Renewable Energy in Emerging Markets
Low carbon energy and economy transformation
ENERGY BIG PUSH BRAZIL

Strengthening Innovation for a Sustainable Energy Transition in Brazil

24th REFORM Group Meeting August 24-28, 2020 – Raitenhaslach
How to reach Carbon Neutrality/Climate Neutrality?

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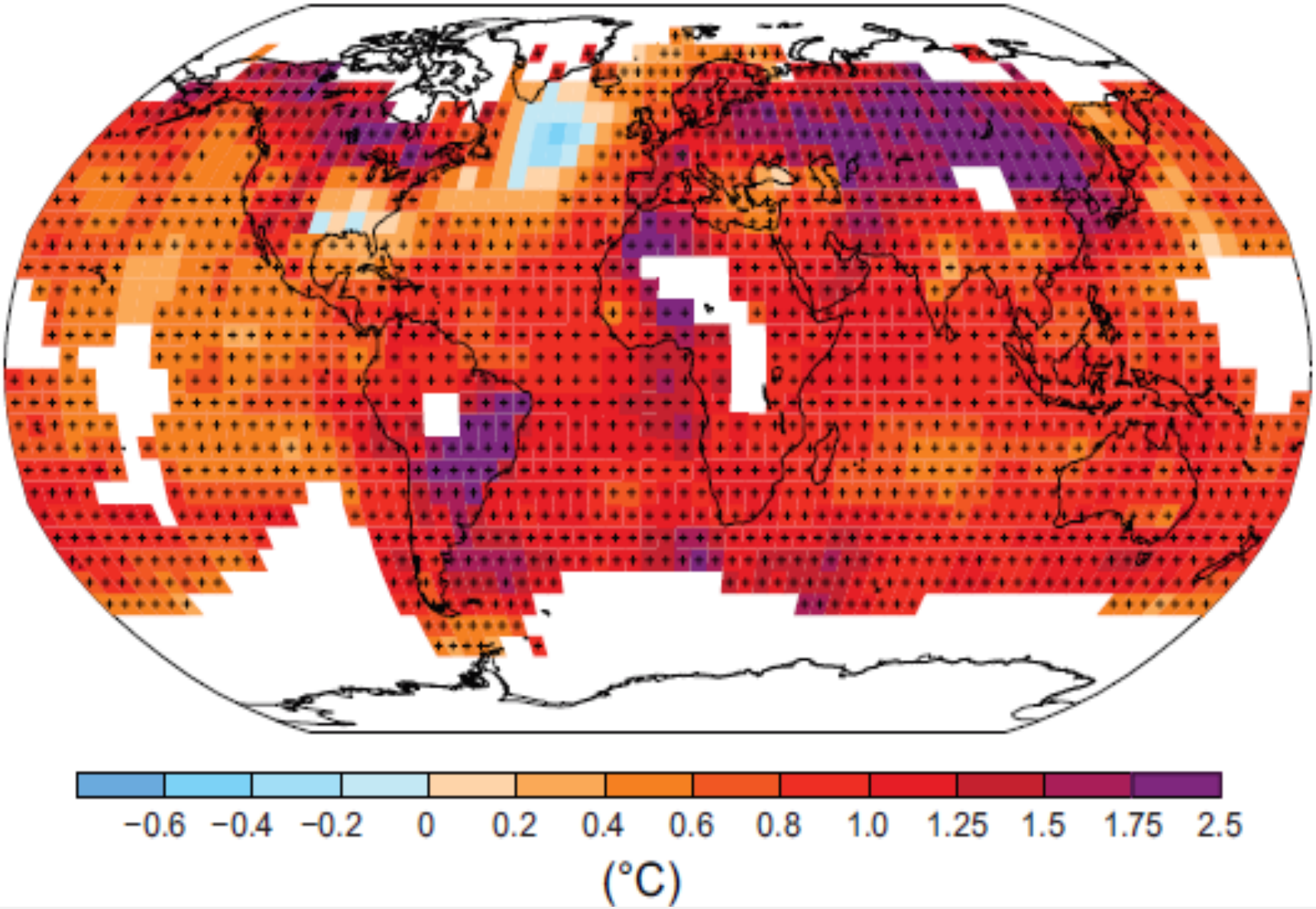
Ciência, Tecnologia e Inovação

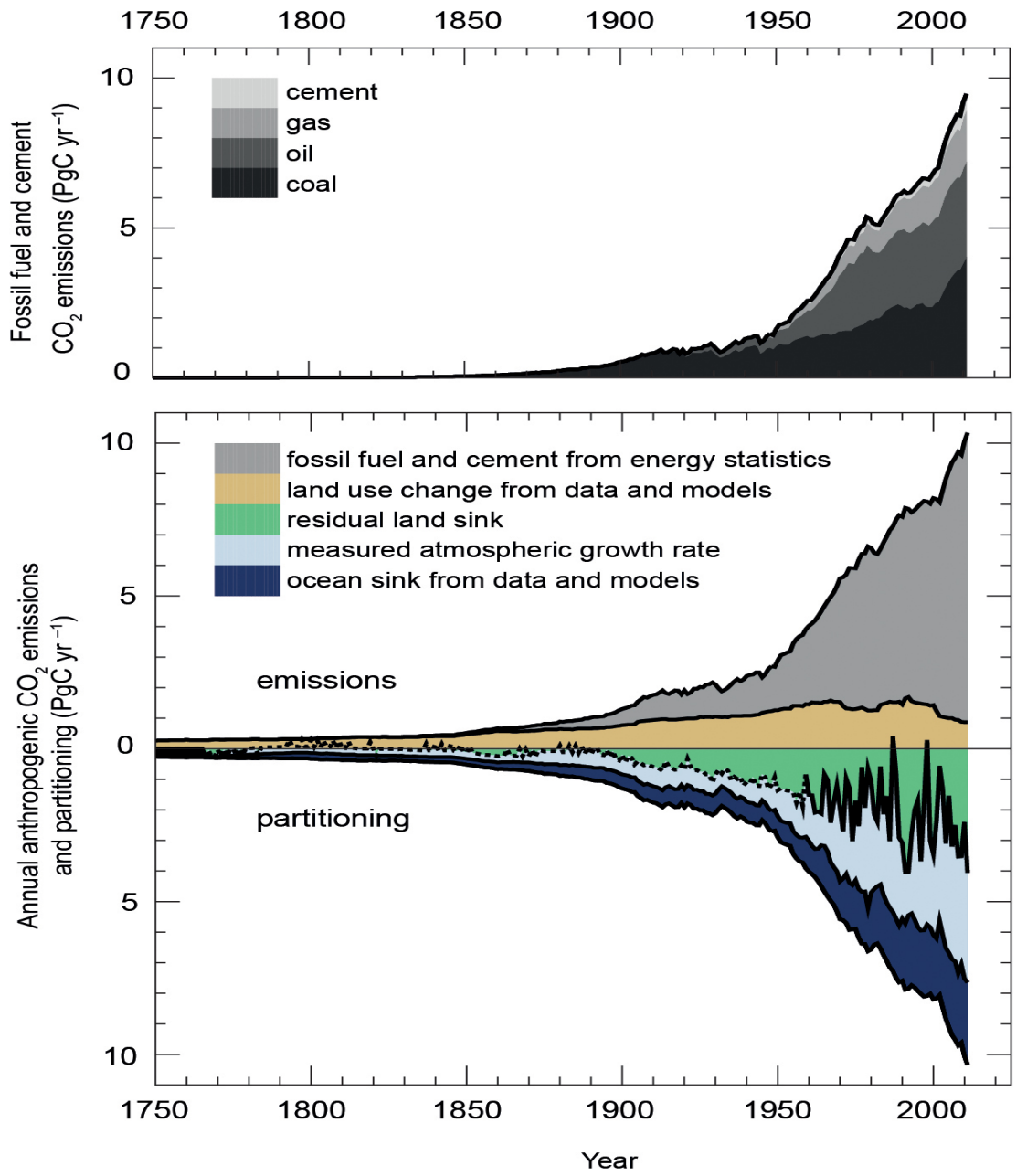
Marcelo Poppe

Observed change in surface temperature 1901-2012



Source: IPCC, 2013: Summary for Policymakers.

Observed CO_2 emissions



GHG emissions continue to rise because of human activities, especially from intense and growing fossil fuel combustion, followed by deforestation, whose contribution decreases and can be virtually absorbed by terrestrial sink.

Source: IPCC, 2013: Technical Summary.

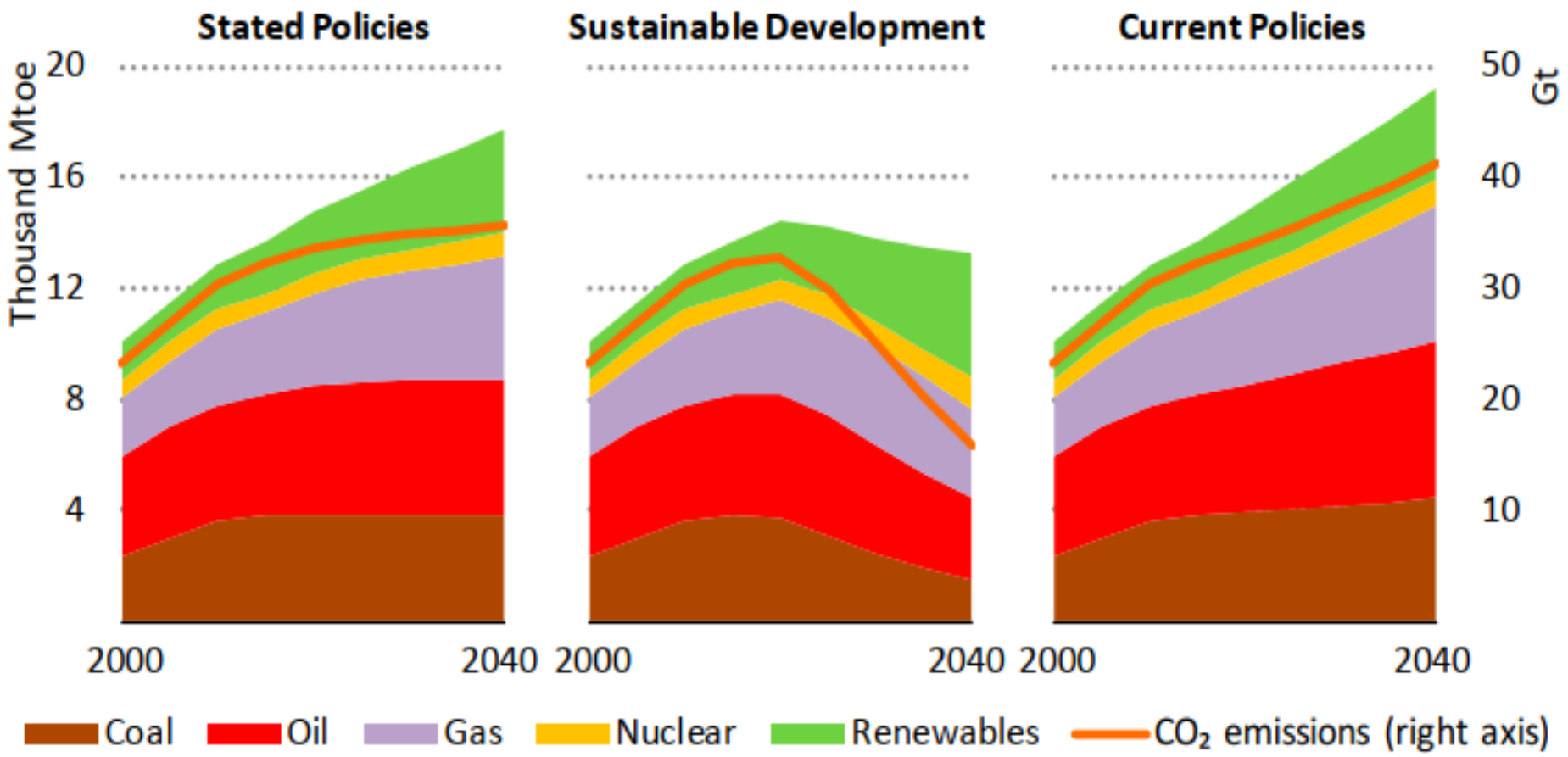
Global energy challenge

- Three quarters of the world's energy supply come from fossil fuels, responsible for large local pollution loads and for most of the greenhouse gases emissions
- The scale on which they are being used will quickly lead to their depletion, intensifying planet temperature mounting and rushing climate change
- The world energy consumption should grow as a result of the progress of many of the world's developing regions
- Industrial countries have not succeeded in reducing energy use without compromising the quality of life, even though it is known that this can and must be done

- **The challenge, therefore, is to seek sustainable renewable energy sources and to increase efficiencies in energy production and use on an unprecedented scale**

