ECT 2024 Conference, New Delhi

ECOCAT INDIA PVT. LTD.
VICAT
VIKAS GROUP
Technologies for Clean Environment

An Alternative Path to Clean Air and Fast GHG Reduction

Claus Goersmann, Alok Trigunayat, Rajan Bosco, Vishnuvarthan Muthusamy

23.10.2024

Contents

- Introductions
- Paths to Net Zero for the Transport Sector in Europe
  - Comparison of different fuel use scenarios from FVV-Fuel Studies
- An Alternative path for India
  - India‘s Decarbonisation of Vehicles
  - E-fuels for India?

Introduction / Ecocat (India) Pvt. Ltd

- Vikas Group company
- Complete emission control systems for a wide range of applications with in-house...
  - Metallic substrates
  - Coating
  - Canning
- Development of new emission control systems in Mechanical and Chemical R&D departments
  - Substrate and canning design and manufacture
  - Catalyst development and coating
  - Engine and vehicle testing
- Applications: Gasoline, CNG/LNG, H_2, Diesel for LDVs, LDVs, 3-wheeler, 2-wheeler

www.ecocatindiavicas.com

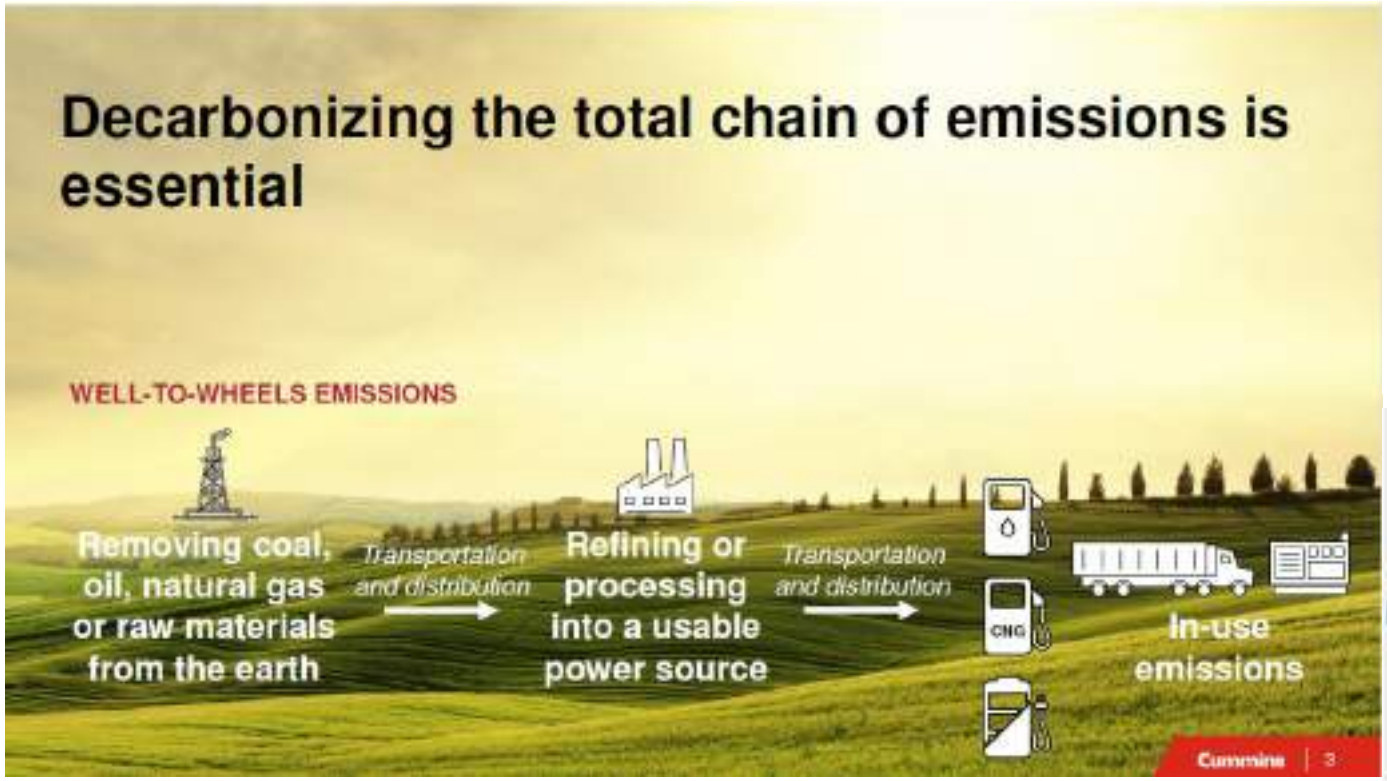
Introduction / Context

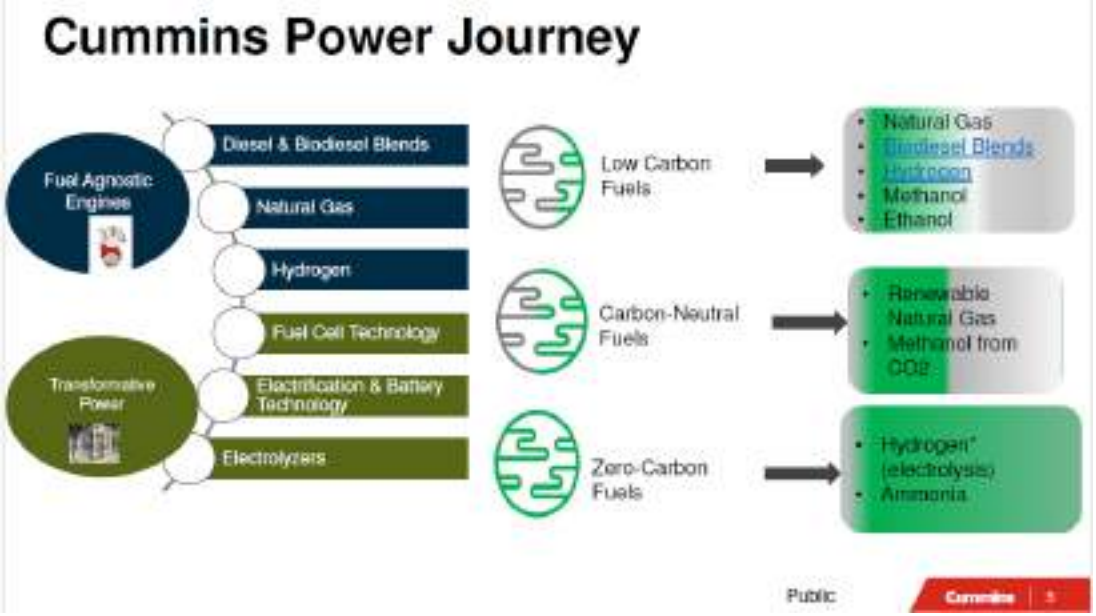
- At last year‘s ECT 2023 conference, various organisations demonstrated the feasibility of optimised emission control technologies to meet the expected stricter future emission legislations

