RCN Conference on Pan American Biofuels & Bioenergy Sustainability

Bioenergy in Northeastern Brazil: Opportunities and Challenges

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- Fundação de Amparo à Ciência e Tecnologia do Estado de Pernambuco (FACEPE)

Brazil – primary energy sources (2012)

%

FONTES	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	SOURCES
NÃO RENOVÁVEL	**53,0**	**52,2**	**52,7**	**52,6**	**51,3**	**51,6**				**54,0**	***NON-RENEWABLE ENERGY***
PETRÓLEO	42,0	40,3	42,0	42,1	40,6	39,7	42,0	42,1	42,5	41,6	*PETROLEUM*
GÁS NATURAL	8,5	8,9	8,8	8,3	8,1	9,0	8,7	9,0	9,3	9,9	*NATURAL GAS*
CARVÃO VAPOR	1,0	1,1	1,2	1,0	1,0	1,1	0,8	0,8	0,8	1,0	*STEAM COAL*
CARVÃO METALÚRGICO	0,0	0,1	0,1	0,0	0,0	0,0	0,1	0,0	0,0	0,0	*METALLURGICAL COAL*
URÂNIO (U_3O_8)	1,5	1,9	0,7	1,1	1,6	1,7	1,7	0,7	1,6	1,5	*URANIUM - U_3O_8*
RENOVÁVEL	**47,0**	**47,8**	**47,3**	**47,4**	**48,7**					**46,0**	***RENEWABLE ENERGY***
ENERGIA HIDRÁULICA	14,3									13,9	*HYDRAULIC*
LENHA	14,1									10,0	*FIREWOOD*
PRODUTOS DA CANA-DE-AÇÚCAR	15,4									17,5	*SUGAR CANE PRODUCTS*
OUTRAS RENOVÁVEIS	3,1									4,6	*OTHERS*
TOTAL	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	*TOTAL*

Fossil fuels= 54%

Renewable sources= 46%

About 30% of the energy produced is derived from biomass sources:

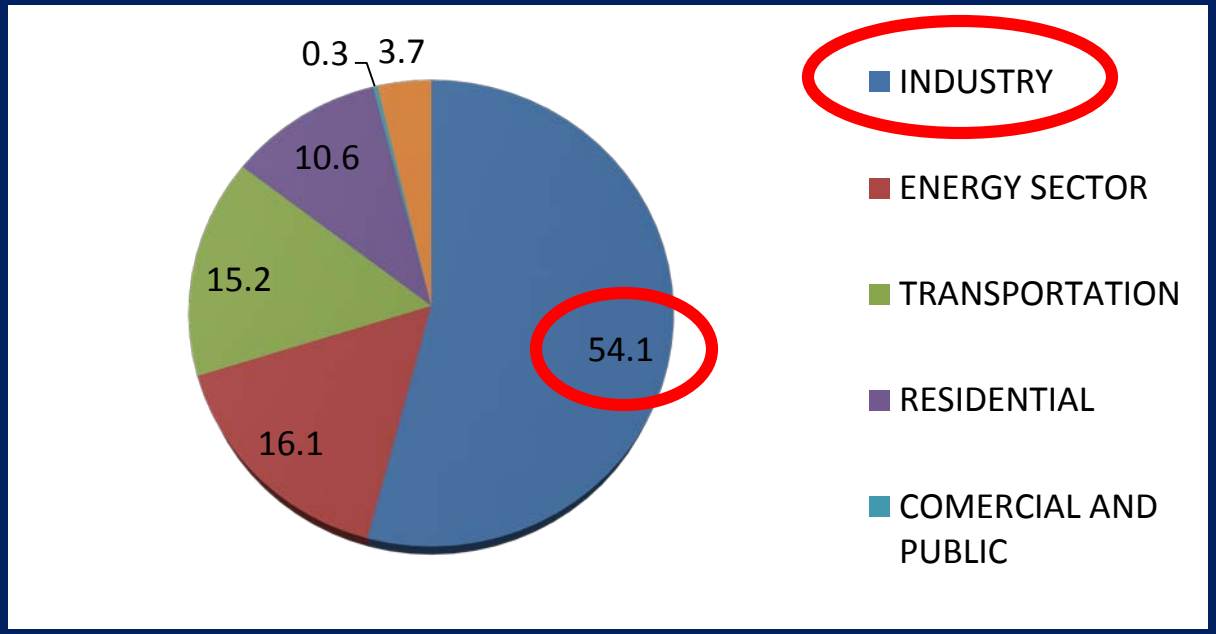
Charcoal~2.5%

Firewood =10%

Sugarcane =17.5%

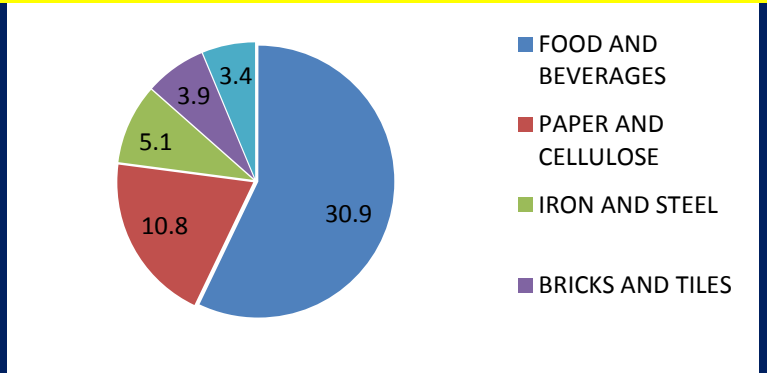
Source: National Energy Balance (2013)

Energy consumption by sector in Brazil



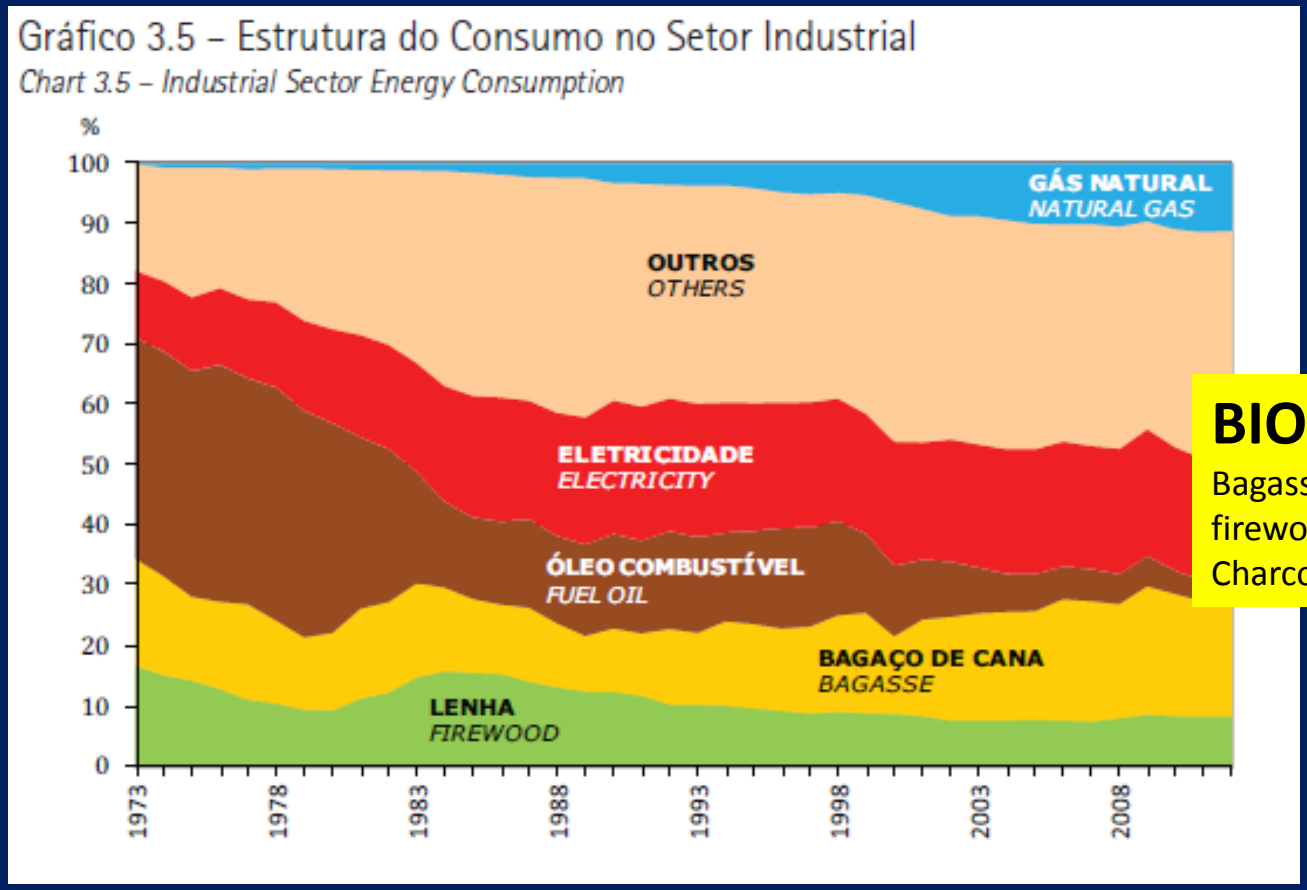
Industrial sector:
54%
of total energy consumption in Brazil

Detailed consumption in the industry sector



Source: National Energy Balance (2013)

