ProQR
COMBUSTÍVEIS ALTERNATIVOS
SEM IMPACTOS CLIMÁTICOS

Potential syngas production by different industries in Brazil

epe
Empresa de Pesquisa Energética

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Por ordem do
Ministério Federal do Meio Ambiente, Proteção da Natureza e Segurança Nuclear
da República Federal da Alemanha

Por meio da:
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

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SECRETARIA DE EMPREENDEDORISMO E INOVAÇÃO

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E INOVAÇÕES

PÁTRIA AMADA BRASIL GOVERNO FEDERAL

Agenda

- Introduction
- Identified industries for syngas production
- Syngas potential of analysed industries
- Conclusion and outlook

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Introduction

Synthesis gas

$CO + H_2$

(syngas)

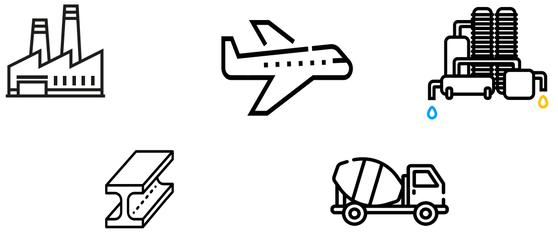
- **Direct Syngas**
- **Indirect Syngas**

Fischer-Tropsch (FT) Synthesis

Synthetic products

- **Sustainable Aviation Fuel (SAF)**
- **FT Diesel**
- **Gasoline**
- **Chemical products**
- **...**

