Biofuels at the Centre of Energy-Environmental Efficiency in Mobility – the case of RenovaBio in Brazil

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Brazil is already substituting 45.9% (2019) of its gasoline with bioethanol, but there is a need of more Previsibility to drive Investments in fuels and mobility

Brazil´s Otto cycle fuel consumption in 2019: 51.5 billion liters
CAGR (2019): +4.1% p.a.

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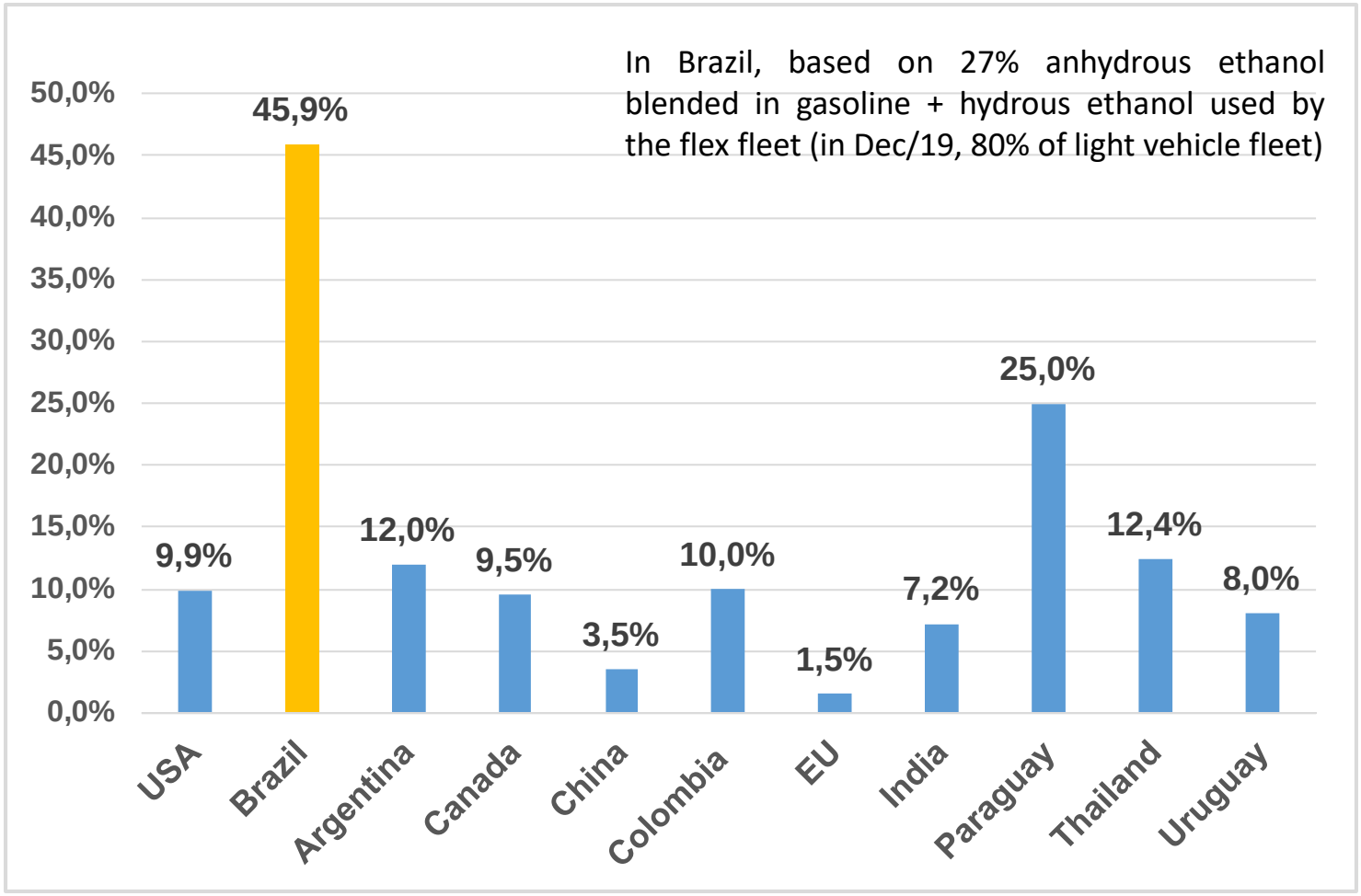
% of Ethanol in Consumption of Otto Cycle Fuels, 2019



Source: DATAGRO, in gasoline equivalent.

