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29th March 2009 Country Study - Brazil

Contents

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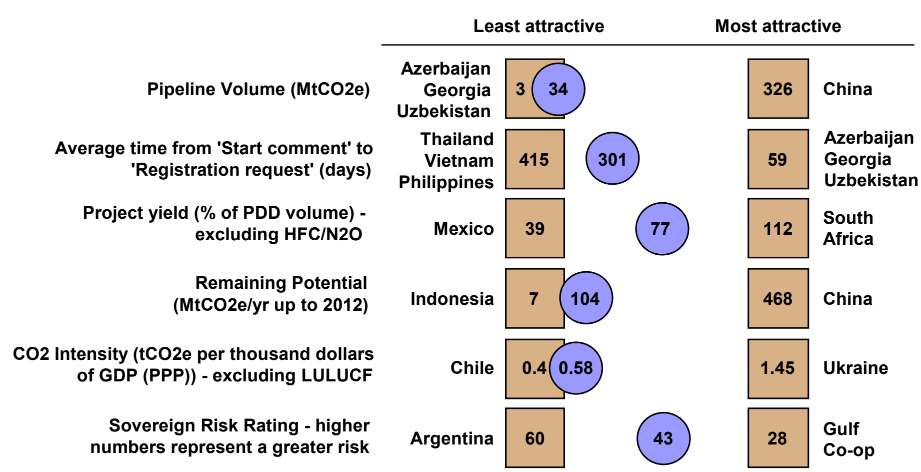
Executive Summary

Brazil has become a more prevalent CDM player since the publication of our first country study in 2008. The stronger climate change plan unveiled at Poznan was a welcome turnaround from its less ambitious predecessor. Emission reduction targets and a commitment to CDM are now set. Brazil can not be expected to surpass the current CDM favourites China or India due to the already clean energy matrix of the country. It is likely to remain the third largest provider of international credits. In detail:

- Our forecast for Brazil total emissions in 2008 is 2390MtCO2e[1]. This represents an increase of only 920MtCO2e from 1994 levels. Brazil has a low carbon energy supply. The most influential driver on the rate of emissions is that of deforestation.
- Even though economic activity looks set to reduce by 1.3% in 2009, long term growth prospects remain strong. The electricity sector alone is expected to grow by some 50% in the next 10 years.
- Our forecast for the remaining PDD potential is 90.5MtCO2e/yr up to 2012, the majority of which lies with the agriculture and waste, renewable energy, and industrial sectors.
- The single greatest opportunity for CDM development in Brazil would be from the forestry sector, however the Brazilian government is strongly opposed to the sale of CDM credits from this area, particularly from REDD, and so we continue to heavily discount this potential.
- The performance of domestic CDM infrastructure with respect to average delays in Brazil has been relatively poor to date due to local bureaucracies. Project yields however are in line with the world average.

Figure 1: CDM summary for Brazil



Source: New Carbon Finance, UNEP Risoe, IMF, EIU

[1] Previous estimate accounted for Amazon deforestation only.

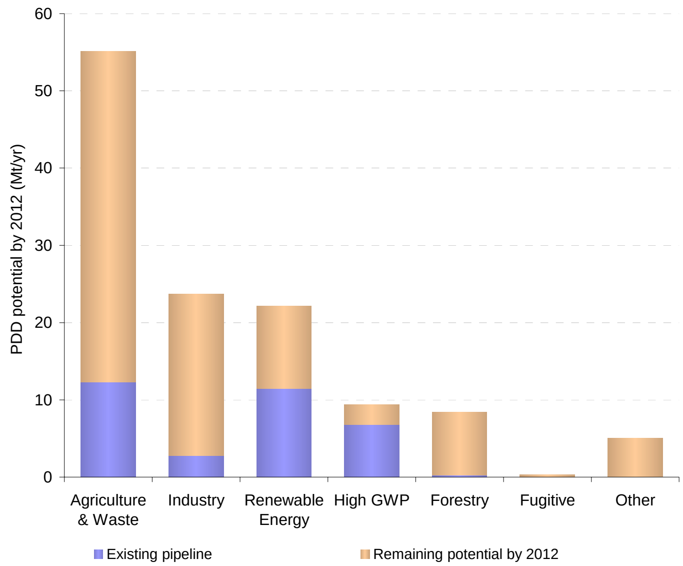
1. Remaining PDD potential

Brazil has a remaining PDD potential of 90.5MtCO2e/yr in 2012. 82.17% of this remaining PDD potential is expected to come from agriculture, waste renewable energy and industry.

New Carbon Finance assesses countries on the basis of their future potential for project development, which we quantify in terms of annual PDD volume potential which is shown in Figure 2 along with the existing project volume in the UNFCCC pipeline. For a detailed description of the methodology please refer to Section 2.

We calculate a PDD reduction potential for Brazil of 124.2MtCO2e/yr up to 2012. As 27.1% of the PDD potential is already in the CDM pipeline we calculate a remaining PDD potential of 90.5MtCO2e/yr up to 2012. The majority of this remaining potential exists within the agricultural and waste (47.32%), industry (23.09%), renewable sector (11.76%), and forestry (9.04%) but we also calculate that there will be small contribution from the other sectors, mainly from transport and PFC reduction in the aluminium industry.

Figure 2: PDD potential of CDM projects in Brazil by 2012



Source: New Carbon Finance

- The most attractive prospect for CDM projects is agricultural and waste sectors, particularly within biogas. Brazil can implement further CDM projects in these sectors equivalent to 42.8MtCO2e/yr by 2012.
- The second-largest potential for CDM projects relates to fuel switching within industry sectors. There is already 1.9MtCO2e/yr in the pipeline, but there is a remaining potential of 17.6MtCO2e/yr.
- The renewable energy sector represents the next largest CDM opportunity, which we estimate to be 22.1MtCO2e/yr. In spite of significant activity, 48.1% of this potential is yet to be developed.
- There is remaining PDD potential of 8.2MtCO2e/yr by 2012 in the forestry sector. There is huge practical potential in the forestry sector; however the Brazilian government is adamantly opposed to the selling of offset credits from this area (REDD).
- Most possible projects related to High GWP gases are already in the pipeline, but PFC reduction in the aluminium industry could provide a further 2.6MtCO2e/yr in 2012.
- There remains meagre PDD potential of only 0.3MtCO2e/yr by 2012 for fugitive projects, most of which is from coal mine methane.
- There is PDD potential of 5.0MtCO2e/yr for other sectors, mainly within the transport sector.

Table 1: Positive and negative drivers for CDM projects in Brazil (MtCO2e/yr)

	Practical potential by 2012	PDD potential by 2012	Positive drivers	Negative drivers
1) High GWP Gases	**10.9**	**9.4**		
HFC	0.0	0.0		No projects left
PFCs/SF6	4.5	3.0	Large aluminium production	Dispersed sources
N2O	6.4	6.4		Few projects left
2) Renewables	**32.4**	**22.1**		
Biomass energy	9.9	8.3	Large feedstock; short-lead times;	Additionality concerns (bagasse)
Geothermal	0.0	0.0	Long term local studies	Low geothermal temperatures
Hydro	20.6	12.3	Large remaining potential	Environmental licensing
Solar	0.0	0.0	Favourable environmental conditions	Low grid factor; high costs
Marine/tidal/wave	0.0	0.0	Favourable environmental conditions; local technology	Environmental licensing; unclear regulation
Wind	2.0	1.6	Favourable env. conditions; cost of transmission reducing	Future policy unclear
3) Agriculture and Waste	**135.3**	**55.1**		
Biogas	108.7	33.5	Untapped potential in the ethanol industry	Smaller size of MM opportunities
Landfill gas	26.5	21.6	Relatively high number of remaining sites	Precarious conditions of landfills.
4) Fugitive	**0.7**	**0.3**		
Coal-bed mine methane	0.3	0.3	Concentrated production	Small size of mines
Oil	0.2	0.0	Growth in production	Additionality concerns
Gas distribution	0.1	0.0	Growth in production	Dispersion; high costs
5) Industry	**39.0**	**23.7**		
Cement	6.4	3.6	Fuel switch opportunities; clinker replacement with local	Dry processes in place
Energy efficiency	31.0	19.6	Fuel switch opportunities	Gas availability
Power sector- EE and FS	1.6	0.6	Growth in fossil fuels	Low grid factor
6) Other	**85.1**	**13.5**		
Energy distribution	0.1	0.0	High losses	Long distances
End use (residential/commercial)	0.7	0.0		Low grid, technology availability
Forestry	54.8	8.4	A/R for industrial use	Government against REDD in the market.
Transport	29.5	5.0		Methodology availability
TOTAL	**303.4**	**124.2**		