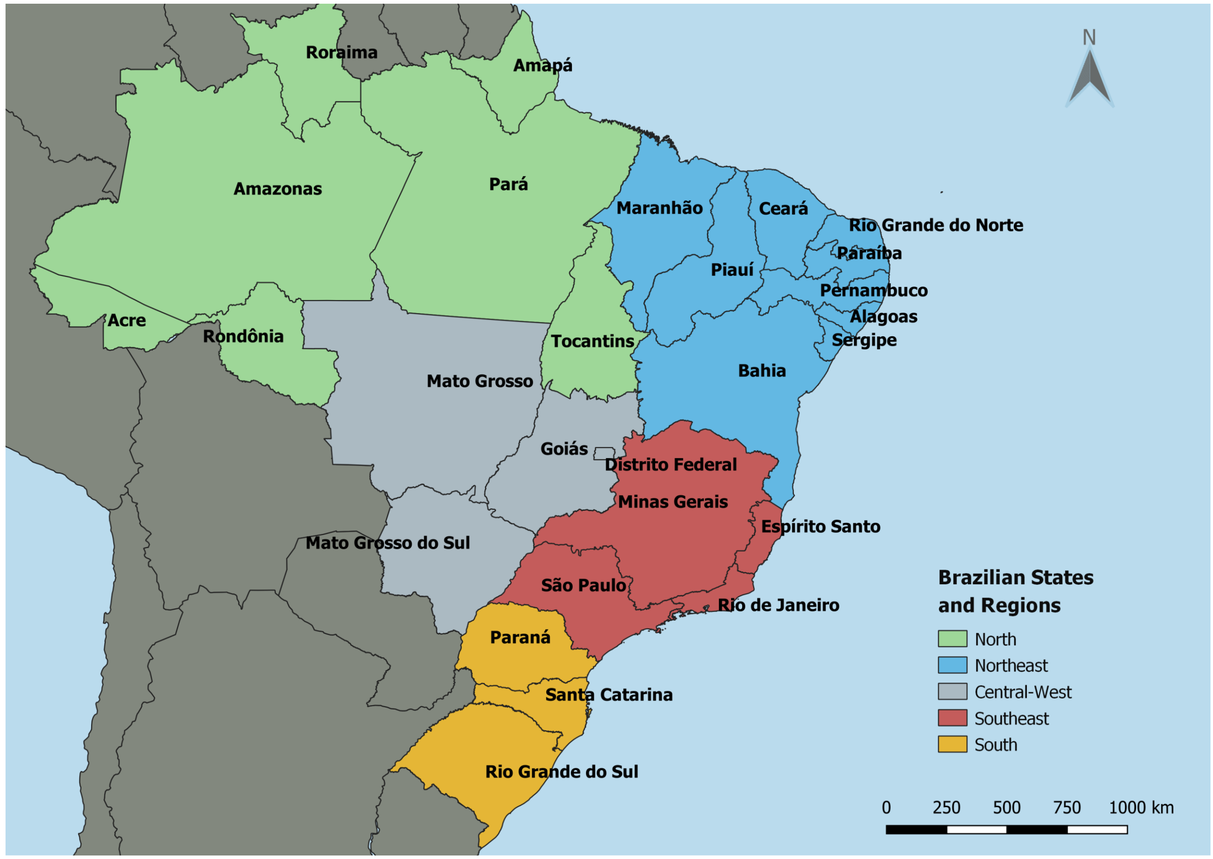
Decarbonized industries



Main assumption and Objective of the study

- Syngas is the initial intermediate in the FT synthesis and can be obtained through the conversion of different feedstock sources
  - In order to produce Sustainable Aviation Fuel (SAF), in this study only industrial residues and low-value by-products are considered

- The utilization of residues and creating more value-added products is still not appreciated and can ensure the transition into a circular economy



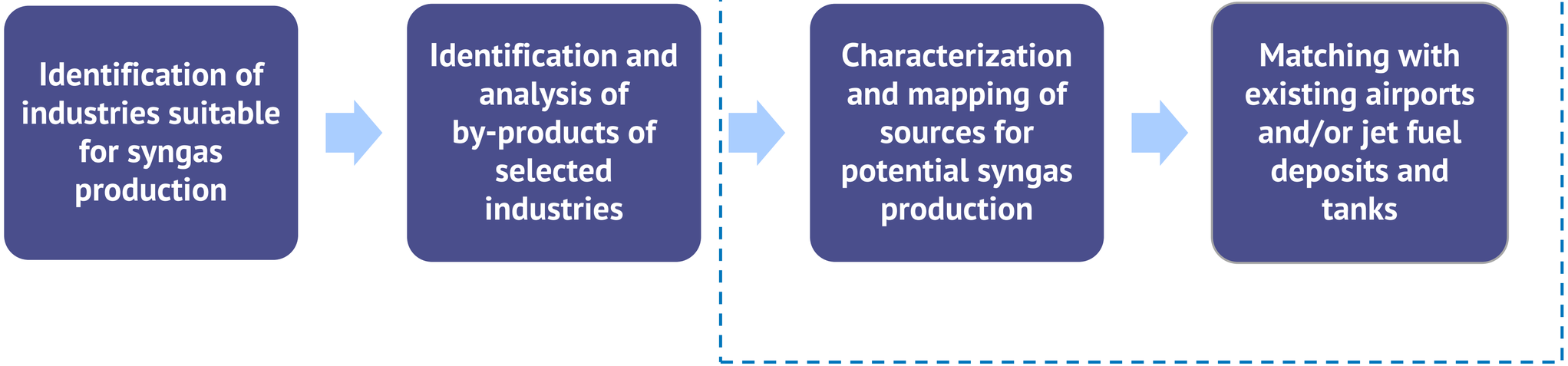
Objective

The Objective of the study is to investigate the potential syngas production from residues and low-value by-products by different industry segments in Brazil to further estimate the theoretical potential to generate Sustainable aviation Fuels (SAF)

