CARBON BUSINESS ACTION BRAZIL

Mapping Report
Energy Efficiency in Industry

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PROJETOS

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ABBREVIATIONS

ACEEE – American Council for an Energy-Efficient Economy
ANEEL – Agência Nacional de Energia Elétrica
AQUA – Alta Qualidade Ambiental
ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers
BEN – Balanço Energético Nacional
BNDES – Banco Nacional de Desenvolvimento
CBCS – Conselho Brasileiro de Construção Sustentável
CFL – Compact Fluorescent Lamp
CNI – Confederação Nacional da Indústria
CONPET – Programa Nacional de Racionalização do Uso de Derivados do Petróleo e do Gás Natural
CTEE – Comitê Temático para Eficiência Energética
EMS – Energy Management System
EPE – Empresa de Pesquisa Energética
EU – European Union
HVAC – Heating, Ventilation and Air Conditioning
IBGE – Instituto Brasileiro de Geografia e Estatística
INMETRO – Instituto Nacional de Metrologia, Qualidade e Tecnologia
LEED – Leadership in Energy and Environmental Design
PBE – Programa Brasileiro de Etiquetagem
PROCEL – Programa Brasileiro de Conservação de Energia Elétrica
SEBRAE – Serviço Brasileiro de Apoio às Micro e Pequenas Empresas
SENAI – Serviço Nacional de Aprendizagem Industrial
SMEs – Small and Medium Enterprises
VRF – Variable Refrigerant Flow

1 Executive Summary

Industrial energy efficiency

This report identifies the principal characteristics of the Brazilian industrial energy efficiency sector and maps potential business opportunities for European small and medium-sized enterprises in this area.

Mapping industry in Brazil

There is significant heavy industrial activity in Brazil, much of this in energy-intensive sectors. The country has historically had relatively abundant and clean energy, but recent rises in energy costs and the carbon emissions associated with electrical production are likely to focus attention on the sector of energy efficiency in industry.

Industry is concentrated in the South-East and South of the country, especially in São Paulo, Rio de Janeiro and Minas Gerais states. The largest industries by energy consumption are food & beverage, iron & steel, paper & pulp, chemicals and non-ferrous metals, in that order.

Although Brazil's non-industrial sectors are responsible for an increasing proportion of GDP, national industry continues to grow, especially in areas linked to mining and agriculture. However, an economic slowdown since 2013 has drastically reduced output and investment in new capacity. As such, despite the cost-cutting imperative, significant investments in energy efficiency are only likely to occur when national output starts to grow again.

Suppliers, industry sectors and intermediary companies

Industrial energy efficiency is divided into ten sub-sectors, representing the principle types of technologies, services and processes which could represent business opportunities for European companies. While eight principal segments of Brazilian industry are studied, it should be noted that in many cases, companies will need a local partner in order to be able to supply technologies, services and processes to the Brazilian market. As such, six types of intermediary company are identified. It is likely that as well as Brazilian industry, any matchmaking mission will involve many intermediary companies looking to form partnerships to offer European technologies, processes and services to the Brazilian market.

Energy efficiency sub-sectors	Principal industry segments	Potential intermediary companies
– Automation and controls – Compressed air systems – Steam systems – Driven systems – Furnaces – Cooling system – Lighting – Consultancy and software – Design and engineering – Training and certification	– Food and beverage – Chemical – Cement – Ceramics – Pulp and paper – Mining, metallurgical and ferro-alloys – Textiles – Others	– ESCOs – Design and engineering – Energy consultancies – Importers and equipment suppliers – Energy distributors – Tech hubs

Barriers and business opportunities

There are significant barriers to the business opportunities identified in Brazil, including the cost of the solutions and difficulties of doing business in the country. The most crucial issue will be timing: companies should aim to be well positioned to take advantage of business opportunities when investment in the sector starts to grow again.

There are several key technological areas which show high potential, due to gaps in the Brazilian market or ease of importation and competition. These include:

- Specialised services such as design, engineering, consultancy, CFD simulation and pinch-point analysis;
- Software, automation, control and energy management systems;
- Specialised equipment for energy efficiency and maintenance programmes;
- Systems related to process heating and combustion; and
- Training and certification.

There are likely to be many additional opportunities based on individual innovations of European companies, which will emerge from the matchmaking process. It is recommended that the matchmaking missions should be pushed forward to 2017 if possible, in the expectation that the industrial sector will be facing less uncertainty and a period of more stable growth.

2 Brief characterization of the sector in Brazil

The energy cost fraction of an industrialized product can reach 60% of its total final cost, and therefore energy costs (including taxes) are considered a competitive factor for almost all Brazilian industries (MME, 2011). Historically, achieving higher energy efficiency levels has always been a challenge for national industry, due mainly to the plentiful low cost energy sources available, and also to the lack of expertise when developing long-term and consistent energy management systems.

The industry sector represents today 32.5% of all national energy consumption in Brazil – however, there is no unified, long-term public policy concerning the efficient use of energy in industry. Most of the energy efficiency public policies focus on residential, commercial and public sectors, which represent only 14.4% of national energy consumption (the remaining 53.1% is divided between transport, agriculture, energy production and non-energetic final consumption) (CNI, 2009; EPE, 2016).

This chapter presents a brief characterization of energy efficiency and carbon emissions in Brazilian industry, considering the use of energy in industrial processes, cost reduction opportunities and public policies regarding this topic.

Energy consumption in industry sector

The Brazilian Energy Balance (BEN – *Balanço Energético Nacional* in Portuguese) is an annual report published by the Energy Research Office (EPE – *Empresa de Pesquisa Energética* in Portuguese) which brings together key statistical information relating to energy supply and consumption, as well the conversion process and foreign trade, and is the main source of statistical data on energy consumption in industry.

The proportion of energy consumed in industry has been relatively constant since 1970, remaining between 27.7% and 37.7%, although its rate of increase has leveled off in recent years and this has been exacerbated by an economic slowdown since 2014 (Figure 1). In 2015, Brazilian industry consumed 84.6 million tons of oil equivalent (toe).

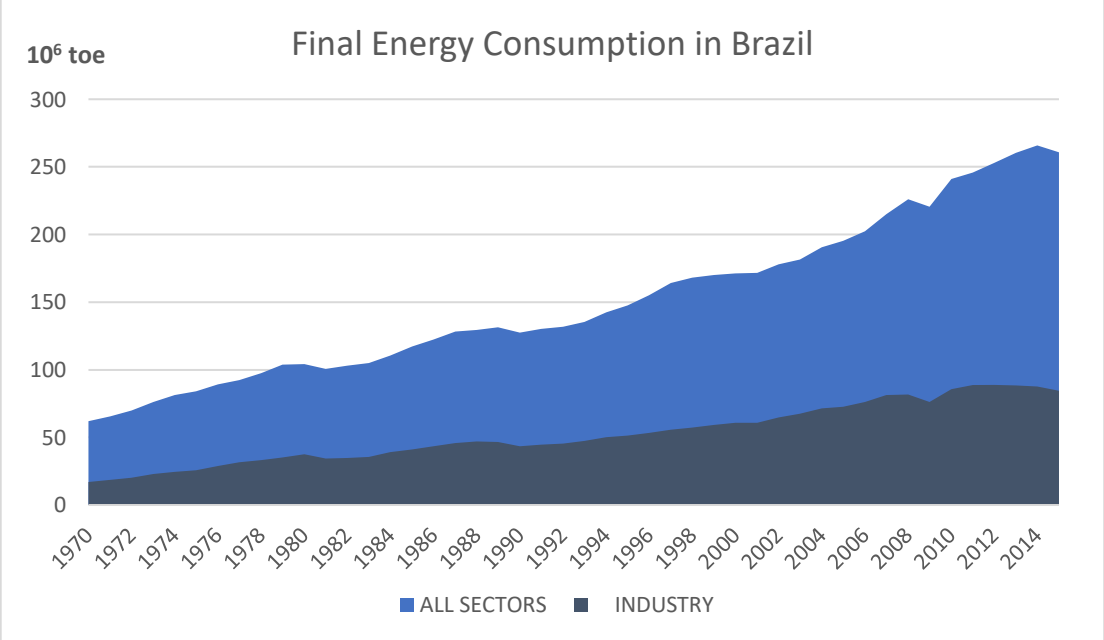

Figure 1 – Final energy consumption in industry sector
Source: adapted from EPE, 2016

As total consumption has grown in the last forty years, the fuel mix has evolved. In the early 1970s, fuel oil was the main energy source in industry, followed by biomass[1] and bagasse[2]. In the modern energy mix, fuel oil and firewood have lower participations and the use of natural gas, electricity, bagasse and other energy sources has increased (Figure 2). It should be noted that biomass products are a significant proportion of Brazil's industrial energy mix; this is linked to the large and dynamic agricultural sector.

Geopolitical factors have had a significant impact on Brazil's evolving energy mix; for example, natural gas has been aggressively promoted as a substitute for oil since a major cooperation agreement with Bolivia from the late 1990s guaranteed natural gas supplies to Brazil.

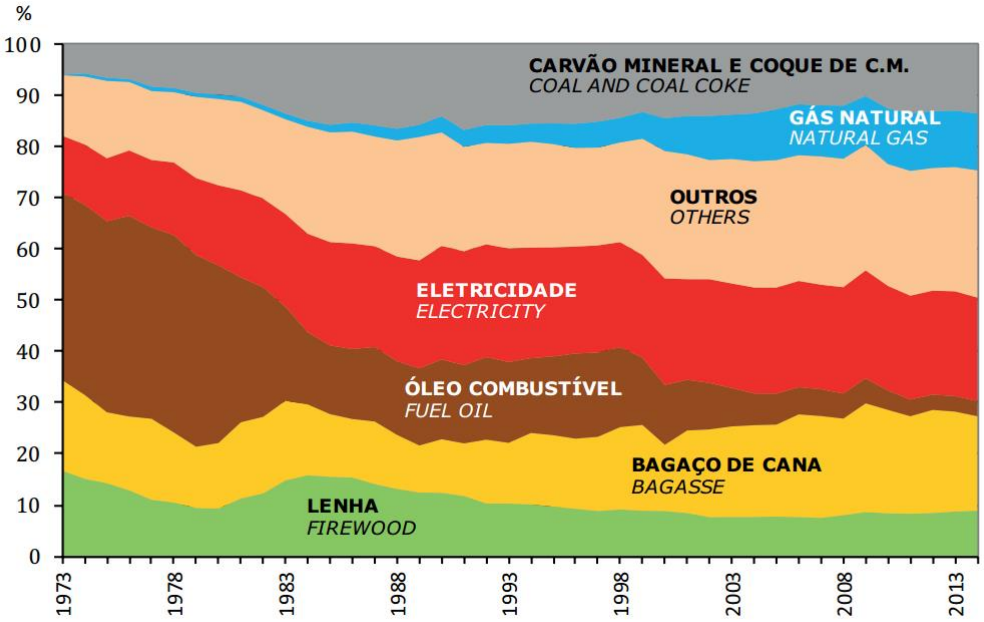

Figure 2 – Industrial sector energy consumption by energy source
Source: EPE, 2015

Energy intensive industry segments

The Brazilian industry sector can be divided in different segments according to its final products. Many of these sectors are energy intensive, meaning energy represents a significant proportion of total production costs. The Brazilian National Energy Balance (BEN) database (2016), available online[3], separates energy use in the following industry segments: foods and beverages, pig-iron and steel, paper and pulp, chemical, non-ferrous and other metallurgical, cement, ceramics, mining/palletization, iron-alloys and textiles. Just three of these sectors (foods and beverages, pig-iron and steel, and paper and pulp) represent a significant proportion of total national energy consumption, as shown in Figure 3.

The Brazilian National Confederation of Industry (CNI) and Eletrobras, the state-controlled electricity holding company, through the National Electricity Conservation Program (PROCEL) Industry, have worked in close cooperation since 2004 and in 2009 published a detailed diagnosis of key opportunities and priorities for the development of energy efficiency in

[1] Biomass here refers to agricultural products and by-products, principally firewood, which is still widely used in some industrial segments.
[2] Brazil's large sugar and ethanol industries produce significant biomass side products, and sugar cane bagasse is a major fuel source in Brazil, used for heating and cogeneration in industrial plants.
[3] https://ben.epe.gov.br/

industry. This diagnosis considers three additional energy intensive segments, which are not individually analysed in the BEN but are relevant in energy use: lime production, glass and foundry.

The final energy consumption by industry segment presented in Figure 4 stresses the increasing energy use since 1970 (rising from 17.2 million toe to a peak of 88.7 million toe in 2011). The impacts of economic slowdowns are clearly visible in 2009 and 2014-2015. However, it should be noted that these effects do not impact all sectors in the same way, and some industrial segments continue to show significant growth.

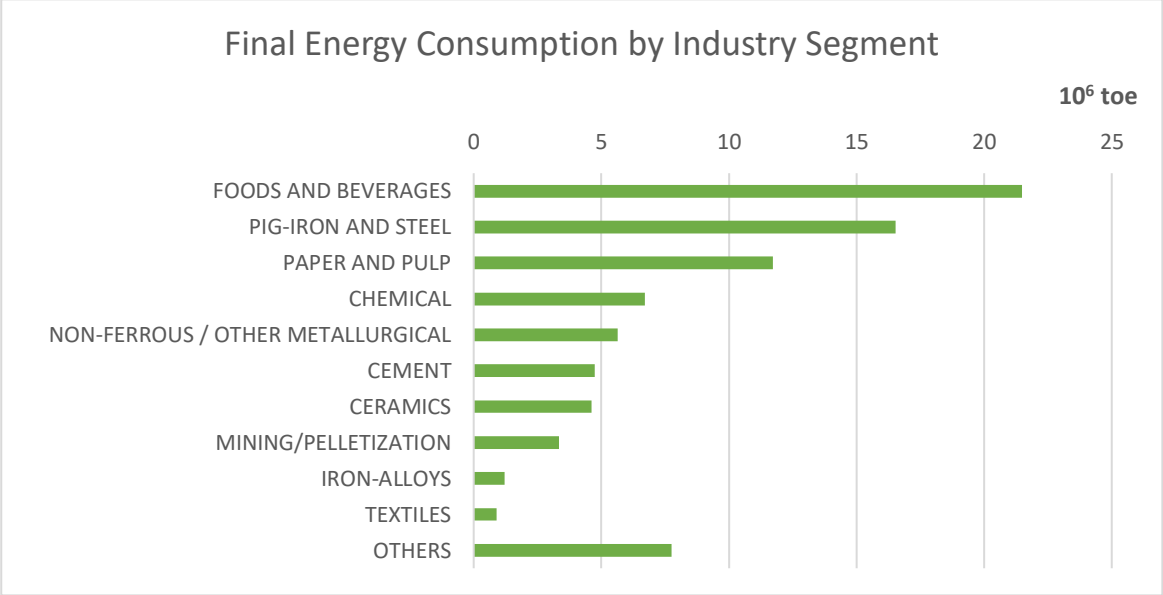

Figure 3 – Final energy consumption by industry segment (ranking)
Source: EPE, 2016.

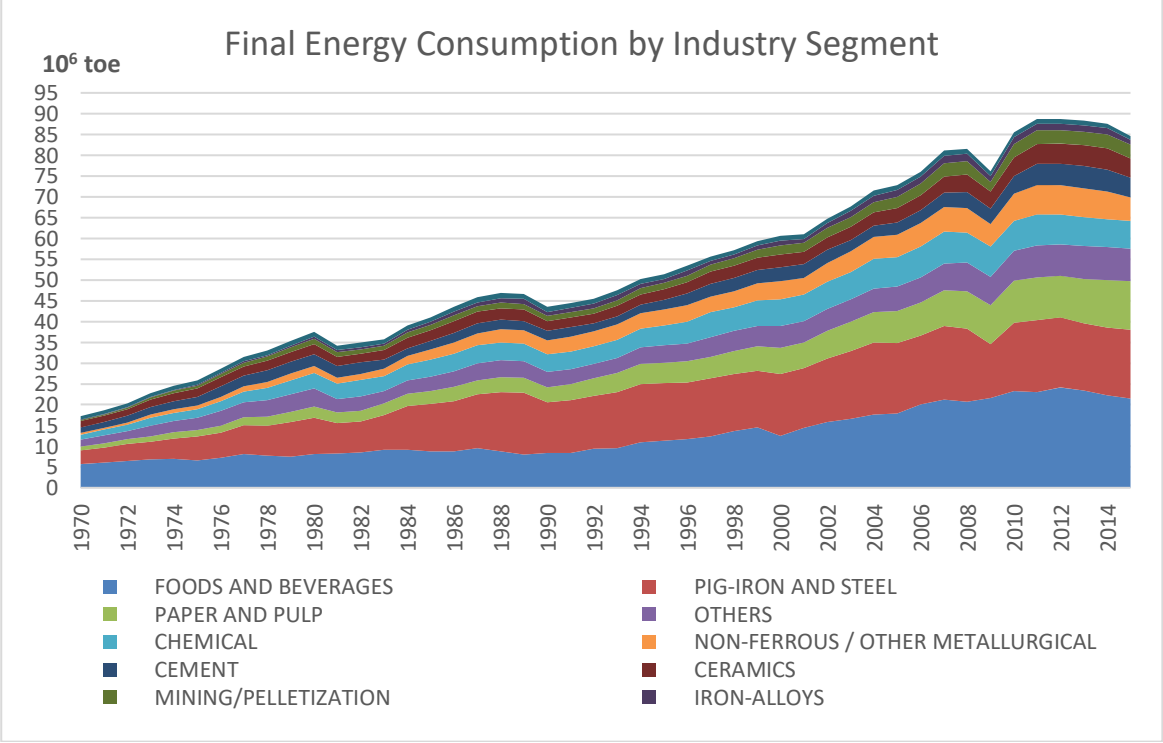

Figure 4 - Final energy consumption by industry segment (timeline)
Source: EPE, 2016.

The last Useful Energy Balance (BEU – *Balanço de Energia Útil* in Portuguese) report was presented by the Ministry of Energy in 2005 and allows sectorial information on energy consumption from the National Energy Balance to be processed to obtain final energy estimates. The final uses considered in these estimations are:

- **Driven system:** stationary motors or transport vehicles (individual, collective or cargo), tractors, agricultural machinery, earthworks and earthmoving;
- **Process heat:** boilers, water heaters or thermal fluids;
- **Direct heating:** kilns, furnaces, radiation, heating induction, conduction and microwaves;
- **Cooling:** refrigerators, freezers, refrigeration equipment and air conditioning (both compression and absorption cycles);
- **Lighting:** interior and exterior lighting;
- **Electrochemistry:** energy used in electrolytic cells, electroplating processes, and electrophoresis;
- **Other uses:** computers, telecommunications, machinery office, xerography and electronic control equipment.