Biomass contribution for energy supply to the industrial sector in Brazil



BIOMASS = 33,1%

Bagasse=20,1
firewood=8,4
Charcoal=4,6

Source: National Energy Balance (2013)

Background – NE region of Brazil

NE region of Brazil

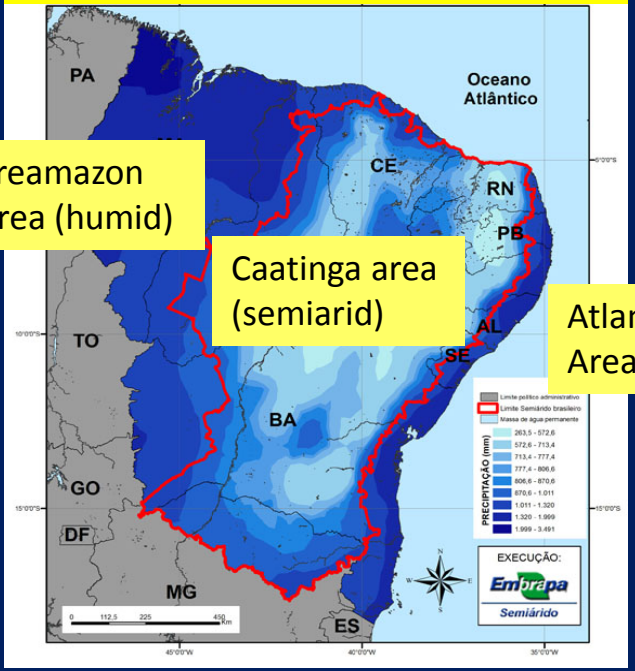
Total area: 1.561.177 km²
Equivalent to the areas of Germany, Holand, Belgium, France, Spain, and Portugal combined.

Population ~ 55 million people

- **Bioenergy in NE Brazil**
  - Biomass is an important energy source in Brazil;
  - The NE region of Brazil is very large but relatively little studied in this respect.

NE Region of Brazil:
High environmental variability

Rainfall precipitation

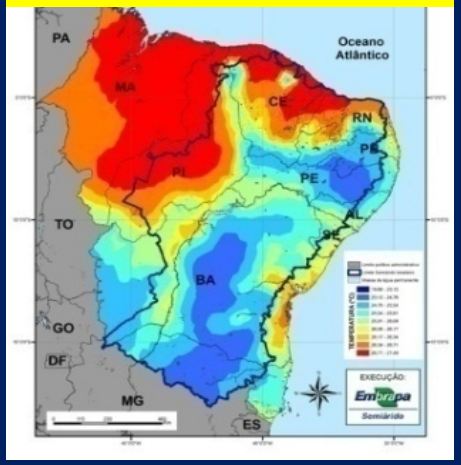


Preamazon Area (humid)

Caatinga area (semiarid)

Atlantic forest Area (humid)

Average temperatures



Soil types

Biomass sources and availability vary according to each area

Main points for this talk

- What are the LESS KNOWN OPPORTUNITIES about biomass sources for energy recovery in NE Brazil?

- What are the main RESEARCH AND POLICY GAPS that need to be approached?

Bioenergy Atlas of Brazil

_ Elaborated by the National Biomass Center (Cenbio)_

- Published first version in 2009 and a second and expanded version in 2012;

- For the NE region considered only: sugarcane, pig manure, forest residues, crop residues (rice, coconut, peanut) and palm oil.

Are there other relevant biomass sources that could be used for energy recovery in NE Brazil?

- How much is produced from each biomass source?
- Where this biomass is produced?
- How much energy may be recovered from these sources?
- What are the main routes to process these biomass sources?
- **What are the opportunities and challenges for the industrial sector and government institutions to allow the use of these biomass sources?**

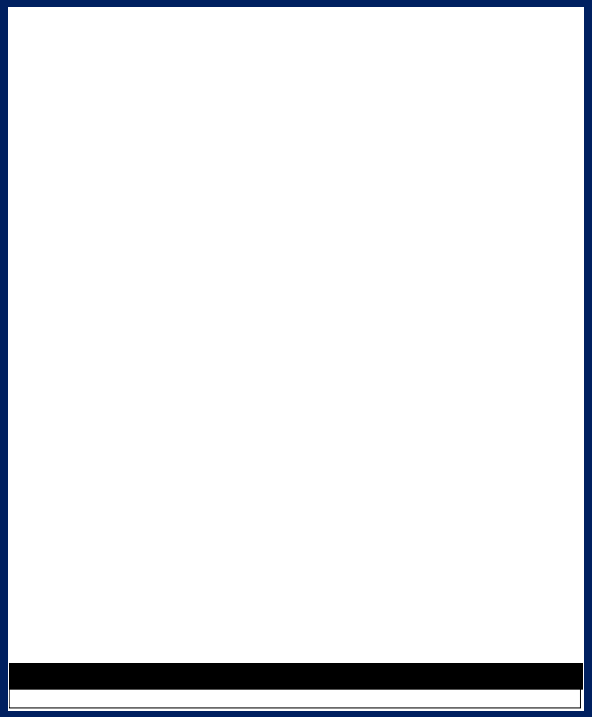
“Bioenergy Atlas of NE Brazil”

Elaborated by our research group

“BIOENERGY ATLAS OF NORTHEASTERN BRAZIL”

Sources of data:

- National Bureau of Statistics (IBGE)
- Ministry of Agriculture
- Literature review



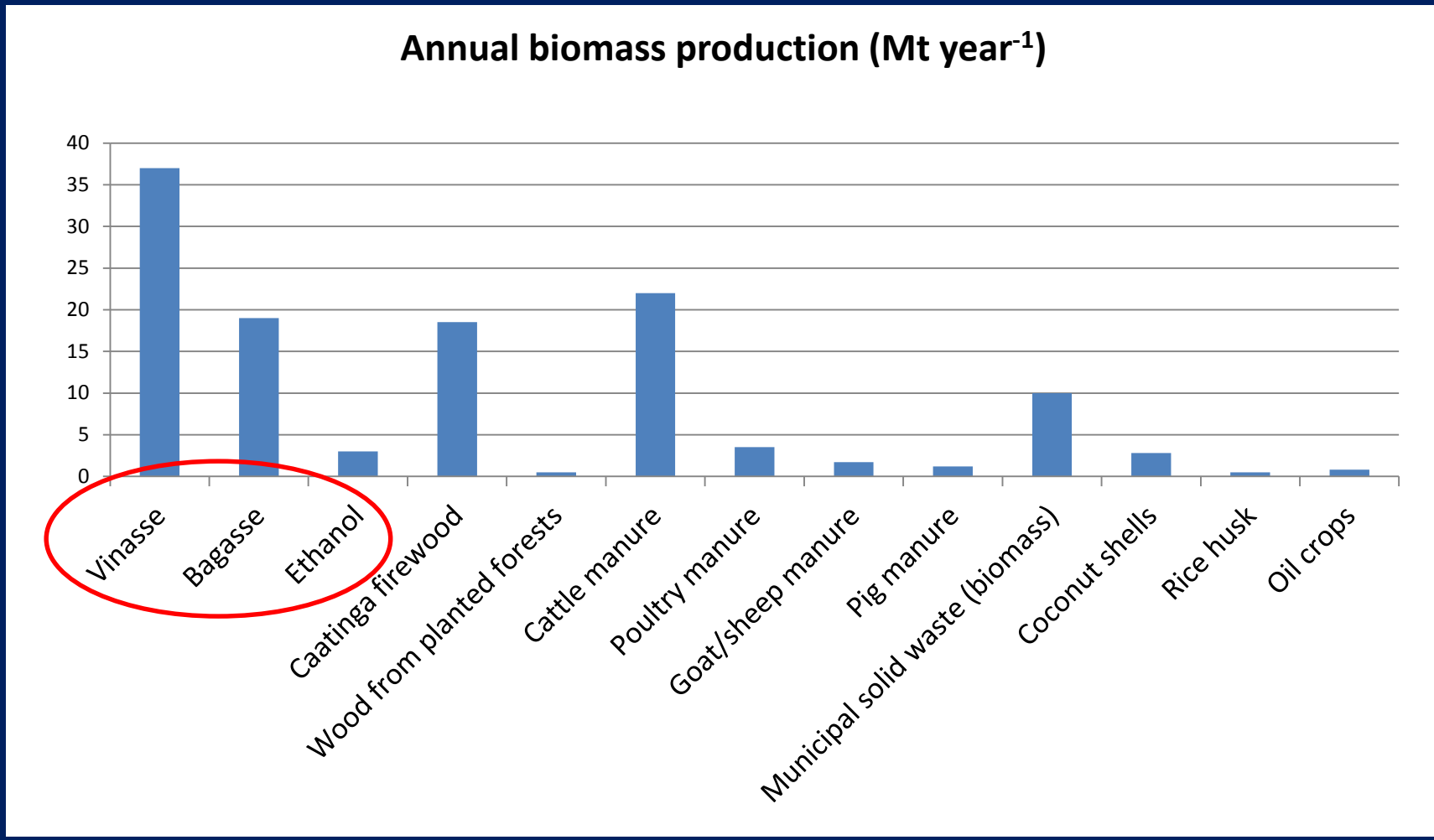
Biomass sources evaluated

Sugarcane (bagasse, ethanol and vinasse)
Firewood (from caatinga and from planted forests)
Manure (cattle, pigs, goats, sheep, poultry)
Municipal Solid Waste (Organic fraction)
Crop residues (rice husk, coconut)
Oil crops (soybean, castor bean, sunflower, peanuts)
Perenial species that produce oil (palm oil, babaçu)

Estimates of potential energy recovery from biomass sources

- Briefly, for each source, we considered:
  - The amount produced annualy per municipality;
  - The calorific value;
  - Conversion routes (direct combustion, fermentation, anaerobic biodigestion, pyrolisis, etc);
  - Conversion efficiencies to produce electricity.

