# RED3, FuelEU, RefuelEU

## Deep Dive into 2030 Consumption Perspectives

*V1 - November 2023*



SQUARECO

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## About SQUARECO

Based on the Leman Lake shores in Switzerland, SquareCo develops market intelligence solutions designed to help players active in renewable fuels markets to gain a deeper understanding of regulatory frameworks, market dynamics and industry developments.

SquareCo delivers high-quality expertise through the publication of articles, market reports and thematic studies displayed on our Web Platform. Our strong emphasis on data monitoring allows us to supply our clients with access to a comprehensively organized database.

We help energy suppliers to the road, maritime and aviation sectors to navigate serenely the complexity of regulations applying to low carbon fuels markets. Relying on 15 years of experience and an extensive network of contacts at ministries and companies around the world, we keep our clients constantly updated about the current and coming rules.

# Summary

# RED3, Fuel EU, Refuel EU

Deep Dive into 2030 Consumption Perspectives

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# 1. Introduction - objectives of the study

Since the EU institutions reached political agreements on RED3, FuelEU, and RefuelEU, SquareCo has focused on analyzing the texts, extensively consulting experts to clarify their meaning. We reviewed the scientific literature on 2025-2050 energy forecasts and cross-checked with our regulatory experts to understand their main implications.

A few weeks after the Council and the European Parliament had voted on the texts, this study analyzes the implications of the EU legislators' decisions. It explains how the three texts imbricate together to promote renewable in transport, and how it will impact the energy use in the four main transport sectors: road, rail, maritime, and aviation.

Before MS start their transposition/implementation work, which will ultimately determine the quantity of renewable fuels that will be required in 2030, we stick to a macro approach, ignoring the split per country. We focused on comprehending the energy mix in EU transport in 2030, when all the required objectives and constraints would be met. At this stage, our objective is to understand the mechanism of the three regulatory frameworks and their implications, rather than forecast the future. Rules applied at a national level (multiple-count, caps, eligible products, pooling rules, etc.) and those obligating MS under RED3 by 2030, are two different realities. This study focused on the latter, sticking to EU-wide rules.

The core ambition of the study is to modelize the low carbon fuel demand required to meet the new EU 2030 requirements, assuming a "perfect" compliance of all EU members. Before the transposition/implementation work starts at MS, we examined all challenges to answer burning "how much" questions: how much biomass-based renewable fuels are required under RED3? How much RFNBOs is the 1% e.c sub-target? How much Sustainable Aviation Fuel (SAF) is required under RefuelEU? How much 9A and 9B biofuels will be required overall? And so on.

We demonstrate that the implications of the RED3 enactment are massive. They will double the transport target (14 to 29%) and extend the scope to all transport sectors simultaneously, with major repercussions on the low-carbon fuels market. Since EU legislators require maritime and aviation sectors to cover 6% GHG reduction and 6% volume by 2030, they implicitly burden more mature sectors (road and rail) to compensate for this significant gap in the RED3 perspective. Moreover, extending the scope to a broader energy pool significantly impacts the size of the crop/9B caps and advanced/RFNBOs sub-targets.

The electrification of the road sector will shape the path to 2030. We looked at the various scenarios and picked two different ones that allowed us to highlight the potential impacts of this process on the demand of liquid renewable fuels by 2030.

This is the first version of a study that will be updated every year to include MS transposition plans and results recorded. This series of studies will serve as a compass for RED3 transposition and Fuel/Refuel EU implementation.



# 2. Modeling energy demand in 2030

The study's first objective was to model the total energy demand for each transport sector for 2022-2030, independently from their specific mix (fossil/renewable).

## 2.1 General Methodology

### 2.1.1 Scan of the scientific literature available

We fully scanned publicly available studies to forecast energy in the EU-27 transport for the coming decades. The IEA World Energy Outlook 2022 was the most complete and interesting to base our thinking on.

[redacted]

[redacted]

We also extensively analyzed various IEA databases, as mentioned below.

<u>Other studies</u>

We based our modeling of the energy used in each transport sector on several other studies. Some were used for general considerations, while others were more specific to transport sectors or technologies' potential.

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### 2.1.2 Limits of IEA data

Our cross-check of three different IEA datasets highlighted some incoherencies, as explained below.

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[redacted]

[redacted]

### 2.1.3 SquareCo assumptions for 2022-2030

We made important choices to balance inconsistencies in the studies we analyzed, ignoring extremely optimistic assertions or estimations not in line with other sources, including figures from national agencies that we monitor constantly.

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## 2.2 Road sector

The road sector is the most challenging one to forecast because it is the only transport sub-sector that will see its energy demand decrease by 2030 compared to 2022. IEA figures incoherency (see above) and the importance of electrification scenarios are two challenges to address in this regard.

We built two case scenarios that adjusted IEA inconsistencies, and implied various electrification paces and the evolution of other drivers. The first one is more optimistic than IEA's in regards to EV sales market shares in the coming year, resulting in a greater EV stock share by 2030. The second one is based on IEA APS scenario.

### 2.2.1 Electrification pace

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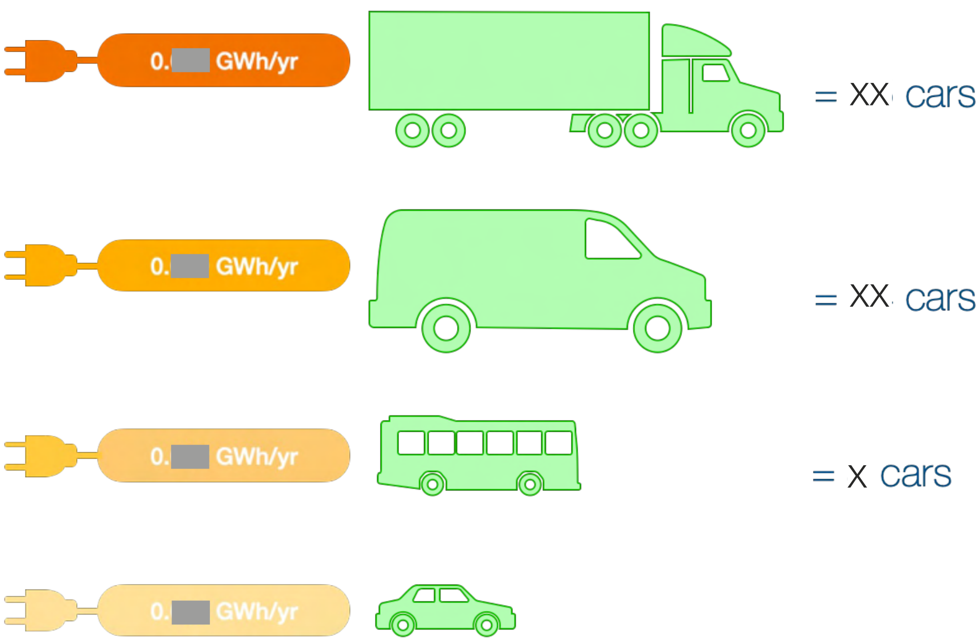



Chart 1: Annual electricity demand by EV type (GWh)

[redacted]

The following chart shows a model based on IEA's study "the Global EV Outlook", which data comes from IEA's dataset "Global EV Data Explorer". Green points are given points  calculated from the study. The red line goes through each given points, representing the relationship between the EV stock share and the electricity share of the road sector.


Chart 2: Relationship between EV share and electricity share

This model served to understand the evolution of the electricity demand in relation to the evolution of the EV stock and then to calculate the impact of electrification on the final road sector's final energy demand.

[redacted]

Using data provided by IEA, we calculated there would be a **XX**-million EV stock in 2030 under STEPS, and a **XX**-million EV stock under APS, each representing **XX.X**% and **XX.X**% of the total passenger vehicle pool, respectively. Since the difference is as low as **X.X**%, we conclude that IEA did not really establish an accelerated case for the vehicle electrification, and the announced policy may not have a significant impact on the current electrification trend.

Low electrification scenario

We referred to the EV estimation under APS of IEA's study "Global EV Outlook" as our low electrification scenario. This study made the stock estimation of each EV (incl. Plug-In-Hybrid (PHEV)) type in 2025 and in 2030 in Europe. We have adjusted IEA's EV stock to the EU-27 by multiplying with a share that we calculated for 2021: **XX**% for EV car, **XX**% for EV bus, **XX**% for EV van, and **XX**% for EV truck (this latter assumption may be too low but the impact on the final result is very limited).

The case is called "low electrification", but it refers mostly to a normal situation where the EV stock would increase steadily with the current trend. The case suggested that the EV sales share would increase from **XX**% in 2022 to **XX**% in 2030, which means that on average **XX**% more EVs would be sold each year than in the previous year. In this case, the share of EVs in 2030 was estimated at **XX.X**%. The following table gives the estimated EV stock:

Table 1: EU-27 estimated EV stock under Low Elec (units)

| | EV cars | EV vans | EV Buses | EV Trucks | Total EV stock | Electricity demand (GWh) | Electricity demand (EJ) |
|---|---|---|---|---|---|---|---|
| 2022 | X XXX XXX | XXX XXX | XX XXX | X XXX | X XXX XXX | XX XXX | X.XX |
| 2025 | XX XXX XXX | XXX XXX | XX XXX | XX XXX | XX XXX XXX | XX XXX | X.XX |
| 2030 | XX XXX XXX | X XXX XXX | XXX XXX | XXX XXX | XX XXX XXX | XXX XXX | X.XX |

Our model simulated a result that the energy demand of the road sector in 2030 would be decreased to **XX** EJ, which is **X**% lower than in 2021. The electricity share in 2030 is estimated at **X.X** %, meaning the electrification speed would be **XX** % from 2021 to 2030.

High electrification scenario

We referred to cross-checks between scientific studies and expert opinions to build a case for the possibility of faster electrification of the EU car fleet. In this high electrification scenario, the share of EV stock was increased to **XX** % in 2030, or **X** % higher than in the low electrification case.

The following table shows the estimated EV stock in 2022, 2025, and 2030.

| Table 2: EU-27 estimated EV stock under High Elec (units) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | EV cars | EV vans | EV Buses | EV Trucks | Total EV stock | Electricity demand (GWh) | Electricity demand (EJ) |
| 2022 | X XXX XXX | XXX XXX | XX XXX | X XXX | X XXX XXX | XX XXX | X.XX |
| 2025 | XX XXX XXX | XXX XXX | XX XXX | XX XXX | XX XXX XXX | XX XXX | X.XX |
| 2030 | XX XXX XXX | X XXX XXX | XXX XXX | XXX XXX | XX XXX XXX | XXX XXX | X.XX |

When the EV stock is estimated at **XX** % in 2030, our regression model simulated that the total energy demand of the road sector should be decreased to **X.X** EJ, which is **XX** % lower compared to 2021 and **X** % lower compared to the result of low electrification case. The electricity share in 2030 is calculated at **X.X** %, and the speed of the electrification from 2021 to 2030 is calculated at **XX** %.

We also estimated that the share of EV sales under the high electrification scenario could be up to **XX** % by 2030, and in 2025 it was estimated at **XX** %. This means that the acceleration will mostly happen from 2025, which makes this scenario different from the low electrification one.

### 2.2.2 Other drivers included in our projections

In the APS scenario built by the IEA, the following drivers are mentioned for the EU-27 transport sector: Average emissions of new cars to reduce emissions by **XX**% from 2030, and by **XX**% from 2035 relative to 2021 levels.

- Alternative Fuels Infrastructure Regulation to accelerate the vehicle recharging infrastructure deployment.
- Revision of the Clean Vehicles Directive, including minimum requirements for aggregate public procurement for zero emissions urban buses.

Other drivers including low emissions areas in big cities, inter-modality impact (transfer from car to train/bike), and transfer from road to rail for good transport were not considered.