Source: New Carbon Finance

Table 2: Practical and PDD potential for CDM projects in Brazil in 2012 (MtCO2e/yr)

	Existing PDD pipeline	Practical potential by 2012	PDD potential by 2012	Remaining PDD potential by 2012
1) High GWP Gases	**6.8**	**10.9**	**9.4**	**2.6**
HFC	0.0	0.0	0.0	0.0
PFCs/SF6	0.4	4.5	3.0	2.6
N2O	6.4	6.4	6.4	0.0
2) Renewables	**11.5**	**32.4**	**22.1**	**10.6**
Biomass energy	5.5	9.9	8.3	2.8
Geothermal	0.0	0.0	0.0	0.0
Hydro	5.4	20.6	12.3	6.9
Solar	0.0	0.0	0.0	0.0
Marine/tidal/wave	0.0	0.0	0.0	0.0
Wind	0.6	2.0	1.6	1.0
3) Agriculture and Waste	**12.3**	**135.3**	**55.1**	**42.8**
Biogas	2.9	108.7	33.5	30.6
Landfill gas	9.4	26.5	21.6	12.2
4) Fugitive	**0.0**	**0.7**	**0.3**	**0.3**
Coal-bed mine methane	0.0	0.3	0.3	0.3
Oil	0.0	0.2	0.0	0.0
Gas distribution	0.0	0.1	0.0	0.0
5) Industry	**2.8**	**39.0**	**23.7**	**20.9**
Cement	0.3	6.4	3.6	3.3
Energy efficiency	1.9	31.0	19.6	17.6
Power sector- EE and FS	0.6	1.6	0.6	0.0
6) Other	**0.3**	**85.1**	**13.5**	**13.2**
Energy distribution	0.0	0.1	0.0	0.0
End use (residential/commercial)	0.0	0.7	0.0	0.0
Forestry	0.3	54.8	8.4	8.2
Transport	0.0	29.5	5.0	5.0
TOTAL	**33.7**	**303.4**	**124.2**	**90.5**

Source: New Carbon Finance

2. Supply potential methodology

The purpose of country study reports is to provide a quantitative and qualitative framework to show what CDM project potential remains in the country or region. The quantitative analysis starts with the total sector emissions and works down to the remaining PDD potential through several stages, each of which is defined in Table 3 below. A worked example, of landfill gas flaring, is used alongside the definition to assist the explanation.

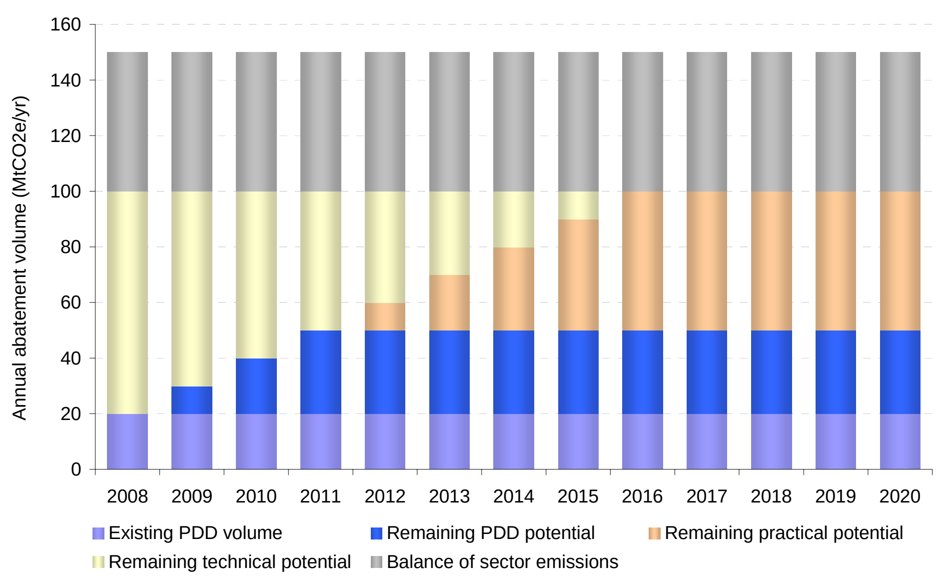
Table 3: Definitions of remaining potential by stage

Term	Definition	Worked example for landfill gas flaring in Country X
Total sector emissions	Total sector emissions	Landfills in Country X emitted 150MtCO2e/yr in 2008 and this is not expected to change over the period to 2020
Technical potential	The fraction of total sector emissions of which it is technically possible to abate	After considering leakage rates and the difference in GWP between methane and CO2, 66% of the total sector emissions are technically able to be abated. This gives a technical potential of (150*66% = 100) 100MtCO2e/yr over the period to 2020.
Practical potential	The fraction of the technical potential that could be constructed, assuming a build rate unconstrained by economics	We judge that it would take 10 years to realise the technical potential, which therefore allows the practical potential to grow by ((1/10)*100 = 10) 10MtCO2e/yr each year. This build rate would be referred to as 10% in the country study – 10% of the technical potential could be added to the pipeline each year.
PDD potential	The proportion of the practical potential that could be included in the CDM pipeline, given considerations of CDM methodology coverage, local government support and economics.	There is an relevant CDM methodology that could be used for 100% of these sites over the entire 2008-20 period, however 50% of the landfill sites are very small and unlikely to be economically attractive, so (100%*50% = 50%) 50% of the technical potential is deemed PDD potential. This provides a cap at 50MtCO2e/yr in Country X, which is reached in 2011.
Existing PDD volume	PDD volume already in pipeline – before risk adjustment	Project developers in country X have already put several PDDs in the pipeline, which have PDD totals of 20MtCO2e/yr.

Source: New Carbon Finance

The worked example from Table 3 is shown below in Figure 3 to demonstrate the methodology.

Figure 3: Illustrative PDD potential example of landfill gas in Country X



Source: New Carbon Finance

The underlying analysis extends out to 2020; however these reports will refer to a forecast for 2012 in tables and throughout the text, as this timeframe was considered to be more relevant to project developers making decisions about investments over the next couple of years. New

Carbon Finance performs its price forecasting within models that consider supply and demand fundamentals out to 2020 as important demand centres such as the EU ETS increasingly adjust their buying profile to push more demand into the 2012-20 period.

Table 4: Sample PDD potential reporting format for Country X

Sector	Existing PDD pipeline (MtCO2e/yr)	Practical potential in 2012 (MtCO2e/yr)	PDD potential in 2012 (MtCO2e/yr)	Remaining PDD potential in 2012 (MtCO2e/yr)
Landfill gas (as in example)	20	60	50	30
HFC	125	130	130	5
N2O	10	50	45	35

Source: New Carbon Finance

A summary of the factors that influence each stage of the calculations are shown below in Table 5 showing the successive reductions that are applied at each stage of the volume adjustment process.

Table 5: Criteria considered at each stage of supply potential calculations

	Physical constraints	Time constraints	Economic constraints	CDM methodology constraints
Technical potential	Yes	No	No	No
Practical potential	Yes	Yes	No	No
PDD potential	Yes	Yes	Yes	Yes

Source: New Carbon Finance

Throughout this report, technology specific tables are included to reflect the estimates that have been made to carry out the supply potential calculations. Table 6 below shows what this looks like for a specific technology, in this case for HFC gases in Country X, where it is possible to see that although any available volume should be quickly exploited, the bulk of the opportunity has been taken already.

