

Latest Trends for Passenger Car

Waseda University, December 14th, 2023

G. Fraidl

Flashlight on PassCar Regional Trends

(European Perspective December 2023)

EUROPE

- Tank to Wheel CO₂
 - Push to BEV
 - ICE Sales stop 2035

Automotive News Europe
September 20, 2023 12:37 PM

**Britain pushes back ban on new ICE cars;
automakers slam delay**



**LONG-TERM DECISIONS
FOR A BRIGHTER FUTURE**

**Just matching to EU ?
back to economic reality ?**

Or even more ?



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*) Renewable Energy Directive

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- CO₂ neutral fuel as potential back-door for ICE ?
- Funding schemes and RED*) not in favor of e-fuels
- EU7 late changes, timing & content still discussed

“Dogmatic”
Electrification

Political Dogma:
“ICE is bad – BEV saves the world !”

Potential Game Changers

*) Renewable Energy Directive

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“Dogmatic”
Electrification

The New York Times
European Climate Czar Steps Down to Take Part in Dutch Elections
Frans Timmermans is stepping down at a crucial time for European climate laws to become the lead candidate for a left-wing coalition in the Dutch elections in November.



EUROPEAN
ELECTIONS
2024

REVIEW
CO₂ STANDARDS
2026

LIFE CYCLE
assessment
methodology
2025

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“Dogmatic”
Electrification

CHINA

- Electrification
= BEV+HEV

Changes in NEV Share

PHEV

BEV

25,0%

34,0%

75,0%

66,0%

Oct. 2022

Oct. 2023

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**“Dogmatic”
Electrification**

CHINA

- Electrification = BEV+HEV
- New Dedicated Hybrid Engines

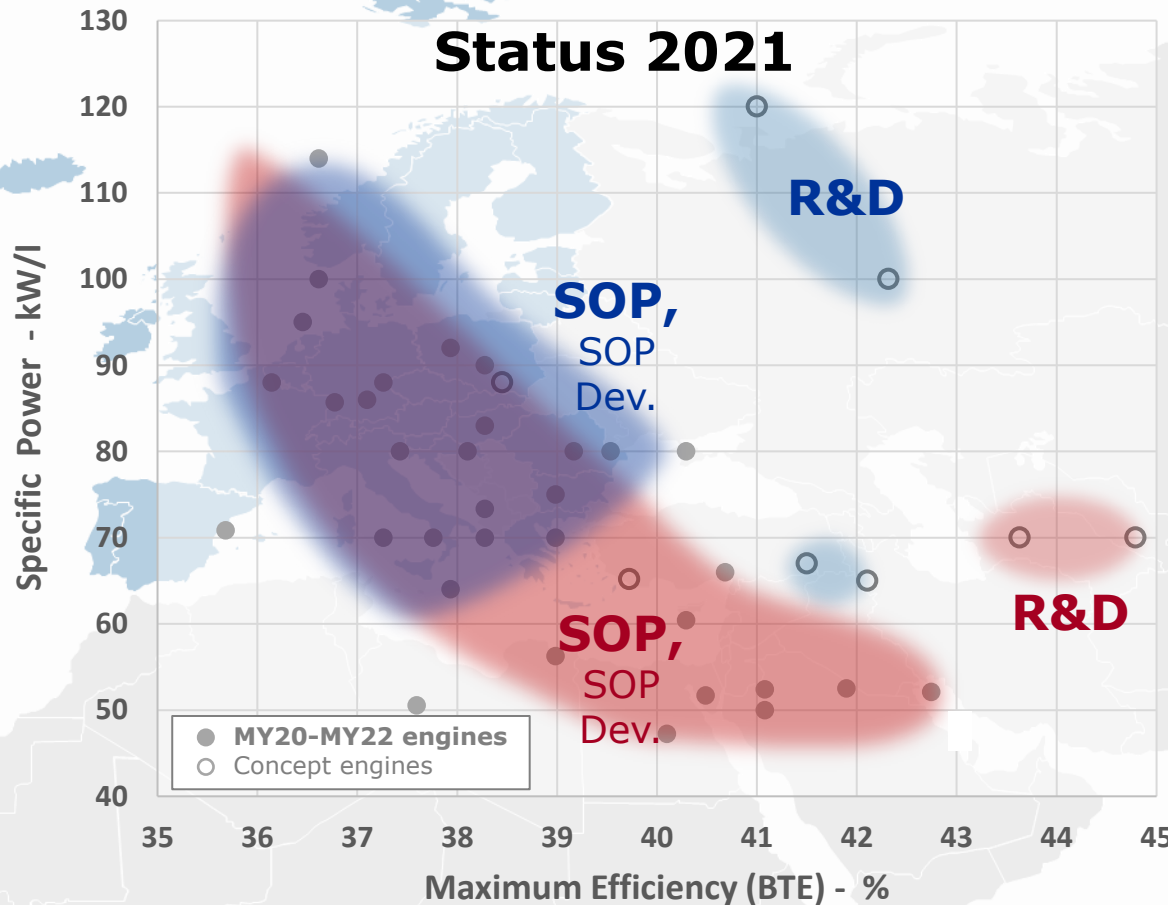


Engine Power / Efficiency Trends

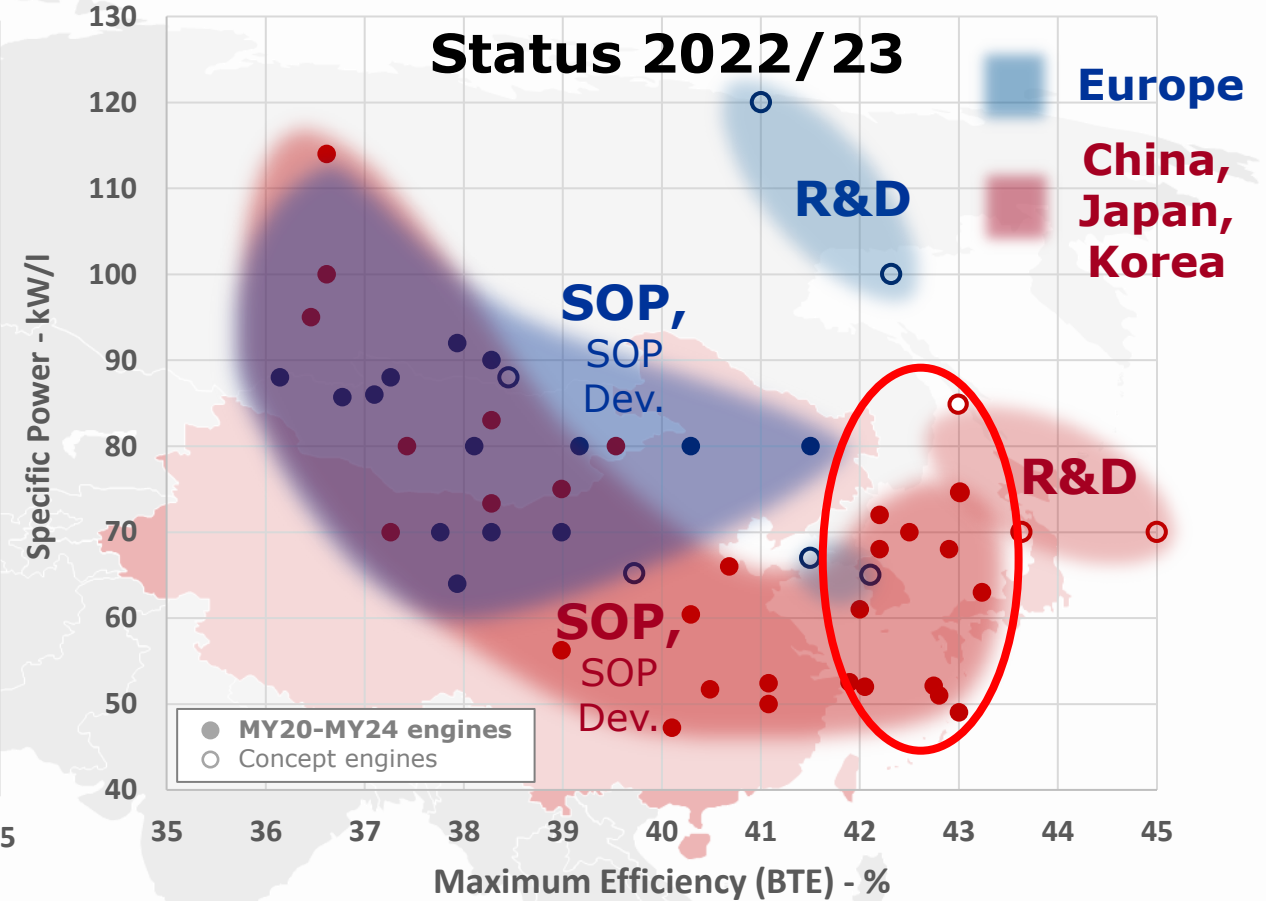
EUROPE versus ASIA

Stoichiometric Gasoline Engines

Status 2021



Status 2022/23



**Europe is applying same modular base ICE's both for Stand Alone and Hybrid,
Asia is developing new Dedicated Hybrid Engines with top efficiency**

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Electrification

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- Electrification
NEV = BEV+HEV
- New Dedicated Hybrid Engines
- Push for H₂ and Methanol ICE also with PassCar
- Hype for Range Extender
- Towards Well to Wheel FE legislation

“Pragmatic”
Electrification



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Electrification

CHINA

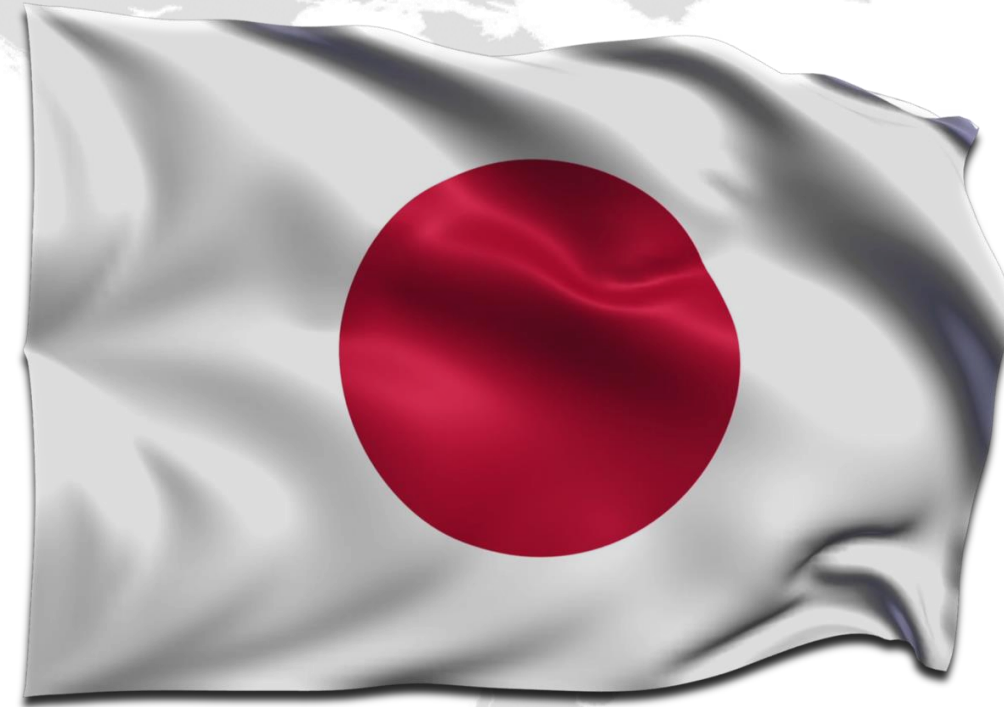
- Electrification
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“Pragmatic”
Electrification

Japan

- Comprehensive view on CO₂ and energy supply
- Well to Wheel CO₂ legislation for most cost-effective CO₂ reduction
- Still proceeding with Hybrid
- H₂-ICE also with PassCar

“Fact based”
Electrification



Flashlight on PassCar Regional Trends

(European Perspective December 2023)

*) Renewable Energy Directive



EUROPE	CHINA	Japan	US
• Tank to → Push to → ICE Sal • CO₂ neut - as potent - door for IC • Funding so - and RED*) r - favor of e-fu • EU7 late cha - timing & con - still discusse	• Comprehensive view on CO₂ and energy supply • Well to Wheel legislation - most cost-effective CO₂ reduction	• “Inflation Reduction Act” as immense push for localization of green technology and energy • Offset between political wish towards BEV and infrastructure & customer needs	
“Dogmatic” Electrification	“Pragmatic” Electrification	“Fact based” Electrification	“Protective & Opportunistic” Electrification

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“Fact based”
Electrification

US

- “Inflation Reduction Act” as immense push for localization of green technology and energy
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“Protective & Opportunistic”
Electrification

Emerging Countries

Quick growth of electrification limited by:

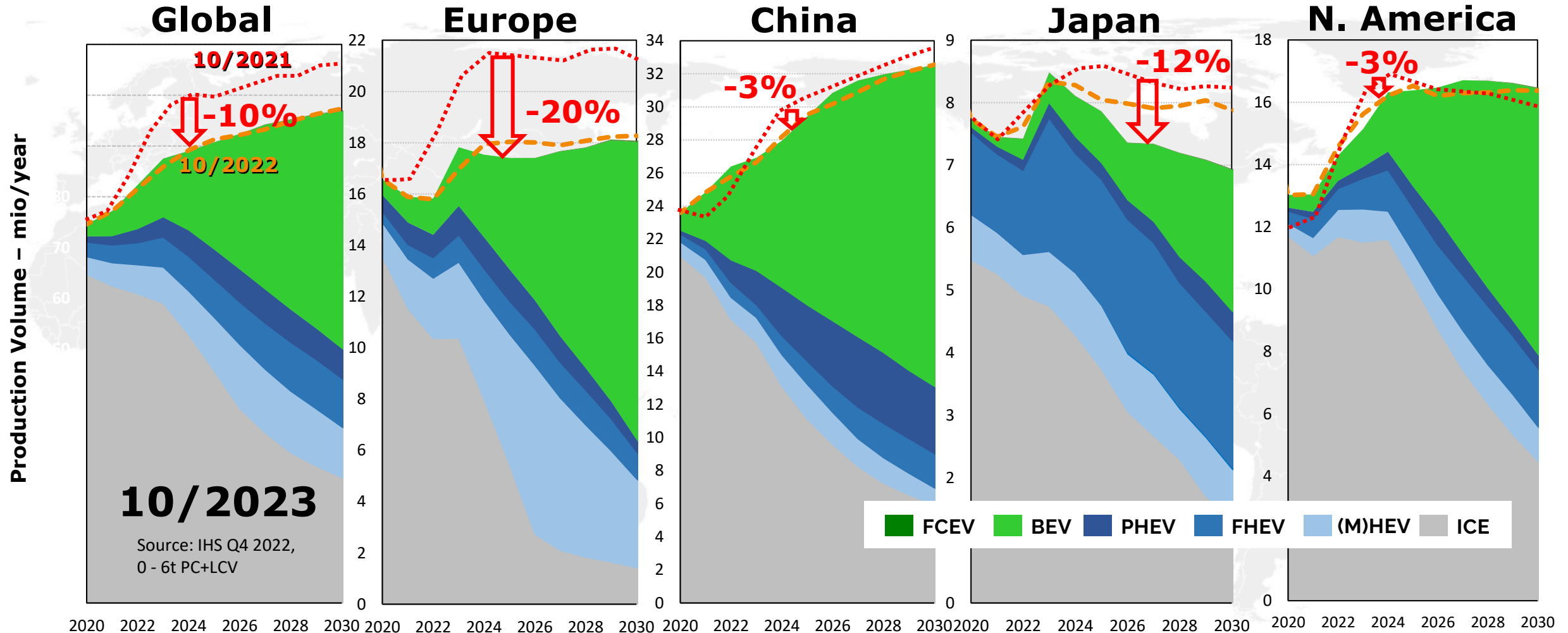
- Primary energy supply
- Infrastructure
- Affordability

“Limited”
Electrification

Different political priorities – Europe on economically risky path

PassCar Production Volumes

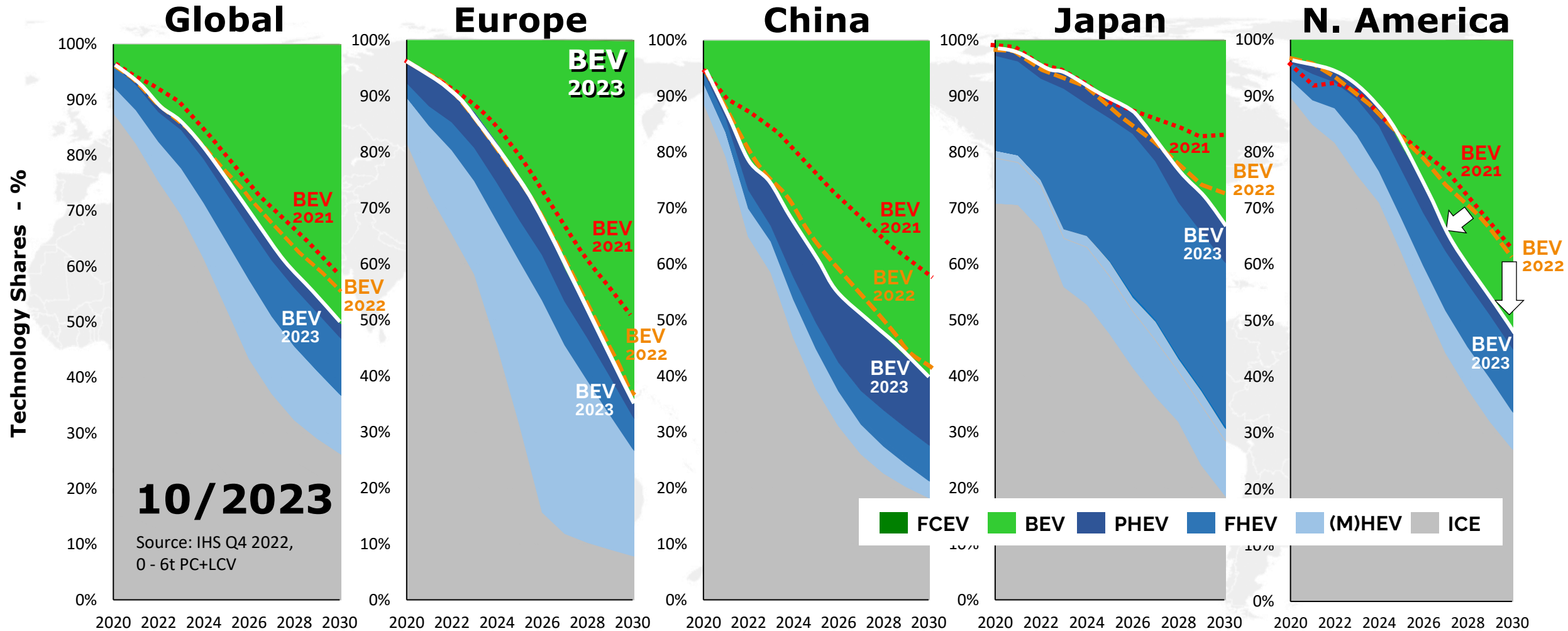
IHS Prediction 10/2023 vs. 10/2022 vs. 10/2021



Most significant drop of production volumes in Europe and Japan

PassCar Technology Split

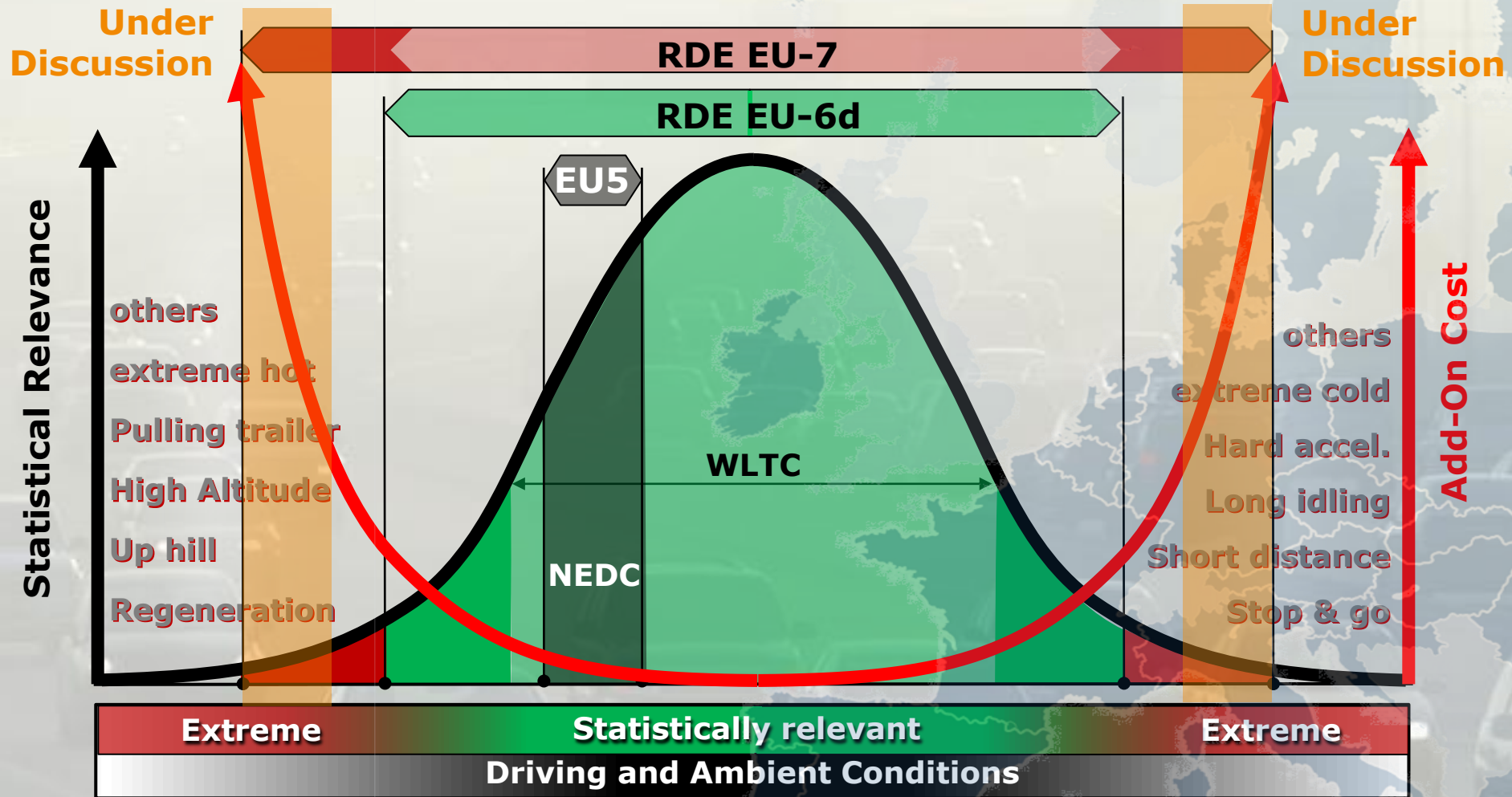
IHS Prediction 10/2023 vs. 10/2022 vs. 10/2021





Pollutant Emission

EU Pollutant Emission Legislation versus Statistical Relevant Driving Conditions



EU6 → EU7: From "Focus on statistical relevant areas" towards "Emission-free always and everywhere"

EU Pollutant Legislation History (Schematic)



Not representative boundaries (NEDC)

→ **Compromising AIR QUALITY**



Focus on statistical relevant boundaries

→ **Most cost-effective improvement of Air Quality**



Political Dogma: Max. emission reduction w/o regard to statistical relevance & cost

→ **Compromising AFFORDABILITY**



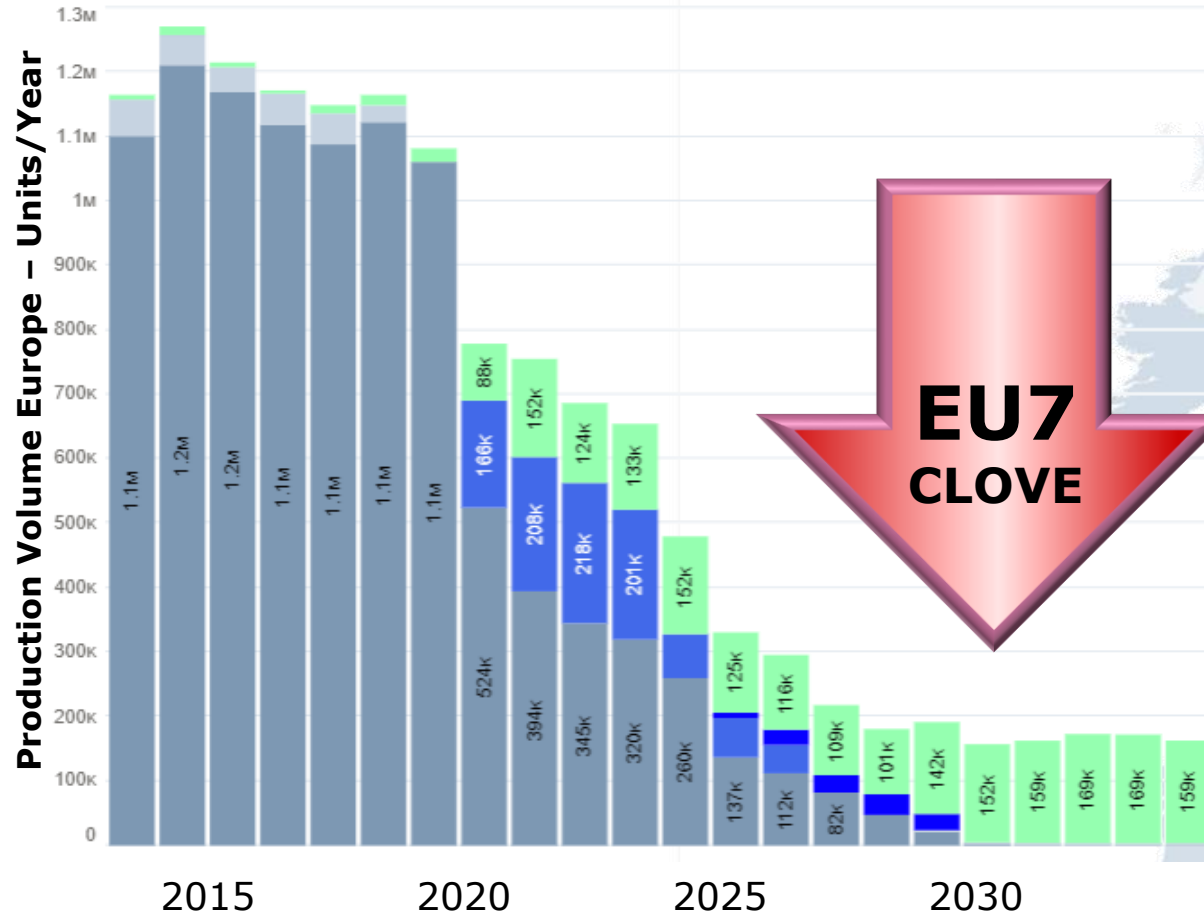
Organized resistance against EU7 Commission Proposal

