

# RenovaBio, a LCFS: is it up to the challenge of decarbonising Brazil's transport sector?

PhD candidate: Danilo Perecin

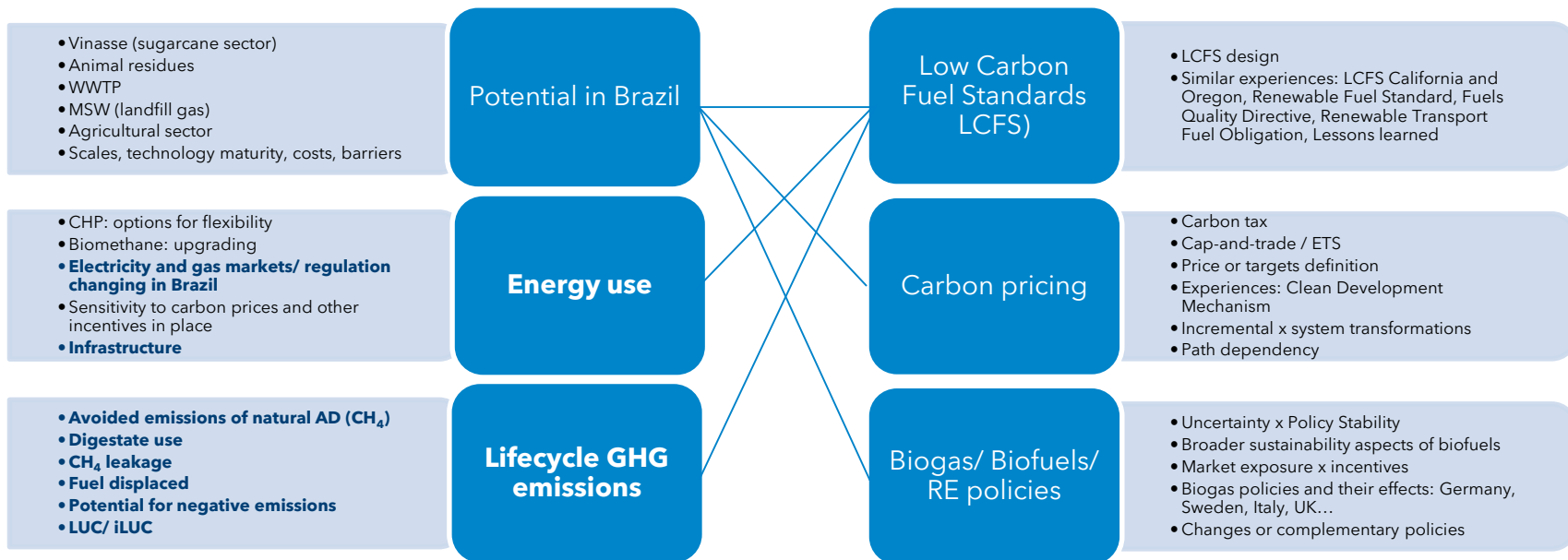
Supervisor: Dr. Suani T. Coelho

Institute of Energy and Environment, University of São Paulo, Brazil

Co-supervisor: Dr. Jeremy Woods

Centre for Environmental Policy, Imperial College London, UK

# Biogas ↔ RenovaBio (LCFS)



# Biogas ← → RenovaBio (LCFS)

- **Vinasse (sugarcane sector)**
- Animal residues
- WWTP
- MSW (landfill gas)
- Agricultural sector
- Scales, technology maturity, costs, barriers

Potential in Brazil

- CHP: options for flexibility
- Biomethane: upgrading
- Electricity and gas markets/ regulation changing in Brazil
- Sensitivity to carbon prices and other incentives in place
- Infrastructure

Energy use

- Avoided emissions from natural AD (CH<sub>4</sub>)
- Digestate use
- CH<sub>4</sub> leakage
- Fuel displaced
- Potential for negative emissions
- LUC/ iLUC

Lifecycle GHG emissions

Low Carbon Fuel Standards (LCFS)

- LCFS design
- Similar experiences: LCFS California and Oregon, Renewable Fuel Standard, Fuels Quality Directive, Renewable Transport Fuel Obligation, Lessons learned

Carbon pricing

- Carbon tax
- Cap-and-trade / ETS
- Price or targets definition
- Experiences: Clean Development Mechanism
- Incremental x system transformations
- Path dependency

