Concawe
Environmental Science
for European Refining

Fit for 55 modelling

[redacted]

Meeting DG MOVE, 01 April 2022

Concawe modelling work – FF55

A look into transport (Energy and GHG emissions)

Transport

A step-wise analysis:

(1) Baseline

Energy demand and fuel mix estimate as a consequence of modelling:

- Activity levels, energy efficiency gains, etc
- FitFor55 package elements:
  - CO_2 standards in LDV
  - FuelEU Maritime
  - ReFuelEU Aviation
- Penetration of alternative powertrains/fuels
  - Intermediate targets (FF55)
  - Volumes for drop-in fuels based on what the industry could potentially deployed by 2030 (Concawe Scenarios)

Comparison of total energy and RES in transport (baseline) vs RED III targets / subtargets

(2) Adjusted RED III

Adjusted volumes of low carbon fuels and type of feedstocks / technologies to meet the RED III targets and sub-targets

(3) ETS compliance

- Analysis based on individual comparison of GHG reductions per sectors vs cap
- In case of gap between GHG emissions and cap:
  - Cost compliance estimate
  - Adjusted volumes of low carbon fuels potentially required to fill in the gap (as an extreme sensitivity case to understand level of ambition)

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1

Transport modelling

2030 estimated energy demand and fuel mix

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Step 1. CO2 standards – Basis for modelling

INPUT. Impact of level of ambition (2030) – Light Duty

Approach: PC (55% reduction vs 2021) and Vans (50% reduction vs 2021) in WLTP

Sales composition inspired in HIGH ambition scenario proposed by EU COM

Table 3: Target levels under the options considered (% reduction compared to 2021 starting point)

	2025		2030		2035		2040	
	Cars	Vans	Cars	Vans	Cars	Vans	Cars	Vans
TL_Low	15%	15%	40%	35%	60%	55%	80%	80%
TL_Med	15%	15%	50%	40%	70%	70%	100%	100%
TL_High	15%	15%	60%	50%	100%	100%	100%	100%

55% target for PCs as an intermediate value between Med and High target levels (not reported in detail)

Table 4: New cars and vans powertrain composition in 2030, 2035 and 2040 under different target levels (TL) options

	Cars				Vans			
2030	ICEV*	PHEV	BEV	FCEV	ICEV*	PHEV	BEV	FCEV
TL_0	61,5%	13,3%	24,5%	0,6%	71,6%	14,7%	13,4%	0,3%
TL_Low	56,1%	12,8%	30,5%	0,6%	66,9%	13,6%	18,9%	0,7%
TL_Med	48,0%	16,1%	35,1%	0,8%	61,9%	16,0%	21,3%	0,7%
TL_High	39,4%	14,3%	45,3%	1,0%	51,3%	13,3%	34,7%	0,7%
2035								
TL_0	56,0%	16,8%	25,3%	1,8%	58,2%	18,4%	22,0%	1,3%
TL_Low	38,7%	20,1%	38,8%	2,4%	43,4%	21,2%	32,7%	2,6%
TL_Med	28,0%	21,8%	46,8%	3,4%	28,7%	21,8%	47,4%	4,2%
TL_High	0,0%	0,0%	90,2%	9,8%	0,0%	0,0%	94,2%	5,8%
2040								
TL_0	46,7%	17,6%	32,4%	3,2%	50,1%	20,8%	26,8%	2,3%
TL_Low	18,5%	19,2%	55,1%	7,2%	17,7%	22,9%	52,3%	7,2%
TL_Med	0,0%	0,0%	87,0%	13,0%	0,0%	0,0%	85,6%	14,4%
TL_High	0,0%	0,0%	89,9%	10,1%	0,0%	0,0%	93,0%	7,0%

* including HEV and gas fuelled vehicles

Additional demand reduction

40 % of hybridisation of ICEs

Energy Efficiency improvement of new powertrains

Source: EU COM (July 2021)

Action: To estimate demand reduction because of a more ambitious standard
Fleet composition will be in between Med and High in terms of mix composition.