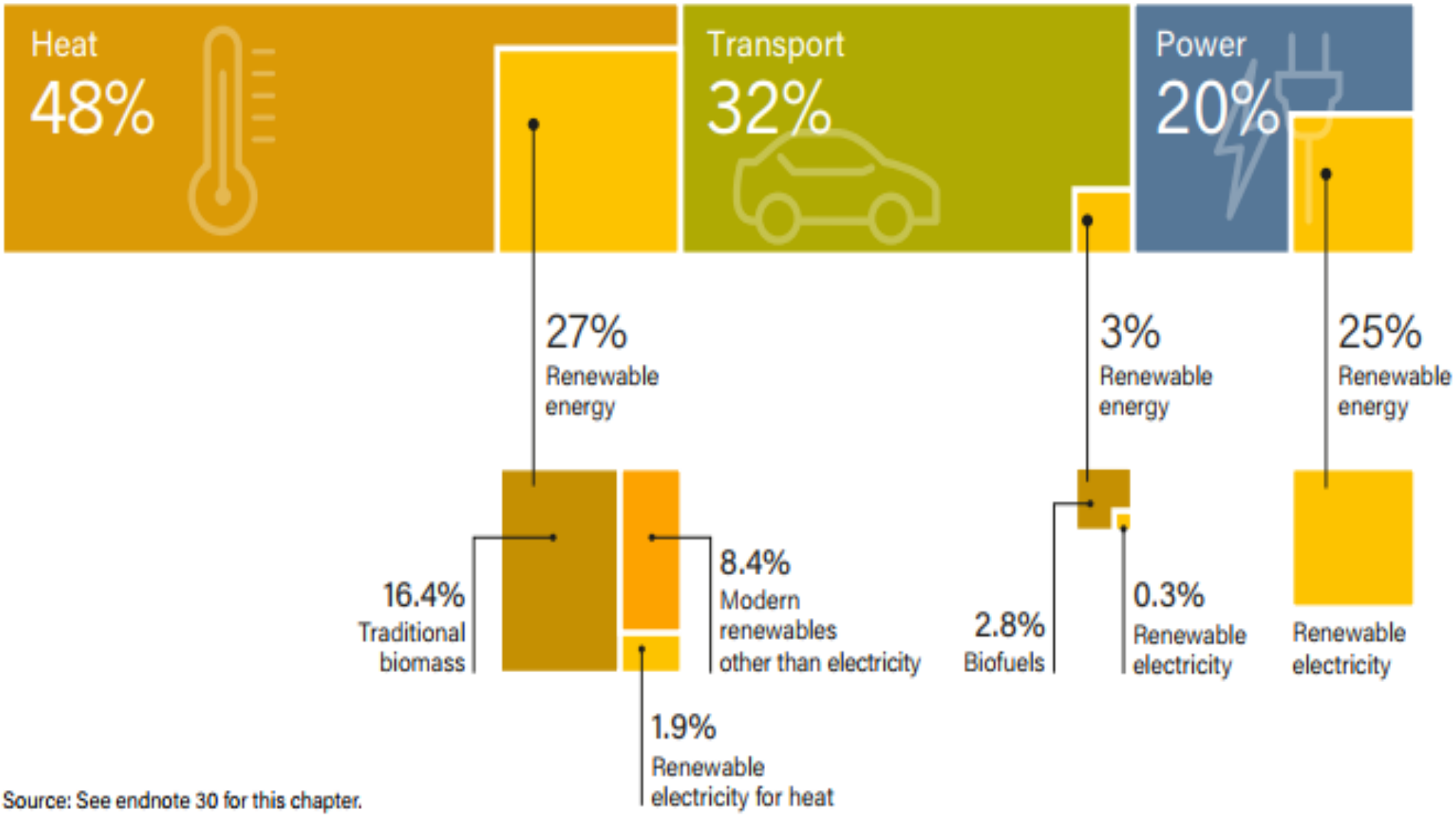
Global energy context & background

World primary energy demand by fuel and related CO_2 emissions by scenario



Source: IEA 2019

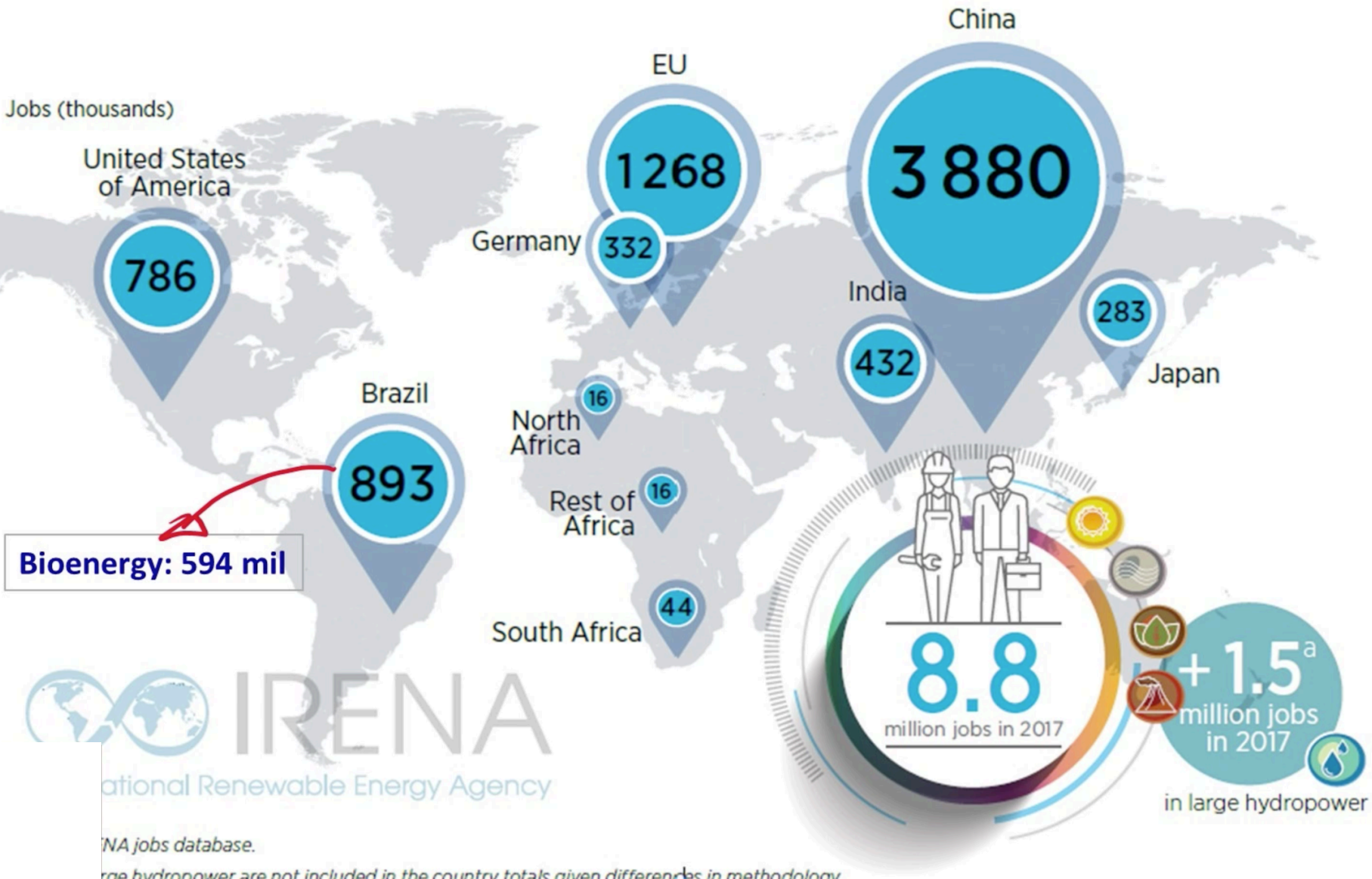
Renewables on final energy consumption today



Source: REN21

Renewables jobs

FIGURE 8: RENEWABLE ENERGY EMPLOYMENT IN SELECTED COUNTRIES



IRENA

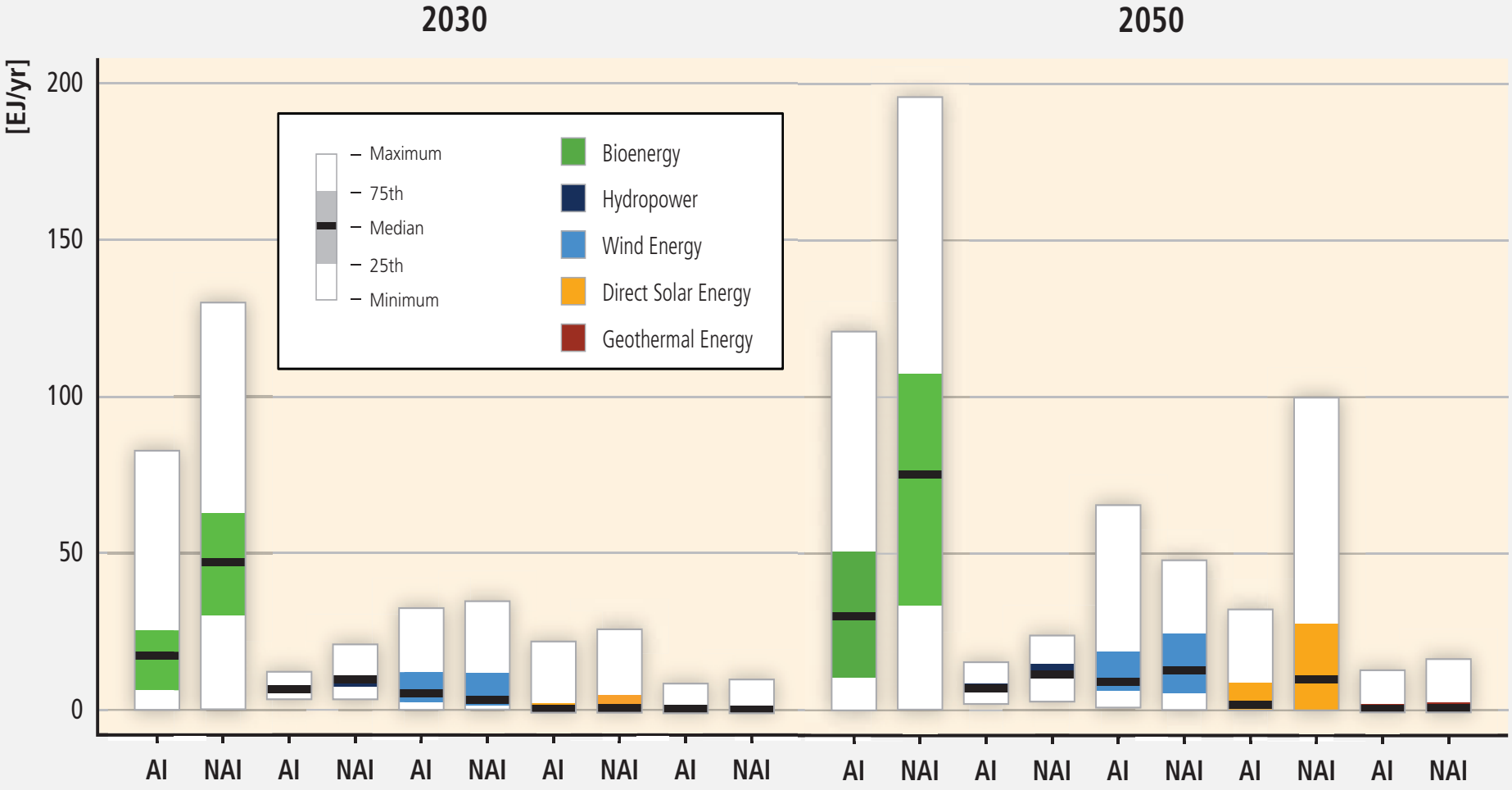
International Renewable Energy Agency

NA jobs database.

rge hydropower are not included in the country totals given differences in methodology
ainties in underlying data. However, data for the EU and Germany include large hydropower jobs.

Renewables assessment on primary energy supply

To achieve suitable climate mitigation scenarios, bioenergy and specially liquid biofuels, have a crucial role relative to other renewable energy sources.



Source: IPCC, 2012

2DS (IEA): transport energy by fuel, 2010-2075

(Fulton et al., Biofuels, Bioprod. Bioref. 9:476–483 (2015); doi: 10.1002/bbb)

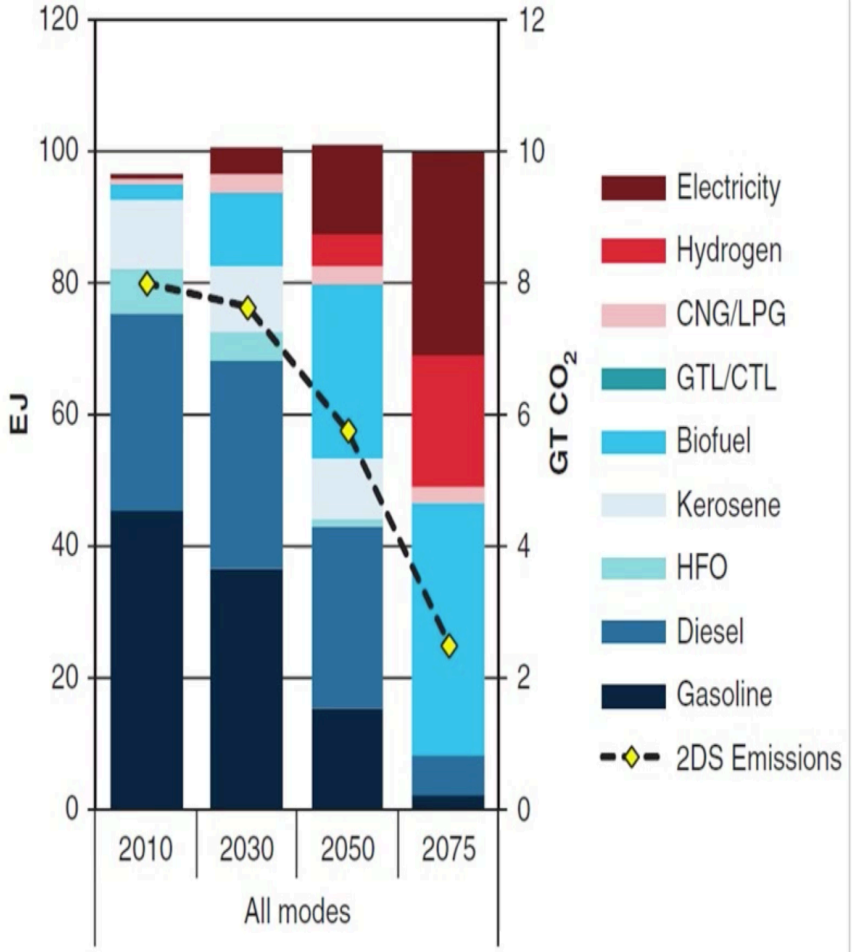
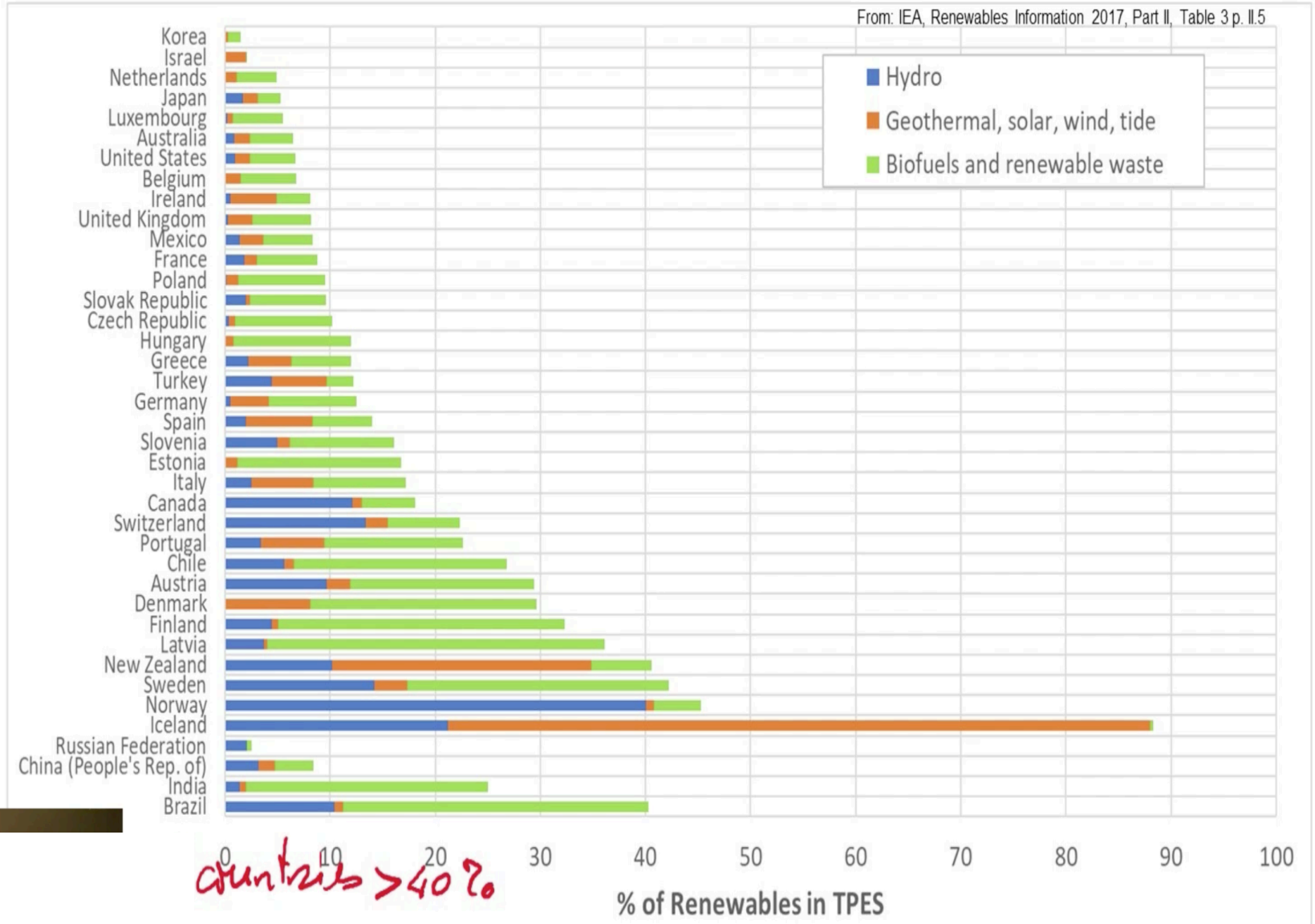