Biogas/ Biofuels/ RE policies

- Uncertainty x Policy Stability
- Broader sustainability aspects of biofuels
- Market exposure x incentives
- Biogas policies and their effects: Germany, Sweden, Italy, UK...
- Changes or complementary policies

**Future of Biofuels**  **RenovaBio (LCFS)**

## Future of Biofuels

and the challenge  
ahead for the  
Brazilian biofuels  
industry,  
government,  
universities, and  
research centres:  
**innovation**

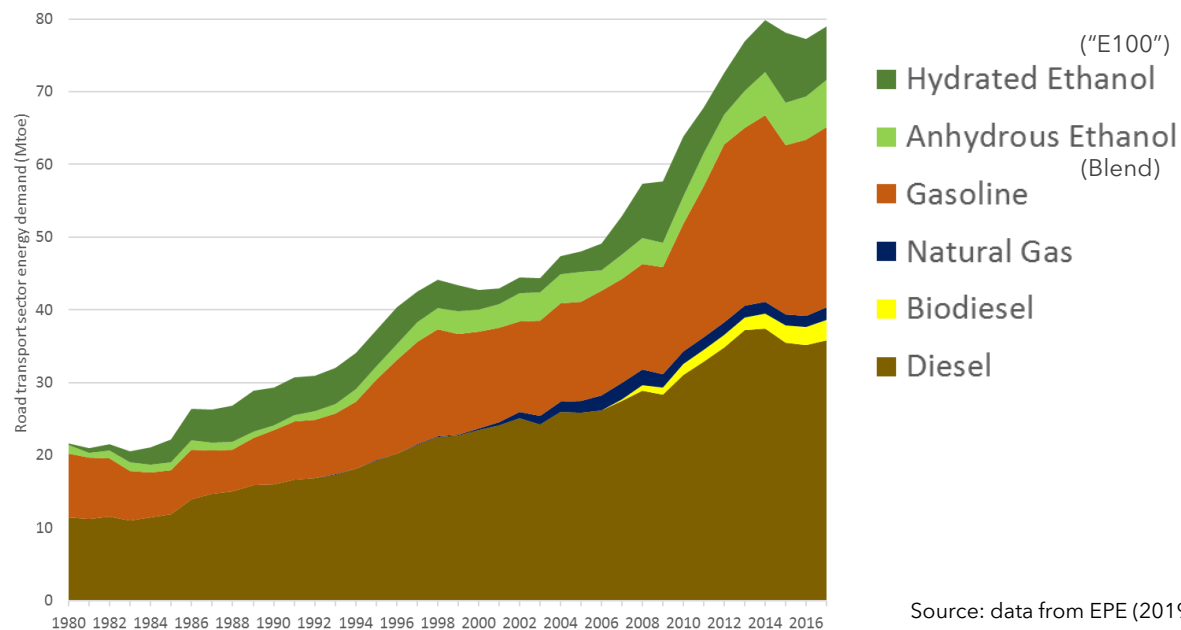


## RenovaBio (LCFS)

its instruments and  
capacity to  
decarbonise Brazil's  
biofuels and transport  
sector

- ▶ Ethanol: phases
  - 1) 1970-80's: Government push (Proálcool)
  - 2) 1990's: Liberalisation
  - 3) 2000's: Euphoria
  - 4) 2010 - 2014: Crisis
  - 5) 2015 - Today: Recovery
- ▶ Biodiesel
  - 1) Blend mandate to fossil diesel (2019: 11%)