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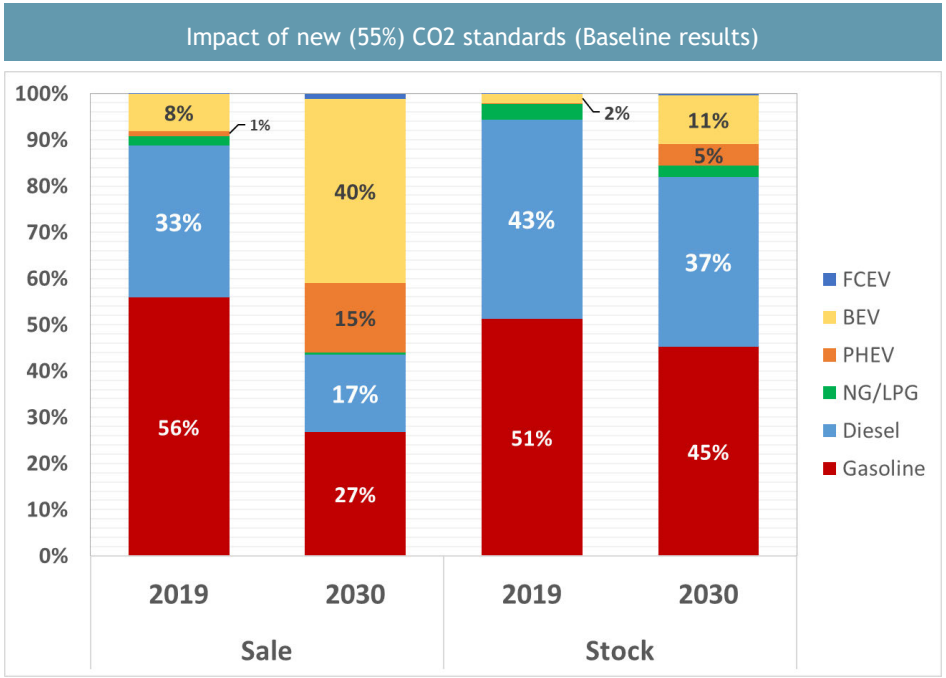
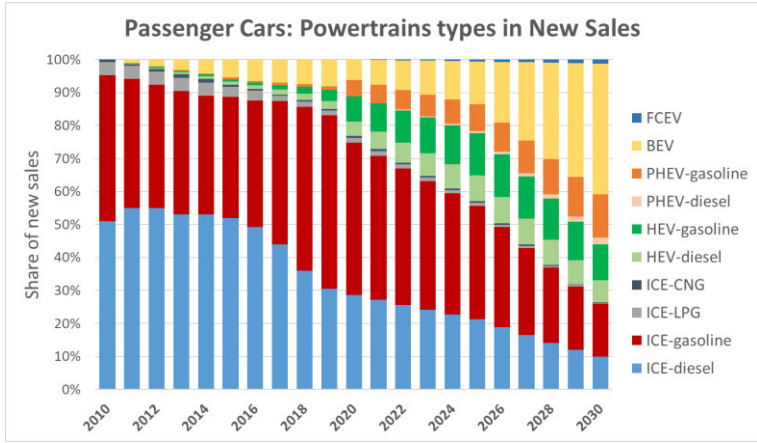
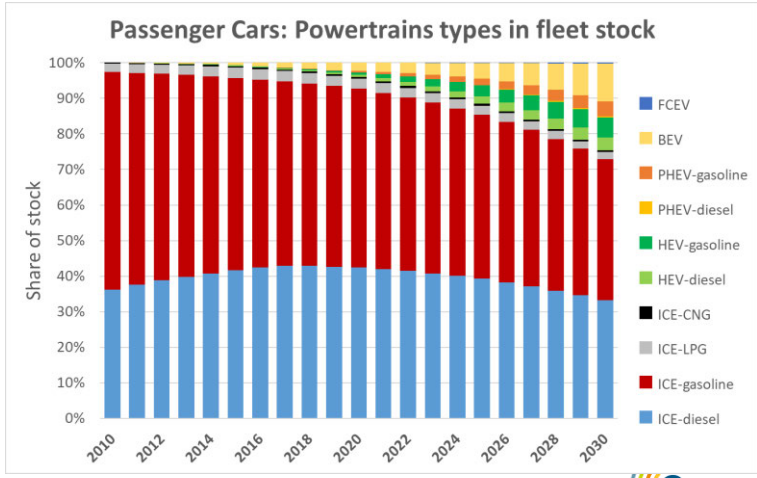
Road Transport: Passenger Car Fleet Mix







EV Sales in 2030 (EU27):

- BEV: 5.2 M
- PHEV: 2.0 M
- Total Sales: ~13 M

EV Stock in 2030 (EU27):

- BEV: 29 M
- PHEV: 12.5 M
- Total Stock: ~272 M

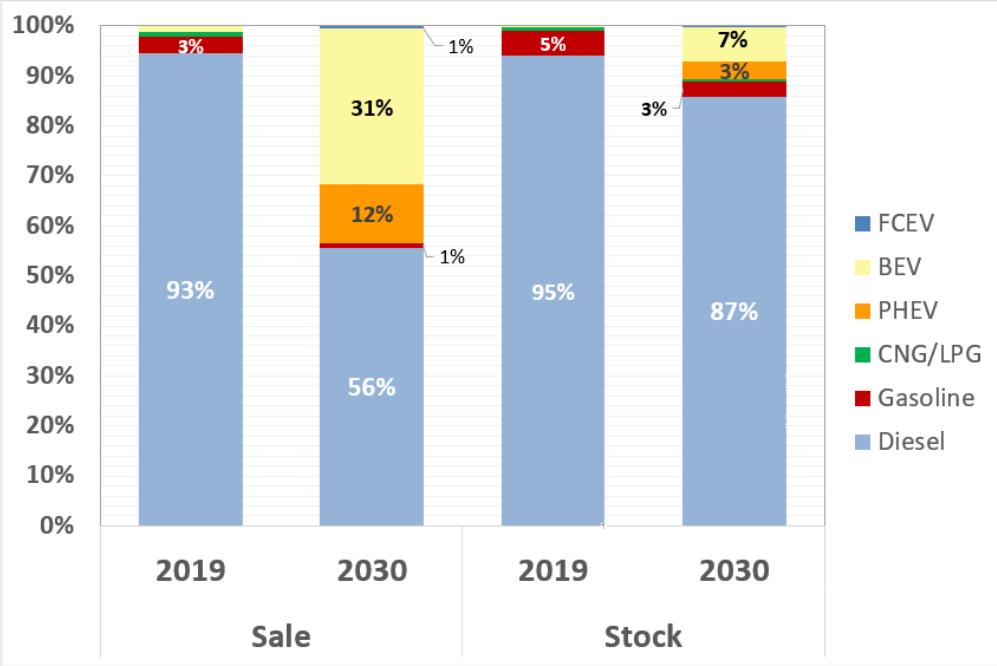
Total ZEV: ~30 M vehicles
(ZEV <> BEV + FCEV) consistent with AFIR)

New Concawe model. Calibrated to EU-27 (2020). NEDC to Real World factors per powertrain (~30-35%)

Road Transport: Light Commercial Vehicle Fleet Mix

Additional info

Baseline modelling for Vans (50% reduction vs 2021) in WLTP



Efficiency increase of new ICE/HEV	New sales emission in 2021 WLTP gCO2/km	New sales emission in 2030 WLTP gCO2/km	2030 sales emissions reduction vs 2021 (WLTP gCO2/km)
1.5% per year	178	84	~-50%

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Road Transport: Heavy Duty

Additional info

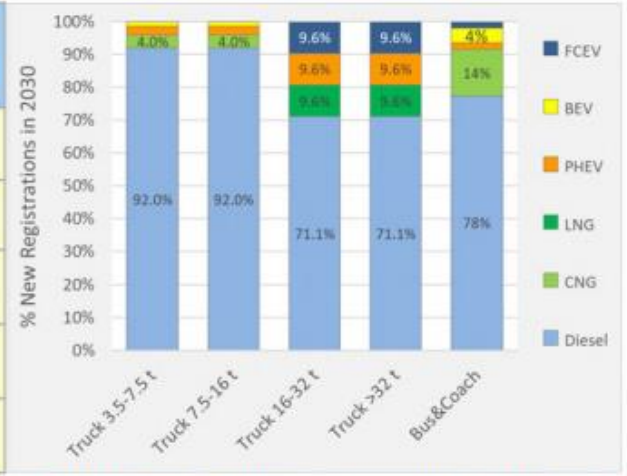
No modification in targets included in the FitFor55 package.

