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Combustíveis Alternativos na Indústria de Cimento (Projeto Roadmap Brazil)

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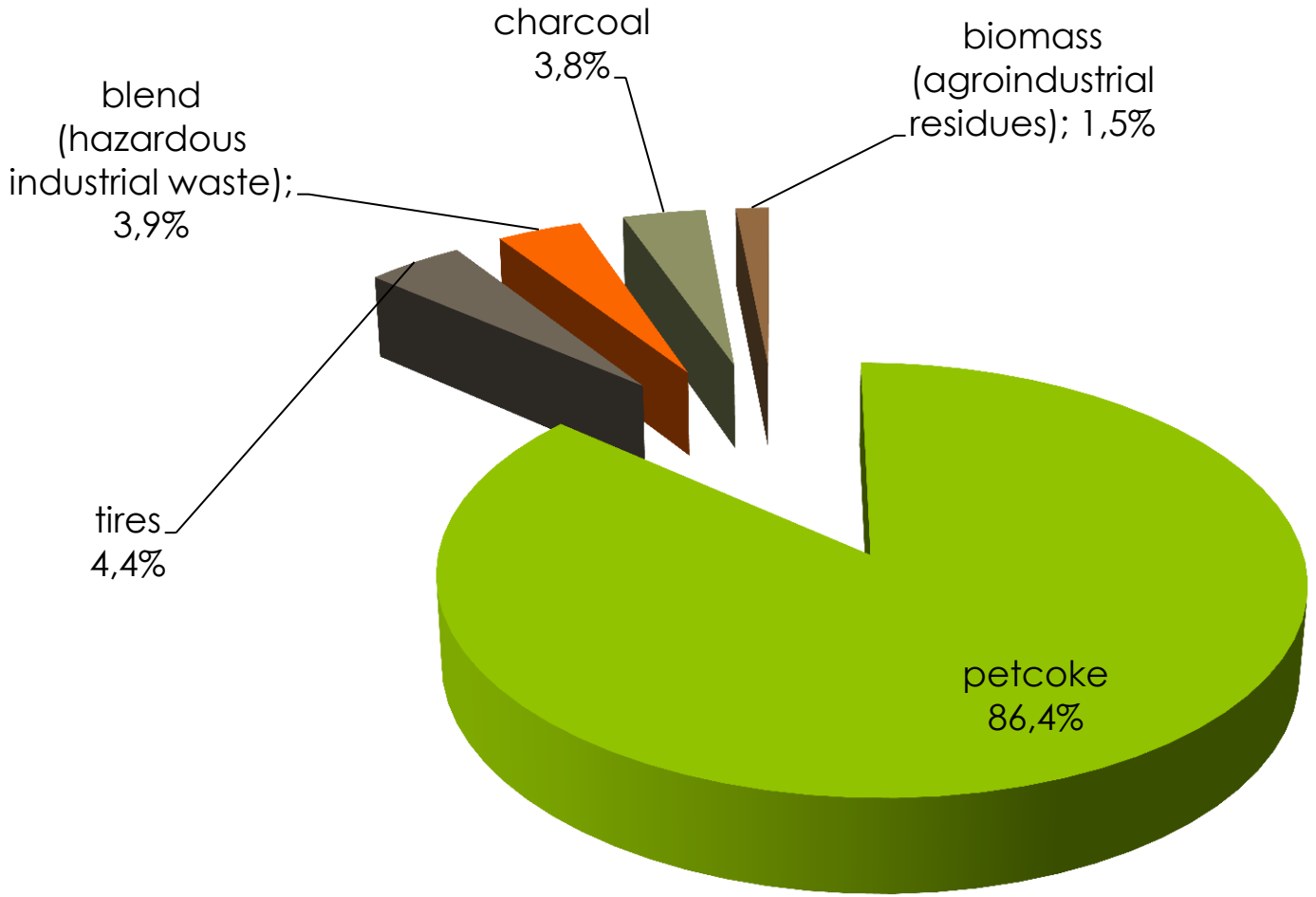
Realização

Summary

- Energetic profile
- Co-processing in Brazil
- Alternative Fuels
- Opportunities / Barriers / Recommendations
  - Tires
  - Blend
  - Non hazardous industrial waste
  - MSW
  - MSS
  - Biomass
- Vision of future
- Conclusions

ENERGETIC PROFILE

Profile of fuels for thermal energy in cement industry



CO-PROCESSING IN BRAZIL

Co-processing in Brazil

- 2 specific federal laws (CONAMA Resolution)
  - 264/1999
  - 316/2002
- In general, this legislation

a) excludes co-processing of
  - raw household waste
  - health services
  - radioactive
  - explosive
  - organ chlorines
  - pesticides

b) establishes the rules for the licensing process and the maximum limits of atmospheric emissions, including dioxins and furans.

Specific legislation for co-processing

- Four states: Minas Gerais (MG), Paraná (PR), Rio Grande do Sul (RS) and São Paulo (SP).
- Prohibit others types of residues
  - galvanic and septic tanks sludges (PR);
  - wood containing halogenated organic compounds or heavy metals (SP);
  - oil and grease residues originated in the co-process unit that could be re-refined (SP).
- Specific laws for atmospheric emission standards.