→ **Back to reasonable approach or overshooting ?**

Euro 7 - Damage already happened



Production Forecast A-Segment Vehicles Europe

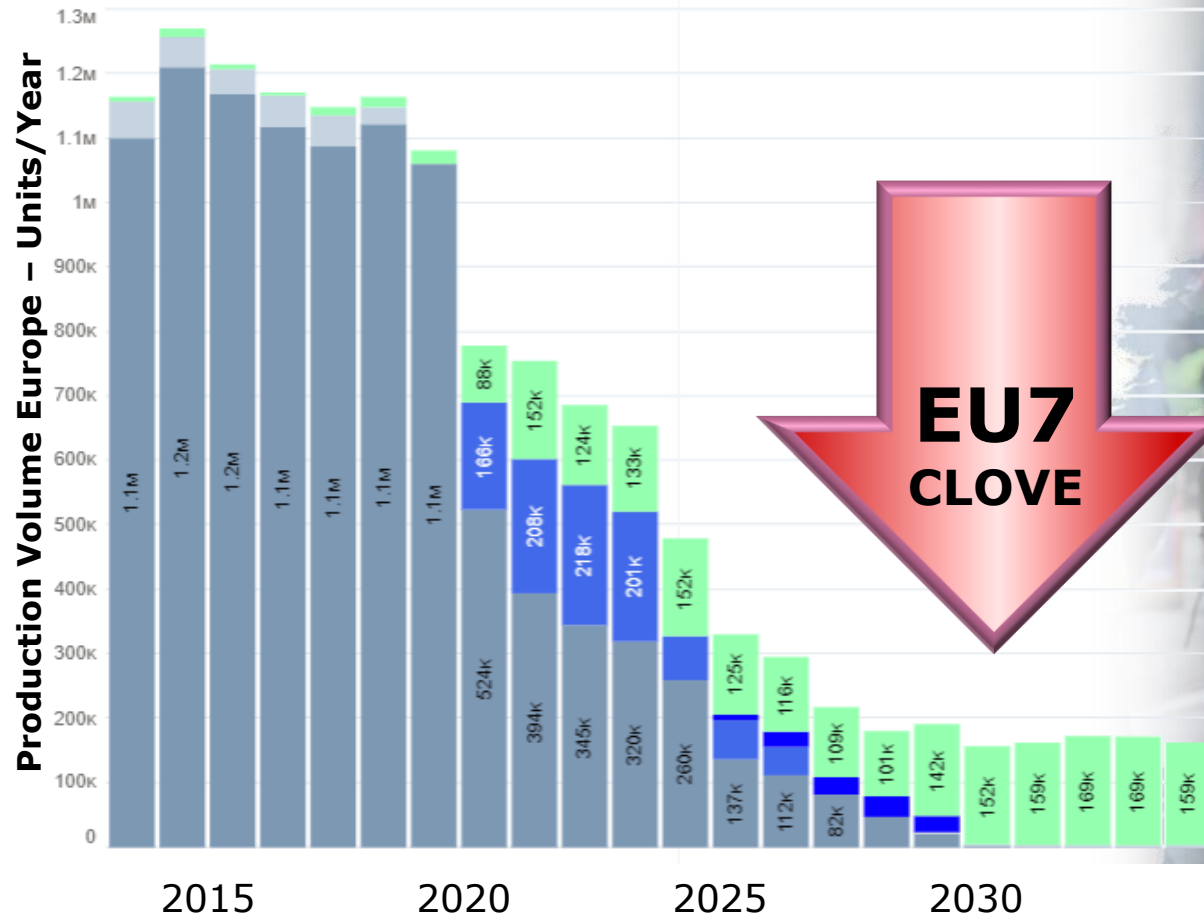


*) ..Data Source: IHS 10/2022

EU-OEM's won't offer affordable A-Class vehicles anymore

Risk of a Too Severe EU7 Legislation

Production Forecast A-Segment Vehicles Europe

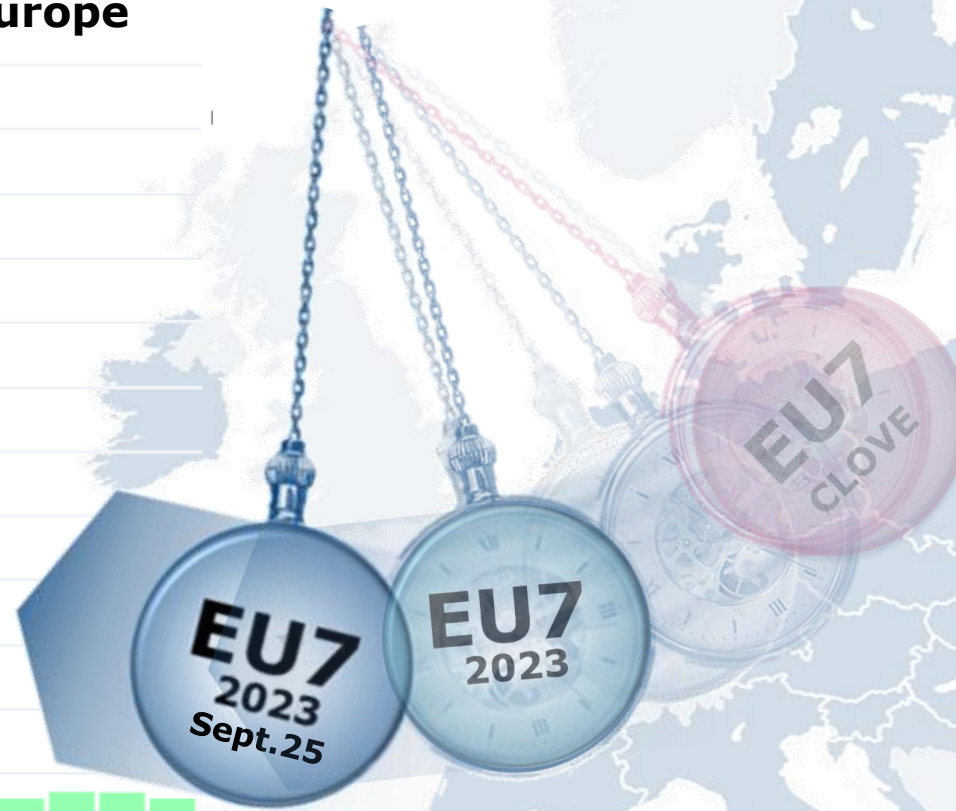
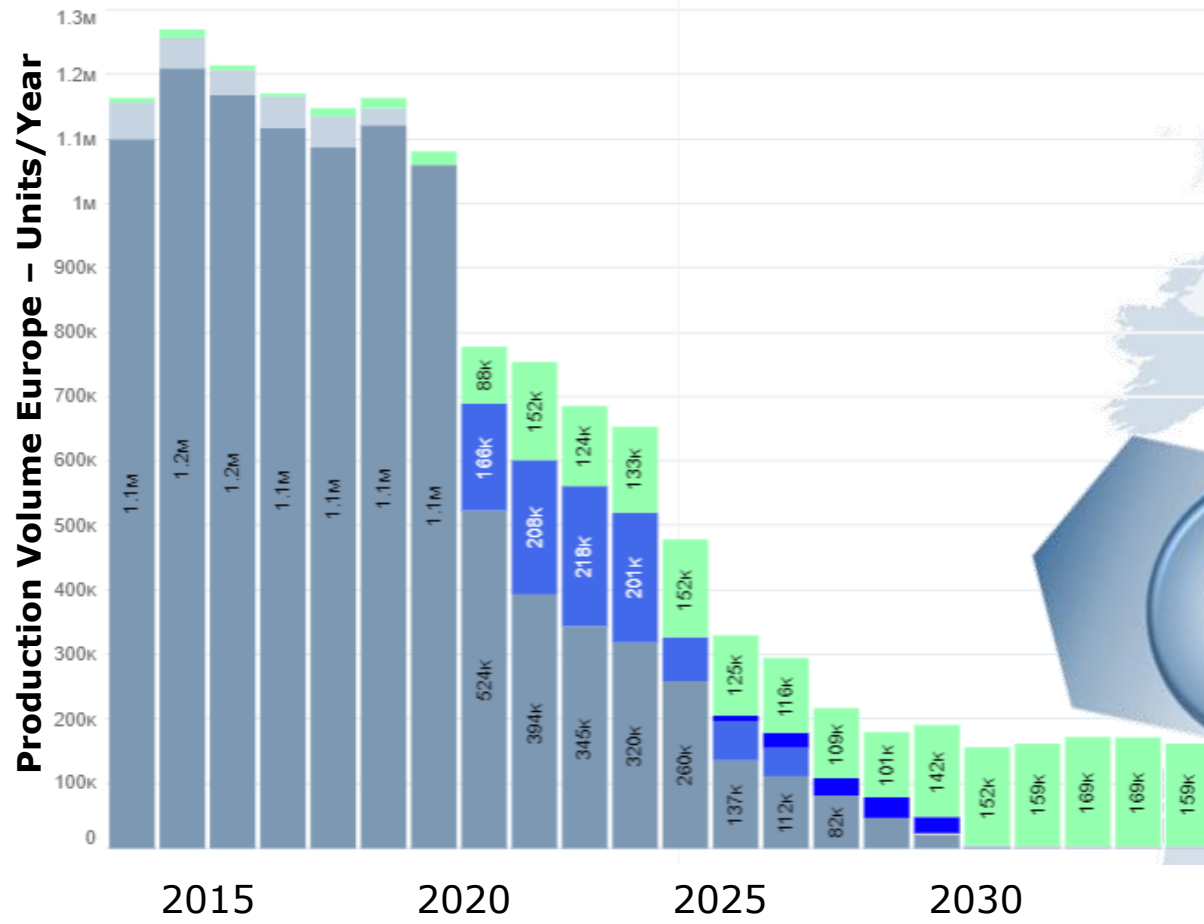


How will aggressive parts of our society react when they recognize the upcoming burdens on individual mobility ?

We might face a **SOCIAL CHALLENGE**

Risk of a Too Relaxed EU7 Legislation

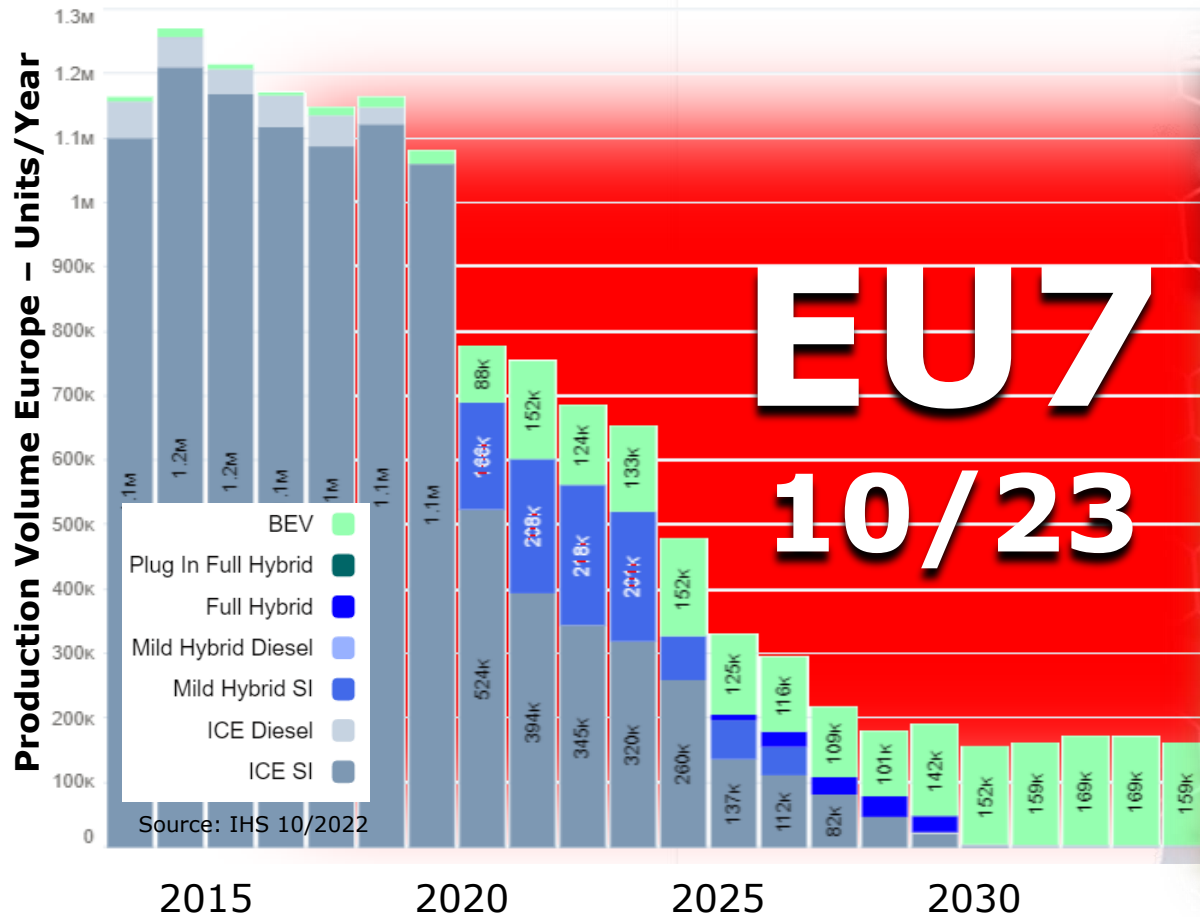
Production Forecast A-Segment Vehicles Europe



Actual Council Proposal swinging back to EU6e⁺ level

Risk of a too relaxed EU7 Legislation

Production Forecast A-Segment Vehicles Europe



EU7 acc. to Council proposal would fully open EU-ICE Market for Chinese OEM's

EU: Emission & Energy Related Legislation

EU Vehicle Emissions are regulated by:

- **3 different legislations**, which are made by
- **3 different EU Commission Directorate-Generals (DGs)**



CO₂ legislation by DG-CLIMA:

DG Climate fights against climate change at European and international level.

