

Brazil's Experience with Flex Fuel Vehicles & Ethanol Use



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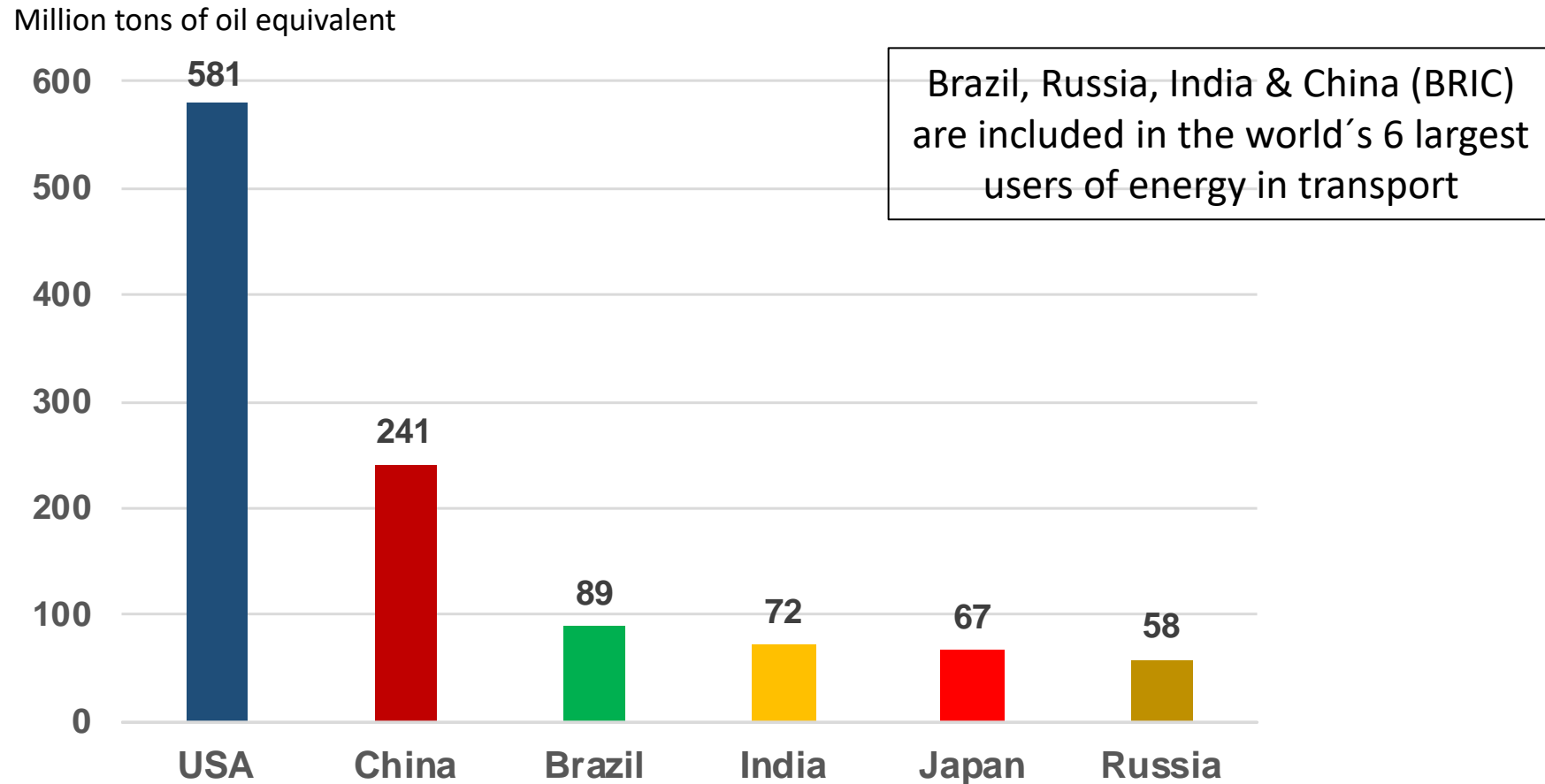
ISMA, Indian Sugar Millers Association Webinar on Alternative Fuel