- At ECT 2023‘s Fuels and Fuel Blend‘s session the presentations from Cummins, ARAI, IOCL and Maruti Suzuki showed the role of alternative fuels for sustainability, their technological and regulatory perspectives as well as specific opportunities for bio fuels like Ethanol and Bio CNG

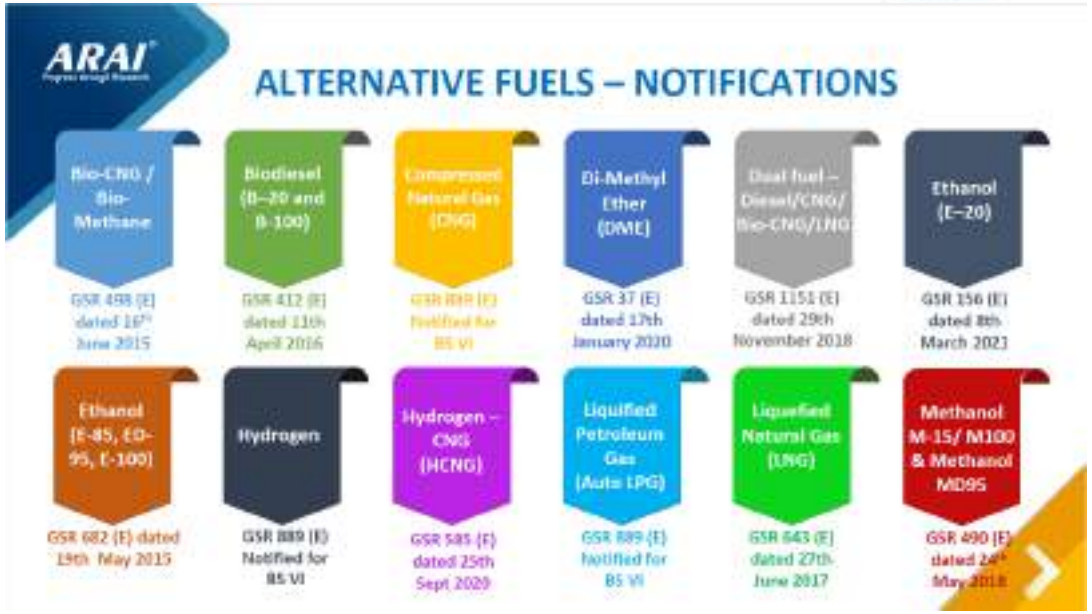
- This presentation aims to address the strategic importance of alternative fuels to meet green-house-gas emission targets and to address general challenges for this alternative path (compared to the EU approach) towards net-zero.

Introduction / Context (from Cummins Presentation ECT2023)





Introduction / Context (from ARAI Presentation ECT2023)



Introduction / Background Emissions - EU Legislation / Situation

- Emission control legislation over the past decades has been a huge success impoving urban air quality. EU legislators decided that only minor improvements are required for the ultimate emissions legislation EU 7
- The EU has decided to phase out CO_2 emitting ICE powertrains for cars and urban buses by 2035, and requires 90% green-house gas (GHG) reduction for trucks by 2040.
- As CO_2 emissions are only considered at tailpipe, it is anticipated that ICE engines powered by gasoline, diesel or natural gas will be replaced by battery electric or hydrogen powered Fuel Cell or H_2-ICE powertrains.
- Currently the GHG benefits of E-fuels or bio-fuels are not taken into account as they don’t show at the tailpipe.
- Huge efforts are required to provide an electrical charging and/or hydrogen fueling infrastructure.