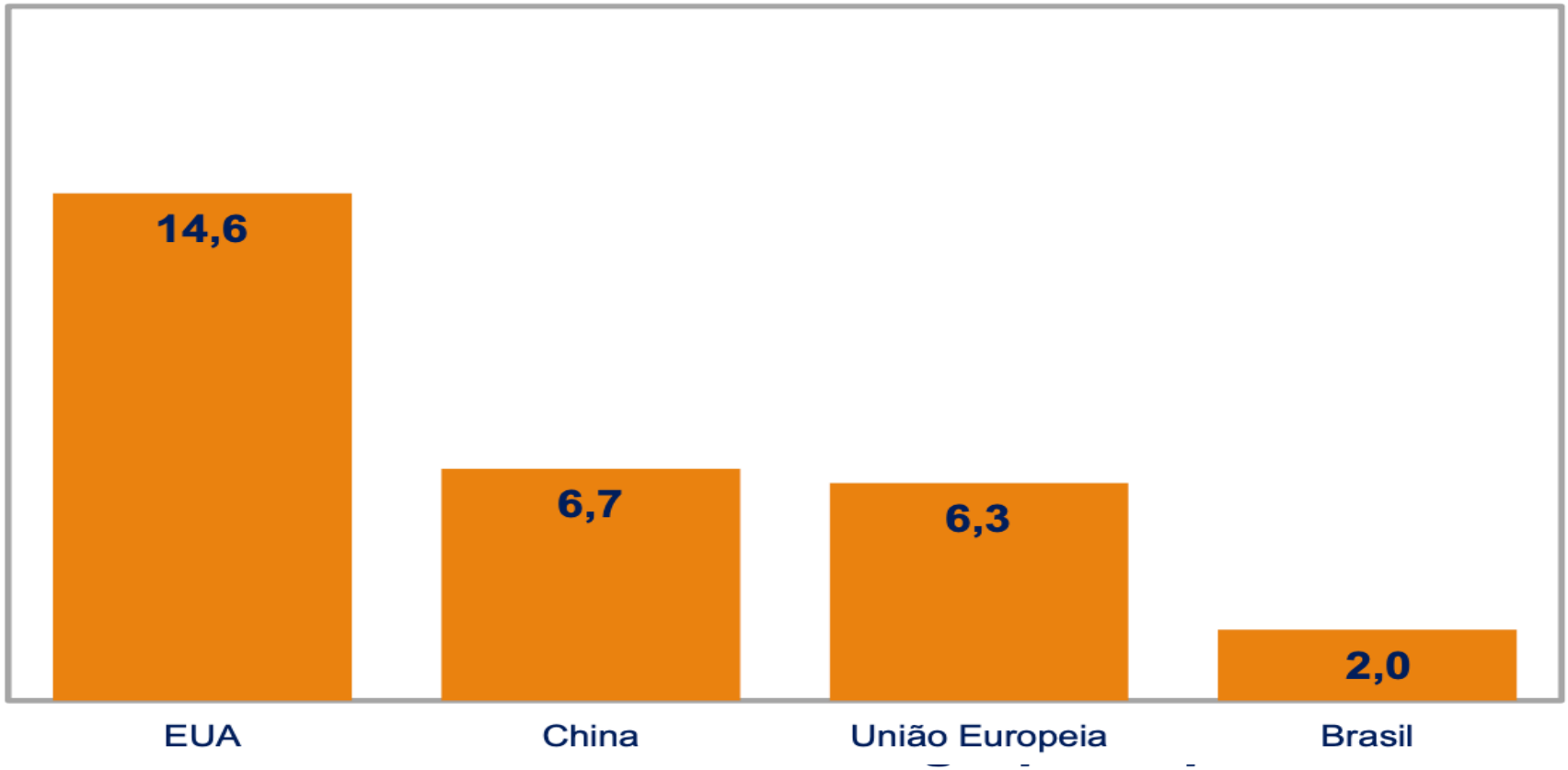
Figure 4. Transport energy use by fuel and year, displaced CO_2 emissions by fuel and year, and total CO_2 emissions

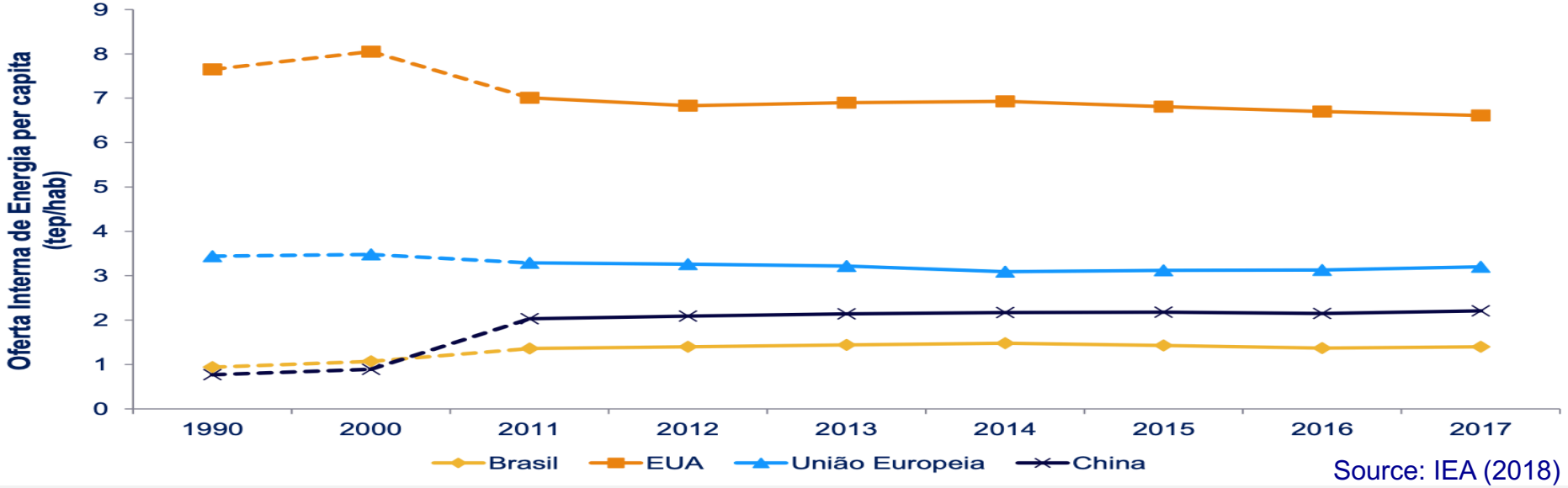
- Even with aggressive reductions in travel growth, shifts to mass transport modes, strong efficiency improvements, and deep market penetration by vehicles running on electricity and hydrogen, there remains a large demand for dense liquid fuels in 2050 (80% of transportation fuel) and even in 2075 (50%).
- This demand is due largely to aviation, ocean shipping, and long-haul trucking.

BRIC and OECD countries: % renewables in Total Primary Energy Supply, by type



GHG emissions per capta



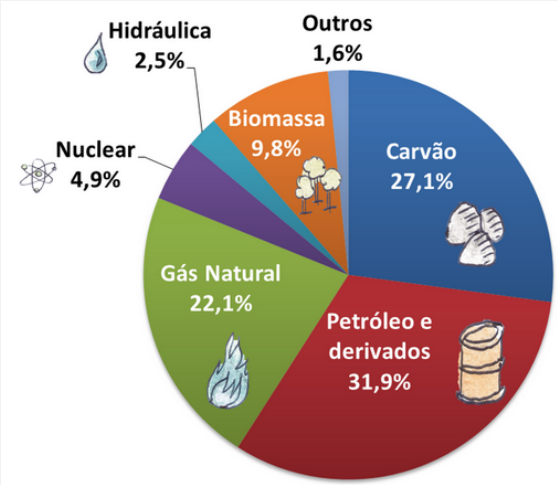


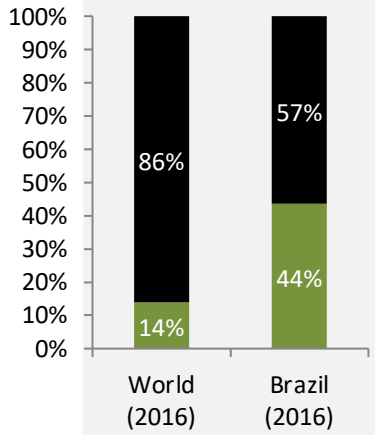
Source: IEA (2018)

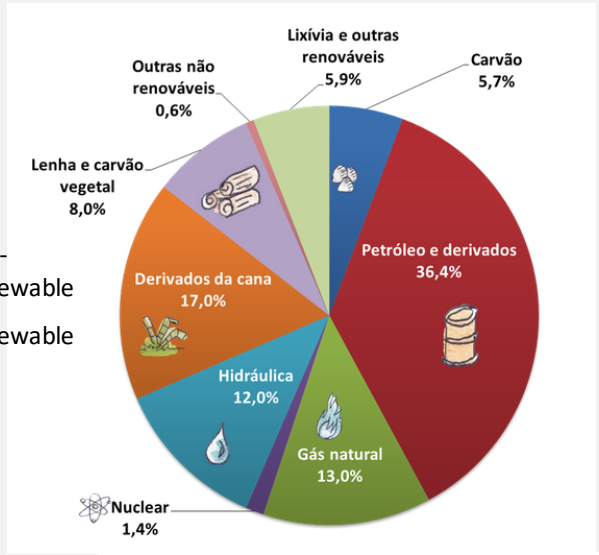
Energy & Electricity - World & Brazil

Energy mix

World 2016
Source IEA, 2018

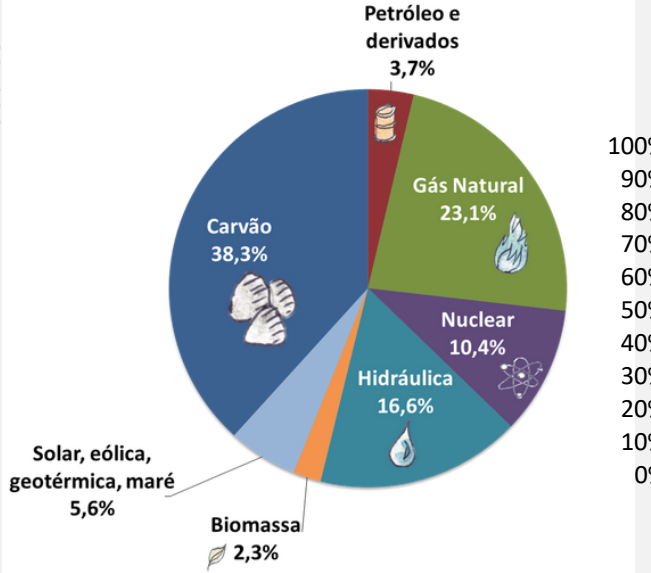


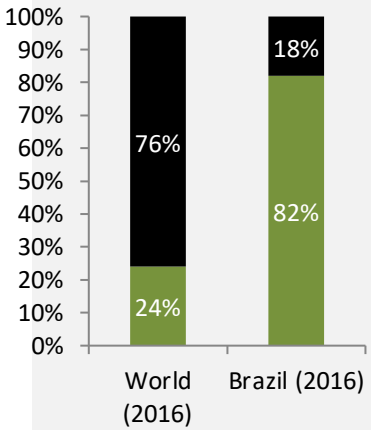


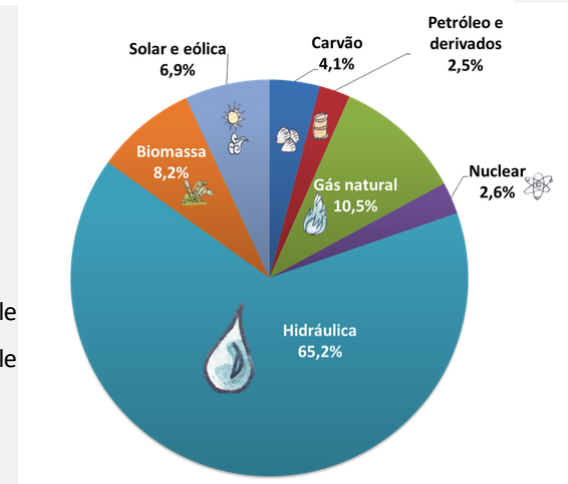


Brazil 2017
Source EPE, 2018

Power mix







Brazilian energy mix

RENOVÁVEIS ▶ 46,1%

Biomassa da Cana 18,0%

Hidráulica[1] 12,4%

Lenha e Carvão Vegetal 8,7%

Outras renováveis 7,0%

NÃO RENOVÁVEIS ▶ 53,9%

Petróleo e derivados 34,4%

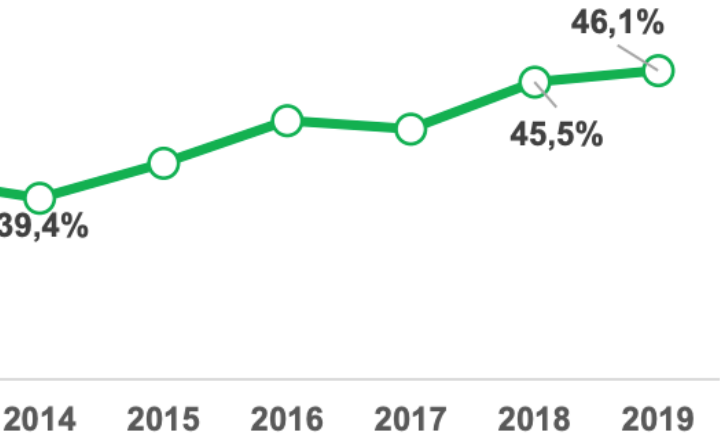
Gás Natural 12,2%

Carvão Mineral 5,3%

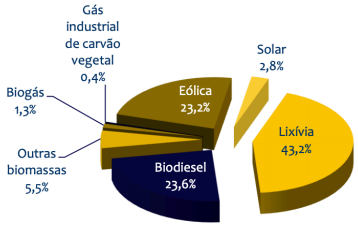
Urânio 1,4%

Outras não renováveis 0,6%

Source: EPE (2020)