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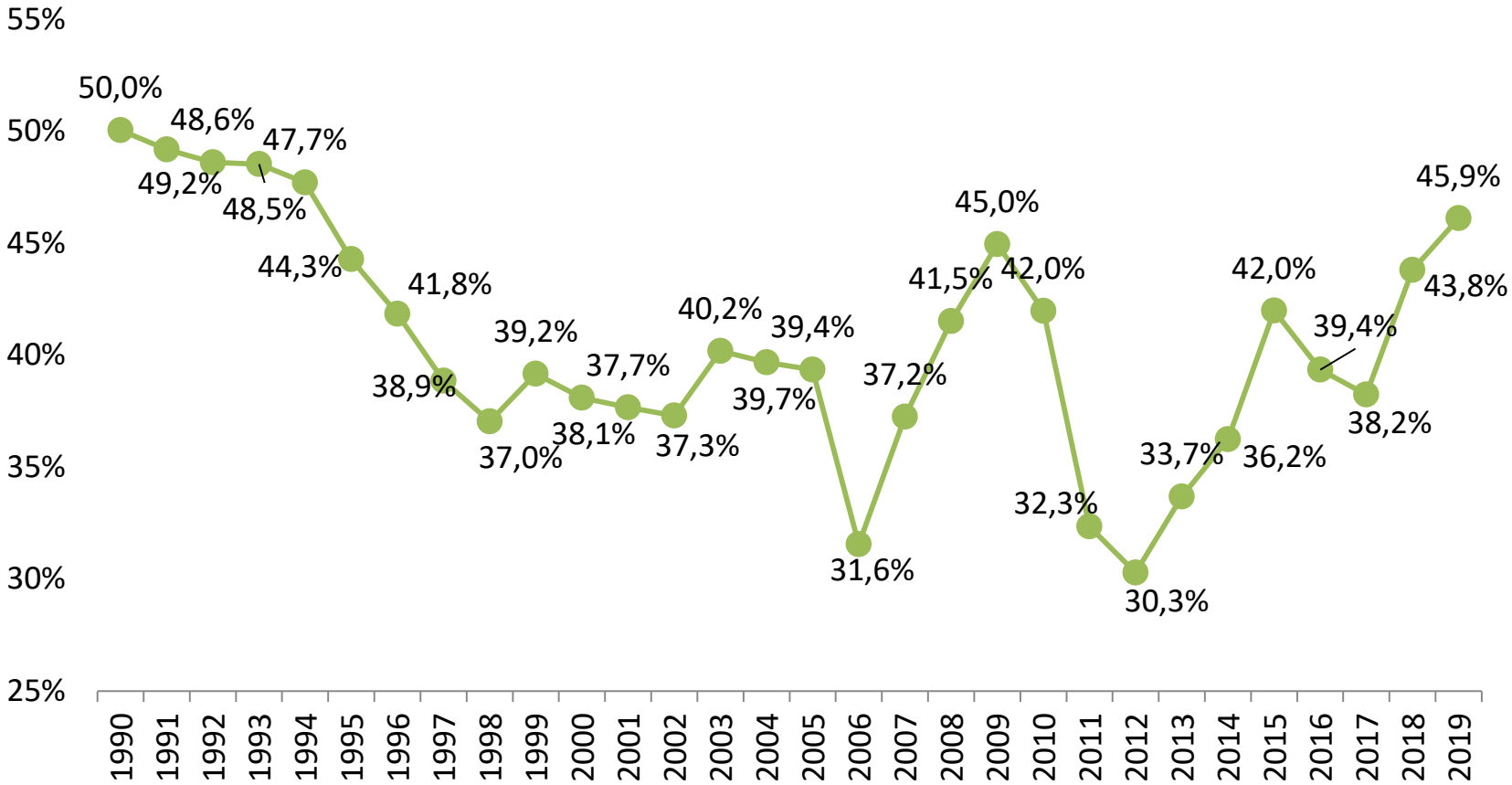
% of Ethanol in Otto Cycle Fuel Consumption

in gasoline equivalent



Source: DATAGRO

The **Option of Technological Pathway** for **Fuel & Motorization** depends on the method used to measure **Energy Efficiency & Environmental Impact**

Cradle-to-Tumb (CtT)

or

Well-to-Wheel (WtW)

or

Tank-to-Wheel (TtW)