Introduction / A Fast Transition

- To stop the global warming, GHG emissions need to be reduced to zero as fast as possible. The emissions during the transition to net zero are key to avoid missing the Paris Agreement target.
- Even if from today onwards all new vehicles would be zero emission BEV or H_2 powered vehicles, it would take 10-20 years until the current fleet has been exchanged
- During this time existing fossil fuel powered vehicles would continue to emit green-house gases

→ The existing vehicle fleet has to become part of the solution!

Contents

- Introductions
- Paths to Net Zero for the Transport Sector in Europe
  - Comparison of different scenarios from FVV-Fuel Study IVb
- An Alternative path for India

Guidance from Studies addressing the Net-Zero Transition from FVV e.V.

- **FVV e.V. // Science for a moving society** is an Innovation + Transfer Network based in Frankfurt/Main, Germany (www.fvv-net.de)
- A number of projects has been dedicated to the net-zero transition
- They looked at the **Efficient use of the global CO2 budget in the mobility sector***
- **Fuel Study IVb*** is the latest study of a number of studies fuel studies dedicated to future fuels and was supported by Frontier Economic (www.frontier-economics.com) and ifeu (www.ifeu.de)
- Focus is on EU, but findings are valid for other regions as well
- Study looked at single technology scenarios first and identified technical bottlenecks
- Study looked then at mixed technology scenarios including infrastructure and material bottlenecks

* https://www.fvv-net.de/fileadmin/Storys/020.30_Bilanz_gezogen/FVV_LCA_Life-cycle_analysis_Briefing_paper_2020-06_EN.pdf
** https://www.fvv-net.de/fileadmin/Storys/000.00_Wie_schnell_geht_nachhaltig/FVV_H1313_1452_Future_Fuels_FVV_Fuel_Study_IVb_2022-12.pdf

FVV-Studies: Efficient use of the global CO_2 budget in the mobility sector*

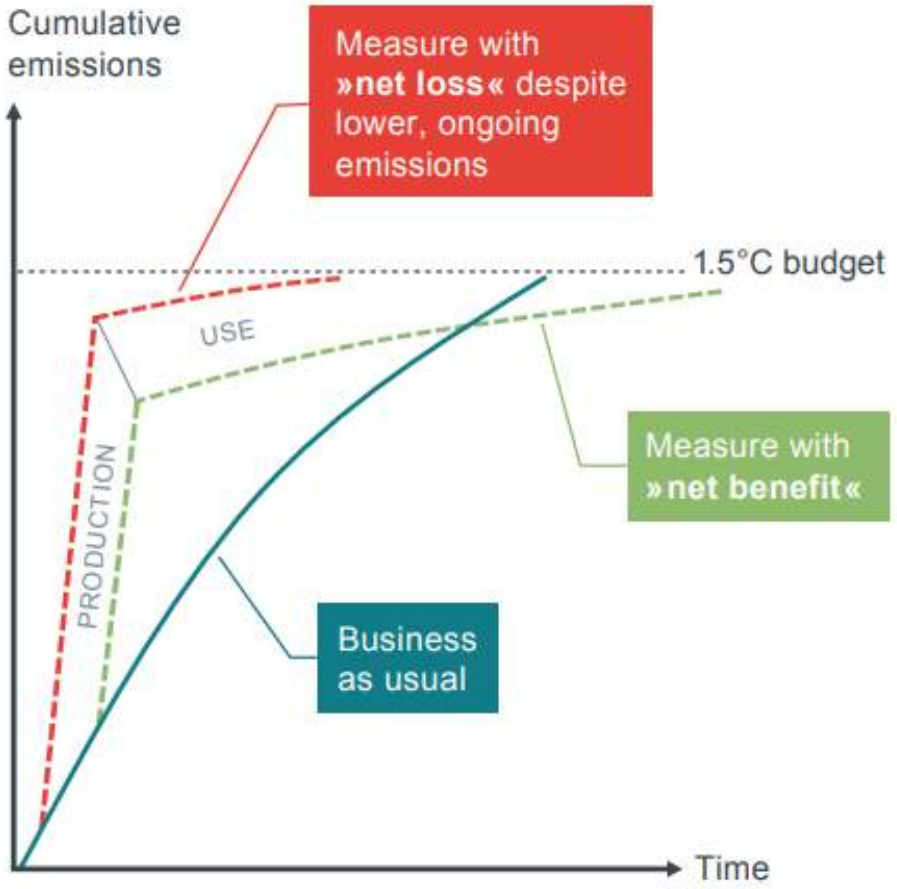
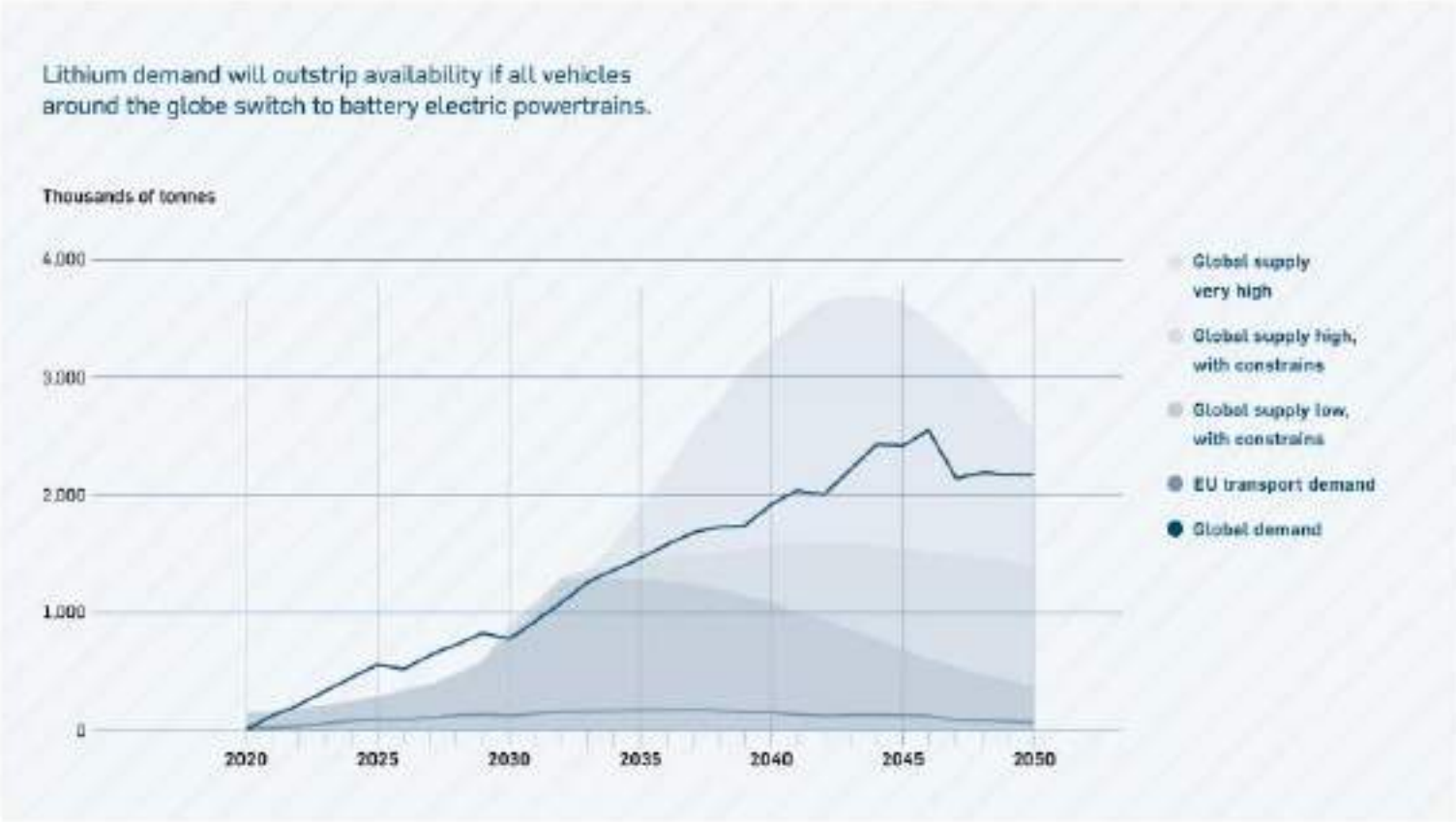