Therefore, current levels maintained: Emission reduction target of 30% (to be reviewed in 2022)

New sales composition (Example 16-32 t segment)

Figure 12. Figures for emission intensity and new registration for heavy-duty commercial vehicle sales in 2030

Category	2019 Fleet gCO_2/km	2030 Fleet gCO_2/km
Truck 3.5 – 7.5t	325	280
Truck 7.5 – 16t	467	402
Truck 16-32t	671	476
Truck >32t	789	560
Bus & Coach	1310	1107



Note. Assumption: 50% of new ICE diesel vehicles (16-32 t segment) will be equipped with hybrid technology by 2030.

Details for other types + buses/coaches in Concawe report [21/2]
Concawe's Transport and Fuel Outlook towards EU 2030 Climate Targets

Road Transport: Energy Consumption (Concawe modelling)

Impact of Energy Efficiency improvement levels (Concawe projections based on adjusted JEC WTW v5 data for LDV and Concawe Outlook [R21-2] for HDV

Hybridisation Level in 2030	2030 sales emissions vs 2021 (WLTP gCO2/km)
40%	-55%

Based on JEC WTT v5 data

Example for HDV trucks (16-32 t) below

Details for other types + buses/coaches in Concawe report [21/2]

Concawe's Transport and Fuel Outlook towards EU 2030 Climate Targets

Additional info

Table 16. Estimated energy consumption and emission intensity for HDV trucks 16-32t

Powertrain	Energy Consumption (MJ/km)			Emission Intensity (g CO2/km)			Emission Intensity (g CO2/tkm)		
	2015	2018	2030	2015	2018	2030	2015	2018	2030
Diesel	9.3	9.3	7.8	682	679	574	110	109	91
CNG	11.5	11.4	10.0	644	641	562	104	103	89
LNG	11.5	11.4	10.0	647	644	564	104	104	90
PHEV	6.7	6.2	4.9	277	212	143	45	34	23
BEV	4.9	4.9	3.9	0	0	0	0	0	0
FCEV	6.9	6.8	5.6	0	0	0	0	0	0
Average new fleet	9.3	9.3	7.5	682	679	476	110	109	76

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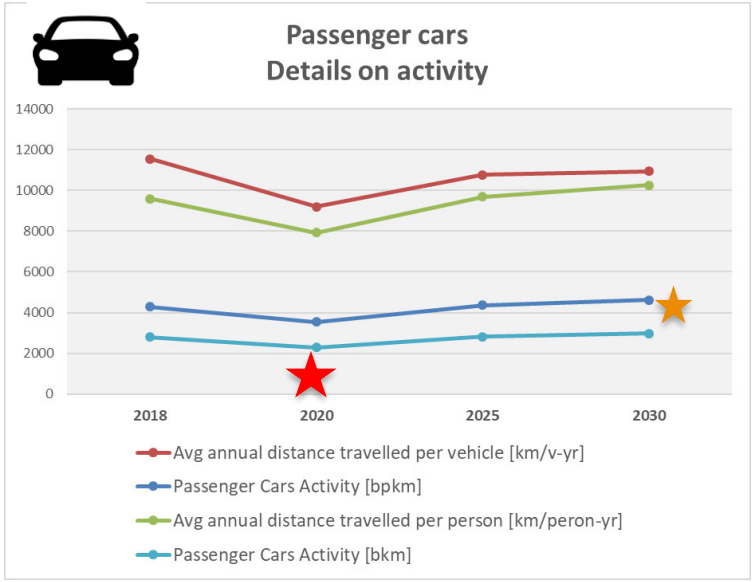
Road Transport: Activity levels (Concawe modelling)

Concawe Modelling



Additional info

Example for HDV trucks (16-32 t) below

Details for other types + buses/coaches in Concawe report [21/2]

Concawe's Transport and Fuel Outlook towards EU 2030 Climate Targets

4.3. HDV TRUCKS 16-32 T

Table 14. Assumptions for HDV 16-32 t (baseline based on statistics and expert's view)

HDV 16-32t	Unit	2015	2018	2030
Sales	Million units	0.1442	0.1444	0.1286
Stock	Million units	1.489	1.584	1.491
Vehicle mileage	km/yr	47500	49800	60300
Load factor	tkm/vkm	6.192	6.213	6.295
Share of BEV in (BEV+PHEV)	%	0%	0%	0%
PHEV e-driving	%	59%	69%	75%

25% increase (2015-2030)

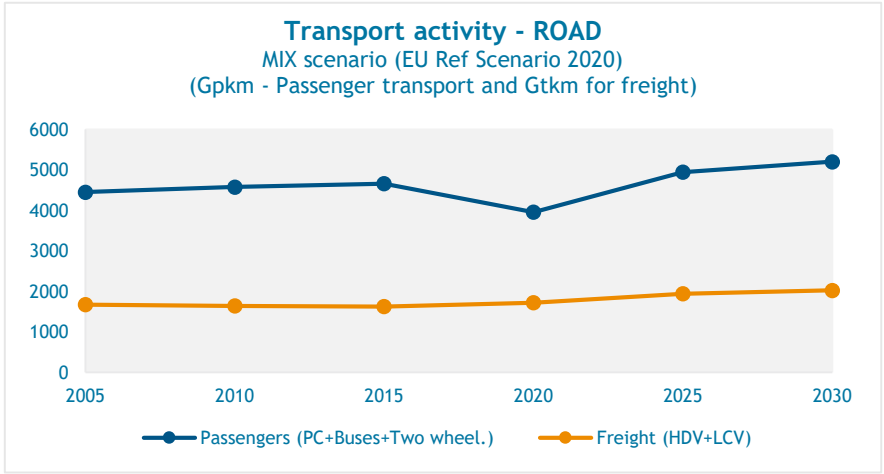
★ Covid impact considered (2020 EU Ref Scenario) (link)