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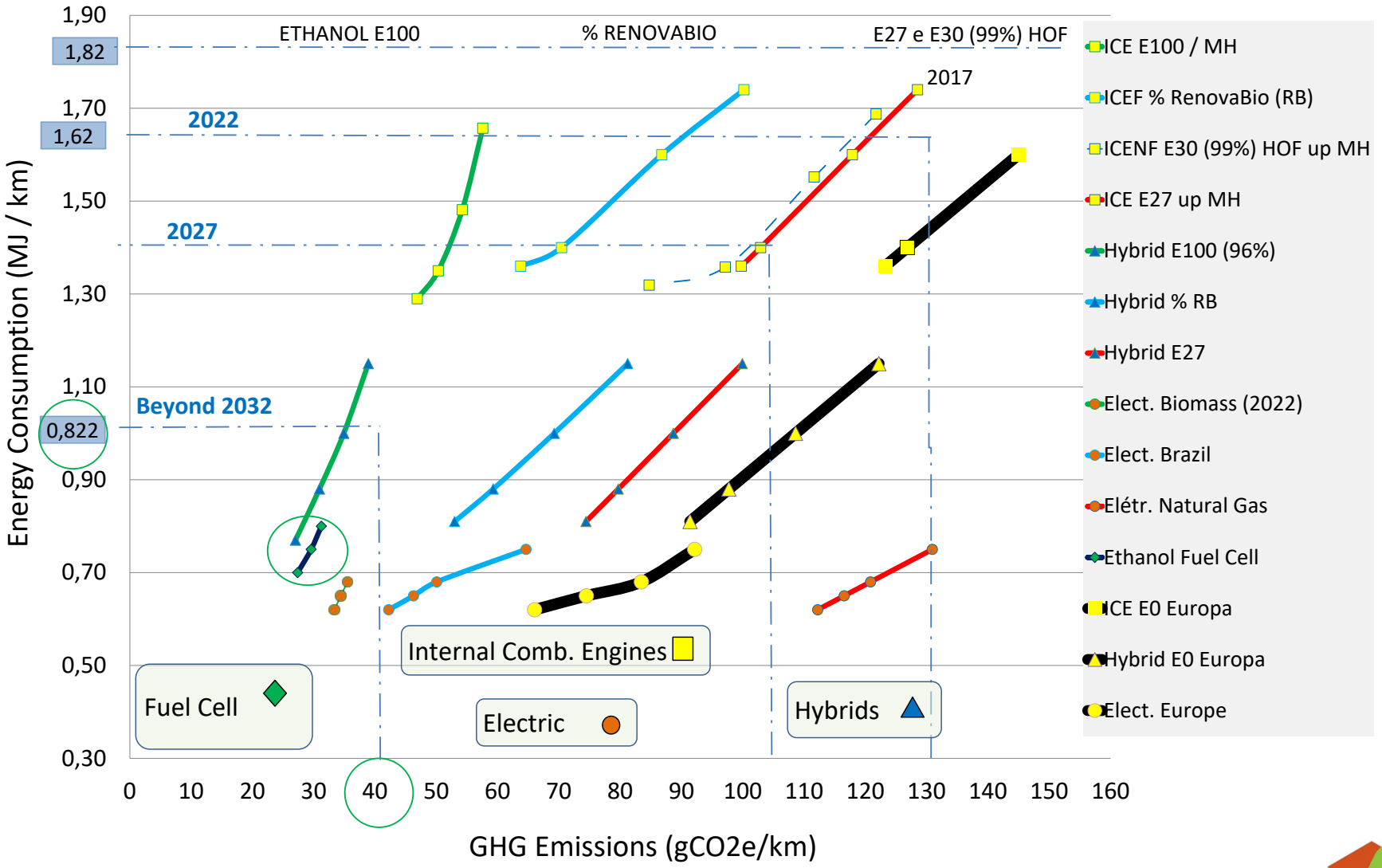
Comparison of Fuels & Motorization under WtW



Source: AEA , Brazilian Association of Automotive Engineering, MAHLE, 2019.