Methodology

National level

Regional level



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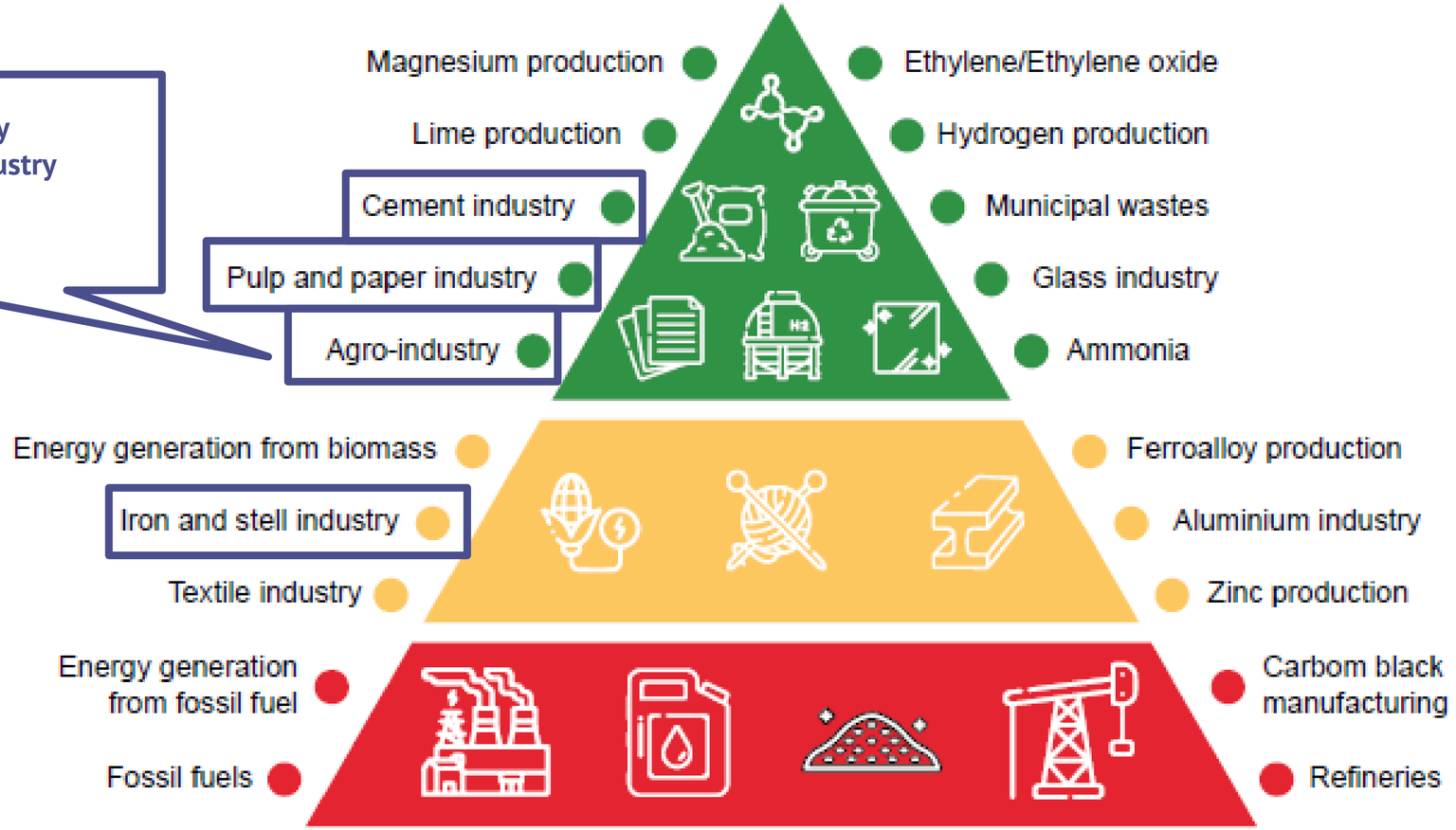
Identified industries suitable for syngas production