Data from BEU provides information regarding which energy source and how it is used in different industrial segments. The main energy sources and final uses per segment are presented in Table 1 and Table 2. The most common final uses in the industrial sector are direct heating, driven system and process heat.

Table 1 – Main energy sources per industry segment
Source: MME, 2005; GORLA, 2009; MME, 2015.

Industry segment	Main energy sources									
	Biomass	Electricity	Petroleum products	Natural gas	Coal	Charcoal	Petroleum coke	Process gas	Black liquor	Oil fuel
Food and Beverages	✓	✓		✓						
Pig-iron and steel					✓	✓		✓		
Paper and Pulp		✓							✓	
Chemical			✓	✓						
Non-ferrous and other metallurgical		✓								✓
Ceramics	✓			✓						
Cement		✓					✓			
Mining and Pelletisation										✓
Iron-alloys		✓				✓				
Textiles	✓			✓						✓
Lime	✓						✓	✓		
Glass				✓						
Foundry		✓				✓				✓

Table 2 – Main final uses per industry segment
Source: MME, 2005; GORLA, 2009; MME, 2015.

Industry segment	Main final uses						
	Driven system	Process heat	Direct heating	Cooling	Lighting	Electrochemistry	Other uses
Food and Beverages	✓	✓	✓	✓			
Pig-iron and steel	✓		✓				
Paper and Pulp	✓	✓	✓				
Chemical	✓		✓			✓	
Non-ferrous and other metallurgical	✓	✓	✓			✓	
Ceramics	✓	✓	✓				
Cement	✓	✓	✓				
Mining and Pelletisation	✓	✓	✓				
Iron-alloys			✓				
Textiles	✓	✓	✓	✓			
Lime	✓		✓				
Glass			✓				
Foundry	✓	✓	✓				

Carbon emissions from industry

Brazil's industrial processes accounted for 6.5% of total carbon emissions in 2014, with another 30.8% from the energy sector (the remaining emissions are dominated by agriculture and land use change (SEEG, 2015)). The carbon emissions of the industrial sector are deployed in two classes, according to IPCC (2006): emissions from physical or chemical transformation processes and from the use of fuels. For the final results in the industrial sector both are considered.

Since the 1970s, greenhouse gas emissions from industry have grown steadily in line with the development of domestic industry (Figure 5). Between 1990 and 2012 there was a visible growth from fuel usage (130%) in comparison with the industrial processes (65%) (Figure 6). This difference is caused by diversification of industry in this period, including the development of the automotive, electronics and construction segments.

It is worth highlighting the drop in carbon emissions in 2009, resulting from the global economic slowdown, which decreased the physical production of the major processing industries (except cement). In addition, total industrial emissions have stabilised over the last three years, in line with industrial production, but this trend is not homogeneous across all branches of industry and should be analysed case by case. For example, due to reduced demand many industrial units in the steel industry are currently operating far from their optimal point, which may increase the energy intensity and specific greenhouse gases emissions. The capacity utilization in steel industry was 71% in 2012, compared with values always above 85% in the years leading up to 2008 (SEEG, 2014; SEEG, 2015).

Emissions from industrial processes were mapped for five segments: pig-iron, steel and non-ferrous metallurgy (mainly aluminium), cement, chemical, lime, glass and refrigerating fluids production (HFC, PFC and SF_6). Although this group represents a relatively small proportion of Brazilian industrial plants, it is responsible for 97% of industrial emissions of greenhouse gases (SEEG, 2014). The industrial segments pig-iron and steel metallurgy, cement, lime and chemical production are responsible for more than 81% of the industry total carbon emissions (Figure 7) (SEEG, 2014).

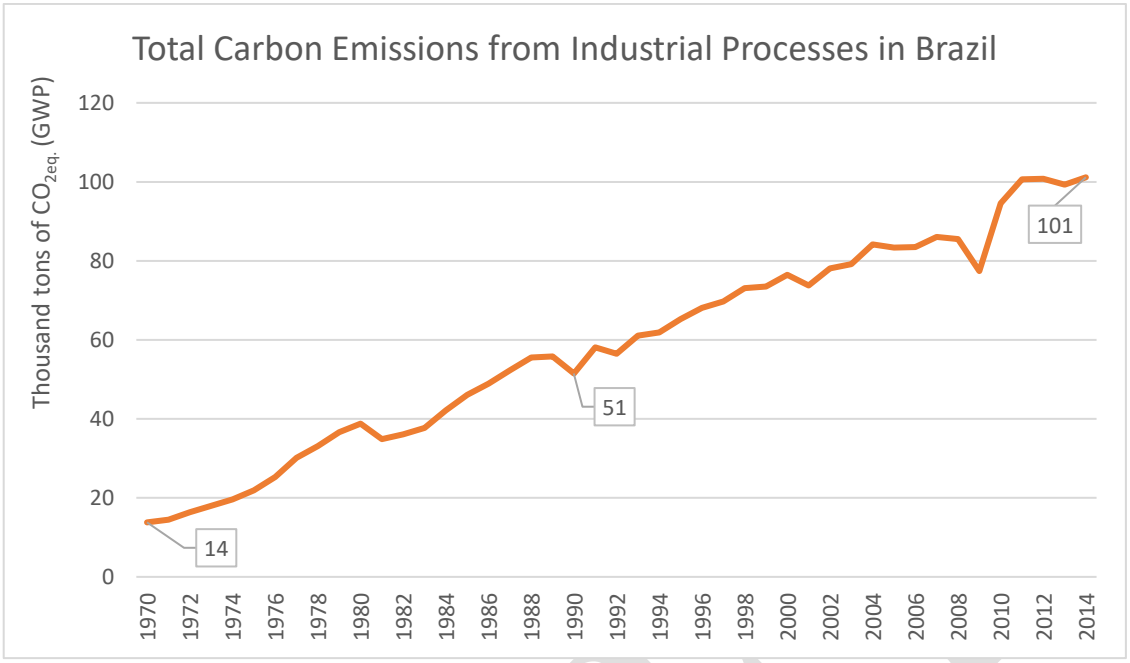

Figure 5 – Total carbon emissions from Industrial Processes
Source: Sistema de Estimativa de Emissão de Gases de Efeito Estufa (SEEG, 2016)

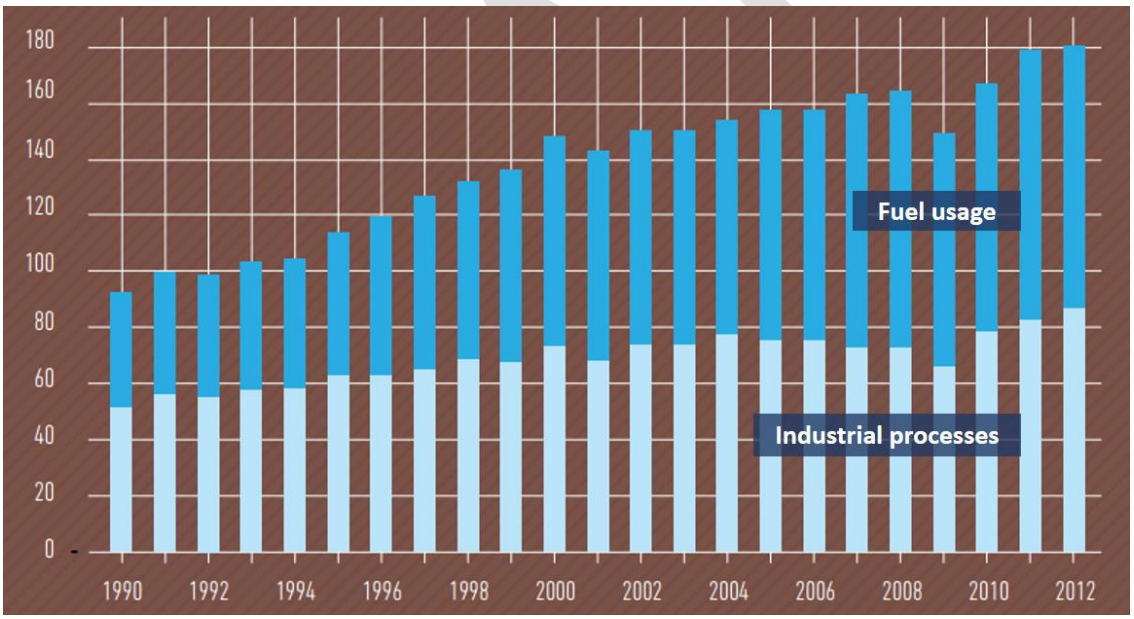

Figure 6 – Total emissions from industry: industrial processes and fuel usage, Million tons of $CO_{2eq.}$
Source: SEEG, 2014

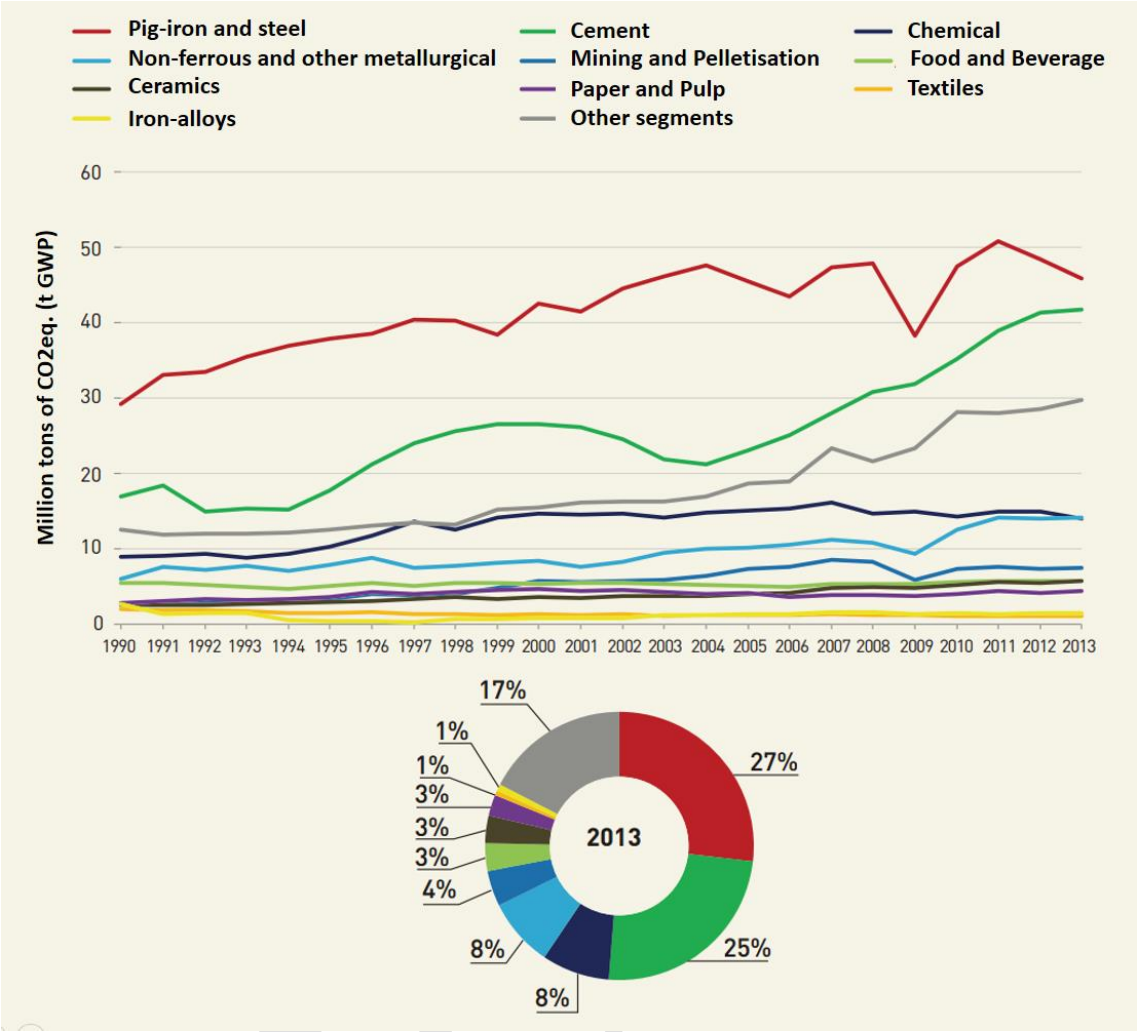

Figure 7 – Carbon emissions from industry by segment
Source: SEEG (2015)

Energy costs

Electricity is an important energetic for industry (Table 1), around 80% of industrial companies use this resource as their main energy source (CNI, 2016). Around 70% of electricity generation in Brazil is hydroelectric, meaning that historically it has had a relatively cheap and "green" grid supply. However, the impacts of energy subsidies implemented in 2013 (and subsequently repealed), along with the enduring effects of a drier than usual period from 2012 to 2014 and restructuring of the sector to diversify production have caused significant changes in the sector.

Electricity costs have risen sharply since early 2014, due to many reasons, including the repealing of a 2012 law which subsidised prices to control inflation and the increased marginal cost of generation from thermal power stations. The average energy tariff for the industrial sectors rose rapidly between 2014 and 2016, as can be seen in Figure 8.

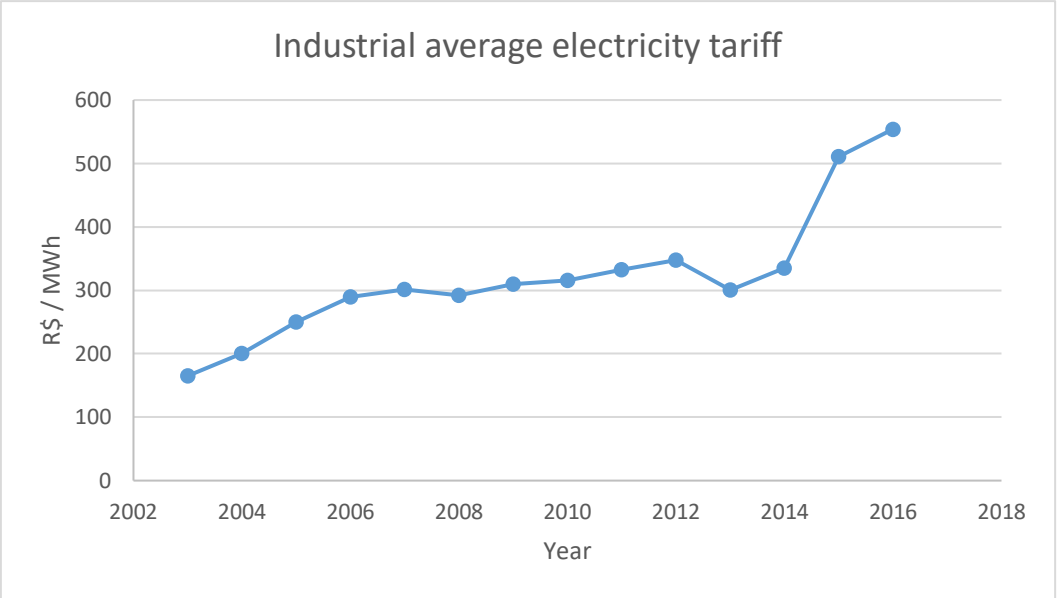

Figure 8 – Average regulated electricity tariff for industrial plants
Source: ANEEL (2016)

In parallel, the increased use of thermal power plants with higher carbon emissions has meant that the grid carbon emissions (average tonnes of CO_2 equivalent emitted per MWh of electricity generated) were 4.6 times higher in 2014 than in 2011 (Figure 9).

In 2015 and early 2016 both costs and carbon emissions appear to have stabilised, and the slump in national industrial output has actually reduced energy consumption slightly, helping to control cost and avoiding the risks of under-supply, which could have occurred as a result of the 2014 drought reducing production from hydroelectric plants. However, the new level of cost and environmental impact of energy have made many energy efficiency investments viable and renewed interest in the sector since 2014.

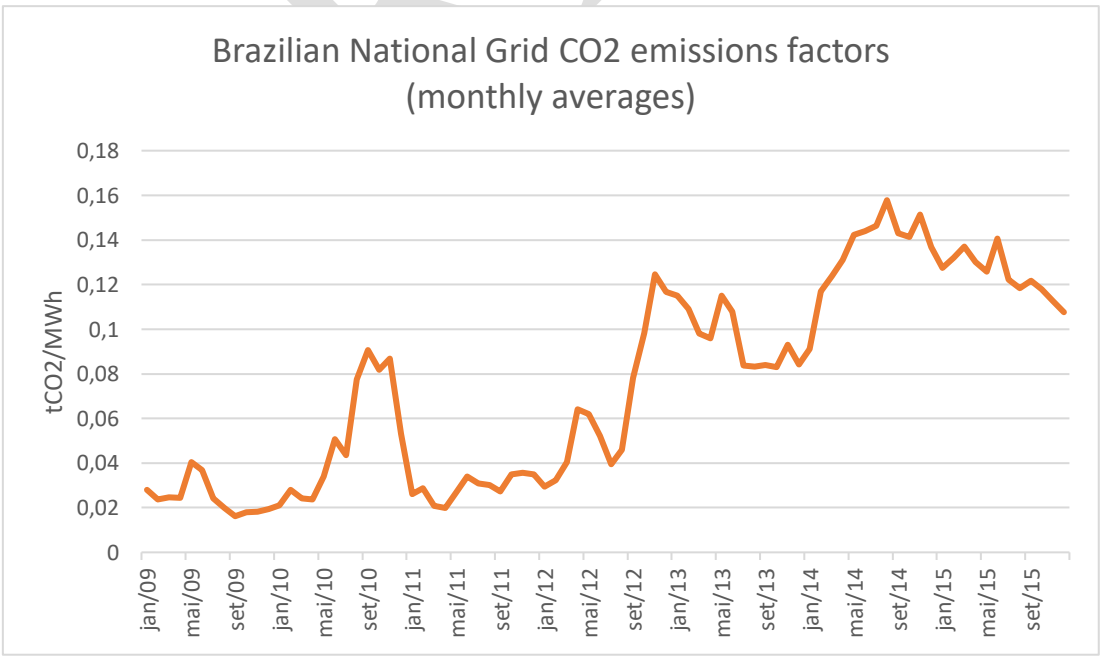

Figure 9 – Brazilian National CO_2 emissions factors
Source: Brazilian Ministry of Science, Technology and Innovation (MCTI)

Large consumers who have over 500kW of contracted demand and connections of at least 2.3kV have the right to migrate to a competitive Open Market (*Mercado Livre* in Portuguese) for energy, should they so choose. This gives them the right to buy energy directly from electricity generators through long-term contracts; oversupply or shortfalls are traded on the "spot" market. Long-term contract prices may be significantly lower than the costs on the regulated market (shown in Figure 8).