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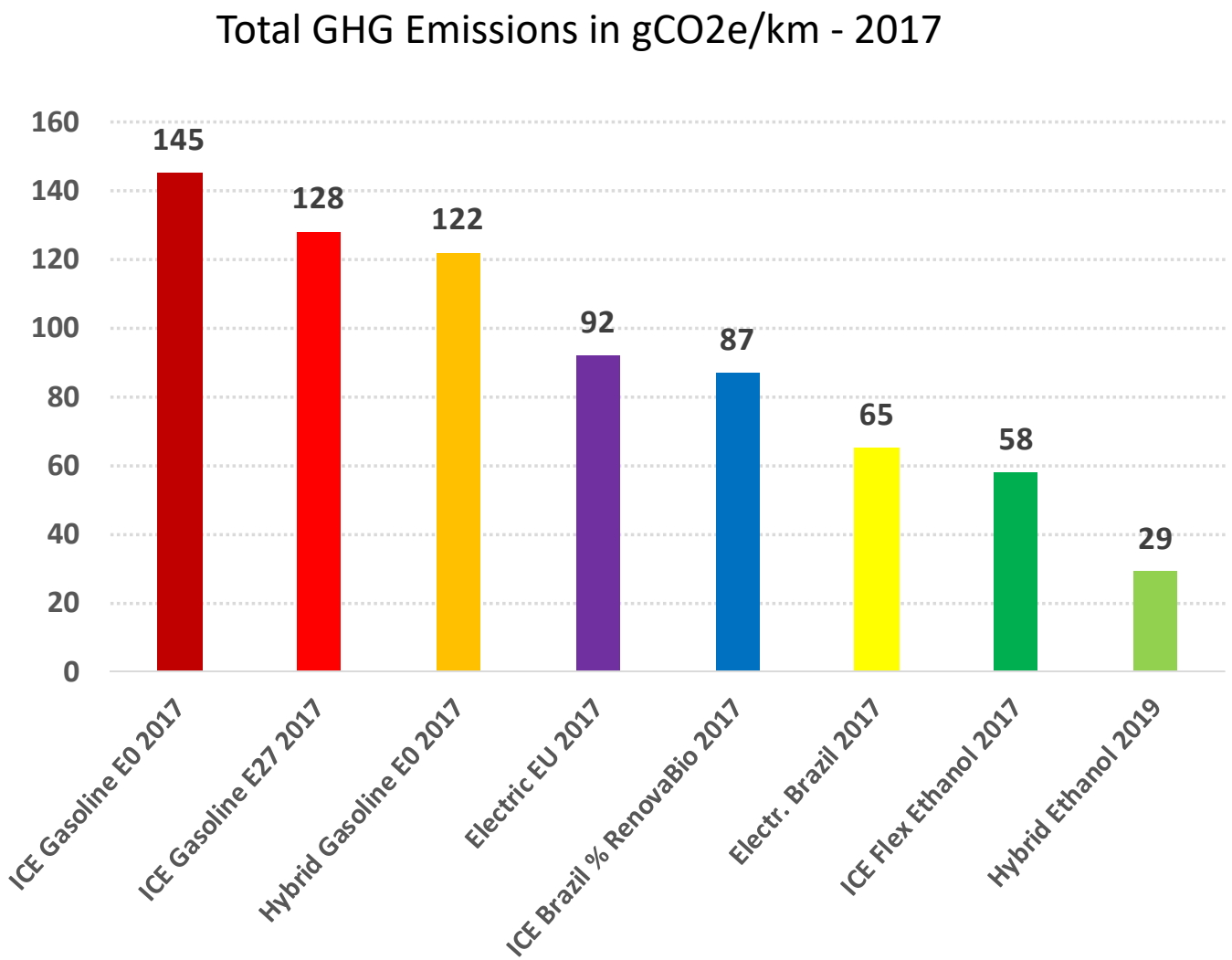
Comparison of GHG Emissions under WtW - 2017



Source: AEA / MAHLE, 2019.