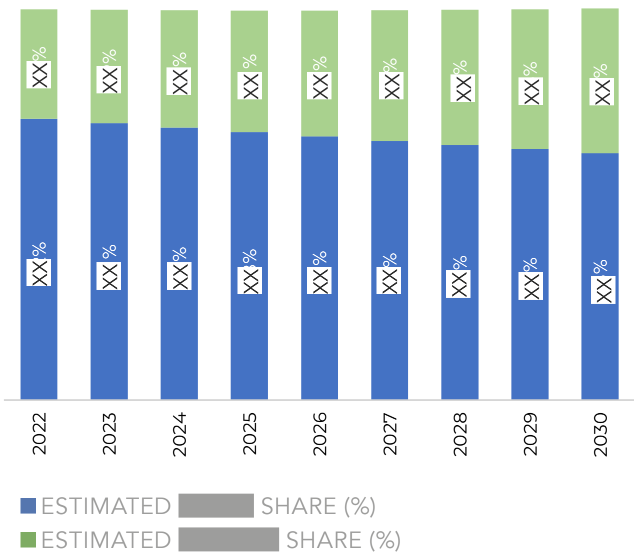
For both scenarios, 2022-2024 figures were retrieved from the Aug-**XX** version of SquareCo forecasts. The total demand for 2025-2029 was calculated by applying a **X.X**% AAGR.

The split within the fossil liquid fuels pool (conventional fuels (diesel+gasoline) LPG and CNG/LNG) was calculated based on the following assumptions:
LPG pool (2024-2030) AAGR of **X.X**%.
CNG/LNG pool (2024-2030) AAGR of **X**%.

- Conventional fuels pool (diesel and gasoline) deducted as Pool - LPG - CNG/LNG – Elec
- Diesel/Gasoline share within conventional fuel pool based on IEA projections (see table)

Table 3: IEA estimation of diesel/gasoline split

| Diesel | Gasoline |
|---|---|
| XX % | XX % |
| XX % | XX % |
| XX % | XX % |
| XX % | XX % |
| XX % | XX % |
| XX % | XX % |
| XX % | XX % |
| XX % | XX % |
| XX % | XX % |



### 2.2.3 Road fuel pool

Table 4: Road pool under Low elec (EJ)

| | Diesel | Gasoline | LPG | CNG/LNG | Elec | Total |
|---|---|---|---|---|---|---|
| 2022 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2023 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2024 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2025 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2026 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2027 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2028 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2029 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2030 | X.XX | X.XX | X.XX | X.XX | X.XX | XX |

Table 5: Road pool under High elec (EJ)

| | Diesel | Gasoline | LPG | CNG/LNG | Elec | Total |
|---|---|---|---|---|---|---|
| 2022 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2023 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2024 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2025 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2026 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2027 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2028 | X.XX | X.XX | X.XX | X.XX | X.XX | XX.XX |
| 2029 | X.XX | X.XX | X.XX | X.XX | X.XX | X.XX |
| 2030 | X.XX | X.XX | X.XX | X.XX | X.XX | X.X |

## 2.3 Rail sector

"The Future of Rail" by IEA and "Transport and Fuel Outlook towards EU 2030 Climate Targets" by Concawe have both given **X.X** Mtoe as the final energy demand by rail sector in Europe in 2030. Knowing that in 2021 the rail energy demand by the EU-27 represented a share of **XX**%, we suppose that this ratio would remain stable until 2030, so we calculated that the final energy demand of the rail sector by the EU-27 in 2030 would be **X.X** Mtoe, which is **X,XX** EJ.

[redacted]

[redacted]

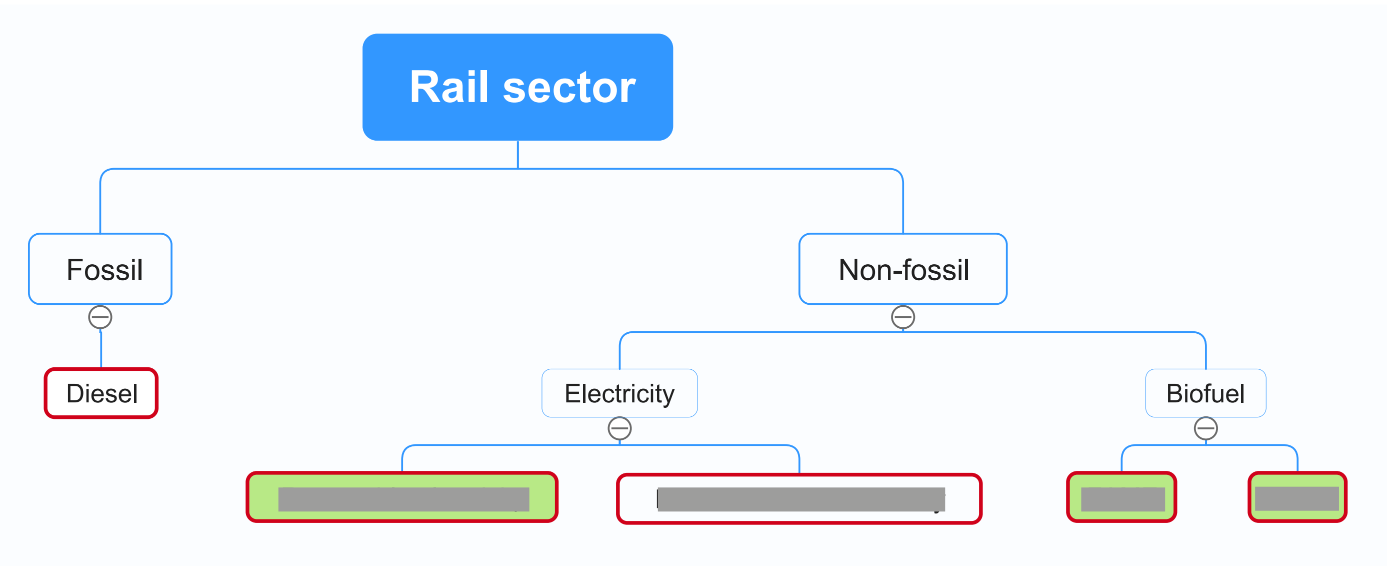



Chart 3: Energy mix of the rail sector

Until 2030, the main changing factor is the electrification ratio, as pointed out in several studies. In the Concawe study, the total energy demand by non-electric fuel was estimated at **X.X** Mtoe in 2030, which represents **XX**% of the total; therefore, the share of electricity is calculated at **XX**%, versus **XX**% in 2021. Supposing that the electricity share and the total energy demand would increase homogeneously with the AAGR from 2021 to 2030, we have obtained the following result:

| Table 6: Electricity demand and total energy demand of rail sector (EJ) | | | |
|---|---|---|---|
| | Electricity pool | Diesel pool | Total demand |
| 2022 | X.XXX | X.XXX | X.XXX |
| 2023 | X.XXX | X.XXX | X.XXX |
| 2024 | X.XXX | X.XXX | X.XXX |
| 2025 | X.XXX | X.XXX | X.XXX |
| 2026 | X.XXX | X.XXX | X.XXX |
| 2027 | X.XXX | X.XXX | X.XXX |
| 2028 | X.XXX | X.XXX | X.XXX |
| 2029 | X.XXX | X.XXX | X.XXX |
| 2030 | X.XXX | X.XXX | X.XXX |

## 2.4 Maritime sector

The current fuels for maritime sector (ships > **X'XXX** gross mt) rely on the following main* pools:

Table 7: Current fuels matrix for the shipping industry

| Fuel oil | Distillates | LNG | Methanol |
|---|---|---|---|
| Heavy Fuel Oil (HFO) | Marine Diesel Oil (MDO)** | | |
| Very Low Sulfur Fuel Oil (VLSFO) | Marine Gas Oil (MGO) | | |
| Ultra Low Sulfur Fuel Oil (ULSFO) | | | |

**A very limited number of vessels also run on LPG; our current model ignores those tiny volumes of energy.*

*** MDO is a mix of heavy fuel oil and MGO.*

According to IEA's 2021 final data, total fuel oil (**XX** million mt) and diesel oil (**XX**.**X** million mt) categories accounted for **XX**.**X**% of the energy supplied to the sector, including domestic and bunkering segments.

The energy transition spurred by voluntary initiatives, FuelEU Maritime, ETS and IMO regulations in the Union will mainly occur within those four segments, including for the RFNBO requirements. Ammonia, hydrogen in fuel cells, and electricity technologies are still developing, without massive impacts anticipated by 2030.

Even though those technologies look promising, from the pragmatic perspective they are immature for now, so too uncertain to predict in the medium-term.

[redacted]

[redacted]

[redacted]

[redacted]

The **XX** survey participants are primarily companies formally affiliated with maritime decarbonization entities, with more ambitious decarbonization goals than their industry peers. This explains why the results of the study look particularly optimistic when it comes to alternative fuels market penetration by 2030, as summarized in the table below.

Table 8: Maersk McKinsey Moller Center study: vision of the 2030 fuels mix in the shipping industry

| Vision about 2030? | Market segment | Average expected mix in 2030 |
|---|---|---|
| Yes XX % | Fuel oil | XX % |
| No XX % | LNG | XX % |
| | Biodiesel | XX % |
| | Biomethanol | X % |
| | Blue ammonia | X % |
| | Biomethane | X % |
| | e-methane | X % |
| | e-ammonia | X % |
| | Others | X % |

[redacted]

[redacted]

From there, we considered an AAGR of **X**% for the overall pool of the EU-27 shipping industry during 2024-2026, and a conservative **X**% for 2027-2030.

[redacted]

Methanol

[redacted]

For all those reasons, we worked with the assumption that the EU-27 methanol pool would not exceed **X** million mt in 2030. With more bunkering capacity becoming a  reality by the end of 2023, notably in Sweden, we bet on a surge to **XX** KT in 2024, followed by a doubling of the outlet in 2025, 2026 and then 2027, before the real take-off would occur in 2028 (**XXX** KT).

LNG

Data recently communicated by DNV suggested the LNG trend is consolidating after record 2021 and 2022 (~**XXX** orders each), despite a slowdown in 1H23. There should be at least **X'XXX** LNG-fueled ships (>**X'XXX** mt) in operation by 2030, with a chance to see the figure closer to the double.

Forecasting LNG use in the coming years is a challenge. Most ordered LNG-fuels will be on a dual mode; they will bunker only partially in the EU-27 and the quality of the current data is poor (IEA does not have a figure yet for it).

[redacted]

[redacted]

Ammonia

[redacted]

[redacted]

Final pool

From above, we calculated the resulting pool for conventional maritime fuels (fuel oils + distillates) as: Total pool – LNG – Methanol. We applied the stable ratio of **XX**% for fuel oils vs total of conventional fuels recorded during 2021-2023 to determine the final pool.

Table 9: Energy mix of the maritime sector in EU-27 projected to 2030, incl. renewables (EJ)

| | Fuel oils | Distillates | LNG | Methanol | Total |
|---|---|---|---|---|---|
| 2022 | X.XXX | X.XXX | X.XXX | X | X.XXX |
| 2023 | X.XXX | X.XXX | X.XXX | X | X.XXX |
| 2024 | X.XXX | X.XXX | X.XXX | X.XXX | X.XXX |
| 2025 | X.XXX | X.XXX | X.XXX | X.XXX | X.XXX |
| 2026 | X.XXX | X.XXX | X.XXX | X.XXX | X.XXX |
| 2027 | X.XXX | X.XXX | X.XXX | X.XXX | X.XXX |
| 2028 | X.XXX | X.XXX | X.XXX | X.XXX | X.XXX |
| 2029 | X.XXX | X.XXX | X.XXX | X.XXX | X.XXX |
| 2030 | X.XXX | X.XXX | X.XXX | X.XX | X.XXX |

## 2.5 Aviation sector

As EU regulations will apply almost exclusively to planes using Jet-A fuel, this is the only type of aviation fuels considered in our model.