Figure 1: The conversion of powertrains and energy carriers will initially result in increased CO_2 emissions. This must be managed in such a manner that the emissions saved during operation will further delay the point in time when the CO_2 residual budget is used up.

* https://www.fvv-net.de/fileadmin/Storys/020.30_Bilanz_gezogen/FVV_LCA_Life-cycle_analysis_Briefing_paper_2020-06_EN.pdf

FVV-Studies: Bottlenecks, Example Lithium demand and Supply*

Concentrating on a single technology will result in a lack of resources, even in a circular economy.



* https://www.fvv-net.de/en/science/six-theories-on-climate-neutrality-in-the-european-transport-sector

FVV Fuel Study IVb – Some Key Findings

- ...the speed of deploying GHG-neutral mobility solutions (complete GHG-neutral technology pathways on a WtW basis) is much more important than the choice of technologies.
- A mix of carbon-neutral energy carrier/powertrain pathways can speed up the transition to GHG neutrality for the EU27+UK road sector
- The decisive factor to minimise GHG emissions is the fastest possible departure from fossil fuels – infrastructure and material bottlenecks need to be addressed quickly
- E-fuels provide a unique technology option to carbon-neutrally operate the existing fleet
- Banning ICE vehicles from 2035 would lead to higher GHG emissions than necessary
- Shifting the heavy-duty segment towards carbon-neutral technology pathways is a big lever to enable significant GHG emission savings

*Source: https://www.fvv-net.de/fileadmin/Storys/000.00_Wie_schnell_geht_nachhaltig/FVV_H1313_1452_Future_Fuels_FVV_Fuel_Study_IVb_2022-12.pdf