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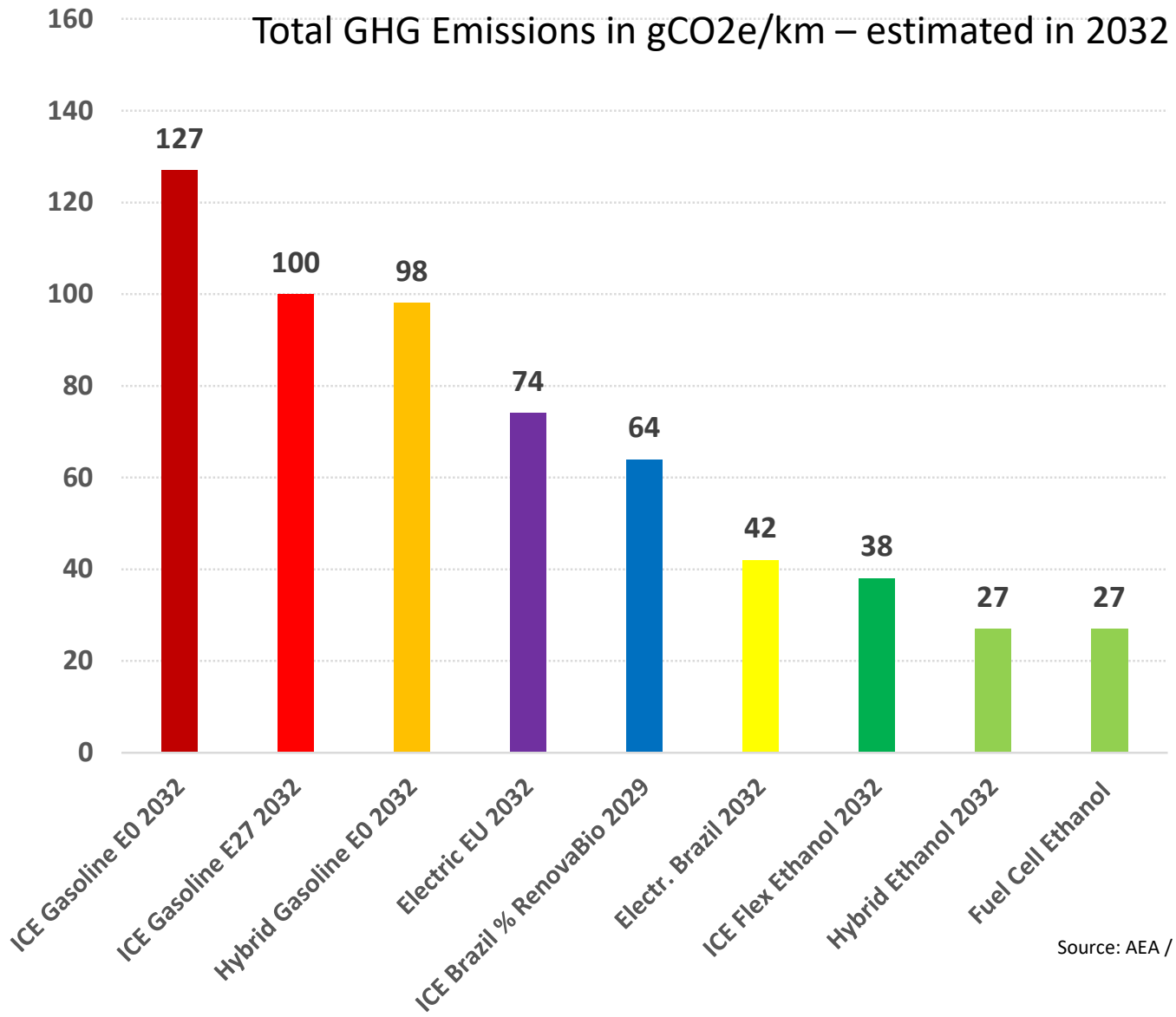
Comparison of GHG Emissions under WtW - 2032



Source: AEA / MAHLE, 2019.

Other Environmental & Health Benefits

Ethanol, Biodiesel e Biomethane substitute / reduce emissions of:

- Particulate Matter, $MP_{2.5}$
- Tetra-ethyl lead
- Carcinogenic Aromatics
- Carbon Monoxide
- Formaldehydes
- Volatile Organic Compounds (VOCs) precursors of photochemical smog