Table 6: Sample technology specific summary for Country X (HFC)

	2008	2012	2016	2020
Practical potential (MtCO2e/yr)	1.5	1.9	1.9	1.9
Methodology coverage (%)	100%	100%	100%	100%
PDD potential (MtCO2e/yr)	1.5	1.8	1.8	1.8
Current volume in the UNFCCC pipeline (MtCO2e/yr)				1.4
Technical potential as fraction of total sector emissions				95%
Annual uptake/build rate as a fraction of technical potential				50%
Fraction of the technical potential that will become CDM/JI				90%

Source: New Carbon Finance

2.1. Methodology for renewable power sources

For most sectors, abatement opportunities arise from the reduction of existing emissions through the application of a more efficient technology, by flaring a high-GWP gas into CO2, or by replacing a high carbon intensity fuel with one of lower carbon intensity. For renewable power abatement is achieved through the displacement of fossil fuel power production with zero-carbon electricity production. With many developing countries struggling to build enough generation capacity to keep up with very high growth rates in power demand growth, in many cases the displacement is not of power from existing power plants (which might still need to run at full capacity to meet peak demand) but from displacing new build carbon intensity and many CDM methodologies reflect this accounting when calculating emission reduction baselines. For countries with drastically different carbon intensities between existing and new build power generation fleets (such as Brazil with its large installed hydro base) this is a particular issue.

While within other sectors the existing sector emissions provide a natural cap on the abatement potential available in the sector, for renewable power it is mostly an economic decision about how much abatement is desired at what cost. The approach that these country studies take is therefore to use government forecasts or targets for their build rate, which are assessments that are developed in conjunction with New Energy Finance, the parent company of New Carbon Finance, which specialises in this area of forecasting. This installed capacity is combined with a country specific load factor and grid intensity (weighted to reflect a balance of existing and new entrant plant) to determine the carbon abatement.

A technology specific summary for renewable power generation is summarised in the format of Table 7 below.

Table 7: Sample technology specific summary for Country X (Wind)

	2008	2012	2016	2020
Practical potential (MtCO2e/yr)	0.6	3.0	5.2	7.4
Methodology coverage (%)	90%	100%	100%	100%
PDD potential (MtCO2e/yr)	0.6	2.0	3.3	4.6
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.5
Fraction of these projects that will become CDM/JI				60%

Source: New Carbon Finance

3. Key actors

3.1. Government – Designated National Authority (DNA)

In contrast to many DNAs in other Latin America countries, the Brazilian DNA has no promotional role and also reports to the Ministry of Science and Technology, instead of the most commonly used route of the Ministry of Environment.

The Brazilian Inter-ministerial Commission on Global Climate Change (CIMGC in Portuguese), which was created in 1999 to consider and approve CDM projects, is formed by members coming from the Ministries of Foreign Affairs; Agriculture, Livestock and Supply; Transportation; Mines and Energy; Development, Industry and Foreign Trade; and the Chief of Staff of the Presidency of the Republic.

Unlike most Latin America Countries DNAs, which report to the Ministry of Environment or its equivalent, the Brazilian DNA reports to the Minister of Science and Technology (MCT), who chairs CIMGC and acts as the Executive Secretary (SE) thus handling the daily operations. The Minister of the Environment, who is also part of the CIMGC, is the vice-chair.

Also in contrast to many DNAs in other Latin America Countries, the Brazilian DNA only evaluates and approves projects. The DNA does not have the role of CDM promotion; this has been done by the private sector. However, the DNA's effort to offer all the Brazilian projects and other relevant documentation in 3 languages (English, Spanish and French) in addition to Portuguese can be seen as an attempt to facilitate and thus attract international investors. Furthermore, other institutions close related to the government have started promoting the CDM.

Other functions of the Commission include: provide a statement, whenever requested, on proposals for sectoral policies, legal instruments and norms related to climate change mitigation and adaptation; provide inputs to the Government's positions in international negotiations; and define eligibility criteria additional to those arising from the CDM EB.

The SE assists the Commission by: coordinating the implementation of the UNFCCC and the National Inventory; following the IPCC scientific works and the international negotiations of UNFCCC; disseminating the IPCC's reports to national experts; acting as the intermediary between project participants and the Commission. The SE also maintains a public database of all project proposed under the CDM, containing information about the PDDs, the reports that served as the basis for the decision of the Commission, and the validation and verification reports of emission reductions from approved projects.

Even though the DNA activities are overseen by staff from different institutions, the distribution of information on CDM regulations among different stakeholders have improved the countries' capacity to deal with CDM, as there seems to be a clear division of institutional responsibility and accountability among the participant institutions.

3.2. Brazilian Climate Change Forum

The Forum, which was created in 2000 and is headed by the President of the Republic, brings together stakeholders including government institutions, the private sector, the scientific community and NGOs. The initiative, which was initially concerned in opening up national discussions on the issue, developed over time and in 2006 it became a legal observer of the Commission and is called to participate at meetings at the discretion of the Commission.

In 2007 the Forum proposed a National Plan of Action to Combat Climate Change, which had the objective of organizing all actions related to climate change, its impacts on the country, mitigation and adaptation research and policies and CDM facilitation. The Forum has made many proposals covering a wide range of related issues, and its impact on the design of policies was made more evident in the initial draft of the National Plan on Climate Change (PNMC), which is discussed on section 4.

The centre for energy research of the Federal University of Rio de Janeiro (COPPE/UFRJ in Portuguese) has a pivotal role in the Forum, particularly through its coordinator Prof. Luiz Pinguelli Rosa and its various researchers, many of them IPCC authors.

3.3. BNDES

Brazil's national development bank (BNDES) is the sole provider of affordable long term debt in the country and in 2008 alone has financed US3.7 billion in renewable energy.

Brazil's national development bank (BNDES) has various initiatives and specific credit lines to promote energy efficiency, renewable energy, CDM projects and forestry. Furthermore, as the sole provider of affordable long term debt most if not all infrastructure and development projects, including renewable energy depend largely on this institution. In 2008 alone it has invested US$3.7billion renewable projects (not considering large hydro). Some of the more relevant initiatives/responsibilities related to climate change include:

- The launch of two private equity funds, which are to explicitly invest in companies that can generate carbon credits.
- Manager of the Brazilian Amazon Fund, which is the governments' proposal for REDD initiatives in the country.
- Manager of the up-coming National Fund for Climate Change, which is to support the National Plan on Climate Change released in the end of 2008.

Although only one of the hedge funds is already fully operational, but still raising funds, both have a target of BRL$400million. The funds are to be managed privately but under the watch of the equity arm of the bank BNDESPAR[2], which has a BRL$100million stake on each fund. The funds are to endure for eight years, which is extendable for up to two years and the investment period is four years, extendable for up to one year.

3.4. Brazilian Mercantile and Futures Exchange

Despite BM&F efforts, its platforms have showed little progress.

The BM&F carbon facility, which was launched in 2005 jointly by the BM&F and the Brazilian Ministry of Development, Industry and Foreign Trade (MDIC in Portuguese), aims at not only facilitate the trading of CERs and solidify the Brazilian carbon market but also evolve into the market global benchmark.

Initially it offered projects participants the on-line registration of both their projects ideas and also validated projects, with the hope to find investors and CERs buyers for Brazilian projects. Foreign investors can also register their particular interest at the Exchange.

For a project to be included in the BM&F registries it must first be analyzed by one of the accredited research institutes within either the University of Sao Paulo or the Federal University of Rio de Janeiro. This initiative has had no positive results so far.

In addition to that BM&F has been operating since 2007 a web-based electronic trading platform for carbon credit auctions. Qualified participants of the global carbon market willing to bid must register in advance of the auctioning to receive full instructions of the operating system.

The first auction at the BM&F saw the purchase of 808,450 CERs by Fortis Bank at €16.20 per credit in 2007. Ten more CER auctions were expected in 2008, but only 1 happened and for the same landfill project; indicating that BM&F's objective of becoming a global benchmark is not very realistic.

3.5. Project Developers

Although Ecoinvest has by far the largest number of projects in Brazil, in terms of volumes of credits Perspectives Gmbh dominates.

As of February 2009, 366 projects had initiated the CDM process in Brazil. Of these two were withdrawn, and 19 have been rejected. Withdrawn and rejected projects are not in Table 8 below.