FVV Fuel Study IVb – GHG Emissions Trends for various Scenarios*

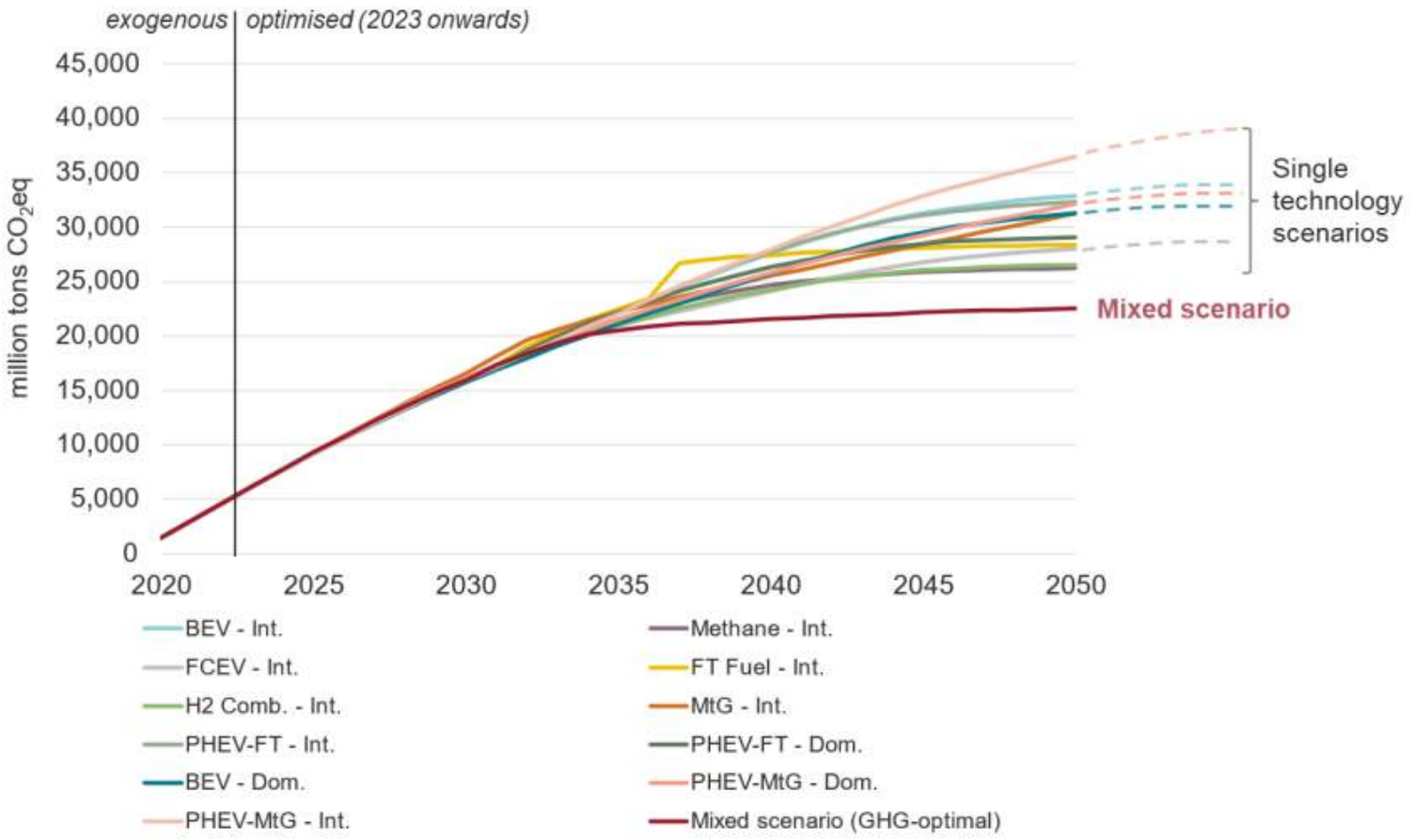


Figure 2: Cumulated GHG emissions in mixed technologies scenario and single technology scenarios. Note: Given technical bottlenecks and vehicle lifetime assumptions, no full decarbonisation is reached in single technology scenarios of BEV Dom./Int., FCEV, PHEV-FT Int. and PHEV-MtG Int. by 2050 (dashed lines).

* https://www.fvv-net.de/fileadmin/Storys/000.00_Wie_schnell_geht_nachhaltig/FVV_H1313_1452_Future_Fuels_FVV_Fuel_Study_IVb_2022-12.pdf

India's Decarbonisation of Vehicles

- India is committed to achieve net-zero emissions by 2070
  - Amongst other measures like support for public transport and urban planning, vehicle specific efforts include:
    - Fuel efficiency standards (e.g. Bharat Stage Emission Standards)
    - **Electrification of Vehicles**: Incentives and subsidies for manufacturers and consumers, e.g. FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) Scheme

    and
    - **Encouragement of the use of alternative Fuels (biofuels, CNG, LNG, hydrogen...)**

→ ☺ With the encouragement of alternative fuels India is actually following a more pragmatic approach than Europe

→ This minimises the impact of technical and infrastructure bottlenecks and will lead to a better (lower GHG emissions) transition than effectively banning ICEs as planned in Europe

What about E-fuels?