## Road transport fuel mix



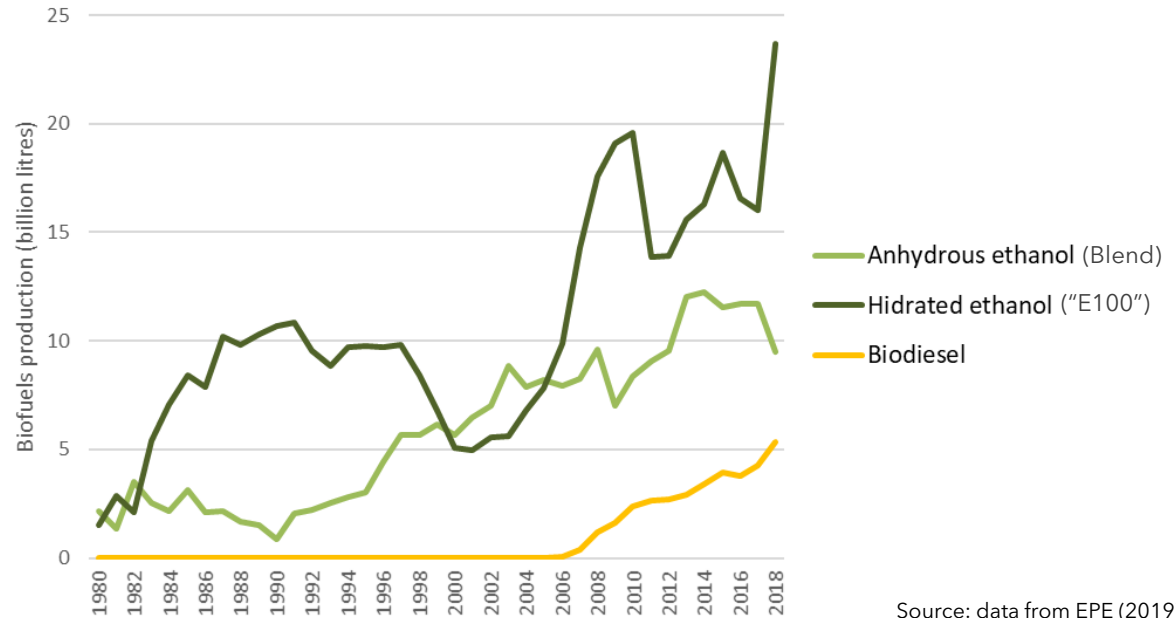
► Ethanol: phases

- 1) 1970-80's: Government push (Proálcool)
- 2) 1990's: Liberalisation
- 3) 2000's: Euphoria
- 4) 2010 - 2014: Crisis
- 5) 2015 - Today: Recovery

► Biodiesel

- 1) Blend mandate to fossil diesel (2019: 11%)

## Biofuels production



Source: data from EPE (2019)

- ▶ Ethanol: Post-euphoria crisis
- 1) Gasoline price control and fiscal incentives reduction (inflation control + fiscal constraint)
- 2) Export expectations frustrated: domestic production (US), broader sustainability concerns (EU)
- 3) Unfavourable climate (2009-2011)
- 4) 2008 crisis: indebted companies facing higher cost of credit
- 5) Currency devaluation: US\$ denominated debt explosion = insolvency

- ▶ What does it take to recover ? (Nastari, 2014):
- 1) Certainty, stability, predictability
- 2) Adequate price signal
- 3) Pricing externalities (environmental benefits)
- 4) Make the most of the sugarcane: 2<sup>nd</sup> gen. ethanol, high pressure CHP with solid residues, biogas replacing diesel - productivity increase and zero emissions by incentivising efficiency
- 5) Concept: LCFS of California

Sources: Rodrigues & Rodrigues (2018), FGV (2017)



## RenovaBio: The National Biofuels Policy

### ► Goals

- 1) Deliver biofuels contribution to Paris Agreement targets
- 2) Promote an adequate expansion of biofuels, focussing on the regularity of the fuel supply by ensuring certainty for the fuels market
- 3) Induce energy efficiency improvements and the reduction of GHG emissions in the biofuels value chain

### ► Instrument: Decarbonisation credits (CBio)

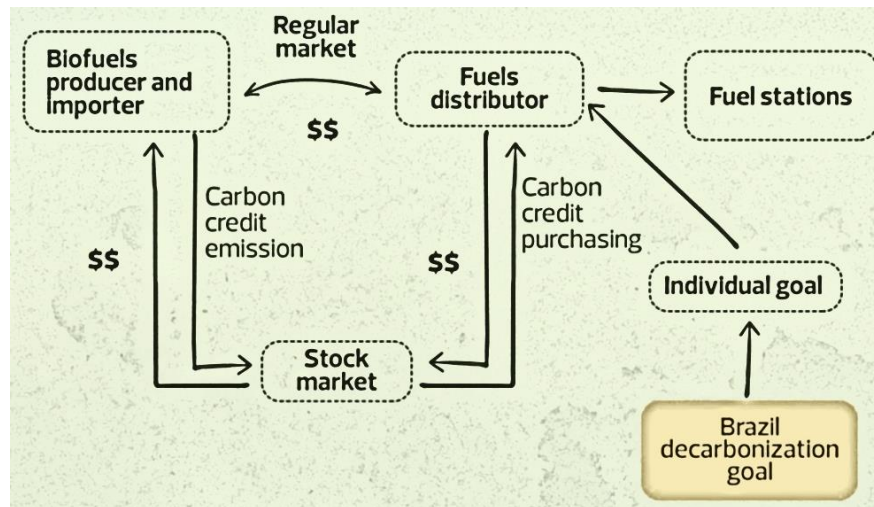
- 1) Life-cycle GHG assessment of each biofuel producer using real data - input to government provided calculator
- 2) Emissions Reduction (per MJ) =  $\text{GHG}_{\text{FOSSIL FUEL}} - \text{GHG}_{\text{BIOFUEL}}$
- 3) CBio created based on ER and volume sold, meaning 1 ton of CO<sub>2</sub> reduced
- 4) Annual national targets for fuel supply Carbon Intensity determined for a 10 year period
- 5) Fuel distributors have a annual CBio purchasing requirement based on their market share