Digital Format

October 12, 2021



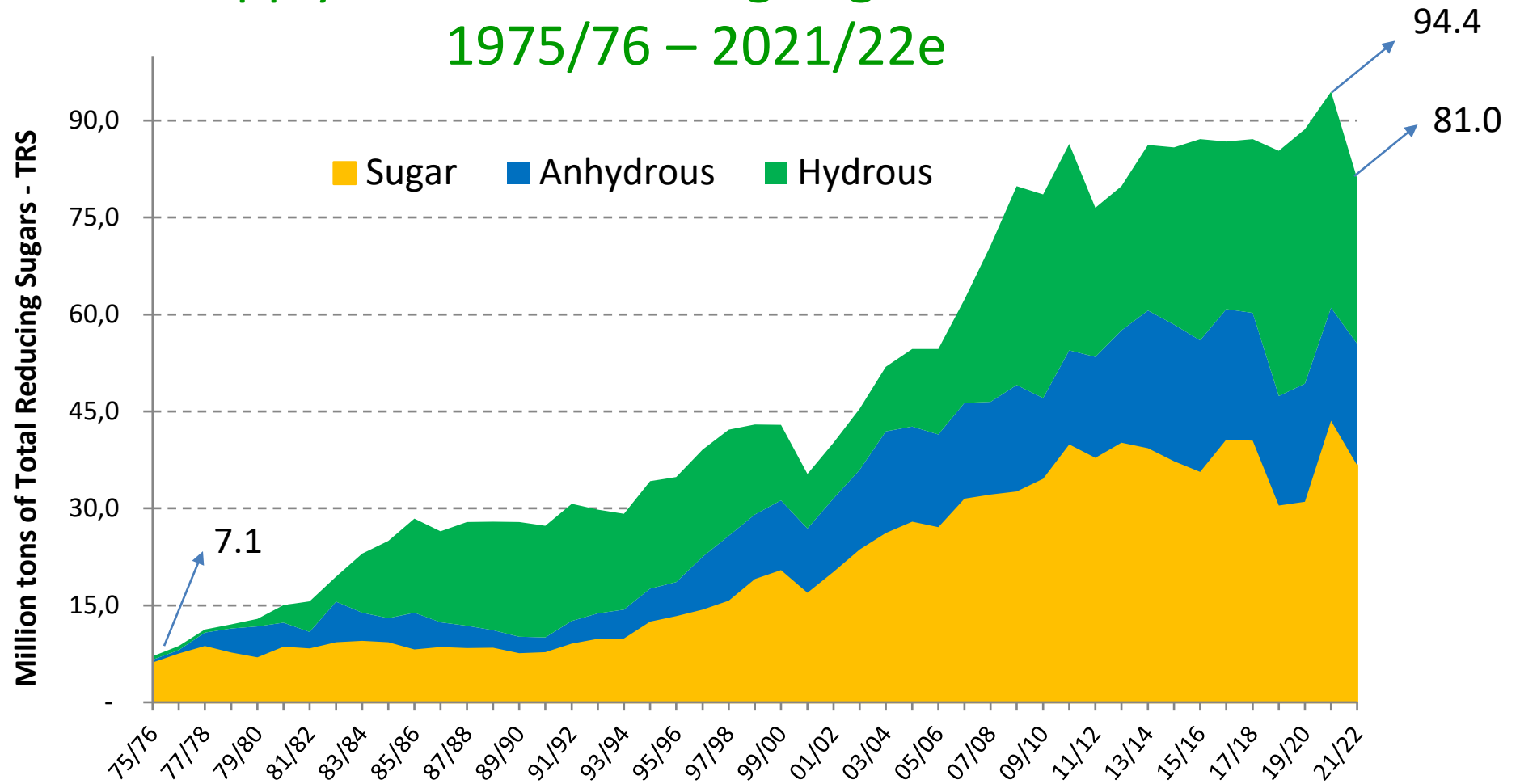
Brazil's experience in fuels is relevant since it is world's 3rd largest user of Energy in Transport