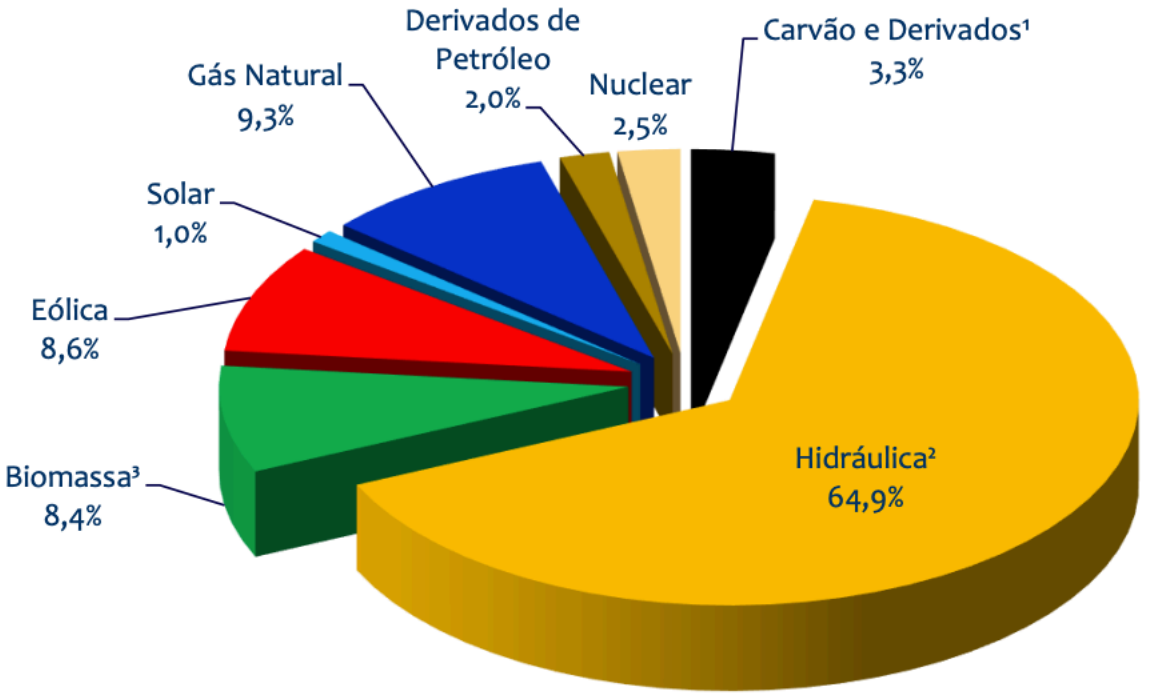


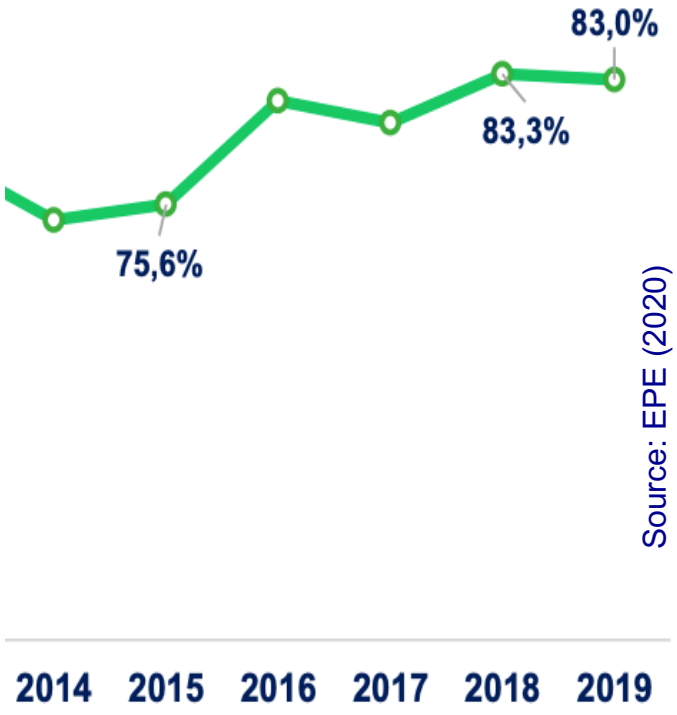
Outras renováveis 7,0%



Outras renováveis (mil tep)	2018	2019	Δ 19 / 18
Lixívia	9.553	8.948	-6,3%
Biodiesel	4.391	4.878	11,1%
Eólica	4.169	4.815	15,5%
Outras biomassas[1]	1.134	1.149	1,4%
Solar	298	572	92,2%
Biogás	204	269	31,8%
Gás industrial de carvão vegetal	88	81	-8,0%
Total	19.837	20.712	4,4%

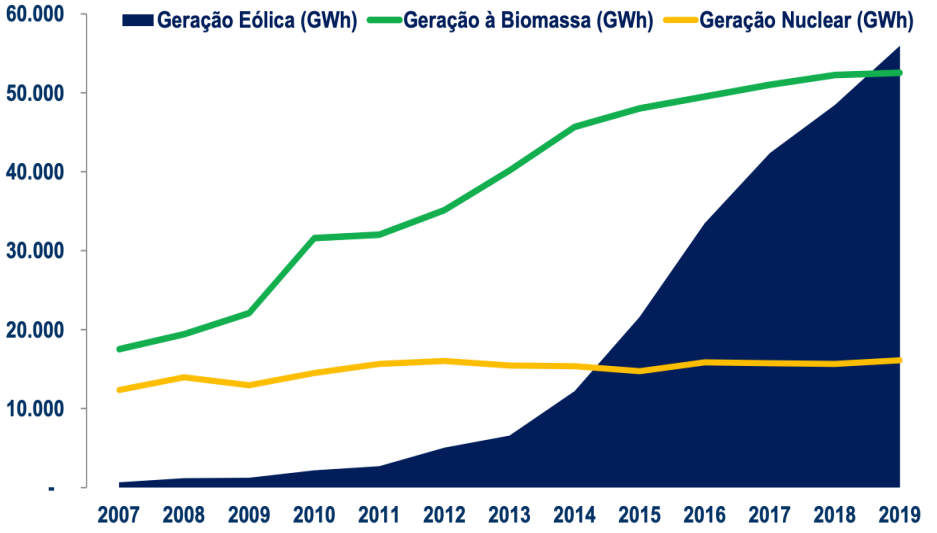
Brazilian power mix





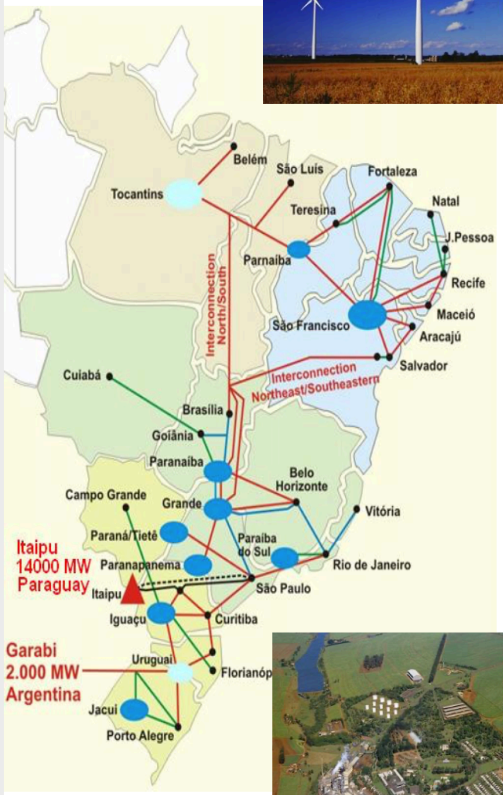
Source: EPE (2020)

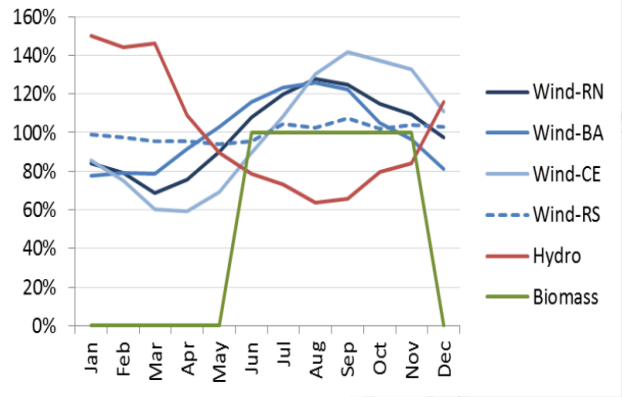
Fonte	2018	2019	Δ 19/18
Hidrelétrica	104.139	109.058	4,7%
Térmica²	40.523	41.219	1,7%
Eólica	14.390	15.378	6,9%
Solar	1.798	2.473	37,6%
Nuclear	1.990	1.990	0,0%
Capacidade disponível	162.840	170.118	4,5%

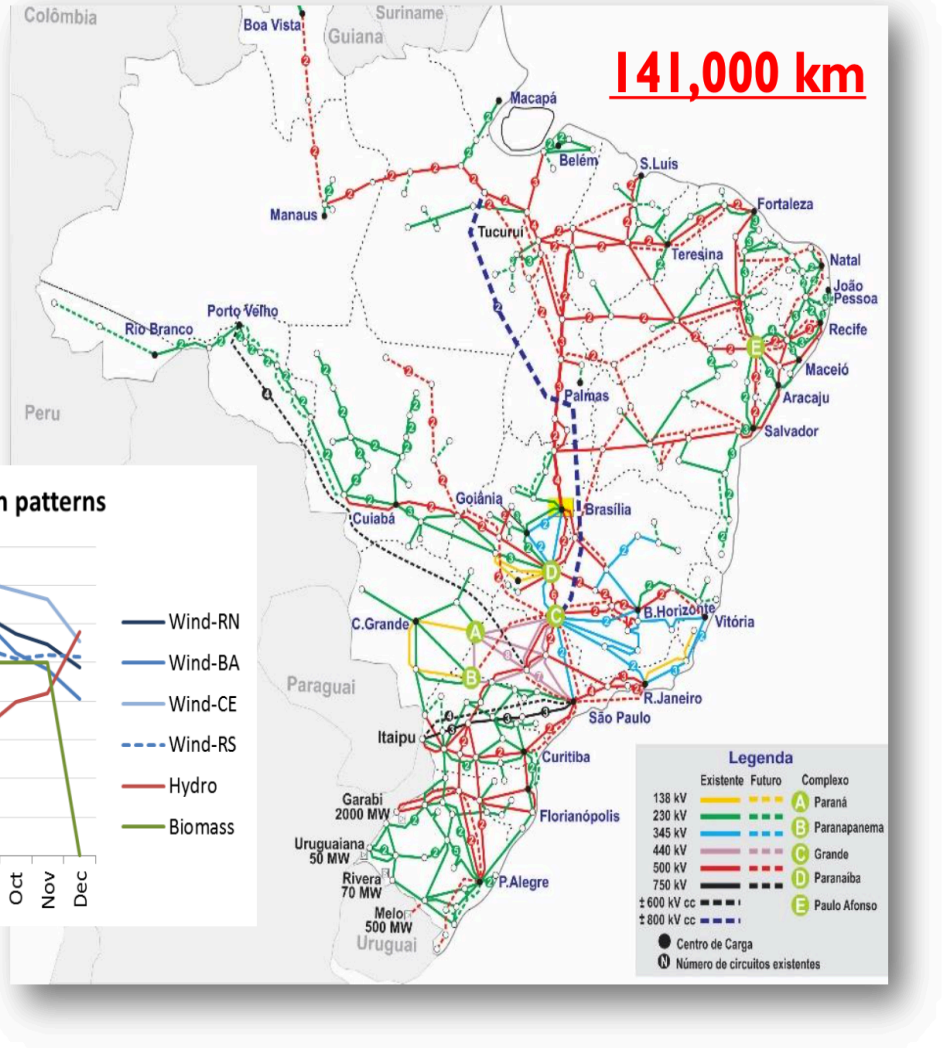


Brazilian power grid

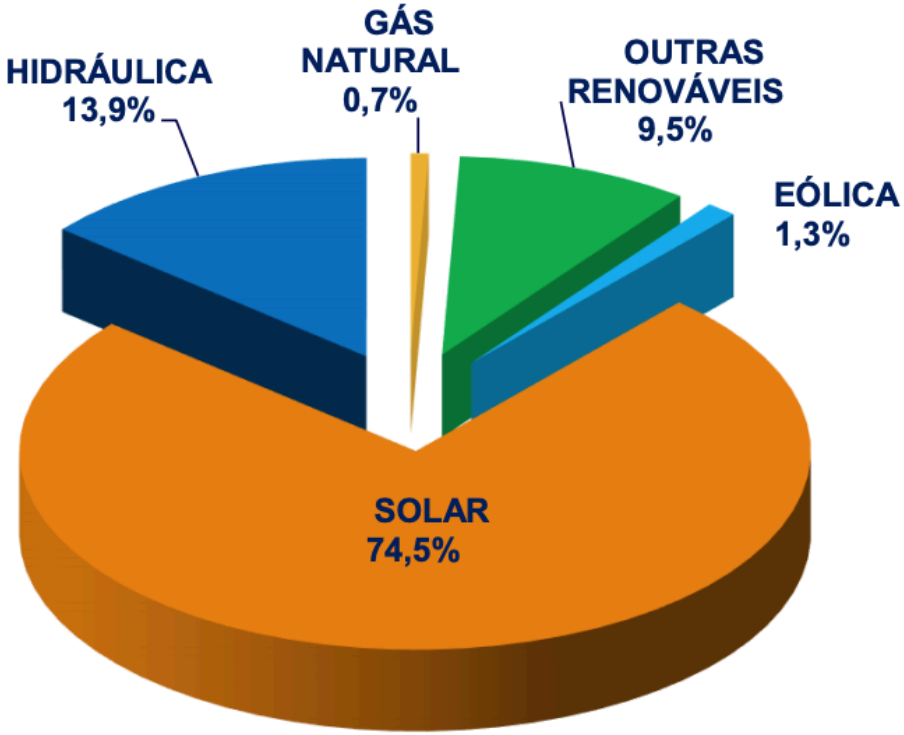
Integration of hydro, solar, wind and bioelectricity