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Next steps

Optimization of ICE Flex

Hybrid Flex

Electrification using Sustainable Biofuels

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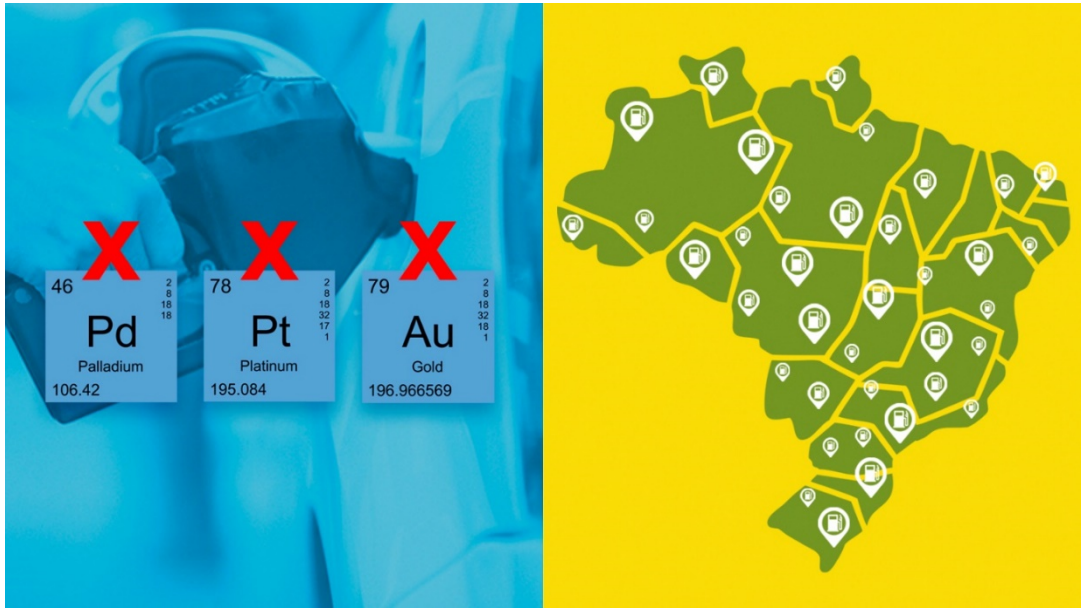
Automotive Technology

- Electrification with biofuels
  - "With the current ethanol distribution infrastructure, Brazil has already solved the Hydrogen distribution hurdle" (Nissan, June 2016).
  - Electrification with ethanol does not require use of rare metals.
  - Distribution of ethanol, as a sole or blended fuel in gasoline, is equivalent to a network of Hydrogen already in place.



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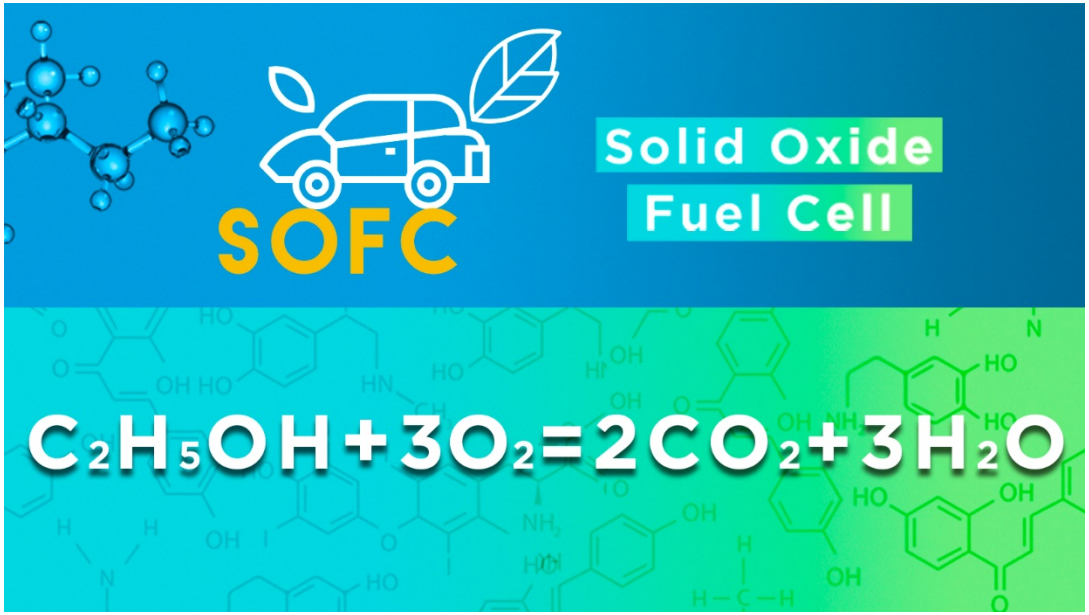
Automotive Technology

- Electrification with Ethanol
  - Is an electric car using ethanol, without the problems faced by Electric Battery Vehicle, taking advantage of the high content of Hydrogen in ethanol.



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Prototype presented at 16th DATAGRO´s Conference in S.Paulo, in October 2016.