[redacted]

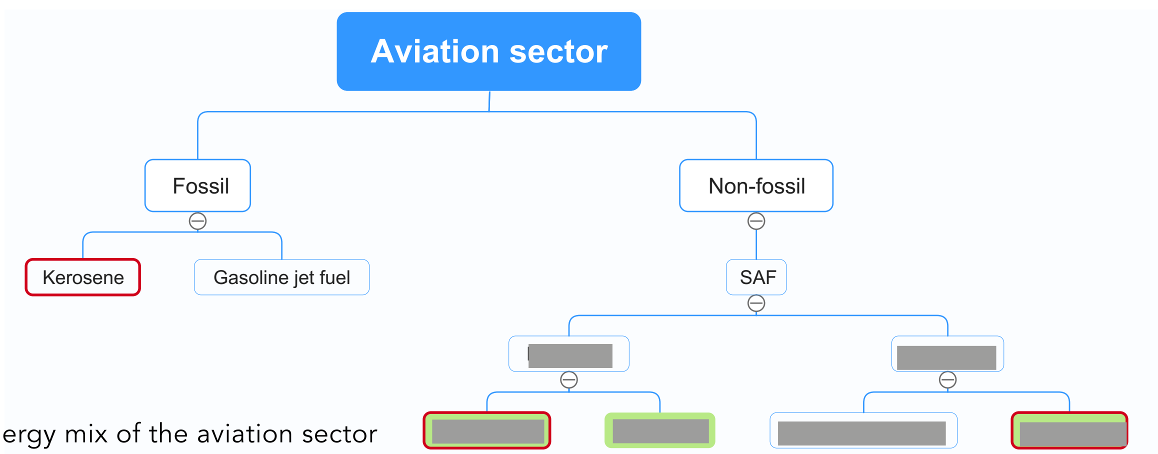



Chart 4: Energy mix of the aviation sector



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[redacted]

| Table 10: Energy mix of the aviation sector in EU-27 projected to 2030, incl. renewables (EJ) | |
|---|---|
| | Total demand (EJ) |
| 2021 | X.XX |
| 2022 | X.XX |
| 2023 | X.XX |
| 2024 | X.XX |
| 2025 | X.XX |
| 2026 | X.XX |
| 2027 | X.XX |
| 2028 | X.XX |
| 2029 | X.XX |
| 2030 | X.XX |

SAMPLE - Not For Use or Distribution

# 3. Regulatory drivers for renewable use in transport

## 3.1 RED3 guidelines

The recast of the RED**X** Directive has been finalized in April. At the time of writing (Sep-**XX**), the final text had yet to be voted on and published in the Official Journal. The latest version voted by the European Parliament on September **XX** contained the following key elements to be imposed on MS in 2030.

29% e.c share of renewable energy within the final consumption of energy in all* transport OR 14.5% GHG intensity reduction by 2030.
Importantly, the RED3 Directive obliges MS only for the 2030 year. From the transposition (2025) to the year before (2029), MS don't have any formal obligation.
The dramatic increase of the target vs RED3 (**XX**% e.c) will not be the sole driver for renewable demand growth; extending the scope to maritime and aviation pools will also have crucial repercussions, as we'll demonstrate in sections **X** and **X** of the study.
Overall renewable shares, advanced sub-targets, crop and 9B caps, which were all previously calculated on the small RED3 scope (road + rail), will be calculated on a significantly higher scope (min. +**XX**% according to our estimates) as a; this implies that the absolute amounts of energy to reach them will be significantly higher than under RED3.
9A + RFNBOs sub-target of **X**.**X**% in 2030, incl. minimum **X**% RFNBOs.
Min. **X**.**X**% e.c RFNBOs in total energy supplied to the maritime sector in 2030.

- RFNBOs used in the production of conventional fuels and biofuels are eligible for the target (when GHG savings are not accounted for in the biofuels GHG intensity).

- Cap food/feed crops at **XXXX** + **X**% e.c, max. **X**% e.c.
- Reduction of the overall target by the gap between actual share vs **X**% e.c, for energy target and GHG savings (**XX**% GHG savings granted in this case to the "not used" food/feed crop share).

Cap of 9B feedstock cap at **X**.**X**% e.c physical; however, **X**/ the EC has the power to increase this threshold before 2030 and **X**/ MS still can increase it if availability is big enough and approved by the EC.

[redacted]

- [redacted]

[redacted]

[redacted]

[redacted]

The RED3 Directive obliges Member States to respect the biding 2030 targets, calculated with the above-mentioned rules. At the time of writing, it was unclear how and when MS would communicate their choice about the transport target (energy or GHG reduction) to the EC.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

## 3.2 Fuel EU

Once again, EU legislators have not favored moderation when establishing the level of complexity for the rules promoting renewable energy in the maritime sector. The basic regulatory features of the regulation, which will apply directly to economic operators, are summarized below.

Table 11: FuelEU main regulatory items

| | Renewable share obligation (GHG reduction) | Baseline (gCO2eq/MJ) | Cap Crop food/feed | RFNBO sub-target |
|---|---|---|---|---|
| 2025 | X % | XX.XX | X % | |
| 2030 | X % | XX.XX | X % | |
| 2031 | X % | XX.XX | X % | X %* |
| 2033 | X % | XX.XX | X % | |
| 2034 | X % | XX.XX | X % | X % |
| 2035 | XX % | XX.XX | X % | |
| 2040 | XX % | XX.XX | X % | |
| 2045 | XX % | XX.XX | X % | |
| 2050 | XX % | XX.XX | X % | |

- GHG reduction obligation imposed on >**X'XXX** mt ships owners only.
- The scope of it is limited to **XXX**% of the energy used intra-EU and **XX**% of the energy used on voyages from/to ports located outside of the EU.
- Crop-based biofuels will not be eligible to generate savings.

[redacted]

[redacted]

[redacted]

[redacted]

Annexes of the regulation provide complex formulas to calculate GHG emissions of fuels used in ships. Our analysis ran all the formulas for each fossil fuel mentioned, resulting in the following default values:

Table 12: Fossil fuels default values calculated and used in our forecast models

| Calculated from FuelEU Annexes | | Used in our forecast models | |
|---|---|---|---|
| Fuel | CI (gCO2eq/MJ) | Fuel | CI (gCO2eq/MJ) |
| HFO | XX.XX | Fuel oils fossil (w. av)* | XX.XX |
| LSFO | XX.XX | | |
| ULSFO | XX.XX | | |
| VLSFO | XX.XX | | |
| LFO | XX.XX | Distillates oils (w. av)** | XX.XX |
| MDO | XX.XX | | |
| LNG otto med | XX.XX | LNG (w. av)*** | XX.XX |
| LNG otto slow | XX.XX | | |
| LNG diesel slow | XX.XX | | |
| HX (NG) | XXX | - | - |

* Calculated based on 2022 bunker sales in Rotterdam: VLSFO 53%, HFO 37%, ULSFO 10%
** Calculated based on 2022 bunker sales in Rotterdam: LFO 62%, MDO 38%
*** Based on market cross-checks assuming the following LNG engines' shares in 2030: diesel slow 80% and Otto slow 20%

[redacted]

[redacted]

[redacted]

$$FuelEU\,Penalty = \frac{\text{[redacted]}}{\text{[redacted]}} \times \text{[redacted]}$$

Where:

$$Compliance\,Balance(gCO_2eq) = \text{[redacted]}$$

In the formula, GHGIE target is the GHG intensity that the ship should comply with; details about this reference value were given in the Article **X** (**X**). **XX'XXX** is the energy content of **X** mt of VLSFO, its unit is MJ. **XXXX**, meaning that the amount of the penalty is **XXXX** EUR/mt of VLSFO equivalent.

[redacted]

[redacted]

[redacted]



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## 3.3 ReFuel EU

Although both RED3 and FuelEU texts require energy and GHG reduction-based targets, EU legislators choose to apply a volumetric system to aviation, further increasing complexity and lack of coherency between the numerous pieces of law.

[redacted]

The basic regulatory features of the regulation are summarized below.

Table 13: ReFuelEU main regulatory items

| | Renewable share obligation ( % vol) | Synthetic aviation fuels sub-target ( % vol, no DC) | Cap Crop food/ feed | Cap non-crop, non 9A/B (% vol of renewables)*** |
|---|---|---|---|---|
| 2025 | X % | - | X % | X % |
| 2030/31 | X % | X.X %* | X % | X % |
| 2032/33 | X % | X %** | X % | X % |
| 2034 | X % | X % | X % | X % |
| 2035 | XX % | X % | X % | X % |
| 2040 | XX % | XX % | X % | X % |
| 2045 | XX % | XX % | X % | X % |
| 2050 | XX % | XX % | X % | X % |

** **X** year average, min. **X,X**% each year*

*** **X** year average, min. **X,X**% each year*

**** Uncategorised feedstocks such as tallow cat.**X***

- The regulation applies to aircraft operators (>**XXX** commercial/>**XX** cargo flights per year), Union airports (> **XXX'XXX** passengers per year, not in the outermost region) and aviation fuel suppliers operating commercial air transport flights.

[redacted]

- [redacted]

[redacted]

- [redacted]

[redacted]

- [redacted]

[redacted]

[redacted]

## 3.4 Other drivers

Several other EU regulations may have a limited impact on renewable energy in 2025-2030 transport. When MS will transpose RED3 and adapt their national legislation to FuelEU and RefuelEU, they will also consider the following regulations:

ETS: [redacted]

ETS 2: [redacted]

Energy Tax Directive (ETD): the drafting version suggests low-carbon fuels will enjoy favorable taxation through a system based on three categories: 9A+RFNBOs (Category **X**), 9B+Crop/fossil natural gas until 2033 (Category **X**) and Crop/fossil natural gas from 2033 (Category **X**). At the time of writing, the final content of the ETD remains highly uncertain, including its enforcement date. This legal text has the most potential to influence renewable energy in transport beside RED3/FuelEU/RefuelEU.

- Effort Sharing Regulation (ESR): [redacted]

RepowerEU: [redacted]

Those regulations add incentive layers that increase the complexity of understanding the link between regulatory and market impact. We believe they will reinforce the price signals to use more renewable energy under RED3, FuelEU, and RefuelEU.

[redacted]

[redacted]

## 3.5 How regulatory layers weaves together

We discuss here how FuelEU, RefuelEU and RED3 impact each other and how it comes down to reducing MS flexibility by 2030.

[redacted]

[redacted]

[redacted]

[redacted]

Then they will look at incentivizing the use of renewable fuels in the road sector to “top” the basic requirements of RED3, namely:

- The advanced sub-target (**X**.**X**% e.c)

The 9B cap, set at **X**.**X**% e.c (**X**.**X**% MC), which can be lifted,

The crop cap, theoretically set at 2020 +**X**% e.c, but likely to be largely under-filled, reflecting most MS’s will to freeze their reliance on crops at the current levels. We assume a stable absolute use of crop, accounting for **X**.**X**% e.c of the road pool in 2025 and **X**.**X**% in 2030.

[redacted]

[redacted]

Table 14: RED3 fulfillment logic used in our model

| Sector | Category | Multiplier |
|---|---|---|
| Renewable energy use mostly independant from blending mandates | | |
| Rail | Elec RE | X.X |
| Rail | Crop (food/feed) | X |
| | | |
| Aviation | 9A | X.X |
| Aviation | 9B | X.X |
| Aviation | RFNBO green | X |
| | | |
| Maritime | 9A | X.X |
| Maritime | 9B | X.X |
| Maritime | RFNBO | X |
| | | |
| Industry (fuels production) | RFNBO | X |
| | | |
| Road | Elec RE | X |
| Gap to fil with renewable fuels used in road | | |
| Road | 9A sub-target min. "topping" | X |
| Road | 9B cap min. "topping" | X |
| Road | Crop cap/limit min "topping" | X |
| | | |
| Road | Uncategorized additionnal required | X |
| Road | 9A additionnal required | X |
| Road | 9B additionnal required | X |



# 4. Modeling renewable use under regulatory drivers

## 4.1 Maritime: FuelEU

FuelEU pool: intra-EU vs Extra-EU

To determine the fuel pool obliged under the FuelEU regulation, the share of intra-EU maritime traffic must be established. We used 2021 Eurostat data to demonstrate that **XX**% of passenger traffic is intra-EU, while the ratio fell to **XX**% for goods transport. According to figures from the EMSA-EEA study, the EU-27 maritime traffic is dominated by passenger ships (**XX**%), with cargo ships accounting for the rest (**XX**%).

As **XXX**% and **XX**% of the intra-EU and extra-EU voyages, respectively, will be obligated under FuelEU, we calculated that **XX**.**X**% of the total energy supplied to the maritime sector will be under the FuelEU scope.