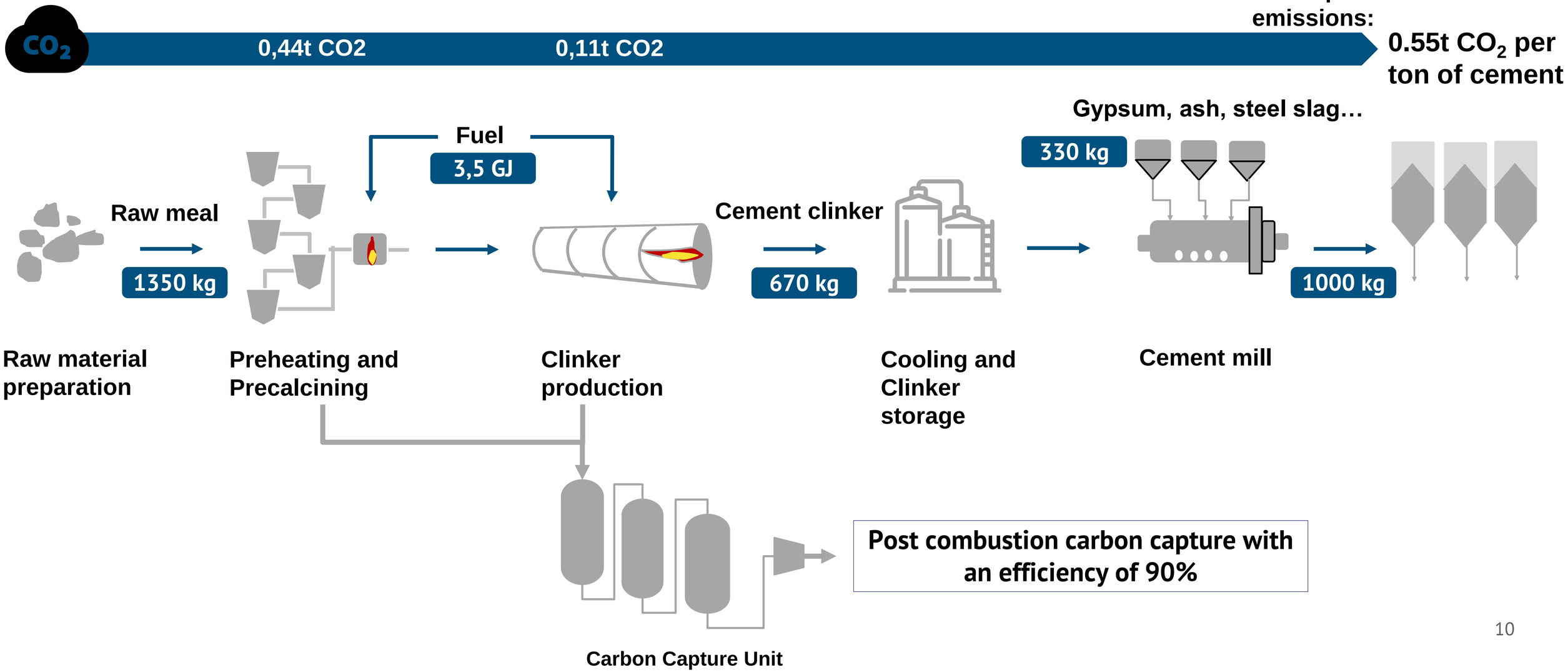
Direct syngas production Thermochemical conversion – Gasification, Reforming, Pyrolysis	Indirect syngas production CO_2 + H_2O (co-electrolysis)	
Agroindustry • Agricultural and animal wastes • Bioethanol, Biogas and Biodiesel industry • Forest residues **Municipal waste** • Municipal solid wastes • Wastewater treatment **Pulp and paper** **Biomass** **Fossil fuels** • Natural gas, coal,…	**Agroindustry** • Bioethanol, Biogas industry **Mineral industry** • Cement • Glass **Metal industry** • Iron and steel • Magnesium, Aluminium • Ferroalloys, Zinc **Pulp and