Out of the rejected projects, eight were of energy efficiency at different branches of the market leader supermarket in Brazil, Pão de Açúcar. Four were of biomass energy, two at cement plants, two hydro, two fossil fuel switche and one was related to energy efficiency at an iron and steel industry.

It is interesting to note that two of them, cement blending with blast furnace slag and fly ash, were rejected as these practices are considered to be common in the region and thus the technical barrier was not evident.

Finally, two of them were rejected at the request of one of the parties, in this case the Brazilian DNA. One had its LoA nullified due to problems with the environmental regulator at the project's site and the other contained differences between the PDD presented at the CDM EB and the PDD presented at the DNA. One of them, from Ecosecurities, was re-submitted as a small scale project and is now registered.

The following are major project developers in Brazil:

Perspectives Gmbh, founded by Axel Michaelowa (a leading expert in the field of the Clean Development Mechanism), provided CDM guidance for Rhodia adipic acid plant, which accounts for 35.7MtCO2 of its total and is the single largest source of emissions reductions.

Econergy International Corporation, which is a renewable energy company with a focus in the Americas, is second on the number of emissions reduction potential. Out of its 49 projects, 34 are biomass projects (all bagasse power), 8 are landfill flaring based, 3 are from wind projects, 2 fossil fuel switch and one hydro.

[2] BNDES Participações S.A

Ecoinvest is leading the number of CDM projects developed so far. Out of its 64 projects, 29 are hydro projects, 19 are biomass to energy, 3 fossil fuel switches, 2 biogas, one energy distribution, 3 energy efficiency in industry and 3 landfill gases, one PFC and one wind.

Ecosecurities, the world leader project developer in terms of projects and emission reduction potential, has a relatively high number of emission reduction potential compared to its number of projects, but still has only 34 projects. Project types have ranged from renewables, including biomass and hydro, to energy efficiency, landfills and biogas.

Table 8: Key Project Developers

	Project Type	Project Number	2012 ktCO2e	% of Emissions Reductions
Perspectives GmbH	Various	5	36327	19%
Econergy	Various	48	25881	14%
Ecoinvest	Various	64	23244	12%
Ecosecurities	Various	34	18568	10%
ICF	Various	6	11926	6%
AgCert	Biogas	35	11560	6%
Conestoga-Rovers & Associates	Landfill	3	8539	4%
First Climate	Landfil, FFswitch	2	4890	3%
CantorCO2e	Various	10	4888	3%
Sol Coqueria Tubarao	Waste heat recovery	2	3158	2%
World Bank – Plantar	Reforestation	1	3148	2%
MGM	Various	14	2814	1%
Enerbio	Hydro, biomass	6	2123	1%
Others	Various	115	33181	17%
Total		345	190247	100%

Source: New Carbon Finance, UNEP Risoe

3.6. Credit Buyers

Although there is clear prevalence of unilateral projects in Brazil, the key buyer is Noble Carbon and ORBEO, off takers of the large N2O project at Rhodia.

Most projects in Brazil are unilateral, which are developed without direct initial participation of Annex-I countries or foreign buyers, which tend only to enter agreements after the project is accepted by the EB. Although for many projects there is more than one buyer, Table 9 below indicates some of the dominating buyers:

Noble Carbon and Orbeo buys credits from the largest project in Brazil. This project involves the decomposition of N2O from adipic acid production at Rodhia's plant in Paulinia. The project developer was Rodhia itself, although it relied on the expertise of Axel Michaelowa from Perspectives to develop the appropriate monitoring process.

Chugoku Electric, the Japanese energy company, has chosen to buy projects within their experience, particularly in hydro and thermal. Seven projects were in hydro and four in biomass-to-energy (three bagasse and one forest residues).

Ecosecurities normally buys the credits from its projects, but it has also bought credits from projects developed by other developers and some with have co-buyers, including Essent Energy Trading and Shell.

The German bank **Kfw** is the credit buyer of two large landfill projects developed by Econergy, which are expected to reduce emissions by 15MtCO2e until 2012. As Kfw does not finance more than 50% of a particular project, the final buyers of these projects are yet not known. For instance, one of the projects it had financed had some of its CERs auctioned in the BM&F Exchange of São Paulo, where 0.8MCERs were bought by Fortis bank.

BHP Billiton, the giant mining company, is the credit buyer of four projects. Three of the projects were developed by Ecoinvest, all of which were biomass related to obtaining energy from sugar-cane bagasse. The remaining one was a landfill project developed by Factor Consulting and Management.

The government of the Netherlands, through its various public funds, is the credit buyer of a diverse portfolio of seven projects. Three projects were developed by the Dutch developer PTZ Bioenergy involving the use of sugar-cane bagasse. Two were hydro projects developed by Ecoinvest, one project was developed at a landfill site by Ecosecurities and finally, one small-scale charcoal project was developed by RS Consultants.

Table 9: Dominant Credit Buyers

	Project Type	Project Number	2012 ktCO2e	% of Emissions Reductions
Noble / Orbeo	UK / France	2	36214	19%
Chugoku Electric	Japan	12	7135	4%
Ecosecurities	UK	31	6711	4%
Showa Shell	Japan	1	6667	3%
BHP Billiton	Netherlands	4	5733	3%
Kfw	Germany	6	4837	2%
No buyers		177	48893	26%
Others	Various	112	74057	39%
Total		345	190247	100%

Source: New Carbon Finance, UNEP Risoe

4. Regulatory Environment

4.1. Kyoto Eligibility – current status

Brazil is fully eligible for the Kyoto Protocol. Indeed Brazil was the first country to sign the UNFCCC during Rio 92.

Brazil was the first country to sign the UNFCCC during Rio 92 and started working in its National GHG Inventory in 1996. Brazil is therefore fully eligible for the Kyoto Protocol. Despite these early efforts, the Brazilian First Communication was released only in 2004 with revised data for the years of 1990 and 1994. The second national communication, which is to be released during the first semester of 2009, is expected to cover the years 2000 (all sectors) and 2004 (partial). Furthermore, only in late 2008 and just before the Poznan talks started, Brazil released its National Climate Change Plan.

4.2. Approval procedures and criteria

Application

In spite of the DNA procedures being long, bureaucratic and somewhat uncertain, the development of projects in Brazil has been significant with numerous national developers and international players.

The procedure for evaluating and approving CDM projects was established by the CIMGC in 2003, but several minor changes occurred since then. Some of them were mere pro forma activities, such as updating regulations according to the EB, others however served to increase the bureaucratic requirements for developers and some even increased project risks.

Project proponents must submit electronic and hard copies addressed to the Executive Secretary of the Commission in Brasília of the following documents:

- A cover letter addressed to the Secretary enlisting the documents sent.
- The PDD, written in both Portuguese and English, must contain a description of the contribution of the project to sustainable development and also be textually the same as the one sent to the EB, under the penalty of the SE asking the CDM EB for review.
- Copies of the invitations for comments, which must be sent before the validation starts, sent by the project proponents to the various stakeholders[3] containing the project's details[4].
- The validation report, written in both Portuguese and English, must be textually the same as the one sent to the EB.
- A declaration identifying the person and form of communication with the Executive Secretariat of the CIMGC. This declaration must be signed by all the PPs legal representatives in their respective letterhead paper.
- A letter of commitment to report the distribution of CERs delivered by the project signed by all the PPs legal representatives in their respective letterhead paper. PPs must in 30 days after issuance present a proof of distribution of these CERs among themselves.
- Documents, which attest the compliance of the project with the environmental and labour legislation, must be signed by all the PPs legal representatives in their respective letterhead paper.
- Documents giving further evidence that the project will contribute to sustainable development or clarifying further any of the previous request may be added under a supplementary heading.

Approval process

Though the decision over a project should take a maximum of 65 days, in practice the LoA is received on average only after 210 days.