Source: IEA, 2016

Diversification towards Ethanol enabled growth

Supply of Total Reducing Sugars from Cane
1975/76 – 2021/22e

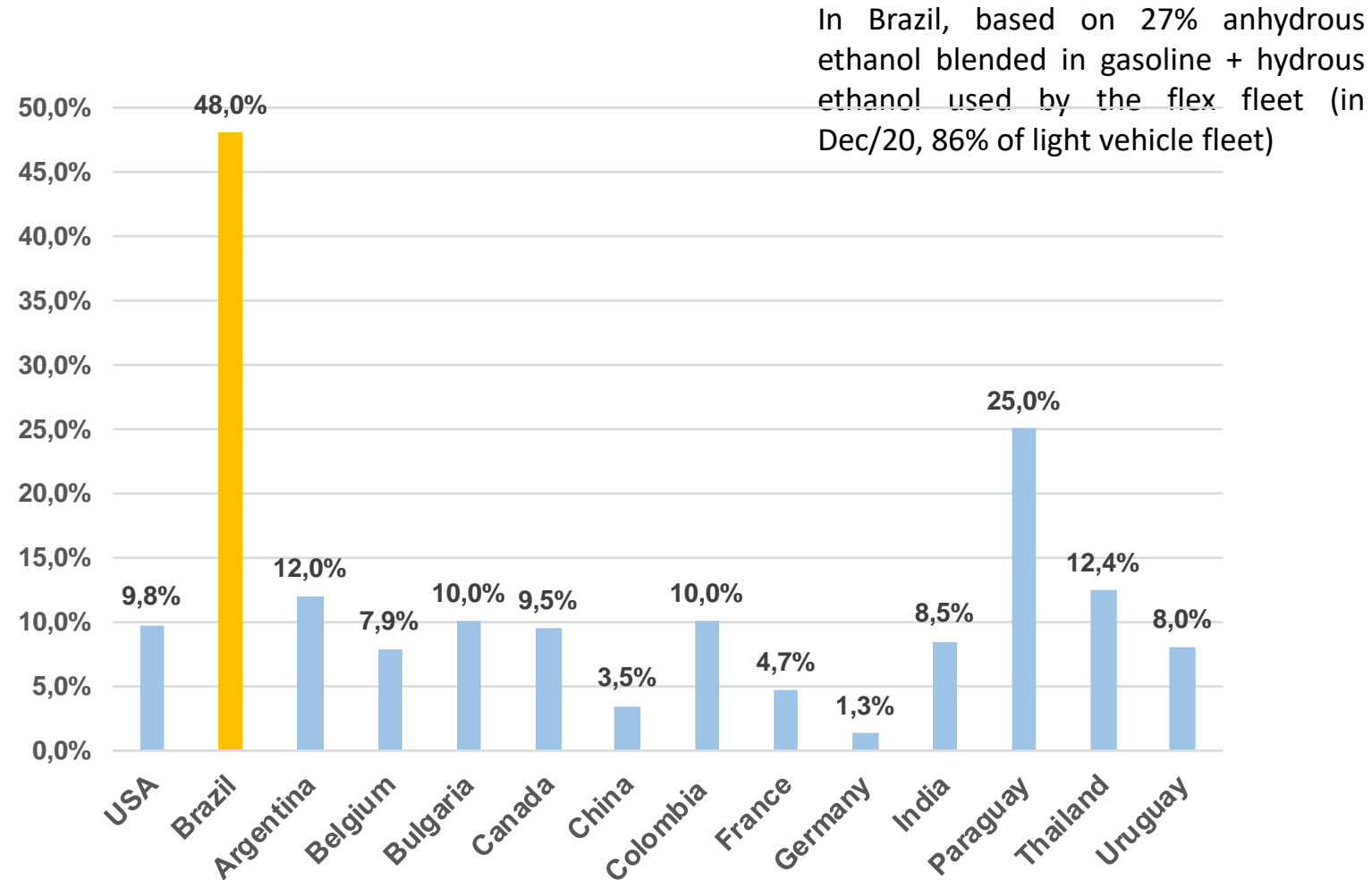


Source: DATAGRO

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Global experience for India in its drive to E20 DATAGRO

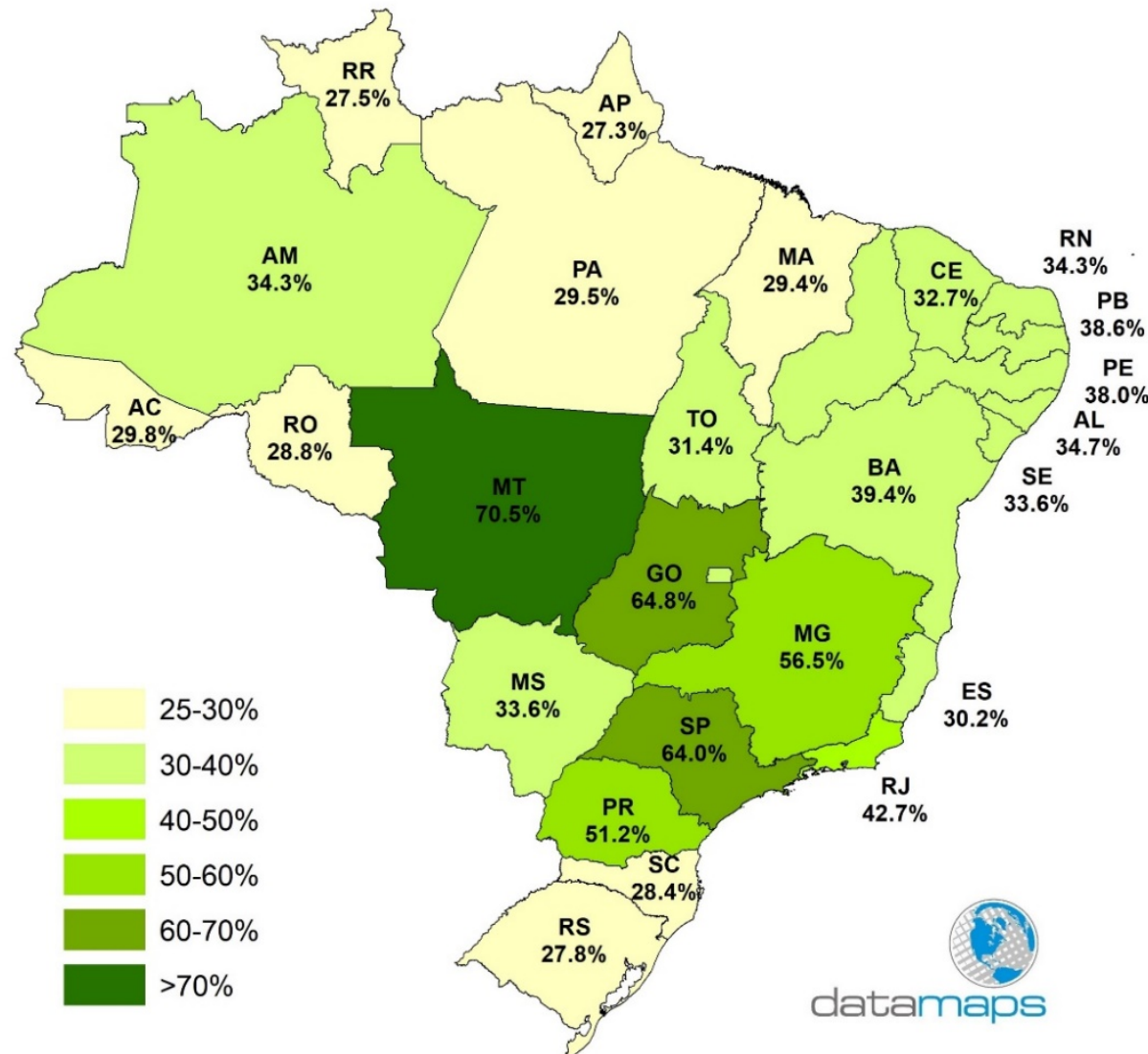
% of Ethanol in Consumption of Otto Cycle Fuels 2020



Source: DATAGRO, in gasoline equivalent.