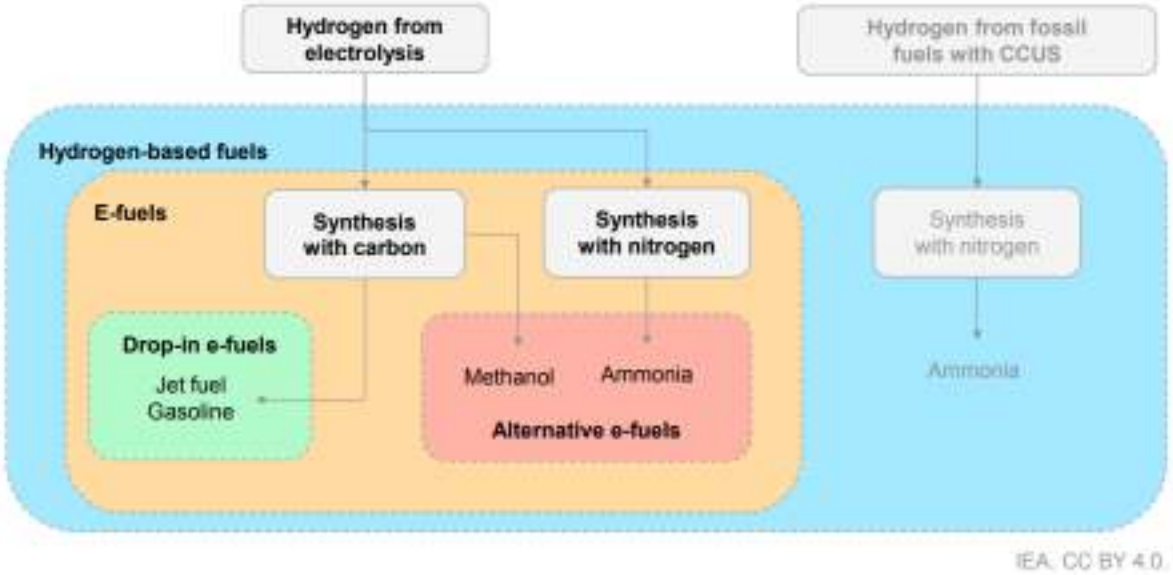
E-fuels are of great interest in Europe

- For example: www.efuel-alliance.eu

Why not in India??

E-Fuels

- Carbon based E-fuels are made from captured CO_2 and non-fossil fuel based H_2. It‘s use releases the same amount of CO_2 as was captured before
  - E-Gasoline, E-Diesel, E-Methane could be used as „drop-in“ fuels
    - Theoretically the fastest way to de-carbonise the existing vehicle fleet
    - Expensive to make: could be used for aviation first
- Non carbon based E-fuels (avoid the need for carbon capture) but cannot be used as „drop-in“ fuels
  - H_2
  - NH_3



Note: E-fuels represent a subset of hydrogen-based fuels, a category that also includes fuels obtained from hydrogen produced from fossil fuels with CCUS.

Graph from IEA:
https://iea.blob.core.windows.net/assets/a24ed363-523f-421b-b34f-0df6a58b2e12/TheRoleofE-fuelsinDecarbonisingTransport.pdf

E-Fuels Production (Source IEA)*

Figure 3.4 Map of announced projects for low-emission e-ammonia production

Note: Map also includes announced projects starting after 2030.
Source: IEA (2023), Hydrogen Production and Infrastructure Projects Database.

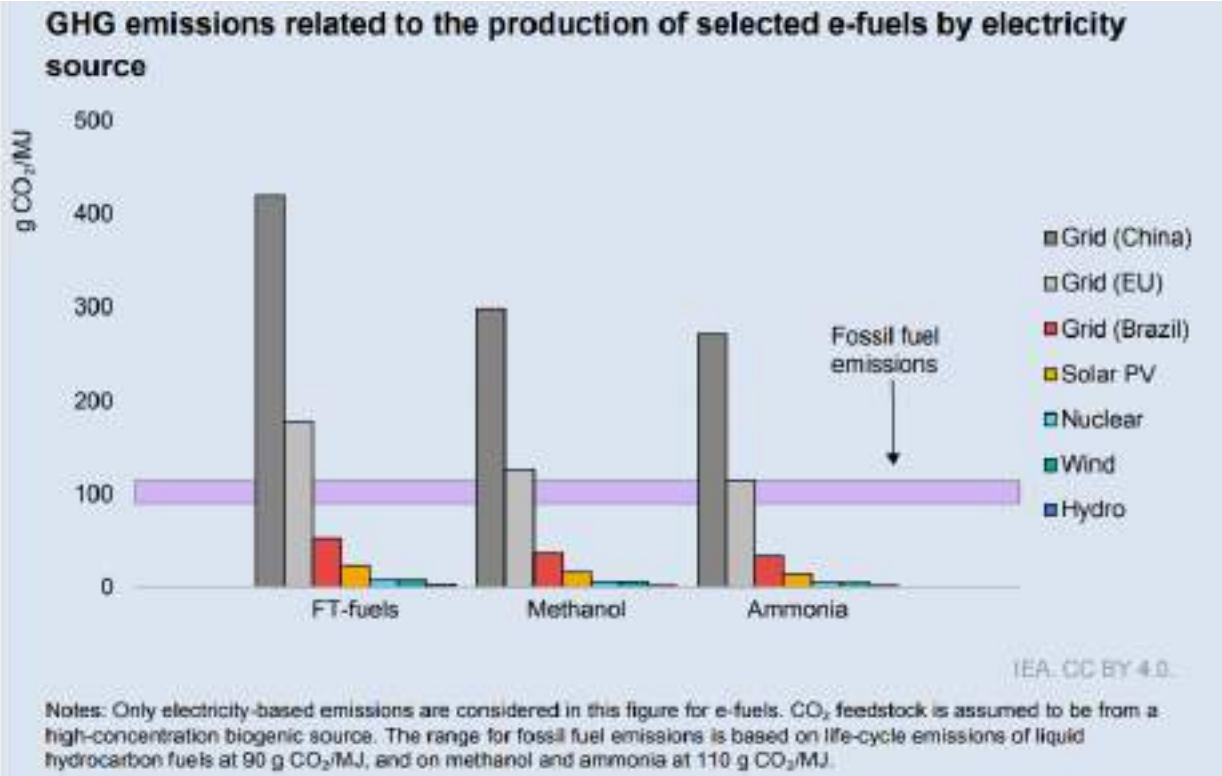
Figure 3.5 Map of announced projects for carbon-containing low-emission e-fuels production