[redacted]

[redacted]

Renewable fuels carbon intensities

[redacted]



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| Table 15: Renewable fuels assumed values in our model | | | |
|---|---|---|---|
| Product | CI estimation | CI (gCO2eq/MJ) | Vs Fuel comparator (94) |
| FAME | Average of 9A and 9B feedstocks | X | XX % |
| HVO | Average of 9A and 9B feedstocks | X | XX % |
| Bio LNG | Average of 9A feedstocks | XX | XX % |
| Bio methanol | Study methanol | XX | XX % |
| E-methanol | Study methanol (wind-solar source) | X | XX % |

Like RED3, the FuelEU regulation considers the well-to-wake emissions that includes the entire process of fuel production. Note that the inclusion of the maritime sector within the ETS scope from 2024 will consider only tank-to-wake emissions, which are logically lower than the ones used for FuelEU.

[redacted]

[redacted]

[redacted]

We modelized that it would require about **XXX** KT of e-methanol to cover the RED3 maritime RFNBO share of **X**.**X**% e.c. We assumed that only **X**% e.c (after multiple count ***X**) would be covered by 2030, calling for **XXX** KT of e-methanol used in the EU-27 by that year.

As explained in section **X**.**X**, we choose to remain very conservative regarding the development of e-ammonia (**X** KT in 2030). In parallel, we assumed that double counting would not create an e-diesel outlet in the shipping sector by 2030.

<u>Biomethanol</u>
The point of using methanol ships is to rely on bio substitutes, as the fossil version's carbon intensity is

higher than the baseline. [redacted]

[redacted]

[redacted]

| Table 16: Forecasted quantities of renewable fuels used under FuelEU (KT) | | | | | |
|---|---|---|---|---|---|
| | FAME | HVO | BioLNG | Biomethanol | E-methanol |
| 2022 | XXX | X | X | X | X |
| 2023 | XXX | X | X | X | X |
| 2024 | XXX | X | XX | X | X |
| 2025 | XXX | XXX | XX | X | X |
| 2026 | X XXX | XXX | XX | XX | XX |
| 2027 | X XXX | XXX | XXX | XX | XX |
| 2028 | X XXX | XXX | XXX | XX | XX |
| 2029 | X XXX | XXX | XXX | XXX | XXX |
| 2030 | X XXX | XXX | XXX | XXX | XXX |

[redacted]

## Bio-LNG

[redacted]

[redacted]

## HVO and FAME

Because of the limited drives of the alternative fuels mentioned previously, we anticipate that most of the savings needed under FuelEU will be generated by biodiesel consumption.

[redacted]

[redacted]



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[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

| Table 17: Forecasted quantities of 9A/9B quantities used under FuelEU (KT) | | | | |
|---|---|---|---|---|
| | FAME/HVO | | BioLNG | Biomethanol |
| | 9A | 9B | 9A | 9A |
| 2022 | XXX | X | X | X |
| 2023 | XXX | X | X | X |
| 2024 | XXX | X | XX | X |
| 2025 | XXX.X | XXX | XX | X |
| 2026 | XXX | XXX | XX | XX |
| 2027 | XXX | XXX | XXX | XX |
| 2028 | X XXX | X XXX | XXX | XX |
| 2029 | X XXX | X XXX | XXX | XXX |
| 2030 | X XXX | X XXX | XXX | XXX |

Savings generation: **XX**% from Fame

Our analysis shows that the respect of the FuelEU regulation in the EU-27 in 2030 will require [redacted]

Our analysis shows that the respect of the FuelEU regulation in the EU-27 in 2030 will require about 10.7 million mt of $CO_2$eq savings.

[redacted]

- [redacted]
- [redacted]

[redacted]

[redacted]

- [redacted]

Savings generated by each product (mt $CO_2$eq)

| | | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| Conventionnal | Fuel oils fossil | X XXX XXX | X XXX XXX | X XXX XXX | X XXX XXX | X XXX XXX | X XXX XXX | X XXX XXX | X XXX XXX | X XXX XXX |
| | Distillates fossil | -X XXX | -X XXX | -X XXX | -X XXX | -X XXX | -X XXX | -X XXX | -X XXX | -X XXX |
| | FAME | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX |
| | HVO | X | X | X | -XXX XXX | -XXX XXX | -XXX XXX | -XXX XXX | -X XXX XXX | -X XXX XXX |
| LNG | LNG fossil | -XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX |
| | BioLNG | X | X | -XX XXX | -XX XXX | -XXX XXX | -XXX XXX | -XXX XXX | -XXX XXX | -X XXX XXX |
| Methanol | Methanol fossil | XXX | X | X XXX | XX XXX | XX XXX | XX XXX | XXX XXX | XXX XXX | XX XXX |
| | Biomethanol | X | X | X | X | -XX XXX | -XX XXX | -XX XXX | -XXX XXX | -XXX XXX |
| | E-methanol | X | X | X | X | -XX XXX | -XX XXX | -XX XXX | -XXX XXX | -XXX XXX |
| | Total | -XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -X XXX XXX | -XX XXX XXX |

RFNBO share: far from the 2031 target

In our scenario, which adopted a balanced stance about the development of RFNBO in shipping within the EU-27, the share of RFNBO would reach **X**.**XX**% e.c physical by 2030.

**XXX** KT of e-methanol used in 2030 would cover **X**.**XX**% e.c of the fuel pool (after DC) under the FuelEU compliance.

Covering **X**% e.c (after DC) of the pool would require about **XXX** KT of e-methanol.

## 4.2 Aviation: ReFuelEU

The regulation mentions that aircrafts obliged under the RefuelEU will account for about **XX**% of the total EU traffic. We applied this ratio to the forecasted pool (see **X.X**) to determine the jet fuel pool under compliance.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

| Table 18: Forecasted quantities of renewable fuels used under ReFuelEU (Kcum) | | |
|---|---|---|
| | SAF (HEFA) | e-kerosene (FT) |
| 2022 | XXX | X |
| 2023 | XXX | X |
| 2024 | XXX | X |
| 2025 | X XXX | X |
| 2026 | X XXX | X |
| 2027 | X XXX | XX |
| 2028 | X XXX | XXX |
| 2029 | X XXX | XXX |
| 2030 | X XXX | XXX |

## 4.3 Electricity in road and rail

Implications of road electrification

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted] ber [redacted]

[redacted]

| Table 19: Average Renewable share of the EU-27 electricity mix projected to 2030 | | |
|---|---|---|
| | Forecasted | Average 2 previous years |
| 2022 | XX.X % | XX.XX % |
| 2023 | XX.X % | XX.XX % |
| 2024 | XX.X % | XX.XX % |
| 2025 | XX.X % | XX.XX % |
| 2026 | XX.X % | XX.XX % |
| 2027 | XX.X % | XX.XX % |
| 2028 | XX.X % | XX.XX % |
| 2029 | XX.X % | XX.XX % |
| 2030 | XX.X % | XX.XX % |

The electrification pace will determine three important features of the energy mix:

[redacted]

[redacted]

1. [redacted]

| Table 20: Blend walls calculated under our two senarios (KT) | | | | |
|---|---|---|---|---|
| | B7 (Fame equ.) | | E10 (ethanol equ.) | |
| | 1-high elec | 2-low elec | 1-high elec | 2-low elec |
| 2022 | XX XXX | XX XXX | X XXX | X XXX |
| 2023 | XX XXX | XX XXX | X XXX | X XXX |
| 2024 | XX XXX | XX XXX | X XXX | X XXX |
| 2025 | XX XXX | XX XXX | X XXX | X XXX |
| 2026 | XX XXX | XX XXX | X XXX | X XXX |
| 2027 | X XXX | X XXX | X XXX | X XXX |
| 2028 | X XXX | X XXX | X XXX | X XXX |
| 2029 | X XXX | X XXX | X XXX | X XXX |
| 2030 | X XXX | X XXX | X XXX | X XXX |

[redacted]

[redacted]

<u>Rail</u>

Because of the centralized railways system in Europe, MS will be able to capture **XXX**% of the RE supplied to the sector (accountability rate = **XXX**%). Calculated with the same RE shares, the RE rail (physical) use will be **X**.**XXX** EJ in 2030.

[redacted]

[redacted]

| Table 21: Forecasted quantities of renewable fuels used in the rail sector (EJ and KT) | | | |
|---|---|---|---|
| | FAME (EJ) | FAME (KT) | RE (EJ) |
| 2022 | X.XXXX | XX | X.XXX |
| 2023 | X.XXXX | XX | X.XXX |
| 2024 | X.XXXX | XX | X.XXX |
| 2025 | X.XXXX | XX | X.XXX |
| 2026 | X.XXXX | XX | X.XXX |
| 2027 | X.XXXX | XX | X.XXX |
| 2028 | X.XXXX | XX | X.XXX |
| 2029 | X.XXXX | XX | X.XXX |
| 2030 | X.XXXX | XX | X.XXX |

[redacted]s”.

## 4.4 Hydrogen used at refineries

As mentioned under **X**.**X**, hydrogen used in the production of fuels will not be included to the **XX**% e.c obligation imposed on green hydrogen in industry. However, the green hydrogen used at refineries to produce fuels will be [redacted]

Green hydrogen at existing and new (bio) refineries will be needed to:

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

| Table 22: Hydrogen used at refineries projected in the EU-27 (KT) | | | |
|---|---|---|---|
| | Total | Fossil/Grey/Pink | Green |
| 2022 | X XXX | X XXX | X |
| 2023 | X XXX | X XXX | X |
| 2024 | X XXX | X XXX | X |
| 2025 | X XXX | X XXX | X |
| 2026 | X XXX | X XXX | XX |
| 2027 | X XXX | X XXX | XX |
| 2028 | X XXX | X XXX | XXX |
| 2029 | X XXX | X XXX | XXX |
| 2030 | X XXX | X XXX | XXX |

Our research highlights that the energy component of pure green hydrogen used at refineries [redacted]

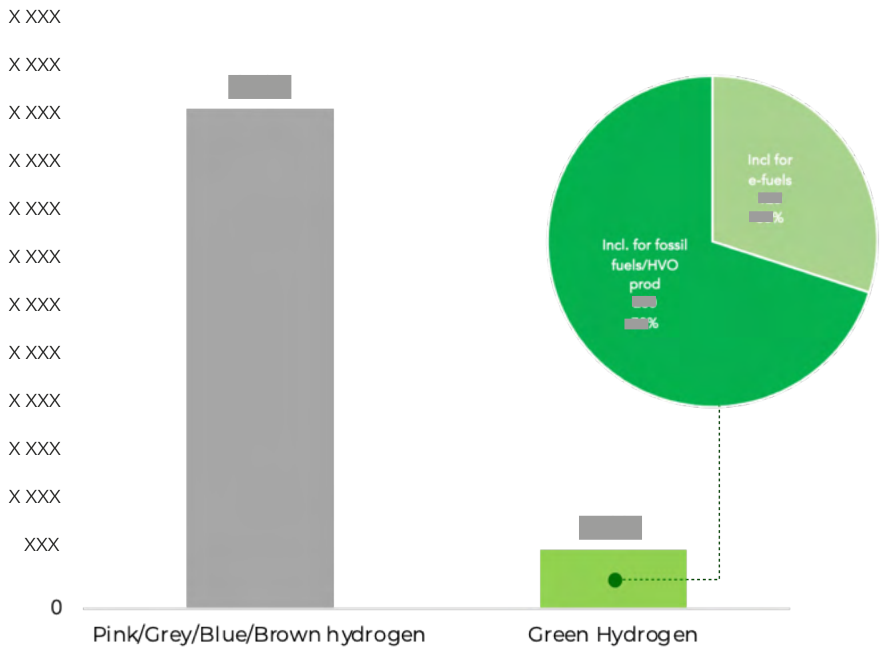


Chart 5: Hydrogen used at refineries in 2030 (KT)

As energy used at refineries is not accounted for in the RED3 pool, the green hydrogen (~**X.X** EJ MC) will create a "surplus" of renewable energy in regard to the **XX**% e.c target. This is equivalent to the surplus generated by the rail sector.

