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NATURAL GAS AS A LEADING FUEL FOR EFFICIENT INDUSTRY GROWTH

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FUEL GASES AS MORE EFFICIENT ENERGY ALTERNATIVES TO ELECTROTHERMY IN THE INDUSTRIAL SECTOR

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CNG IN THE PUBLIC TRANSPORTATION SYSTEM IN A MAJOR METROPOLITAN AREA

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CNG IN THE PUBLIC TRANSPORTATION SYSTEM IN A MAJOR METROPOLITAN AREA - BACKGROUND

- BACKGROUND

Background

After the second oil crisis on 1979, the Brazilian oil production was about just 20% of the country's demand, it means that imported oil expenditures was becoming significantly high.

Therefore, the government started two main programmes to reduce the imported petroleum derivatives by electricity due to the availability of hydropower potential and the ethanol from sugar cane. Then some incentives were established to allow the replacement of oil by electricity in the industry.

Background

But in the long term, due to the increasing risk of electricity shortage, the oil crisis reverted into an electricity crisis

Consequently, using electrothermy as heat source, which is strongly established by an electricity culture in the Brazilian industry, must be changed.

Such change in the final use of electricity is mandatory due to the increasing OIL and NG power generation in the country.

Aims

- AIMS

Aims

This paper aims to analyze the prospect of fuel gases as final energy in order to get useful energy in Direct Heating (DH) and Process Heat (PH), identifying and quantifying potentials in order to replace electrothermy, it means, the use of electricity to produce heat in the Brazilian industry.

The following pages will show where and how much primary energy can be saved by the electrothermy displacing.

Methods and results

- METHODS AND RESULTS

Methods and results

The main source of data is the Brazilian Energy Balance (BEB) 2013 and the Useful Energy Balance (UEB).

Bibliographic research accompanied by practical experiences developed by the authors along their professional lives as energy consultants and professors.

Methods and results

DEFINITION

Direct heating means the application of the energy vector directly on the industrial process, without an intermediary heat transfer media.

And process heat is when the heat transfer media as steam or other thermal fluid is applied.

Methods and results

Industrial activities

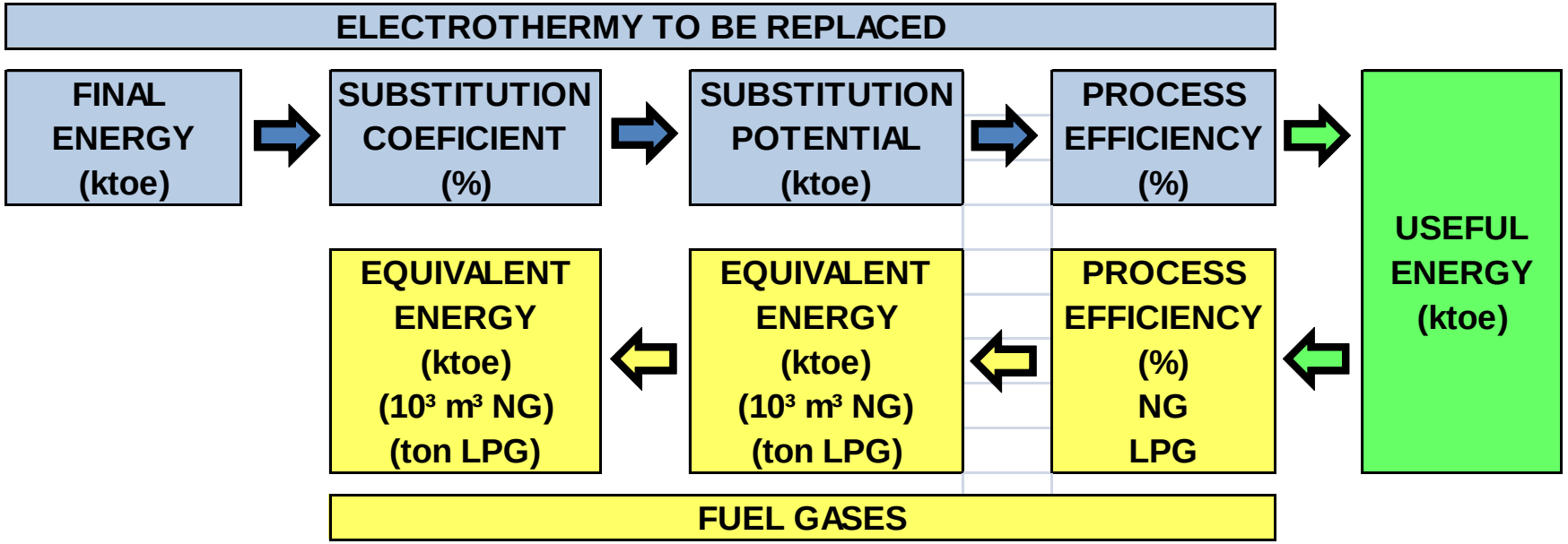
This paper has considered the following groups of industrial activities:

- Cement
- Pig iron and steel
- Ferro-alloys
- Mining
- Iron pellets
- Aluminium
- Other metals
- Chemical
- Food and beverages excluding sugar
- Sugar
- Textiles
- Pulp and paper
- Ceramics
- Other sectors

Methods and results

Algorithm

The first calculation aims to estimate the equivalent energy in fuel gases (natural gas and LPG) when electrothermy is displaced in each industrial activity. The following algorithm was used, taken into account the UEB per industrial activity.