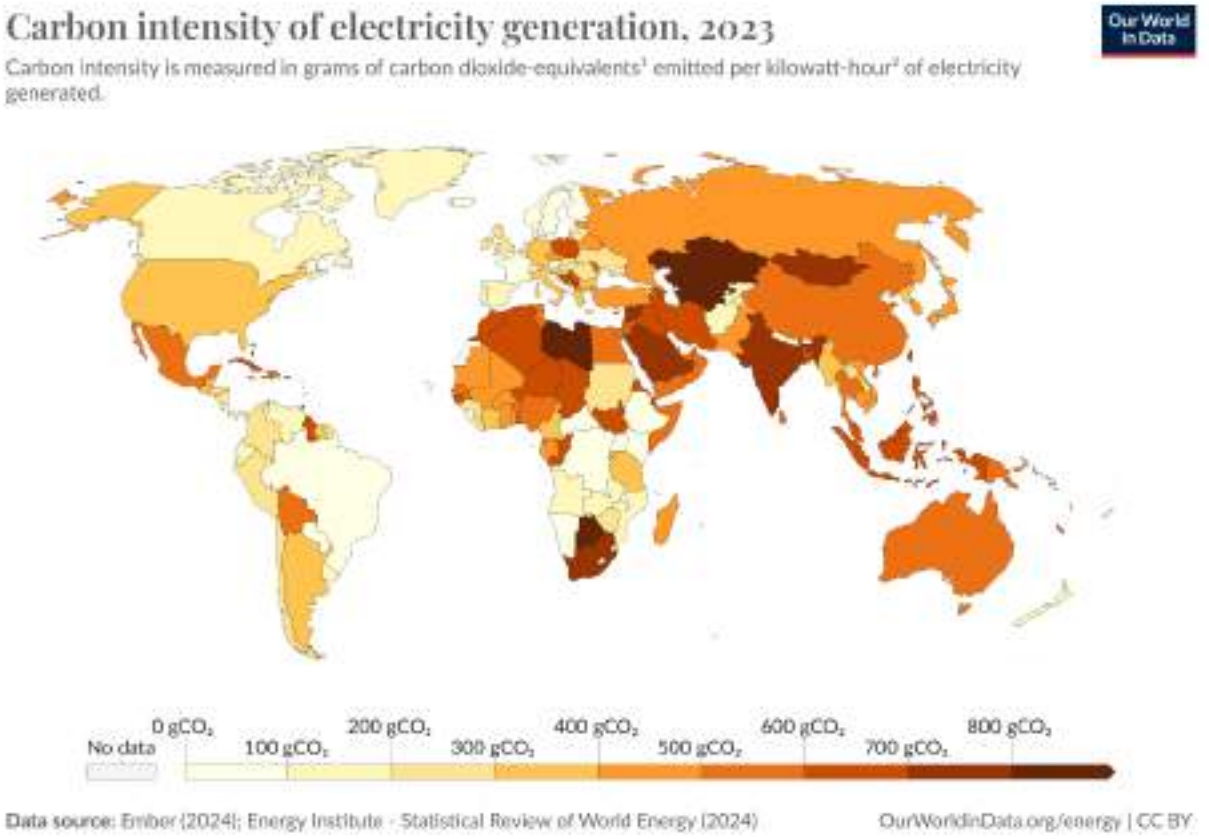
Note: Map also includes announced projects starting after 2030.
Source: IEA (2023), Hydrogen Production and Infrastructure Projects Database.

* https://iea.blob.core.windows.net/assets/a24ed363-523f-421b-b34f-0df6a58b2e12/TheRoleofE-fuelsinDecarbonisingTransport.pdf

-> E-fuels don‘t seem to play a significant role in the medium-term future for global decarbonisation of transport

E-Fuels Production (Sources: IEA* and Our World in Data**)