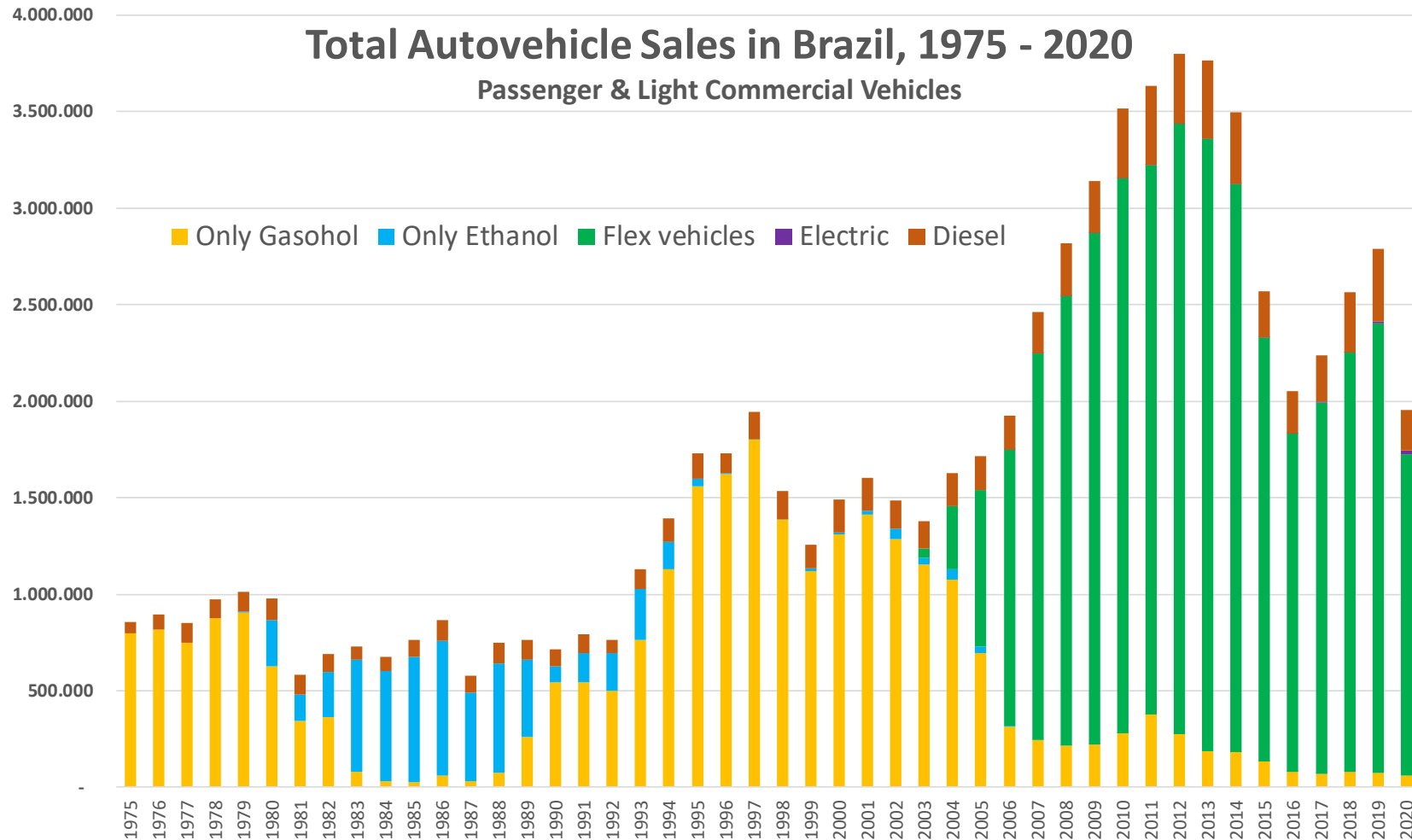
SHARE OF ETHANOL IN OTTO CYCLE FUEL CONSUMPTION

BY STATE IN BRAZIL (2020), in % of gasoline equivalent



Source: DATAGRO

AUTOVEHICLE SALES IN BRAZIL ACCORDING TO FUEL USE

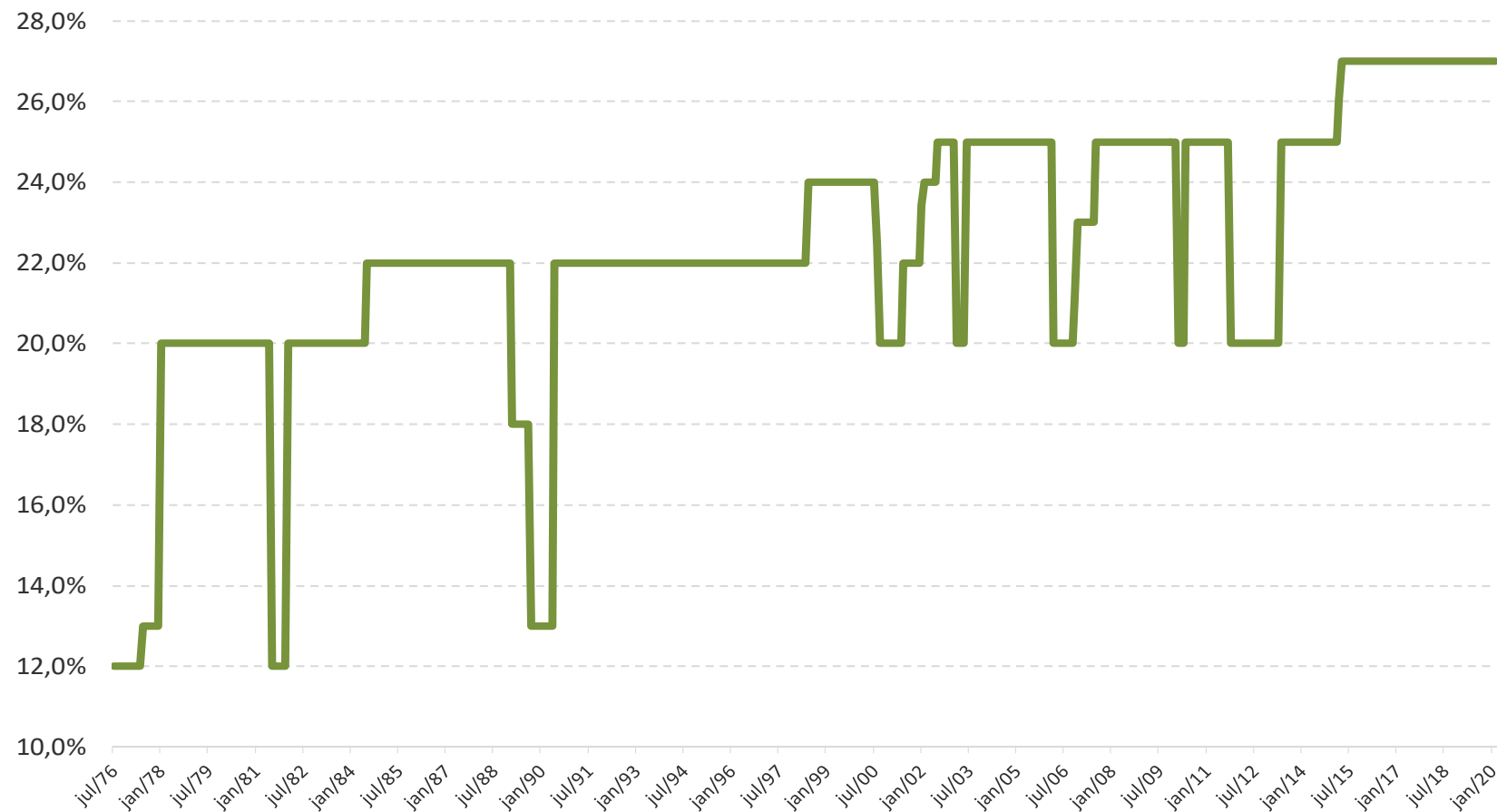


Source: ANFAVEA, Brazil's Automanufacturers Association, prepared by DATAGRO.

- **1984-87: neat ethanol car sales were 92% to 96% of all car sales.**
- **2020: Flex-cars are 85.2% of all vehicle sales.**
- **In Dec/20, flex-fuel cars accounted for 85% of total light vehicle fleet.**
- **Since 2015, mandatory blend of 27% in all common gasoline sold in the country.**