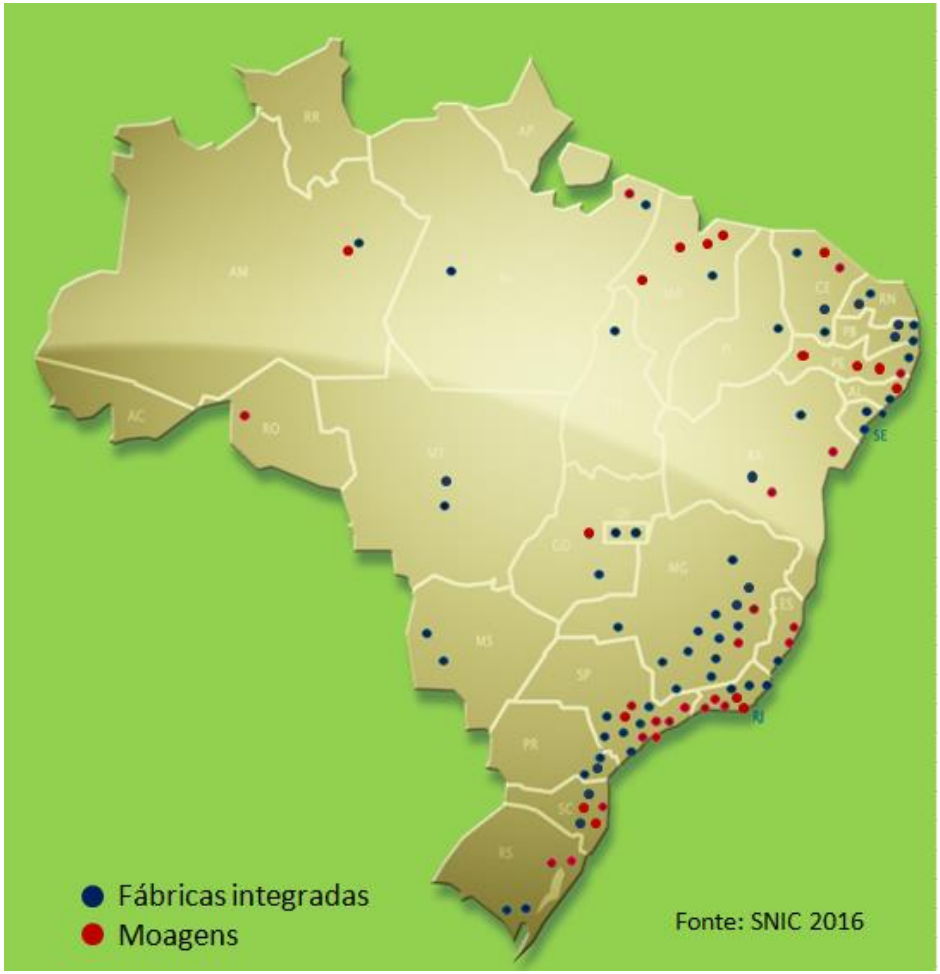
Minimum heating value: AF co-processing

Residues	HV (GJ/t)			
	MG [1]	PR [2]	RS [3]	SP [4]
Blending or alone	LHV ≥ 8.4	HHV ≥ 6.3 [a]	LHV (dry basis) ≥ 11.3 [b]	LHV (dry basis) ≥ 11.6 [c]
Treated Household	LHV ≥ 6.3	Not mentioned		

[a] It is allowed wastes with HHV > 4.2 GJ/t, provided the blending HV > 6.3 GJ/t
[b] It is allowed wastes with LHV (dry basis) > 6.8 GJ/t, provided blending > 11.3 GJ/t
[c] If LHV < 11.6 GJ/t, the use will be studied