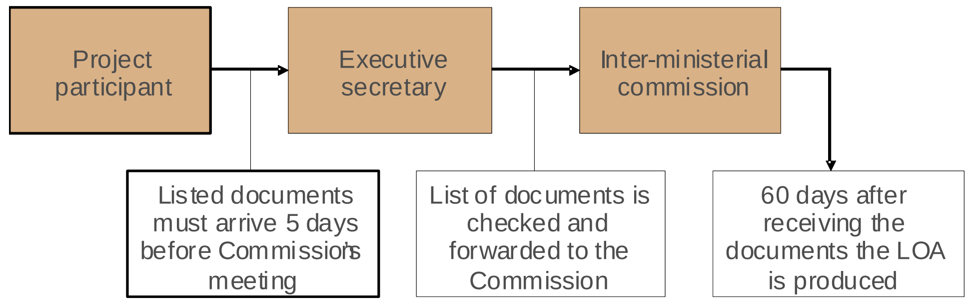
The PDD and all the documentation listed above must be addressed to and received by the SE 5 working days before the meeting or the project will be considered only in the next meeting. Figure 4 below illustrates the process, which is simple but bureaucratic and slow.

Upon arrival the SE verifies if all requested documents have been delivered and then forward them to the Commission. The Commission meets every two months and should issue a final decision within sixty days of the first ordinary meeting subsequent to receipt of the documents. However, developers in the country report that in practice this takes 210 days on average[5].

Approval, which requires a 2/3 vote from the total of nine Ministries that form the Commission, is dependent upon a technical analysis of the project, including analysis of baseline, additionality, the calculations used to define the number of CERs and the contribution to sustainable development. After all this consideration the project may be approved, approved with reservations or not approved, as explained in the next section.

[3] Municipal governments and City Councils, State and Municipal Environmental Agencies, Brazilian Forum of NGOs and Social Movements for Environment and Development, Community associations, and State Attorney
[4] The name of the project; the website where the PDD is to be found; and a description of how the project contribute to sustainable development;
[5] Ecosecurities presentation at Carbon Markets Americas (2008)

Figure 4: Brazilian application process



Source: New Carbon Finance

The Brazilian DNA requirements for the validation report, copies of the invitations for comments that were sent to different stakeholders and the PPs' commitment to submit reports on the results of the certification of CERs are rather unique and may be cause of concern to developers, especially the request for the validation report.

While the DNA would argue that this is to ensure high standards and also that risks are reduced at other stages of the CDM cycle and thus a better price can be obtained by developers even at early stages, it is also conceivable that this may cause delays and thus loss of emission reductions.

As the DOE must see the Letter of Approval (LoA) before it can validate a project, a compromise has been reached whereby the DNA accepts an incomplete validation report that is without the host nation approval.

However, as this initial process becomes longer a number of regulatory changes may occur, such as the period of validity of a methodology may expire or new PDD requirements published. In case of these events, the validation report will need to be updated and resubmitted to the DNA. This in turn may cause further delays and thus loss of potential CERs.

Although this excessive zealousness could have reduced the interest from international players in developing projects in Brazil since other Latin-American countries' DNAs have less stringent and bureaucratic rules and procedures, the development of projects in Brazil has been significant and consistent with numerous national developers and international players.

The explanation for this lies not only on the large amount of emission reduction opportunities, but also on the technical and financial capacity of local developers and entrepreneurs, which are only constrained by the unstable regulatory framework, high interest rates, institutionalized corruption, bureaucratic labyrinths, heavy tax burden and now a global economic crisis.

Approval criteria

In addition to regular national legislation a clear set of sustainability criteria is to be observed.

In addition to the conformity to all national relevant legislation, the project's contributions to sustainable development are assessed under the following criteria:

- The local environmental sustainability: wastes, waste water, air pollution, etc.;
- The improvement of working conditions and net employment creation: project commitment towards social responsibility, health, education and human rights. Both direct and indirect jobs are taken into account when compared to business as usual scenario;
- Income distribution: inequality and poverty alleviation compared to baseline;
- Capacity building and technology development: innovation of technology deployed; potential for replication; equipment origin and the need for royalties/licenses; dependence on international technical assistance;
- Regional integration and trans-sectoral engagement: co-benefits and integration of project with other regional activities.

Reasons for non-approval

The LoA may be withdrawn increasing the risks for developers due to major, but also minor issues such as the non-observance of textual differences between versions of the PDD

The non-observance of any of the requirements as explained above in addition to editing errors, shortages in relation to the sustainable development criteria or inconsistencies of information between different PDD versions and validation reports can lead to the project non-approval. Two situations may thus arise:

- For minor mistakes the project is considered approved with reservation and the fulfilment of the requirements explained by the SE lead to the immediate issuance of the letter of approval (LoA). The PPs has 60 days to address the issues raised.
- For major mistakes the project is considered under review and PPS have 60 days to address the issues raised or have the project refused.

Since the end of 2006, if the Inter-ministerial Commission is alerted by one of its members of any legislative infringement or any act contrary to the public interest caused by the PPs, then it may through the SE request additional related information to the relevant departments and/or the PPs.

In case the suspicions are substantiated, the DNA can initiate a process that may lead to the annulment or revocation of an already approved project. The LoA may be annulled if evidence is found supporting the contention that legal vices in the process of obtaining the LoA or during the project activities have occurred. The LoA may suffer revocation if evidence is found supporting the contention that acts contrary to the public interest have been caused by the PPs.

In these cases, the SE informs the PPs and makes them aware of the reasons. After receiving the communication the PPs have 15 days to mount their defence. A final decision will be given by the Commission 15 days after the following meeting. If it decides for annulment or revocation the PPs will be informed as well as the CDM EB. If the project has not been registered yet the SE will request the CDM EB for a review.

Brazil has been known to generate such upheaval in the whole process for the non-observance of textual differences between versions of the PDD (approved version and version submitted for registration), so attention to the procedures detailed above is essential.

This new rule was aimed at tackling not only ill intentioned or less attentive developers, but also facilitate the enforcement of environmental, labour and other national legislation. Project developers should thus carry out extensive due diligence to verify if the company site where the CDM project is to be developed has no pending issues with any of the regulatory agencies.

On a more positive note, this could also counteract the problem of corruption, which is part of the non-observance of legislative compliance. Despite the good intentions, this can lead to difficulties for all developers from raising finance to securing a better price in ERPAs, as the early country approval risk will only be surpassed when the project is actually registered.

Furthermore, given the short period of time (15 days) from receiving the official communication, honest developers which incurred in defensible mistakes can be over penalized.

4.3. Climate Change / CDM policies

Considering only the forestry objectives of the National Climate Change Plan, an overall emission reduction of 40% from 1990 levels by 2017 is estimated, beating pledges from all major economies so far.

The creation of the CDM, as one of the flexible mechanisms in the Kyoto Protocol, is the consequence of the work of Brazilian negotiators, whose proposal during the COP3 about a clean development fund concept intended to fund adaptation activities in developing countries by forcing industrialized countries to pay a penalty for not meeting their assumed reduction commitments. In spite of that, and ignoring its vocation for renewable sources of energy, Brazil has not to date actively promoted the CDM nor actively pursued emission reductions.

The National Plan on Climate Change released in December 2008 indicates a turnaround on the country’s policies. Emission reduction targets have been set and the government now wants to leverage the CDM to achieve some of its emission reductions objectives.

The original National Climate Change Plan was released in October 2008 and was criticised both domestically and internationally for the lack of measurable, reportable and verifiable (MRV) actions as committed to during the Bali talks by governments, including Brazil. This could have undermined CDM activity in the country, as both the US and the EU have signalled restrictions on the import of international credits from countries without some form of commitment.

The changes in the final version have been included to both develop a negotiation strategy and address domestic Brazilian concerns. However, even this latest version of the plan has raised criticisms from various sectors, particularly NGOs, as it does not foresee an end of deforestation in the Amazon region and in their opinion does not go far enough in other areas either.

The highlights of the PNMC were:

- The plan now exhibits measurable, reportable and verifiable (MRV) actions in all sectors with particularly emphasis on forestry,.
- We estimate that the goals set by the Plan would mean, considering only the forestry objectives, an overall emission reduction of at least 40% from 1990 levels by 2017, beating pledges from all major economies so far.
- Further renewable energy development from hydro sources, including small hydro. Biomass, and wind projects will continue to be supported even after current national targets under PROINFA are achieved via renewable energy-specific auctions.
- A first-ever requirement or subsidy for solar PV installations connected to the grid in Brazil to be developed eventually by the Ministry of Mines and Energy.
- Ethanol supply will grow 11% per year on average, as forecast by the Ministry of Mines and Energy. Such growth will be supported by the next phases of the Plan with biofuels resulting in emissions reductions of 570 mtCO2 between 2008 and 2017.