As shown on Figure 10, spot prices fluctuate wildly, depending on the water available in hydropower reservoirs (as in Figure 11), the costs of alternative supplies (usually marginal thermal generation) and instantaneous demand. After spikes in cost in 2014, the maximum price was fixed at R$383 per MWh in 2015, before the economic downturn significantly reduced demand and drove prices down again. As the impacts of climate change intensify, Brazil may suffer longer and more frequent droughts, with a direct effect on the volatility of energy costs.

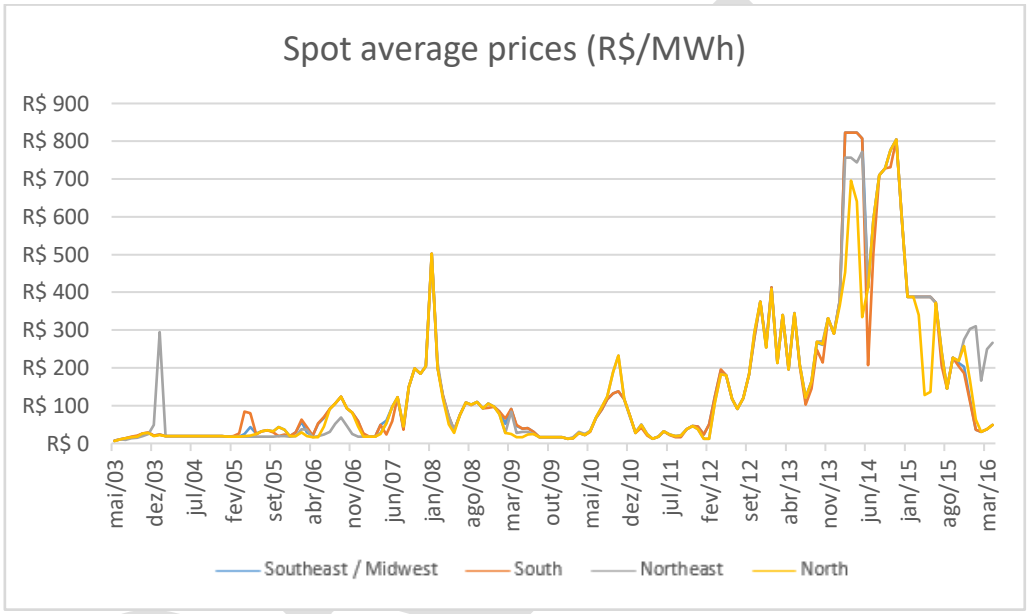

Figure 10 – Spot average prices in Brazilian regions
Source: Câmara de Comercialização de Energia Elétrica (CCEE)

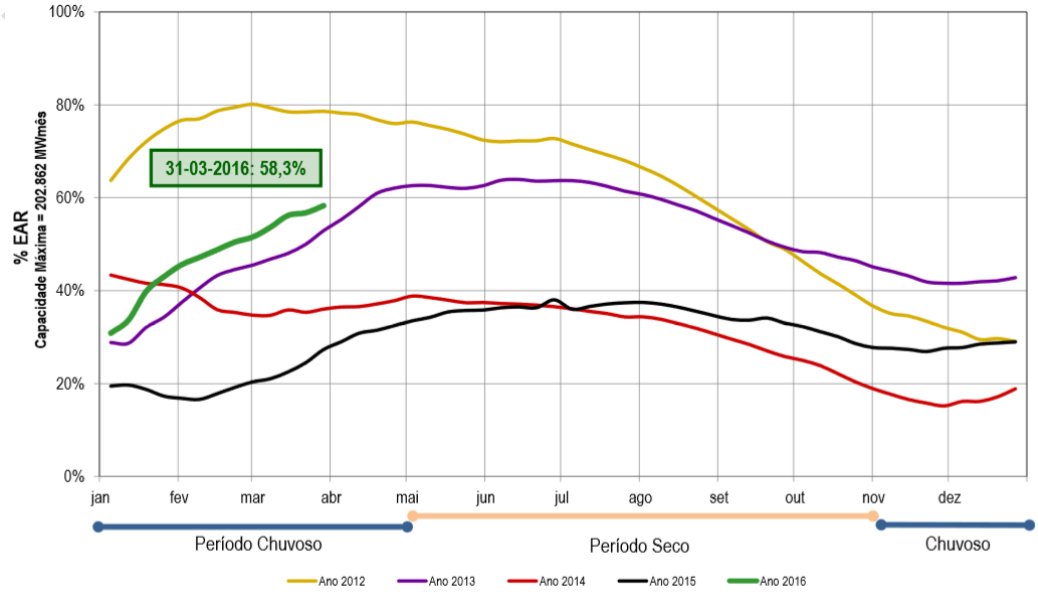

Figure 11 – Natural Energy Stored (Energia Natural Armazenada, EAR) in Southeast and Midwest of Brazil
Source: Ministério de Minas e Energia (MME)

Although small consumers currently pay a fixed price per kilowatt-hour, recent legislation allowed distributors to charge higher costs in months where generation costs are higher (denoted by a red flag). There is a move towards a "white flag" system, which would allow varying time-of-day charges.

The National Confederation of Industry (CNI) produces and publishes a series of industrial indices based on data from the Annual Industrial Research (PIA) of the Brazilian Institute of Geography and Statistics (IBGE). The Industrial Cost Indicator (ICI) has been growing since 2010, and it has increased 10.7% between the last semester of 2014 and 2015, and this growth was driven by the electricity rising tariff (CNI, 2016). The Energy Cost Index, a component of ICI, is a combination between the electricity and oil fuel industry costs, weighted by its participation in total industry energy consumption published at BEN. Figure 12 presents this index growth.

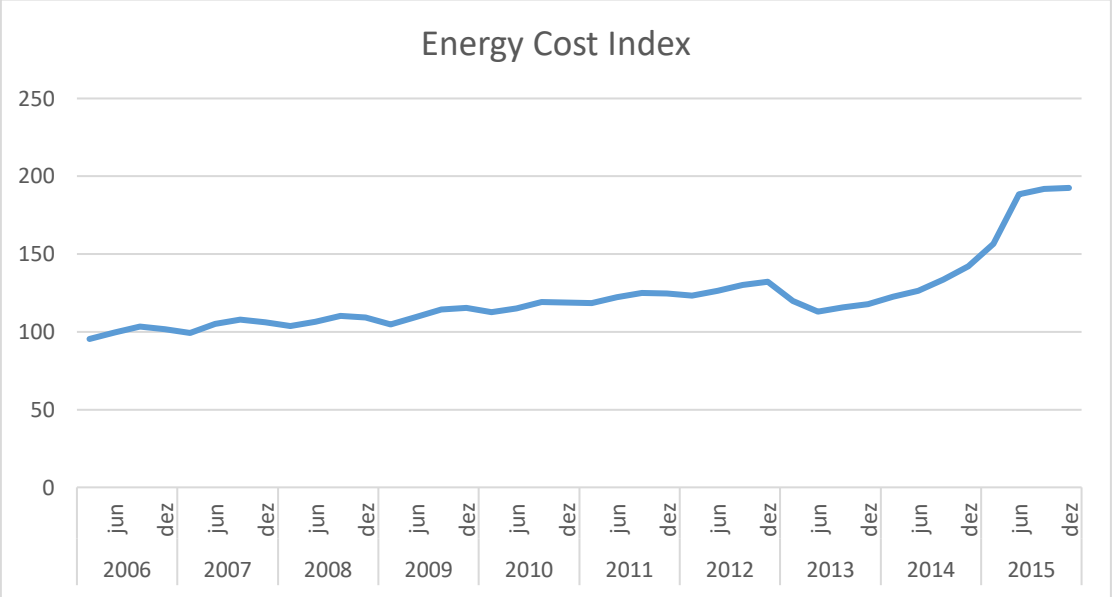

Figure 12 – Energy Cost Index
Source: CNI (2016)

Energy efficiency and low carbon practices in Brazilian industry

As commented above, achieving higher energy efficiency levels has always been a challenge for the national industry, due mainly to the plentiful low cost energy sources available, and also to the lack of expertise when developing long-term and consistent energy management systems. However, the recent rapid growth of electricity costs has pushed most of companies to implement some simple energy efficiency measures. Also, there are some specific industrial segments in which the energy consumption reduction and carbon emissions management have been enhanced, discussed and in some cases, implemented.

The National Confederation of Industry (CNI) has carried out surveys with industry companies regarding electricity quality and costs. The last survey performed in March 2016 noted that 94% of companies affirmed the high electricity cost had a significant impact on production costs, in all enterprise sizes. The most impacted segments mapped in this survey were the non-metallic mining (61%) and plastics production (55%).

Within companies that use electricity as a main energy source, 52% implemented specific measures to deal with the higher energy tariffs, and 71% of these companies implemented energy efficiency actions or programs (Figure 13). The category “Others” was an open question which

included reducing the number of working shifts, changing periods to off-peak hours. Among the different industrial segments, the percentage of companies which have acted to deal with the rising cost of energy varies: rubber (70%), textiles (69%), metallurgy (67%), leather (65%), non-metallic minerals (40%), clothing (41%), wood (45%), shoes (47%), and construction (36%) (CNI, 2016).

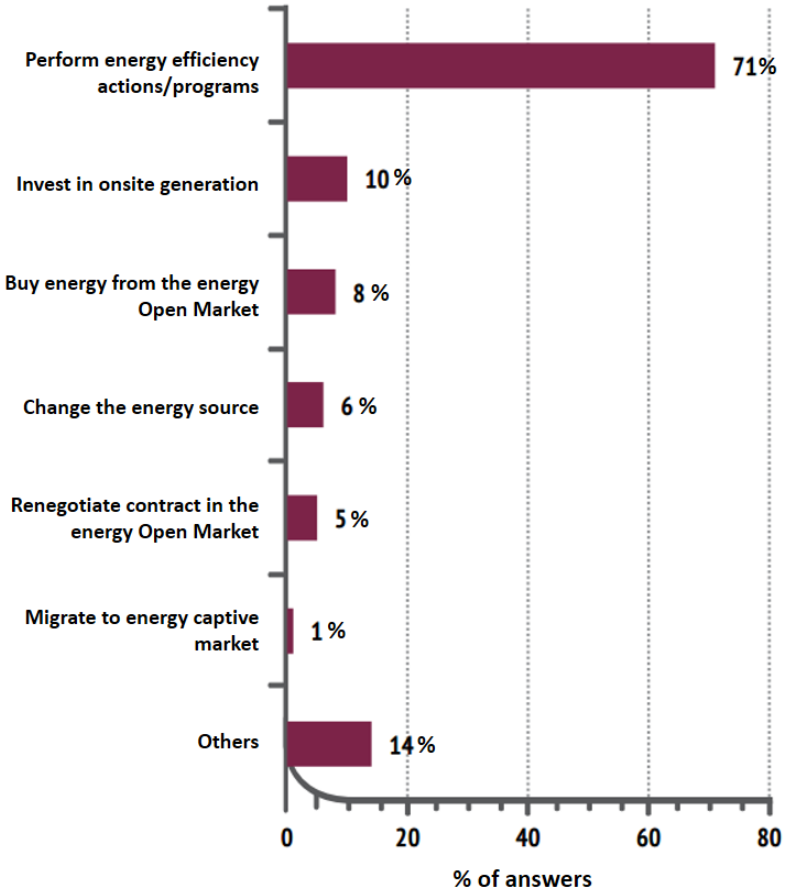

Figure 13 – Industry's actions to deal with energy cost in the last 12 months
Source: adapted from CNI (2016)

In the food and beverage industry, the most energy intensive in Brazil, there is a large variation between highly equipped, purpose-built, modern plants and older factories which may have much outdated equipment and have passed through several retrofit and adaptation cycles. This industry must be analysed on a case-by-case basis, but in general some energy efficiency opportunities would be: implement an energy management system, improved motors, pumps, fans, compressed air systems and steam boilers, and heat recovery.

Pig-iron and steel metallurgy, cement and chemical production are the main carbon intensive segments, and efforts have been made since 1995 to reduce emissions. The reduction of iron ore, whose primary processing in blast furnaces produces pig-iron, is the most carbon intensive process, and most of Brazilian pig-iron and steel industries use coking coal for this process. The main energy efficiency opportunity in this segment is steel recycling, in which it is melted in electrical furnaces. Carbon reductions can be achieved by the use of charcoal from sustainable reforestation to replace coal. However, the traditional blast furnaces designed for coke coal cannot be converted to use charcoal due to their dimensions. All production line and stages are designed to optimize the use of traditional furnaces, so this transition would imply in redesigning the whole production system (SEEG, 2014).

The main carbon intensive process in cement industry is the clinker production, which is prepared by sintering limestone and alumino-silicate materials. Brazilian cement industries have done transition to petroleum coke instead of mineral coal since 1995. Local innovations since 2003 like the precalcining process, the use of slag from metallurgy and ashes from thermoelectric plants as raw materials, and the co-processing of solid waste have decreased carbon emissions from this segment. Further energy efficiency can be achieved by improving distribution and final use life cycle stages, as cement has a relatively short shelf-life (around 60 days), so energy costs and carbon emissions from distribution are critical, as is waste in construction plants and small reforms and retrofits.

In the chemical segment, transformation and gas production are the main carbon intensive processes, and some control projects in the production of adipic and nitric acid have been implemented since 2007.

The national indicator of industrial energy intensity (tons of oil equivalent consumed/US$ of GDP) has decreased in the last ten years, from 206.1 toe/US$ of industrial GDP in 2003 (the maximum value in historical database) to 161.8 toe/US$ of industrial GDP in 2014 (Figure 14). This is likely to be caused by changes in fuel source and industrial production, rather than the widespread implementation of energy efficiency. Figure 15 shows how Brazil's total GDP has continued rising, even with industrial emissions having stabilised since 2011; this is likely to be a consequence of the increasing focus on services sector within Brazil's economy.

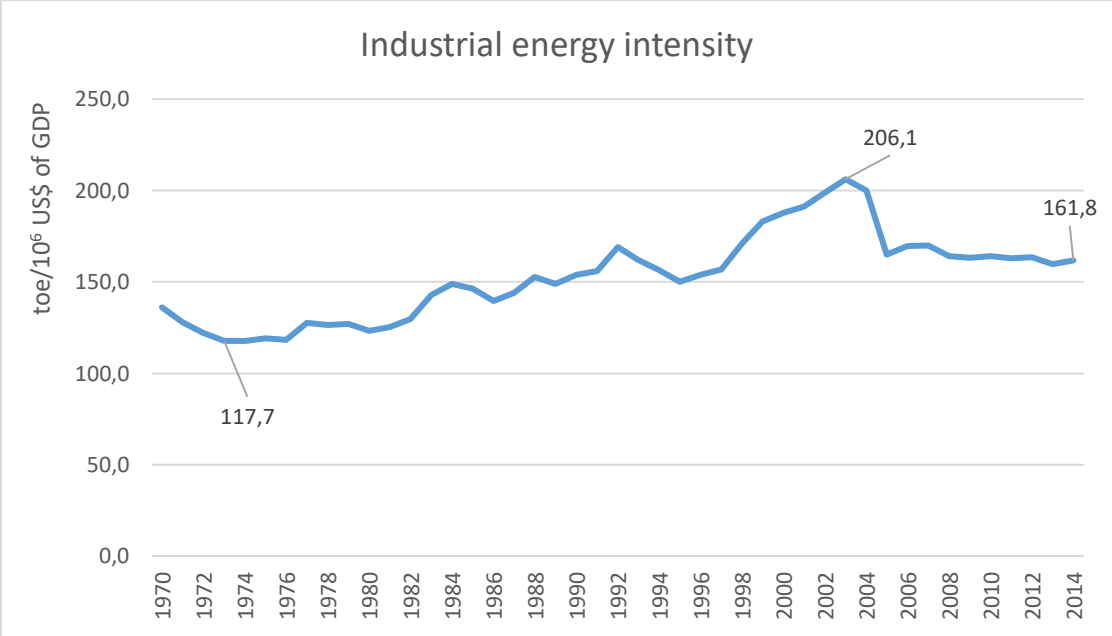

Figure 14 – Industrial energy intensity (toe per 10^6 US$ of GDP)
Source: BEN - MME (2016)

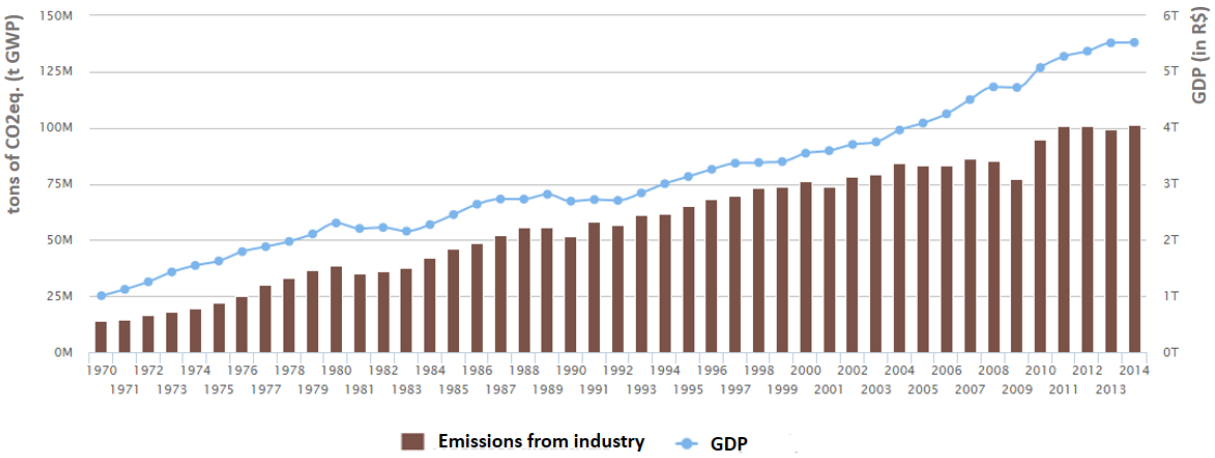

Figure 15 – Carbon emissions from Industry and total GDP (in R$)
Source: SEEG (2016)

Public policy

The main Brazilian energy efficiency programs are the National Electricity Conservation Program (PROCEL), the National Rational Use of Oil Products and Natural Gas Program (CONPET), and the Brazilian Labelling Program (PBE). The main public initiatives focused on the industrial sector are PROCEL Industry, financing lines linked to energy efficiency from the Brazilian Development Bank (BNDES) and the Energy Efficiency Program (PEE) of the National Agency of Electrical Energy (ANEEL), explained below:

- **PROCEL Industry:** established in 2004 by Eletrobras, the program aims to minimize energy losses in driven systems existing in the Brazilian industry – responsible for half of electricity consumption. Industries are approached through sector associations and federations, and the program has seen implementation in more than 15 Brazilian states;
- **CONPET:** operates in the industry sector together with PROCEL and CNI through the Industry Energy Conservation Awards;
- **BNDES Energy Efficiency:** formerly known as PROESCO established by BNDES in 2006 and redesigned in 2015, the program is a credit line which can finance up to 70% of energy efficiency projects focused on cogeneration and other energy systems;
- **PEE:** program conducted by ANEEL in which all the energy distributors must invest 0,5% of their net revenue in energy efficiency programs. In the period between 2008 and 2015 there were 58 projects implemented in the industry, saving 166 GWh/year.