Annual production of biomass sources in Northeastern Brazil (million tons year^{-1})



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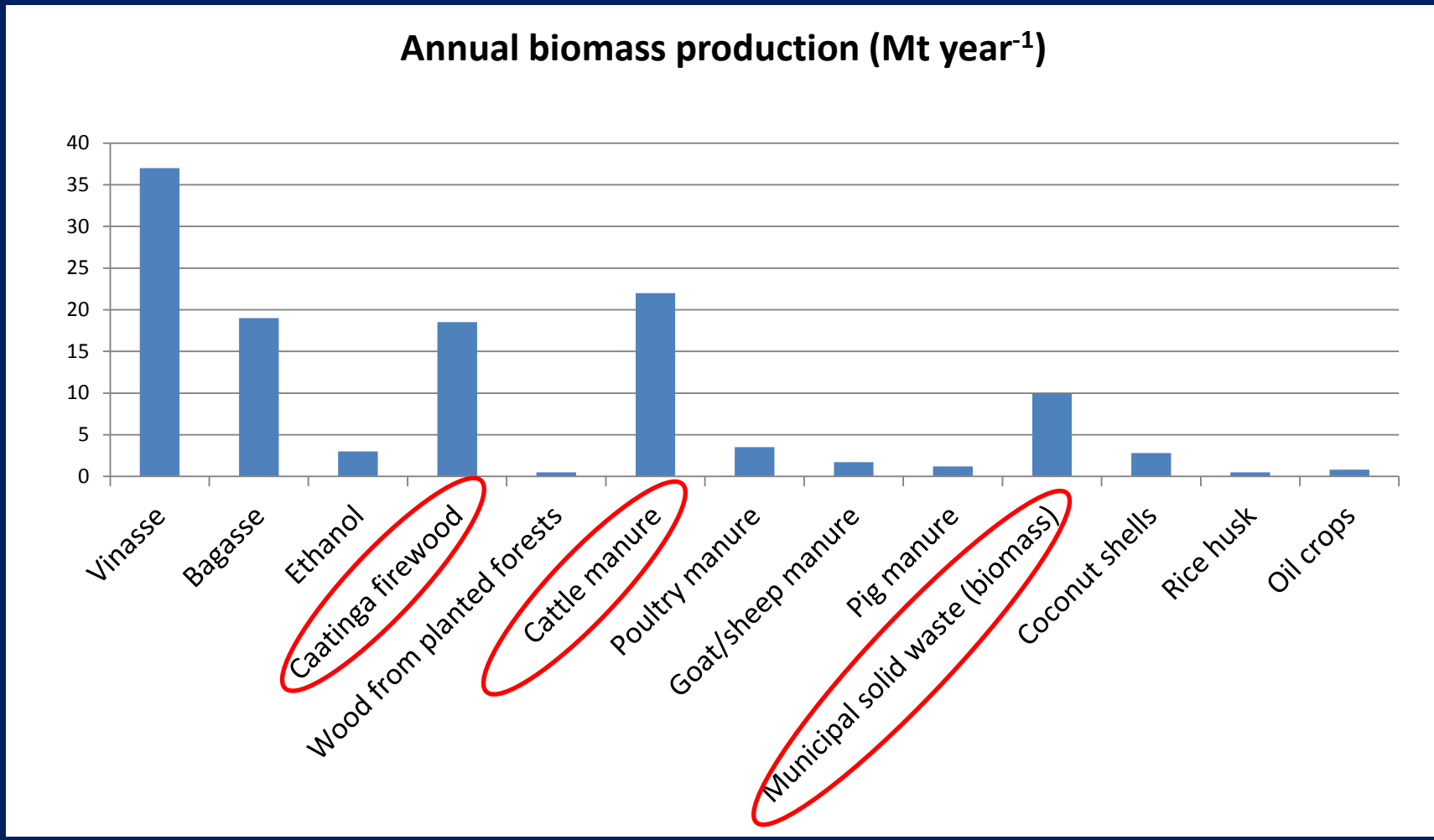
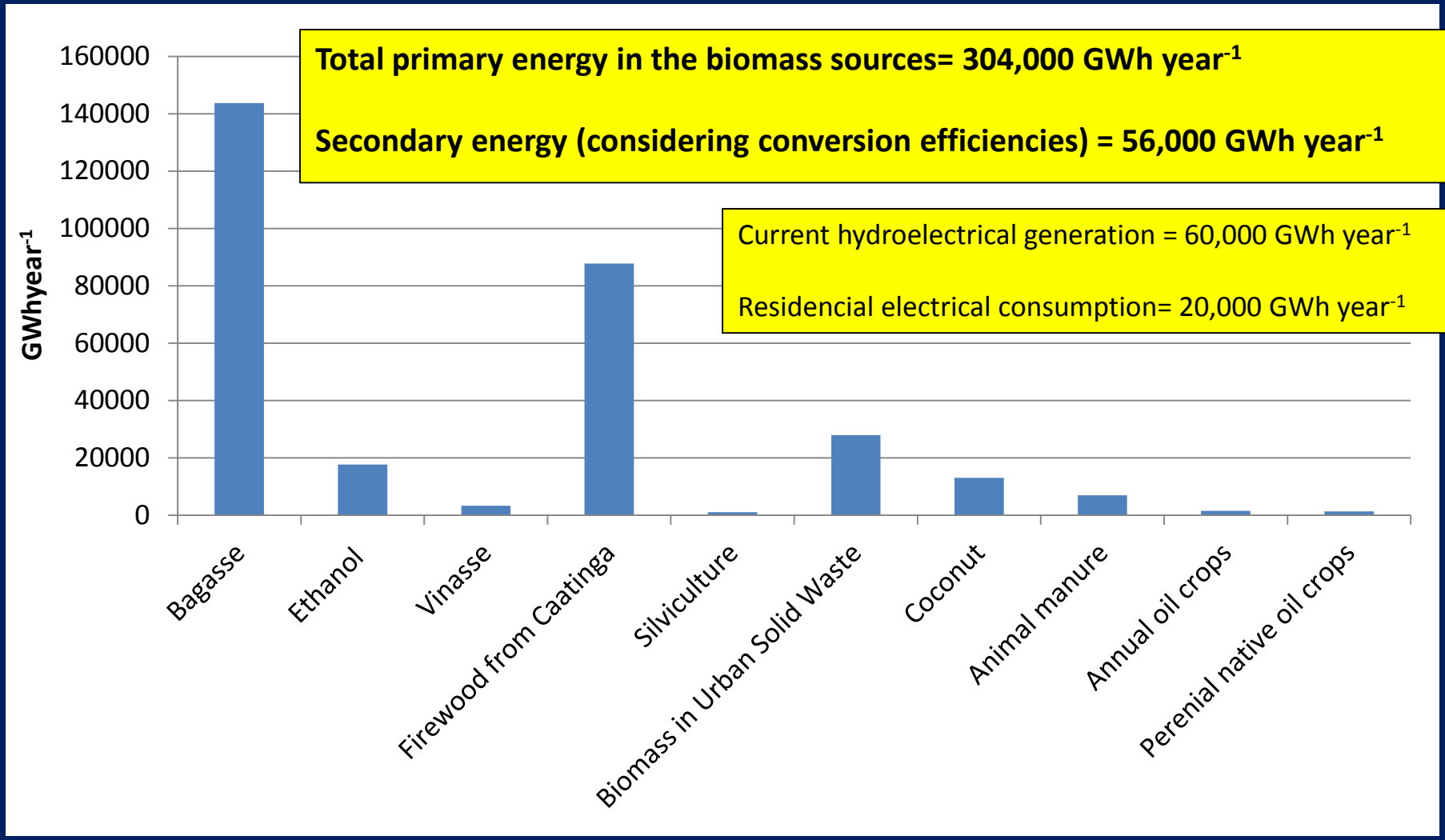


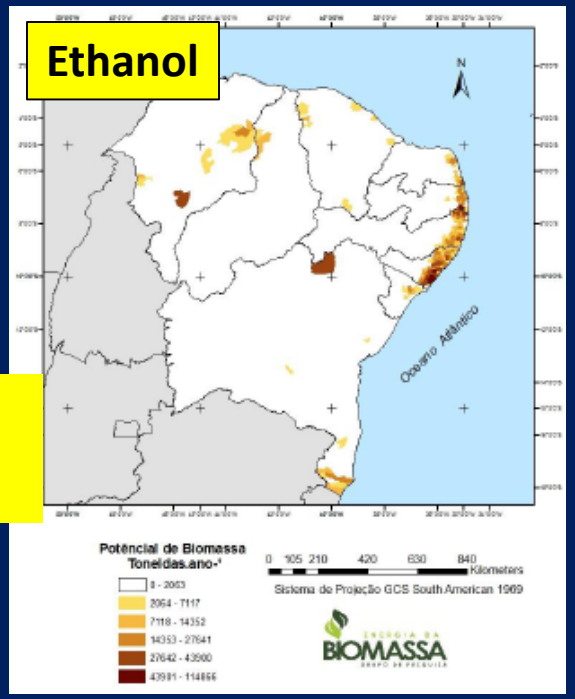
Primary energy content of biomass sources produced in Northeastern Brazil (GWh year^{-1})