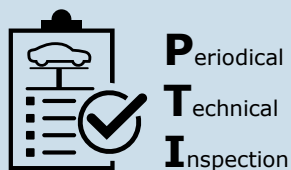
- Limits CO₂ average fleet emission. This the discussion about "Ban of ICE", H₂ and e-fuels.



Pollutant emission legislation by DG-CROW:

DG Internal Market, Industry, Entrepreneurship focuses on internal and global market, goods, services, growth and intellectual properties.

- Limits the pollutant emissions
- Defines how CO₂ is measured



Periodical Technical Inspection by DG-MOVE:

DG Mobility and Transport aims to promote a mobility that is efficient and environmentally friendly.

- Defines the requirements of the periodical technical vehicle inspections.

Understanding how EU legislations are made



EU legislation making process is complex:



EU legislation making process:

The EU Commission proposes a legislation followed by a negotiation between the

- **European Commission**
- **European Parliament**
- **European Council**

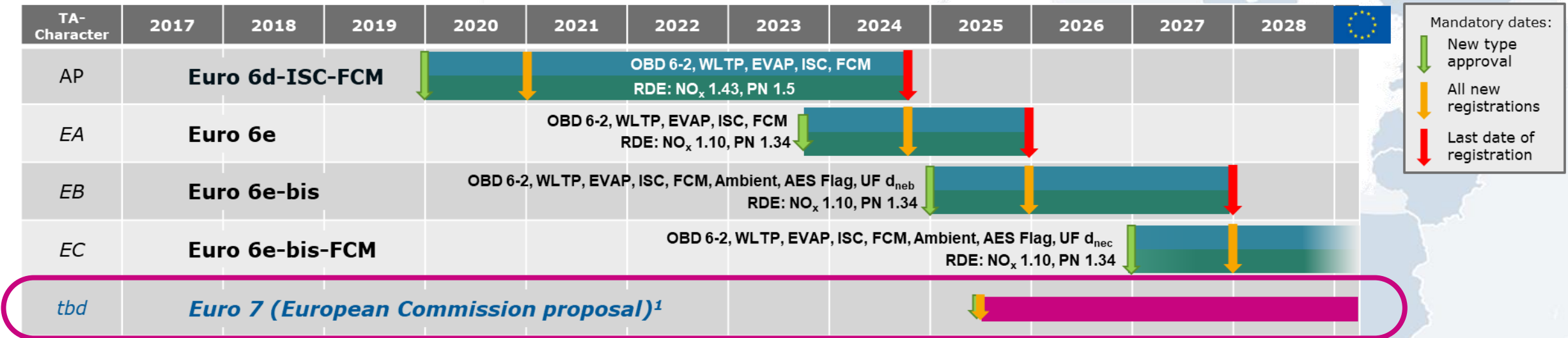


Trilogue:

Trilogue is an informal negotiation between the European Parliament, the Council and the Commission.

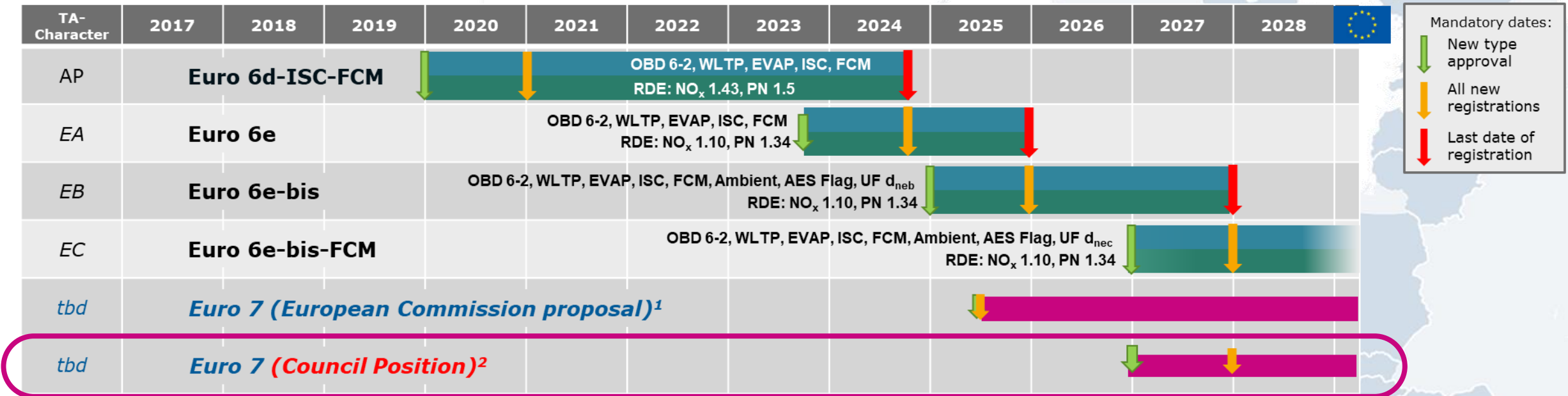
The aim is to reach a provisional agreement and resolving outstanding issues on a legislative proposal from the EU Commission, that is acceptable to all.

Euro 6d, 6e & Euro 7 Implementation Passenger Cars



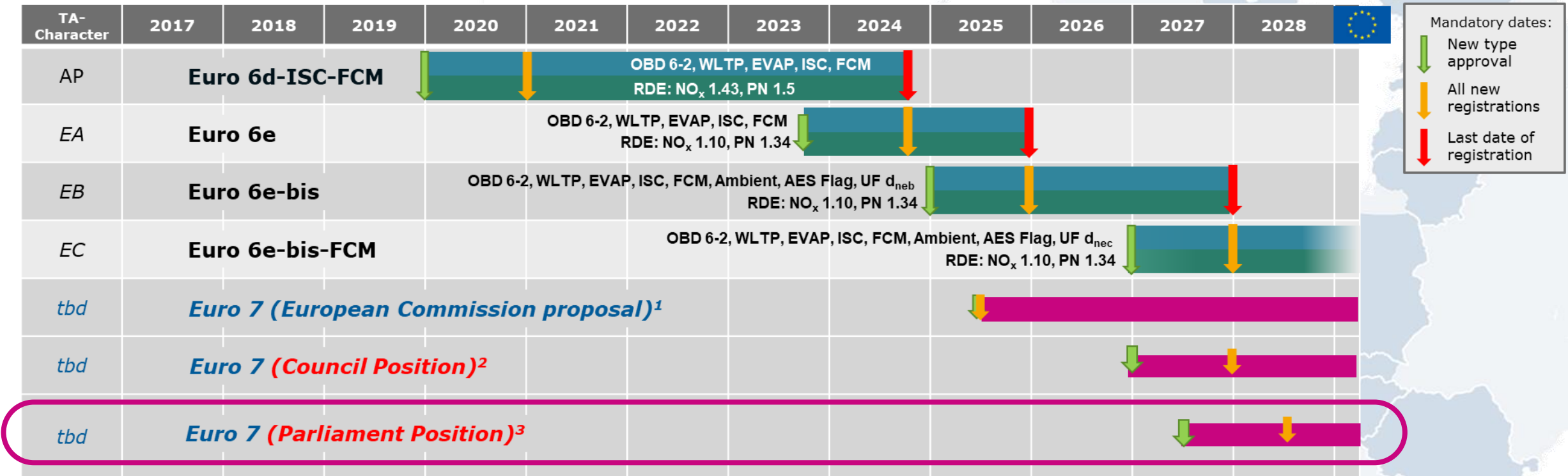
**EU-Commission proposes mid 2025 (NT+AT)
for EU7 introduction**

Euro 6d, 6e & Euro 7 Implementation Passenger Cars



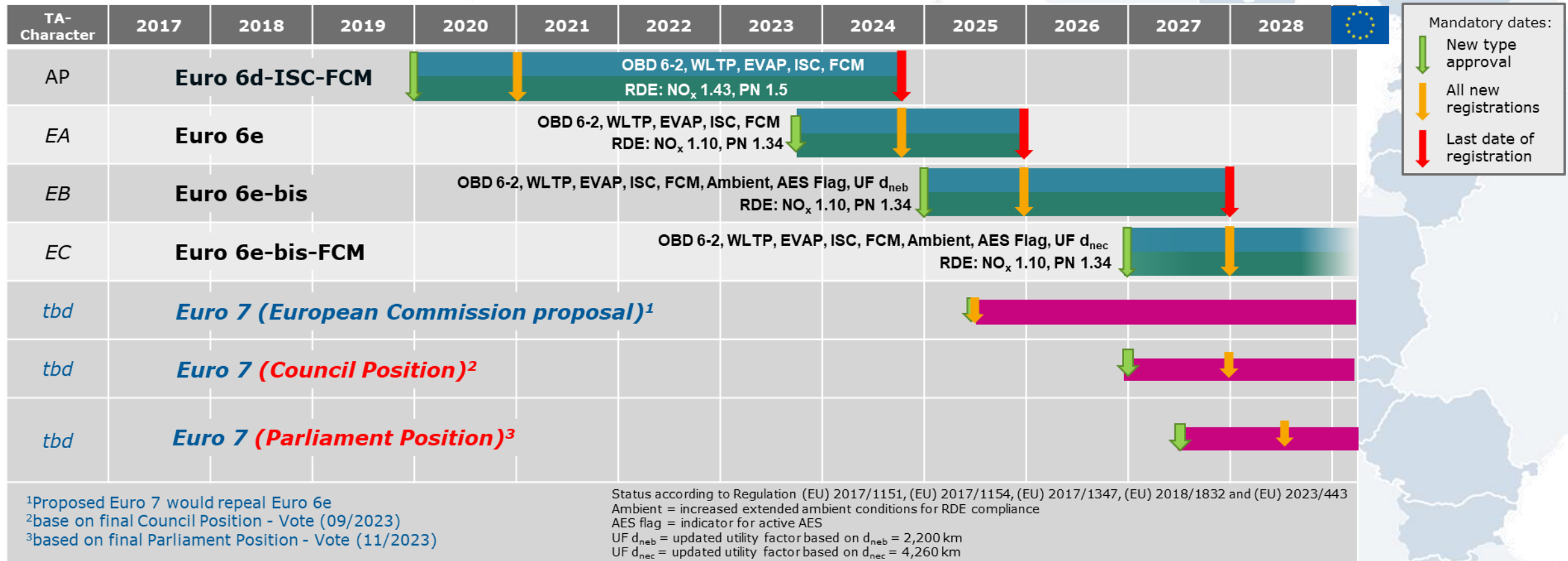
**EU-Council proposes begin 2027(NT) / 2028 (AT)
for EU7 introduction**

Euro 6d, 6e & Euro 7 Implementation Passenger Cars

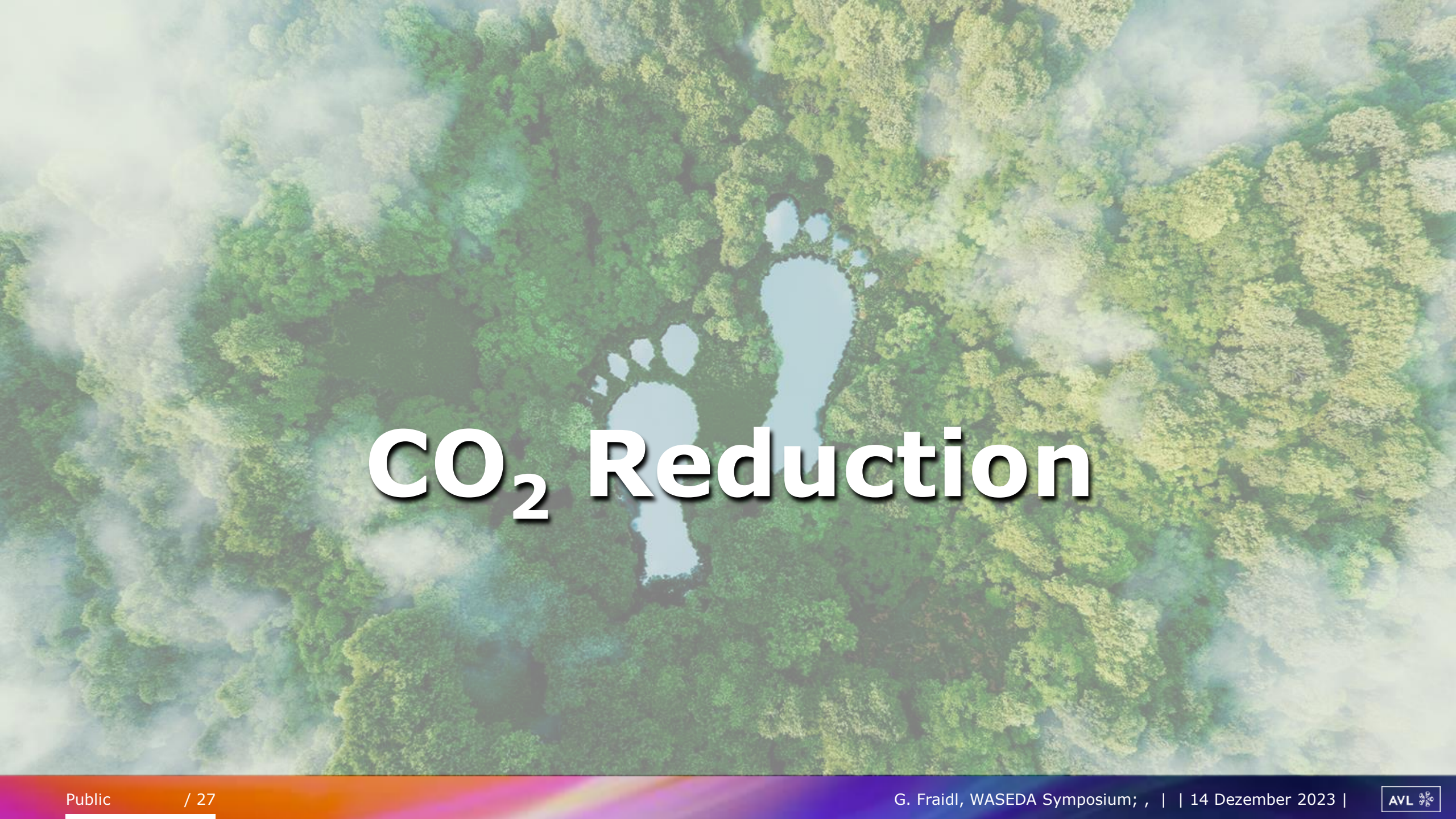


EU-Parliament proposes begin 2027 (NT) / 2028 (AT) for EU7 introduction

Euro 6d, 6e & Euro 7 Implementation Passenger Cars



AES requirements (full map stoichiometric operation) coming on top

An aerial photograph of a dense green forest. In the center of the forest, there is a large, irregularly shaped pond that forms the outline of a human footprint. The text "CO₂ Reduction" is overlaid in white on the footprint-shaped pond.