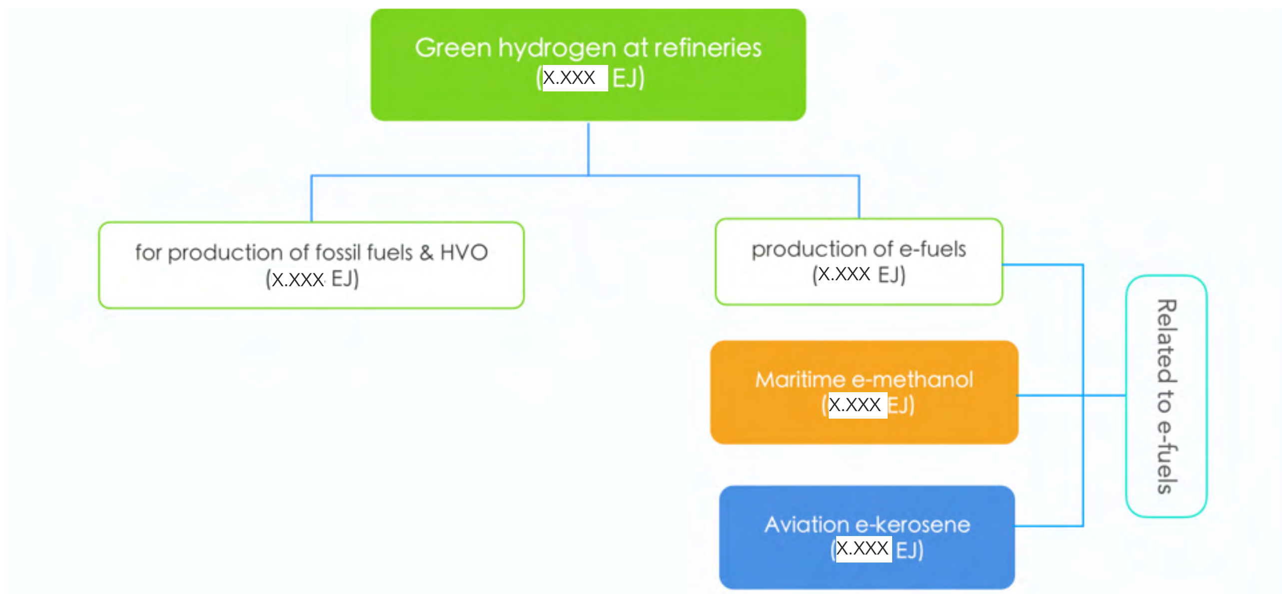


Chart 6: Green hydrogen and e-fuel (EJ)

## 4.5 Gap to fil with road renewable fuels

### 4.5.1 What pools exactly will be included in the denominator?

[redacted]

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted]

[redacted]

[redacted]

### 4.5.2 Road will need to overcome 29% e.c

[redacted]

[redacted]

[redacted]

[redacted] e.c [redacted]

[redacted]

[redacted]

[redacted]

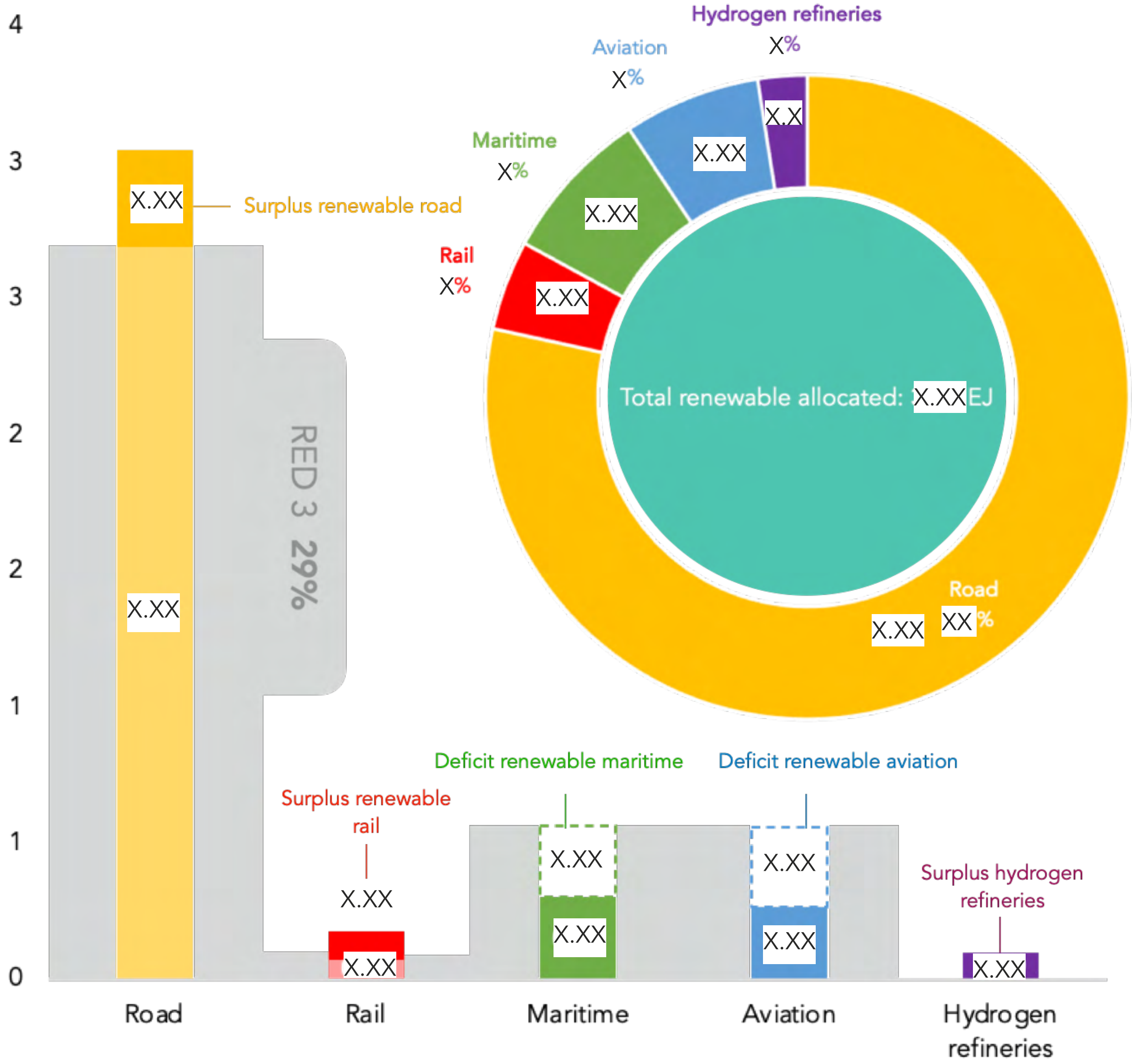


Chart 7: Renewable energy allocation under high electrification (EJ)

In the low electrification, [redacted]

[redacted]

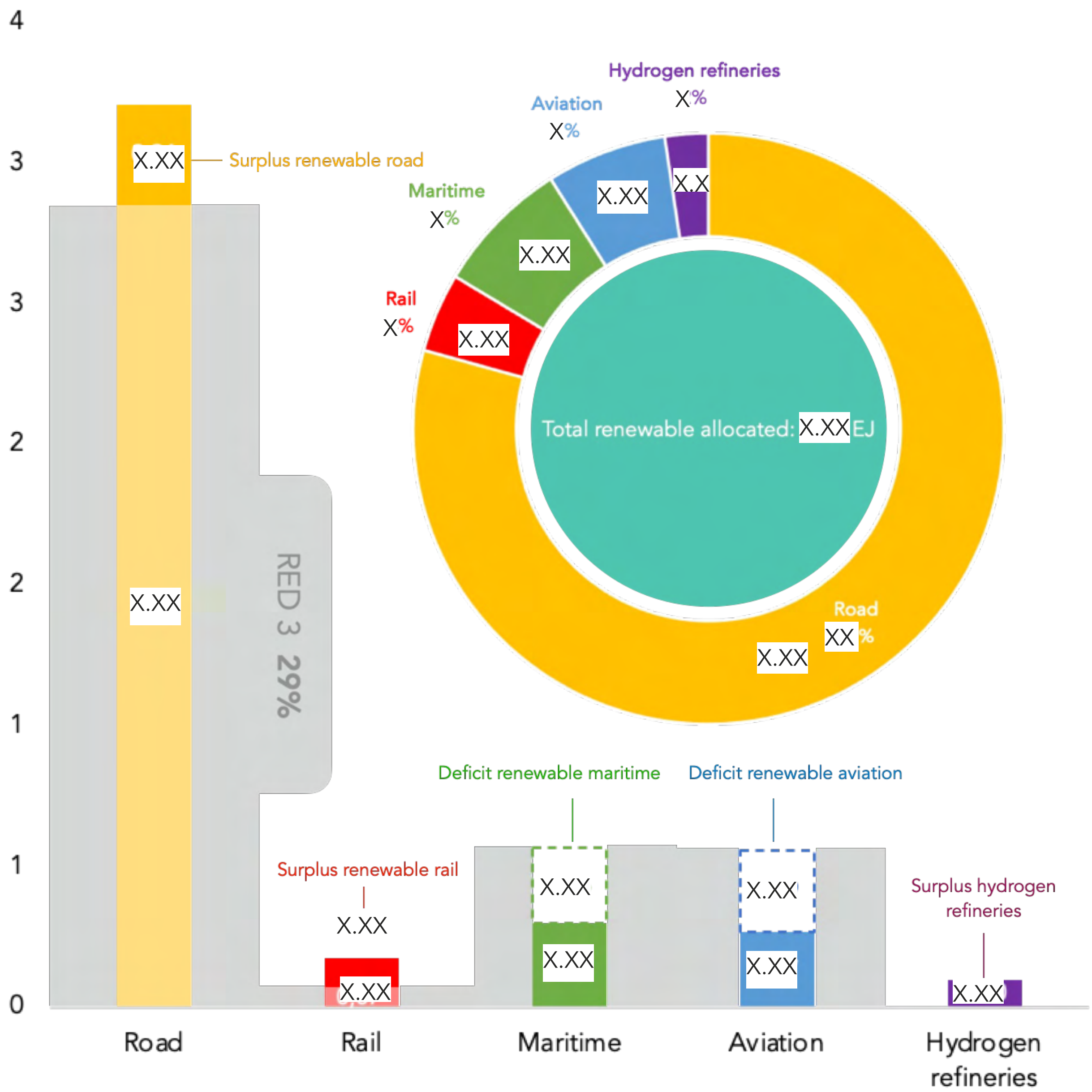


Chart 8: Renewable energy allocation under low electrification (EJ)

### 4.5.3 Scenarios for road renewable energy

In the current version of our models, the renewable contribution of rail, maritime, aviation, and green hydrogen (refineries) total up **X.XX** EJ in 2030. This represents about **XX-XX**% of the total renewable energy required by RED3 at the EU level by then.