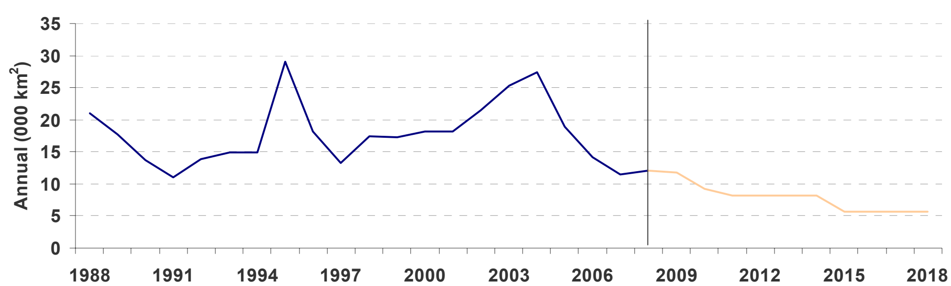
The pledges in the plan are however, conditional on securing additional national and international resources to guarantee monitoring, policing and economic re-orientation of the forests, including those raised by the Amazon Fund. The Plan will be implemented with the financial support of the National Fund for Climate Change (NFCC) with part of the resources coming from the profits of activities of exploration for oil in Brazil. The PNMC not only places Brazil in a better position at the international climate talks but should increase the country's attractiveness for investments in forestry, renewable energy and CDM. The next phases of the Plan will specify the new policies and financial instruments that will support renewable energy development in Brazil through specific legislation with no specific date for the overall conclusion of the process.

Forestry

The two main goals for forestry in the Plan are to reduce the rate of deforestation and to eliminate the net loss of forested area in Brazil. The first goal seeks to reduce the rate of illegal deforestation to zero, but conditional on international support. The first targeted period of 2006-2010 will aim for a 40% reduction from the reference scenario, which is the average of deforestation within 1996-2005. The next two periods of 4 years will have a target of 30% each. Emission reductions of 4800MtCO2e between 2006 and 2017 are expected, considering 100tC/ha.

The second goal is to eliminate the net loss of forested area in Brazil by 2015 by doubling the area of planted forests, particularly in degraded areas, from the current 5.5 million hectares to 11 million hectares, 2 million of which should be from native forests. Much of this is hoped to be achieved through the use of CDM finance. Other goals of the plan with regards to forestry include a program for the sustainable use of forests for fuel and the concession of 4 million hectares of public forests for sustainable management ventures.

Figure 5: Historical and Projected Deforestation in the Amazon



Source: INPE, PNMC and New Carbon Finance

Grid factors

In 2008, after much discussion the government published a universal baseline emission factor for the Brazilian electricity sector, which is an improvement from the initial 2007 plans to have individual factors for each of the 4 sub-systems. Such a revision was a big step forward for CDM in Brazil, as it was estimated by a group of project developers led by Ecosecurities and Ecoinvest that the total loss of renewable investments in the country was to amount to BRL153 million (USD 70 million[6]).

The final revision of the emission factor calculation not only allowed project developers to move ahead with their projects but also equalised the risks of projects around the country. However, the new approach still does not provide enough incentives to reverse the increasing intrusion of fossil fuels into the energy matrix.

Local Initiatives

The City of São Paulo set a 30% emission reduction target by 2012 from 2003 levels.

Curitiba, Rio de Janeiro, Belo Horizonte and Porto Alegre have joined the CCP – Cities for Climate Protection network established by ICLEI – International Council for Local Environmental Initiatives. One of the initial outcomes was the inventory of GHG emissions from the city of Rio de Janeiro prepared by Federal University of Rio de Janeiro (UFRJ).

Besides the inventory of current and past GHG emissions, the study also quantified the amount of GHG emissions avoided by local government policies and measures. In addition to that it identified a number of additional mitigation options (such as methane recovery from landfills and the improvement of bus transportation systems) that is to be included in a Climate Action Plan in debate at the local government of Rio de Janeiro.

The City of São Paulo also carried out a GHG inventory, which revealed that the city total emissions were equal to 15.7MtCO2e in 2003. The study aimed at identifying mitigation options that can be supported by the local government and led to the establishment of a Climate Change Mitigation Policy. The plan now envisages a 30% emission reduction target by 2012 from 2003 levels. We estimate the two large landfill projects under the CDM and the fast uptake of flex-fuel cars from 2004 will make the bulk if not all of the required target.

The sate of Sao Paulo has also hinted that it would implement similar measures and emission reduction targets. However, we believe this is unlike to happen in the near term, as the state contributes 41% of the total industrial GDP[7] and the industry has already declared it will be against any such measure. In addition to that, the economical downturn caused by the global financial crisis will likely further diminish the state impetus in pursuing this policy, especially when the governor is to run for the next presidential election in 2010.

Policies by technology and sector

Brazil has for a long time devised a range of programmes that already had some impact in the country's emission profile, particularly ethanol programme.

Brazil has for a long time devised a range of programmes that already had some impact in the country's emission profile. The list below summarises the most relevant of those:

- Light for All (Luz para Todos, in Portuguese): started in 2003 to replace previous relatively similar programmes, which also aimed to achieve the universal access to modern energy in rural areas;
- Programme to Conserve Electricity (in Portuguese, PROCEL): started in the 80s with the aim of reducing electricity wastage in both the demand and supply side;
- National Programme of Efficiency in Public Illumination (in Portuguese, RELUZ): started in 1986 with a clear focus as suggested by its name.
- The National Programme for the Efficient Use of Oil Derivatives and Natural Gas (in Portuguese, CONPET): established in 1991 to encourage the efficient use of energy in transport, households, commerce, industry and farming.
- Ethanol (Proalcool in Portuguese): started in the 70s in response to the oil crisis of the time.
- Various cities (+40) have already established laws that force new buildings and large house to use solar heat collectors

However, it is the Programme to Encourage Alternative Sources of Energy (in Portuguese, PROINFA), which was created in 2002 with the aim to promote renewable energies to the grid, that is the most relevant for CDM. Though this programme is eligible for credits from the CDM, controversies have arisen over whether the government or project developers own the credits and the final outcomes is yet to be known. This has caused serious complaints from developers and litigation is still on course in same cases, obviously impacting negatively on the development of CDM projects.

During the first phase of the PROINFA programme, 60% of all equipment and services needed to be nationally sourced. A 50% discount for access to the transmission lines and distribution by the generators was ensured and Eletrobrás guaranteed purchase agreement over a 20 years period, giving preferential treatment to wind, small hydro power (SHPs), and biomass, respectively. The

[6] Ecosecurities presentation at Carbon Market Americas
[7] BNDES

envisaged second phase has been delayed as many of the projects from the first phase are yet to be implemented.

It is also unclear how future support for wind, small hydro and biomass will be delivered in the near future, even though there is clear impetus in that direction and bit and pieces of legislation are coming through that in one way or another help the development of such technologies. One example is the reduction in capex costs for biomass projects in a couple of states caused by the transfer of initial transmission costs from developers to distributors. As recent as the first week of February 2009 the government announced this type of benefit would apply to all wind farms, potentially boosting the activity in the sector. Instead of a programme however, the government is likely to in the future set technology specific auctions. One for wind has already being announced for this year, though with no date.

Transport

Legislation passed in 2005 established mandates for blending of diesel with biodiesel. The initial 2% biodiesel blend was subsequently increased to 3% for the period 2008-2012, and 5% from 2013. Nonetheless, there is increasing talk at both the industry and government level that the 5% blend should be adopted, as substantial increases in production have been already evident and much capacity is expected to be added. The current global economic situation may however reduces the new build rate, as the main provider of debt in Brazil, BNDES, has already increased the requests for guarantees and reduced the debt portion, forcing investors to provide more equity in a time that capital is scarce.