According to the National Plan for Energy Efficiency (PNEF – *Plano Nacional de Eficiência Energética* in Portuguese), between 1999 and 2009, R$161 million have been invested in 217 different energy efficiency projects in the industry, most of them developed within the Energy Efficiency Program (PEE) of ANEEL (MME, 2011). The projects covered 13 industrial sectors, 19% were related to the substitution of motors, 20% to improvements in lighting systems, and 8% to improvements in compressed air systems.

The 10-Year Energy Plan 2024 (PDE – *Plano Decenal de Expansão de Energia* in Portuguese) estimates that energy efficiency actions shall save around 4.7% in 2024, with 53% of these savings from industry. The PNEF 2030 estimates 10% reduction of electricity consumption in 2030, in which industry is responsible for 37% of the results. However, implementation of the PNEF has not been prioritised over the last three years.

The National Policy for Climate Change (PNMC – *Política Nacional sobre Mudança do Clima* in Portuguese), enacted in 2009, demands the development of sectorial mitigation plans. The Industry Plan establishes as a target the 5% reduction of industrial process emissions and energy

use compared to the BAU scenario (Business As Usual) projected for 2020. One of its main pillars is the implementation of a monitoring, reporting and verifying emissions system of carbon intensive segments (SEEG, 2015).

Recently the National Council on Energy Policies approved the creation and establishment of a Thematic Committee for Energy Efficiency (CTEE), which aims to propose strategies for the promotion of energy efficiency and their inclusion in the set of policies and actions for the sustainable development in Brazil.

Norms and standards

There are few Brazilian norms and standards directly related to energy efficiency in industry, and most were launched in the last five years. As voluntary standards, they are published and updated by the Brazilian Association of Technical Norms (ABNT).

NBR ISO 50001:2011 specifies the requirements for establishing, implementing, maintaining and improving an energy management system (EMS), whose purpose is to enable organizations to follow a systematic approach of continuous improvement of energy performance, including energy efficiency, energy use and consumption.

NBR ISO 50004:2014 provides practical guidance and examples for establishing, implementing, maintaining and improving an energy management system (EMS) according NBR 50001. The guidelines are applicable to all organisation types, regardless of size, location or level of maturity.

Regarding the energy performance of products, in 2015 ABNT launched ISO/TS 14067:2015, which establishes principles, requirements and guidelines for quantification and communication of products' carbon footprints. This standard is based on other life cycle analysis and environmental labelling standards. More information of this certification system can be found at the ABNT Sustainability Portal[4].

Comparison with the global energy efficiency market

Within the global energy market, all countries still have energy efficiency potential. While the sector has been playing a role in the economies of developed nations for decades, cost-effective energy efficiency continues to be an underutilized energy resource. The average score of the *International Energy Efficiency Scorecard 2016* (developed by the American Council for an Energy-Efficient Economy – ACEEE) was just 50 points, while the maximum possible score for a country is 100 points, allocated equally to National Efforts, Building, Industry and Transportation sectors. Out of the 23 large economies analysed in this report, Brazil ranked 22th with 32.5 points (Figure 16).

[4] http://www.abntonline.com.br/sustentabilidade/(S(u524m1cjpha2xmqg4yrattuf))/

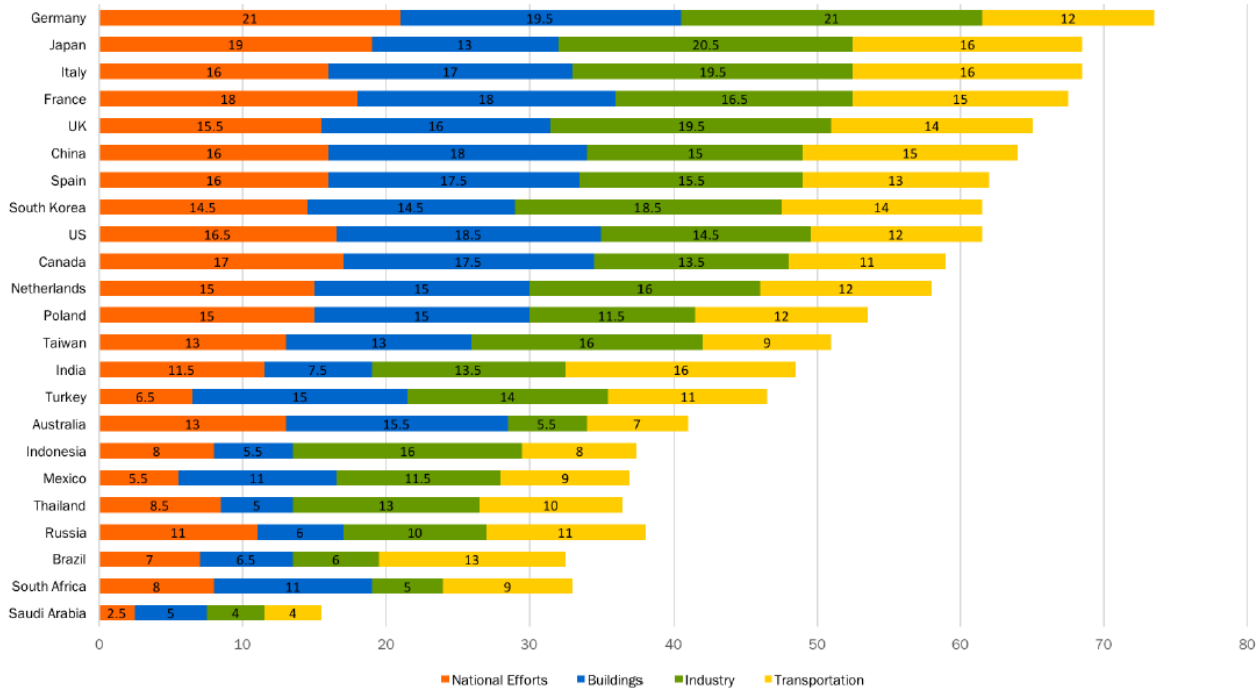

Figure 16 – Overall country scores by sector
Source: ACEEE (2016)

In the industry sector countries were scored based on performance criteria: the sector's energy intensity, the investment in industrial Research and Development (R&D), and how much of the industrial electricity comes from combined heat and power supply (CHP). Policy metrics (National efforts) were evaluated considering the government efforts for industrial energy efficiency, mandates requiring periodic energy audits and onsite energy managers, and the implementation of voluntary programs.

The top-scoring country in the industrial sector is Germany, followed by Japan, and the United Kingdom and Italy tied for third (Figure 16). Brazil was fourth from the bottom in the industrial section, and this sector obtained fewer points than any other national sector (Figure 17). According to ACEEE (2016), the country would benefit from public-private voluntary agreements for energy efficiency and requirements for plant energy managers and/or periodic energy audits, as less than one percent of industrial electricity is generated with combined heat and power.

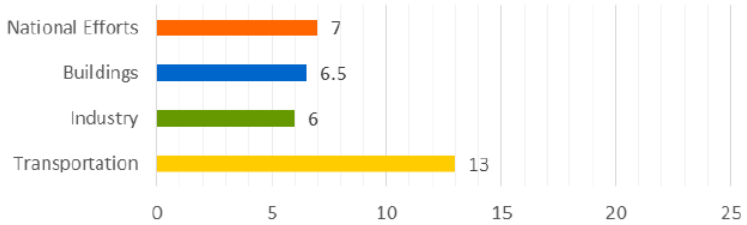

Figure 17 – Brazilian energy efficiency scores.
Source: ACEEE (2016)

Key Players

The main stakeholders in the industrial energy efficiency sector are listed in Table 3, which briefly describes the role of each one.

Table 3 – Key Players in the energy efficiency in industry sector

Organisation	Full name in English	Role	Website
CNI	National Confederation of Industry Brazil	Defend and represent industry in the promotion of a favourable environment for business, competitiveness and sustainable development	http://www.portaldaindustria.com.br/cni/
SEBRAE	Brazilian support service for SMEs	National organisation which supports SMEs in a range of areas	www.sebrae.com.br
SENAI	National Industrial Apprenticeship Service	Organisation in each state which provides technical training	www.sp.senai.br
ABESCO	Brazilian Association of Energy Services Companies	Association of ESCOs (Energy Services Companies) which provide consultancy in energy efficiency and sometimes performance contracting	www.abesco.com.br
ANEEL	National Electrical Energy Agency	Regulates the energy distributors and the energy efficiency investment programme (PEE)	www.aneel.gov.br
EPE	Energy Research Company	Branch of the energy ministry which publishes data on the sector and develops energy planning scenarios for supply and demand	www.epe.gov.br
MME	Ministry for Mines and Energy	National ministry responsible for energy	www.mme.gov.br
Procel	Brazilian Electrical Energy Efficiency Programme	Develops national standards and programmes for energy efficiency	www.procel.gov.br

3 Main technologies, services and processes

This section of the report divides the energy efficiency in industry sector into ten sub-sectors, which represent the main systems that are commercially available in the sector. This evaluation has gone beyond simply mapping products, to include technologies, services and processes (collectively defined as energy efficiency systems).

Table 4 – Main technologies, services and processes by energy efficiency in industry by sub-sector

Sub-sector	Examples of technologies and services	Description
Process automation and controls	Meters	Systems that provide information on energy consumption and processes automation.
	Control systems	
Compressed air systems	Efficient compressors and dryers	Technologies and equipment to optimize compressed air systems.
	Improved distribution	
	Maintenance services	
Steam systems	Improved boiler technology and performance	Technologies and equipment to optimize steam systems.
	Economisers and heat recovery	
	Optimised distribution and maintenance	
	Improved condensate recovery	
Driven systems	Efficient motors	Technologies and equipment to optimize driven systems.
	Efficient pumps	
	Efficient fans	
Furnaces	Thermal insulation	Technologies and equipment to optimize furnaces efficiency.
	Combustion analysis	
Cooling systems	Heat exchangers	Hardware and controls for increased efficiency of heat exchangers, ventilation and air conditioning systems.
	Chillers and other HVAC systems	
Lighting	Natural lighting	Systems to provide desired light levels and quality more efficiently to the end-users, using both natural and artificial lighting.
	LED lighting	
	Lighting automation	
Consultancy and Software systems	Diagnostics	Professional and customised services and software solutions for efficient energy consumption diagnosis and management.
	Energy management	
Design and Engineering	Industrial processes design	Professional services provided during the design or redesign of new industrial plants, products or processes.
	Machinery design	
	Engineering design projects	
Training and Certification	ISO Standards	Provision of training courses and certifications to upskill professionals in the sector and provide manpower for the operation of more complex, efficient systems.
	Energy Management Training	

4 Segmentation of Brazilian markets

A primary aim of this study was to map and identify Brazilian companies with potential for cooperation and business opportunities through contact and matchmaking with appropriate European companies supplying technologies, processes and services in the area mapped above. This was carried out through an analysis of the literature, a review of sector-specific reports and semi-structured interviews with key specialists in the area. These interviews have been transcribed and are annexed to this report (in Portuguese).

The ultimate aim of the matchmaking missions is to generate bankable proposals for business agreements between the European and Brazilian partners.

It became clear from this mapping that Brazilian industries still do not recognize energy efficiency as a strategic guideline to reduce costs, increase competitiveness and maximize profitability. When industries are looking for energy efficiency opportunities, the first port of call is reportedly equipment suppliers and importers, with specialised consultancies being contacted as a second option. In order to organise the mapping of potential participants in the matchmaking project, the following diagram illustrates the two types of potential partner organisations: associations of intermediaries (equipment supplier and importer, consultancies, etc) and segment associations (association of chemical industry, etc) (Figure 18). Table 5 presents some examples of sector organisations and companies that could be considered intermediaries, while Table 6 shows sector organisations in each specific area of industry.

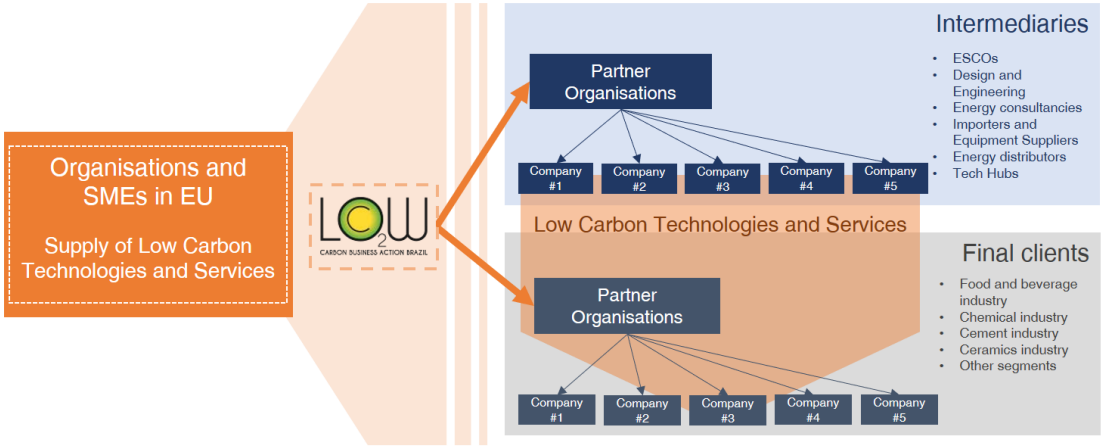

Figure 18 – Strategic sector segmentation

Table 5 – Sector organisations, types and examples of companies with demand for energy efficiency systems

Intermediaries		
Type of company	**Sector organisations**	**Example of companies**
ESCOs	ABESCO	• 3E Engenharia em Eficiência Energética • Eficienergy • Green Yellow • CPFL Eficiência • EDP Comercialização e Serviços
Design and Engineering	-	• Petroeng • Mixing Consultoria • Optimus
Energy Consultancies	-	• GCE do Brasil • Lemke • Grugeen
Importers and Equipment Suppliers	ABIMAQ ABIMEI	• Intertech do Brasil • Eletrothermo • Atlasmaq
Energy Distributors	ABRADEE ABRATE ABCE	• AES Eletropaulo • CPFL Energia
Tech Hubs	-	• CPqD • Celta

Table 6 - Industrial segments and sector organisations

Final clients	
Industrial segments	**Partner organisations**
All segments	SEBRAE, CNI, SENAI, ABRACE
Food and Beverage	ABIAF, ABRABE, ABIR, ABIC, ABIS, CERV Brasil
Chemical	ABQUIM, ABRAFATI, ABPOL
Cement	ABCP
Ceramics	ABCERAM
Pulp and Paper	BRACELPA
Mining, Metallurgical and Ferro-aloys	ABM, ABRAFE, Instituto Aço Brasil
Textiles	ABIT
Others	ABIVIDRO

Brazilian industry: size, geographical and segment distribution

The contribution of Brazilian industry to the gross national product (GDP) has reduced in the last ten years, and has reached almost the same percentage share presented seven decades before. In 1947 the percentage share of industrial activities in GDP was 11%, and in the 1980s it reached its maximum, 22%. However, the sector went into rapid decline trend in the past

decade, between 2010 and 2013 its contribution varied from 27.4% to 24.9% (CNI, 2016).

Figure 19 shows the percentage variation of GDP and the industry participation share, with forecasts for 2015 and 2016 (CNI, 2015). Figure 20 presents the same declining trend in the physical production index for all industry segments, from data developed and published by IBGE. In terms of industrial companies' size, Figure 21 shows that 97% of industry has less than 100 employees, and 46% employs between 5 and 29 personnel (IBGE, 2016).