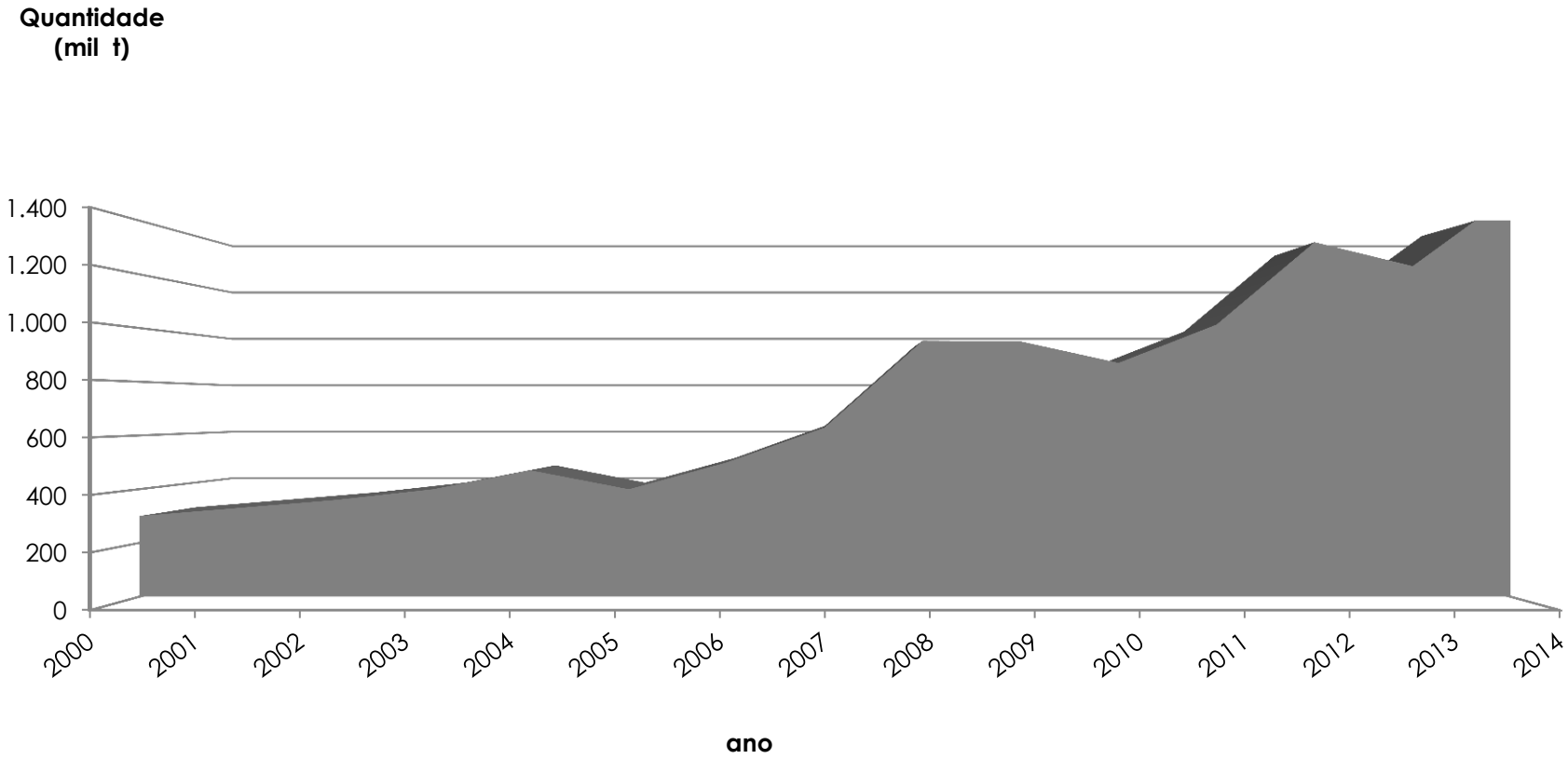
Sources:
[1]Deliberação Normativa COPAM nº 154/2010;
[2]CEMA Resolution 076/2009;
[3]CONSEMA Resolution 02/2000;
[4]Norma Técnica CETESB P4.263/2003

Cement Units



- 59 integrated units
- 37 units have kilns licensed for co-processing
- 63%

Evolution of co-processed residues in cement kilns

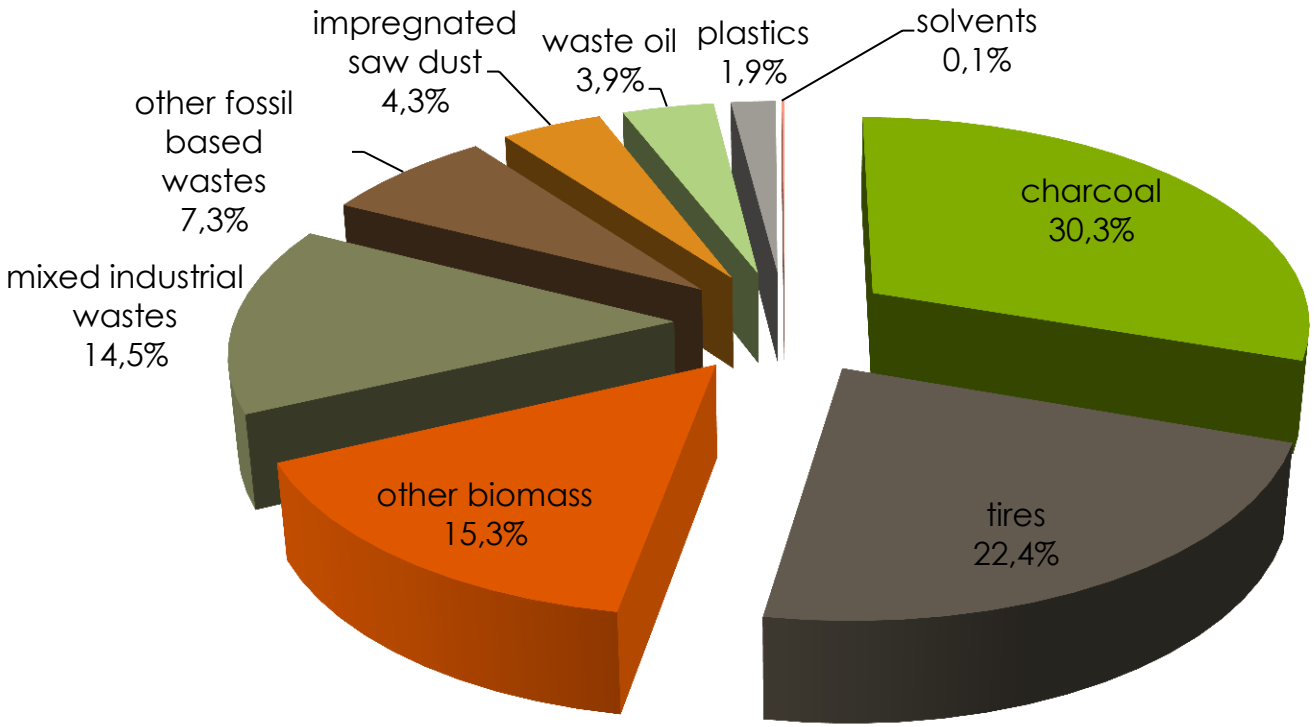


Source:ABCP (2015)