★ Passenger Car activity in 2030 quite similar to EU COM:
- 2020 EU Ref Scenario: 4,533 Gpkm (See slide #10)
- Concawe modelling results: 4,600 Gpkm

Road Transport: Activity levels (2020 EU Ref Scenario)

EU MIX scenario (Excel file)

Excel files for MIX scenario (europa.eu)



	EU:'Fit for 55' MIX					
TRANSPORT	2005	2010	2015	2020	2025	2030 *
Transport activity						
Passenger transport activity (Gpkm)	5277	5453	5618	4498	6088	6487
Buses and coaches	498	484	487	313	473	542
Passenger cars	3841	3981	4057	3548	4354	4533
Powered two-wheelers	115	115	120	100	123	129
Rail	417	444	471	275	532	633
Intra-EU aviation	373	398	450	244	571	612
Inland waterways and domestic maritime	32	31	34	19	36	39
Freight transport activity (Gtkm)	2362	2320	2314	2377	2750	2999
Heavy goods and light commercial vehicles	1677	1645	1628	1721	1945	2027
Rail	395	375	396	382	476	600
Inland waterways and domestic maritime	291	301	290	274	329	371

MIX scenario
Increase in activity PCs:
2005-2030: +15%
2020-2030: 22%
(Covid impact)

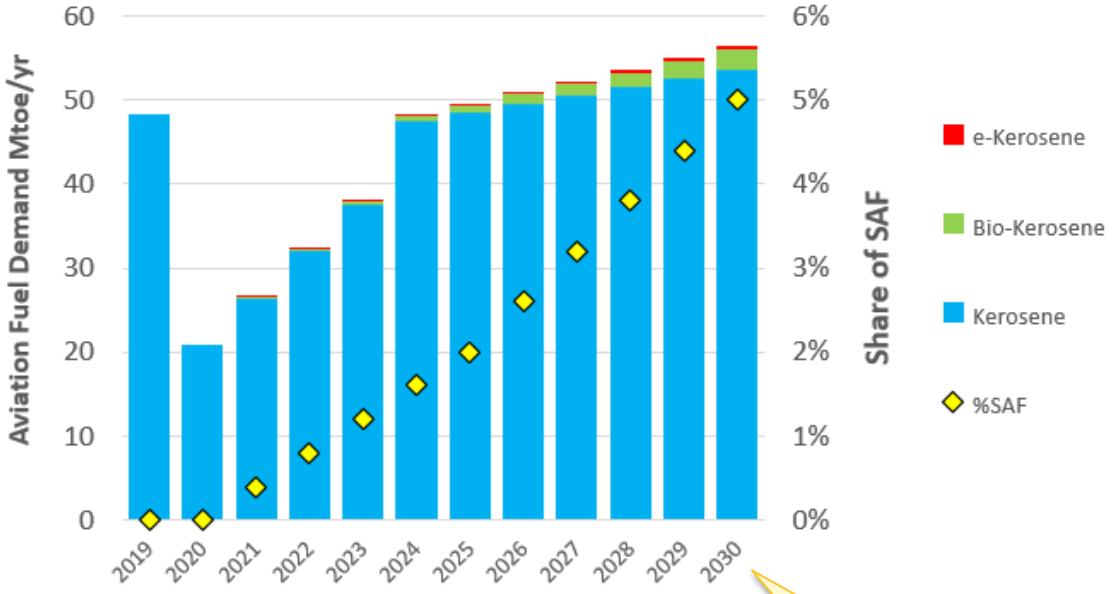
MIX scenario
Increase in activity (HDV+LDV):
2005-2030: +20%
2015-2030:+25%
2020-2030: -15% (Covid impact)

Additional info

Aviation: Total fuel demand and share of SAF

Key Assumptions:

- **Scope: EU27 (Domestic + International)**
- **Total demand in 2019: 48.3 Mtoe [1]**
- **COVID-19 impact:**
  - **Temporary demand reductions during 2020-23**
  - **Total demand in 2020: 20.9 Mtoe [2]**
  - **Recovering to 48.3 Mtoe in 2024**
  - **No impact on long-term trend**
- **Historical emissions: EEA database [3]**
- **Demand growth during 2022-2030:**
  - **4.7%/yr increase based on avg growth during 2014-19 [1]**
  - **2%/yr decrease due to efficiency improvement [4]**
  - **Net demand growth: +2.6%/yr during 2024-2030**
- **2030 demand estimate: 56.4**



Baseline EU27 Aviation fuel demand Projection: applying a 4.7% growth rate during 2024-2030 based on the 2015-19 5-year average in conjunction with a 2% annual efficiency improvement.

+17% total growth in energy demand versus 2019

[1] Eurostat: https://ec.europa.eu/eurostat/databrowser/view/nrg_bal_c
[2] EU Reference Scenario 2020 | Energy (europa.eu)
[3] EEA greenhouse gases - data viewer — European Environment Agency (europa.eu)
[4] Estimating sustainable aviation fuel feedstock availability to meet growing European Union demand (theicct.org)

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Aviation: Total 2030 fuel demand (Data analysis)

Additional info

Uncertainty in total 2030 fuel demand for aviation

a) A Clean Planet for All [EU COM]

~57 Mtoe (EU28) x 78% (Adjustment factor to EU27 based on statistics) = **44 Mtoe** (EU27)

A Clean Planet for All: com_2018_733_analysis_in_support_en_0.pdf (europa.eu)

b) EU Reference Scenario 2020 / Energy [EU COM]

Similar estimate as in A Clean Planet for All

c) Comparison with historical values

2019 data: 48 Mtoe (EU27)

~45 Mtoe (a/b) projections by 2030 seems too low

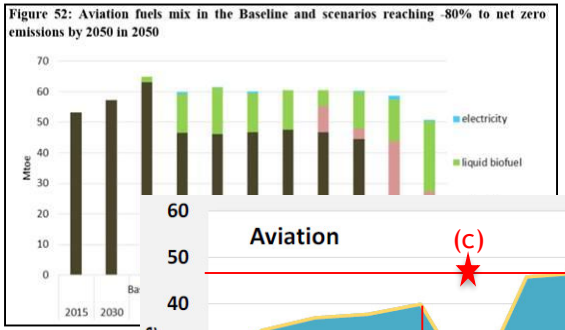
d) Other 2030 projections.