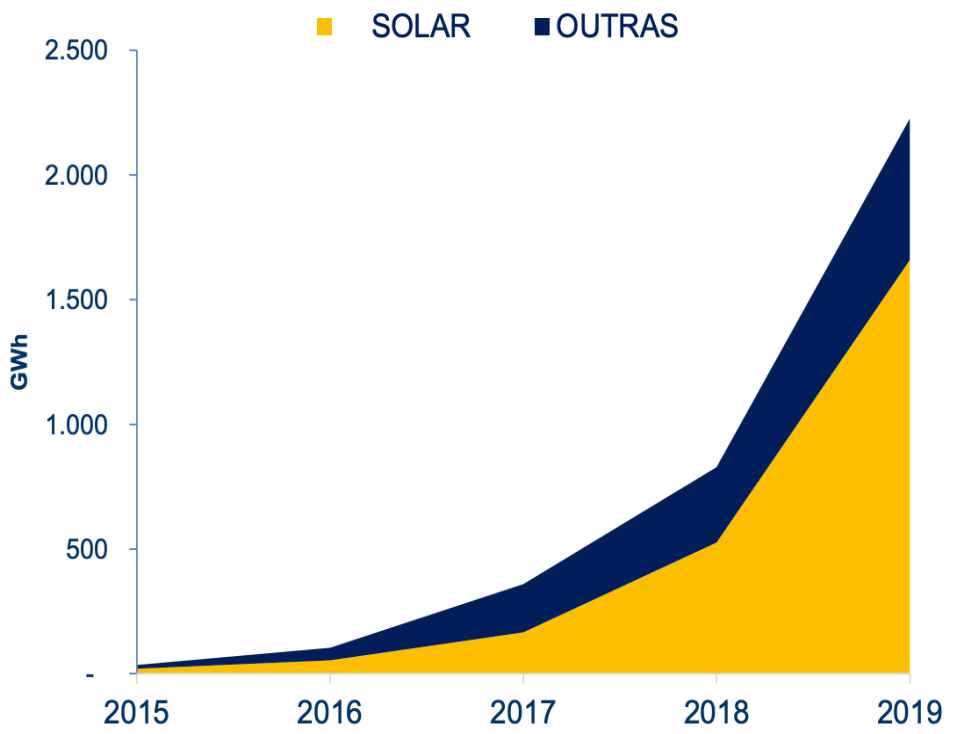






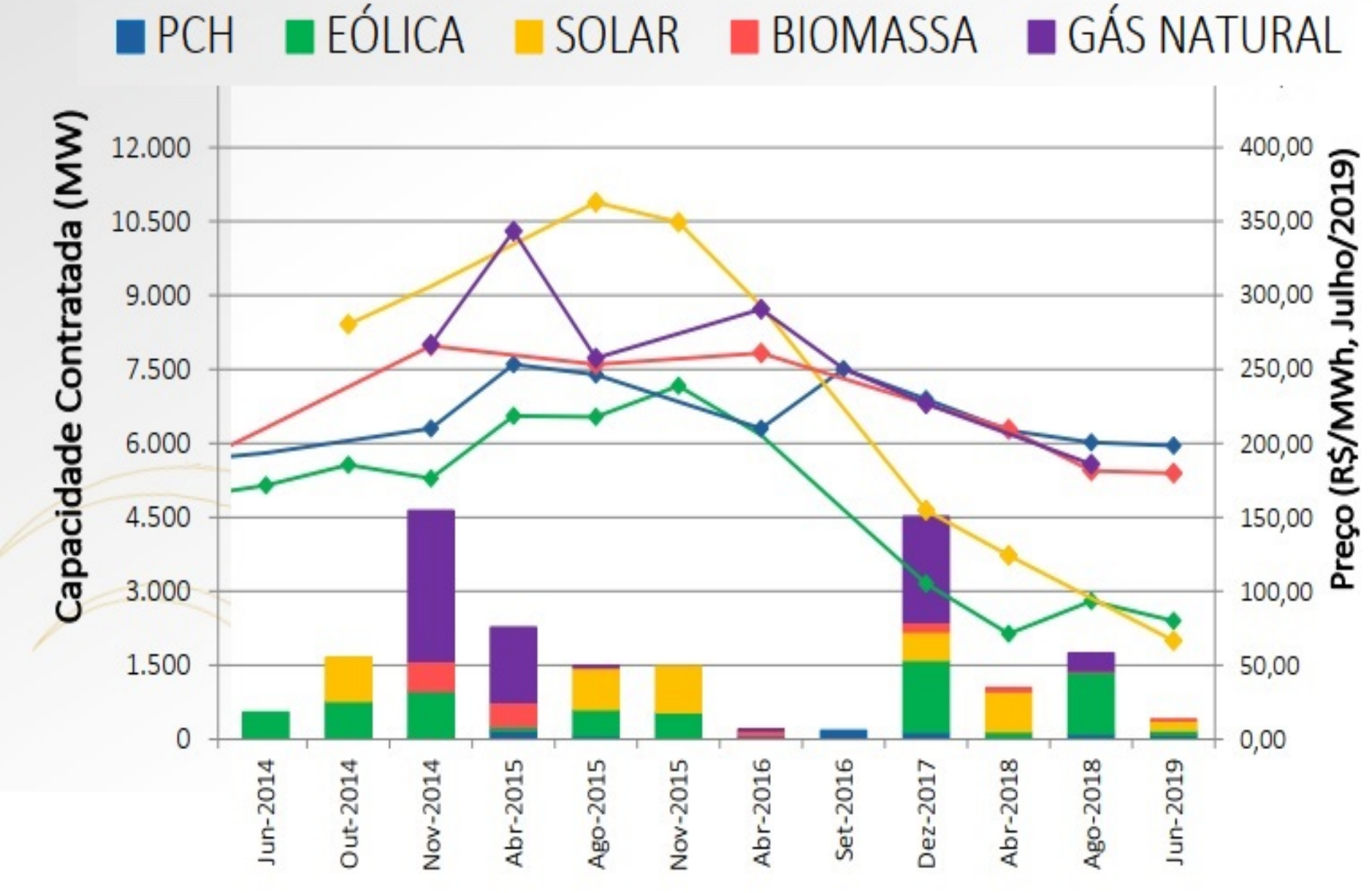
Brazilian distributed power generation





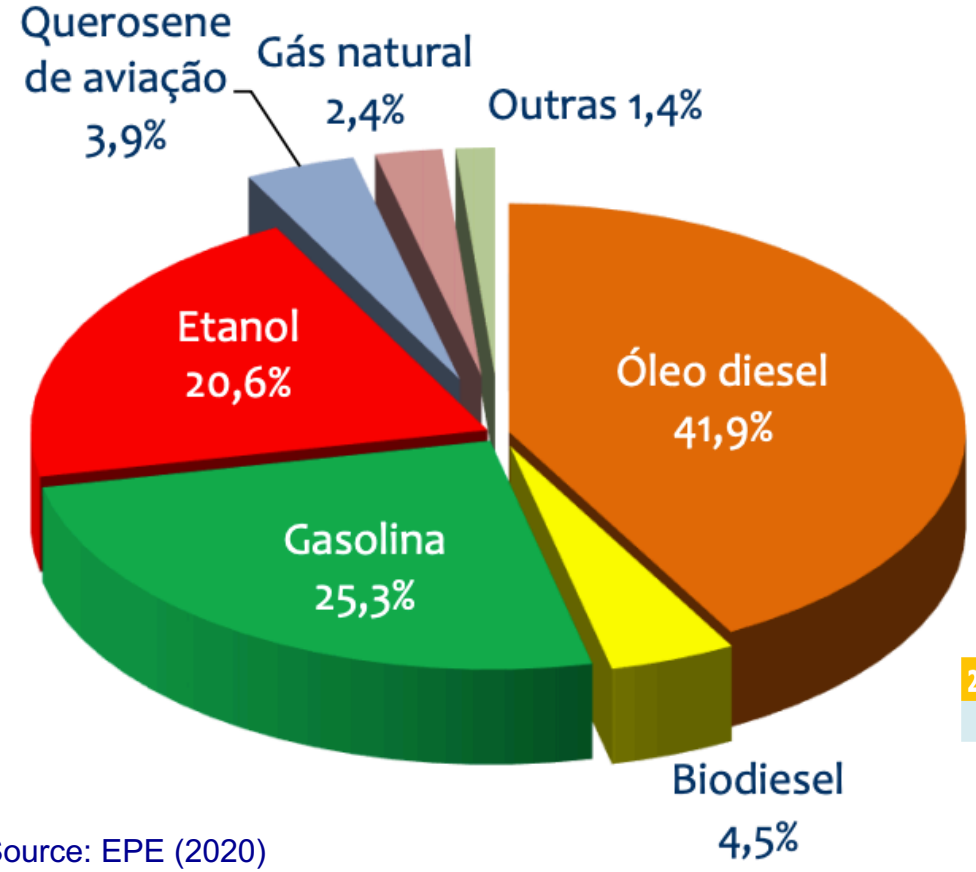
Source: EPE (2020)

Auctions' power capacity and prices evolution

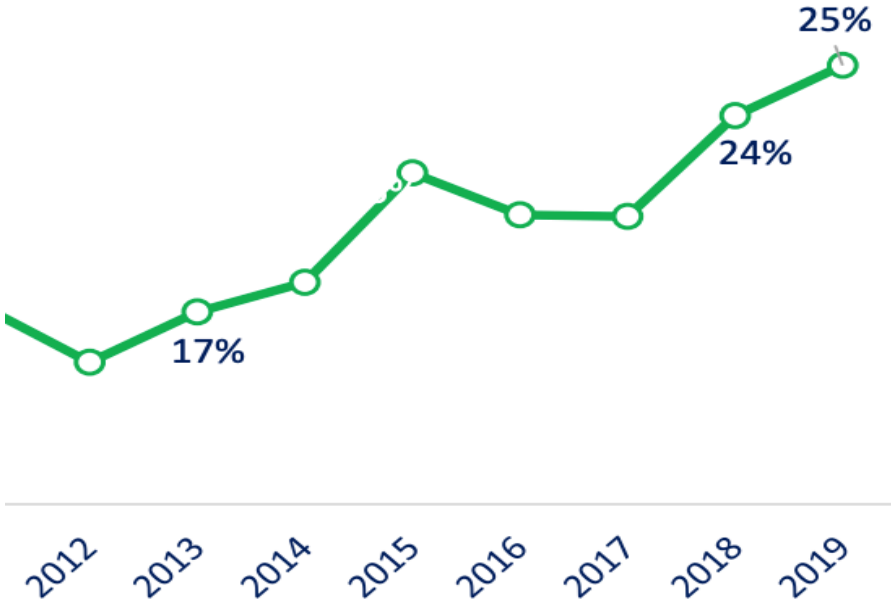


Source: EPE (2020)

Brazilian transport fuel mix

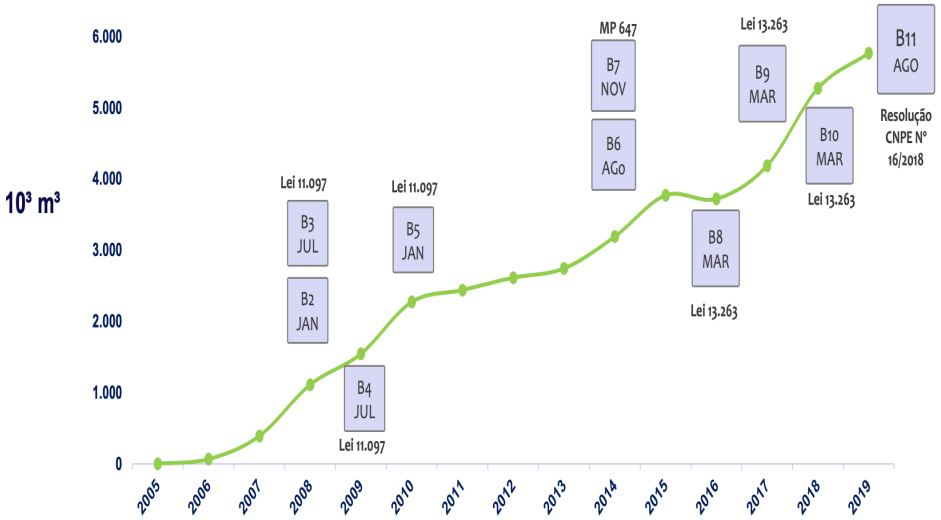


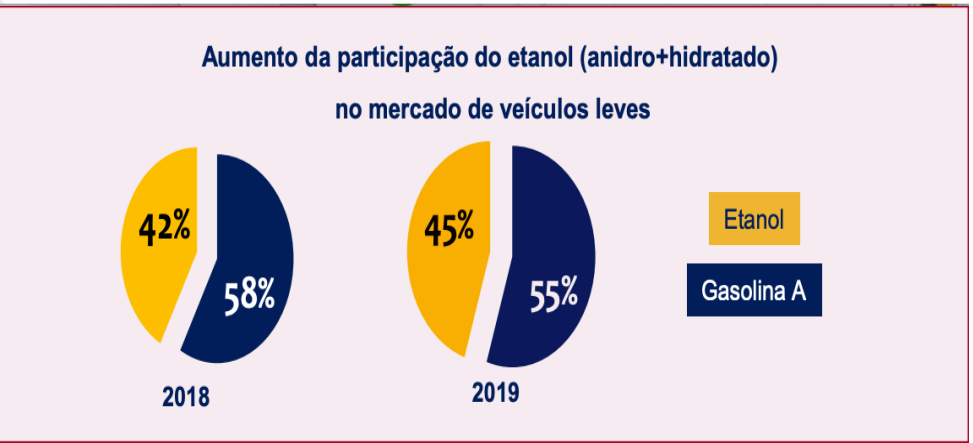
Source: EPE (2020)



Em 10^3 m³

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1	66	391	1.111	1.543	2.272	2.439	2.612	2.742	3.189	3.769	3.719	4.183	5.270	5.762





Projeto

ENERGY BIG PUSH

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Nações Unidas
CEPAL

70 CEPAL
POR UM DESENVOLVIMENTO SUSTENTÁVEL COM IGUALDADE

epe

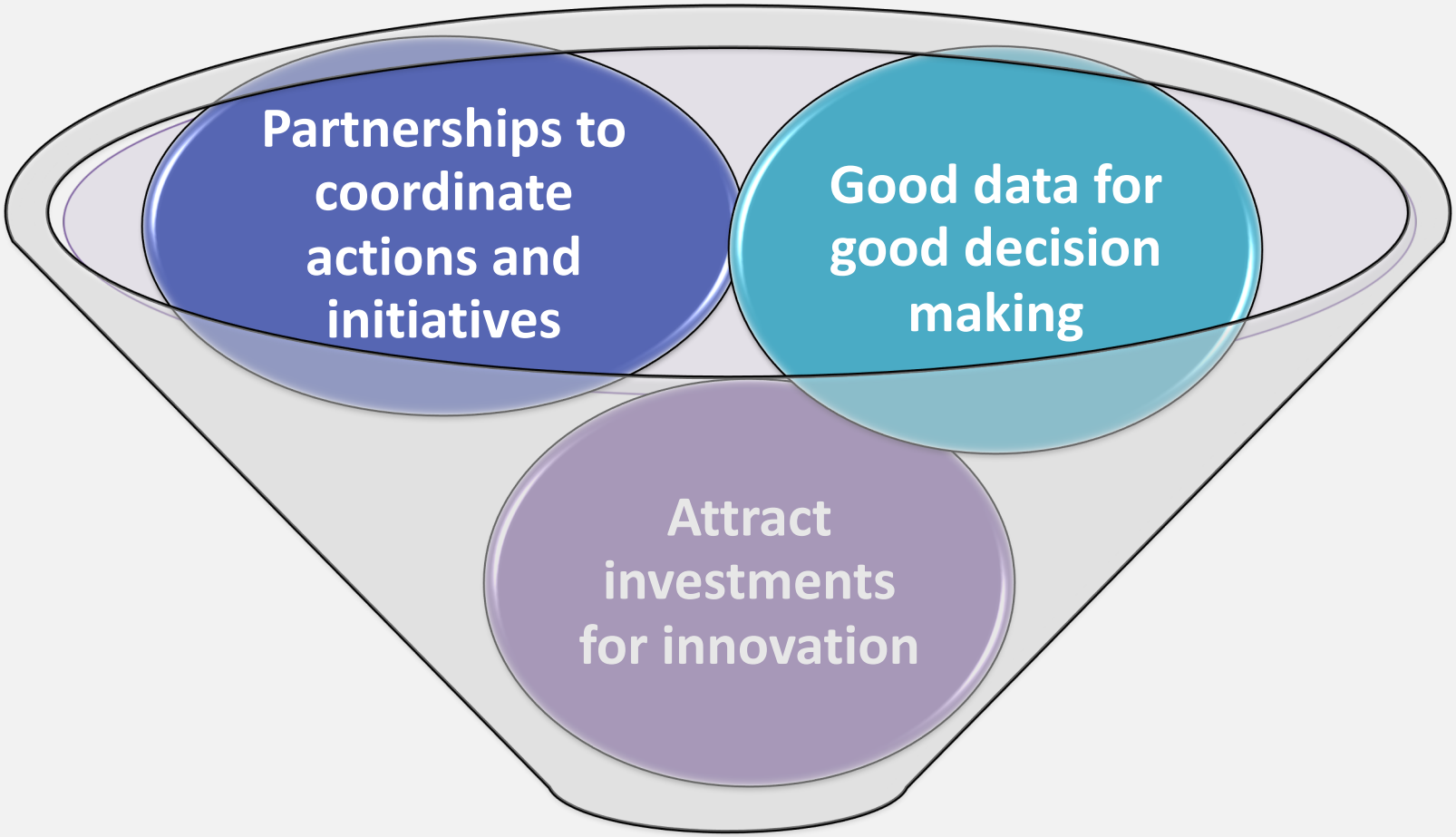
iea

Context & background - energy & innovation partners

Agenda 2030 & SDGs, Paris Agreement, NDCs & LTS

- **Positive Agenda for Climate Change and Sustainable Development**
- **Energy Planning & Mission Innovation**
- **Big Push for Sustainability**
- **Clean Energy Transitions Program**

Challenges & opportunities



Energy Big Push

Goals

Strength Brazil's energy transition to a low carbon economy through capacity building in innovation and pushing investments in clean energy

Develop methodologies to track and classify a suitable set of energy innovation indicators

Collect, analyse and report data on selected energy innovation indicators to inform decision making

Design, develop and implement a digital platform capable of offering data intelligence to policymakers and investors and to promote multistakeholder dialogue amongst actors of the energy innovation ecosystem

Promoting information sharing about the key findings and best practices in clean energy innovation to policymakers, entrepreneurs and other stakeholders

Energy Big Push

WG 1
RD&D investments data tracking

WG 2
Performance indicators for sustainable solutions

WG 3
Incentive mechanisms for innovation

WG 4
Communication strategy

Suitable outcomes

- **Improve RD&D data transparency and management**
- **Develop efficiency and effectiveness of public investments in RD&D**
- **Progress legal and regulatory framework**
- **Intensify business and investors engagement**

Energy Big Push is a starting point...

