.6	-3.0	-0.1	-1.4	-1.0	-5.1	-6.7	0.0	0.4	0.0
Warehousing	Early	Low	164.7	0.0	0.7	0.6	0.8	0.4	0.3	1.3	2.1	0.0	-0.1	0.0
Warehousing	Mid	High	-182.3	-0.3	-0.7	3.3	-0.6	-0.4	-1.0	-2.9	1.6	0.0	0.1	0.0
Warehousing	Mid	Low	71.0	0.1	0.3	-1.5	0.6	0.2	0.4	1.1	-0.6	0.0	0.0	0.0
Warehousing	Late	High	-311.6	-0.2	1.1	5.6	3.1	-0.4	-0.5	-2.5	6.1	0.0	1.0	0.0
Warehousing	Late	Low	141.6	0.1	-0.6	-3.2	-2.0	0.2	0.4	1.4	-2.9	0.0	-0.5	0.0

Source: Cambridge Econometrics' E3ME model.