Co-processed residues in 2014

- **1.5 million tons**
  - **15.5% (231 mil t) → substitution raw material**
  - **84,5% (1,265 mil t) → alternative fuel**

AF profile (% weight) 2014



ALTERNATIVE FUELS FOR CO-PROCESSING

Waste used by cement plants as AF - 1

Category	Alternative Fuels	Biomass content	CO_2 emissions	NO_x emissions
Biomass	**biomass/green wastes**	100%	decrease	no impact
Hazardous Waste	**hazardous spent solvents**	0	no impact	no impact
	waste oil and industrial oils	0	no impact	no impact
	aqueous waste	0	no impact	decrease
	industrial sludge	very variable	decrease	depend on the moisture content
	oil sludge	0	no impact	no impact
Municipal Wastes	**municipal wastes**	25-50 % (wood, paper, organic wastes)	decrease	no impact
	sewage sludges	100%	decrease	decrease (in case of wet or semi-dry)

Waste used by cement plants as AF - 2

Category	Alternative Fuels	Biomass content	CO_2 emissions	NO_x emissions
Non-Hazardous Industrial and Commercial Wastes	**non-hazardous industrial wastes**	25-50 % (wood, paper, organic wastes)	decrease	no impact
Other Unclassified Alternative Fuels	**used tires and rubber wastes**	25-35 %	decrease	decrease
	construction and demolition wastes	100 % (wood fraction)	decrease	no impact
	animal meal	100%	decrease	no impact

AF Selected

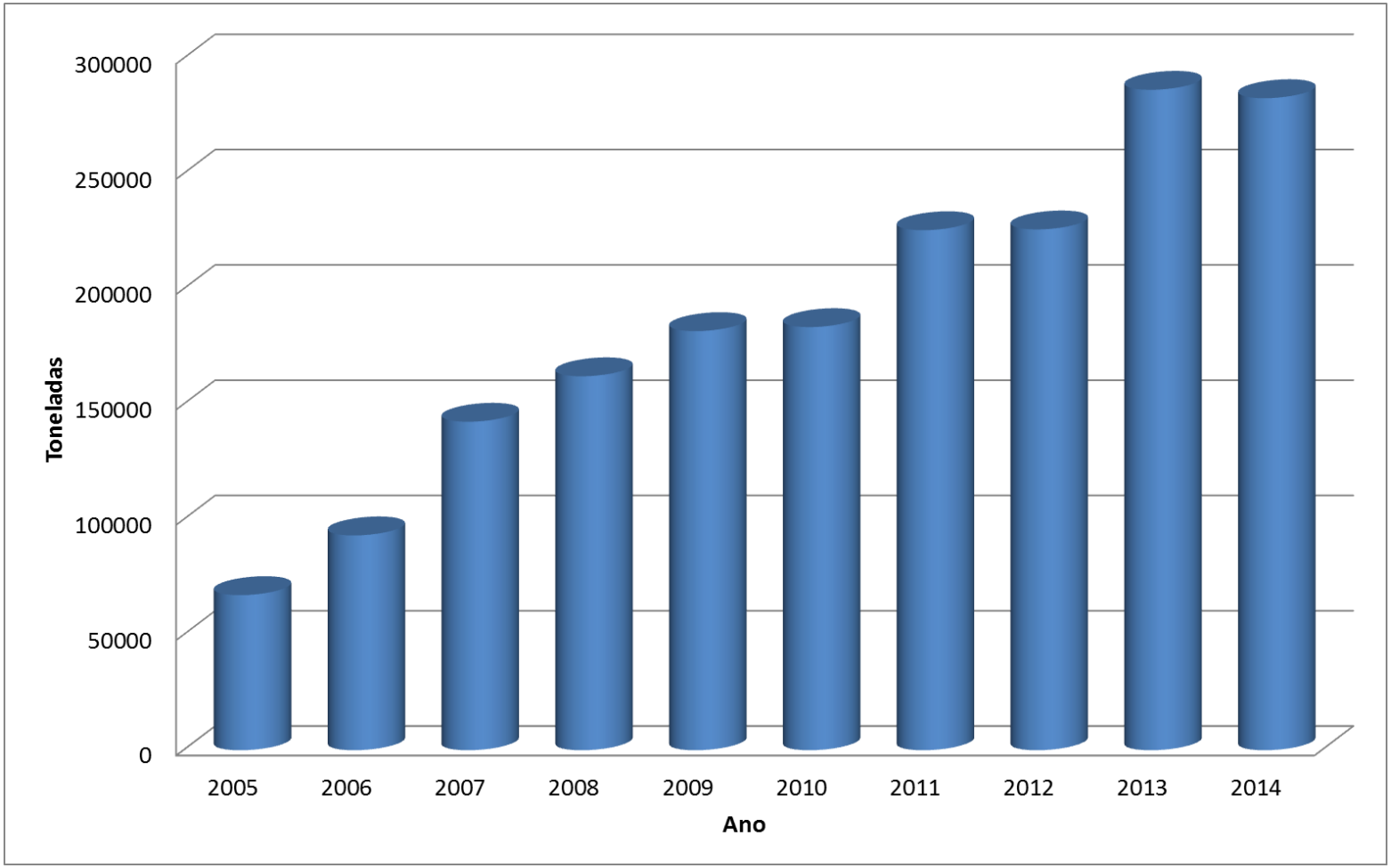
- None of the AF can by itself fulfill the entire thermal requirement.
- To increase the Brazilian use of AF and to reduce CO_2 emission, the cement industry selected 6 types of AF:
  - the 3 ones that are already in use:
    - Tires
    - blend (hazardous industrial solid waste)
    - non hazardous industrial waste
  - 3 others with the greater contents of biomass:
    - municipal solid waste
    - municipal sewage sludge
    - Biomass (agro and agro industrial residues)