5. PDD Potential by technology

5.1. High Global Warming Potential (GWP) gases

HFC

Brazil is not one of the developing countries involved in the manufacture of HFCF-22.

According to the Brazilian Initial National Communication, total emissions of HFC 23 were in 1994 equal to 0.2Kt. Given this gas warming potential is 11,700, total emission were equivalent to 2.3MtCO2e in that year. However, these emissions do not come from the HCFC-22 production, as Brazil is not one of the developing countries involved in the manufacturing of this gas.

Developing countries that are currently producing this gas are: China, India, South Korea, Mexico, Venezuela and Argentina[8]. Aside Venezuela projects have been developed in all these countries. We estimate **there is neither practical potential nor PDD reduction potential**.

PFC

Brazil is the sixth largest primary aluminium producer in the world and considerable potential still exist in this sector.

There are two methodologies for the abatement of PFCs, AM30 and AM59. While the latter is yet to be used by project developers, the former has three projects in the pipeline at the validation stage. One project is in Argentina and two are in Brazil. Both apply to aluminium smelting facilities. One of the projects in Brazil is located at Albras plant in Barcarena in the Pará State and the other is located at Alcoa's plant in Minas Gerais.

According to the Brazilian Association of Aluminium, Brazil is the sixth largest primary aluminium producer, the fourth largest alumina producer and fifth exporter of primary aluminium/alloys in the world. Albras in turn is the largest producer of primary aluminium in Brazil. With 27% of total production it is followed closely by CBA and Alumar, both producing 25% each of total production in 2007. Novelis plants (formerly owned by Alcan) produced 13% of primary aluminum in Brazil and Alcoa and Valesul were responsible for just over 5% of total output each.

The first national communication estimated emissions level at 0.35Kt of CF4 and 0.03Kt of C2F6 in 1994. Considering the global warming potential of these gases are 6,500 and 9,200, respectively then total emissions can be estimated at 2.5MtCO2e for that year. Neither the National Communication nor the US EPA estimates emissions from semi conductors.

Despite the efficiency gains since 1994 in terms of CO2e emissions per tonne[9], the industry has grown significantly since then due to high global and national demand. Between 2002 and 2007 alone the industry in Brazil has grown by 25%.

Table 10: Reduction potential of PFC - Al in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	1.26	3.42	3.90	4.48
Methodology coverage	75%	100%	100%	100%
PDD potential (MtCO2e/yr)	1.46	2.74	3.12	3.59
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.11
Technical potential as fraction of total sector emissions				95%
Annual uptake/build rate as a fraction of technical potential				50%
Fraction of the technical potential that will become CDM/JI				80%

Source: New Carbon Finance

The USA EPA estimates PFC emissions in the aluminium production in Brazil were about 3MtCO2e/yr in 2005. However, considering the production level of 1.6Mt of primary aluminium and the emission factor 0.18Kg CF4 of aluminium produced, as reported by the country's aluminium production association[10], emissions from this sector can be estimated at 1.8MtCO2e in 2007. Considering US EPA estimates and that all other installations can develop a similar project to the one in Albras, then **we estimate a practical potential 3.42MtCO2e in 2012 and we calculate a PDD reduction potential of 2.74MtCO2e in the same year**, as shown on Table 10.

[8] Cames et all (2007).
[9] Albras CDM PDD
[10] www.abal.org.br

SF6

The largest possible project in the country for SF6 abatement in the Mg industry has been developed.

There are two approved methodologies AM35 and AM65. While the former allows credits to be created via reductions of emissions from electrical grids through the recycling or leakage reduction of SF6 from an electric utility, the latter allows credits to be generated from the replacement of SF6 with alternate cover gas in the magnesium industry.

As 80% of global SF6 production is used in gas insulated switch gear and about 5-7% in blanketing molten magnesium[11], most of opportunities would be within the methodology AM35. Currently however, there are no projects in the CDM pipeline that utilizes AM35 and only three projects using AM65 (1 in Brazil and two in Israel).

AM65

According to Climate VISION[12], a US government program, SF6 is manufactured mostly by six major global producers: Asahi Glass Chemicals (Japan); AlliedSignal Inc. (USA); Air Products & Chemicals (USA); Ausimont (Italy); Kanto Denka Kogya (Japan); and Solvay Fluor und Derivate GMBH (Germany).

Total global sales of SF6 were estimated at 8,500 tonnes in 1996 and have been increasing at an average annual rate of about 5% per year since 1990, so production could be estimated at about 14,500 tonnes currently[13]; if the growth rates remained the same and other unidentified producers do not became major players. This would therefore be equivalent to about 350MtCO2e per year, if all production is eventually released to the atmosphere, as it is assumed nowadays.

The strong growth in magnesium production is due to the increased interest of magnesium dies casting for the auto industry. This recent boom in primary production and die casting has been one of the main factors that contributed to the increase of global SF6 sales for magnesium and is likely to remain so in the future, as magnesium can be the lightest of the structural materials, depending on the application[14].

SF6 is used for protection of molten magnesium during the production of primary magnesium ingots at smelters; die casting of magnesium alloys; gravity casting of magnesium alloys, and production of secondary magnesium through recycling of magnesium or its alloys. Other end uses of primary magnesium do not involve melting in a pure state and therefore do not require a protective atmosphere. In addition to that, 75% of global emissions of SF6 from magnesium come from primary magnesium smelters[15].

According to the International Magnesium Association, Brazil produced in 2006 6Kt of primary magnesium, which is about 0.83% of global production. Rima Industrial, the world's second largest magnesium die caster and the only primary magnesium producer in South America, has since the last report, which indicated its potential developed the largest possible project in the country. Secondary magnesium producers, die and gravity casting can be numerous, small and dispersed and thus more difficult to develop. **We estimate a practical potential 0.49MtCO2e in 2012 and we calculate a PDD reduction potential of 0.27MtCO2e in the same year**.

Table 11: Reduction potential of SF6 - M in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	0.44	0.49	0.57	0.67
Methodology coverage	25%	50%	50%	50%
PDD potential (MtCO2e/yr)	0.27	0.27	0.27	0.27
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.27
Technical potential as fraction of total sector emissions				95%
Annual uptake/build rate as a fraction of technical potential				50%
Fraction of the technical potential that will become CDM/JI				25%

Source: New Carbon Finance

[11] International Magnesium Association
[12] Voluntary Innovative Sector Initiatives
[13] Ibid
[14] Rima Industrial
[15] Climate VISION. Available from: www.climatevision.gov

AM35

Although the potential to abate SF6 in electrical systems could be high, we estimate that there is no PDD potential.

Electric utilities and electrical equipment manufacturers are the main buyers of SF6, due to its uses in electrical insulation, arc quenching, and current interruption in high-voltage electrical equipment.

The partnerships created through the Climate VISION program in the US achieved significant reductions in emissions from electrical systems, as after five years the SF6 emission rate dropped from 17% to 9.5% among those participating in the initiative. The initiative, which reached 40% of the American industry, reduced emissions by 1MtCO2e/yr since its inception.

Despite this evidence, and due to the lack of systematic or compulsory data collection of this source, the Brazilian estimates for SF6 emissions from this source are very difficult to be made. The SF6 emissions from industrial sources were in 1994 equal to 0.002Kt[16], which given SF6 warming potential of 23,900 is equivalent to 47.8KtCO2e. Given the continental size of Brazil and the data from the US program, it is apparent that emissions should be much higher. Two PDDs in the Brazilian pipeline compound the difficulty of making any meaningful estimates of SF6 emissions from electric equipment as one suggests leakage occurs at a rate of only 1% of total SF6 use and the other suggests fugitive emissions could be as high as 10%.

Newton Paciornick[17], authority in greenhouse gases of the Brazilian Ministry of Science and Technology, confirmed that currently there is not any government program aimed at the reduction of SF6 and the lack of detailed information prohibits a robust analysis of the emission reduction potential at the national level.

Assuming that through a programmatic methodology, perhaps in the moulds of the Climate VISION program, and a 95% technical practical potential, **we estimate that the practical potential is small at 0.59MtCO2e/yr in 2012 and that there is no PDD potential,** as indicated in Table 12 below.