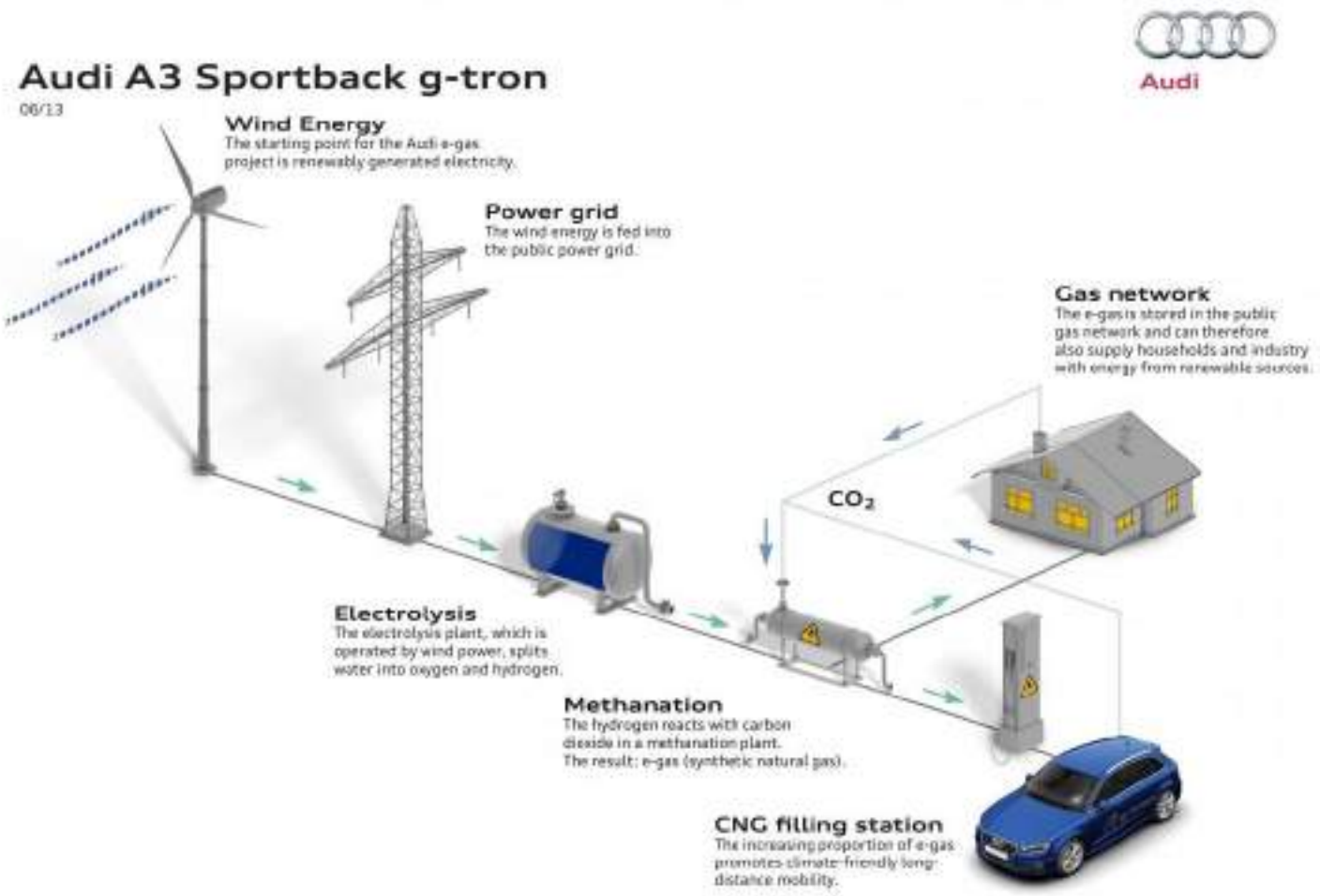


* https://iea.blob.core.windows.net/assets/a24ed363-523f-421b-b34f-0df6a58b2e12/TheRoleofE-fuelsinDecarbonisingTransport.pdf

** https://ourworldindata.org/grapher/carbon-intensity-electricity

-> The production of E-fuels does not make much environmental sense in places where the electricity production is based on a high share of fossil fuels. But could be feasible for using excess electricity from renewable sources, like wind or solar.

Example Audi e-gas Project* / A way to replace CNG with synthetic Methane



In the last decade Audi offered CNG vehicles in Germany, which could be credited with e-gas (biogas upgraded with synthetic methane).

Windenergy → Electricity → Electrolysis of water to produce H_2

$2H_2O \rightarrow 2H_2 + O_2$

Biogas = $CH_4 + CO_2$

$3H_2 + CO_2 \rightarrow CH_4 + H_2O$

* https://www.audi-technology-portal.de/en/drivetrain/hybrid-technologies/audi-a3-g-tron_en
https://www.audi-technology-portal.de//en/mobility-for-the-future/audi-future-lab-mobility_en/audi-future-energies_en/audi-e-gas_en

Conclusions

- Assuming future vehicle emission limits are similar to EU 7, exising emission control technologies can be optimised to meet emission limits
- Europe‘s policy makers push for an ICE ban in 2035 effectively forcing consumers to switch to BEVs and H_2-powered vehicles
- India‘s policy makers have chosen a technology diverse path for it‘s decarbonsation of the transport sector

  →Effective and efficient GHG reduction
- E-fuels could provide „drop-in“ fuels for existing and future ICE powered vehicles
  - ... but the electricity grid needs to de-carbonise or
  - ... if excess renewable energy (wind or solar) is used to make them

ECOCAT INDIA PVT. LTD.

VIKAS GROUP

VICAT

Technologies for Clean Environment

Thank you

Ecocat (India) Pvt. Ltd.
Dr. Claus Goersmann
Chief Technology Officer
claus.goersmann@ecocatindia.com
www.ecocatindiavikas.com

Useful Links

- www.ecmaindia.in
- www.aecc.eu
- www.meca.org
- www.fvv-net.de
- www.theicct.org

- www.ecocatindiavikas.com

Slide Title

ECOCAT INDIA PVT. LTD.
VIKAS GROUP
VICAT
Technologies for Clean Environment

Interim Conclusions

ECOCAT INDIA PVT. LTD.
VIKAS GROUP
VICAT
Technologies for Clean Environment