TIRES

Opportunities: Tires

- In Brazil, since 1999, tire manufacturers and importers are required to collect and give proper destination to waste tires, (CONAMA Resolution 416/2009) .
- For each new tire sold to replacement the manufacturers or importers must ensure proper disposal to 1 waste tire or 70% of the original weight
- 55 million units: 780 mil t in 2014 → 550 mil t.
- In 2014: 1,558 collection points.
- Proper disposal SE 57.6%; S: 22.4%; N: 2.7%; NE: 5.6% and CO: 11.7%.
- Reciclanip (civil entity, maintained by the tire manufacturers): responsible for preparing the collection management plan, storage and disposal of waste tires.

Yearly trend in the use of tires as AF in Brazil



From 2009 to 2014, 53% collected tires were co-processed

Tires Barriers

- **Technical:**
  - **(i) management of whole tires causes impact on injection and on the process;**
  - **(ii) few collection points in some Brazilian areas.**

- **Financial: Competition with other energy recovery processes and with material recovery, mainly the usage in civil work and the production of granulates, based on a good market price for them.**

Recommendations: Tires

- **Reciclanip must improve the distribution of collection points throughout the country and the communication with consumers about the appropriate destination to be given to the waste tire.**

BLEND
(HAZARDOUS INDUSTRIAL SOLID WASTE - HISW)

Opportunities: Blend

- **HISW: all industries with processing, producing or using chemicals or oils, as chemical, paint, car, steel, pharmaceutical, cosmetology, metallurgic, oil (both extraction and refining), and also the industrial cleaning activities.**

- **Estimated 3.8 million t /year.**

Blend Barriers

- **Technical: moisture and calorific value; chlorine, granulometry and heterogeneity, skills for chemical handling in cement plants.**

- **Financial: competition with landfilling due to low landfill gate fee and competition with incineration: incinerator fixed costs are expensive, so it must be operated at full capacity to be profitable. However, compared to existing cement plants, building an incinerator represents a higher investment.**

- **Policy/market: some quantities of wastes are still disposed in inappropriate destination as landfill or unauthorized recovery/recycling destinations.**

Recommendations: Blend

- **“Thermal Destruction Certificate” could be given directly to the company that generates the residue (not blending unit).**

- **Change CONAMA Resolution and SP laws: quantify organo-chlorine. Cause: all the wastes: industrial (H or NH), MSW and MSS can contain small quantities of organo chlorine. To make less difficult the co-processing licensing and prevent several blending units located in São Paulo to use the cement co-processing in others states.**

NON HAZARDOUS INDUSTRIAL WASTE
NHIW

Opportunities: NHIW

- **Different sources as the packaging wastes, the process wastes as pulper wastes in recycling paper industry (estimated in 11 million t/y) and the off-spec products, the product falls**

NHIW Barriers

- **Technical: moisture and calorific value; chlorine, granulometry and heterogeneity.**
- **Financial: competition with landfilling due to low landfill gate fee and competition with incineration: incinerator fixed costs are expensive, so it must be operated at full capacity to be profitable. However, compared to existing cement plants, building an incinerator represents a higher investment.**
- **Policy:**
  - **(i) application for a permit to use waste could be complex and could raise opposition from the population;**
  - **(ii) regulation that bans any thermal usage: co-processing and recycling should be complementary (the former using the wastes of the latter).**

Recommendations: NHIW

- **Competition with landfilling: create**
  - **risk mitigation mechanisms in relation to final disposal of wastes;**
  - **Public policies to make the co-processing of residues in cement kilns more economically attractive;**
  - **Programs and incentives based on benefits of co-processing for the community and environment;**
  - **Mechanisms and public policies to repress inadequate disposal in dumps or clandestine landfills.**
- **Create a CONAMA Resolution that:**
  - **priories the existing equipments to increase the efficiency of the waste management;**
  - **bans in the generator industry the mixing of polluted packaging (considered as hazardous) and non-polluted.**

MUNICIPAL SOLID WASTE (MSW)

Opportunities: MSW

- **78.5 million t produced (SNIS, 2016)**
- **64.4 million t collected in 2014**
- **37% of the MSW collected is disposed in dumps or inadequate landfills. So the amount of MSW will increase in the next years.**
- **Increase 2.9 % (2013 – 2014) (population 0.9%)**

MSW Barriers

- **Heterogeneity: the MSW quantity and quality can vary widely for each region of Brazil, size of the city, population economic level, etc.**
- **Several cement kilns located far from the cities (or set of cities) with at least half a million inhabitants**
- **Absence of equality of co-processing with landfills**
- **Conflict with waste pickers (scavengers)**
- **State law projects prohibiting heat treatment of MSW**
- **Deficient selective collection**
- **Difficulties on licensing the co-processing kilns to use MSW**