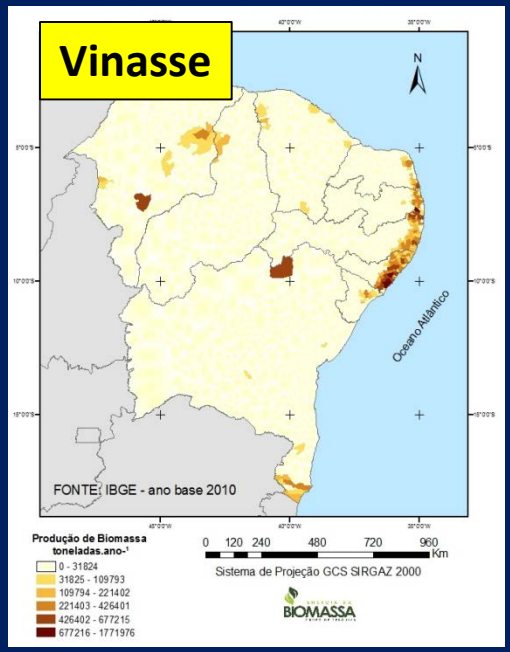


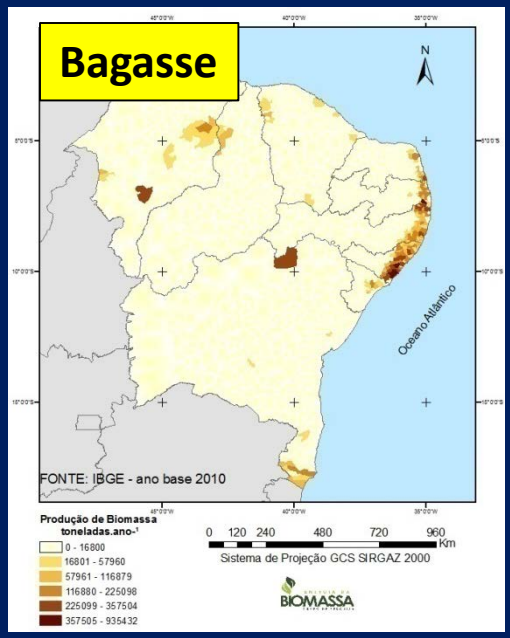
Spatial distribution of biomass sources

Distribution of sugarcane biomass production in NE Brazil (t year^{-1})

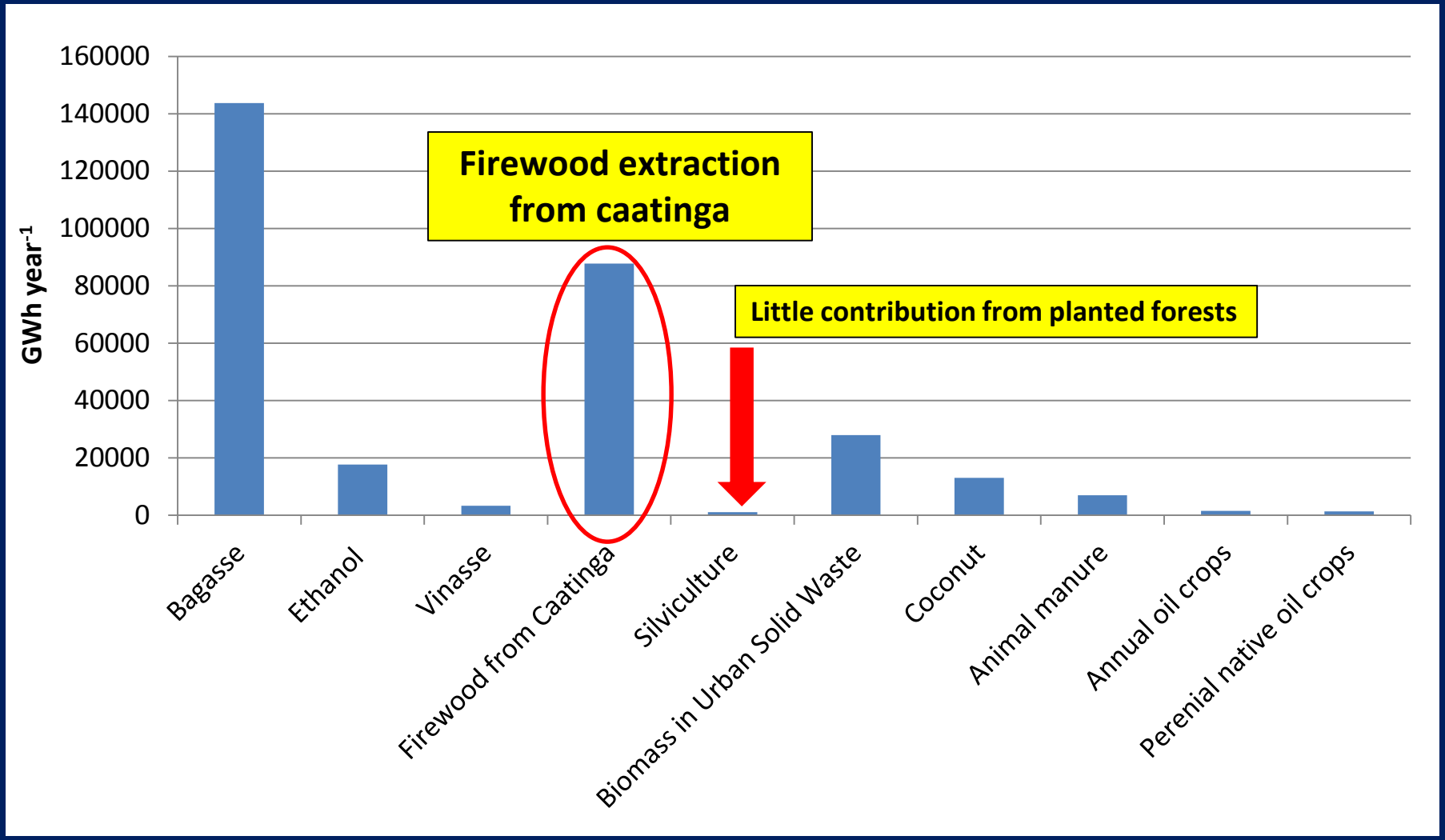
Sugarcane biomass was already discussed in a previous talk.



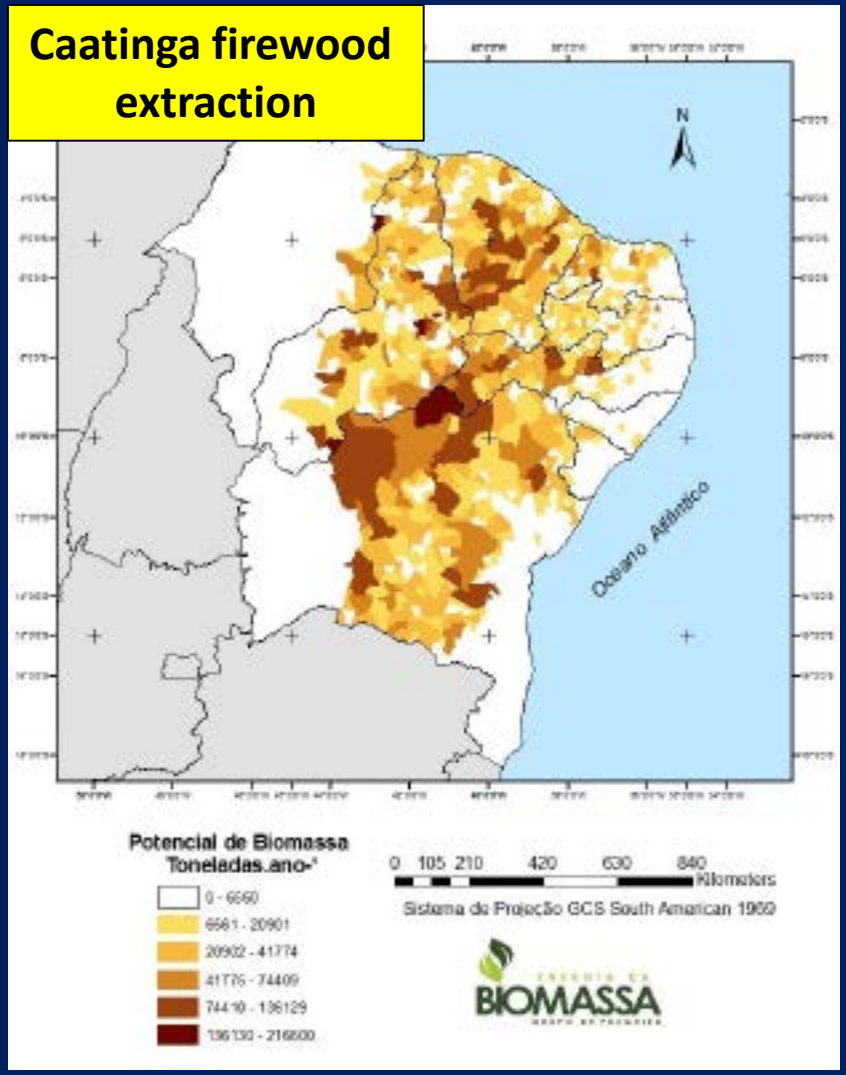




Primary energy content of biomass sources produced in Northeastern Brazil (GWh year^{-1})