[redacted]

[redacted]

- [redacted]

[redacted]

[redacted]

Table 23: Forecasted road pool under the High Elec scenario during 2025-2030 (KT and GWh)

| (KT) | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|
| Diesel fossil | XXX XXX | XXX XXX | XXX XXX | XXX XXX | XXX XXX | XXX XXX |
| FAME 9A | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| FAME 9B | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| Fame crop | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| HVO 9A | XXX | XXX | X XXX | X XXX | XXX | X XXX |
| HVO 9B | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| HVO crop | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| HVO C3 | XX | XXX | XXX | XXX | XXX | XXX |
| | | | | | | |
| Gasoline fossil | XX XXX | XX XXX | XX XXX | XX XXX | XX XXX | XX XXX |
| Ethanol 9A | XXX | XXX | XXX | XXX | XXX | XXX |
| Ethanol crop | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| BIONAPHTA 9A | XX | XX | XXX | XXX | XXX | XXX |
| BIONAPHTA 9B | XXX | XXX | XXX | XXX | XXX | XXX |
| BIONAPHTA crop | XXX | XXX | XXX | XXX | XXX | XXX |
| BIONAPHTA C3 | X | XX | XX | XX | XX | XX |
| | | | | | | |
| LPG fossil | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| BioLPG 9A | XX | XX | XX | XX | XX | XX |
| BioLPG 9B | XX | XX | XX | XX | XX | XX |
| BioLPG crop | X | X | X | X | X | X |
| BioLPG C3 | X | X | XX | XX | XX | XX |
| | | | | | | |
| CNG/LNG fossil | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| CNG/LNG 9A | XXX | XXX | XXX | XXX | XXX | X XXX |
| | | | | | | |
| Elec non RE RED3 (GWh) | XX XXX | XX XXX | XX XXX | XX XXX | XX XXX | XX XXX |
| Elec RE RED3 (GWh) | XX XXX | XX XXX | XX XXX | XX XXX | XX XXX | XXX XXX |

Table 24: Forecasted road pool under the Low Elec scenario during 2025-2030 (KT and GWh)

| (KT) | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|
| Diesel fossil | XXX XXX | XXX XXX | XXX XXX | XXX XXX | XXX XXX | XXX XXX |
| FAME 9A | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| FAME 9B | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| Fame crop | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| HVO 9A | XXX | XXX | X XXX | X XXX | X XXX | X XXX |
| HVO 9B | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| HVO crop | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| HVO C3 | XX | XXX | XXX | XXX | XXX | X XXX |
| | | | | | | |
| Gasoline fossil | XX XXX | XX XXX | XX XXX | XX XXX | XX XXX | XX XXX |
| Ethanol 9A | XXX | XXX | XXX | XXX | XXX | XXX |
| Ethanol crop | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| BIONAPHTA 9A | XX | XX | XXX | XXX | XXX | XXX |
| BIONAPHTA 9B | XXX | XXX | XXX | XXX | XXX | XXX |
| BIONAPHTA crop | XXX | XXX | XXX | XXX | XXX | XXX |
| BIONAPHTA C3 | X | XX | XX | XX | XX | XXX |
| | | | | | | |
| LPG fossil | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| BioLPG 9A | XX | XX | XX | XX | XX | XX |
| BioLPG 9B | XX | XX | XX | XX | XX | XX |
| BioLPG crop | X | X | X | X | X | X |
| BioLPG C3 | X | X | XX | XX | XX | XX |
| | | | | | | |
| CNG/LNG fossil | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| CNG/LNG 9A | X XXX | X XXX | X XXX | X XXX | X XXX | X XXX |
| | | | | | | |
| Elec non RE RED3 (GWh) | XX XXX | XX XXX | XX XXX | XX XXX | XX XXX | XX XXX |
| Elec RE RED3 (GWh) | XX XXX | XX XXX | XX XXX | XX XXX | XX XXX | XX XXX |



# 5. Main findings

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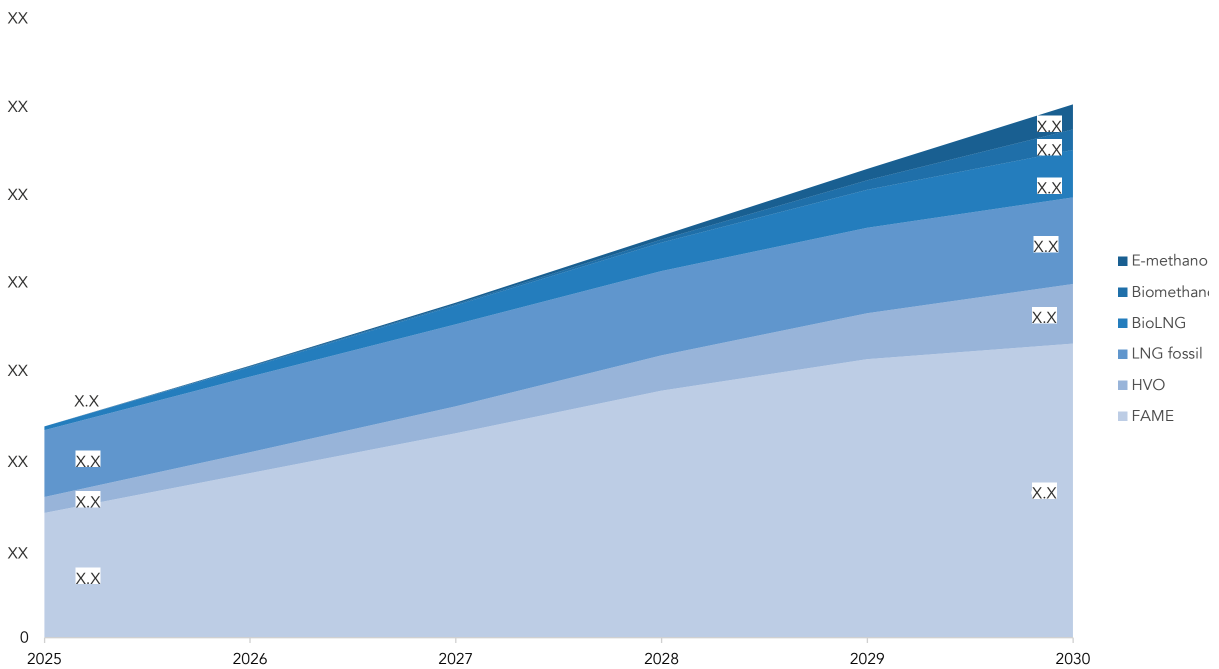
[redacted]




GHG savings generation projected under FuelEU in 2025-2030 (million mt CO2eq)



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[redacted]

[redacted]

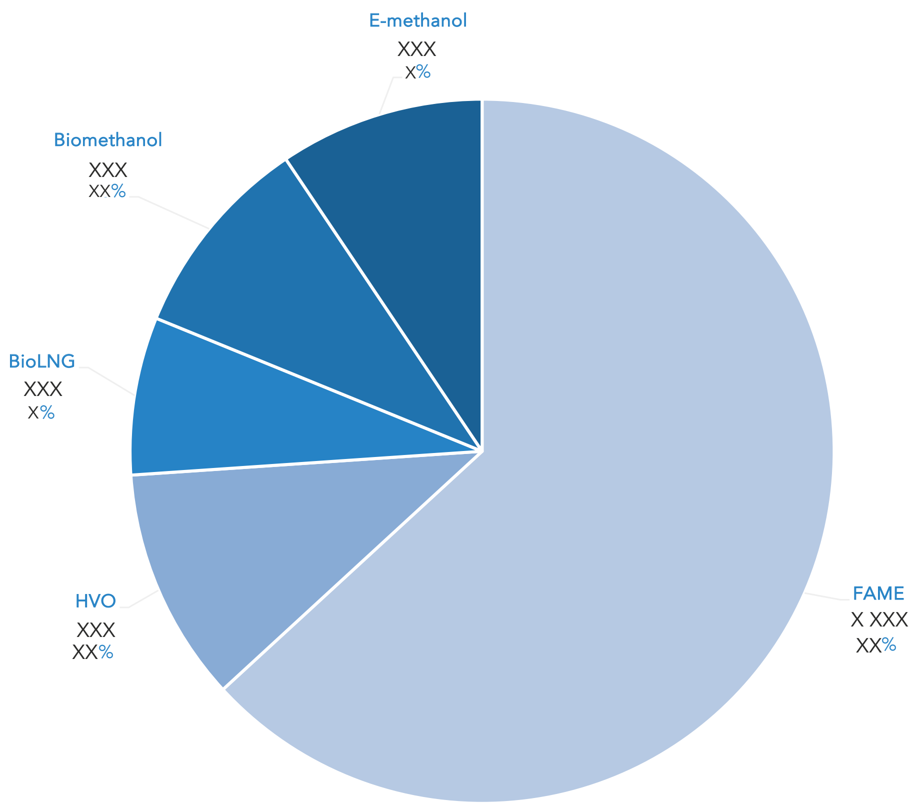


Chart 9: Renewable fuels mix projected in maritime sector in 2030 (KT)

[redacted]

[redacted]

[redacted]

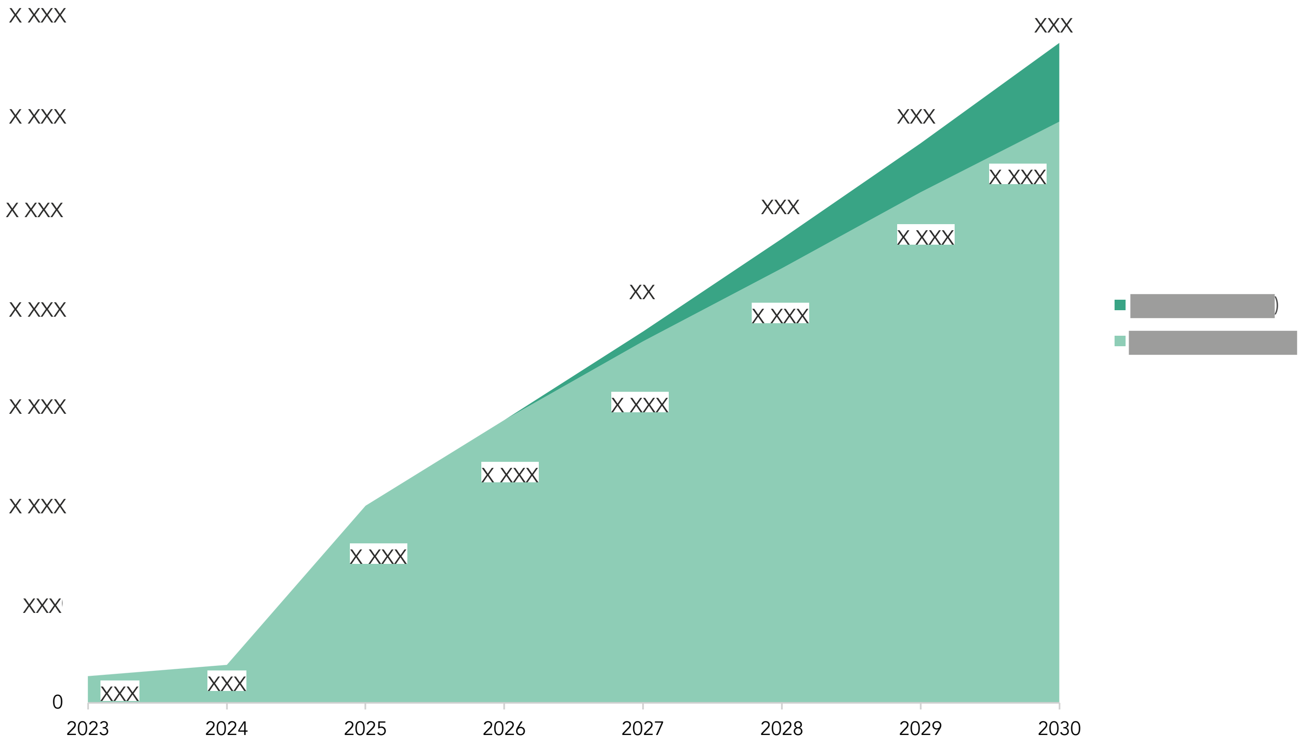


Chart 10: Renewable fuels mix evolution projected in aviation from 2023 to 2030 (KT)

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

| Table 25: Renewable mix projected in 2030 (KT) | | |
|---|---|---|
| | Low elec | High elec |
| Biodiesel | XX XXX | XX XXX |
| Biogasoline | X XXX | X XXX |
| BioLPG | XXX | XXX |
| BioCNG/LNG | X XXX | X XXX |
| Elec RE (GWh) | XX XXX | XXX XXX |