Recommendations: MSW

- **Competition with landfilling: create**
  - **risk mitigation mechanisms in relation to final disposal of wastes;**
  - **Public policies to make the co-processing of residues in cement kilns more economically attractive;**
  - **Programs and incentives based on benefits of co-processing for the community and environment;**
  - **Mechanisms and public policies to repress inadequate disposal in dumps or clandestine landfills.**
- **Create a CONAMA Resolution that:**
  - **Priories the existing equipments to increase the efficiency of the waste management;**
  - **Prohibits citizens to mix the hazardous wastes with MSW. In this case, the reverse logistics of portable batteries, electronics, lamps, medicines, and others provided in PNRS must be implemented all over the country.**
- **Difficulties of licensing: Amendment to Resolution CONAMA 264 in relation to organo chlorine compounds**

MUNICIPAL SEWAGE SLUDGE (MSS)

Opportunities: MSS

- **Only 40.8% of the sewage produced is treated. So the amount of sludge will increase in the next years.**

- **Brazil has a restrictive rule to use MSS in agriculture (CONAMA 375/2006), so the major part is disposed in landfills. Co-processing could be a better solution.**

MSS Barriers

- **Lack of systemized information about quality and quantity of sewage sludge.**
- **Most of cement kilns located far from the sewage treatment plants (Only South-East region produces significant quantities).**
- **The sludge seems to be produced with a high moisture - mandatory drying step before delivering to a kiln (external, or on-site).**

Recommendations: MSS

- **Competition with landfilling: create**
  - **Risk mitigation mechanisms in relation to final disposal of wastes;**
  - **Public policies to make the co-processing of residues in cement kilns more economically attractive;**
  - **Programs and incentives based on benefits of co-processing for the community and environment;**
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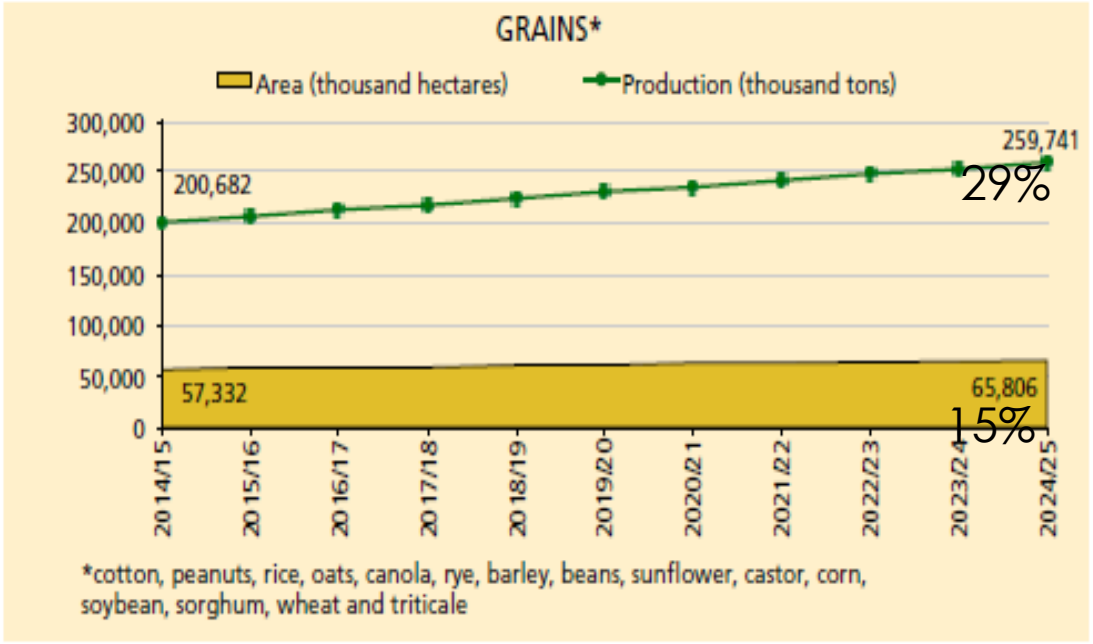
BIOMASS
AGRO AND AGRO INDUSTRIAL RESIDUES

Opportunities: BIOMASS

- **Large agricultural production**
- **Carbon neutrality**

Agro industry.	**290 million t/y**
Livestock	**1.7 billion t/y**
Poultry, pig and dairy cattle	**365 million t/y**
Primary industries	**266 mil t/y**
Wood (harvest / mech proc)	**85 million m³/y**



Source: AGE/Mapa and SGE/Embrapa

Biomass Barriers

- **Heterogeneity: For each residue, quantity and quality can vary widely : crop or animal variety, weather or farming regions.**
- **Geographical dispersion: often spread over large territories what makes the collection expensive.**
- **Seasonality: Most of the agricultural residues are produced only during harvesting periods. Cement plant needs permanent energy supply,.**
- **Competitive uses: Most of the time, used locally for energy purposes, cattle feeding or fertilizer.**
- **Profitability: depends strongly both on the carbon price and on the fossil fuel price. Regarding to current low price of both carbon and fossil fuels, biomass projects could be impacted.**

Recommendations - Biomass

The National Plan of Solid Residues suggests

- **the improvement of policies for agro and agro-industrial residues, including the encouragement of energy use, by combustion or digestion → *The cement sector must include the co-processing as an alternative to these kinds of residues.***
- **the creation of investment funds targeting the implementation of eco-efficient projects for primary agricultural industries, seeking to minimize the generation of waste and proper management → *The cement industry could be a part of the Residue Management Plan of the agro industries.***
- **the development of policies that support forest management, indicating the need of the waste management plan for the residues left in the field → *The cement industry could be part of this residues management, by providing its fleet trucks for waste removal in the field, and with the co-processing as a destination option to these wastes.***

IN GENERAL....