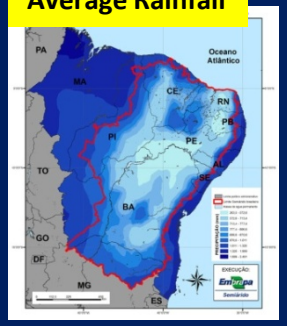
Distribution of the potential for extraction of firewood from caatinga in NE Brazil (t year^{-1})



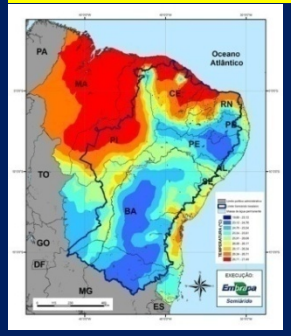
- Largely demanded for industrial, commercial and residential uses;
- Most extraction is illegal and not sustainable;
- Need for incentives for sustainabe production;

Sustainability of firewood extraction systems

Average Rainfall

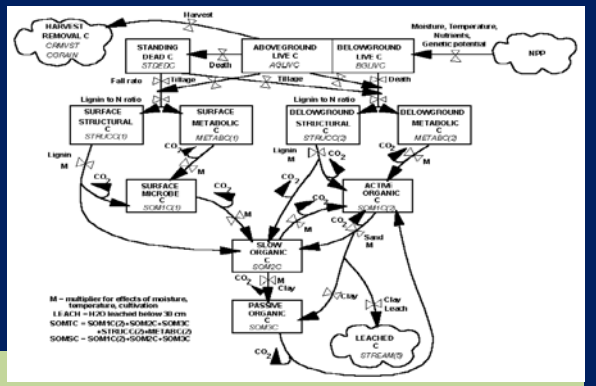


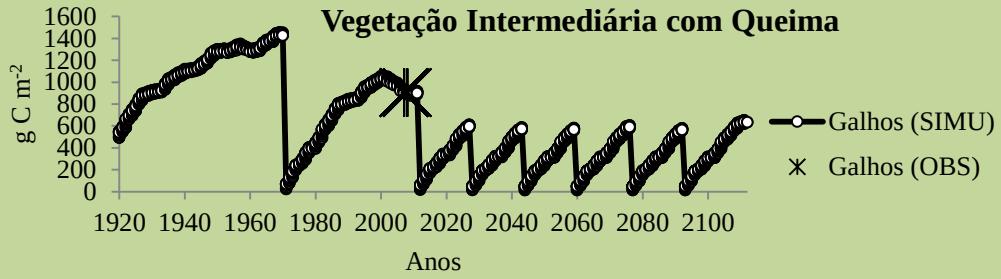
Average Temperature



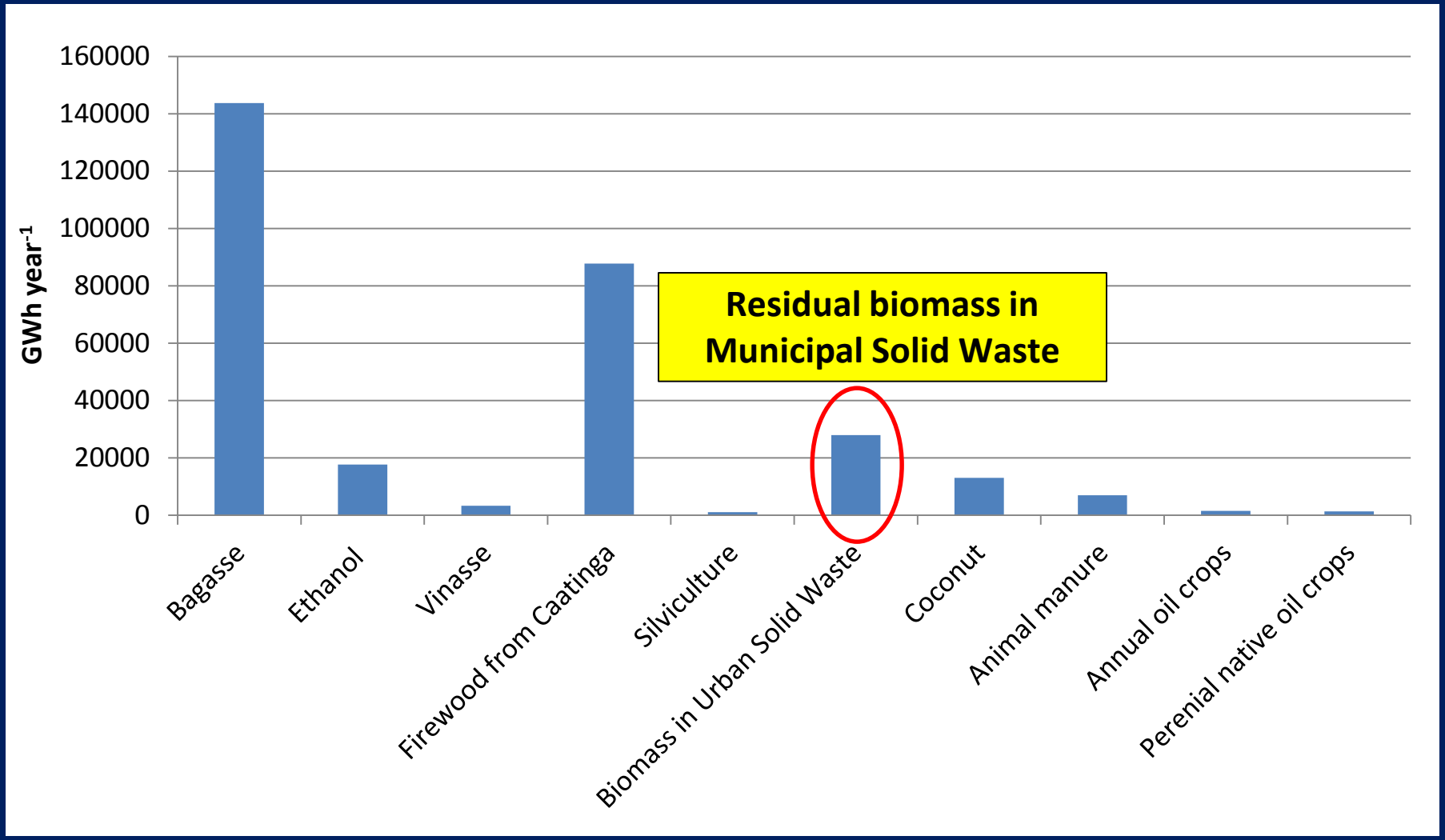
Soil types

- Single recomendation for all environmental situations in the region is not adequate;
- Tools for decision support systems are necessary;
- Ex: Simulation Modelling



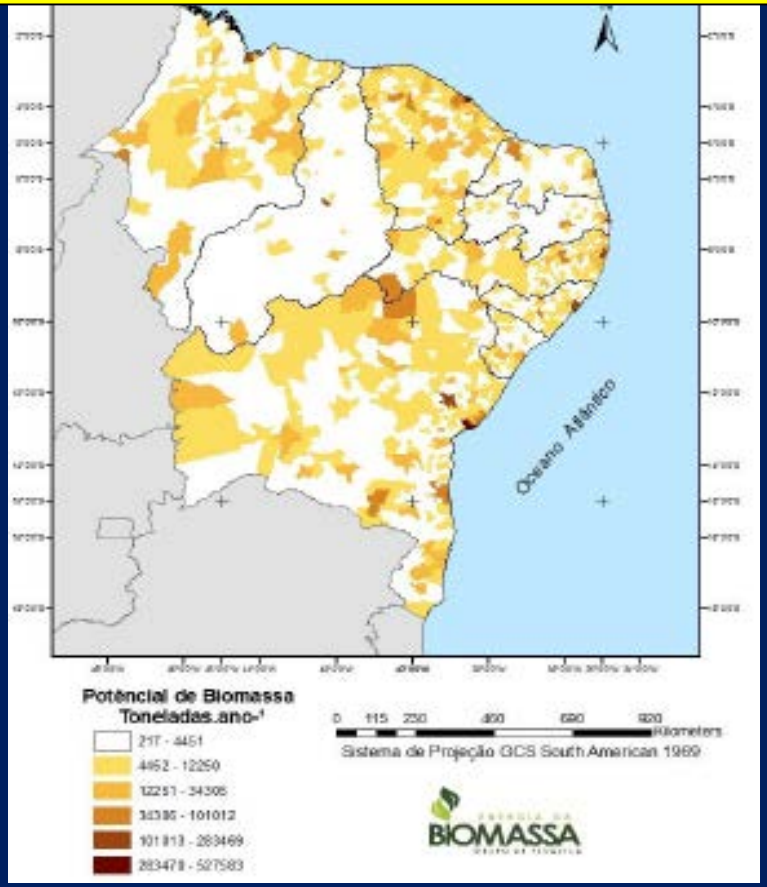


Primary energy content of biomass sources produced in Northeastern Brazil (GWh year^{-1})



Distribution of the production of municipal solid waste in NE Brazil (t year^{-1})

Municipal solid waste (organic fraction)