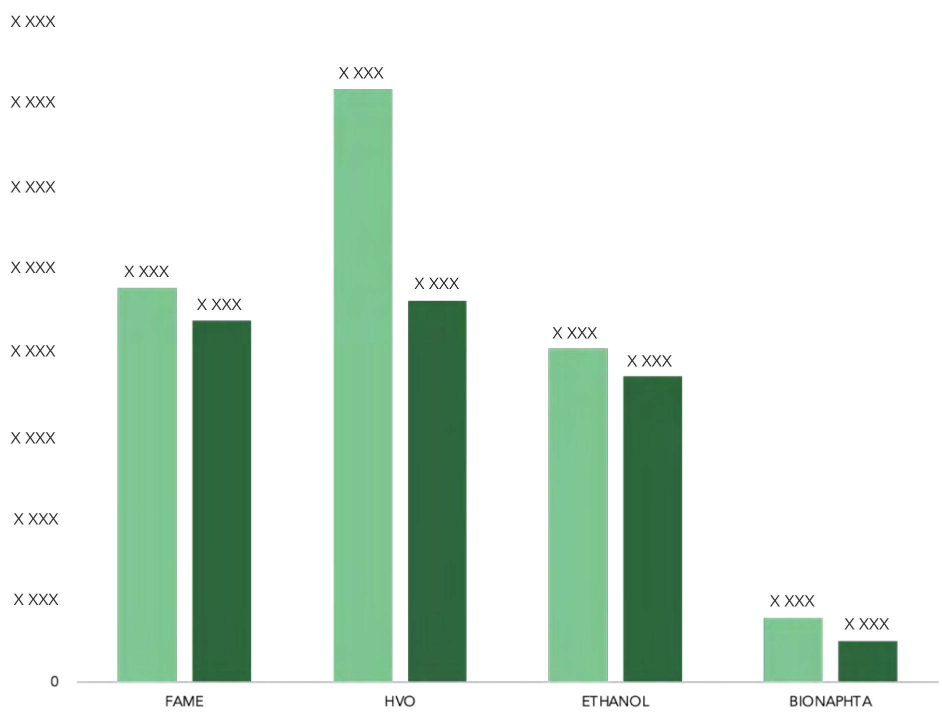


Chart 11: Main road renewable alternatives projected in 2030, depending on electrification pace (KT)

[redacted]

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[redacted]



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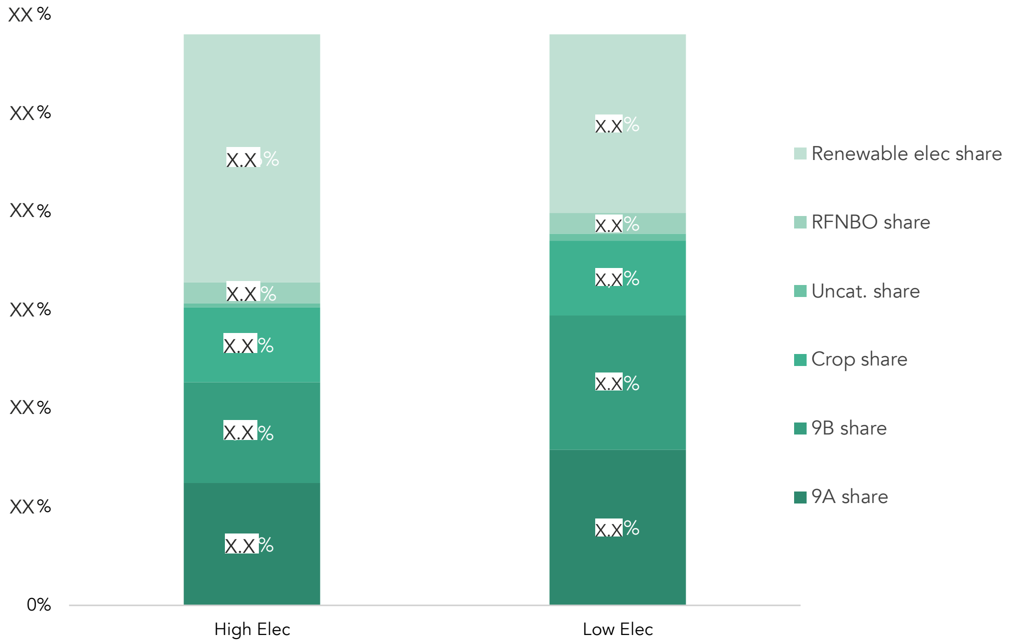


Chart 12: 29% e.c target split by 2030, depending on electrification pace

[redacted]

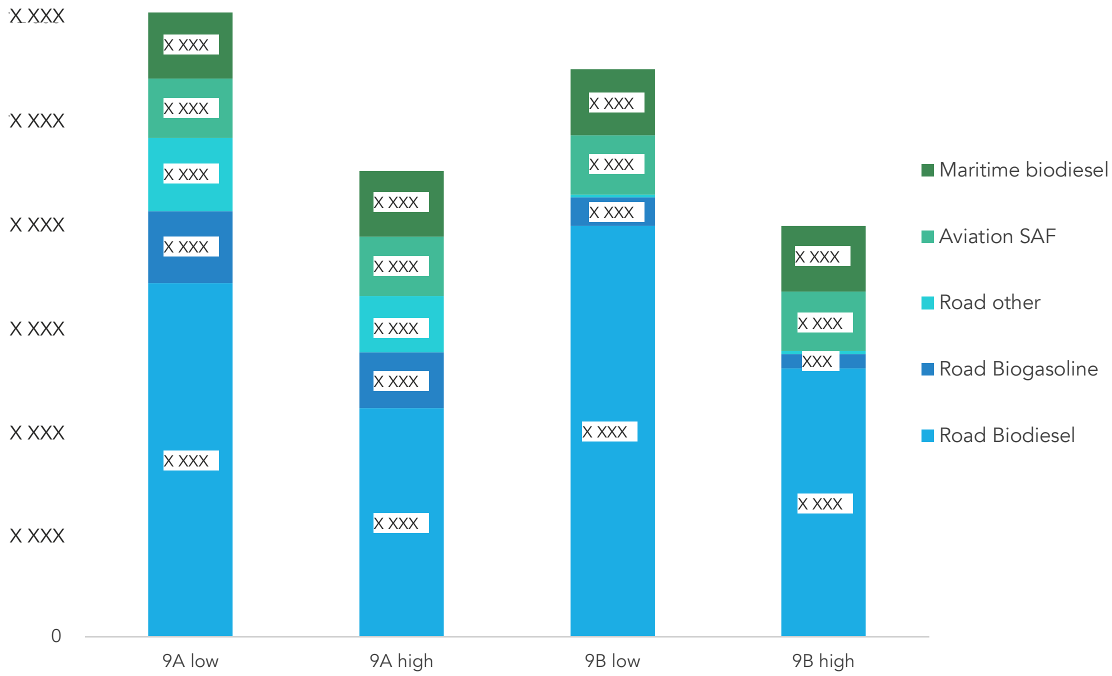


Chart 13: 9A-9B final use under low and high electrification (KT)

[redacted]

[redacted]

[redacted]

[redacted]

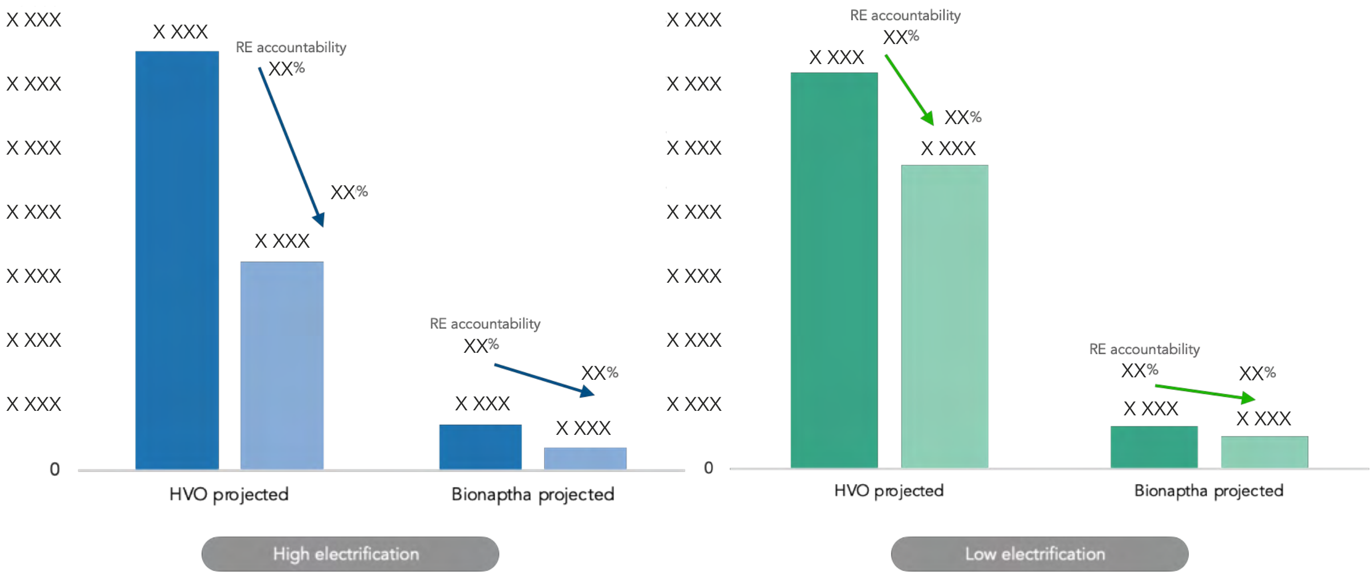


Chart 14: Impact of RE accountability ratio on biofuels road demand (KT)

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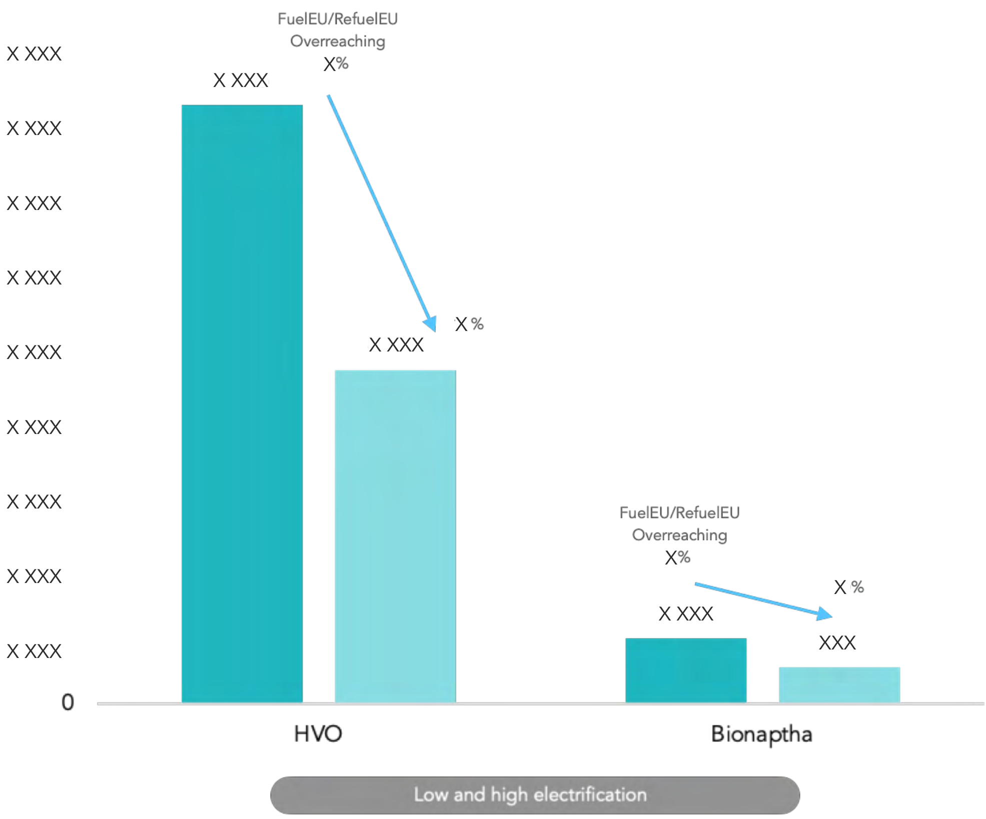


Chart 15: Impact of Fuel-RefuelEU overreaching (KT)



# 6. Limits of our current model

As in any modeling work, many assumptions were made to simplify and anticipate developments that can be projected only on a theoretical approach. As we suggested in the introduction, the study's main objective was to understand the mechanism of the three main legal texts driving renewable energy in transport by 2030.