Methods and results

Example – Direct Heating in the Ceramic Industry

The final energy means the electricity bought by the ceramic industry for DH, totalising 16,800 toe per year. The coefficient of substitution was estimated in 20% based in a market research made by the author. Therefore, the potential will account 3,400 toe. Applying the average efficiencies for DH (electrothermy and fuel gases) in this segment and converting into commercial units, the annualy potential would reach 4,026 x 10^3 m^3 NG or 3,192 ton of LPG.

CERAMIC INDUSTRY - DIRECT HEATING

ELECTRICITY					FUEL GASES		
FINAL ENERGY (ktoe)	SUBSTITUTION COEFICIENT (%)	SUBSTITUTION POTENTIAL (ktoe)	PROCESS EFFICIENCY (%)	USEFUL ENERGY (ktoe)	PROCESS EFFICIENCY (%)	EQUIVALENT ENERGY (ktoe)	EQUIVALENT ENERGY (commercial unit)
16,8	20,0	3,4	58,0	1,9	55,0	3,5	4.026 x 10^3 m^3 GN
					55,0	3,5	3.192 ton GLP

TOTAL Potential for Direct Heating

POTENTIAL MARKET FOR FUEL GASES - DIRECT HEATING		
INDUSTRIAL SECTORS	FINAL ENERGY BASIS 2012 (10^3 m^3 NG)	(ton LPG)
Cement	0	0
Pig iron and steel	n.e.	n.e.
Ferro alloys	156.500	124.072
Mining	43.831	34.750
Pelletizing	2.557	2.027
Aluminium	620.217	491.704
Other metals	396.738	314.531
Chemical	58.224	46.160
Food and beverage excluding sugar	133.404	105.762
Sugar	0	0
Textiles	0	0
Pulp and paper	0	0
Ceramics	5.507	4.366
Other sectors	250.159	198.323
TOTALS	1.667.138	1.321.696

Remark: n.e. - not estimated

TOTAL Potential for Process Heat

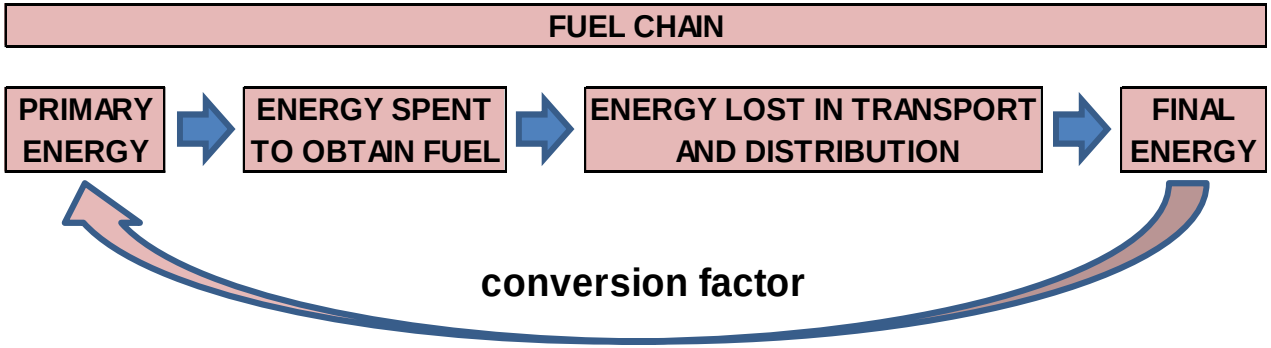
POTENTIAL MARKET FOR FUEL GASES - PROCESS HEAT		
INDUSTRIAL SECTORS	FINAL ENERGY BASIS 2012 (10^3 m^3 NG)	(ton LPG)
Cement	0	0
Pig iron and steel	47.958	38.021
Ferro alloys	0	0
Mining	19.598	15.538
Pelletizing	0	0
Aluminium	3.243	2.571
Other metals	0	0
Chemical	48.366	38.345
Food and beverage excluding sugar	349.440	277.033
Sugar	0	0
Textiles	0	0
Pulp and paper	63.239	50.136
Ceramics	0	0
Other sectors	80.773	64.036
TOTALS	612.618	485.679