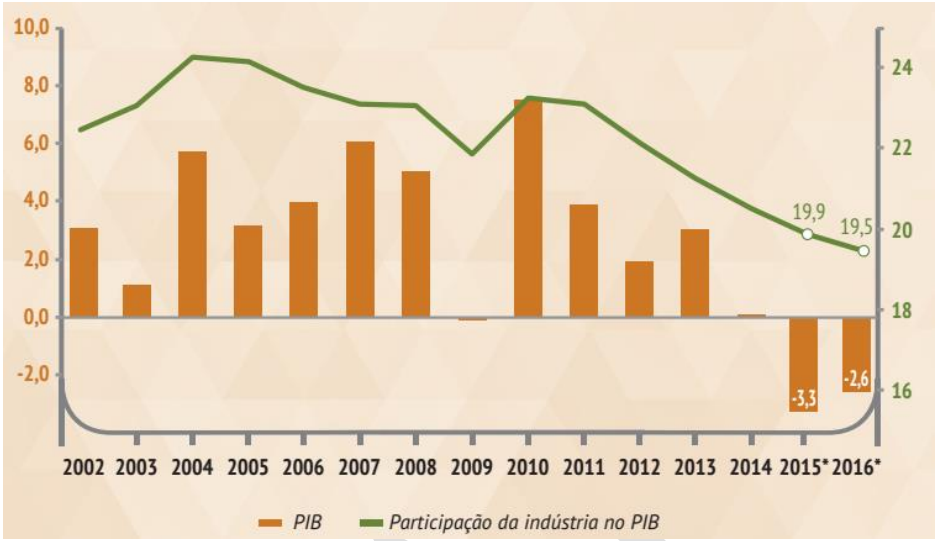

Figure 19 – Annual variation of GDP (orange) and industry share of GDP (green), both in %
Source: CNI (2015)

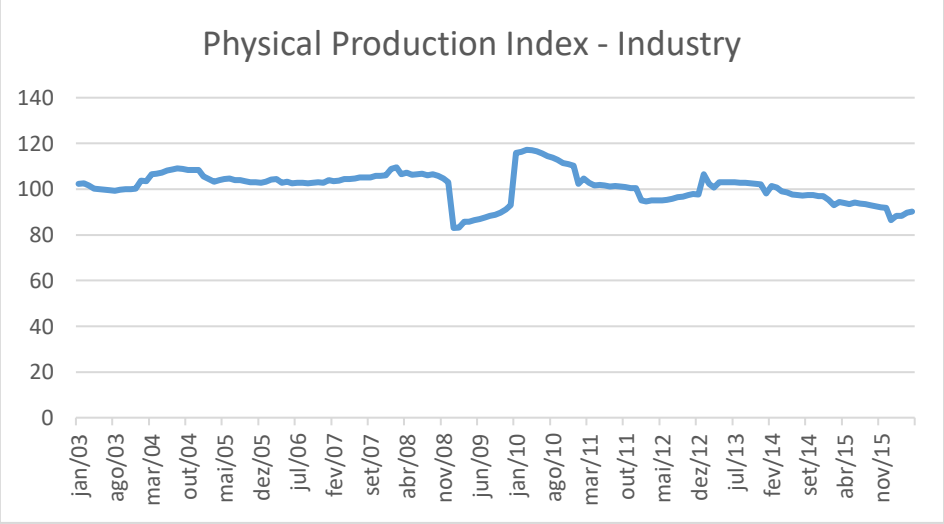

Figure 20 – Physical Production Index of all industry segments
Source: IBGE (2016)

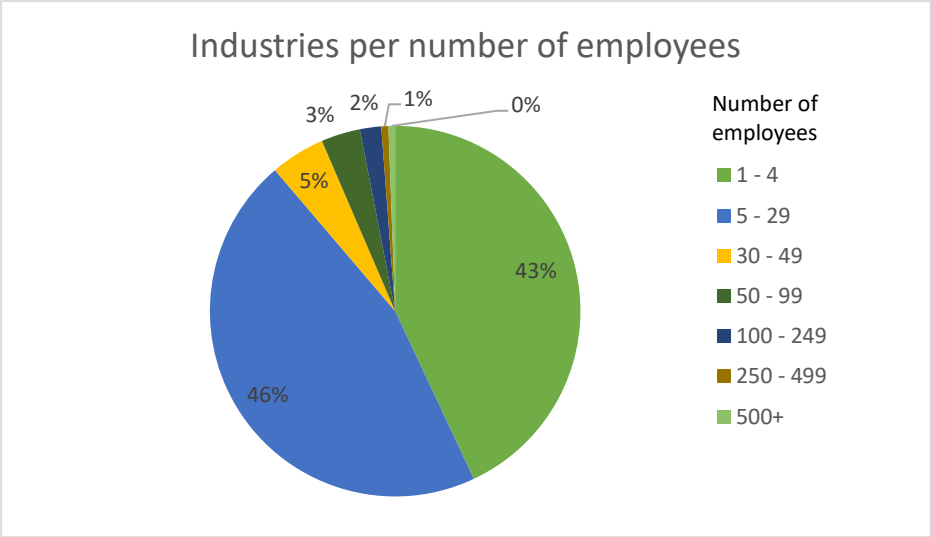

Figure 21 – Percentage of Brazilian industries per number of employees
Source: IBGE (2014)

In terms of industrial production, the four largest Brazilian states – São Paulo, Rio de Janeiro, Minas Gerais and Paraná – account for 61% of production and the top ten states account for over 85% of industrial production by value. Figure 22 presents the percentage share of Brazilian states in industrial national GDP. São Paulo has the biggest industrial production of the country (28.6%), followed by Rio de Janeiro (14.4%), Minas Gerais (11.6%) and Paraná (6.6%) (CNI, 2016).

Table 7 presents the industrial GDP, compares electricity tariffs with the national average and depicts the main industrial segments of the main ten states accounting for industrial production.

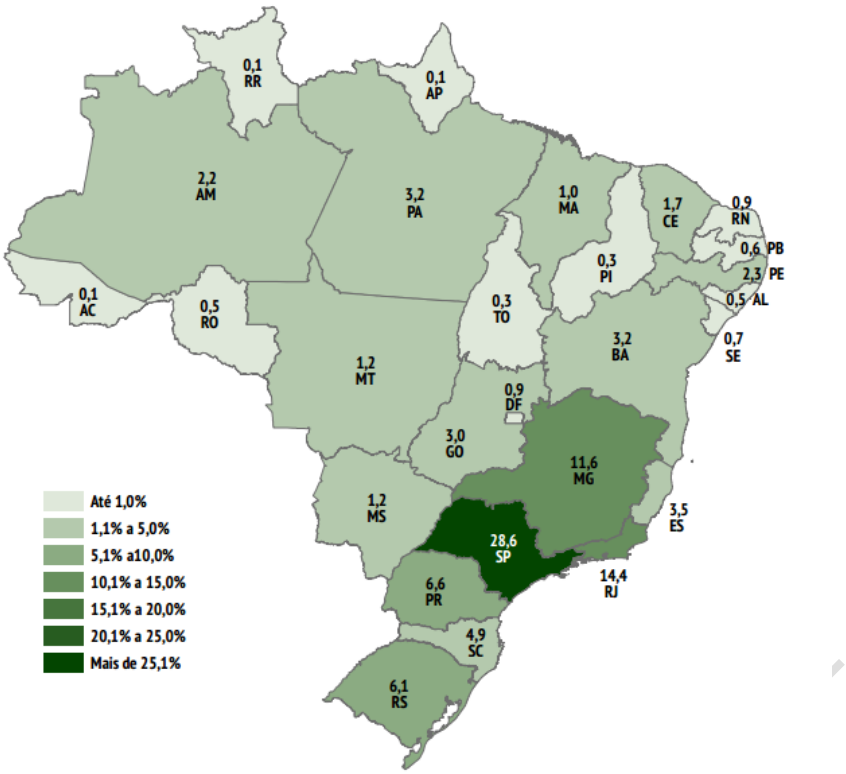

Figure 22 – Percentage share of Brazilian states in industrial national GDP, 2013
Source: CNI (2016)

Table 7 – Industrial GDP, electricity tariff comparison, and main industrial segments per state
Source: CNI (2016)

Ranking	State	Industrial GDP 2013 (million R$)	Relative electricity cost – comparison with national average tariff 2015 (%)	Main industrial segments
1	São Paulo	323,301.6	1.7%	Construction (24.8%), Food (9.8%), Petroleum products and biofuels (8.4%) and Motor vehicles (8.2%)
2	Rio de Janeiro	162,520.1	25%	Oil and gas exploration (22.2%), Construction (20.9%), Petroleum products and biofuels (12.4%), and Public utility industrial services (7.2%)
3	Minas Gerais	131,234.0	7.7%	Construction (23.8%), Metallic mineral extraction (20.0%), Food (8.7%) and Metallurgy (8.2%)
4	Paraná	75,068.4	12%	Construction (21.7%), Public utility industrial services (15.2%), Food (13.6%) and Motor vehicles (13.2%)
5	Rio Grande do Sul	69,500.3	2.5%	Construction (21.7%), Food (11.5%), Motor vehicles (9.5%) and Machinery and equipment (8.2%)
6	Santa Catarina	55,765.1	2.0%	Construction (20.0%), Food (13.1%), Public utility industrial services (7.4%) and Electric machinery and materials (7.4%)

Ranking	State	Industrial GDP 2013 (million R$)	Relative electricity cost – comparison with national average tariff 2015 (%)	Main industrial segments
7	**Espírito Santo**	39,476.5	21.9%	Metallic mineral extraction (24.0%), Oil and gas exploration (17.5%), Construction (15.7%) and Metallurgy (6.6%)
8	**Pará**	36,525.1	-3.2%	Metallic mineral extraction (51.8%), Construction (23.6%), Public utility industrial services (9.1%) and Food (4.6%)
9	**Bahia**	36,472.5	-26.6%	Construction (41.4%), Petroleum products and biofuels (14.6%), and Public utility industrial services (8.2%) and Chemical (7.3%)
10	**Goiás**	34,498.5	-7.7%	Construction (30.7%), Food (26.3%), Public utility industrial services (13.7%) and Petroleum products and biofuels (3.8%)

Machinery and equipment: domestic production and imports

The importation of industrial machinery and equipment represents a significant share of their consumption in the sector, almost equal to domestic production. The apparent consumption (domestic production – exports + imports) presented a 14.7% growth between December 2015 and January 2016, but there was a 25% drop when comparing to January 2015 (ABIMAQ, 2016).

The physical production index for machinery and equipment national production and maintenance also shows this declining trend since 2013 (Figure 23). It is interesting to observe that the maintenance, repair and installation sector overcame the production index in 2013. Since the economic recession in the end of 2015 there is a tendency to maintain old equipment rather than buying new ones – however, a future growth of economy will probably reverse this scenario.

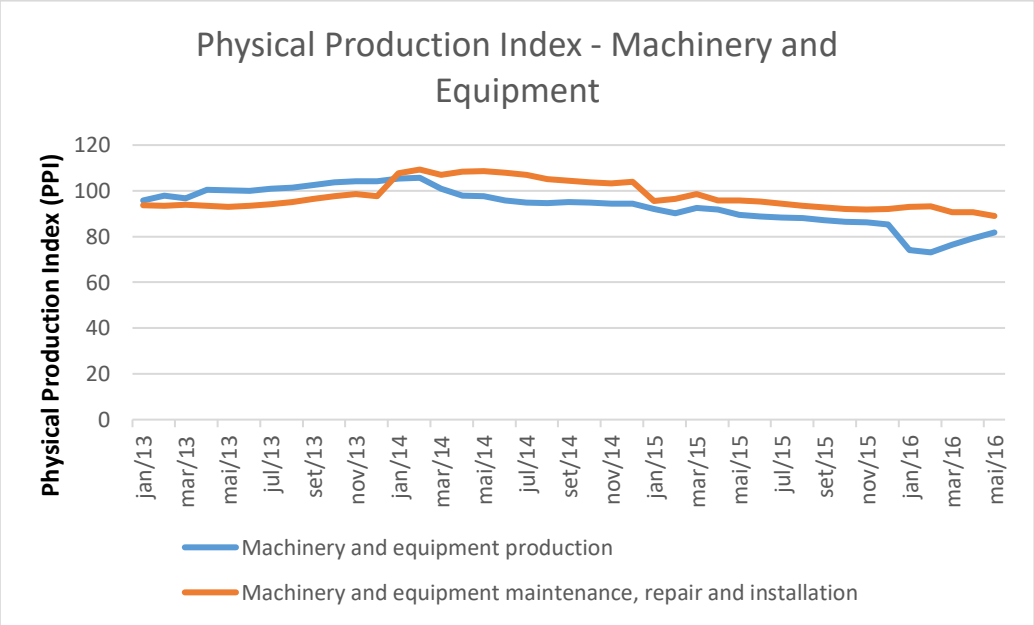

Figure 23 – Physical production index for machinery and equipment production, maintenance and installation[5]
Source: IBGE (2016)[6]

The imports of industrial machinery and equipment also had a low point in 2009, within the global economic crisis. Figure 24 presents the declining trend of these products' importation. Comparing to December 2015, in January 2016 imports presented a 17.1% growth – however, in comparison to January 2015, there was a 30.4% decrease in imports. Unfortunately, this decline was not counterbalanced to the increase of national production (Figure 23) (ABIMAQ, 2016). According to Brazilian Association of Industrial Machinery and Equipment Imports (ABIMEI – *Associação Brasileira dos Importadores de Máquinas e Equipamentos Industriais* in Portuguese), this is a natural reflex of the drop of confidence levels in the Brazilian producers (FOLHA, 2016).

However, at the time of writing, the industrial sector has already started to show signs of improved confidence. The Industrial Confidence Index (ICI) rose in June 2016 for the fourth

[5] These industrial segments correspond to the activities national classification (in Portuguese: *3.28 Fabricação de máquinas e equipamentos* and *3.33 Manutenção, reparação e instalação de máquinas e equipamentos*)
[6] There is only available data since 2013 for both sectors.
http://www.sidra.ibge.gov.br/bda/default.asp?z=t&o=1&i=P

consecutive month, and is now at its highest point since February 2015. At the same time, the IE (Expectation Index) rose 7.5%, its sharpest increase in the last 14 years. Since these indices are closely related to the appetite for investment within the business community, the near future should be more favorable to equipament sellers and the sector as a whole.

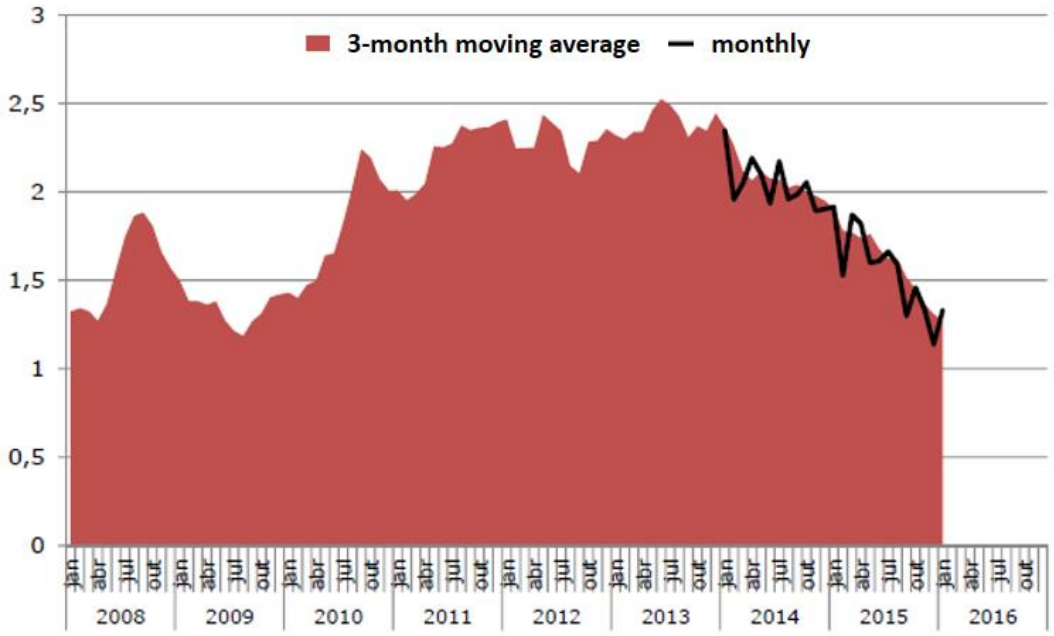

Figure 24 – Machinery and equipment importation, in US$ billion units (FOB)
Source: DCEE/ABIMAQ (2016)

5 Main technologies, services and processes already available, needs and gaps in the Brazilian sector

This section was developed through analysis of literature, review of sector-specific reports, internet search and semi-structured interviews with key specialists in the area in order to map and identify the main technologies and services available in Brazil, and both the needs and gaps of energy efficiency in the industrial sector.

The interviews were carried in June and July 2016 with experts with different perspectives of the energy efficiency in industry market. The semi-structured interviews are annexed to this report, and also the transcription of each one (in Portuguese). Four experts were consulted:

- Paulo Cruz, General Manager of Energy Efficiency, Electric Systems and Energy Market and Solutions at Vale S.A.;
- Paulo Miotto, co-owner of Ecoeficiencia, a company composed of energy efficiency experts and energy technology scientists in the industrial sector;
- Helder Sousa, Energy Efficiency Specialist at ABRACE and in TR Soluções;
- Rodrigo Sarmento Garcia, Policy and Industry Specialist at CNI.

Most of the specialists noted the need for expertise in thermal systems (steam systems and furnaces) as technology gaps in Brazil, and they see business opportunities in this subsector. The other sub-sectors highlighted were automation and control systems, consultancy and software services, and training certifications.

Table 8 presents a brief summary of the conclusions drawn on technologies and services availability, needs and gaps in Brazil.

It was noted that many standard industrial systems and cross-cutting technologies are consolidated markets, dominated by multinational companies. Examples of these areas include chillers and HVAC equipment, compressors, boilers and electric motors. As such, the gaps and needs which are likely to represent business opportunities for EU SMEs are largely related to specialist services or equipment and niche technologies.

Table 8 – Main technologies and services Available in Brazil, innovation, needs and gaps

LOW CARBON TECHNOLOGIES, SERVICES AND PROCESSES ON ENERGY EFFICIENCY IN INDUSTRY		AVAILABILITY IN BRAZIL	INNOVATION, NEEDS & GAPS IN BRAZIL
Sub-sector	Technology/Service/Process		
Process automation and controls	Meters	1 - mature	1 - high
	Control systems	1 - mature	
Compressed air systems	Efficient compressors and dryers	1 - mature	2 - medium
	Improved distribution	2 - established	
	Maintenance services	3 - incipient	
Steam systems	Improved boiler technology and performance	2 - established	1 - high
	Economisers and heat recovery	3 - incipient	
	Optimised distribution and maintenance	3 - incipient	
	Improved condensate recovery	3 - incipient	
Driven systems	Efficient motors	2 - established	3 - low/not required/longterm
	Efficient pumps	3 - incipient	
	Efficient fans	3 - incipient	
Furnaces	Thermal insulation	1 - mature	1 - high
	Combustion analysis	2 - established	
Cooling systems	Heat exchangers	1 - mature	3 - low/not required/longterm
	Chillers and other HVAC systems	2 - established	
Lighting	Natural lighting	2 - established	3 - low/not required/longterm
	LED lighting	2 - established	
	Lighting automation	2 - established	
Consultancy and Software systems	Diagnostics	3 - incipient	1 - high
	Energy management	3 - incipient	
Design and Engineering	Industrial processes design	4 - not available	2 - medium
	Machinery design	4 - not available	
	Engineering design projects	3 - incipient	
Training and Certification	ISO Standards	3 - incipient	1 - high
	Energy management trainings	4 - not available	

6 Main trends in international innovative technologies, services and processes

International policy and trends

Industrial energy efficiency has been a key part of policies to limit energy consumption and CO_2 emissions across the world, as reported in Chapter 3 of the IPCC's 2014 Fifth Assessment Report, which sets out the current and achievable levels of energy efficiency for the main industrial sectors. As shown by a sectorial analysis from 2008 (WORRELL et al, 2008), there is a significant reduction in consumption achievable just by reaching international best practice in manufacturing energy efficiency in different sectors.