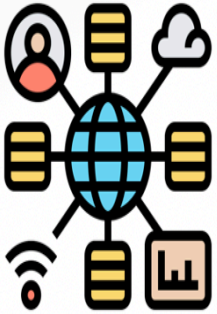
ENERGY BIG PUSH

- RD&D database: FNDCT, CNPq, FINEP, BNDES, ANEEL, ANP, FAPESP, CNEN.
- Energy innovation performance indicators
- Incentive mechanisms for innovation

Inputs

Proposal Outputs

Energy Innovation Platform



- RD&D database expanded and enhanced
- Energy innovation indicators (RD&D and others) prioritized and incorporated into the platform
- Platform developed and implemented

Capacity building for Investments that contribute to the energy transition to a low carbon economy

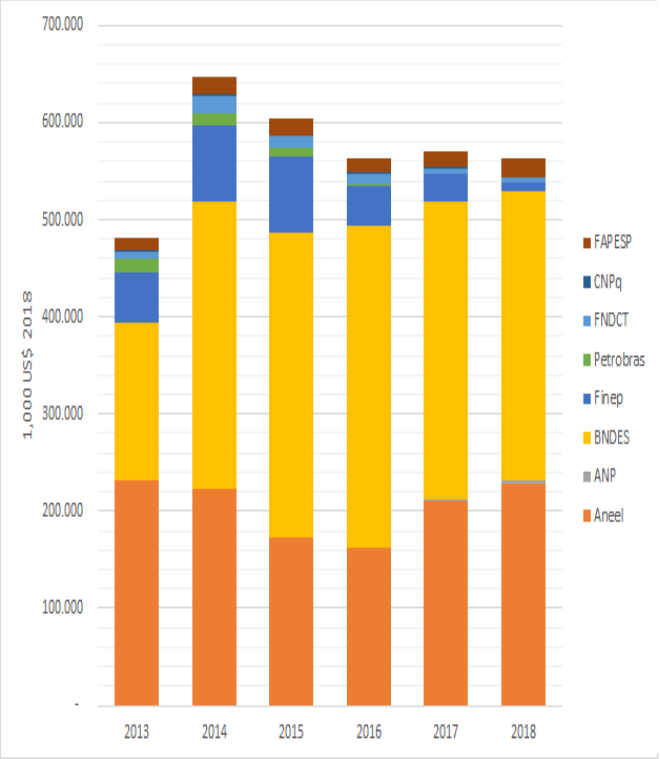
- ✓ **Support Policy Making and Investment decisions**
- ✓ **International cooperation and best practices**

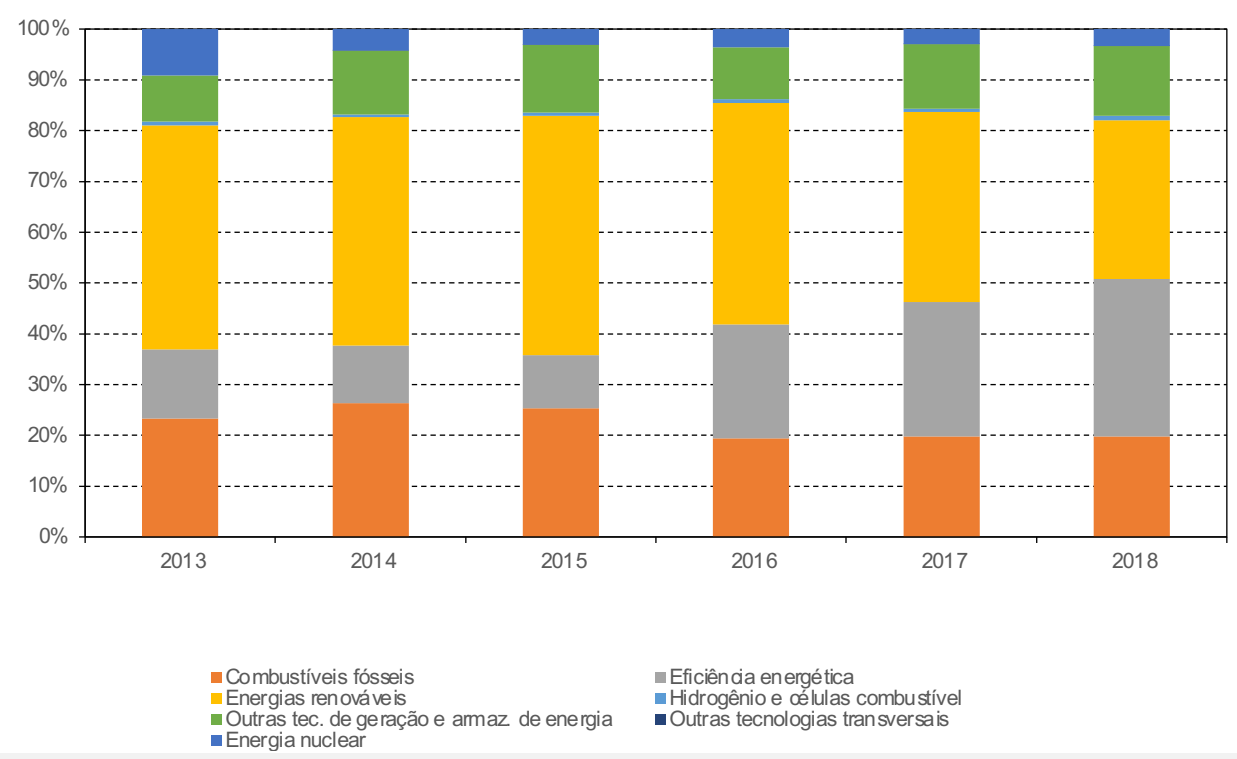
...from products to processes...

Results and lessons learned - WG 1

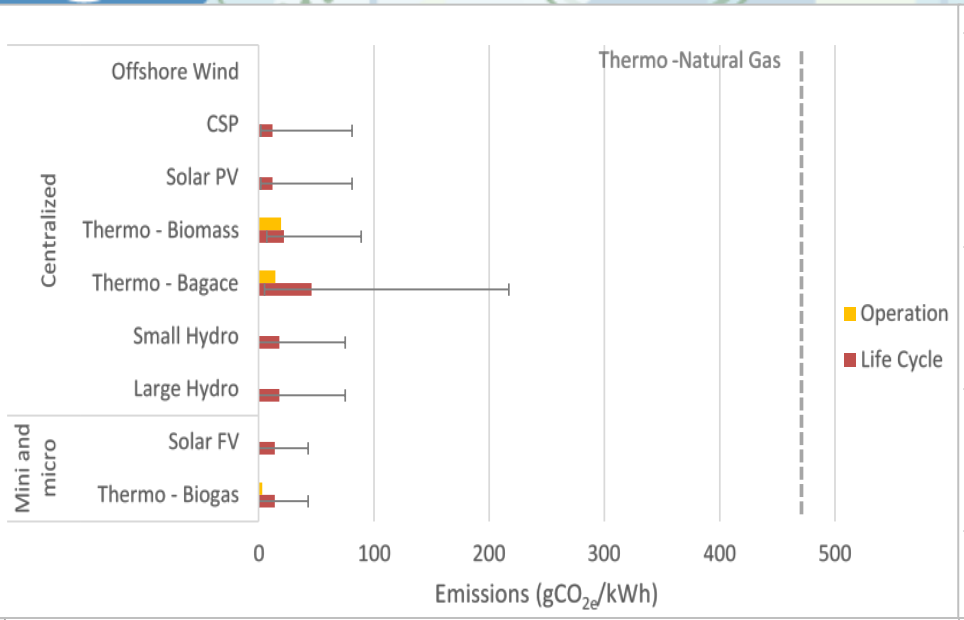
- FNDCT
- FINEP
- ANEEL
- ANP
- BNDES
- PETROBRAS
- CNEN

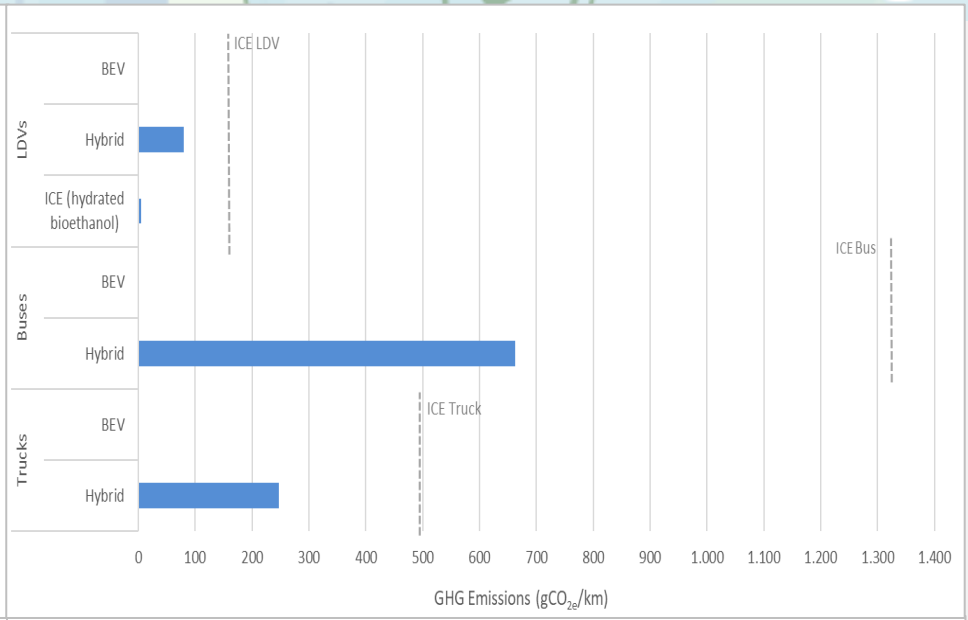
Data collection (federal level) → Verification + Treatment → Filters + Search Terms → Classification + Validation → RD&D projects disaggregated by technology area