## RenovaBio: The National Biofuels Policy

### ► Goals

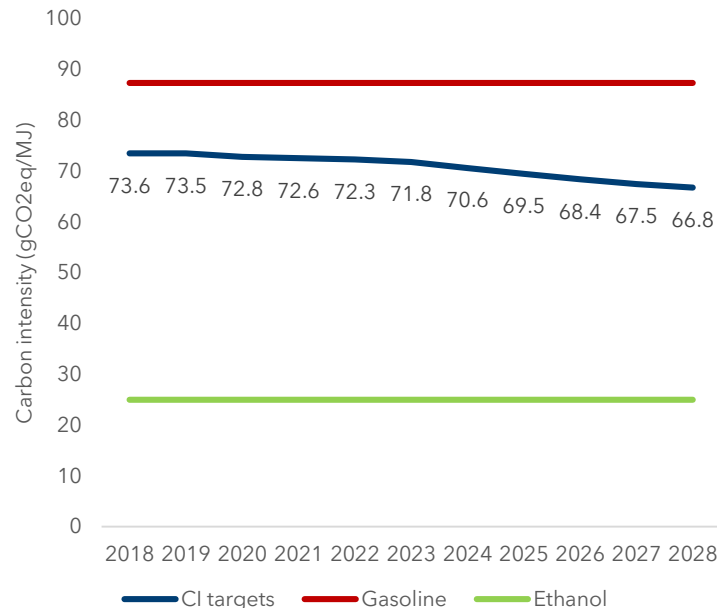
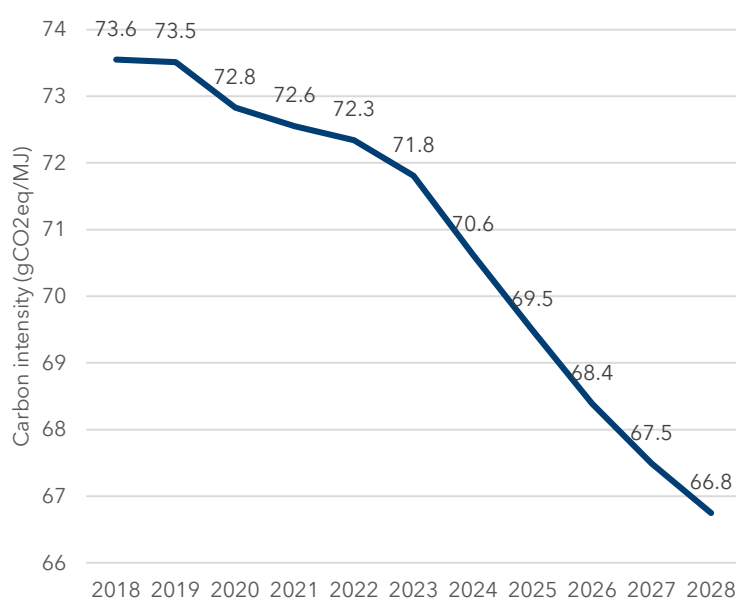
- 1) Deliver biofuels contribution to Paris Agreement targets
- 2) Promote an adequate expansion of biofuels, focussing on the regularity of the fuel supply by ensuring certainty for the fuels market
- 3) Induce energy efficiency improvements and the reduction of GHG emissions in the biofuels value chain