E.g. ICCT 2021 (62,8 Mt in 2030)

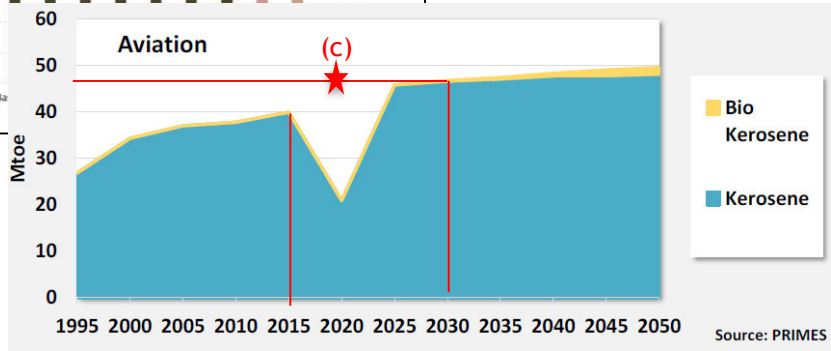
Baseline jet fuel demand

We project future EU-27 jet fuel demand by applying a 4.5% growth rate based on the 2014-2018 five-year average (Eurostat, 2020) in conjunction with a 2.0% annual efficiency improvement (EASA, EEA, EUROCONTROL, & ICAO, 2019). For our central estimate, we expect jet fuel demand to be 55.5 Mt in 2025, 62.8 Mt in 2030, and 71.1 Mt in 2035. The sharp and likely temporary emission reductions across the aviation sector as a result of the COVID-19 pandemic were not accounted for this analysis.

(a)



(b)



As a consequence of this uncertainty
→ Our Concawe modelling 2030 projections for Aviation fuel demand
→ ~56,4 Mtoe (EU-27)

Based on (see details and sources of information used in slide #8):

- recovery to pre-COVID volumes in 2024 (industry estimate)
- a 4.7% growth rate during 2024-2030 based on the 2015-19 5-year average in conjunction with a 2% annual efficiency improvement

Estimating sustainable aviation fuel feedstock availability to meet growing European Union demand (theicct.org)

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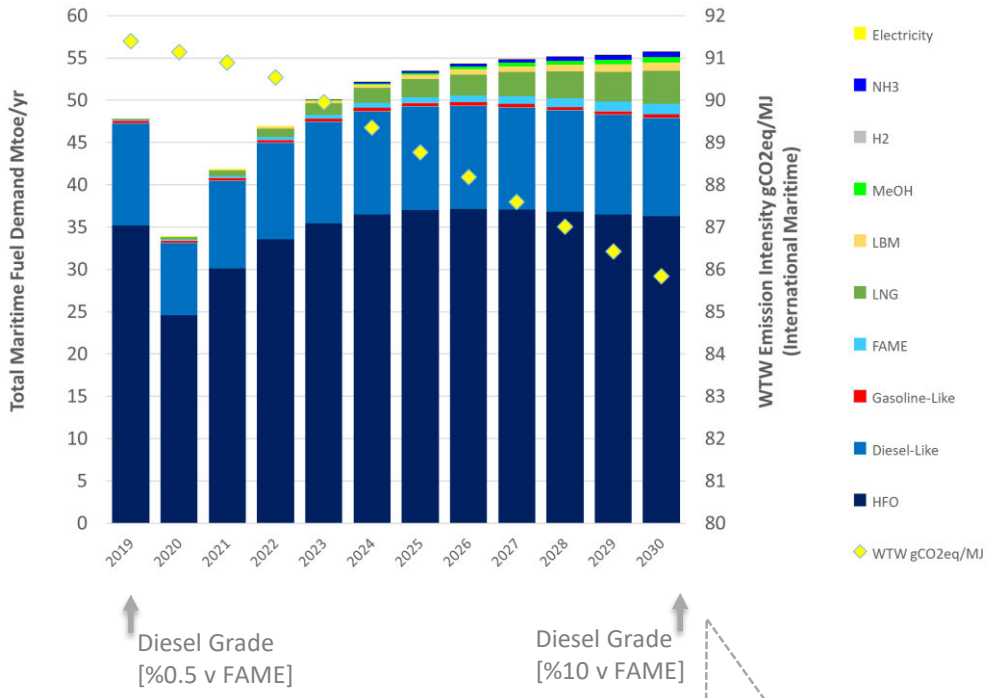
Maritime: Fuel demand and Emission Intensity

Key Assumptions: Domestic Navigation

- Total demand in 2019: 4.2 Mtoe [1]
- COVID-19 impact:
  - Total demand in 2020: 3.4 Mtoe [2,3]
  - No impact on long-term trend
- 2030 demand estimate: 5.0 Mtoe, based on [4]
- Historical emissions: EEA database [5]

Key Assumptions: International Navigation

- Total demand in 2019: 43.6 Mtoe —based on [1]
- COVID-19 impact:
  - Total demand in 2020: 30.5 Mtoe [2,3]
  - No impact on long-term trend
- 2030 demand estimate: 50.8 Mtoe, based on EU COM [4]
- Historical emissions: EEA database [5]



✓ **International Maritime: Emission Intensity Reduction 6% vs 2020**

~15% total growth in energy demand versus 2019

Fuel Mix in 2030 (assumptions):

Gasoline: ~1%	
MGO	20%
HFO	65%
LNG	7%
LBM	2%
FAME	2%
Elec	0.1%
HVO	1.2%
e-MeOH	1.2%
e-NH3	1.2%