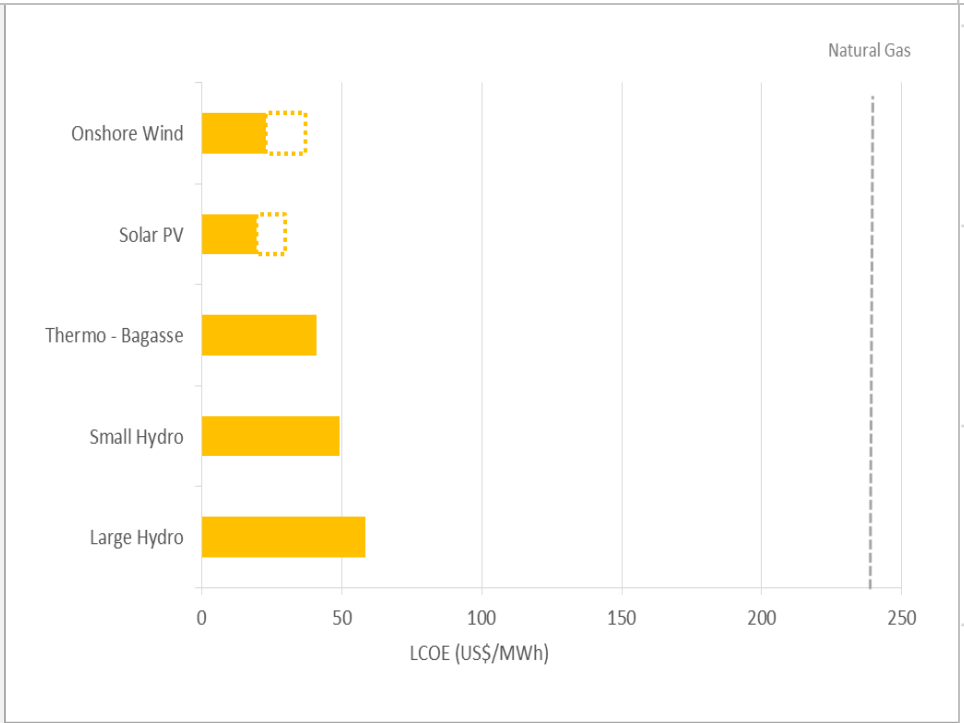


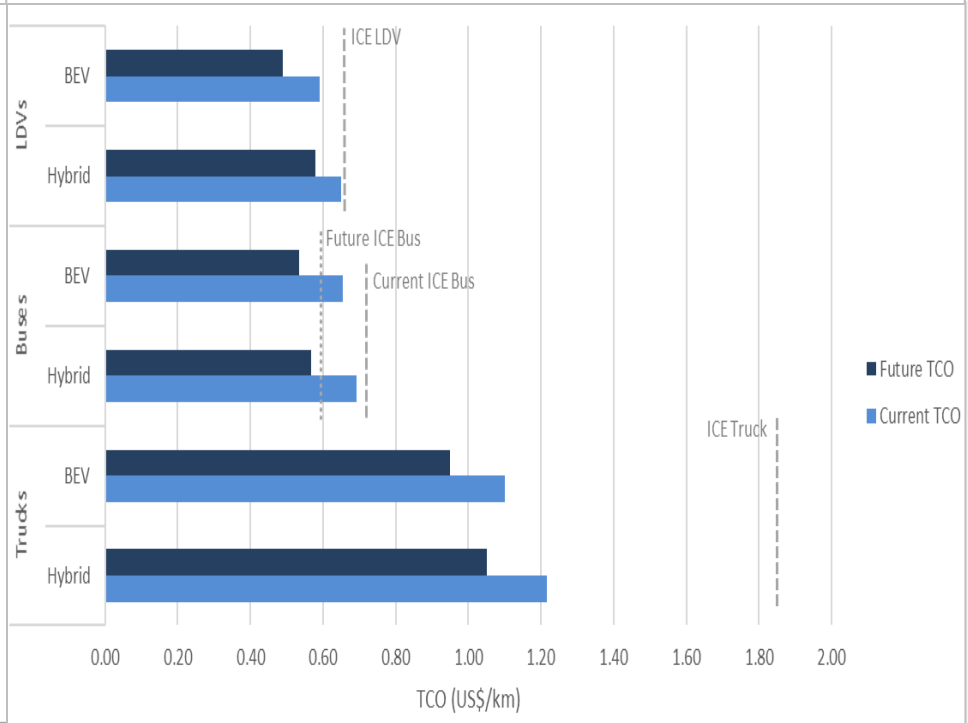


Results and lessons learned - WG 2







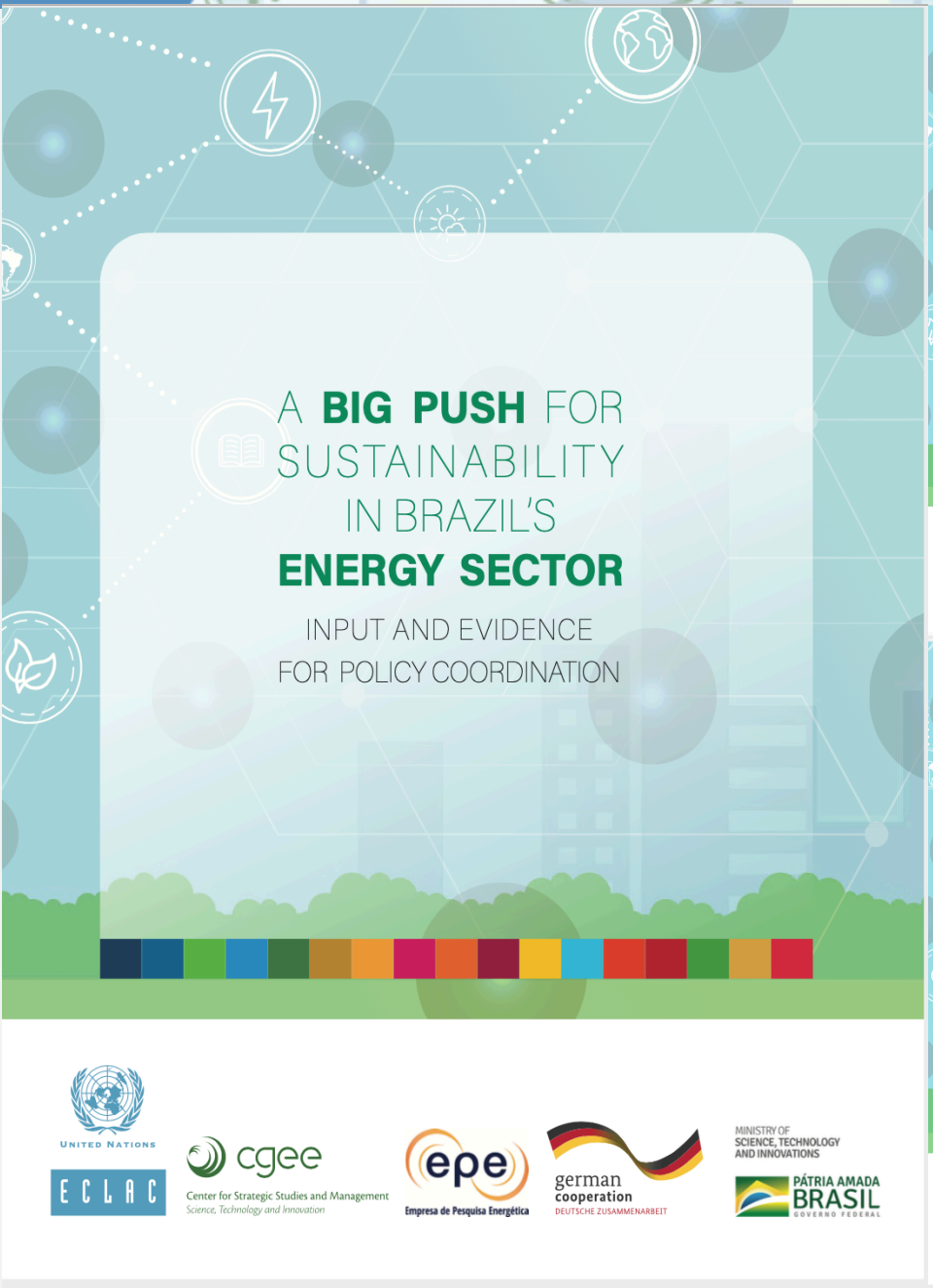


Results and lessons learned – WG 3

Incentive mechanisms avaiable	Basic and aplied research	Development	Demonstration	Commercialization
Research support (CNPq, FAPs)				
Cooperative projects (Embrappii, Conect Finep, Funtec BNDES, FAPs)				
Tax incentives (“Lei do Bem”)				
Subvention Finep				
Preferential Loans BNDES and Finep				
Variable Income Investment				
R&D clauses (ANEEL and ANP)				

Results and lessons learned – WG 4

CGEE-ECLAC Energy Big Push joint publications



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Want to know more and collaborate with us?

Get in touch!

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http://bit.ly/brazilenergybigpush

Marcelo Poppe

Oportunidades e Desafios da Bioeconomia

Opportunities and Challenges of the Bioeconomy

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Ciência, Tecnologia e Inovação

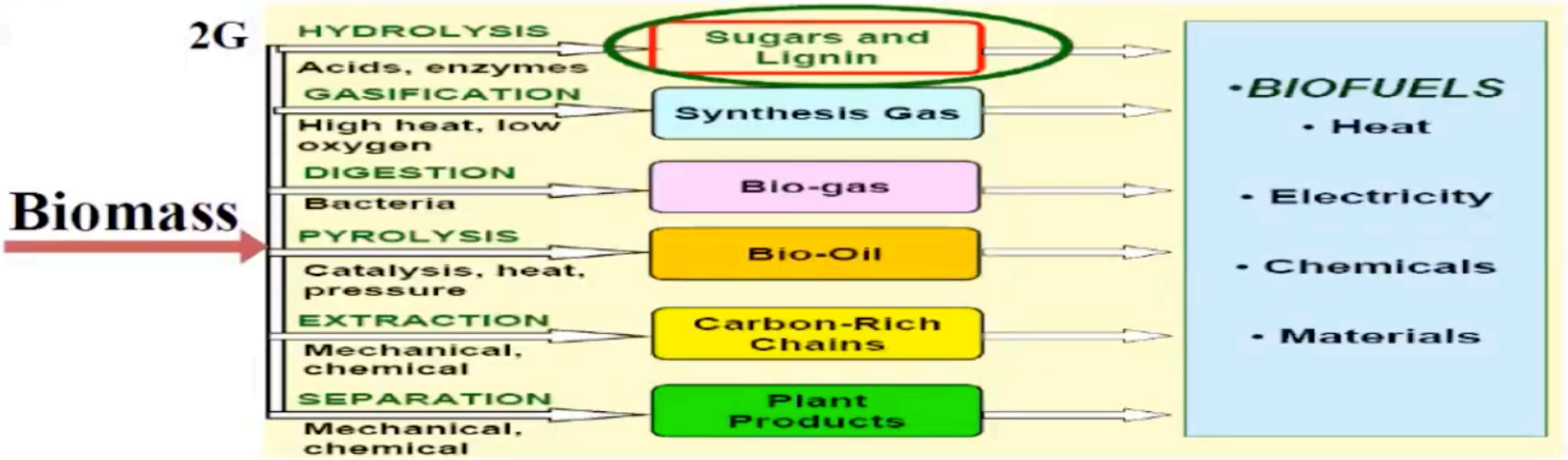
Marcelo Poppe

Bioeconomy Policies around the World

As of May 2017

Possible Routes to Process Biomass into Products

1st Generation → Sugar extracted from "sugar-rich" crops → fermentation
Sugar Cane → Ethanol, Sugar, electricity are the main products with flexibility
Bagasse, Vinasse, CO_2 are by-products that may be used as raw material



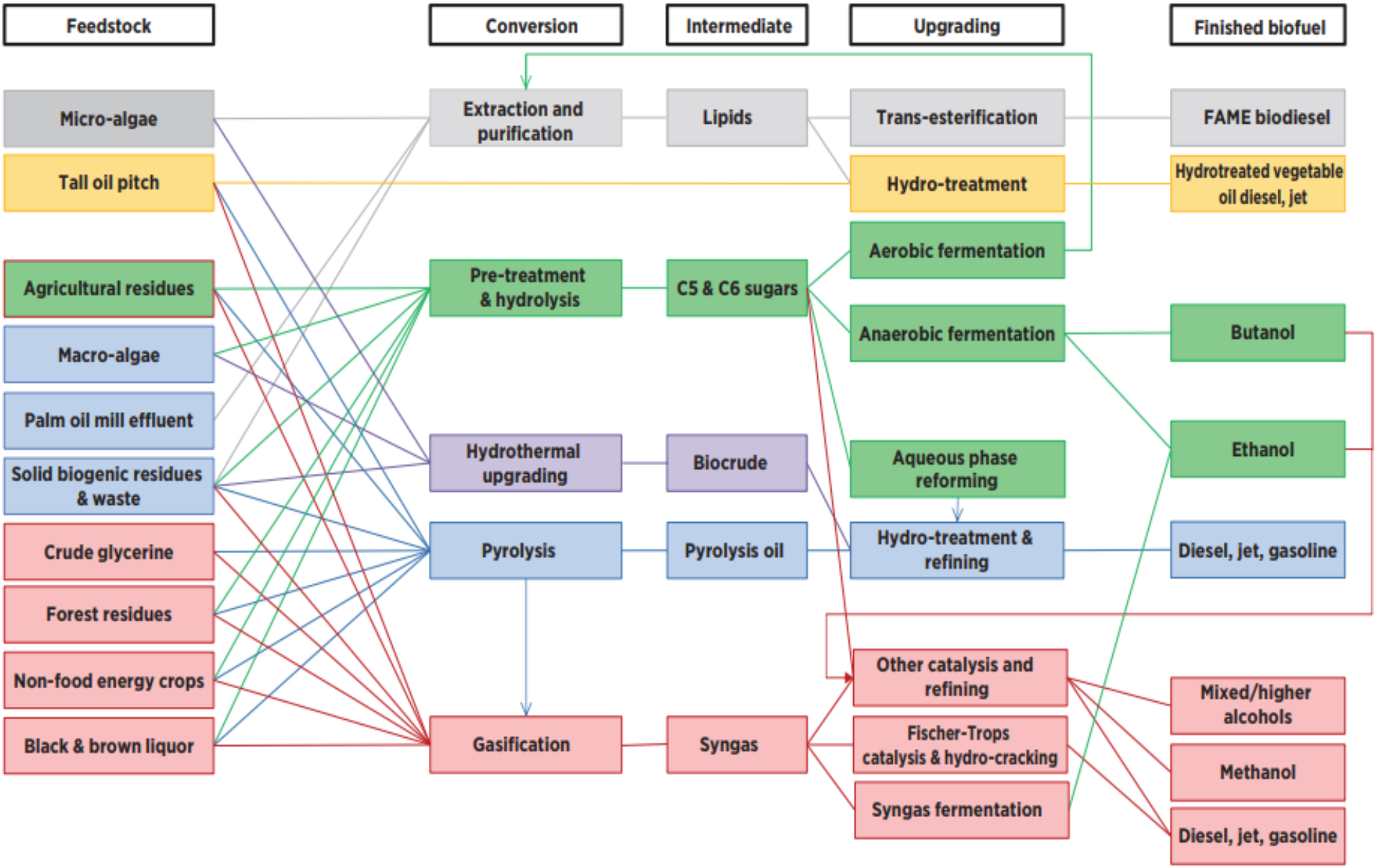
-Catalytic Conversion of Ethanol to hydrocarbons
-Ethanol as Hydrogen carrier
-Vegetable oil → Transesterification and Esterification to Biodiesel
-Vegetable oil, bio-oil → Co-processing /Syngas from Biomass to Hydrocarbons and Fermentation
-Concept of Biorefinery → More products → more flexibility in the business (risks of feedstock price fluctuation due to intensive use)
-Electricity – will play important role (from 18 to 50% by 2050)

Catalytic reforming of ethanol to hydrocarbons has strong potential to bridge the global biofuel supply and demand gap.

- Ethanol will very likely be the lowest-cost biologically-derived liquid fuel, or fuel intermediate, for the indefinite future.
- Although microorganisms are better at producing small molecules than large ones, global demand for biofuels is greatest for large fuel molecules suitable for use in aviation and other heavy-duty applications.
- Technology for converting ethanol to hydrocarbons is rather mature, adds but small cost to ethanol today ($/GJ), potentially no cost in the future[6].

Source: Maciel, R. 2020

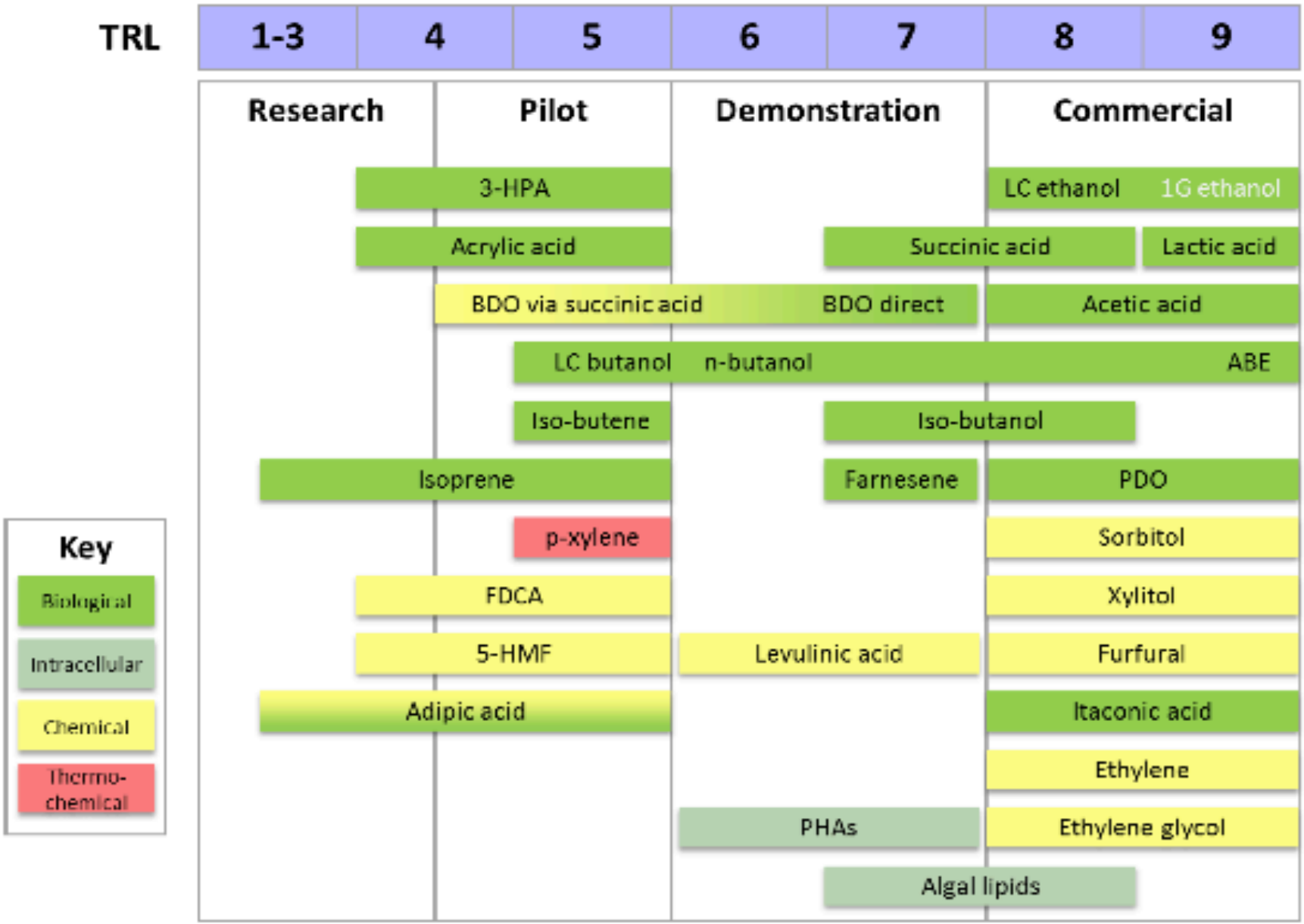
Advanced biofuels technological pathways