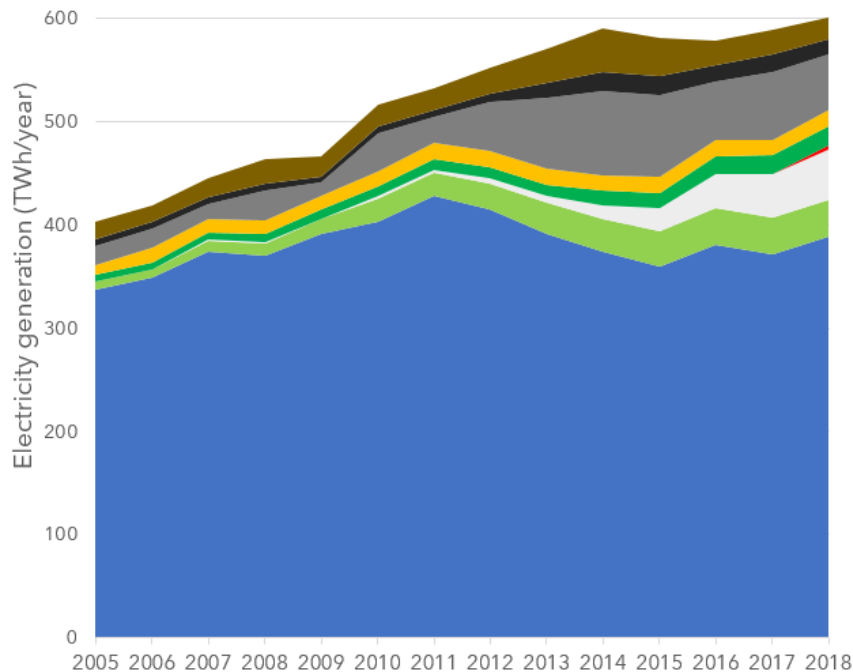
### ► Instrument: Decarbonisation credits (CBio)



Source: Unica

## RenovaBio: Carbon intensity targets





## Electricity supply 2018

Other fossil	15% fossil fuels
Coal	
Natural Gas	
Nuclear	3%
Other renewable	3%
Solar	<1%
Wind	8%
Sugarcane bagasse	6%
Hydro	65%

Source: data from EPE (2019)

► **Where are emissions coming from? Can they be reduced?**

Gasoline emissions = 87.4 g <sub>CO2</sub> /MJ	➔	62.4 g <sub>CO2</sub> /MJ or 71% reduction
Ethanol emissions = 25 g <sub>CO2</sub> /MJ		

- Fertilisers ~30%
- pH correction ~15%
- Diesel consumption ~30%


**Innovations in sight:**

- 2<sup>nd</sup> generation ethanol
- Increase cogeneration efficiency and residues utilisation (e.g. straw)
- Incremental process improvements
- Biogas production
- **CCS: potential for negative emission technology**
- Agricultural innovation with new incentives (reducing GHG intensive inputs)

Source: illustrative data based on companies'  
Public Consultations for RenovaBio.

► **Where are emissions coming from? Can they be reduced?**

Gasoline emissions = 87.4 g<sub>CO2</sub>/MJ  
Ethanol emissions = 25 g<sub>CO2</sub>/MJ



62.4 g<sub>CO2</sub>/MJ or  
71% reduction

- Fertilisers ~30%
- pH correction ~15%
- Diesel consumption ~30%

**Innovations in sight:**

- 2<sup>nd</sup> generation ethanol
- Increase cogeneration efficiency and residues utilisation (e.g. straw)
- Incremental process improvements
- Biogas production
- **CCS: potential for negative emission technology**
- Agricultural innovation with new incentives (reducing GHG intensive inputs)

Great tool to identify emissions sources with incentives to mitigate, but must adapt to cover emission gaps

Will RenovaBio redefine R&D and project priorities or new plants design?

Source: illustrative data based on companies' Public Consultations for RenovaBio.

► **Biofuels to deep decarbonisation: consequences**

- 1) Explore **profound innovation** possibilities within the industry
  - RenovaBio: fit for incremental improvements only?
  - Where will industry revenues go? Will private sector fund R&D?
  - Are the targets (ergo the carbon price) enough?
- 2) A future **unique** transport system?
  - Scale is reduced: will prices increase? Will companies invest on ICE/ethanol vehicles? Does it affect innovation?
  - Risk of lock-in? Is it associated with the fossil fuel industry?
- 3) Land use: **reduce energy demand** to avoid problems
  - Vehicle efficiency is key; Mass transit, bicycles
  - Could it go side-by-side with EVs?
- 4) Jobs, **national industry**, “perfect is the enemy of good”
  - Makes sense to wait until develop EVs infrastructure?



Photo: Marivaldo Oliveira, Folhapress

# **Thank you**

Danilo Perecin

[danieloperecin@usp.br](mailto:danieloperecin@usp.br)

[d.perecin19@imperial.ac.uk](mailto:d.perecin19@imperial.ac.uk)