Note. Assumptions for baseline should not taken as a forecast. Baseline based on equal mix of HVO/e-MetOH and e-NH3 as new fuels into the mix

[1] Eurostat: https://ec.europa.eu/eurostat/databrowser/view/nrg_bal_c
[2] SR_FuelsEurope-_2021.pdf
[3] EU Reference Scenario 2020 | Energy (europa.eu)
[4] A Clean Planet for All: com_2018_733_analysis_in_support_en_0.pdf (europa.eu)
[5] EEA greenhouse gases - data viewer — European Environment Agency (europa.eu)

2 RED III

RED III (Alternative LCF Scenario)

Additional Annex IX Part A and RFNBO/RCF required to comply with sub-mandates

(Delta: ~+ 10 Mtoe <> + 20% vs baseline)

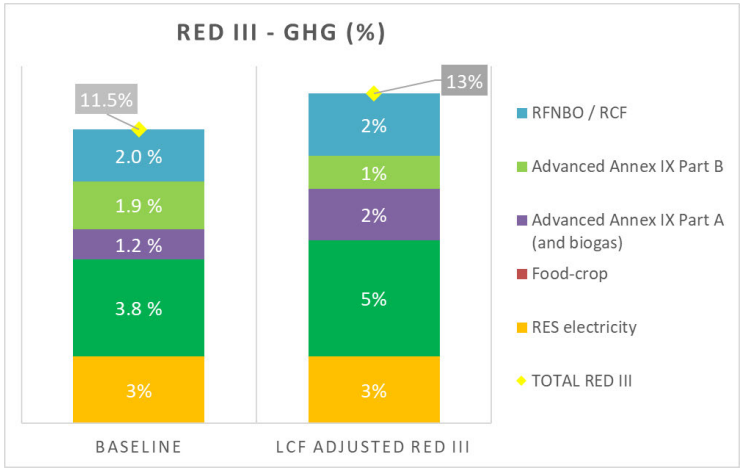
Beyond volumes estimated in Concawe scenarios

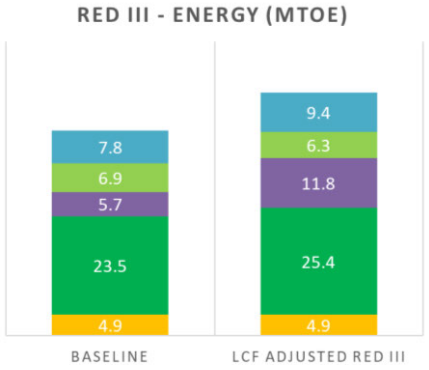
2030				GHG emissions
Fuel or energy carrier	Target/cap	% energy (no multipliers)	% energy with multipliers	Absolute values - no multiplier
Total Ren. Electricity		**1.4%**	**1.4%**	2.6%
Ren. electricity in road transport		0.7 %	**0.7%**	1.4%
Ren. electricity in rail transport		0.6 %	**0.6%**	1.2%
Ren. electricity in all other transport modes		0 0 %	**0.0%**	0.0%
Compliant biofuels		**11.4%**	**11.6%**	7.8%
Food-crop	**7% energy (MAX)**	7.0 %	**7.0%**	4.5%
Advanced part A (and biogas)	**2.2% energy (min)**	2.7 %	2.9 %	2.0%
Advanced part B	**1.7% energy (MAX)**	1.7 %	**1.7%**	1.3%
RFNBO / RCF	**2.6% energy (min)**	2.6 %	2.8%	2.4%
as final fuels (e-fuels / e-H2)		1 2 %	**1.4%**	1.2%
as intermediate (e-H2) for fossil fuel production		1 3 %	**1.3%**	1 3 %
Total RES-T target (all transport sectors)	13% GHG Intens (min)	15.3 %	15.7 %	13 %

In order to comply with Part A/B, reduction of ~30% of Part B in HEFA (far below the current levels and projections in the IA)

Relevance of potential expansion of list Annex IX + relevance of cap on Part B

Comparison with Concawe Scenarios

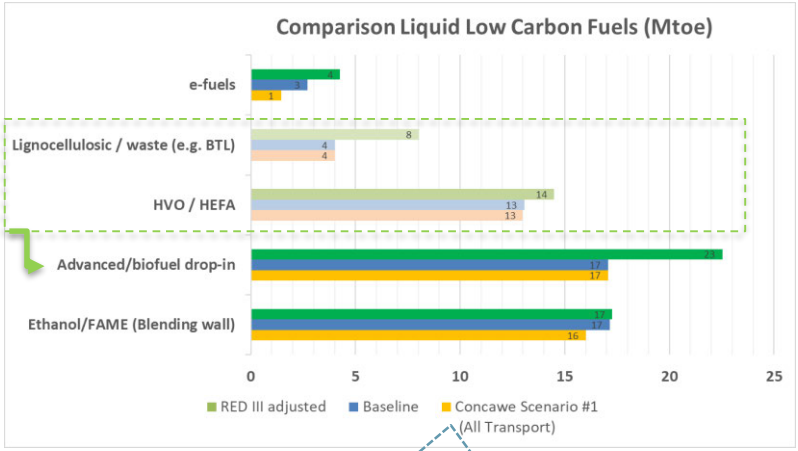




Liquid Low Carbon Fuel

(Details)

Demand



The adjusted RED III scenario (based on the baseline fleet) would require vs Concawe Scenario #1:

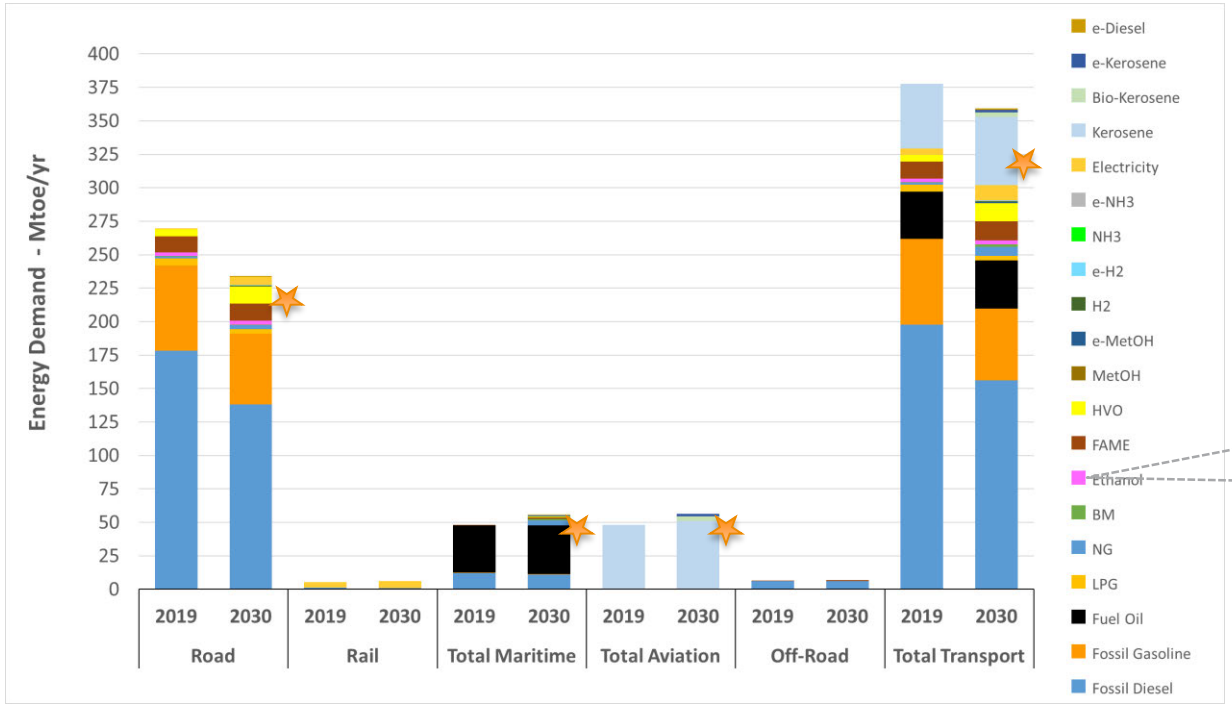
x 4 times e-fuel production
(Total 4 Mtoe including ~1.5 Mtoe e-MetOH and e-NH3)

+30% (~6 Mtoe) additional capacity of Drop-in biofuels
(Total ~25 Mtoe)

Technical readiness / industrial deployment rate / supply chain challenges to achieve RED III-T target/sub-mandates!

Total Transport: Fuel Demand (EU27)
RED-III compliance

(Fleet evolution + CO_2 standards in Road + FuelEU Maritime + ReFuelEU Aviation+RED III)



21 Mtoe/y

~4.5 (Dom.) + 43,5 (Int.) Mtoe/y

~4.5 (Dom.) + 40 (Int.) Mtoe/y

Total: 31 Mtoe/y

~3% reduction in total energy demand vs 2019

~15% reduction in fossil liquid fuels (gasoline, diesel, HFO, LPG, Kerosene) vs 2019

Data from MIX Scenario (2030) Excel files for MIX scenario (europa.eu)

3

ETS

2030 GHG emissions vs proposed cap

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ETS - GHG emission reduction

NEW! Road (and buildings) in new ETS

Objective: **-43%** GHG emissions (cap) reduction in fossil GHG (TTW) in road in 2030 vs 2005

Aviation & Maritime (with Industry) in separate ETS

Objective: **-61%** GHG (absolute) in 2030 vs 2005 for industry, aviation and maritime transport. Upcoming revision for free allowances

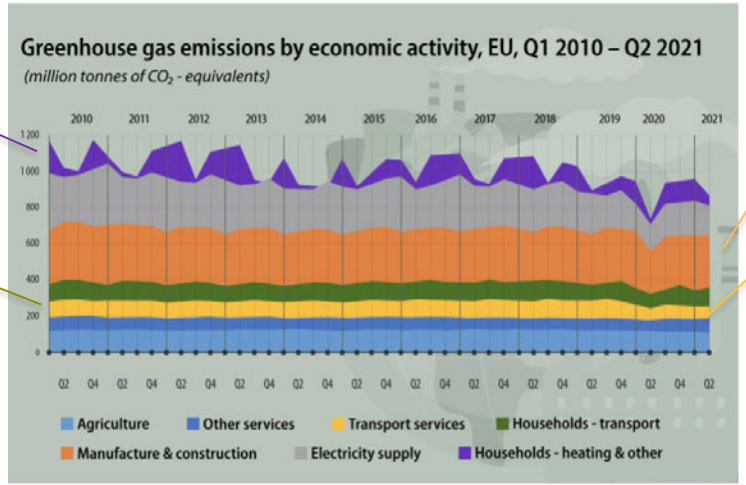
CROSS SECTORIAL NATURE!

A look into EU GHG report (Eurostat in 2021) - No specific data on scope of each ETS clearly defined in the IA

Households

(6% heating and other purposes)

Transport - Households (Passenger Cars?) (~12%)



ec.europa.eu/eurostat

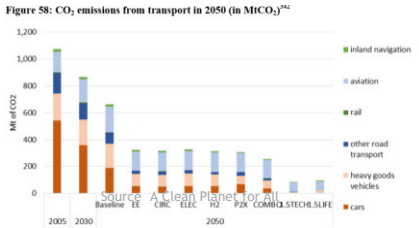
Manufacture and construction (34%)

Transport services (Aviation/Maritime/HDV?) (~8%)