Colors show the main conversion possesses of each raw material

Source: IRENA, 2016

Stage of selected sugar platform bioproducts



Source: EC-DGE, 2015

CGEE publications on bioeconomy

Sustainable bioeconomy for industry, transport and energy transition

2019

South-south and triangular cooperation on the bioeconomy:
in light of the Paris Agreement and the 2030 Agenda for Sustainable Development

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Ciência, Tecnologia e Inovação

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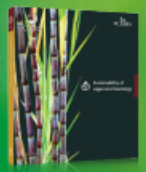
New documents

2019
Bioeconomy in the Americas 2030

2018
Prospecção E2G 2030

2018
Estado da Arte E2G

2017
Second-generation sugarcane bioenergy & biochemicals:
Advanced low-carbon fuels for transport and industry



2012
Sustainability of sugarcane bioenergy

2010
Química verde no Brasil:
2010 - 2030

2008
Bioetanol combustível:
uma oportunidade para o Brasil

2008

Sugarcane-based bioethanol:
energy for sustainable development

Bioetanol de cana-de-açúcar:
energia para o desenvolvimento sustentável

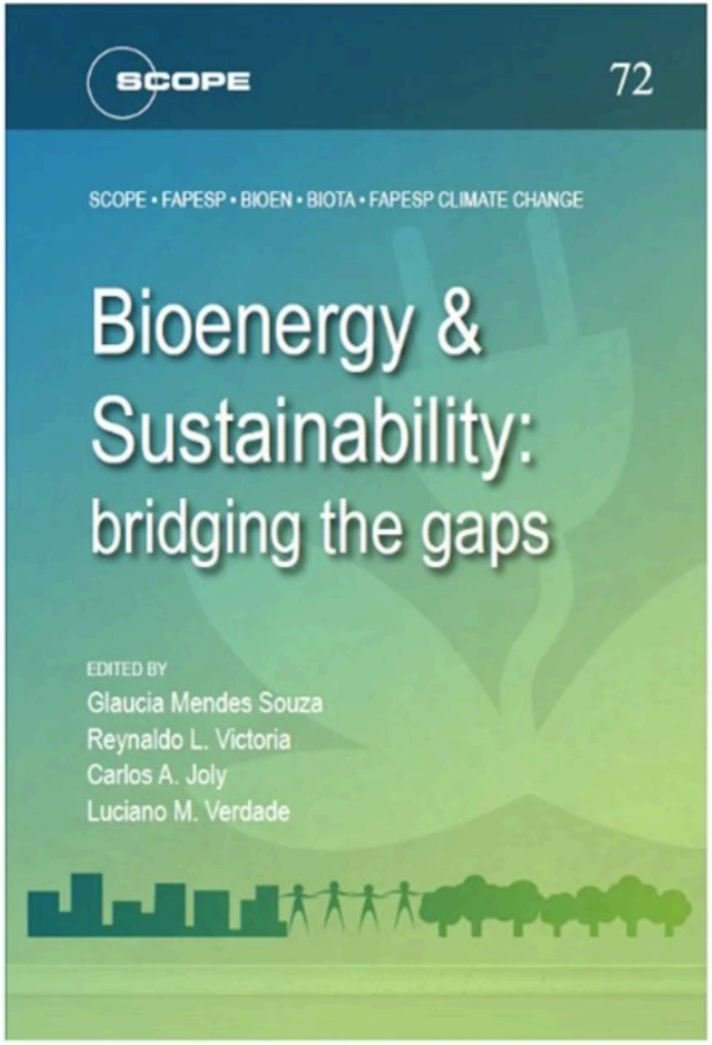
Bioetanol de caña de azúcar:
energía para el desarrollo sostenible

Bioéthanol de canne à sucre:
énergie pour le développment durable

Key figures on biomass sustainability

Bioenergy & Sustainability: bridging the gaps

https://bit.ly/3gP2Fca open access download

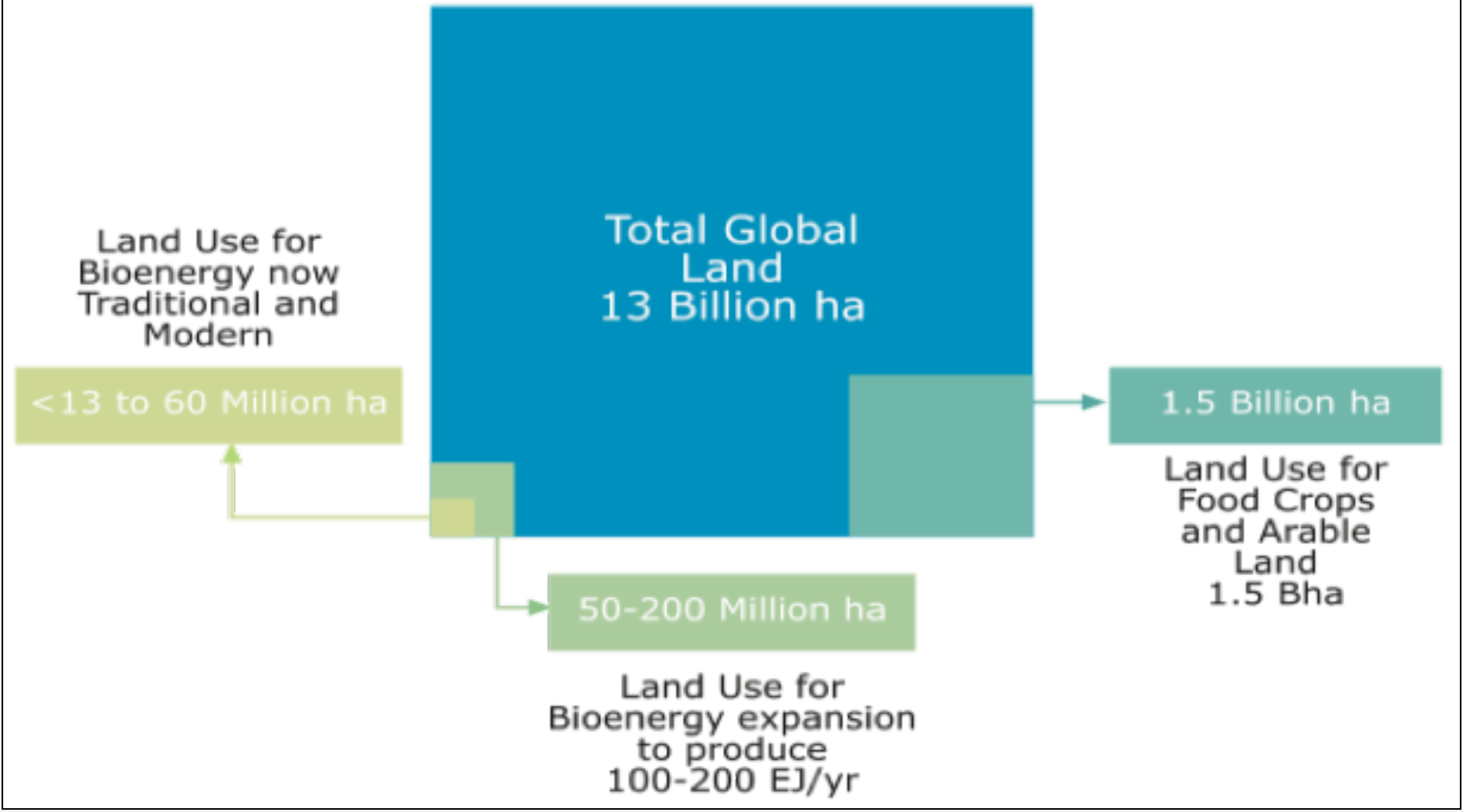


SCOPE Bioenergy & Sustainability is a collective effort with contributions from 137 researchers of 82 institutions in 24 countries.

The volume is the outcome of an assessment that included a meeting held at UNESCO, Paris, in December 2013. Fifty experts discussed bioenergy sustainability across its whole lifeline and crosscutting aspects including energy security, food security, environmental and climate security, sustainable development and innovation.

Global land availability

Today, there is a sound base of data assessing the current and future requirements of arable land to sustainably produce food, feed and biomass for energy, to assure that, from a global perspective, land is not a real concern



Source: SCOPE/UNESCO, 2015

Multilateral initiatives on bioeconomy

IEA Bioenergy

IC4: Sustainable Biofuels

MISSION INNOVATION

biofuture platform
Kickstarting a global, advanced bioeconomy

	IEA Bioenergy	MI Biofuel Challenge	Biofuture Platform	
Americas				
Argentina			x	
Brazil	x	x	x	all
Canada	x	x	x	all
Chile				
Mexico		x		
Paraguay			x	
United States	x	x	x	all
Uruguay			x	
Asia, Pacific				
Australia	x			
China		x	x	
India		x	x	
Indonesia		x	x	
Japan	x			
Korea	x			
Philippines			x	
New Zealand	x			
Africa				
Egypt			x	
Morocco			x	
Mozambique			x	
South Africa	x			
Europe				
Austria	x			
Belgium	x			
Croatia	x			
Denmark	x		x	
European Commission	x	x		
Estonia	x			
Finland	x	x	x	all
France	x	x	x	all
Germany	x			
Ireland	x			
Italy	x	x	x	all
Netherlands	x	x	x	all
Norway	x	x		
Sweden	x	x	x	all
Switzerland	x			
United Kingdom	x	x	x	all
	http://www.ieabioenergy.com/about/contracting-parties/		http://biofutureplatform.org/members/	

biofuture platform

Kickstarting a global, advanced bioeconomy

HELP TO CREATE THE BIOFUTURE!

www.biofutureplatform.org

Action-oriented country-led, multi-stakeholder initiative promoting international coordination on the sustainable low-carbon global bioeconomy

Our mission is to accelerate the transition to an advanced bioeconomy that is innovative and scalable

Biofuture member countries

• Argentina • Brazil • Canada • China • Denmark • Egypt • Finland • France • India • Indonesia • Italy • Morocco • Mozambique • Netherlands • Paraguay • Philippines • Sweden • United Kingdom • United States • Uruguay

Intergovernmental organizations

Food and Agriculture Organization of the United Nations · iea · IRENA International Renewable Energy Agency · SUSTAINABLE ENERGY FOR ALL · UNITED NATIONS UNCTAD · UNIDO United Nations Industrial Development Organization

Private sector organizations

ABBI Associação Brasileira de Biotecnologia Industrial · below50 · cgee Centro de Gestão e Estudos Estratégicos Ciência, Tecnologia e Inovação · wbcsd · WCIB World Council for Industrial Biotechnology

BFP principles for Post-COVID19 bioeconomy recovery

1 **Do not backtrack**

Ensure continuity and long-term predictability of bioenergy, biofuels, and bio-based material targets and existing policy mechanisms that have proved successful

Consider short-term COVID support for producers 2

Where appropriate, address short-term challenges for bioenergy and bio-based materials industries in the context of relief packages related to COVID-driven economic losses

3 **Reassess fossil fuel subsidies**

Take advantage of a low oil price environment to reassess fossil fuel subsidies for a fairer playing field

Where appropriate, integrate the bioeconomy sector as part of broader recovery programmes, e.g. by requiring bioeconomy investments/targets as part of aid and recovery packages for specific sectors such as transport and chemicals

Build Back Better with Bio 4

5 **Reward sustainability**

Integrate sustainability rewarding mechanisms into policy frameworks, promoting positive externalities in the production and use of bio-based fuels, chemicals and materials

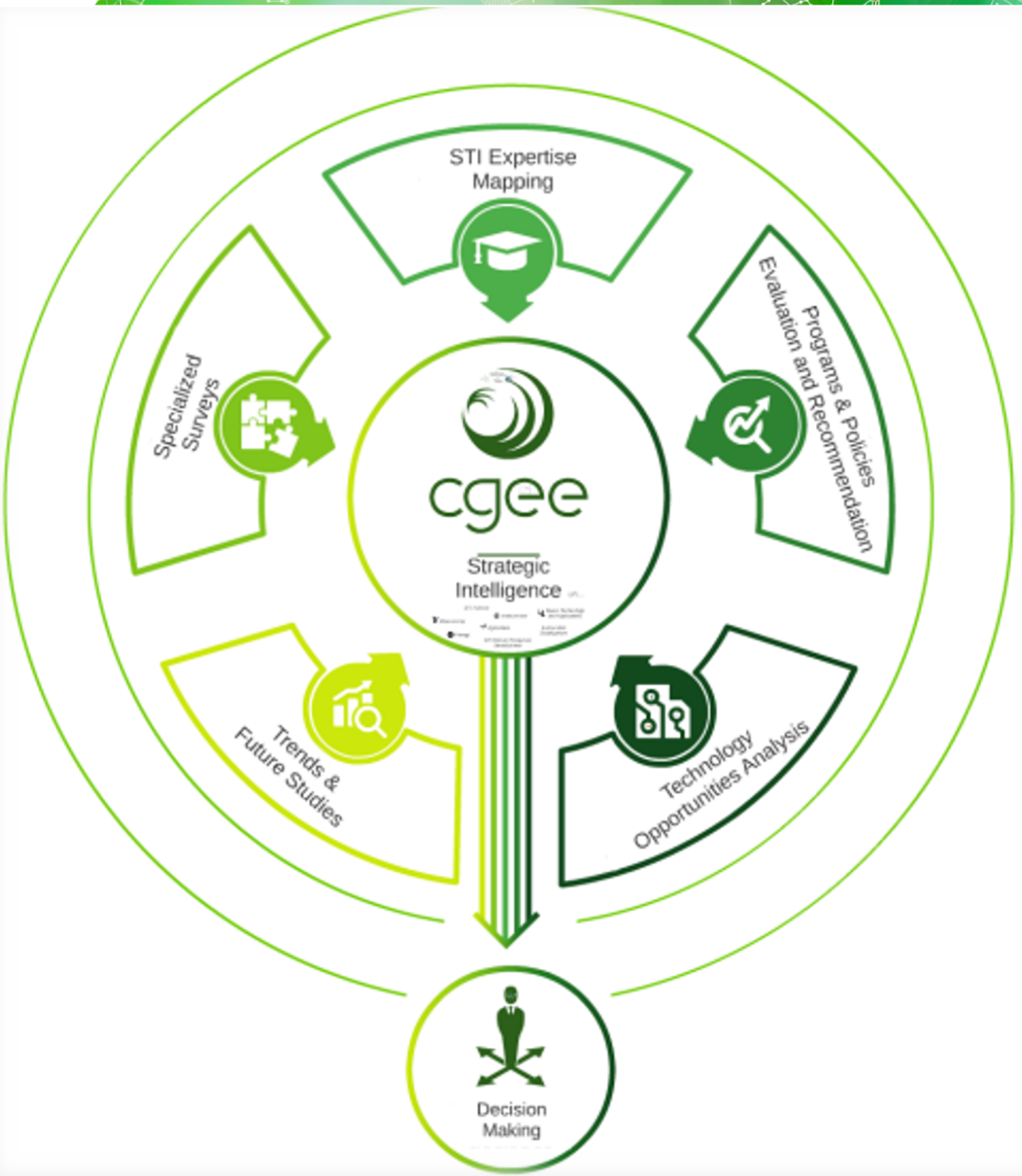
Bioeconomy visionary perception

"I foresee the time when industry shall no longer denude the forests which require generations to mature, nor use up the mines which were ages in the making, but shall draw its raw material largely from the annual products of the fields"

[Henry Ford, Modern Mechanics (1934)]

Ford Model A (1896) fueled by pure bioethanol [Fuel Testers (2008)]

Center for Strategic Studies and Management - CGEE



Want to know more and collaborate with us?

Get in touch!

energybigpush@cgee.org.br

http://bit.ly/brazilenergybigpush

Marcelo Poppe