The International Energy Agency publishes Policy Pathways documents, including a detailed report on energy management programmes for industry (IEA 2012) and runs the Energy Management Action Network to promote industrial energy efficiency savings (http://www.iea.org/topics/energyefficiency/subtopics/industry/). The United Nations Industrial Development Organisation (UNIDO) runs several programmes on industrial energy efficiency, including reports, good practice guides and evaluations of specific sectors (http://www.unido.org/resources/publications/safeguarding-the-environment/industrial-energy-efficiency.html).

A common theme in these programmes is a push to roll out existing best practice in industrial energy efficiency, including energy management, rather than focus on the development of new technology. For this reason, many of the policies proposed and introduced are financial measures, rather than technical research measures.

Most major economies have industrial energy efficiency policies; a few of these are identified in Table 9.

Industrial energy efficiency in Europe

An analysis of "Energy Efficiency Trends and Policies in Industry" (Intelligent Energy Europe 2015) tracks the development of energy consumption in the sector in Europe. It shows that energy consumption in industry has been decreasing in Europe since 2007 and was 17% below 2000 levels by 2013. Industrial energy efficiency was increasing by 1.9% per year until 2007, but since then the rate of improvement has slowed significantly (to 0.9% per year). This is principally due to the steel and cement industries, which have actually reduced their energy efficiency since 2008, as depressed output has meant furnaces have operated below their full capacity, pushing energy intensity up.

The reduction in industrial energy consumption is shown by Figure 25 and Figure 26, while the principal industrial segments in different European countries are shown in Figure 27. The sector with largest overall energy consumption in the EU is now the chemicals sector.

Barriers identified for industrial energy efficiency include information and knowledge deficits, uncertainty, low priority for energy efficiency investment and high transaction costs. European policy on energy efficiency includes both regulatory measures and incentives, and varies significantly between different countries. In most cases, industrial energy efficiency incentives involve financial measures and support for energy management or energy auditing.

Table 9 - Energy efficiency programmes in selected countries.
Source: own elaboration

Country	Energy efficiency governing body	Industrial energy efficiency programme
USA	Department of Energy – Office of Energy Efficiency and Renewable Energy	Advanced Manufacturing Office – (formerly Industrial Technologies Program – ITP)
USA	Environmental Protection Agency - EPA e DOE	EnergyStar for Industry Program
Sweden	Swedish Energy Agency	Programme for Energy Efficiency in Energy Intensive Industry - PFE
UK	Department for Energy and Climate Change	Energy Efficiency Best Practices Programme (defunct)
New Zealand	Energy Efficiency and Conservation Authority - EECA	New Zealand Energy Efficiency and Conservation Strategy (NZEECS) - EECA Business Programme
Japan		Energy Conservation Center, Japan (ECCJ)
Germany		Learning Energy Efficiency Networks (LEEN)
Canada		Canadian Industry Program for Energy Conservation (CIPEC)
France	Agence de l'Environnement et de la Maîtrise de l'Energie - ADEME	Le contrat d'objectifs État - ADEME 2009-2012
Denmark	Danish Energy Authority (DEA)	Denmark's agreement on industrial energy efficiency (DAIEE)
Australia	Department of Resources, Energy and Tourism (DRET)	Energy Efficiency Opportunities program - EEO
European Union	European Commission	Intelligent Energy Europe - IEE
Portugal	ADENE	Gestão dos Consumos Intensivos de Energia na Indústria
Turkey		Improving Energy Efficiency in Industry(IEEI)
India		Perform Achieve Trade (PAT)
Netherlands	Ministry of Economic Affairs	Long-term Agreements on Energy Efficiency (LTAs)
South Africa		National Energy Efficiency Leadership Network (EELN)
Ireland	Sustainable Energy Authority of Ireland (SEAI)	Energy Agreements Programme - EAP

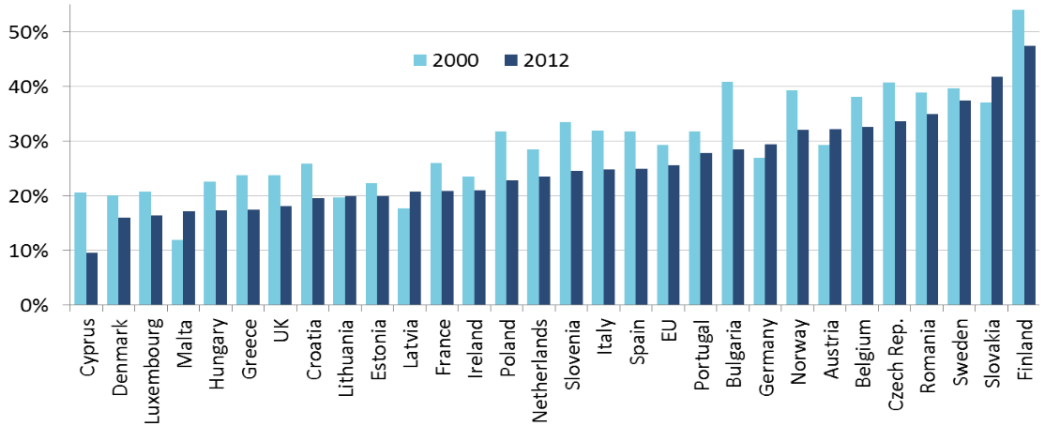

Figure 25 - Share of industry in total final energy consumption in EU countries
Source: Intelligent Energy Europe 2015, with data from ODYSSEE and Eurostat

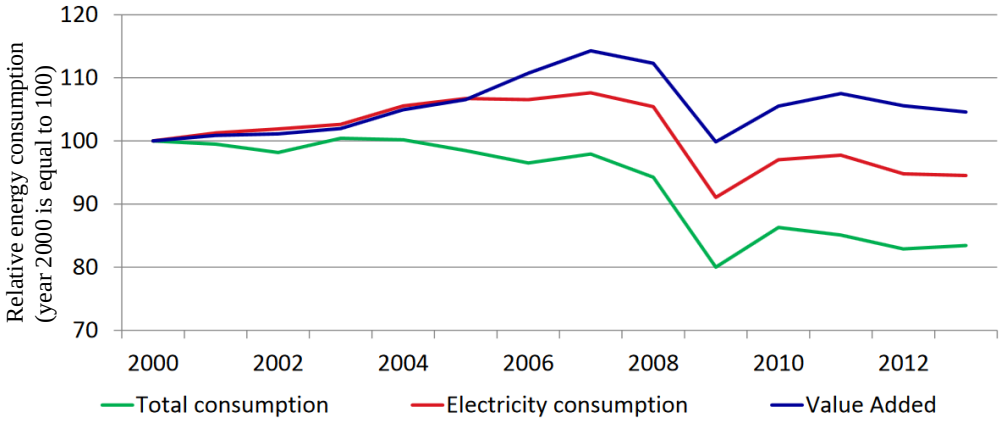

Figure 26 - Energy consumption trends and activity in industry in the EU (base year 2000 is 100)
Source: Intelligent Energy Europe 2015, with data from Eurostat

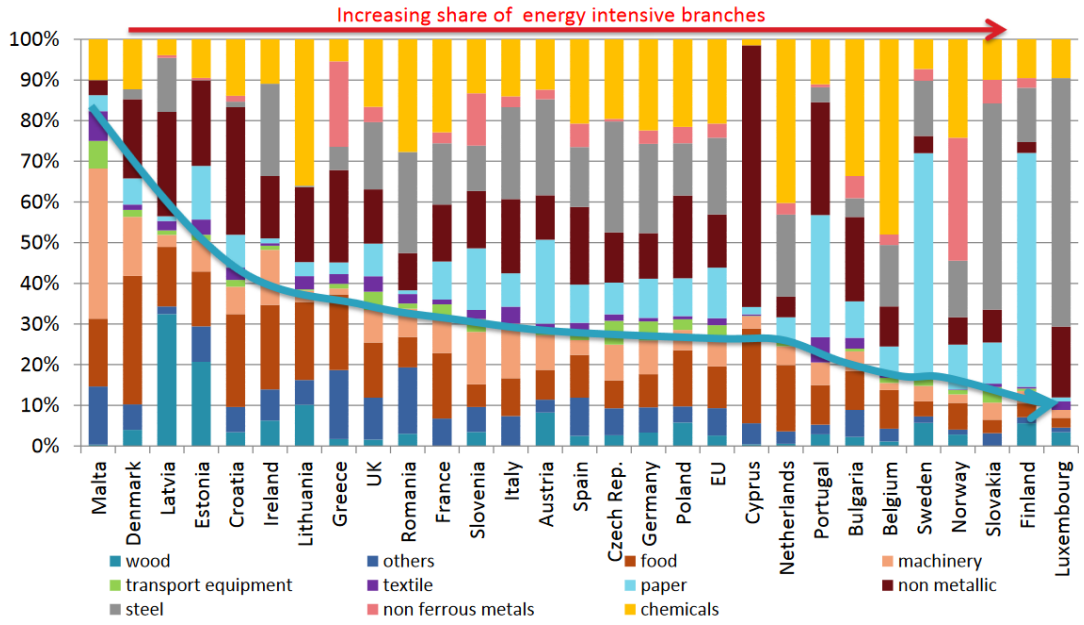

Figure 27 - Share of industrial energy consumption by branch in EU countries (2012)
Source: Intelligent Energy Europe 2015, with data from ODYSSEE

Research and innovation

Industrial energy efficiency programmes often consider dissemination of good practice or best available technology, as well as direct research on new technology. Generally, three types of energy efficiency improvement are considered:

- Energy management;
- Process efficiency, usually sector-specific; and
- Cross-cutting technologies, such as electric motors or other utilities.

These three energy sectors are complementary, and a few examples are given below.

The American Council for an Energy Efficient Economy (ACEEE) and the Federal Energy Management Program (FEMP) are among several organisations that publish energy management guidelines and good practice (http://aceee.org/topics/industrial-energy-efficiency-programs and http://energy.gov/eere/femp/federal-energy-management-program).

The Advanced Manufacturing Office of the US Department of Energy provides energy efficiency information for several key cross-cutting technologies, including steam systems, combined heat and power, pumps, fans and compressed air, available at http://energy.gov/eere/efficiency/advanced-manufacturing.

Other organisations focus on energy efficiency in specific sectors; for example the Carbon Trust in the UK ran an Industrial Energy Efficiency Accelerator; among other things, they produced a series of reports on industrial energy best practices for specific sectors, available at: https://www.carbontrust.com/resources/reports/technology/industrial-energy-efficiency/. The World Business Council for Sustainable Development has a Sustainable Cement initiative, which works on improvements specifically for this sector (http://www.wbcsdcement.org).

International cooperation is also important; the China Energy Group at Lawrence Berkeley National Laboratory focuses specifically on research and technology transfer between the USA and China, with a focus on energy efficiency (https://china.lbl.gov/).

A deeper approach to industrial energy efficiency researches not just the potential gains from process innovation, but also the importance of materials substitution, recycling and reuse in the principal industrial sectors (http://www.withbotheyesopen.com/read.php).

Overall, there is clearly significant potential for improvement of energy efficiency through innovative technologies, services and processes. Most or all of these will have international relevance and can be implemented in several different countries with similar industrial processes.

7 Entry barriers to Brazilian markets

There are significant barriers to enter the Brazilian market, some of which are structural and others which are temporary market effects. Based on the experience of the authors and the results of interviews, the main barriers are listed and summarized below.

Costs

Probably the most important barrier facing most European suppliers is cost, especially when compared to lower-cost Brazilian manufacturers and Chinese imports. The devaluation of the real since its peak in around 2010 has significantly increased costs on the local market. Although European products can present higher quality and efficiency as a competitive advantage, Brazilians customers are extremely sensitive to costs, and even though long term benefits and financial returns are considered in the decision making, they are less important than inicial acquisition costs. Depending on the commercial models adopted, high import duties and local taxes may add to this cost.

Many tender processes (including nearly all public tenders) are carried out on a least-cost basis. This makes it hard for superior quality European products to compete, as they are likely to give better performance and lower lifetime costs, but have higher up-front costs than their competitors.

Bureaucracy

Brazilian law imposes significant bureaucratic costs on companies operating in the country, which tend to lengthen the amount of time required for tasks such as opening a company, registering for an import licence or meeting financial and tax obligations. Almost all the specialists interviewed raised these issues. Having mentioned that, the easiest way to minimise these issues is entering the market with a Brazilian partner.

Justifying investment

In general, many Brazilian companies are averse to long-term investments and may require shorter paybacks than European companies in order to justify investing in energy efficiency. This is linked to historically high levels of economic uncertainty and risk (reflected in high interest rates).

For several decades Brazil had relatively clean and cheap electricity and abundant sources of energy. This means that energy efficiency has not been a priority, and may not be a part of many organisational cultures. As such, it may be more difficult to justify professional services in energy efficiency, such as energy audits or energy management.

High interest rates and inflation make it more difficult to justify capital expenditure in energy efficiency, as the internal rate of return is significantly lower than with the equivalent systems installed in countries with lower interest rates.

The economic crisis that is hitting Brazil makes the company controllers averse to new investments of any sort, at least in the short-term, even if the investment has a low risk.

Figure 28 - Brazilian Reais per 1 Euro, 2011 to 2016
Source: www.xe.com

Certifications and standards

Many products will need to have their performance recertified according to local norms and following procedures laid out by INMETRO. There are few agreements in place to allow international or European CE certifications to be used to prove product performance. In many cases, there are few laboratories equipped to carry out certifications which may make lead times long and costs relatively high.

Some electrical products may require adaptation to work on Brazil's national grid system at 60Hz, instead of the European standard of 50Hz. (Many products will already have to undergo these adaptations in order to be able to supply to the American market.)

Technical support

There is a lack of technical expertise for the design, installation and operation of many of the more advanced technologies that could be offered by European companies. In some cases, solutions will have to be accompanied by training of partners, installers and operators.

If a company is not able to show that it has local capacity to provide technical support, maintenance and spare parts, many clients will reject the system immediately.

Many staff will need additional training in order to operate correctly modern equipment, meaning many importers of new technologies may be required to offer on-site training.

Not every executive in decision making position speaks English and just a few workers in lower positions dominate the language what could be a barrier in the selling process of new technologies.

8 Business opportunities for EU companies in Brazil

There is clear potential for the supply of products, systems and services to the Brazilian market by EU SMEs, especially given the recent rapid increases in cost and environmental impact of energy in Brazil. However, the current recession in Brazil makes it a challenging time to do business and negotiate commercial agreements. As growth is likely to be sluggish in the coming months, companies should aim to plan in the medium term.

This assessment of opportunities is based on Mitsidi's experience within the sector and interviews with other experts in the sector, presented in Annex D. The principal areas of opportunity identified in this study, which should inform the matchmaking exercises, are identified below.

Products and projects opportunities

One group of opportunities involves importation of technology and machinery that are more efficient than those currently used in Brazil. In the interviews with experts it was possible to identify that in matchmaking groups like the one that will be done in this project the product providers generally are more successful than the service providers.

Although almost every technological aspect currently in use in Brazil could be improved with use of European manufacture technologies the heat related technologies are, by far, the main gap and the main opportunity for EU manufacturers. Technologies, processes and services that might be especially attractive are:

- Solar heating for industries
- Steam generation and handling (product, project and specialized maintenance)
- Combustion improvement
- High efficiency furnaces
- Design, engineering and simulation of furnaces and thermal systems, including CFD
- Pinch-point analysis for optimisation of heating and cooling loads
- Analysis and maintenance equipment to efficient operation in compressed air and combustion (e.g. leakage detectors, combustion analysers)
- Waste to energy equipments and systems
- Process design consultancy and engineering

The potential identified in each specific area is briefly summarised in Table 10 and repeated in the Sector Demand Map, shown in Annex A.

Automation and Management opportunities

One big gap in Brazilian industries, compared to their European peers, is the lack of automation and control in production. This is linked to poor energy management practices on many industrial sites.

The energy management sector is significantly more developed in the EU than in Brazil, (as identified above, Brazilian companies have traditionally invested little in energy managemnet). The recent rise in energy costs for Brazilian industry should make improved energy management a priority in many areas.

The sale of software systems, or software as a service (SaaS) could represent energy saving opportunities for those industries that already have the basic controls and automation, primarily located in the southern region. The comparatively low costs of adapting and selling software systems abroad (as compared to importing technology) makes this an attractive option, where

EU companies can be competitive on cost.

Despite the language barrier, training for industrial workers and specialists is likely to represent an opportunity, due to the low levels of expertise currently available on the market.