CO₂ Reduction

Efficient & Robust CO₂ Reduction and Energy Supply

1. Primary Energy Source

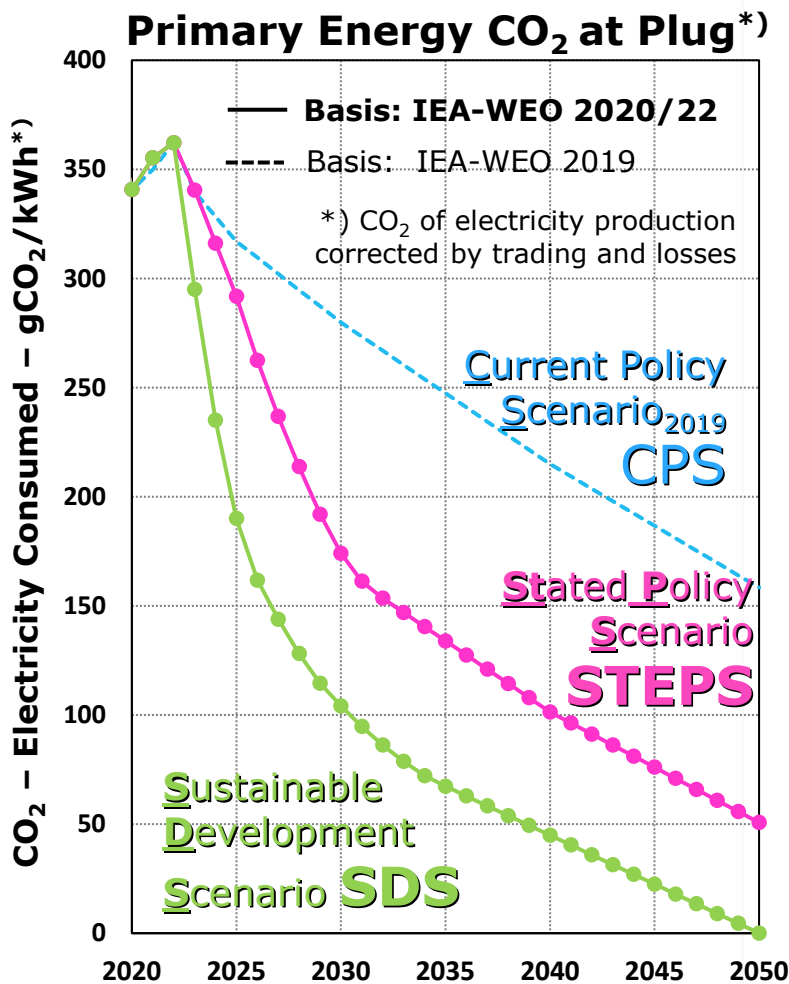
2. Energy Carrier, Storage, Infrastructure

3. Vehicle Portfolio



Does Europe follow the logic sequence ?

Energy Scenarios are Decisive for Lifecycle CO₂



Current Policy Scenario₂₀₁₉ **CPS**

Worst Case Scenario

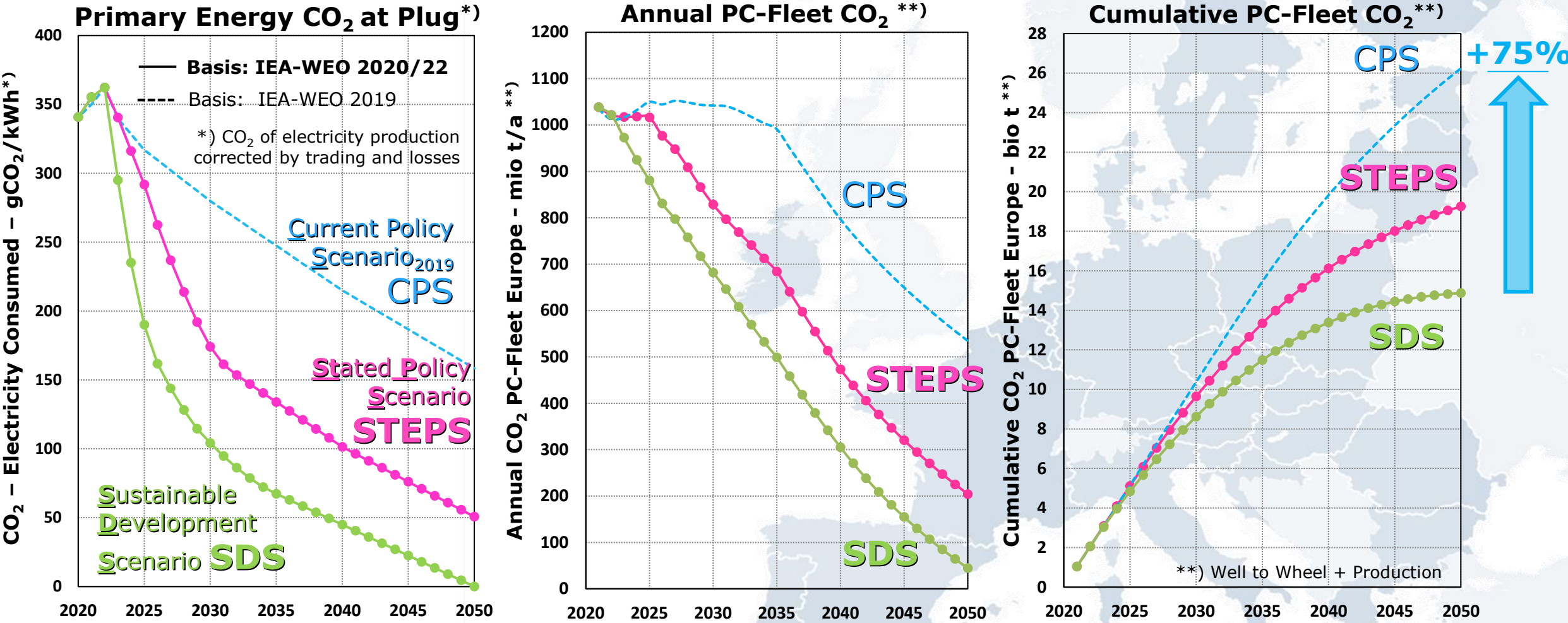
Stated Policy Scenario **STEPS**

Reflecting all announced policy intentions and targets

Sustainable Development Scenario **SDS**

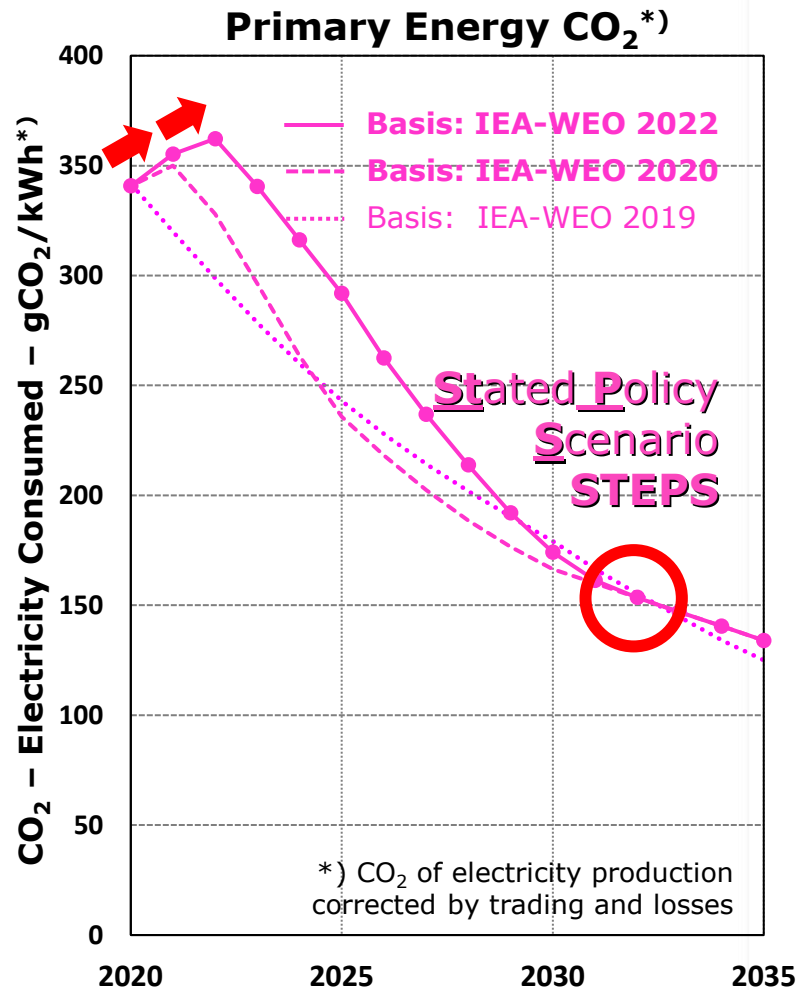
Theoretic scenario to put energy system back on track with Paris Agreement