paper** **Energy generation from fossil fuels**	**Ambient air** **Waste treatment or incineration** **Chemical industry** • Ethylene, Ethylene oxide • Ammonia, Hydrogen • Oil refineries • Natural gas processing **Textile industry** **Energy generation from biomass**

Selection of industries for the analysis

Soybean and Biodiesel industry
Sugarcane and Bioethanol industry
Corn industry
Rice industry



Identified industries – Cement industry
suitable residues and by-products



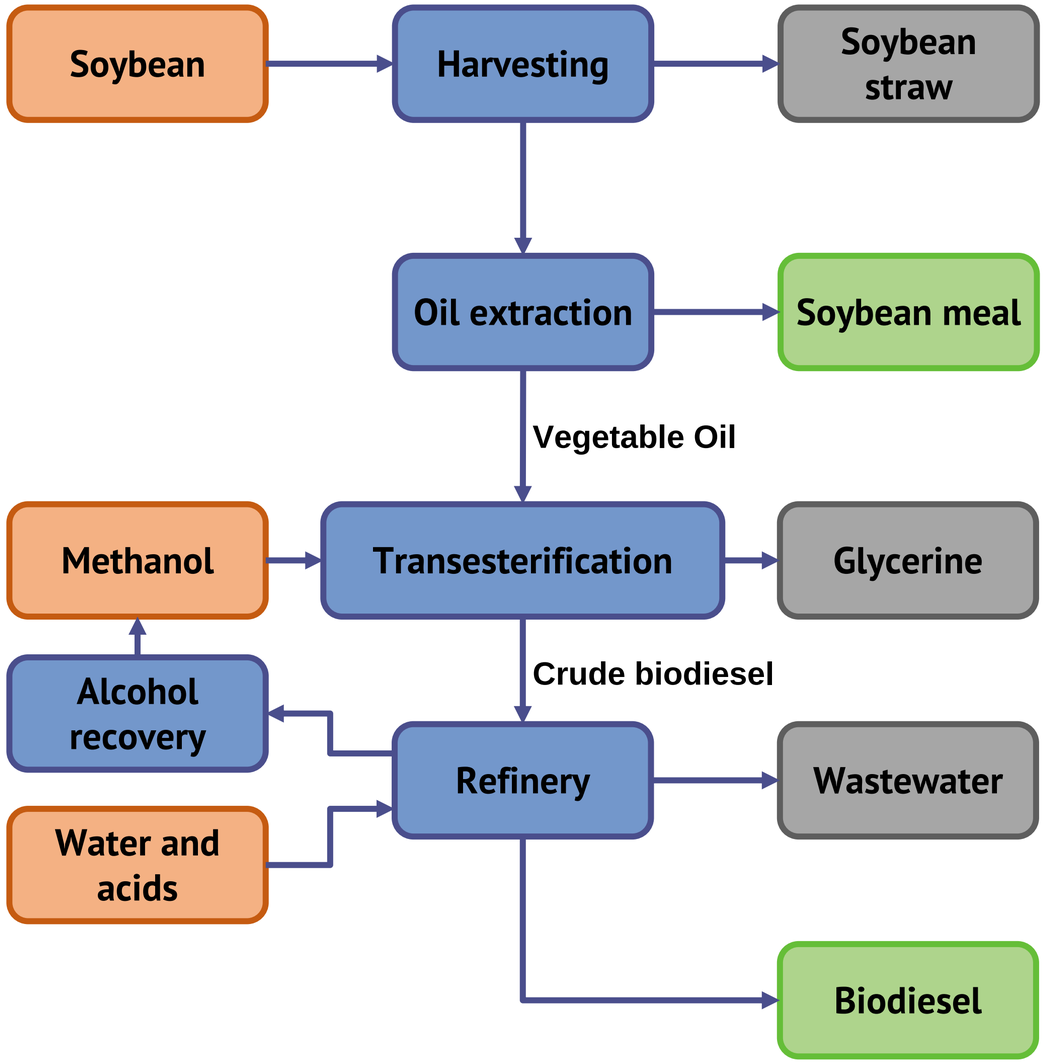
Identified industries – Agroindustry (Soya/Biodiesel industry)
suitable residues and by-products