Table 10 – Main technologies/services available and business potential for the LCBA in Brazil

LOW CARBON TECHNOLOGIES, SERVICES AND PROCESSES ON ENERGY EFFICIENCY IN INDUSTRY		BUSINESS POTENTIAL FOR THE LCBA
Sub-sector	Technology/Service/Process	
Process automation and controls	Meters	Significant potential in process automation and control for medium-sized industries
	Control systems	
Compressed air systems	Efficient compressors and dryers	Potential principally in distribution and maintenance services or equipment
	Improved distribution	
	Maintenance services	
Steam systems	Improved boiler technology and performance	Significant potential in steam system evaluation, design, operation and maintenance, including specialised equipment
	Economisers and heat recovery	
	Optimised distribution and maintenance	
	Improved condensate recovery	
Driven systems	Efficient motors	Some potential in system design or innovative, niche products
	Efficient pumps	
	Efficient fans	
Furnaces	Thermal insulation	Potential to supply services to an under-developed market segment
	Combustion analysis	
Cooling systems	Heat exchangers	Little potential identified
	Chillers and other HVAC systems	
Lighting	Natural lighting	Little potential identified
	LED lighting	
	Lighting automation	
Consultancy and Software systems	Diagnostics	Significant potential, if barriers can be overcome through local partners
	Energy management	
Design and Engineering	Industrial processes design	Significant potential, if barriers can be overcome through local partners
	Machinery design	
	Engineering design projects	
Training and Certification	ISO Standards	Significant potential, if barriers can be overcome through local partners
	Energy management trainings	

9 Requirements for market entry by EU companies

General requirements

According to the *Doing Business* project of the World Bank Group which provides an aggregate ranking on the ease of doing business, Brazil is in 116th amongst the 189 economies compared (World Bank, 2016). This ranking is based on indicator sets that measure and benchmark regulations applying to domestic small to medium-size business through their life cycle, and the Brazilian position in this ranking can be related to the so called 'custo Brasil'. This Portuguese term literally means the 'Brazil cost', and it is used to refer generically to the extra costs when doing business in Brazil, such as excessive bureaucracy, under-developed infrastructure, labor costs, high tax burdens, and so on, as cited in the CMS Brazil Market Entry Guide (2014) and other sector references.

Despite this, the volume of Foreign Direct Investment (FDI) in Brazil grew by 60% between 2009 and 2014, a relevant rate when comparing this kind of investment in the world within the effects of the international financial crisis. In 2012 Brazil received the largest FDI in Latin America and the Caribbean, 27% of the total. According to UNCTAD's 2015 World Investment Report, the Brazilian economy remains one of the most attractive for FDI when companies decide to set up new units and buy other companies, occupying the 6th position in the global ranking.

Once a company has decided to enter the Brazilian market, there are options on how best to approach this. The possible business structures vary depending on the level of connection with the country, from simple exportation to the establishment of a Brazilian subsidiary. Investors are required to register all inflows of foreign capital into Brazil with the Brazilian Central bank within 30 days of the funds entering Brazil, though the e-registration tool, RDE-IED (Electronic Declaration Registry), part of the Brazilian Central Bank's Information System (SISBACEN).

It is generally considered easier for foreign investors to establish companies in Brazil rather than setting up branches. Branch offices of foreign entities are governed by the law of its head office, save for employment and some tax liabilities, and need an authorization from the Ministry of Development, Industry and Foreign Trade (MDIC) to operate in the country. This explains why very few branches of foreign entities operate in Brazil.

The description and requirements for each business option is presented in Table 11. Different legal procedures are required for each of the options shown in this table. This report makes no attempt to provide full guidance on legal and regulatory requirements for opening a business in Brazil, as fuller guidance is available from several sources, including the World Bank and national chambers of commerce in Brazil (BRITCHAM, AMCHAM, AHK and others). Also, the Brazilian Government also provides a website highlighting Brazil's business and investment opportunities called *Trade and Investment Guide – Invest & Export Brazil*. More guidance and references are given in the References section of this document.

Table 11 – Business options and its requirements in Brazilian market
Source: CMS (2014), PwC (2013), EY (2011), AMCHAM (2014)

Business Option	Connection with the Country	Brief description	Requirements	Recommendations / Advices
Exportation	Less connection	Exportation of products or services without hiring a representative or setting up a company.	- Entities established in Brazil must **obtain an import/export permit** granted by the Federal Revenue Services which enables access the international trade electronic system, SISCOMEX - File an application for a non-automatic import license before the good's shipment, when applicable, and pay the application fee - Issue the import license - Completion of the import declaration	- Use a local customs agent or broker
Sales Agency **Distribution** **Franchise**		Entering into an agency, distributions or franchise agreement with a Brazilian individual or corporate entity. It is a quick and inexpensive option to start.	- Consider specific laws relating to the agency agreement, which tend to protect the agent rather than the principal and impose certain mandatory terms in agency agreements	- Set up agreements which clearly describe the rights and obligations of each party; - The local agent should have existing business contacts in the market
Commercial Partnerships (Joint Venture)		A joint venture may be incorporated (involves setting up a Brazilian 'limitada' with the profits, ownership and control split among parties) or contractual (the joint venture business does not have a separate identity from the consortium members).	- **File the consortium contract at the Board of Trade** (local acronym is 'Junta Comercial'), which shall include the purpose of the partnership, the term, the address, form of dispute settlement, obligations and responsibilities of each consortium participant, share of profits/losses, accounting rules, representation, management fees and the form of deciding on common interest issues - For both cases the partnership must **obtain a CNPJ** tax registration number	- To participate in procurements, tender rules usually require a Brazilian company to be the consortium leader - Other types of contractual arrangements can be used and are increasingly common, such as alliances and asset sharing
Consortium				
Acquisition of equity		Acquisition of equity in an already established Brazilian company by the foreign investor.		
Establishment of a Brazilian subsidiary	More connection	Open a new company in Brazil.	- **Register the articles of association or bylaws at the Board of Trade ('Junta Comercial')**	

EU SMEs in the energy efficiency in industry sector

The research and interviews conducted for this study made it clear that European SMEs should aim to work alongside local partners in order to enter the local market for energy efficiency solutions. This will overcome several barriers, and crucially will make it clear to local companies that technical support will be available, if necessary.

However, for this report the consultants' recommendation is that the Brazilian partners in the matchmaking missions should not be limited to just SME's, as this would be likely to significantly limit the potential for commercial opportunities and bankable proposals in this area.

10 Identification of partner organisations and initial indication of potential customers (SMEs) in Brazil

The identification of partner organisations was performed firstly with previous author's contacts in the sector. The consultants have direct experience working with several key sector organisations, and this was complemented by the specialist interviews carried out during the project. These interviews are presented in detail in Annex C. Finally, online research was carried out to identify more company associations.

The list of associations is presented below, and repeated in more detail as an annex of the report, in Excel format.

Table 12 – Identification of partner organisations in Brazil

Sector	Organisations identified
All Segments	ABIMEI - Associação Brasileira dos Importadores de Máquinas e Equipamentos Industriais
	ABIMAQ - Associação Brasileira da Indústria de Máquinas e Equipamentos
	ABESCO - Associação Brasileira das Empresas de Serviços de Conservação de Energia
	SEBRAE - Serviço Brasileiro de Apoio às Micro e Pequenas Empresas
	ABRAVA - Associação Brasileira de Refrigeração, Ar Condicionado, Ventilação e Aquecimento
	ABINEE - Associação Brasileira da Indústria Elétrica e Eletrônica
	SENAI - Serviço Nacional de Aprendizagem Industrial
Cement	ABCP - Associação Brasileira de Cimento Portland
Ceramics	ABCERAM - Associação Brasileira de Cerâmica
Chemical	ABIQUIM - Associação Brasileira da Indústria Química
	ABRAFATI – Associação Brasileira dos Fabricantes de Tintas
	ABPOL - Associação Brasileira de Polímeros
Food and Beverages	CERV Brasil _ Associação Brasileira de Cerveja
	ABIP - Associação Brasileira da indústria de panificação e Confeitaria
	ABIAF - Associação Brasileira da Indústria Frigorífica
	ABRABE - Associação Brasileira de Bebidas
	ABIR -Associação Brasileira das Indústrias de Refrigerantes e Bebidas não Alcoólicas
	ABIC- Associação Brasileira da indústria de Café
	ABIS - Associação Brasileira da Indústria do Sorvete
Minning Metallurgical and ferroalloys	ABRAFE - Associação Brasileira dos produtores de ferroligas e de silício Metálico
Paper and Pulp	BRACELPA - Associação Brasileira de Celulóse e Papel
Pig-iron and Steel	ABM - Associação Brasileira de Metalurgia Materiais e Mineração
	Instituto Aço Brasil
Textiles	ABIT - Associação Brasileira da Indústria Têxtil e de Confecção
Others	ABIVIDRO - Associação Tecnica Brasileira das Indústrias Automáticas de Vidro

Sector	Organisations identified
	ABRAMAT - Associação Brasileira da Indústria de Materiais de Construção
	CBIC - Câmara Brasileira da Indústria da Construção

The identification of potential Brazilian companies (including intermediaries and industry, as well as SMEs and larger companies) was performed firstly with previous authors' contacts in the sector. Through the sector organisations identified above, online research was carried out to identify additional companies. The list of companies is presented below, and repeated in more detail as an annex of the report, in Excel format.

Table 13 – Identification of potential customers (SMEs) in Brazil

Sector	Potential intermediaries identified	Website
Automation & Controls	i System	http://www.i.systems.com.br
	Omega	http://br.omega.com
	Hirsa	http://www.hirsa.com.br
	Warme	http://www.warme.com.br
	HEC Automação	http://www.hecautomacao.com.br/
Consultancy & Software	ACS	http://www.acs.ind.br/
	Lemke	http://lemkeconsultoria.com
	Grugeen	http://www.grugeen.eng.br
Cooling Systems	JPX	http://www.jpxequipamentos.com.br/
	Haasen	http://www.haasen.com.br/
	Hydac	http://www.hydac.com.br/
	TWT	http://www.twttrocadoresdecalor.com.br
	Metacontrol	http://www.metacontrol.com.br/
	Mecalor	http://mecalor.com.br/
	Korper	http://www.korper.com.br/
	Refringer	http://www.refringer.com.br/
Design and Engineering	Petroeng	http://petroeng.com.br
	Mixing Consultoria	http://www.mixing.com.br/
	Optimus	http://www.optimus.eng.br/
	Fluxo consultoria	http://fluxoconsultoria.poli.ufrj.br/
	Motriz Engenharia	http://motrizej.com.br/
	Efficientia	http://www.efficientia.com.br/
	PSR	http://www.psr-inc.com/en/
Driven Systems	Ideal Ventiladores	http://www.idealventiladores.com.br/
	Engegres	http://www.engegres.com.br/empresa
	Bernauer	http://bernauer.com.br/
ESCOs	Light Esco	http://www.light.com.br/grupo-light/Empresas-do-Grupo/light-esco.aspx
	CPFL Eficiência	http://www.cpfl.com.br/unidades-de-negocios/solucoes-para-empresas/cpfl-eficiencia/Paginas/default.aspx
	EDP Comercialização e Serviços	http://www.edp.com.br/edp-comercializacao/areas-de-atuacao/eficiencia-energetica/eficiente/Paginas/default.aspx
	3E Engenharia em Eficiência Energética	http://www.3eengenharia.com.br/
	Eficienergy	http://eficienergy.com.br/

Furnaces	Neotermica	http://www.neotermica.com.br/
	Refratil	http://www.refratil.com.br/
	Restherm	http://www.restherm.com.br
	Isar	http://www.isar.com.br
	Termocom	http://www.termocom.com.br/produtos-iti
	Artec	http://www.artecqueimadores.com.br
	VLM	http://www.vlmcombustao.com.br
	First fornos	http://www.firstfornos.com.br
	Vorah	https://www.vorah.com.br/
	Perfil Térmico	http://www.perfiltermico.com.br/
Steam systems	Sotanques	www.sotanques.com.br
	Aberko	www.vasosdepressao.com.br
	Equipar	www.equipartecnologia.com.br
	Inmar	http://www.inmar.com.br/site/caldeiras/
	Icaterm	http://icaterm.com.br/
	Arauterm	http://www.arauterm.com.br/php/index.php
	Steammaster	http://www.caldeiras.com/
	Engenmax	http://www.engenmax.com/
	Disparco	http://www.disparco.com.br/
	Magetech	http://www.magetech.com.br/
	Quanta	http://www.quantaeng.com.br
	Vapor Total	http://www.vaportotal.com.br/
Other	CPqD	https://www.cpqd.com.br/

11 Identification of potential partner organisations and initial indication of potential suppliers in EU

European sector organisations were identified through the authors' prior experience and online research. These organisations were not contacted during the preparation of this report.

The list of associations is presented below, and repeated in more detail as an annex of the report, in Excel format.

Many organizations identified in this research are not specific for one segment, so the separation in the previous industry sectors is pointless.

Table 14 - Identification of partner organisations in EU

Organisations identified
REHVA - Federation of European Heating, Ventilation and Air Conditioning Associations
LightingEurope
ESTIF - European Solar Thermal Industry Federation
EU-ASE - European Alliance to Save Energy
EFIEES - European Federation of Intelligent Energy Efficiency Services
EHI - Association of the European Heating Industry
Fraunhofer Institute for Solar Energy Systems ISE
Capenergies
Energy Institute
Clean Cluster
Energia Extremadura
European Insulation Manufacturers Association
Association for the Conservation of Energy
Renewables Made in Germany
Energy Efficiency Made in Germany
European Industrial Insulation Foundation
Italian Federation for energy efficiency
European Association for the Promotion of Cogeneration
Association of the European Heating Industry

The identification of potential European suppliers (SMEs) was performed firstly with previous authors' contacts in the sector. Through the sector organisations identified above, online research was carried out to identify additional companies. The list of companies is presented below, and repeated in more detail as an annex of the report, in Excel format.

Table 15 – Identification of potential suppliers (SMEs) EU

Sub-sector	Potential suppliers identified	Country
Automation & Controls	kmb systems	Czech Republic
Compressed air	PSI Global	United Kingdom
Consultancy Software	Logic Energy	United Kingdom
	Power Efficiency	United Kingdom
	Vital Efficienci	United Kingdom
	eSight Energy	United Kingdom
Cooling Systems	Envirotech limited	United Kingdom
	Smartcool Systems	United Kingdom
Design Engineering	Energys Limited	United Kingdom
	EPF Energy	Italy
	Maleta Cyclic Distilation	Estonia
	CMI Groupe	Belgium
Driven Systems	ebm-papst	Germany
	Northey Technologies	United Kingdom
	Albin pumps	France
Furnaces	Selas	Germany
	Combustion Solutions	Austria
Steam Systems	Aalborg energie tecknik	Denmark
	Cannon Bono sistemi	Italy
	UAB Energetikos remonto ir montavimo centras	Lithuania
	Maxxtec GmbH	Germany

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Annex A – Sector Demand Map

A) LOW CARBON TECHNOLOGIES, SERVICES AND PROCESSES ON ENERGY EFFICIENCY IN INDUSTRY		B) AVAILABILITY IN BRAZIL	C) INDUSTRY SECTOR SEGMENTATION	D) INTERNATIONAL TRENDS / INNOVATIVE TECHNOLOGIES (EUROPE)	E) INNOVATION, NEEDS & GAPS IN BRAZIL	F) BUSINESS POTENTIAL FOR THE LCBA
Sub-sector	Technology/Service/Process					
Process automation and controls	Meters	1 - mature	All industrial segments	Most processes are already highly automated, with sophisticated control systems.	1 - high	Significant potential in process automation and control for medium-sized industries
	Control systems	1 - mature				
Compressed air systems	Efficient compressors and dryers	1 - mature	All industrial segments	High-efficiency compressors are standard. Most industries focus on optimising leak control, distribution and final use.	2 - medium	Potential principally in distribution and maintenance services or equipment
	Improved distribution	2 - established				
	Maintenance services	3 - incipient				
Steam systems	Improved boiler technology and performance	2 - established	All industrial segments	There is some innovation in the control of burners, use of biomass and reduction of gas exhaust. Programs for optimising heat recovery and distribution are standard.	1 - high	Significant potential in steam system evaluation, design, operation and maintenance, including specialised equipment
	Economisers and heat recovery	3 - incipient				
	Optimised distribution and maintenance	3 - incipient				
	Improved condensate recovery	3 - incipient				
Driven systems	Efficient motors	2 - established	All industrial segments	Incremental technical improvement. Many benefits available from whole-system optimisation and design.	3 - low/not required/longterm	Some potential in system design or innovative, niche products
	Efficient pumps	3 - incipient				
	Efficient fans	3 - incipient				
Furnaces	Thermal insulation	1 - mature	All industrial segments	Combustion analysis and insulation are already standard procedures.	1 - high	Potential to supply services to an under-developed market segment
	Combustion analysis	2 - established				
Cooling systems	Heat exchangers	1 - mature	All industrial segments	Generally mature markets, consolidated in a few large suppliers.	3 - low/not required/longterm	Little potential identified
	Chillers and other HVAC systems	2 - established				
Lighting	Natural lighting	2 - established	All industrial	Generally mature markets.	3 - low/not	Little potential identified

A) LOW CARBON TECHNOLOGIES, SERVICES AND PROCESSES ON ENERGY EFFICIENCY IN INDUSTRY		B) AVAILABILITY IN BRAZIL	C) INDUSTRY SECTOR SEGMENTATION	D) INTERNATIONAL TRENDS / INNOVATIVE TECHNOLOGIES (EUROPE)	E) INNOVATION, NEEDS & GAPS IN BRAZIL	F) BUSINESS POTENTIAL FOR THE LCBA
Sub-sector	Technology/Service/Process					
	LED lighting	2 - established	segments		required/longterm	
	Lighting automation	2 - established				
Consultancy and Software systems	Diagnostics	3 - incipient	All industrial segments	Increasingly the basis of major energy efficiency programmes and incentives.	1 - high	Significant potential, if barriers can be overcome through local partners
	Energy management	3 - incipient				
Design and Engineering	Industrial processes design	4 - not available	All industrial segments	Highly specialised and generally specific to certain industrial sectors.	2 - medium	Significant potential, if barriers can be overcome through local partners
	Machinery design	4 - not available				
	Engineering design projects	3 - incipient				
Training and Certification	ISO Standards	3 - incipient	All industrial segments	Increasingly widespread.	1 - high	Significant potential, if barriers can be overcome through local partners
	Energy management trainings	4 - not available				

Annex B - List of organisations and SMEs in Brazil and EU

The complete list of sectoral organisations (associations, chambers, clusters) and potential customers and suppliers (companies and SMEs) identified both in Brazil and EU are delivered as an external annex in Excel format.

Annex C – Semi Structured Interviews

Structure used for Expert Interviews

Mapping Report on Energy Efficiency in Industry
IDENTIFYING DEMAND IN BRAZIL
Semi Structured Interviews

1. Sobre eficiência energética na indústria:
   a. Quais são as ações mais recentes sobre o tema?
   b. Qual é sua relevância no cenário brasileiro atual?
   c. Quem são os principais agentes/órgãos que apoiam e dão incentivos a EE na indústria?