Impact of Energy Scenarios on Total CO₂**)) EUROPE

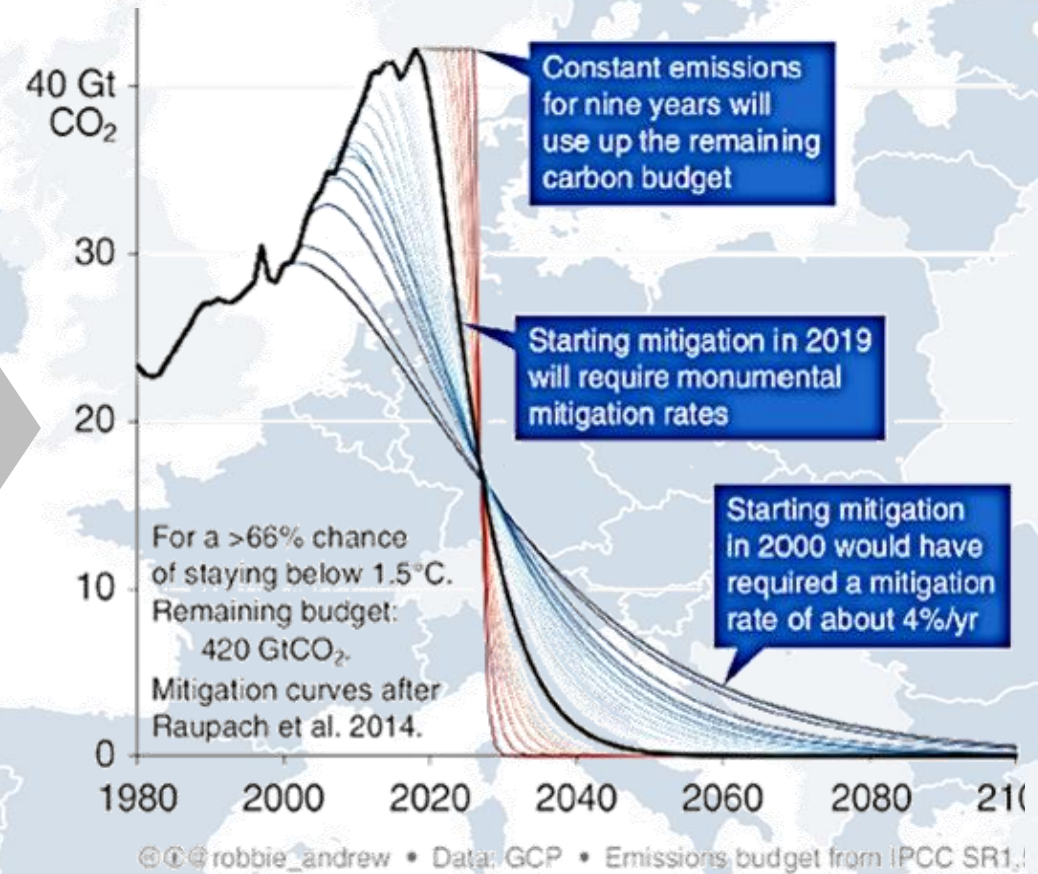


Primary energy CO₂ has decisive impact on fleet CO₂

Evolution of Energy Scenarios EUROPE 2019-2022

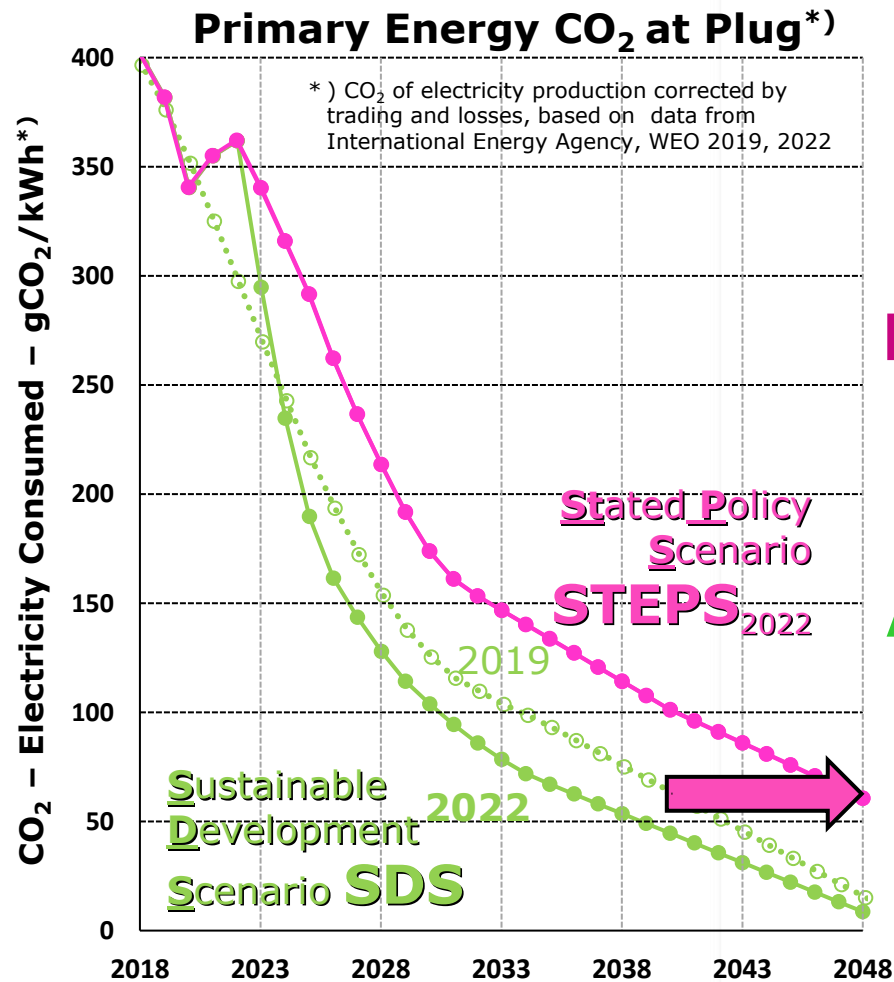


CO₂ Mitigation Curves for 1,5° target



Are we too optimistic in predictions for Primary Energy CO₂ reduction ?

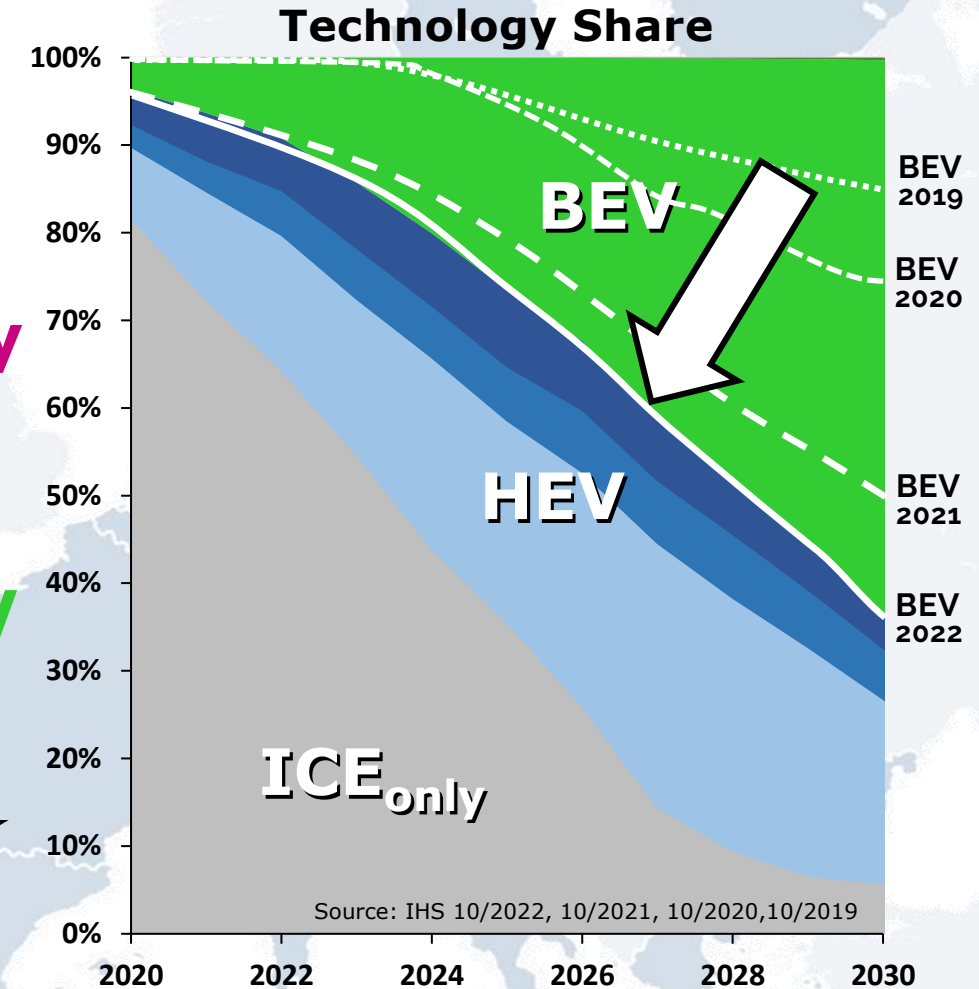
Europe: Delayed Primary Energy CO₂ Reduction versus Accelerated BEV Introduction



Delayed Primary Energy CO₂ reduction

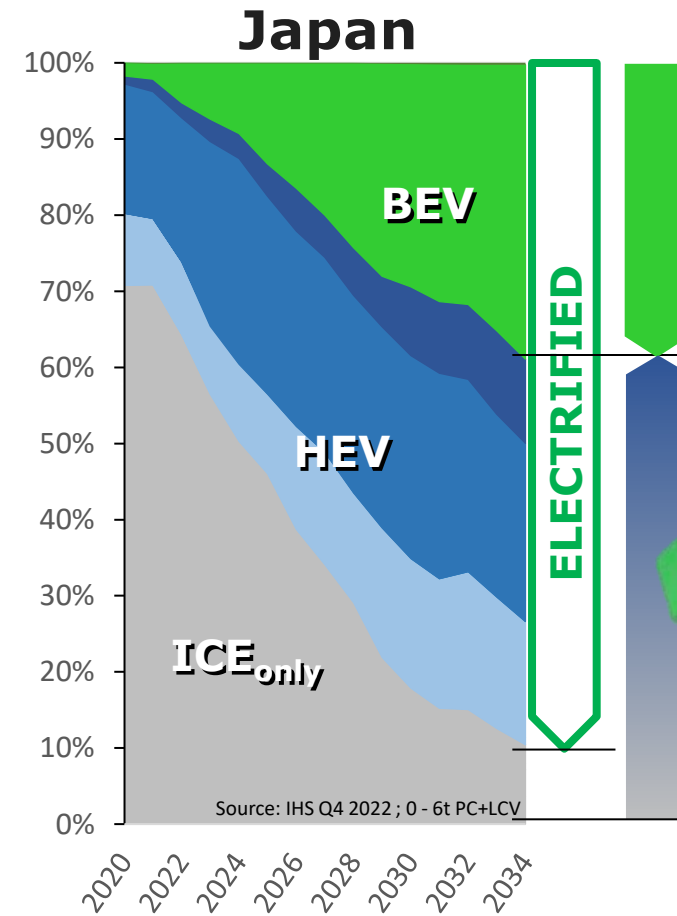
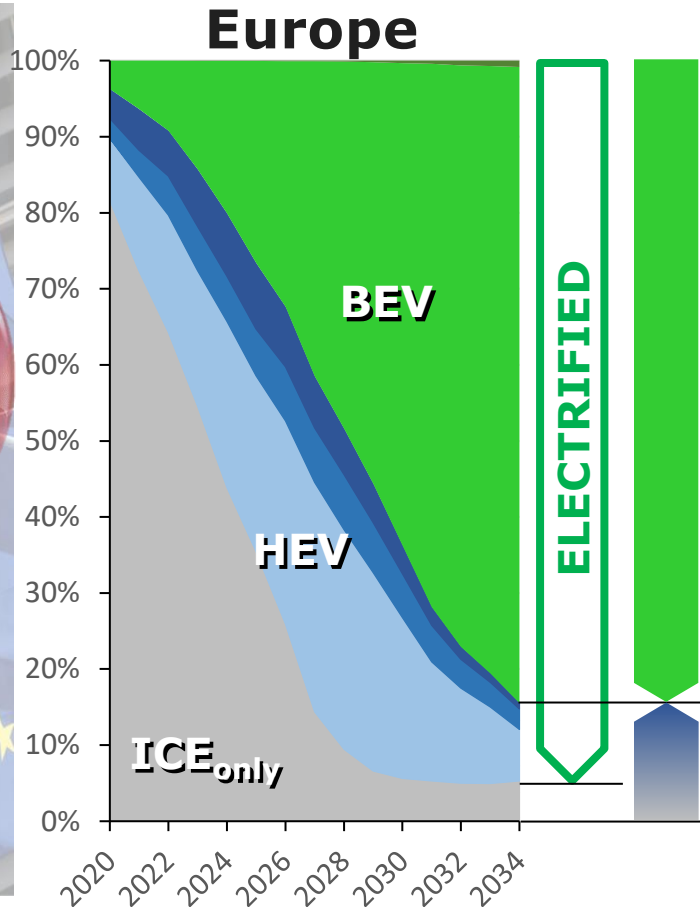
+

Accelerated BEV introduction



EU Reality: Higher Lifecycle CO₂ emission than with a system optimized approach

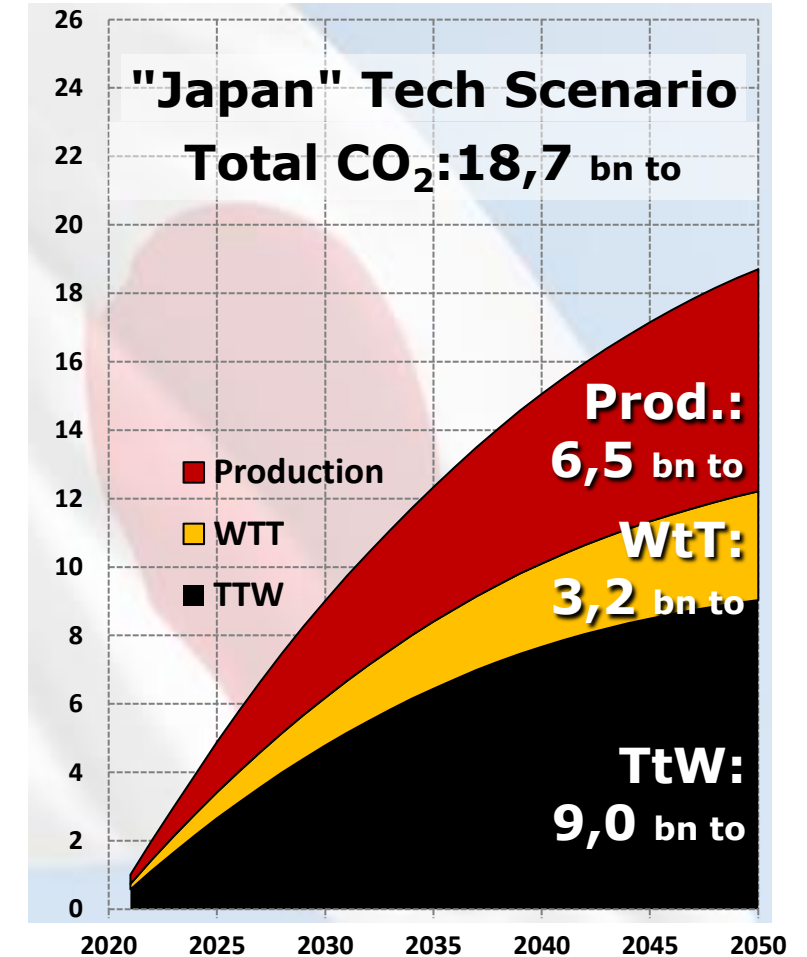
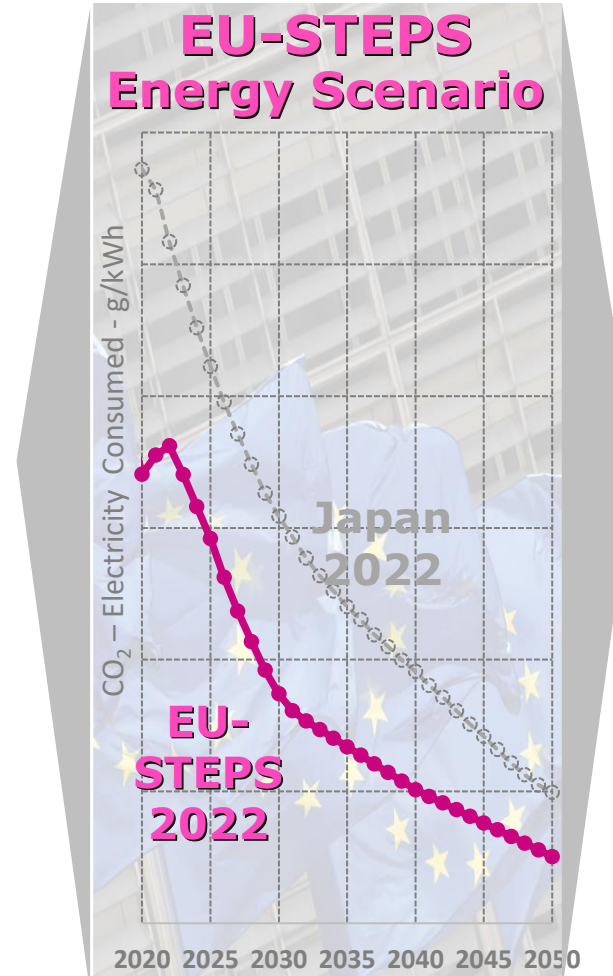
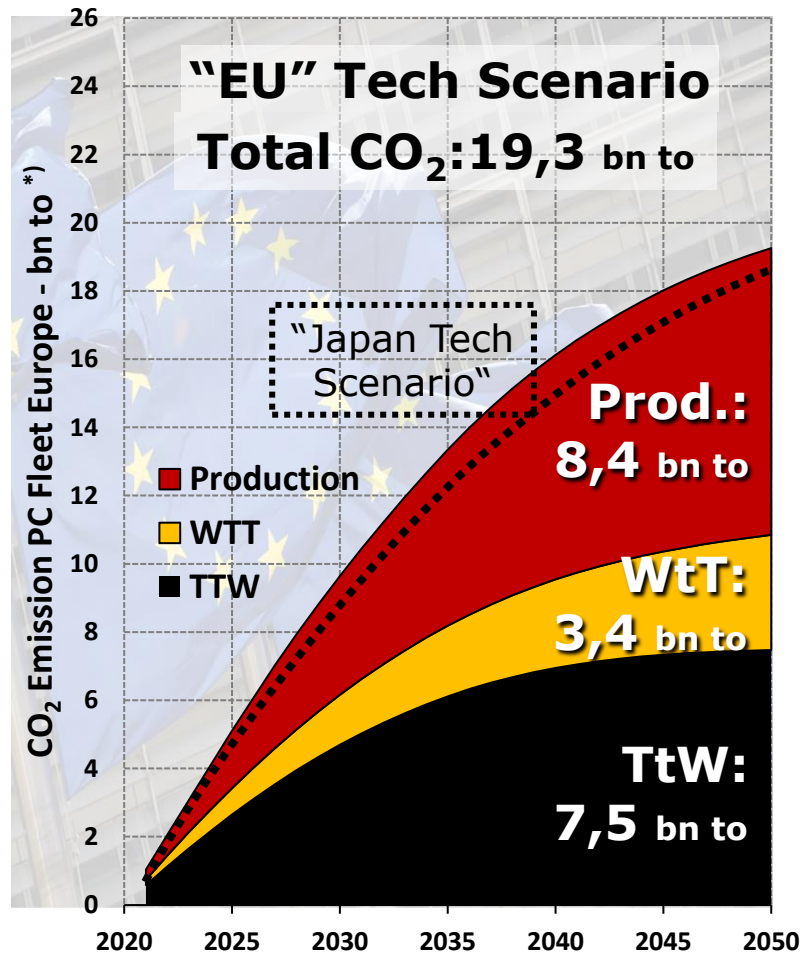
Why so Different Technology Approaches ?