Input

Process

Output

By-product or residue



1.52 ton soybean straw for every ton of soybean harvested

Biodiesel production generates approximately 10% of glycerine by volume

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Syngas Potential of the analysed industries

Industry	By-product and residue	Total annual syngas potential [mill. tons]	Max. potential by state [% of total syngas potential]
Sugarcane industry ● Sugarcane	Sugarcane straw	**146.3**	**53%** (São Paulo)
● Ethanol	CO_2	**21.0**	**49%** (São Paulo)
Soybean industry ● Soybean	Soybean straw	**299.1**	**27%** (Mato Grosso)
● Biodiesel	Glycerol	**0.24**	**25%** (Rio Grande do Sul)
Corn industry	Corn straw	**158.6**	**32%** (Mato Grosso)
Rice industry	Rice straw/husk	**20.8**	**72%** (Rio grande do Sul)
Cement industry	CO_2	**22.3**	**24%** (Minas Gerais)
Iron and steel industry	CO_2	**31.9**	**30%** (Minas Gerais)
Pulp industry	Wood wastes/mill sludge/CO_2	**25.2**	**23%** (Bahia)

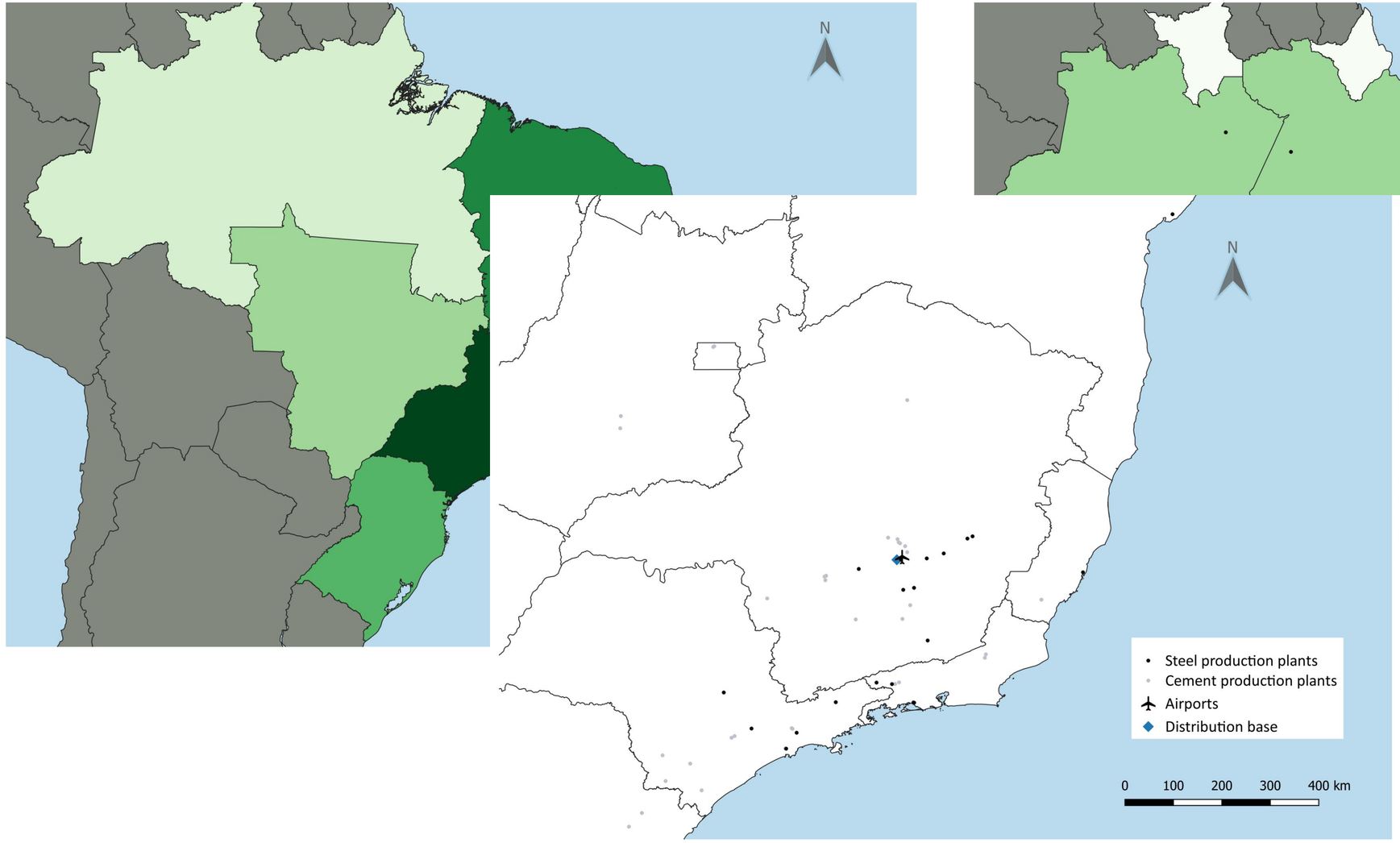
Syngas Potential of the analysed industries

Industry	By-product and residue	Total annual syngas potential [mill. tons]	Max. potential by state [% of total syngas potential]
Sugarcane industry • Sugarcane • Ethanol	Su		**53%** (São Paulo) **49%** (São Paulo)
Soybean industry • Soybean • Biodiesel			**27%** (Matto Grosso) **25%** (Rio Grande do Sul)
Corn industry			**32%** (Matto Grosso)
Rice industry	R		**72%** (Rio grande do Sul)
Cement industry			**24%** (Minas Gerais)
Iron and steel industry	CO_2	**31.9**	**30%** (Minas Gerais)
Pulp industry	Wood wastes/mill sludge/CO_2	**25.2**	**23%** (Bahia)

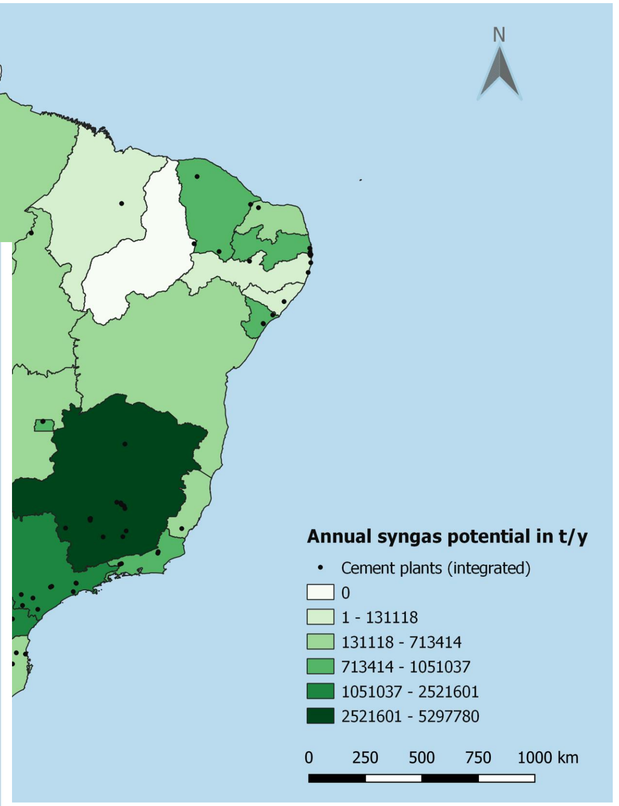
Total annual potential of 193 mill. tons of SAF when considering all the industry segments