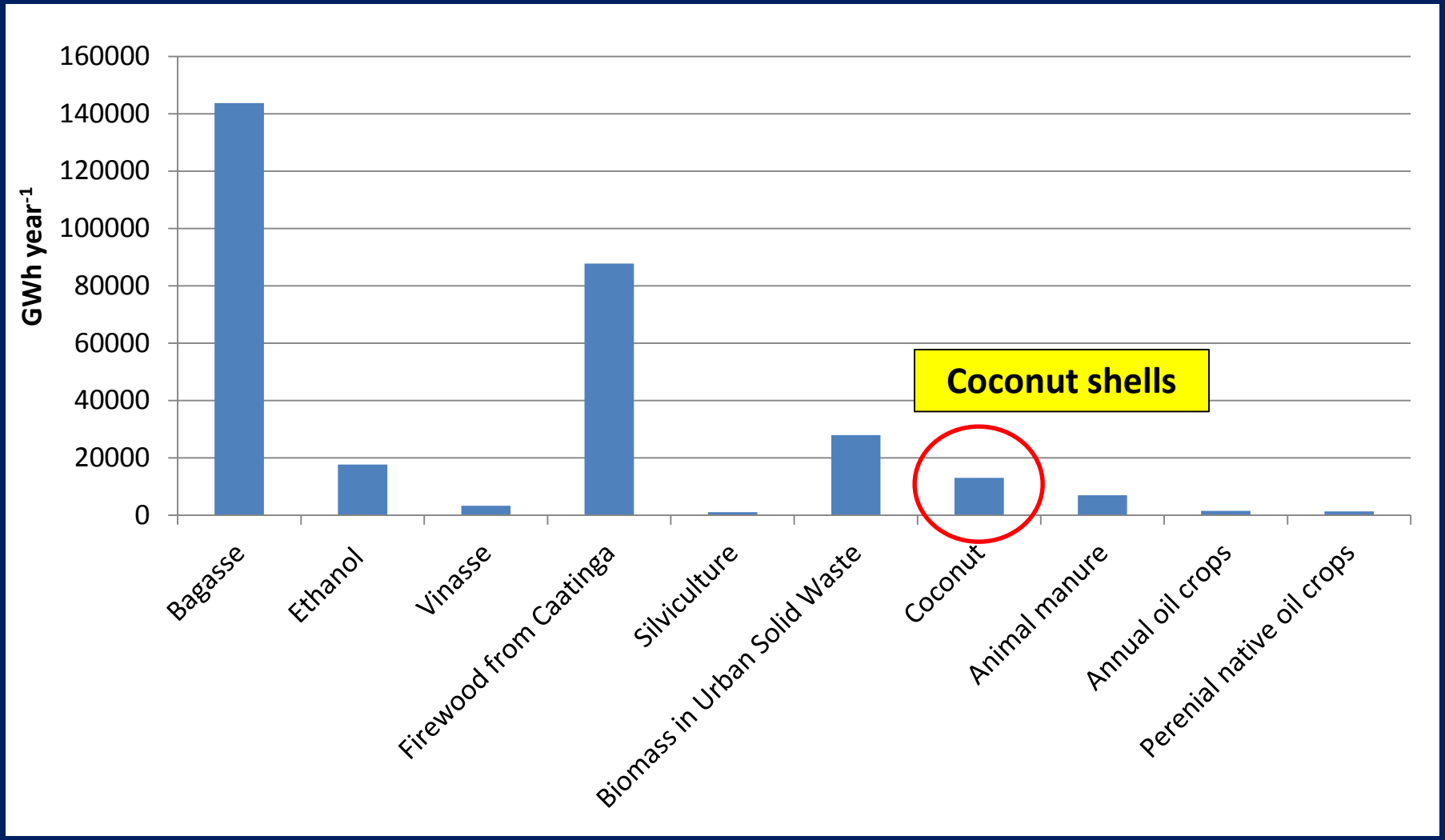


The Law of Municipal Solid Waste may bring changes to this sector;

Opportunities for the industrial sector: energy recovery from residual biomass may be more viable than disposal in landfills;

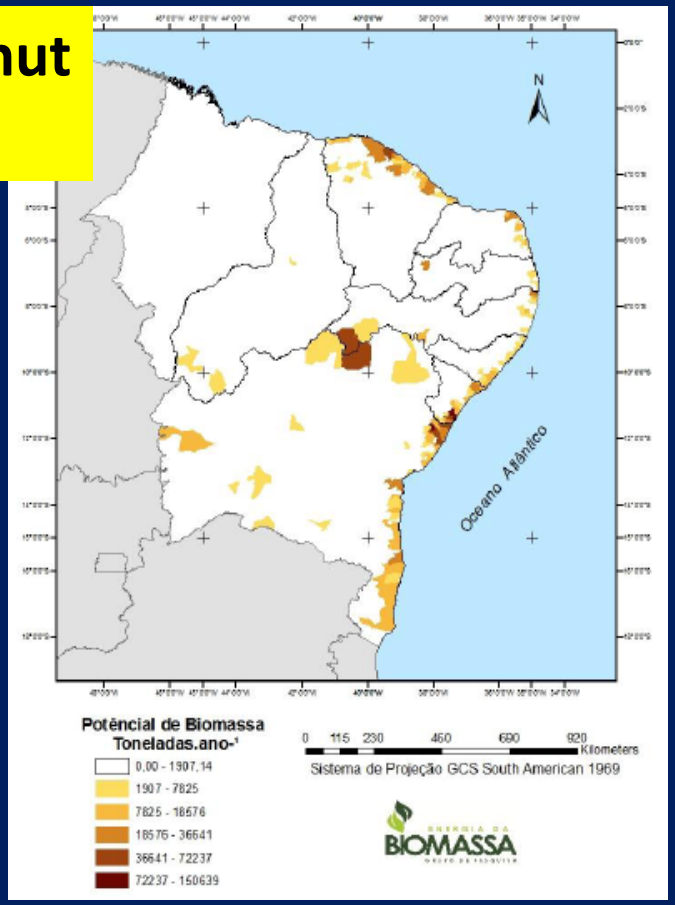
Incentives for effective segregation in the source are crucial.

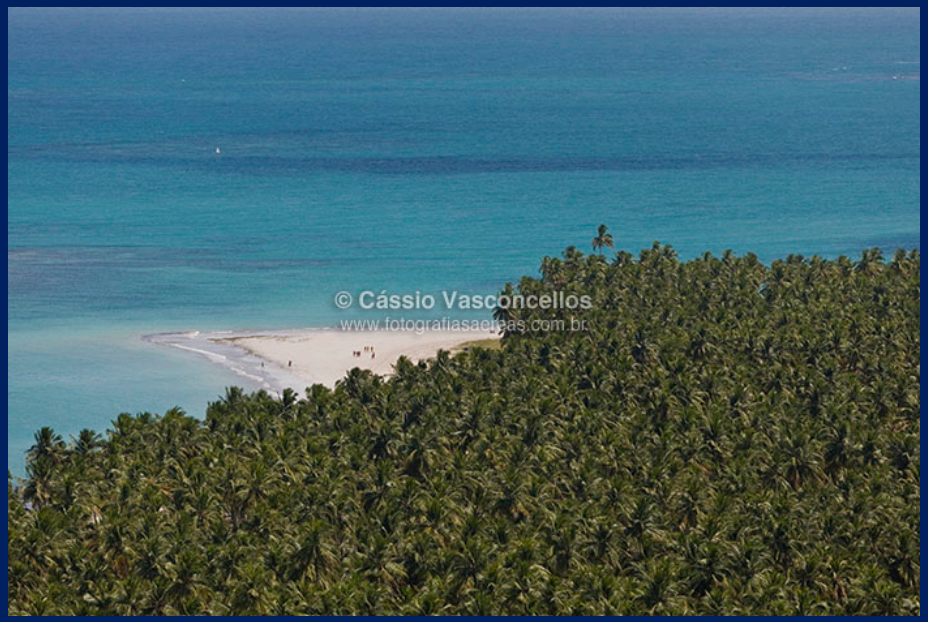
Primary energy content of biomass sources produced in Northeastern Brazil (GWh year^{-1})