CO₂ Legislation ("Tank to Wheel" or "Well to Wheel") is decisive

Cumulative PassCar Fleet Total CO₂ Emission^{*)} EU vs. Japan Technology Scenario, EU Energy Scenario

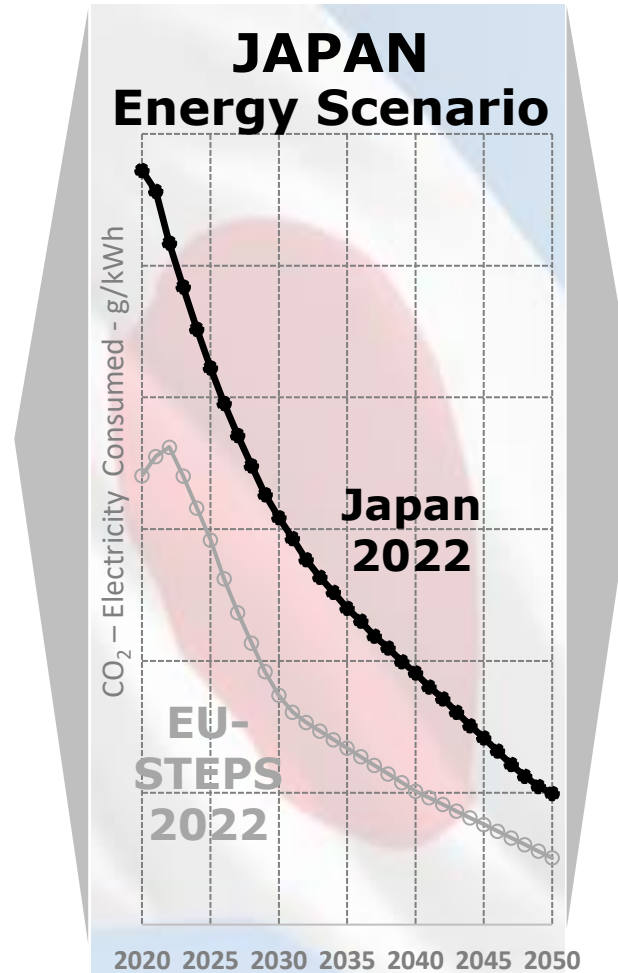
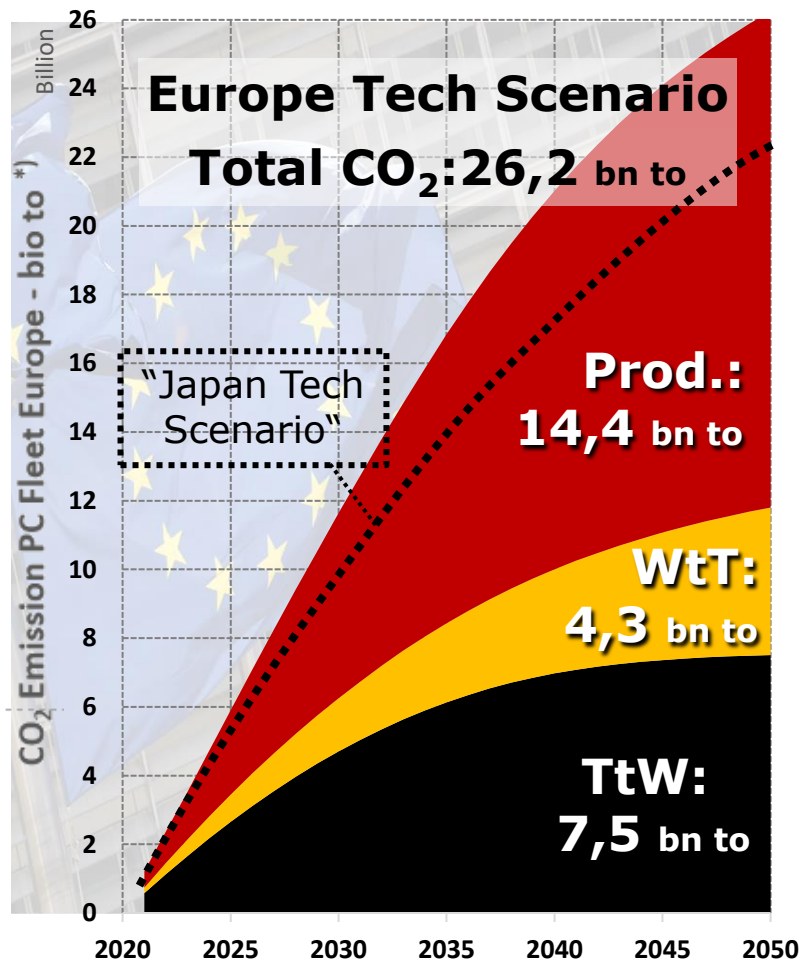
^{*)} Well to Wheel + Production, EU STEPS Energy Scenario, EU fleet volume & mileage



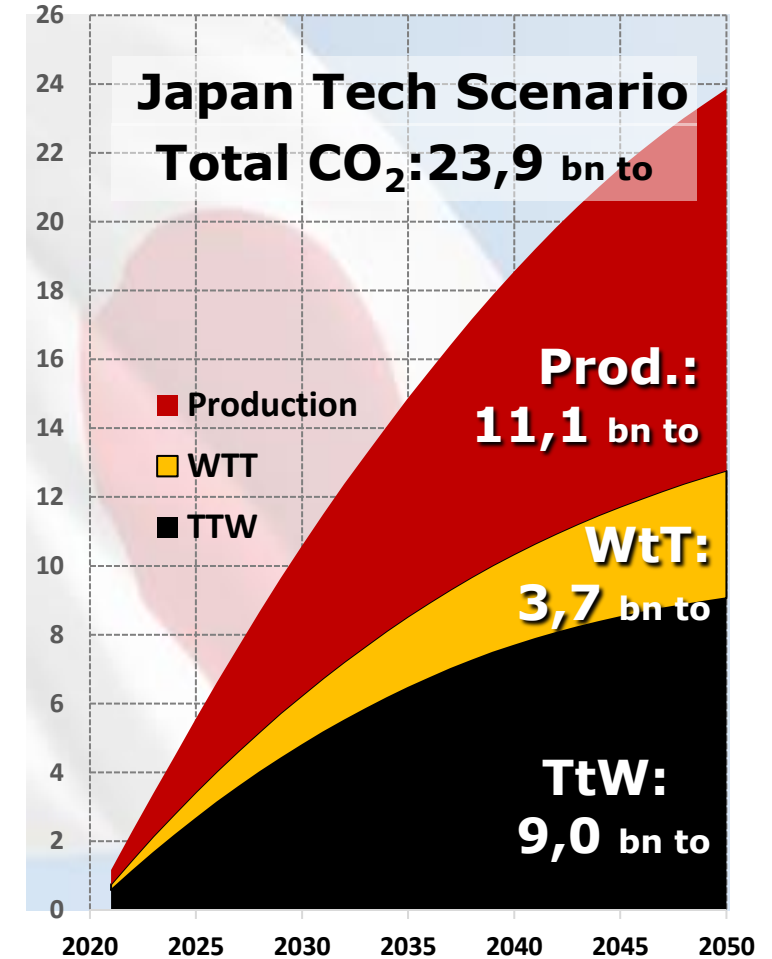
With "EU Energy Scenario",

a "Japan Tech Scenario" would offer similar Total CO₂, however, at significantly lower cost !

Cumulative EU-PassCar Fleet Total CO₂ Emission^{*)} EU vs. Japan Technology, Japan Energy Scenario



*) Well to Wheel + Production, EU STEPS Energy Scenario, EU fleet volume & mileage



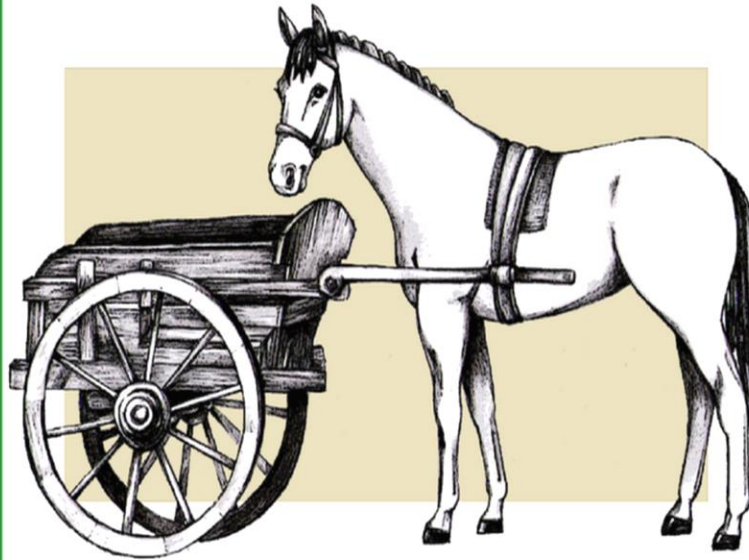
**With "Japan Energy Scenario",
a "Japan Tech Scenario" would offer both lower Total CO₂ and significantly lower cost !**