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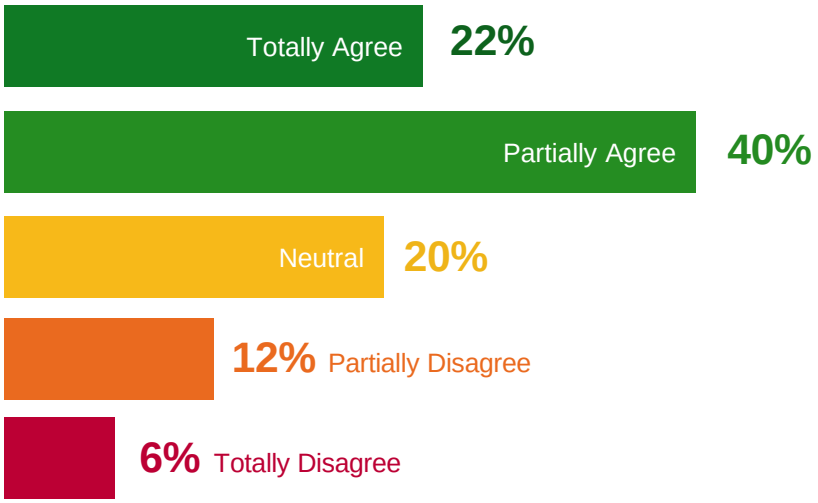
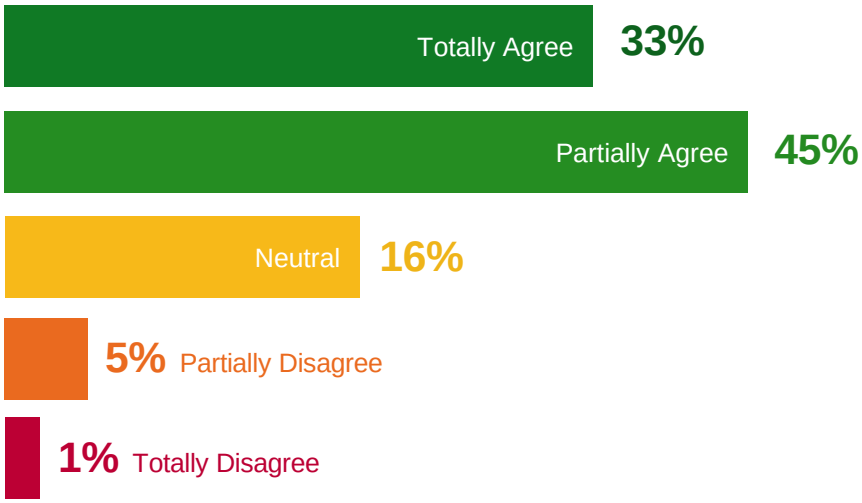
KPMG Global Automotive Executive Survey 2017

Electric Battery Vehicles (EBVs) will fail due to infrastructure challenges, while Fuel Cell Vehicles (FCVs) represent the real advance in electrification in mobility

62% of executives agree totally or partially that EBVs will fail due to infrastructure challenges



78% of executives agree totally or partially that FCVs represent the real advance in electrification in mobility



Source: KPMG 18th consecutive Global Automotive Executive Survey, Feb 2017

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Electrification with Ethanol

- Takes advantage of high energy density of ethanol
- Avoids the trap of fossil-derived electricity (importance of considering WtW concept)
- Electrification with Ethanol has the lowest GHG emission
- Uses existing liquid fuel distribution infrastructure
- Avoids concerns over:
  - Availability and sourcing of lithium-ion and cobalt
  - Life-span of batteries
  - Discart of batteries and the pollution it generates
- Is the option that promotes development (jobs and income) and the simultaneous integration of energy, agricultural, industrial & environmental public policy objectives.

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Strategic Vision for the Future of Mobility in Brazil & Selected Countries

- 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 and in automobile technology for local use and exports.

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RenovaBio

Brazil´s New National Biofuels Plan (RenovaBio), designed by CNPE and enacted into

Law in December 2017,

is a relevant strategy to reinforce policy towards Biofuels and the achievement of

Brazil´s commitments before

the Climate Agreement

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RenovaBio

- Innovation and efficiency in biofuel production and use is at center of Brazil´s strategy for the use of low carbon sources of energy.

- RenovaBio is not subsidy, nor carbon tax.

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RenovaBio

RenovaBio is a regulation based on 2 pilars:

- Induction of energy efficiency in production and use of biofuels;
- Recognition of the capacity of each biofuel to promote carbon reduction.

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RenovaBio

Target:

- Market-driven mechanism to promote expansion of biofuel/bioenergy in final energy demand (including in sea and air transport) based on sustainable practices, and increased energy-environmental efficiency.