AF General opportunities

- **Lack of waste treatment capacity in Brazil with international standards.**

- **Huge fraction of the waste produced is still landfilled in poor conditions.**

AF General Barriers

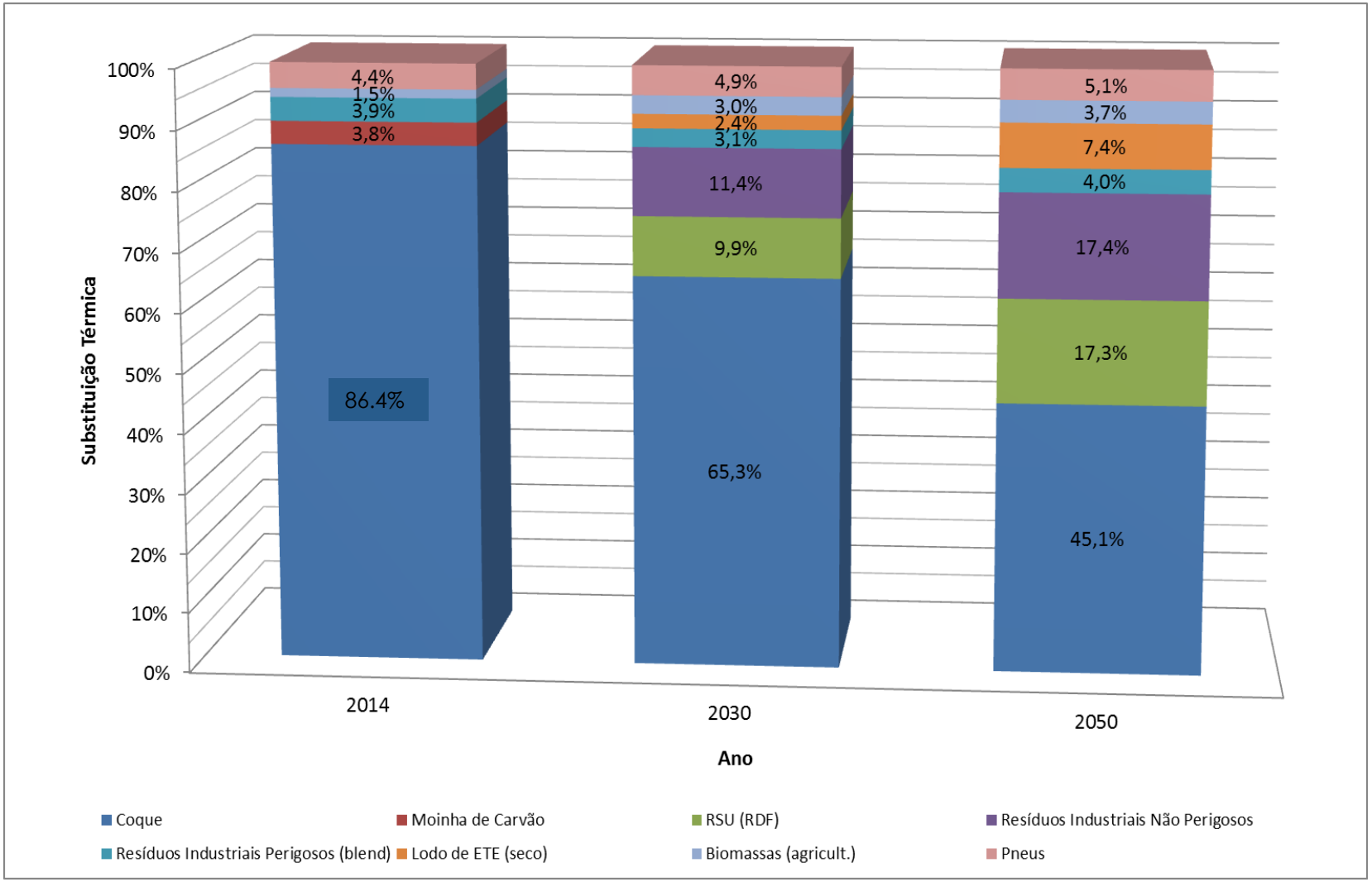
- The LHV is smaller than those of fossil fuels
- Impact on production (scenario high demand)
- In according to the waste management hierarchy presented in Brazilian solid waste policy (non-generation, reduction, reuse, recycling, solid waste treatment and disposal), the energy recovery is one of the last options
- Lack of information about the quantities and quality of the residues
- Lack of a positive list of types of biomass and industrial residues for simplified licensing
- Large geographical area - logistics is a significant barrier for most AF such as MSW, MSS, biomass and industrial residues.