Technical Optimum

1. Primary Energy Source

2. Energy Carrier, Storage, Infrastructure

3. Vehicle Portfolio



***DON'T PUT THE CART
BEFORE THE HORSE***

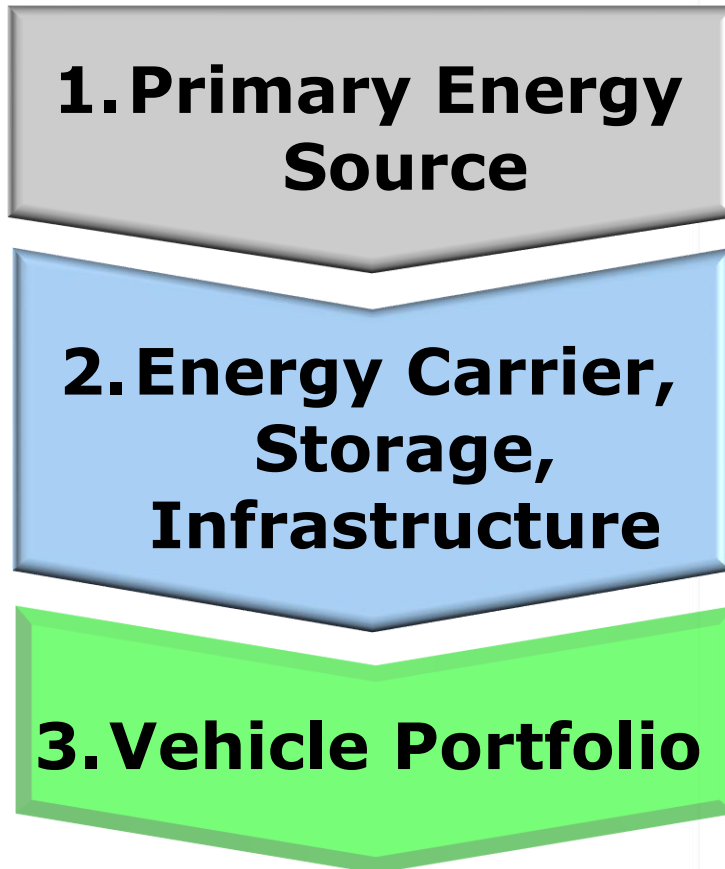
Political Reality

3. Primary Energy Source

2. Energy Carrier, Storage, Infrastructure

1. Vehicle Portfolio

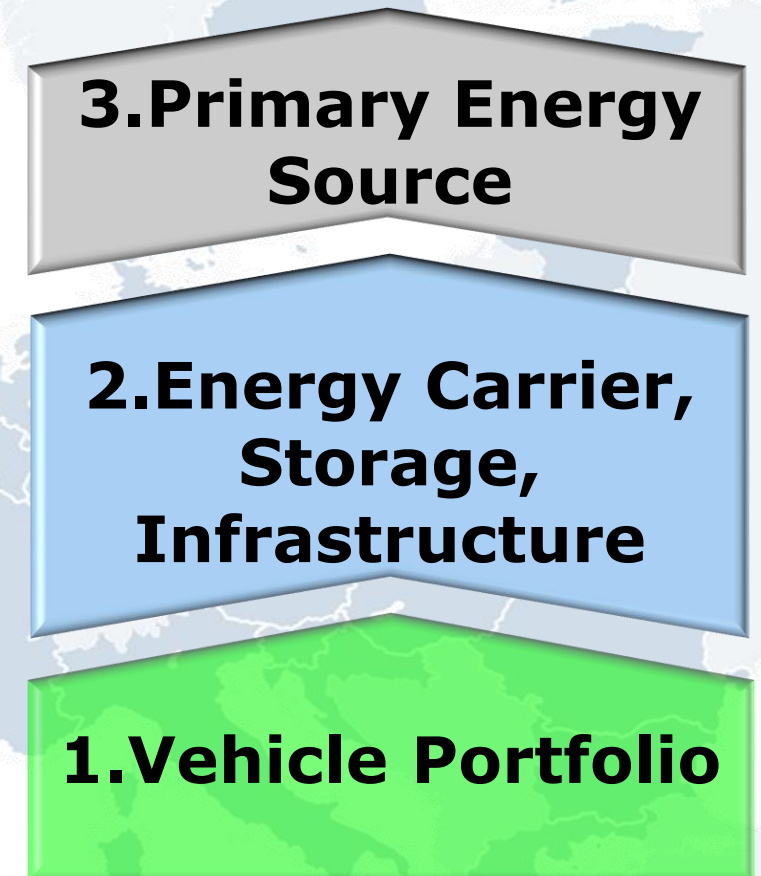
Technical Optimum



The Energy Scenarios will have a much more significant impact on climate relevant CO₂ emissions than the technology scenarios

→ EU discussions should have focused more on Primary Energy CO₂ reduction and less on ICE-ban !

Political Reality





Automotive Economy

The Challenge

**EU Politics might
not chose the
most effective
way**

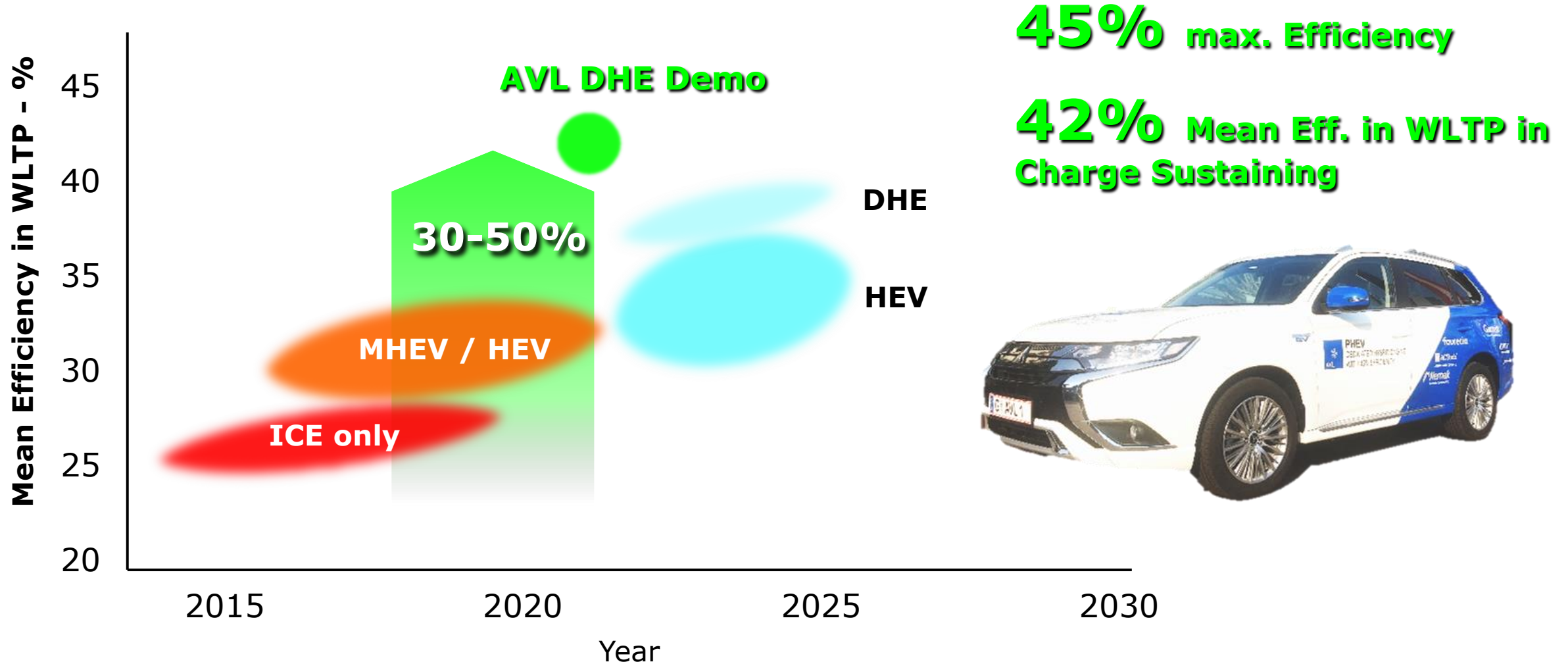
**So what can
we do ?**



Quick Wins with System Optimized Hybrids

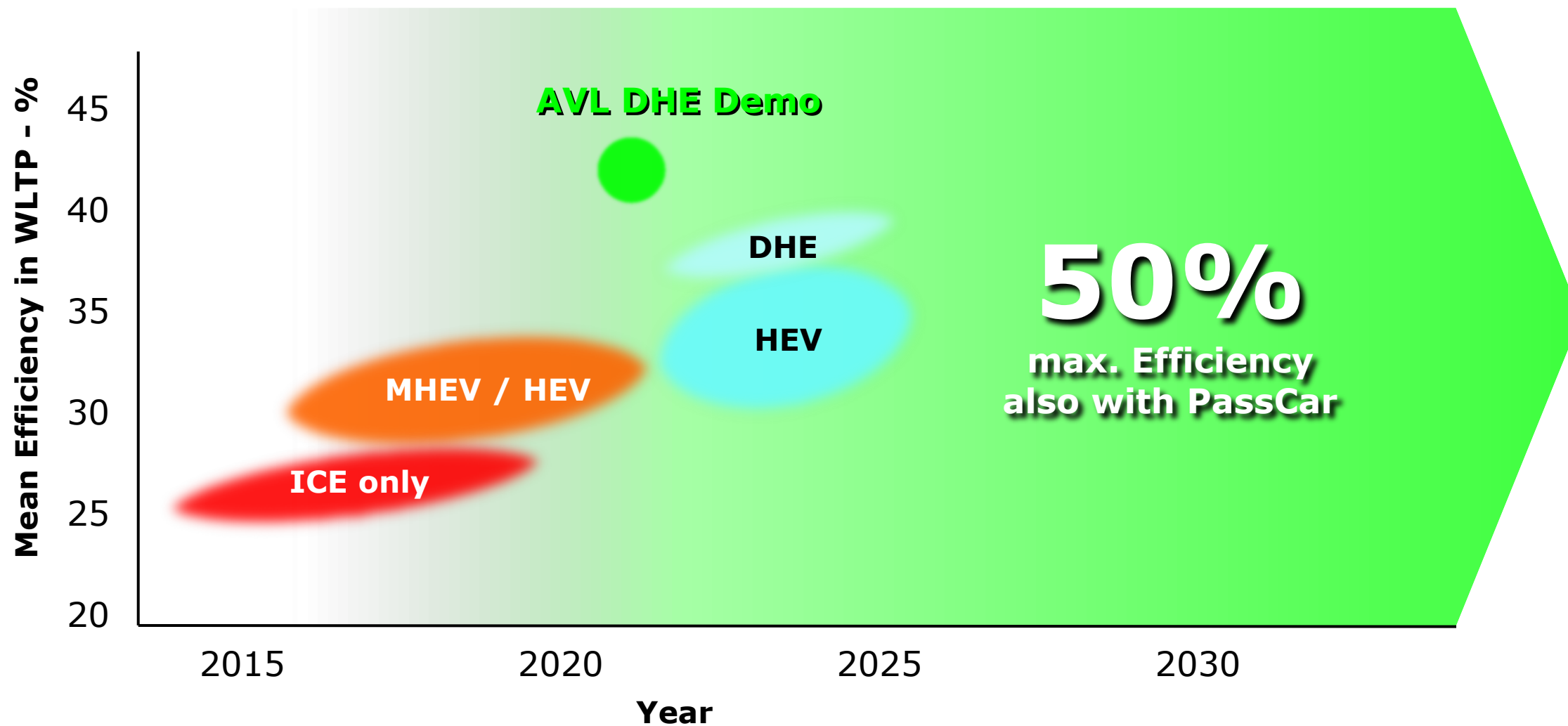
Dedicated Hybrid Engine

Mean ICE Efficiency in WLTP Cycle



Dedicated Hybrid Engine

Future Target



Hydrogen Combustion Engine



Has started with commercial vehicles – proceeding with PassCars ?

Hydrogen Combustion Engine



**Powertrain
Technology
of the Year**



**Motorsport
Engineering
Innovation
of the Year**



Shaping the Electrification Transformation Across All Applications



AVL 800 Volt Pionier: eCarTec Award 2012



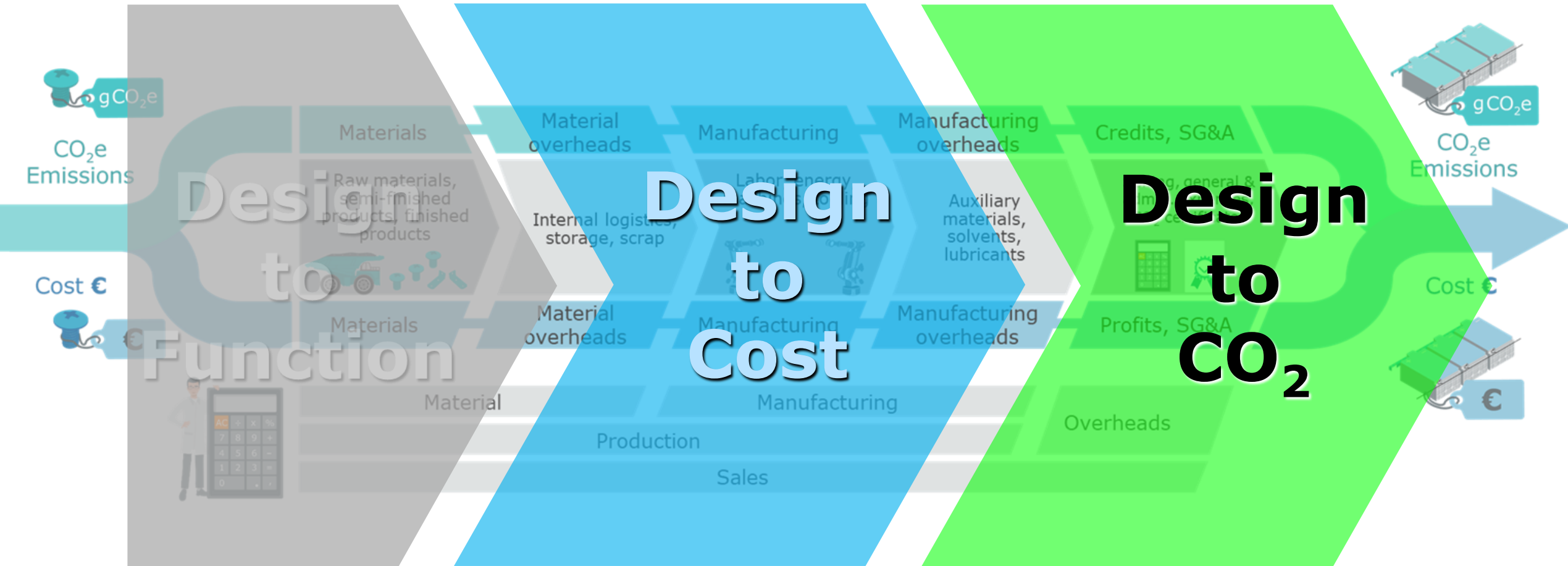
Maximaler Wirkungsgrad - %



**AWARD
WINNER**



Change in Development Philosophy





Net Zero Development & Validation





Net Zero Development & Validation



Virtual Development & Validation



ありがとうございます



75 YEARS
AND
BEYOND.