EVOLUTION OF ETHANOL BLEND MANDATE IN BRAZIL

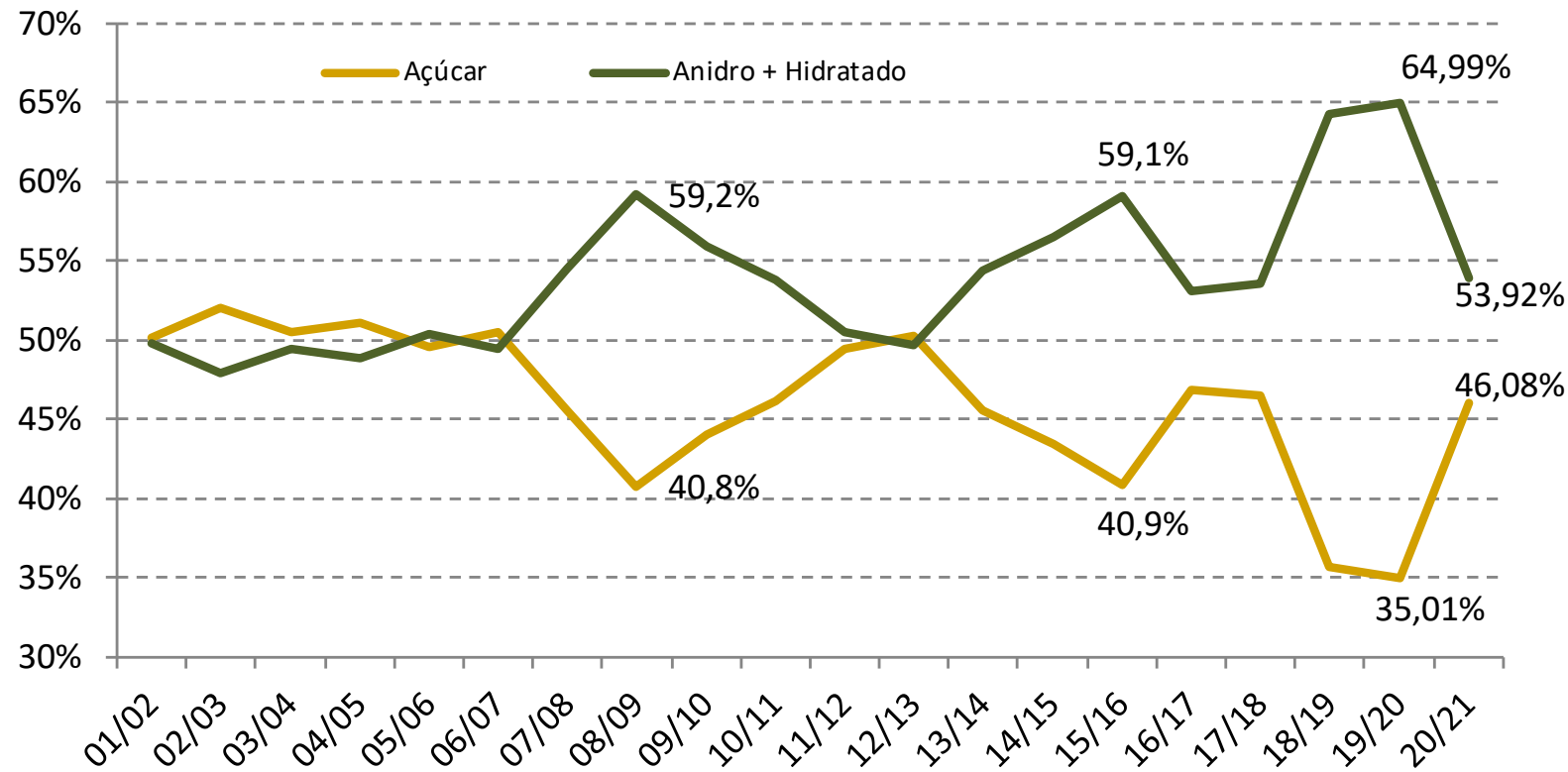
1976-2020



Source: DATAGRO, based on regulations published in Brazil's Official Gazette.

- Mandatory blend of anhydrous ethanol, min 99.5°. GL at 15°. C, as % in volume
- Since Jan/1978, 20% ; Since Jul/1984, 22% ; Since Jun/1998, 24% ; Since Jul/2002, 25%
- Since Mar/2015, 27% - Applies to all common gasoline sold in the country

With Ethanol, Brazil's sugar industry became also Flex (mix in Brazil)

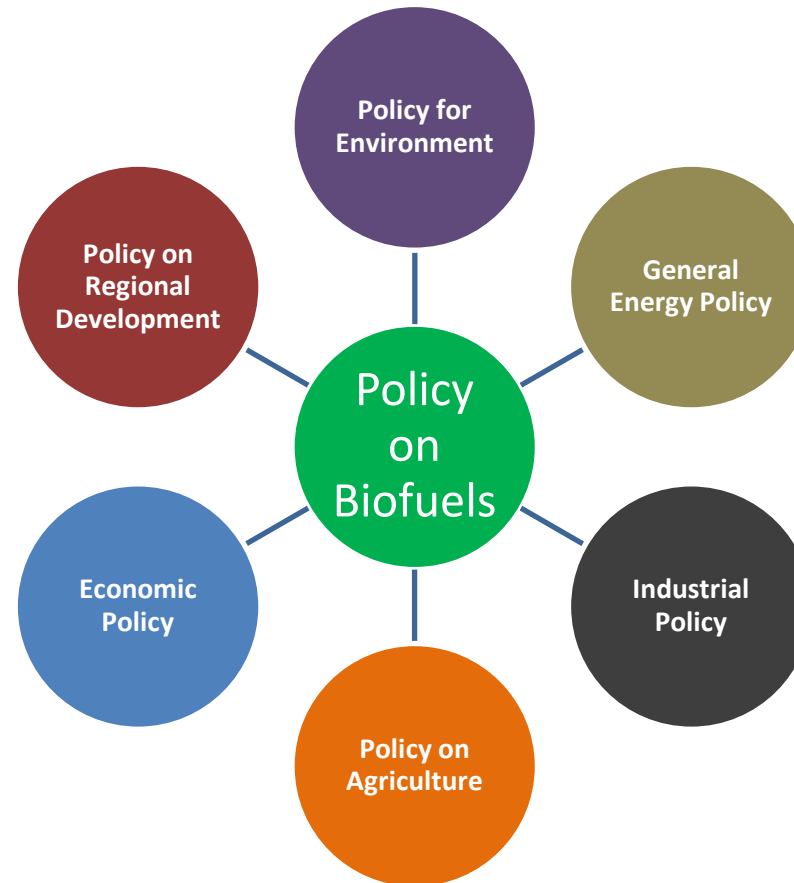


Source: DATAGRO

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Policy on Biofuels must be integrated

- Policy on Biofuels must be integrated with other Policies, and must be consistent overtime



Regulation ensures Efficiency and Sustainability

- It is recommended that Regulations address in a proper, definite, coherent and consistent way:
 - Ethanol Specification (for peruse of producers, automakers, fuel distributors / pump stations);
 - Emission limits that recognize the advantages of ethanol;
 - Incentives for increased energy & environmental efficiency for automakers;
 - Incentives for ethanol producers to increase energy & environmental efficiency in production.
- Regulation can ensure that Ethanol is produced in a Sustainable way, observing:
 - International criteria on sustainability and efficiency;
 - Do not threaten protected biomas.