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RenovaBio

Mechanism:

- Voluntary certification of biofuel producers for their energy-environmental efficiency, based on life-cycle assessment (LCA), which will determine ability to request issuance of Decarbonization Credits (CBios);
- Financial institutions will issue Carbon Reduction Credits (CBios) to be freely negotiated at public exchange;
- Definition of long term country carbon reduction target for the fuel sector, leading to individual fuel distributor carbon reduction targets, to be met with acquisition of CBios.

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RenovaBio

- Market-driven carbon pricing mechanism (endogenous, not exogenous determination), rewarding achievement of individual efficiency, not a common or equal coverage.
- Unleash market forces to implement and drive innovation for increased competitiveness in biofuel/bioenergy production.
- Stimulates continued demand growth, independent of government mandate.
- RenovaBio does not elect/predefine champions – expansion of bioenergy will be driven by energy-environmental efficiency and sustainable production.

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RenovaBio

Elegibility criteria:

- Zero deforestation: biofuel production cannot be based on feedstocks coming from deforested areas.

- All area under cultivation must be registered under CAR System (Brazil´s Forestry Code).

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RenovaBio

Is based on the belief that market forces should drive the choice

for the most efficient option towards

increased energy-environmental efficiency

in fuel production & use.

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Relevance of the distribution system

- Brazil can take advantage of its fuel distribution system for:
  - Hydrous Ethanol used as sole fuel, in fleet which is already over 80% flex 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 (B11), going to B12 in March/2020, and B15 in March/2023.

- **Biofuel is SOLAR ENERGY captured, stored and distributed in an efficient, economical & safe manner.**

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222 biofuel producers are under RenovaBio certification

222 biofuel-producing units are in the process of certification under RenovaBio, of which 138 have completed, or are under public consultation period. These 136 units (8 biodiesel, 1 biogas and 129 ethanol producers) represent potential generation of 22.95 mm CBIOS (mmt CO2e), or 80% of the national target of 28.7 mm CBIOs for 2020 (updated 13 Jan 2020).

Source: DATAGRO, www.datagro.com

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RenovaBio – a model for expansion of clean energy solution in mobility

Target Considered		-10.1% Reduction in C I
Demand (million m3)	**2018**	**2028**
Otto Cycle (gas eq)*	56,0	69,5
Gasoline A (pure)	31,1	30,0
Anhydrous Ethanol	11,5	11,1
Hydrous Ethanol	15,2	36,0
Total Ethanol	**26,7**	**47,1**
Diesel Cycle	57,0	73,9
Diesel A (pure)	51,2	62,8
Biodiesel	**5,7**	**11,1**
CNG (gas eq)*	2,5	2,5
Biomethane	**0**	**0,25**
Jet Fuel	7,2	9,5
Bio Jet Fuel	**0**	**0,36**

*** Values in Gasoline Equivalent**

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COP23-Fiji in Bonn

biofuture platform
Kickstarting a global, advanced bioeconomy

Declaration of Vision, by 19 Nations representing over 50% of world population, 37% of world GDP + IEA + IRENA
Bonn, November 16, 2017

Target for 2030 (to achieve the 2-Degree Scenario)

- % of **Bioenergy** in world energy demand must **double**.
- % of sustainable low carbon **Biofuels** in transport fuels, including sea and air transport, must **triple**.

Scaling up the bioeconomy is possible, given smart agricultural practices, better use of rural and urban waste, and proper policies.

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biofuture platform
Kickstarting a global, advanced bioeconomy

"Beyond 2025, IRENA's Renewable Energy Roadmaps (ReMap) scenario foresees that a global output of 500 billion liters of biofuels would be needed by 2030 (of which 124 billion liters in advanced biofuels) and 1,120 billion liters per year by 2050 to most cost-effectively contribute to the achievement of the Paris Agreement's goals (IRENA, 2017)."

In **Creating the Biofuture: A Report on the State of the Low Carbon Bioeconomy**, 2018, pp.23-24.

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

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Biofuels Solve The Two Biggest Challenges For Humanity

With biofuels we can solve the 2 biggest problems facing Humanity:

- Global Warming and
- The Refugee crisis

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

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We are moving towards the Age of Hydrogen

Not Hydrogen captured and stored in high-pressure, costly and risky Titanium tanks,

but Hydrogen represented by high-density, low carbon footprint, sustainably produced Advanced Biofuels such as

Ethanol, Biogas & Biomethane

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RenovaBio: model for expansion
of clean & efficient energy solution for mobility

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