~1/3

~2/3

Inland navigation



Source: A Clean Planet for All

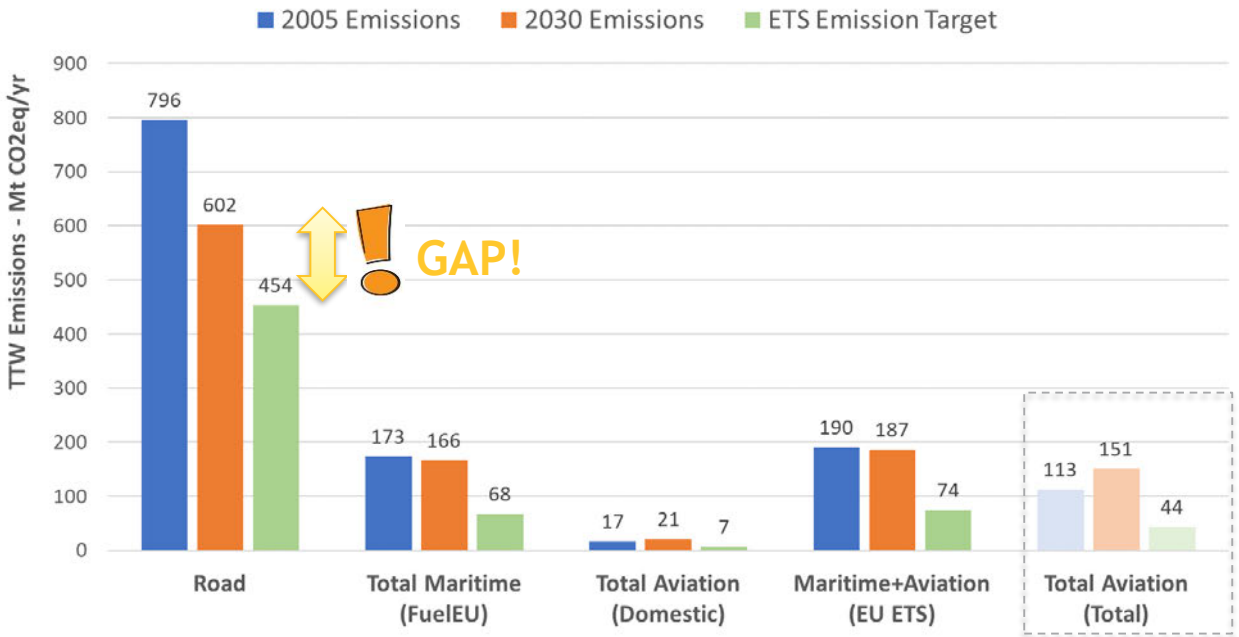
Source: PRIMES

Eurostat releases for the first time estimates of quarterly EU greenhouse gas emissions - Products Eurostat News - Eurostat (europa.eu)

ETS Target and GHG Emissions change compared to 2005

Results: Comparison of ETS Target and TTW GHG Emissions in 2030 (with biogenic credits)

How EU COM approached this gap issue?



2030 Emission vs 2005	-24%	-4%	+22%	-2%
ETS Target	-43%	-61%		

~35%

Subject to CORSIA (if same % as ETS is applied)

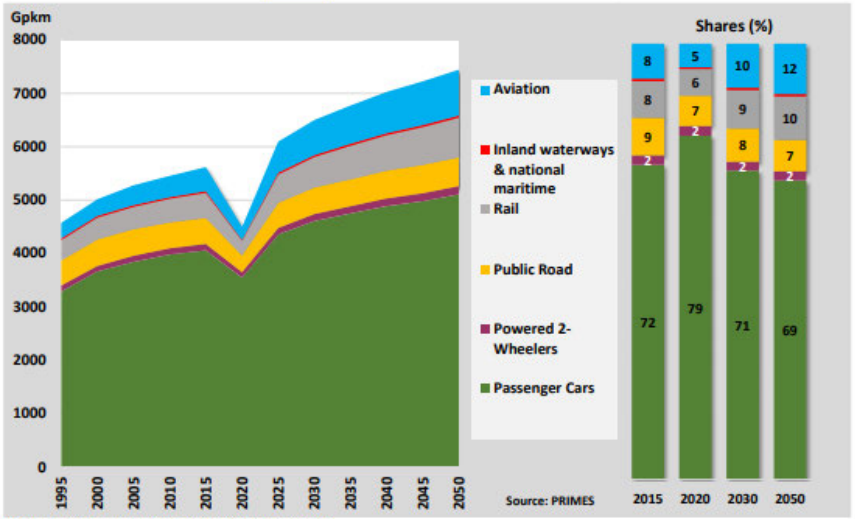
Note. Road (WLTP emissions considered, not RDE)

Road Transport: Modal shift / activity levels

2020 EU reference Scenario

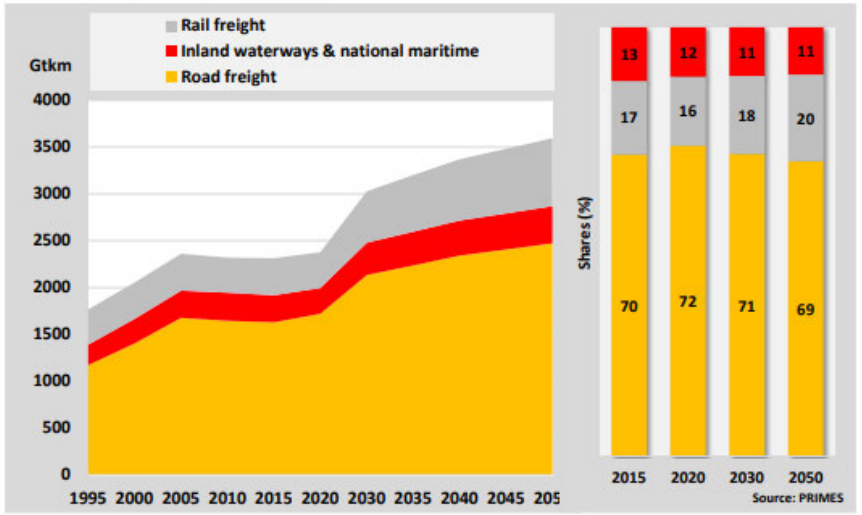
Additional info

Figure 32: Passenger transport activity by mode



Note: Aviation includes only intra-EU aviation

Figure 33: Freight transport activity by mode



Modal shift towards rail/waterways seems limited

Modal shift and activity levels in road (see slide #9-10) do not seem to explain reduction in activity to fill in the ETS gap (see slide #20)

Anything else missing?

Concawe

Thanks!!

Concawe