AF: Recommendations

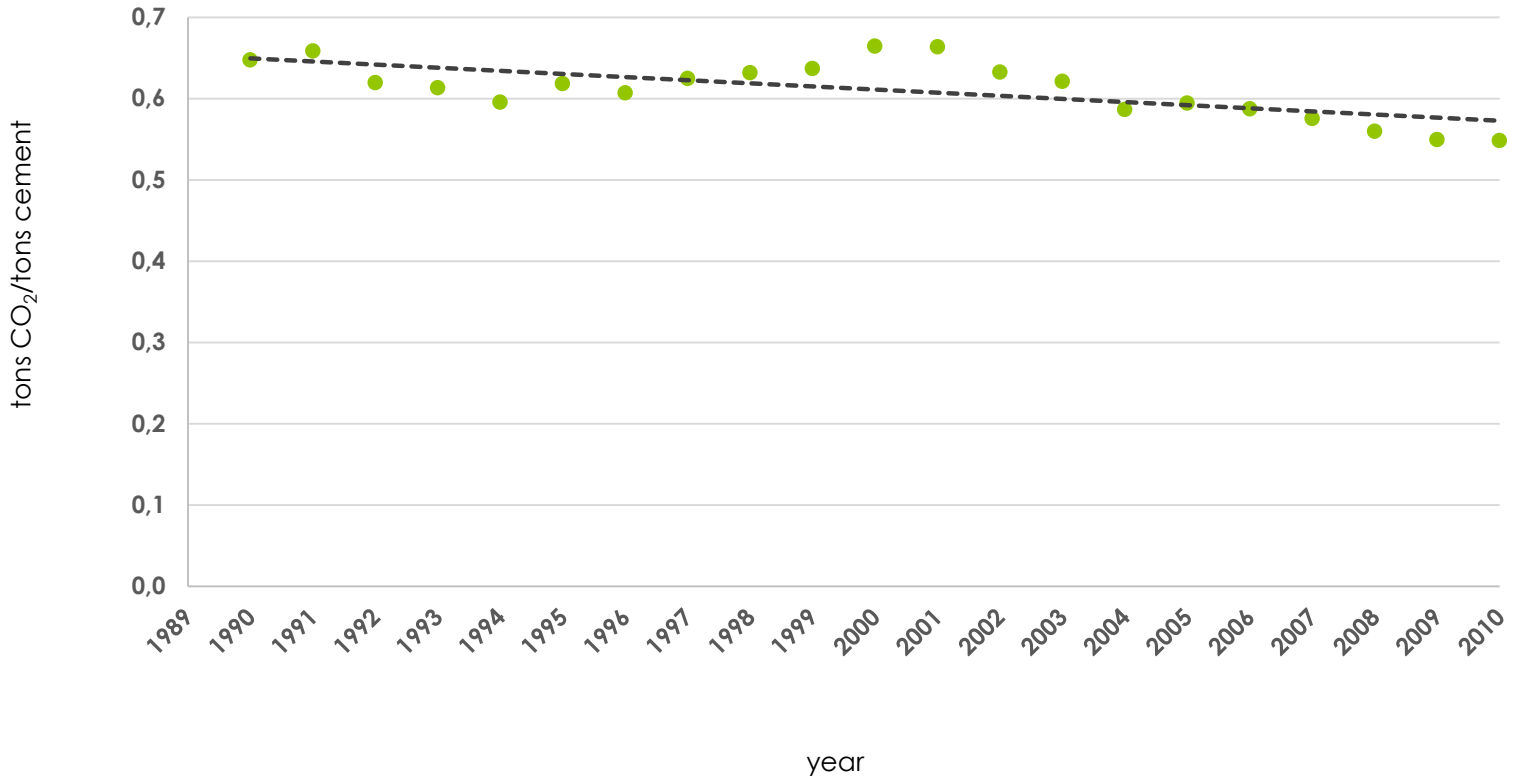
- **Promoting a better understanding of the opportunities and benefits of co-processing.**
- **Introducing federal laws (CONAMA) to:**
  - **promote co-processing for appropriate waste materials;**
  - **avoid disposing**
    - **(i) organic residues (MSW, sewage sludge, etc.) in landfills**
    - **(ii) class I residues with flammability characteristics in Class I landfills;**
  - **avoid recycling of used lubricants packaging (spent a lot of water and need for effluent treatment);**
  - **overtax disposal of MSW (recyclable dry fraction and organic fraction) to landfill.**

VISION OF FUTURE

Thermal Profile



Carbon intensity in cement industry
Carbon emissions/production



Carbon intensity in cement industry
Vision of future

- **The carbon intensity in cement production has been decreasing slowly since 1991 (approximately 1% per year).**

- **If such trend persists one could expect a 30% decrease in the carbon intensity of cement production in Brazil up to 2040-2050.**

- **But the more intense use of AF added to energetic efficiency and clincker substitution will certainly improve the carbon intensity of the sector.**

Conclusions

- **The Brazilian cement industry aims to increase the TSR (14% 2014) to 35% in 2030 and 55% in 2050.**
- **The cement industry will**
  - **be an important environmental management tool to the municipalities and to the industrial sector;**
  - **collaborate to improve the basic sanitation and the industrial management of residues, consequently the life quality of the people;**
  - **decrease the CO_2 emissions;**
  - **strengthen its triple bottom line.**

Acknowledgments

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