ETHANOL BLENDING POLICY: STATUS & IMPLEMENTATION

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REASONS WHY ETHANOL POLICY WAS IMPLEMENTED IN BRAZIL

- After 1970's oil crises, to mitigate high dependence on oil imports (+81% of total demand in 1975)
- Negative impact on trade balance & the economy
- Take advantage of Brazil's tradition in sugar cane cultivation
- Environmental & health benefits were found only much later



ALCOHOL PROGRAM ENACTED BY PRESIDENT GENERAL ERNESTO GEISEL IN 1975















BRIEF CHRONOLOGY OF ETHANOL USE IN BRAZIL

- Ethanol blends have been in use in Brazil since 1924
 - 5% mandatory blend first approved in July 1931
 - Blend level rose to as much as 50% during II WW
- 1975: decision was taken to gradually raise <u>mandatory blend</u> in all gasoline sold & to develop technology for the use of pure (E100) ethanol use in cars
- 1976 onwards: gradual raising of mandatory blend
- 1979 (Aug): pure (E100) ethanol car launched (Fiat 147), for use of hydrous ethanol fuel (avg 95.5^o.
 GL at 15^o. C).
- 1984-87: pure (E100) ethanol cars are great success (92% to 96% of total sales)
- 1989: Ethanol supply crisis affects sales of pure ethanol cars
- 2003 (March): launching of flex-fuel cars
- 2004-2019: flex-fuel cars are great success (96.4% of total sales in 2019)
- 2017: RenovaBio legislation is approved in Congress with massive majority vote
- 2019 (Dec): flex-fuel cars account for +80% of the fleet
- 2020: RenovaBio is implemented



AUTOVEHICLE SALES IN BRAZIL ACCORDING TO FUEL USE



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

- 1984-87: neat etanol car sales were 92% to 96% of all car sales.
- 2019: Flex-cars are 96.4% of all car sales.
- In Dec/19, flex-fuel cars accounted for +80% of total light vehicle fleet.
- Since 2015, mandatory blend of 27% in all 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 etanol, min 99.5^o. GL at 15^o. 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 gasoline sold in the country



BENEFITS GENERATED FROM ETHANOL POLICY

- Over 3.15 billion barrels of gasoline substituted between 1975-2019 (Brazil's total proven petroleum reserves are 15.4 billion barrels in Dec/19)
- Economy from gasoline imports: US\$ 540.6 billion, including service on foregone foreign debt (Brazil's international reserves are US\$ 368.4 billion on Feb 13, 2020).
 - 2019: 449,514 b/d of gasoline saved, with savings of US\$ 13.03 billion in imports
- 870,000 direct jobs + 2 million indirect jobs
- Sustainability + longevity for the use of petroleum derivates
- Strenghtening & support to local auto industry
- Ethanol is equivalent to Hydrogen distribution infrastructure ("hydrogen-on-the-bucket")
- Per capita GDP rise of US\$ 1098 in cities where ethanol is produced
- Biofuels are central for Brazil's low carbon emission strategy



COMPARISON OF GDP & CO2 EMISSIONS

Largest World Economies

2018											
Rank	Country	GDP - Billion USD	Total CO2 emissions (Mt of CO2)	CO2 emissions per capita	CO2 emissions per USD (tons CO2/M USD)						
1º	United States	20.544,3	4.896,0	14,9	238,3						
2º	China	13.608,2	9.302,0	6,7	683,6						
3º	Japan	4.971,3	1.098,0	8,7	220,9						
4º	Germany	3.947,6	683,0	8,2	173,0						
5⁰	United Kingdom	2.855,3	353,0	5,3	123,6						
6º	France	2.777,5	293,0	4,4	105,5						
7⁰	India	2.718,7	2.162,0	1,6	795,2						
8 <u>°</u>	Italy	2.083,9	314,0	5,2	150,7						
9⁰	Brazil	1.868,6	428,0	2,0	229,0						
10º	Canada	1.713,3	573,0	15,5	334,4						
42º	Pakistan	314,6	183,0	0,9	581,7						
Source: World Source: IEA - International Source: Bank Energy Agency Elaborated by DATAGRO											