Relevance of the distribution system

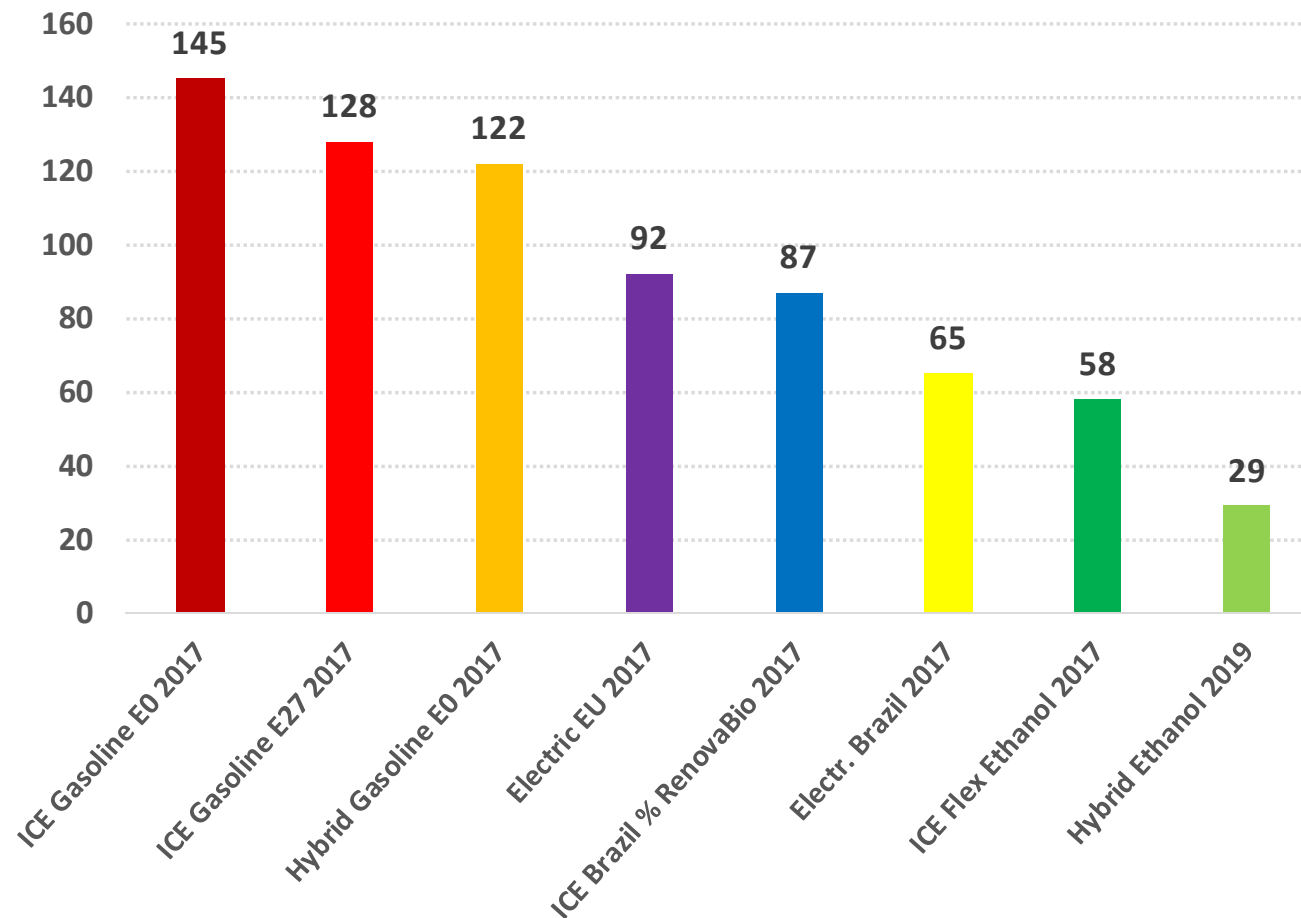
- Brazil has created a fuel distribution system for:
 - Hydrous Ethanol used as sole fuel, in fleet which is already 86% flex (Dec/2020) and growing,
 - Anhydrous Ethanol blended at 27% v/v in all gasoline nationwide (E27) – Brazil has been using “mid-level blends” for a long time,
 - Biodiesel blended in all fossil-based diesel Nationwide (B13), going to B15 in March/23.
- Biofuel is **HYDROGEN** captured, stored and distributed in an efficient, economical & safe manner.

Advantages of Ethanol

- **Drop-in** solution for mid-level blends: does not require built-up of new fleet or fuel distribution infrastructure
- Enables **immediate implementation & results**
- **Replicable**: no technical barrier for implementation
- **Scalable**: can grow overtime using available feedstocks, including organic residues for cellulosic conversion into ethanol
- Very effective and **proven environment & health benefits**
- **Affordable in price** to consumers
- Promotes **jobs & local income** to farmers
- Ethanol's **high octane complements gasoline well** & enables use of lower cost blend feedstocks
- Provides **sustainability & longevity for the use of traditional sources of energy**
- Enables **automakers to meet the most restrictive emission** targets

Ethanol is a clean, practical & efficient option for mobility (WtW) 2017/19

Total GHG Emissions in gCO₂e/km – 2017/2019



Source: MAHLE.