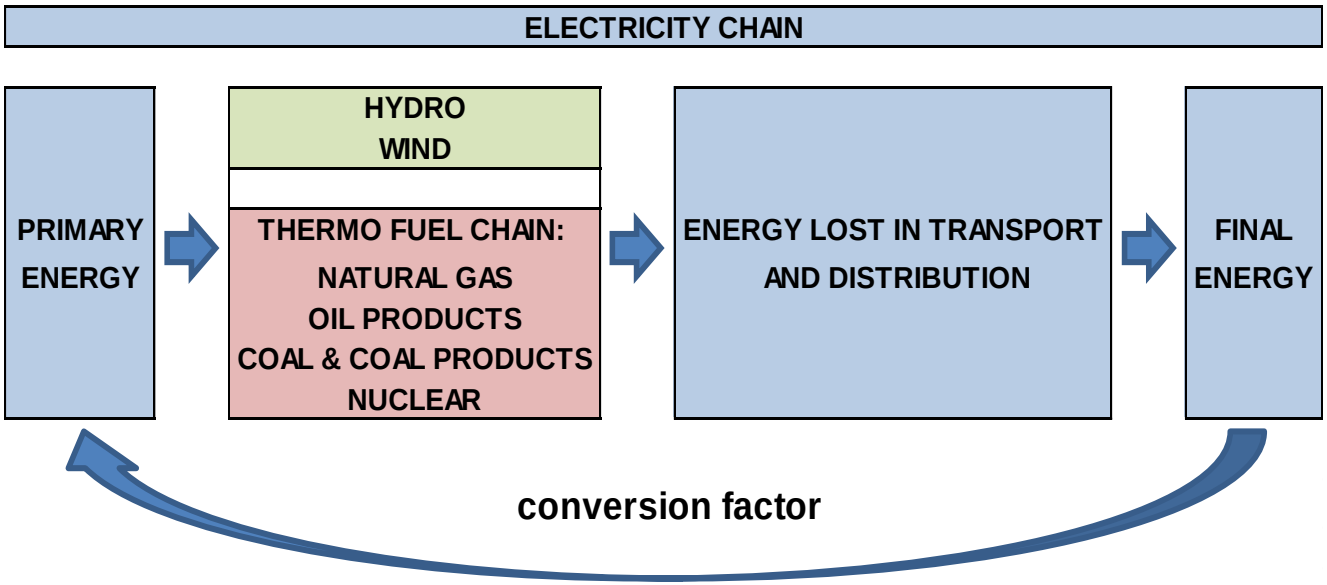
Overall Potential

Accounting both DH and PH, the overall potential corresponds to 9.97% of all electricity consumed by the Brazilian industrial sector.

END USE	POTENCIAL FOR FINAL ENERGIES - BASIS 2012				
	Electrothermy replaced		Fuel gas substitute		
	ktoe	GWh	ktoe	10^3 m^3 NG	ton LPG
Direct heating	1.325,2	15.409,5	1.467,1	1.667.138	1.321.696
Process heat	471,3	5.480,8	539,1	612.618	485.679
TOTAL	1.796,5	20.890,3	2.006,2	2.279.756	1.807.375

Conversion to primary energy





Conversion to primary energy

FINAL ENERGY Vector	(koe)	CONVERSION FACTORS	PRIMARY ENERGY (ktoe)
Electricity (all sources)	1.796,5	1,38 (1)	2.479,2
Electricity (public power plants)	1.796,5	3,18 (1),(2)	5.712,9
Electricity (autoproducers)	1.796,5	2,74 (1),(2)	4.922,4
Electricity (all power plants)	1.796,5	2,98 (1),(2)	5.353,6
Natural Gas	2.006,2	1,09 (1)	2.186,8
Liquefied Petroleum Gas	2.006,2	1,10 (1)	2.206,8

(1) Cursino dos Santos, 2011
(2) Queiroz, 2010

Primary energy savings

It must be considered that all electricity savings will reduce the energy produced by power plants.

PRIMARY ENERGY SAVINGS REPLACING ELECTROTERMY		
FROM	**TO NATURAL GAS**	**TO LPG**
Electricity (all sources)	**11.8%**	**11.0%**
Electricity (public power plants)	**61.7%**	**61.4%**
Electricity (autoproducer power plant	**55.6%**	**55.2%**
All power plants	**59.2%**	**58.8%**

- SUMMARY & CONCLUSIONS

Summary and Conclusions

1. The conversion of electrothermy by fuel gases in the Brazilian industry, considering direct heating and process heat, means a significant potential to reduce about 10% of the industrial consumption of electricity.

2. The replacement of electrothermy reduces the consumption of primary energy. If the conversion results in a reduction of the power plant production, the primary energy saving would be very expressive as well as carbon emissions.

3. The electricity savings allow the industries to renegociate the contracted demand.

4. The Brazilian experience is important for a World increasingly moving towards more-and-more electricity uses

The End

- THANK YOU

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