[redacted]

**Impact of ETS, ETD and ESR**

[redacted]

[redacted]

[redacted]

## Road electricity development and accounting

**RFNBO development and emergence of technologies**

Anticipating the development of e-fuels and other technologies like Alcohol to Jet (ATJ) is challenging. Many stakeholders have been announcing plans to buy or sell new-generation low-carbon fuels, even though construction of the plants to produce them are not yet underway.

We did our best to sort out the most promising projects, as well as cross-check studies and forecasts to understand the availability and demand of e-fuels by 2030. Our synthesis of the available information led us to pick the most balanced and realistic figure. The regulatory guidance (i.e., **X**% e.c RFNBO target in RED3).

Putting a number on how much green hydrogen will be used at EU refineries is tricky, especially since the refining sector will continue to transform in the coming years. Our current assumption of **XXX** KT used by 2030 represents **XX**% of the projected total hydrogen used at EU refineries.

Projecting the availability of e-methanol and green ammonia for shipping on the one hand and types of e-kerosene for aviation on the other, is also challenging. We worked with cautious assumptions, but the error margin (in both directions) appears significant.

**Transposition of directives and implementatiuon of regulatories**

[redacted]

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[redacted]

**Compliance with texts**

[redacted]



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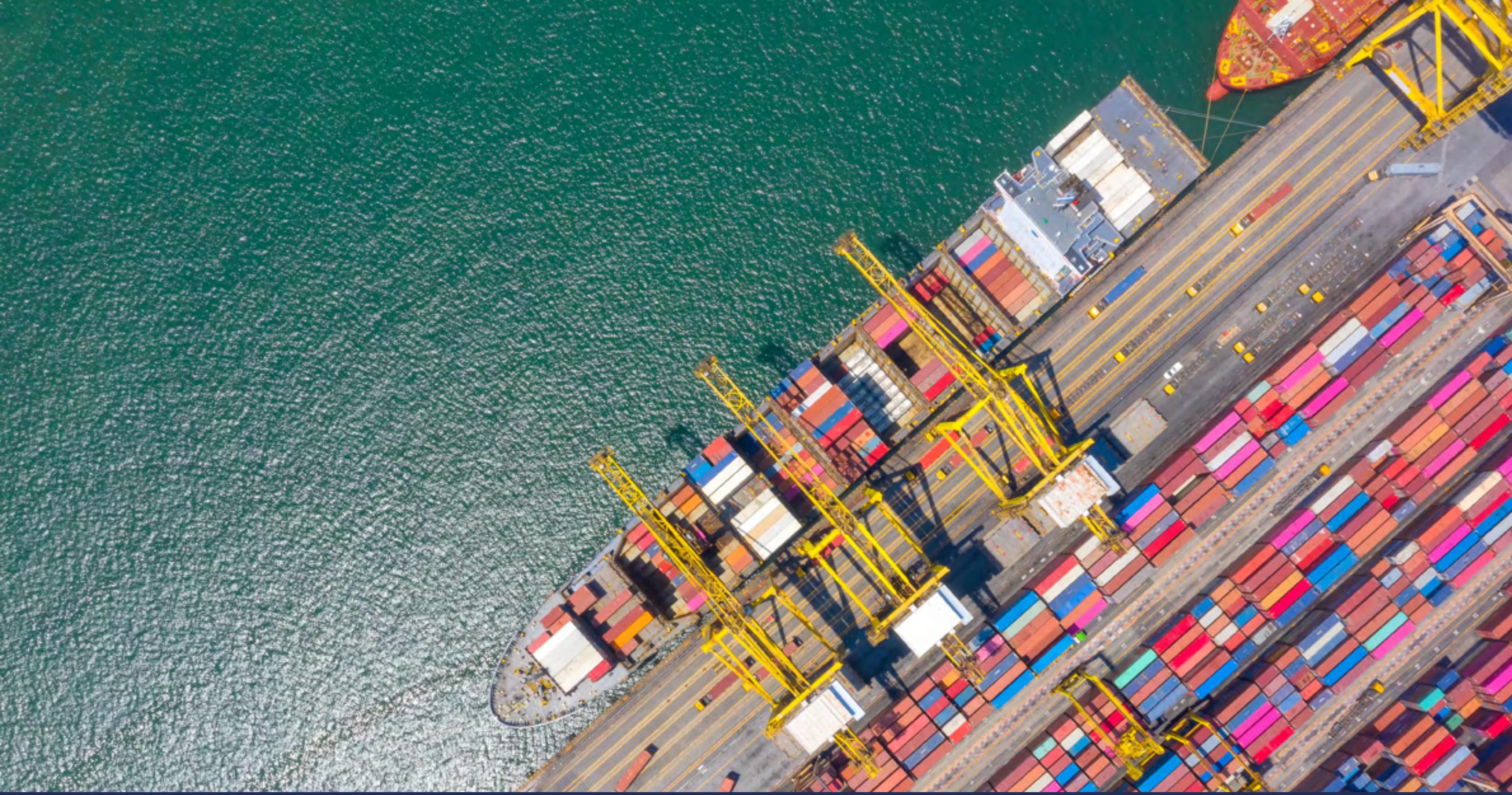
## Other key assumptions influencing our findings

- [redacted]





# 7. Conclusion

The potential demand for low-carbon fuels by the coordinated enforcement of RED3 and Fuel-RefuelEU will be correlated to [redacted]

Under our High Elec scenario, total renewable liquid fuels used in the road sector by 2030 [redacted]

Under our Low Elec scenario, this figure would grow to **XX** million mt, as the limited amount of eligible RE (**XX** TWh vs **XXX** TWh) would, despite the **X**x multiplier, not be sufficient to meet the required amounts of renewable energy under accelerated targets.

[redacted]

5. Main findings

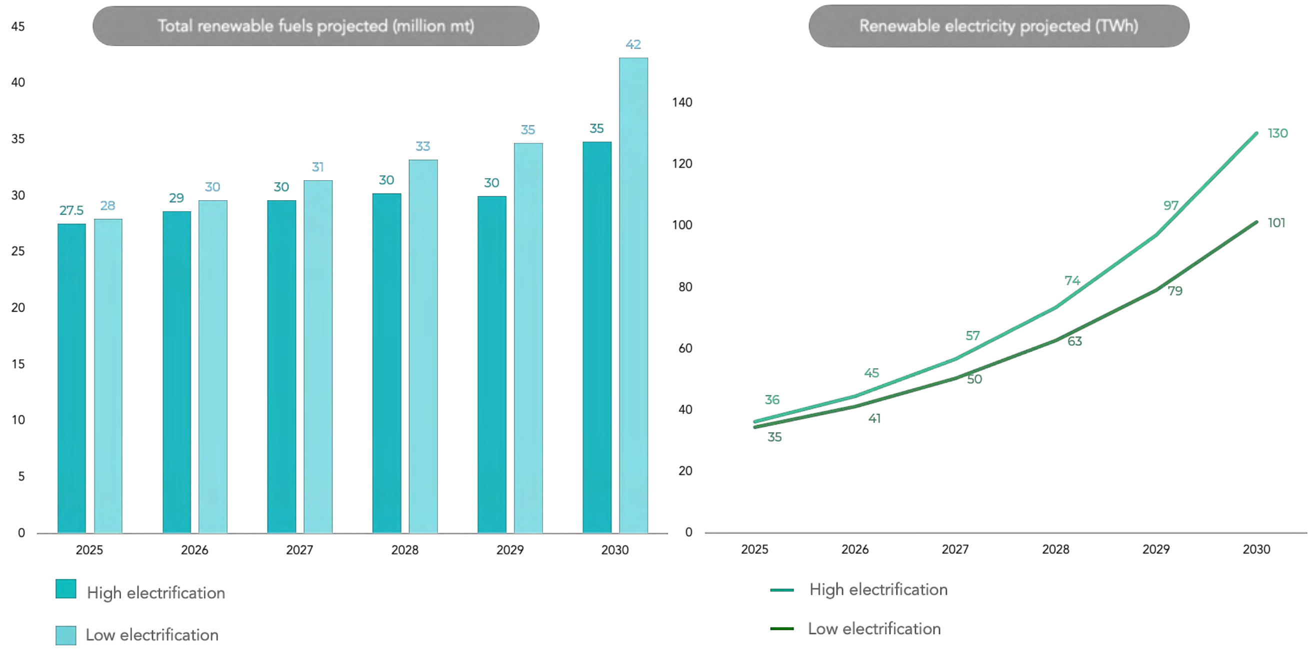



Chart 16: Total Renewable fuels and RE projected by 2030

[redacted]


Chart 17: Fame and ethanol projection (KT)

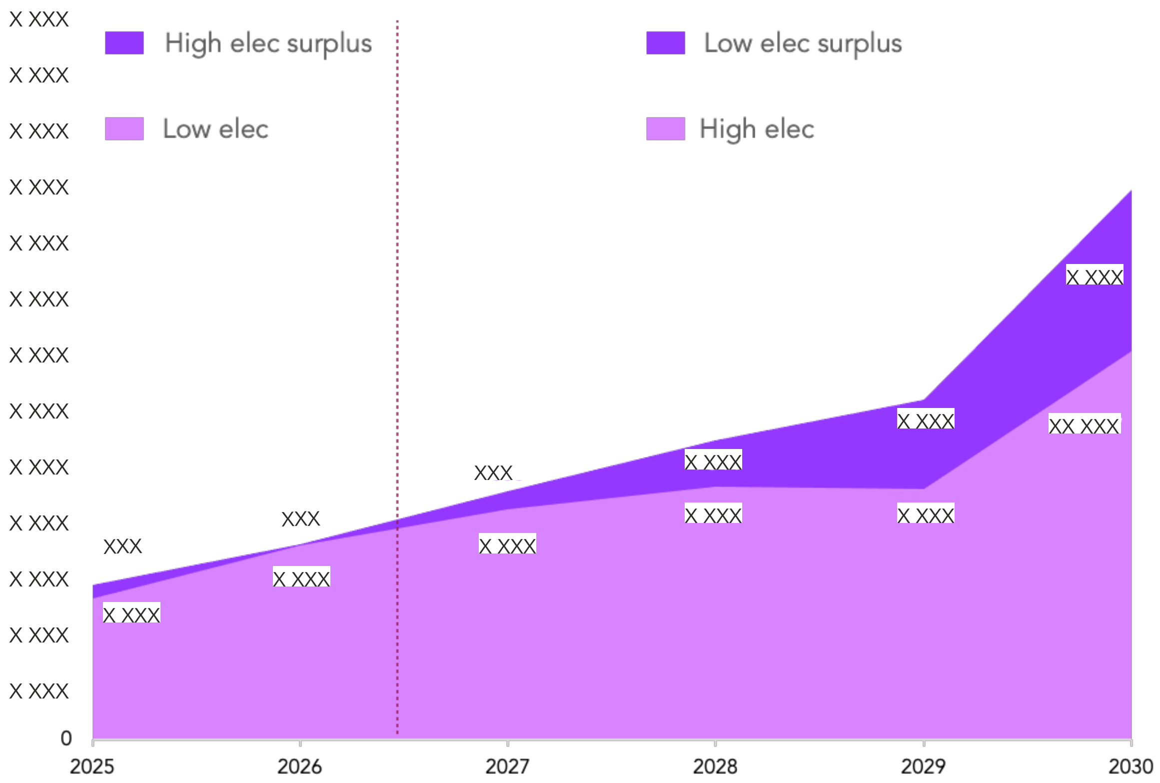



Chart 18: HEFA/HVO fuels projected by 2030 (KT)

[redacted]

We will update this study annually to include recorded MS transposition plans/achievements, refine our assumptions, and extend the scope to all influencing drivers. This series of studies will serve as a compass for RED3 transposition and Fuel/Refuel EU implementation.

# Appendix

# Tables Index

# Chart Index

# References

## General/Transport:


- [redacted]
- [redacted]
- [redacted]
- [redacted]
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- [redacted]
- [redacted]


## FuelEU:


- [redacted]
- [redacted]
- [redacted]
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- [redacted]
- [redacted]
- [redacted]
- [redacted]

# Datasets references

[redacted]

ReuelEU:

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

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Deep Dive into 2030 Consumption Perspectives

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