Next steps

Optimization of ICE using High Octane Fuels (HOF)



Hybrid Vehicles



Electrification using Sustainable Biofuels

Are Battery Electric Vehicles really clean?



Are Battery Electric Vehicles really clean?

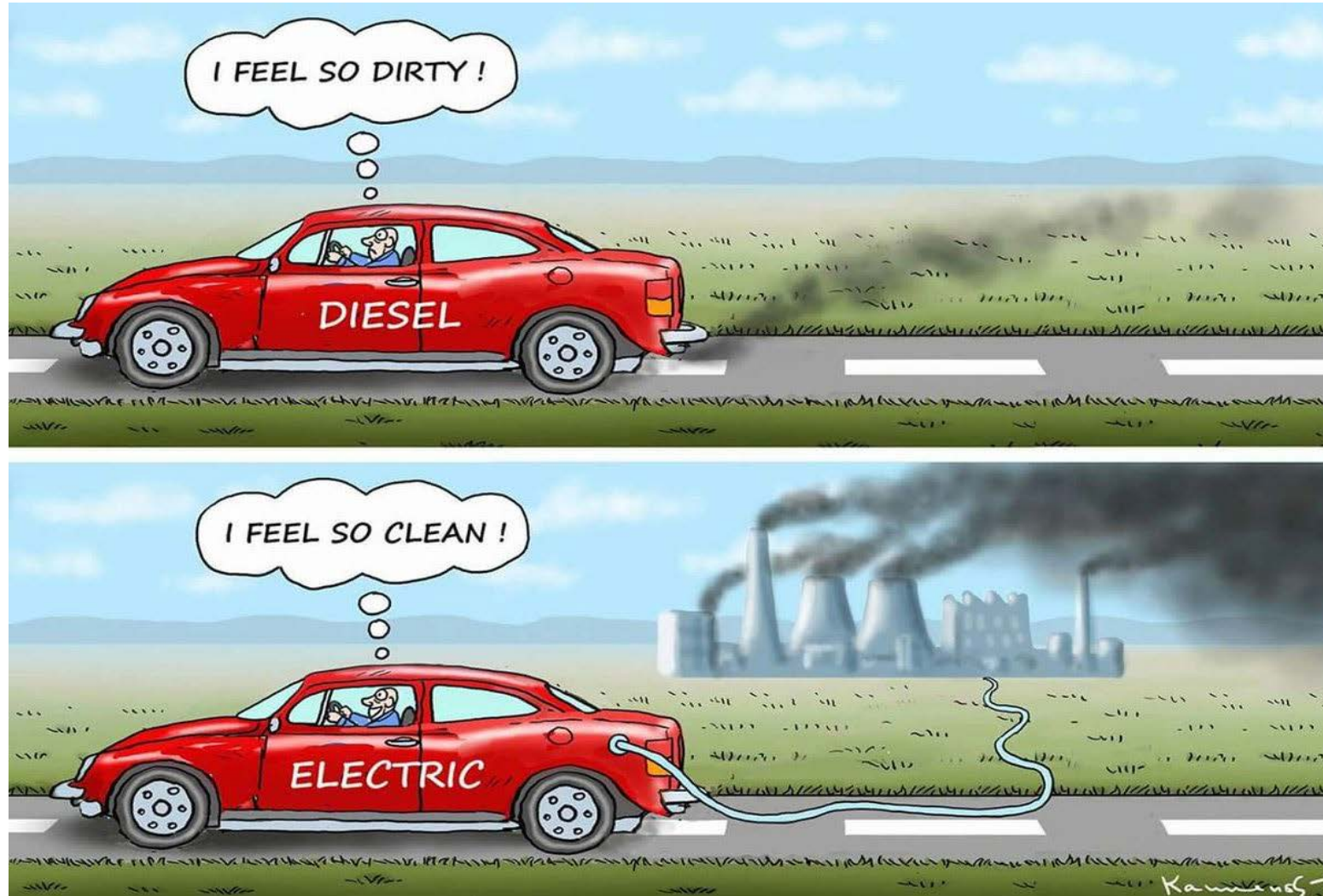


HOW ELECTRIC CARS WORK.

NATIONAL REVIEW ONLINE

FRIDAY, FEBRUARY 24, 2012

Are Battery Electric Vehicles really clean?



Strategic Vision for the Future of Mobility

- It is possible to enlarge the use of high-density low-carbon liquid fuels, stimulating higher energy efficiency and lower environmental footprint,
- Complementing in a virtuous way renewable and traditional fuels,
- Using the existing infrastructure, and
- Promoting local technologies in fuel production, capital goods, and in automobile technology.

Ethanol can resolve two of most pressing issues for Humanity

 Global Warming

 The Crisis of Employment (or the Refugee Crisis)



Nastari, P., Eletrificação com Biocombustíveis, ANP, Fev 2019.

We are moving towards the Age of Hydrogen !

For energy in transport,
Hydrogen represented by high-density,
low carbon footprint, sustainably produced
Advanced Biofuels such as
Ethanol, Biogas & Biomethane
that can use the existing
distribution infrastructure



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