Syngas Potential of the Cement industry

Syngas potential Cement on regional level

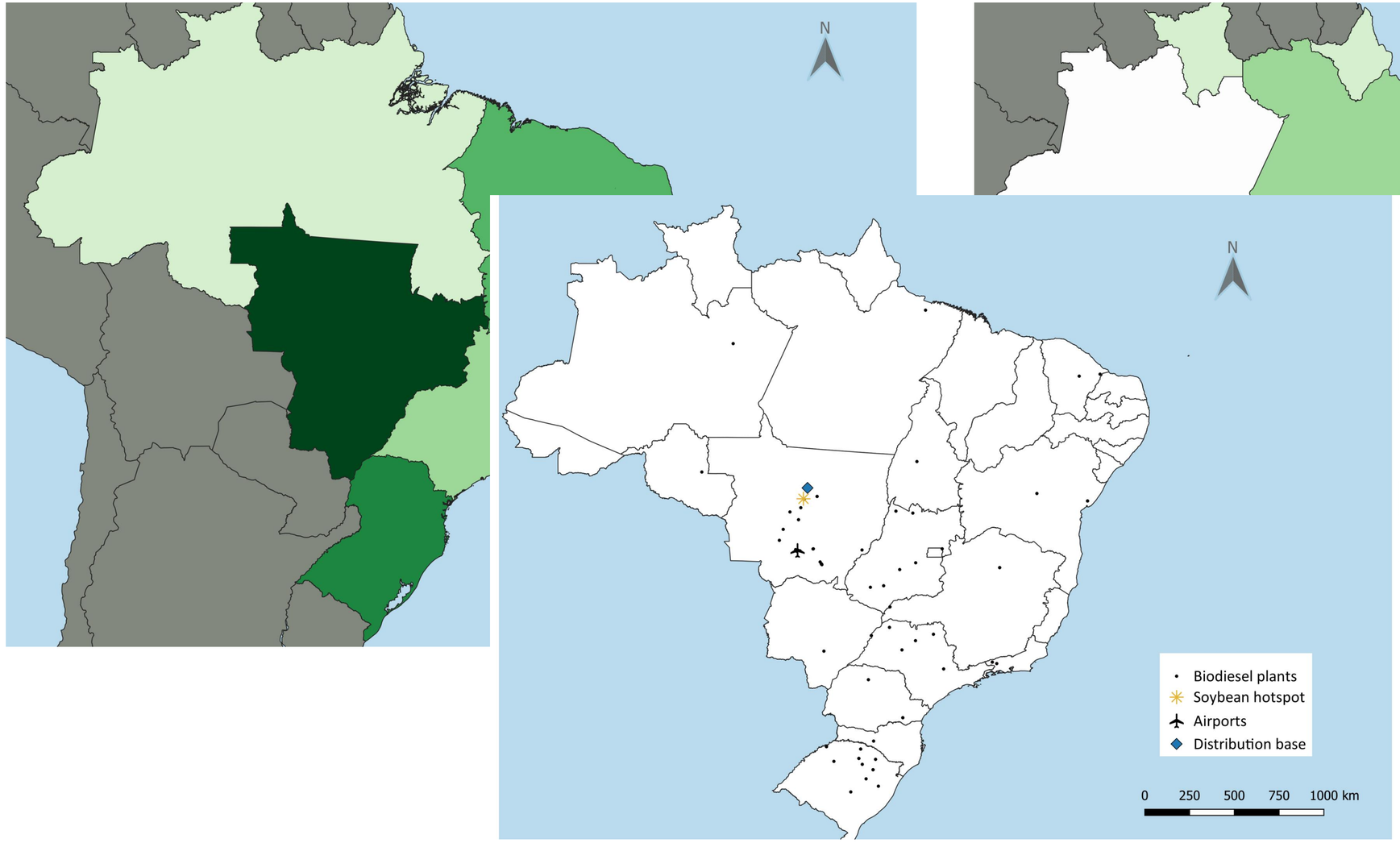


Syngas potential Cement on state level

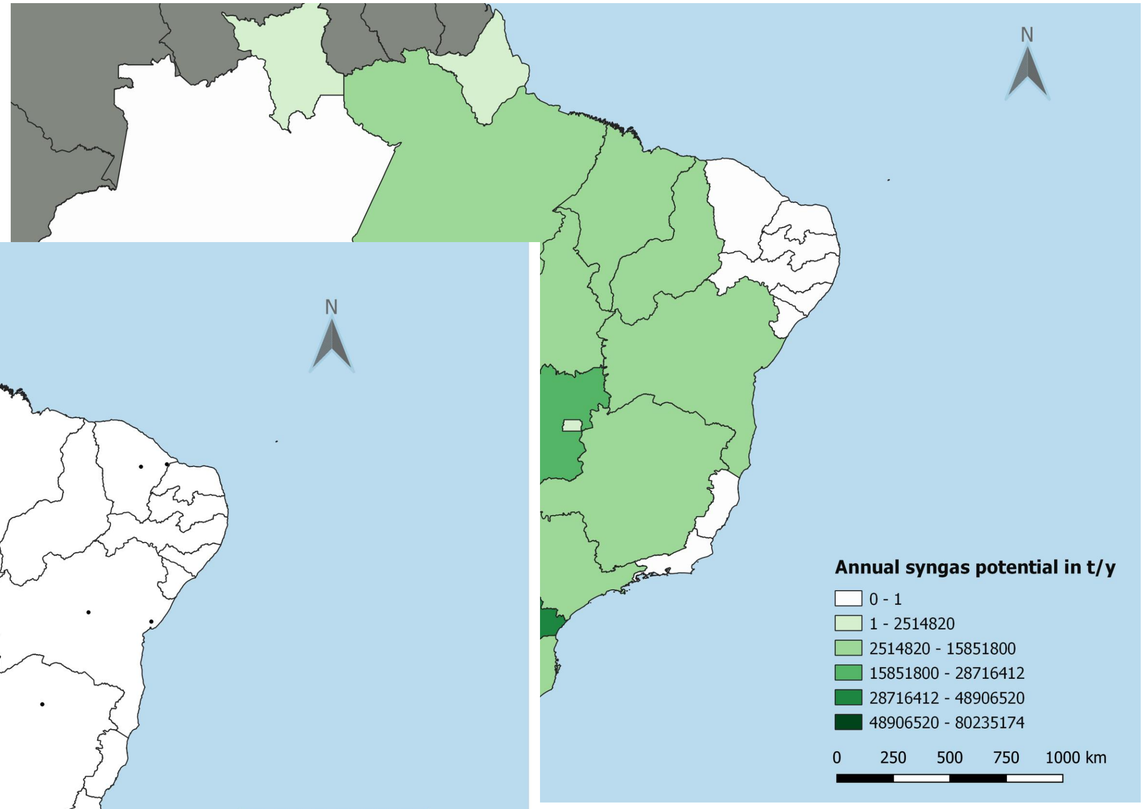


Syngas Potential of the Agroindustry - Soya

Syngas potential soya on regional level



Syngas potential soya on state level



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Conclusion

- Industries for syngas production in Brazil were identified and selected industries with suitable residues and by-products were analysed in detail (Soybean, Biodiesel, Sugarcane, Bioethanol, Corn, Rice, Steel, Cement and Pulp)

- The analysis revealed that the **Central-West** region accounts for the highest syngas potential (37% of total) followed by the **Southeast**, **South**, **Northeast** and **North** with 26%, 23%, 10% and 3% respectively

- The conversion of agricultural residues such as soybean, corn and sugarcane straw have by far the highest potential to produce syngas in Brazil followed by steel, pulp, cement, ethanol, rice and biodiesel industries

- Considering the potential syngas production of all industries, an annual potential aviation fuel production of about **193 million tons** of SAF would result

- The potential to produce Syngas using industrial residues and by-products added to Brazil's favorable conditions for renewable energy puts the country at an advantage in the production of SAF

Outlook

- A more accurate database and a GIS analysis under higher spatial resolution gives better estimations of the potential and helps selecting optimal locations more accurately

- Analysis of the potential of other identified industries such as forestry residues, animal wastes, biogas and municipal wastes should be conducted which may lead to other interesting regional distributions

- A further techno-economic assessment of the different routes such as their social and environmental impacts should be assessed

- By-products used in the conventional process itself and therefore not analysed in the study (such as bagasse and black liquor) could be analysed regarding their possible viability to produce syngas and high-value products

- R&D regarding the conversion of the different syngas production routes is needed (laboratories and Pilot plants)

Obrigado!

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