2. Quando indústrias de diferentes portes procuram ações de eficiência energética, por onde e por quem elas procuram?

3. Existe segmentação do mercado de EE na indústria nas diferentes regiões do Brasil?

4. Dentre os sistemas listados:

Industrial activities and processes	Examples of low carbon opportunities
Process Automation and Controls	Meters Control systems
Compressed Air	Compressors and Dryers Distribution Maintenance
Steam Systems	Boilers Distribution Pressurized tanks
Driven Systems	Motors Pumps Fans
Furnaces	Thermal insulation Combustion analysis
Cooling Systems	Heat exchangers HVAC
Lighting	Natural lighting LED lighting Lighting automation
Training and Certification	ISO Standards
Design and Engineering	Industrial Processes
Consultancy and Software services	Diagnostics Energy Management

   a. Em quais deles o Brasil tem pouca experiência de atuação em EE? Por quê?
   b. Quais deles podem se beneficiar mais com a entrada de empresas europeias com foco em eficiência energética? Por quê?

5. Quais seriam as barreiras de entrada para empresas europeias no mercado nacional?

Obrigado!

Expert interview #1 – Summary of key issues raised

Expert #1: Paulo Cruz, Gerente Geral de Eficiência Energética, Sistemas Elétricos, Soluções de Energia e Mercado, Vale
Data: 30/06/2016
Contato: https://br.linkedin.com/in/ptacruz/pt

1. **Sobre eficiência energética na indústria:**
    a. **Quais são as ações mais recentes sobre o tema?**
    b. **Qual é sua relevância no cenário brasileiro atual?**
    c. **Quem são os principais agentes/órgãos que apoiam e dão incentivos a EE na indústria?**

A eficiência energética (EE) no setor industrial é um tema muito relevante no cenário nacional, uma vez que os custos de energia representam uma grande parcela dos custos industriais totais. Existe, entretanto, uma certa falta de disciplina e organização por parte das indústrias para demandar dos órgãos públicos mais apoio e incentivo aos programas de eficiência. Neste cenário, a CNI e a ABRACE são fundamentais e representam um papel atípico no setor ao levantar propostas e questões relacionados ao tema. O Procel também é um programa que atua na Indústria.

2. **Quando indústrias de diferentes portes procuram ações de eficiência energética, por onde e por quem elas procuram?**

Sob a perspectiva da grande indústria, como é o caso da Vale, existem três níveis em que gestores podem procurar ações de eficiência energética: dentro de sua própria equipe, na busca de consultorias especializadas e direto com o fabricante/revendedor da tecnologia (equipamentos, sistemas, etc), nesta ordem de prioridade. Se uma solução de EE já é muito pulverizada no mercado, como é o caso de bombas mais eficientes, busca-se um consultor para ajudar na tomada de decisão; quando, por sua vez, o fornecedor do equipamento ou a própria tecnologia é muito específica, pode recorrer-se diretamente ao fornecedor.

3. **Existe segmentação do mercado de EE na indústria nas diferentes regiões do Brasil?**

Sim, com certeza. A região Sudeste seria o melhor lugar para se iniciar negócios de eficiência energética na indústria. Não por uma questão de desenvolvimento, mas sim de mercado e demanda de tecnologia.

4. **Dentre os sistemas listados:**
    a. **Em quais deles o Brasil tem pouca experiência de atuação em EE? Por quê?**
    b. **Quais deles podem se beneficiar mais com a entrada de empresas europeias com foco em eficiência energética? Por quê?**

O Brasil tem demanda e é uma tendência no setor a adoção de práticas de gestão e gerenciamento de energia na indústria. Sendo assim, os sistemas/subsetores mais interessantes seriam o de Treinamento e Certificação e Consultoria e Serviços de Software. A grande indústria não possui carência de soluções de automação e controle de processos. O Brasil já possui competência e grande disponibilidade de tecnologias em ar comprimido, sistemas de vapor e força motriz. O que acontece muitas vezes é que essa competência não é suficientemente aproveitada, e o maior gargalo está na gestão da energia e na cultura

organizacional brasileira.

5. Quais seriam as barreiras de entrada para empresas europeias no mercado nacional?

Uma das principais barreiras para empresas estrangeiras no geral é ter apenas mão-de-obra importada, ou seja, não ter parceiros e braços locais. A execução de serviços nas empresas fica então muito comprometida, seja por conta do idioma de comunicação ou problemas culturais. Neste sentido, a recomendação seria trazer empresas que possam se fixar e se especializar no mercado brasileiro. Em outras missões e rodadas de negócio, o que dá mais retorno e obtém sucesso é a venda de equipamentos.

Expert interview #2 - Summary of key issues raised

Expert #2: Paulo Miotto, co-proprietário da Ecoeficiência
Data: 05/07/2016
Contato: https://br.linkedin.com/in/paulo-miotto-3aa056b/pt

1. **Sobre eficiência energética (EE) na indústria:**
    a. **Quais são as ações mais recentes sobre o tema?**

As ações de EE na indústria brasileira tem sido realizadas de maneira pontual, de modo que não existe uma política nacional que reúna esforços na disseminação e promoção do tema. Existe hoje uma tentativa da reativação e fortalecimento do Procel Indústria, e a maior parte das ações pontuais são realizadas pela ANEEL.

    b. **Qual é sua relevância no cenário brasileiro atual?**

O custo de energia é o principal fator motivador da implantação de serviços e tecnologias de EE, visto que ele é um dos principais componentes do nível de competitividade da indústria nacional.

    c. **Quem são os principais agentes/órgãos que apoiam e dão incentivos a EE na indústria?**

ANEEL, Procel e associações privadas. As associações de classe e setoriais costumam tentar sempre a promoção de iniciativas de EE, mas a maior parte delas são iniciativas pontuais.

2. **Quando indústrias de diferentes portes procuram ações de eficiência energética, por onde e por quem elas procuram?**

A maior parte das indústrias brasileiras (95%, mais ou menos) não procuram por ações e medidas de EE porque não conhecem os benefícios que ela pode trazer aos seus negócios. O único motivador para a economia de energia são os custos crescentes de energia, e na grande maioria das vezes os gestores industriais não relacionam estes custos com oportunidades de melhoria de EE.

Quando as poucas indústrias interessadas procuram por eficiência, elas o fazem de duas formas distintas: buscam uma solução específica, como troca de tecnologia e equipamentos, contatando diretamente o fornecedor da solução; ou então buscam consultorias e/ou apoio dos órgãos de classe, normalmente quando não conhecem ou não possuem a EE como cultura. A parcela das empresas que já tem interesse no tema ainda é muito pequena.

3. **Existe segmentação do mercado de EE na indústria nas diferentes regiões do Brasil?**

Sim, existe segmentação geográfica do mercado, mas mais importante que a geográfica é a segmentação por tipo de indústria. Cada segmento (cimento, fundição, etc) possui processos e demandas específicas de EE. O estado de São Paulo e a região de Manaus, AM, possuem mais demanda de eficiência, visto que existem mais indústrias em SP e as plantas industriais em Manaus são muito antigas e ineficientes, devido principalmente ao subsídio no custo de energia concedido anteriormente na Zona Franca.

4. **Dentre os sistemas listados:**
    a. **Em quais deles o Brasil tem pouca experiência de atuação em EE? Por quê?**

b. Quais deles podem se beneficiar mais com a entrada de empresas europeias com foco em eficiência energética? Por quê?

O mercado brasileiro possui profissionais em todos os subsetores citados, entretanto a quantidade de empresas e prestadores de serviços especializados ainda é insuficiente na maior parte do país. O subsetor em que temos menos experiência é o de softwares de otimização de processos e uso energético.

O que se faz necessário na verdade são metodologias de fomento e promoção do tema no setor industrial, como a maior parte dos programas de EE desenvolvido em diversos países. A indústria nacional ainda não conhece e não tem consciência de como o mercado de EE pode melhorar seus negócios e sua produção. A implantação de um programa nacional é que permite a criação da demanda por tecnologias e serviços internacionais.

5. Quais seriam as barreiras de entrada para empresas europeias no mercado nacional?

Uma das grandes barreiras são os critérios de financiamento do BNDES, que estabelecem um índice de nacionalização mínimo de 60% na aprovação de projetos. De modo geral, a indústria vê com bons olhos e confia em fornecedores europeus, não havendo assim fortes barreiras culturais. Uma das formas de entrada no mercado de EE é construir relações de parceria com entidades de classe, como a CNI.

Expert interview #3 - Summary of key issues raised

Expert #3: Helder Sousa, especialista em energia elétrica na ABRACE – Associação Brasileira de Grandes Consumidores Industriais de energia
Data: 30/06/2016
Contato: https://br.linkedin.com/in/helder-sousa-387bab63

1. **Sobre eficiência energética na indústria:**
    a. **Quais são as ações mais recentes sobre o tema?**
    b. **Qual é sua relevância no cenário brasileiro atual?**
    c. **Quem são os principais agentes/órgãos que apoiam e dão incentivos a EE na indústria?**

Não há muito apoio governamental nas ações relacionadas a EE, porém existem ações como a realizada pelo CNI que pretende aumentar a competitividade da indústria através da redução de custos energéticos.

Para o momento atual do país a EE é muito relevante pois, permite reduzir custos rapidamente muitas vezes com pequenos investimentos.

2. **Quando indústrias de diferentes portes procuram ações de eficiência energética, por onde e por quem elas procuram?**

Há uma diferença entre grandes indústrias que tendem a fazer essas ações internamente e as pequenas e médias. As últimas ou contratam uma consultoria especializada, às vezes recomendada pela sua associação ou tentam fazer por conta própria e naturalmente não atingem o resultado esperado.

3. **Existe segmentação do mercado de EE na indústria nas diferentes regiões do Brasil?**

Sim, com certeza. A região Sudeste é a que mais têm indústrias, não por uma questão de desenvolvimento, mas sim de mercado. Como no Nordeste e no Norte há uma oferta muito mais limitada de serviços de EE pode ser uma oportunidade para novos negócios apesar do menor número de indústrias.

4. **Dentre os sistemas listados:**
    a. **Em quais deles o Brasil tem pouca experiência de atuação em EE? Por quê?**
    b. **Quais deles podem se beneficiar mais com a entrada de empresas europeias com foco em eficiência energética? Por quê?**

Entre os setores levantados pode-se de maneira geral destacar os sistemas térmicos (fornos e geração de vapor) que o Brasil não possui tecnologia eficiente.

5. **Quais seriam as barreiras de entrada para empresas europeias no mercado nacional?**

A maior das barreiras de entrada para empresas europeias deve ser a complexidade da legislação e das questões tributárias que, com razão, assustam empresas estrangeiras.

O melhor modo de entrada deve ser fazendo parcerias com empresas locais que possuem experiência com a legislação brasileira.

Outra barreira que aparece é que o financiamento para produtos importados é mais difícil e não se beneficia de taxas subsidiadas. Como uma grande barreira para EE no Brasil é a falta de financiamento, os produtos importados terão uma dificuldade dobrada.

Expert interview #2 - Summary of key issues raised

Expert #4: Rodrigo Sarmento Garcia, Analista de energia da Confederação Nacional das Indústrias
Data: 01/07/2016
Contato: https://br.linkedin.com/in/rodrigo-garcia-52596112/pt

1. **Sobre eficiência energética (EE) na indústria:**
    a. **Quais são as ações mais recentes sobre o tema?**
    b. **Qual é sua relevância no cenário brasileiro atual?**
    c. **Quem são os principais agentes/órgãos que apoiam e dão incentivos a EE na indústria?**

No cenário atual de crise e recessão econômica com destaque para a queda ainda mais acentuada da produção industrial, o empresariado brasileiro está procurando métodos de cortar custos e não mais de expandir a produção. Essa conjuntura é favorável a ações de eficiência energética já que projetos ligados a EE têm rápido retorno. Atualmente as principais ações que estão sento tomadas num nível mais macro são:

- A criação de um programa visando implantar uma cultura de EE nas indústrias e aumentar o conhecimento técnico nacional sobre o assunto e,
- A recente alteração de lei (hoje lei 13.280) que obriga as distribuidoras de energia a repassar 20% dos recursos do PEE diretamente ao PROCEL. Como a indústria é um grande consumidor de energia é natural que receba parte destes recursos para fomentar o mercado de EE no país.

2. **Quando indústrias de diferentes portes procuram ações de eficiência energética, por onde e por quem elas procuram?**

A uma grande diferença entre as indústrias no Brasil. Indústrias grandes possuem corpo de engenharia e este é o primeiro a ser consultado quando se deseja implantar uma medida de EE ou quando precisa-se pesquisar oportunidades de EE em sua planta; após esta consulta interna a grande indústria pode contratar uma consultoria especializada ou em alguns casos fazer o projeto com mão de obra interna.

As indústrias médias e pequenas quando pensam em oportunidades de melhoria relacionadas à EE o que ainda não é muito comum, buscam ajudas através de amigos que entendam do assunto ou então recorrem a internet, mas sem muita instrução. No cenário atual, as oportunidades para as pequenas empresas estão mais ligadas a troca de equipamentos, muitas vezes velhos e quase obsoletos por equipamentos mais modernos e mais eficientes.

3. **Existe segmentação do mercado de EE na indústria nas diferentes regiões do Brasil?**

Grande parte das indústrias brasileiras está concentrada na região sudeste. Quando se leva em consideração o potencial de compra de serviços, a desigualdade fica ainda mais acentuada fazendo com que de modo geral as melhores oportunidades de negócios estejam na região sudeste.

É importante ressaltar que quando se trata das indústrias maiores essa divisão não é tão relevante uma vez que grandes polos industriais por vezes estão fora da região sudeste.

4. **Dentre os sistemas listados:**
    a. **Em quais deles o Brasil tem pouca experiência de atuação em EE? Por quê?**
    b. **Quais deles podem se beneficiar mais com a entrada de empresas europeias com foco em eficiência energética? Por quê?**

Parece bastante claro que as maiores oportunidades no país estão na área térmica. Tanto na parte de fornos como na parte de geração de vapor o Brasil tem muito a aprender.

Também há oportunidade em sistemas elétricos, mas estas são menores.

5. Quais seriam as barreiras de entrada para empresas europeias no mercado nacional?

A maior barreira é a legislação brasileira que é bastante complexa e não favorece a entrada dessas empresas. O custo de entrada também é alto e muitas vezes empresas estrangeiras podem ser pegas de surpresa com a extensão territorial e heterogeneidade do Brasil.

Sugere-se que ao entrar no país a empresa entre como parceira de uma empresa nacional o que facilita muito ao reduzir burocracias.

Annex D – Expression of Interest (EoI) questions for Brazilian companies

Qual(is) segmento(s) industrial(is) você representa, ou em qual(is) segmento(s) estão a maioria dos seus clientes?
( ) Alimentos e Bebidas
( ) Siderurgia
( ) Papel e Celulose
( ) Química
( ) Metalurgia de metais não-ferrosos
( ) Cimento
( ) Cerâmica
( ) Mineração
( ) Ferroligas
( ) Vidro
( ) Outros segmentos

Tecnologias	**Necessidade/Interesse**
a) Automação de processos e controles: medidores, sistemas de controle, etc	Alta ( ) Média ( ) Baixa ( ) Nenhuma
b) Sistemas de ar comprimido: compressores e secadores eficientes, otimização da distribuição, serviços de manutenção, etc	Alta ( ) Média ( ) Baixa ( ) Nenhuma
c) Sistemas de vapor: caldeiras de alto desempenho, economizadores e recuperadores de calor, otimização da distribuição e manutenção, recuperação eficiente de condensado, etc	Alta ( ) Média ( ) Baixa ( ) Nenhuma
d) Sistemas motrizes: bombas, motores ou ventiladores eficientes, etc	Alta ( ) Média ( ) Baixa ( ) Nenhuma
e) Fornos: isolamento térmico, análise de combustão, etc	Alta ( ) Média ( ) Baixa ( ) Nenhuma
f) Sistemas de refrigeração: trocadores de calor, chillers e outros sistemas de aquecimento, ventilação e ar condicionado (AVAC)	Alta ( ) Média ( ) Baixa ( ) Nenhuma
g) Iluminação: iluminação natural, iluminação LED, automação, etc	Alta ( ) Média ( ) Baixa ( ) Nenhuma
h) Consultoria e Serviços de Software (SAS): diagnósticos, gestão de energia, etc	Alta ( ) Média ( ) Baixa ( ) Nenhuma
i) Design e engenharia: projeto de processos industriais, projetos de máquinas e equipamentos industriais, projetos de engenharia, etc	Alta ( ) Média ( ) Baixa ( ) Nenhuma
j) Treinamento e Certificação: normas ISO (50.001 – Gestão de Energia), treinamentos de gestão energética, etc	Alta ( ) Média ( ) Baixa ( ) Nenhuma

Annex E – Expression of Interest (EoI) questions for EU suppliers

Identify the industrial segment(s) that you typically work with, or who could benefit from the energy efficiency solutions your company provides.
( ) Food and Beverage
( ) Pig-iron and steel
( ) Pulp and Paper
( ) Chemical
( ) Non-ferrous / other metallurgical
( ) Cement
( ) Ceramics
( ) Mining / Pelestisation
( ) Ferro-alloys
( ) Glass
( ) Other

17. Specific Technology Offer: Please indicate whether your company can address the demand in the following Technologies: Please note that technologies must be suitable or adaptable to conditions typical for tropical countries.

Technologies/services/processes for energy efficiency in industry	**Products available and suitable/adaptable for this area?**	**If yes, please provide information on these products and upload brochures at the end of this form**
a) Process and automation controls: meters, control systems, etc	Yes ( ) No ( )	
b) Compressed air systems: efficient compressors and dryers, improved distribution, maintenance services, etc	Yes ( ) No ( )	
c) Steam systems: improved boiler technology and performance, economisers and heat recovery, optimesed distribution and maintenance, improved condensate recovery, etc	Yes ( ) No ( )	
d) Driven systems: efficient motors, pumps and funs, etc	Yes ( ) No ( )	
e) Furnaces: thermal insulation, combustion analysis, etc	Yes ( ) No ( )	
f) Cooling systems: Heat exchangers, Chillers and other HVAC systems, etc	Yes ( ) No ( )	
g) Lighting: natural lighting, LED lighting, automation, etc	Yes ( ) No ( )	
h) Consultancy and software systems: diagnostics, energy management,	Yes ( ) No ( )	

etc		
i) Design and engineering: industrial process design, machinery design, engineering design projects, etc	Yes ( ) No ( )	
j) Training and Certification: ISO standards, energy management training, etc	Yes ( ) No ( )	