PAKISTAN & BRAZIL ENERGY MATRIX

Pakistan's Energy Matrix



Other Renewables 14,5% Sugar Cane 17,0% Hydro 12,0% Nuclear 1,4% Coal 5,7%

Source: Ministry of Mines and Energy of Brazil elaborated by DATAGRO

Brazil's Energy Matrix



CARBON EMISSIONS FROM ETHANOL USE ARE THE LOWEST AMONGST ALL POWERTRAINS



Total GHG Emissions in gCO2e/km - 2019



AQI (as MP_{2.5}) FOR MOST POLLUTED CITIES

Most Polluted Cities in the World - Unit: μ g/m ³ - 2018										
Rankig	City	Country	2018 AVG	Rankig	City	Country	2018 AVG			
1	Gurugram	*	135,8	26	Mandi Gobindgarh	*	78,6			
2	Ghaziabad	*	135,2	27	Xingtai Shi	*1	76,7			
3	Faisalabad	C	130,4	28	Shijiazhuang	*1	76,7			
4	Faridabad	<u> (je</u>	129,1	29	Ahmedabad		76,1			
5	Bhiwadi	0je	125,4	30	Aksu	*3	74,1			
6	Noida	*	123,6	31	Handan	*3	74			
7	Patna	*	119,7	32	Anyang	*1	72,9			
8	Hotan	*3	116	33	Baoding	*3	70,7			
9	Lucknow		115,7	34	Linfen	*1	68,2			
10	Lahore	C	114,9	35	Wujiaqu	*3	67,8			
11	Delhi		113,5	36	Xianyang	*3	67,8			
12	Jodhpur		113,4	37	Jaipur	*	67,6			
13	Muzaffarpur		110,3	38	Jiaozuo	*1	66,9			
14	Varanasi		105,3	39	Hengshui Shi	*3	65,7			
15	Moradabad	*	104,9	40	Xuzhou	*9	65,5			
16	Agra	*	104,8	41	Cangzhou Shi	*9	65,2			
17	Dhaka		97,1	42	Pingdingshan	*1	65,1			
18	Gaya		96,6	43	Kaifeng	*9	64,6			
19	Kashgar	*9	95,7	44	Asansol	ŵ	64,4			
20	Jind		91,6	45	Howrah	*	64,2			
21	Kanpur	۲	88,2	46	Xuchang	*1	64,2			
22	Singrauli		86,8	47	Zhengzhou	*1	64,1			
23	Kolkata	*	85,4	48	Tangshan	*1	63,5			
24	Pali	*	82,3	49	Puyang	*9	63,5			
25	Rohtak	*	81,6	50	Luohe	*)	62,6			

<section-header>Of the 50 most polluted cities in the world: 25 in India 22 in China 2 in Pakistan 1 in Bangladesh Islamabad is 239° in the ranking AVG in 2018 – 38.6 µg / m³



São Paulo is 879° in the ranking AVG in 2018 - $16.2 \mu g / m^3$



MAIN ELEMENTS OF BRAZIL'S ETHANOL POLICY

- Long-term approach: main policy goals & instruments must be maintained overtime
- Blend mandate, not simple authorization
- Support to innovation in automobile technology adapted for ethanol use, through fiscal incentives to automaker's improvements in efficiency
- Legal framework to support private investment in expansion of distillation capacity
- Price parity between ethanol & sugar
- Legislation regulating **disposal of vinasse** valuable resource for fertirrigation, provided disposed in proper way.



MAIN ELEMENTS OF BRAZIL'S ETHANOL POLICY

- RenovaBio: new legislation that places innovation and efficiency in fuel 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**
- System of voluntary certification of biofuel producers for their energyenvironmental efficiency, based on life-cycle assessment (LCA), which will determine ability to request issuance of Decarbonization Credits (CBios)
- Market-driven carbon pricing mechanism (endogenous, not exogenous determination), rewarding achievement of individual efficiency, not a common or equal coverage.
- Unleashes market forces to implement and drive innovation for increased competitiveness in biofuel/bioenergy production.



HOW IT ALL HAPPENED

- Blend mandate was raised overtime, as production allowed.
- Obligatory contracts for sale of ethanol to be blended in gasoline between producers and oil company(ies)
 - Contracts are valid for 12 months, and must be renewed every year to meet projected demand of ethanol to be blended in order to guarantee supplies & meet mandate
 - Contracts can be used as colateral to finance expansion of distillation capacity (PPA's)
- Until 1999, price of ethanol at producer level was determined by govt in **parity with sugar.** After market scale was achieved, prices were liberalized
- Since 1999, prices of gasoline and ethanol at producer level are freely determined. Prices at retail for E27 and E100 are also freely determined
- Consumers make the choice of fuel use at the pump
- Regulation on fuel specification confers legal security to automobile & autopart manufacturers and fuel distributors
- Provinces are free to set state-level incentives for ethanol production & use of ethanol as fuel, recognizing its positive externalities



EVOLUTION OF PRODUCTION OF SUGAR & ETHANOL IN BRAZIL



- Diversification towards ethanol enabled production of sugar & ethanol to rise from 7.1 mmt of Total Reducing Sugars (TRS) in 1975/76, to 89.1 mmt in 2019/20.
- % of TRS going to ethanol rose from 13.2% in 1975/76 to 65.2% in 2019/20.
- Industrial flexibility allowed industry to adapt more efficiently to changing market conditions.
- Sugar exports of 19.3 mmt in 2019/20 account for only 22.6% of TRS supply.

Source: DATAGRO



SHARE OF ETHANOL IN OTTO CYCLE FUEL CONSUMPTION BY STATE IN BRAZIL (2019) (in % of gasoline equivalent)





ADVANTAGES OF ETHANOL FOR ENERGY POLICY

- **Drop-in** solution for mid-level blends: does not require built-up of new fleet or 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



BASIS FOR ADOPTION OF ETHANOL USE REGULATION

- Vision that **it is possible to enlarge the use of high-density low-carbon liquid fuels**, stimulating **higher energy efficiency and lower environmental footprint**
- Using largely available biomass feedstocks without compromising food security
- Complementing in a virtuous way renewable and traditional fuels
- Using the existing infrastructure, and
- Promoting local technologies in fuel production and in automobile technology
- Enabling simultaneous **social**, **economic**, **environmental & health benefits**



OUR VISION FOR SUSTAINABLE MOBILITY

- Various forms of motorization will cohexist in the pursuit of higher ENERGY EFFICIENCY & LOWER CARBON EMISSIONS
- Battery Electric Vehicles (BEVs) are clean only if the source of energy is clean
- Batteries have low energy density
- ELECTRIFICATION WITH ETHANOL (Hybrids & SOFCs) is the path:
 - Affordable to consumers
 - Uses a high-density liquid fuel with low carbon footprint
- Desired evolution:
 - Otimization of ICEs using Ethanol (higher blends in gasoline)
 - Hybrids
 - Fuel Cell Vehicles using Ethanol



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



WHAT IS NEEDED TO IMPLEMENT ETHANOL POLICY



Theatre Peter II Ribeirão Preto, Brazil July 1978

STRONG WILL & ANXIETY





REALIZATION:



PROMOTION:





MINISTRY OF FOREIGN AFFAIRS



TECHNICAL SUPPORT