Coconut

Coconut shells





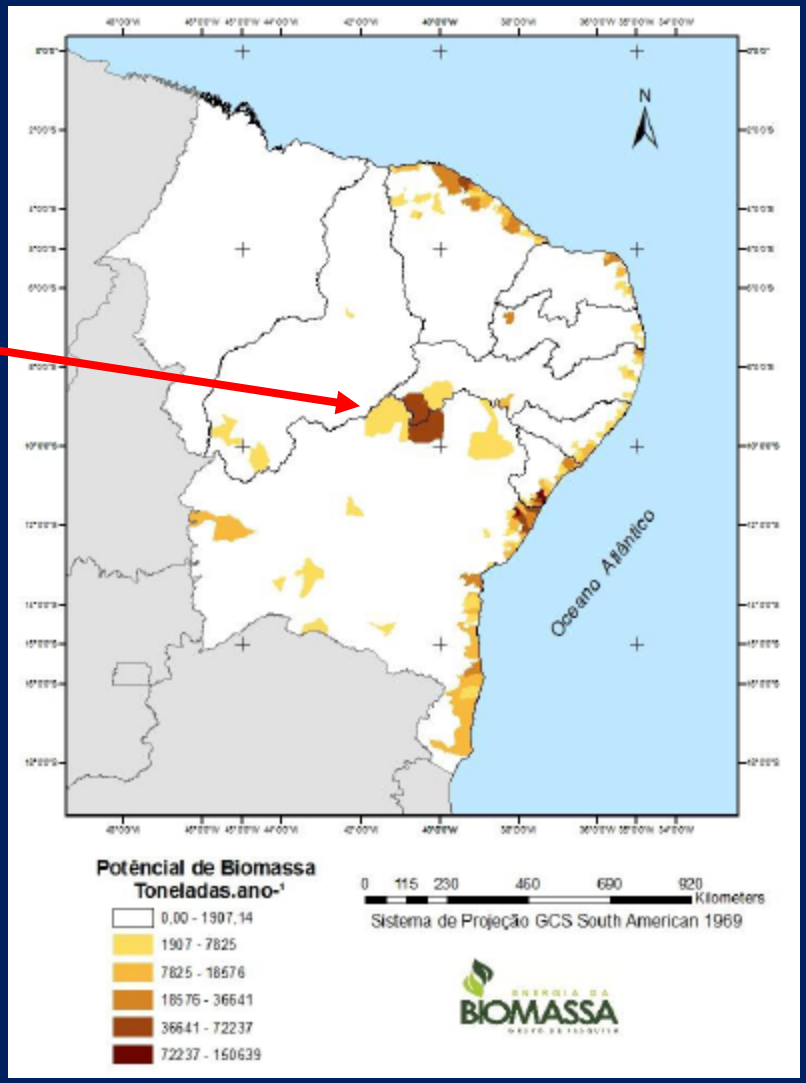
Coconut farms in the coastal area will be affected by urbanization, labor cost, tourism and industrialization

Coconut

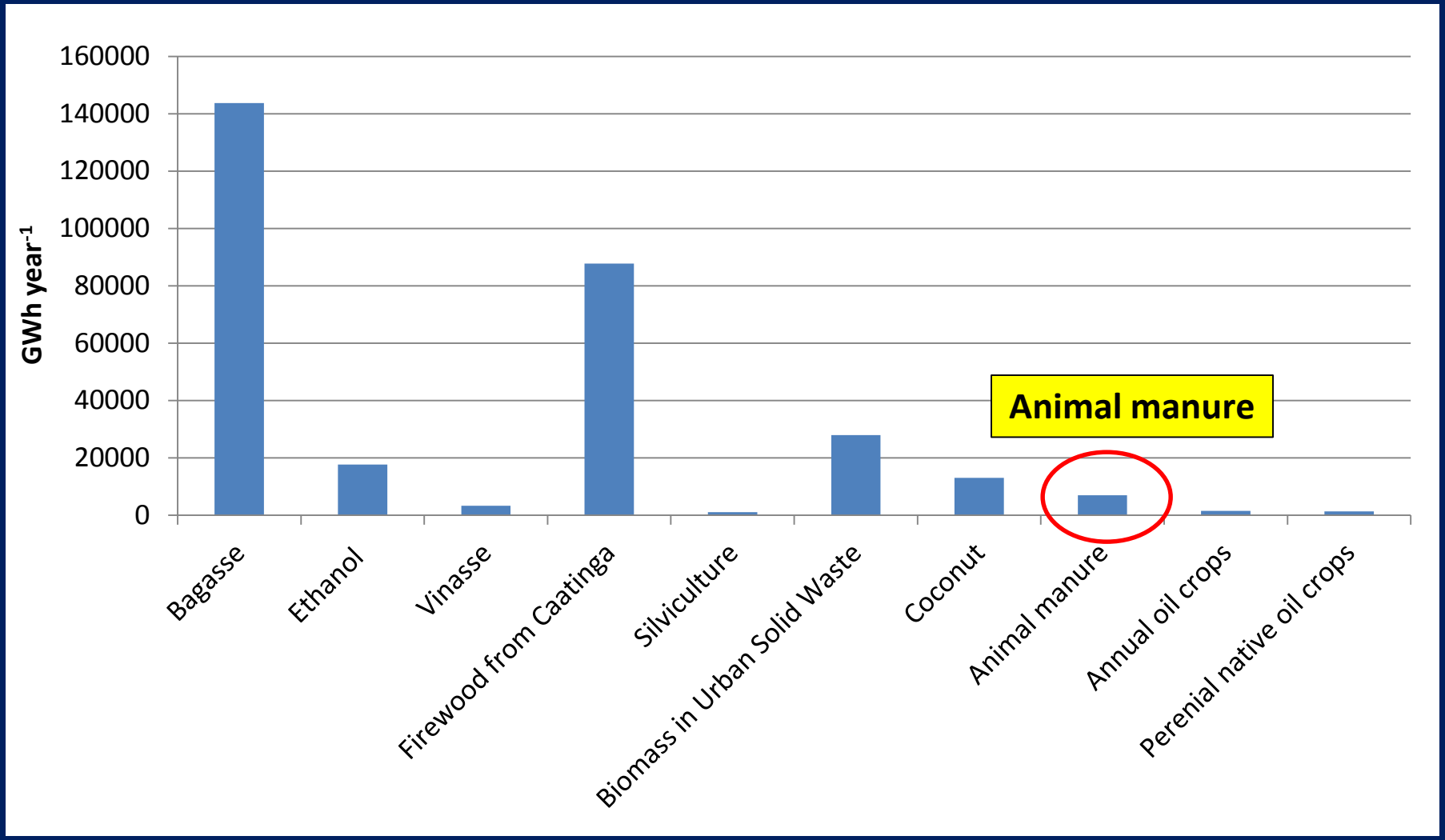
Coconut shells

Irrigated areas in the São Francisco Valley

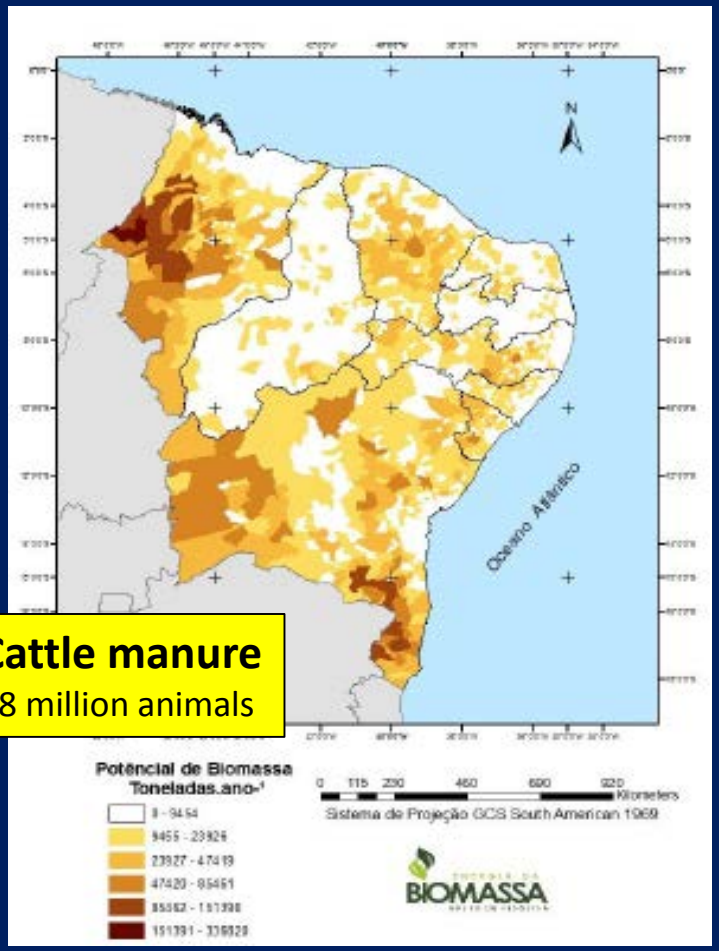
Coconut water processing industries



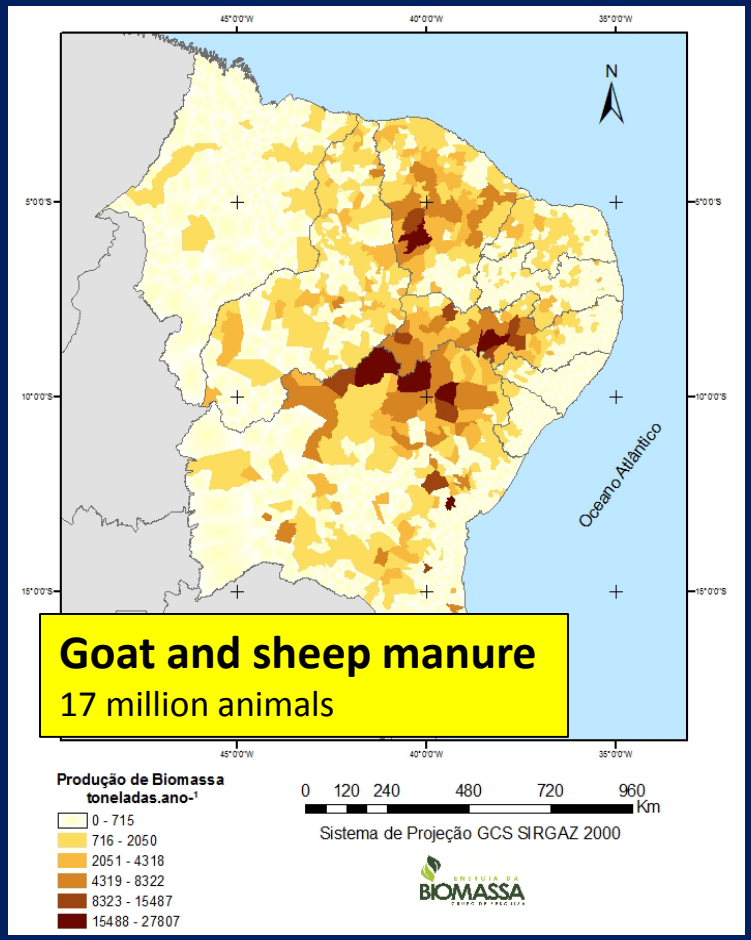
Primary energy content of biomass sources produced in Northeastern Brazil (GWh year^{-1})



Distribution of manure production in NE Brazil (t year^{-1})



Cattle manure
28 million animals



Goat and sheep manure
17 million animals

Anaerobic biodigestion

- **Biodigestion is not relevant in NE Brazil, despite the large amount of biomass sources that could be processed through this route.**

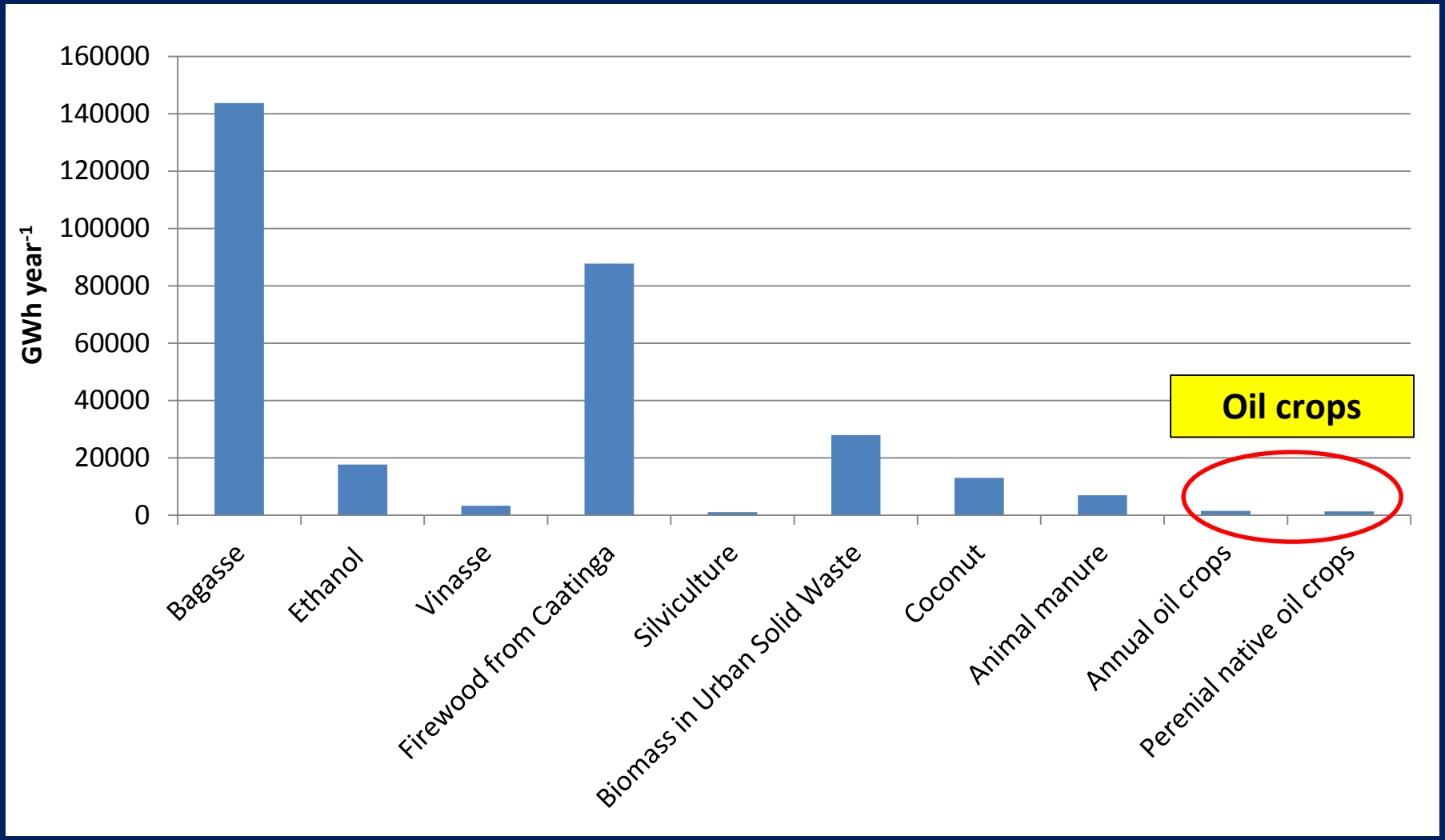
- **There is need for capacity building in all sectors (academic, technical and the productive sector);**

- **Little research is done, few systems are operating;**

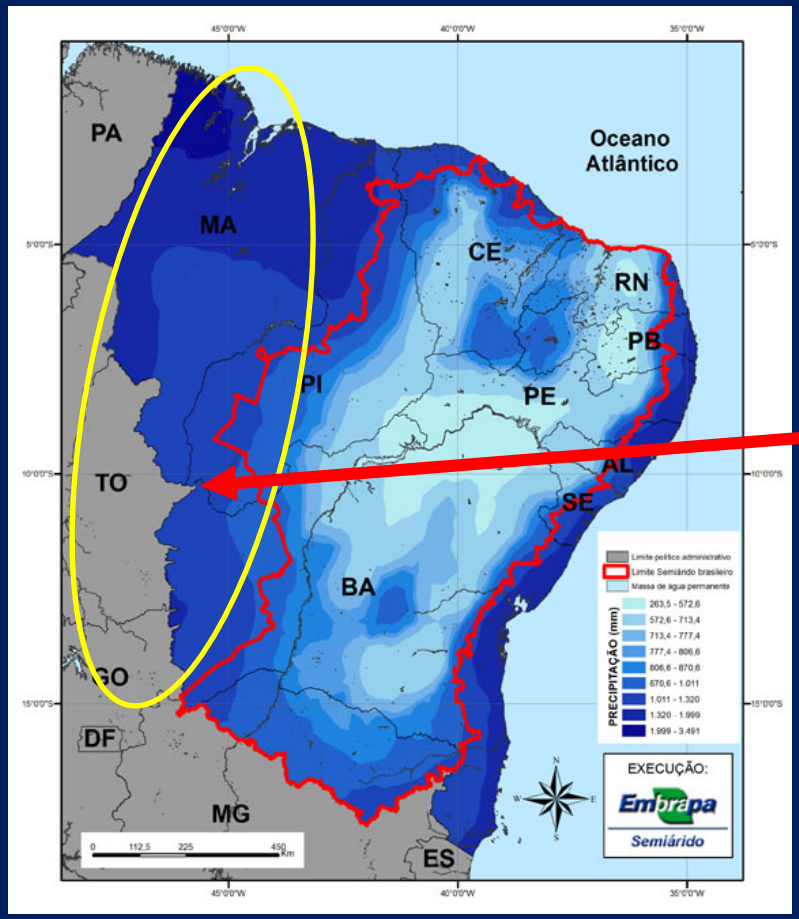
- **Has good potential for widespread microgeneration systems.**

The electricity that could be generated through digestion of vinasse, municipal solid waste, and manures could supply nearly 20,000 GWh year^{-1}.

Primary energy content of biomass sources produced in Northeastern Brazil (GWh year^{-1})



Pre-Amazon region



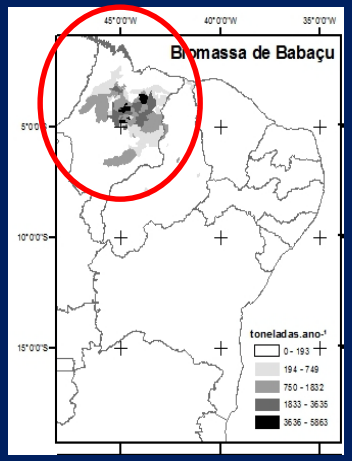
High-input crop systems in the Cerrado and Preamazon areas

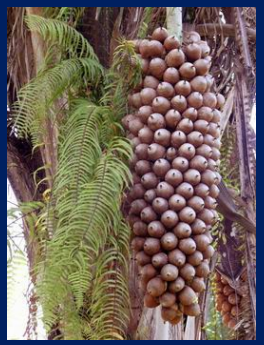
Soybeans and cotton

Native species with potential for oil production

Native oil species

- **Babaçu:**
  - Occupies nearly 5 million hectares in NE Brazil;
  - Energy potential underutilized





Fonte Marcos Alexandre Teixeira, **Departamento de Energia - FEM- UNICAMP, mteixeira@fem.unicamp.br. - www.fem.unicamp.br/~mteixeira**

Concluding remarks

- Sugarcane biomass and firewood from caatinga are important energy sources in NE Brazil. Both sources face nowadays severe sustainability issues;
- Other biomass sources are produced in significant amounts and should be considered for energy purposes, such as: animal manure, vinasse and residual biomass in municipal solid waste;
- Research priorities:
  - Sustainability of firewood extraction systems;
  - Overcome constraints for anaerobic digestion systems;
- Public policy priorities:
  - Incentives to sustainable production and trade of firewood;
  - Reduction of constraints for anaerobic biodigestion systems;
  - Estimulate residual biomass segregation for energy use in urban areas.

Thank you