Table 12: Reduction potential of SF6-E in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	0.11	0.59	1.33	2.20
Methodology coverage	75%	100%	100%	100%
PDD potential (MtCO2e/yr)	0.0	0.0	0.0	0.0
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.0
Technical potential as fraction of total sector emissions				95%
Annual uptake/build rate as a fraction of technical potential				10%
Fraction of the technical potential that will become CDM/JI				0%

Source: New Carbon Finance

N20

There is only 0.12MtCO2e/yr by 2012 of potential left from the release of N20 by industry.

Total N_2O emissions amounted to 550Kt in 1994[18], 90% of which came from the agricultural sector and only 14Kt from industrial processes. Considering that this gas has 310 times the warming potential of CO2, then the total emission for the industrial sector were equivalent to 4.3MtCO2e for the same year.

The Brazilian Association of Chemical Industries (ABIQUIM[19] in Portuguese) estimates that the sector has grown at an average of 5.7% per year from 1990 to 2006. If emissions followed the same level, they can be estimated currently at over 9MtCO2e.

As just one of the projects already in the pipeline is expected to reduce emissions by 5.9MtCO2e /y at Rhodia's adipic acid plant in Paulinia, the above estimate would seem to be reasonable. However, this estimate may be higher than reality as 96% of the industrial N_2O releases originate from the adipic acid production[20].

[16] National Communication
[17] Personal communication with New Carbon Finance
[18] National Communication
[19] www.abiquim.org.br
[20] National Communication

Four other projects in the pipeline are located at nitric acid plants owned by Fosfertil (the largest producer of nitric acid in Brazil), Rodhia and Petrobras. According to Fosfertil[21], the company retained nearly 30% of the market share of nitrate material for the fertilizer industry in Brazil and 60% of consumed nitrate material is imported. Accounting for the nitric acid project from Rhodia there would not be any remaining potential for this kind of project in Brazil, as Rhodia, Fosfertil and Petrobras are the sole producers of nitric acid in Brazil, according to ABIQUIM.

Currently, there is only one project from a caprolactam plant. Located in Thailand, the project has asked registration and allows for the abatement of N_20 from the tail gas of caprolactam production plants at a rate of 0.16MtCO2e/yr from an output of 110,000 tonnes of caprolactam. Considering that Brasken, the sole producer of caprolactam in Brazil, had in 2007 an output of 62,000 tonnes of this compound and all other factors being equal, then a total theoretical rate of 90KtCO2e/yr in emission reductions could be achieved. It is not known however, if the available methodology applies for their production process. W**e estimate a practical potential 6.38MtCO2e in 2012 and we calculate an equal PDD reduction potential in the same year,** as indicated in Table 13 below.

Table 13: Reduction potential of N2O in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	6.38	6.38	6.38	6.38
Methodology coverage	88%	100%	100%	100%
PDD potential (MtCO2e/yr)	6.38	6.38	6.38	6.38
Current volume in the UNFCCC pipeline (MtCO2e/yr)				6.38
Technical potential as fraction of total sector emissions				95%
Annual uptake/build rate as a fraction of technical potential				50%
Fraction of the technical potential that will become CDM/JI				90%

Source: New Carbon Finance

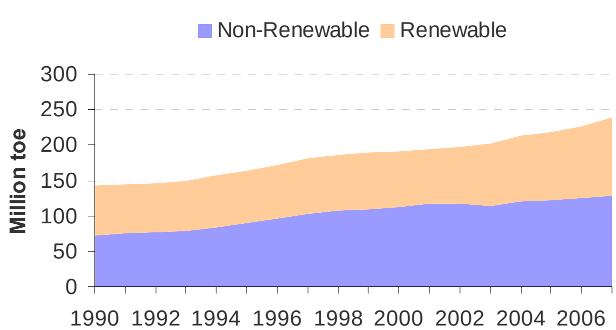
5.2. Renewable energy

Brazil has for a long time relied on renewable sources of energy, which now made up 46% of the country's energy matrix.

Renewable sources of energy have for a long period of time made up significant contributions to the country's energy matrix, as shown on Figure 6. In 2007 hydro and biomass mainly, as shown on Figure 7 amounted to the 46% of total energy supplied by renewable energy as shown on Figure 6. Interesting to note is that sugar-cane energy products currently supply more energy than hydro.

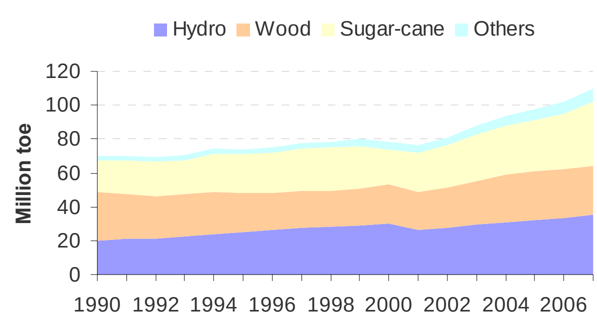
Total electricity production in 2007 amounted to 483TWh. However, as non fossil-fuel sources generated 92% of all electricity in the country, only 40TWh released GHGs to the atmosphere, making the Brazilian electricity matrix the cleanest amongst large economies.

Figure 6: Energy Matrix



Source: BEN, New Carbon Finance

Figure 7: Renewable Energy



Source: BEN, New Carbon Finance

A common CDM methodology in Brazil is to upgrade the boilers of ethanol plants, which are typically self-sufficient in electricity production, from 21 bar (the most common type) to 65 bars.

[21] www.fosfertil.com.br

This increase in pressure gives them additional generating capacity that can be exported to the grid. It is worth noting that carrying out this CDM methodology at all ethanol plants in Brazil would enable all 40TWh of thermal generation in Brazil to be substituted.[22] In spite of the potential to maintain and even increase the share of renewable energy use in the country; fossil fuels are instead increasingly making up a larger fraction of new build. Brazil holds regular reverse auctions for the future supply of electricity to the grid and the results of the auctions are shown on Table 14. The dominance of thermal generation is clearly visible within them.

It is also clear from Table 14 that both biomass and wind are not competitive with fossil fuel and that they require incentives to go ahead. It is here that the low grid emission factor of Brazil as calculated under the ACM02 methodology reduces the volume of CERs available to renewable power generators and therefore the incentive to CDM developers and investors.

Table 14: Results of latest two auctions for new energy

	Date	Conventional fuel	Renewables	BRL$/MWh	TWh/y	PPA (years)	Out-bid RE
For supply in 3 years	09 / 2008	8x fuel oil; 2x gas	None	125-131	9.4	15	49 wind and 55 biomass
For supply in 5 years	09 / 2008	1x coal; 21x oil and gas	1x hydro; 1x bagasse	140 – 146 fossil fuel; 99 hydro;	25 - fossil fuel; 1 - hydro; 0.3 - bagasse	30 - hydro; 15 - others	17 wind and 33 biomass

Source: CCEE, New Carbon Finance

Technology-specific auctions are envisaged by the Brazilian government and while these could facilitate the entry of renewable energy into the grid they could also potentially undermine the additionality of the projects. Nonetheless, as these specific auctions represent an incremental cost to the country and there are other cheaper technological alternatives, the additionality principle should be met as it has been the case for projects under the Proinfa scheme. The next subsections look into each technology in turn.

Biomass

We estimate a practical potential 9.90MtCO2e/yr in 2012 and we calculate a PDD reduction potential of 8.25MtCO2e/yr in the same year for biomass projects connected to the grid.

With the forecast increase in ethanol production, there will be more feedstock available for the production of energy from the remaining biomass. In addition to that, legislation requires that areas that produce sugar-cane and which can be mechanically harvested should actually do so. Mechanical harvesting replaces the traditional harvesting technique that requires the field to be burnt first, a process that consumes all of the potential biomass residues. This process is already occurring as various plants in the state of Sao Paulo and other neighbouring states (which account for over 60% of total sugar-cane production) voluntarily agreed to fully mechanise by 2014 (as opposed to 2020), in anticipation of government targets. Therefore in addition to bagasse (industrial residue), there will be a large and increasing amount of agricultural residue (straw), which contains up to 1/3 of sugar-cane energy content.

In spite of the substantial potential from this other form of residue, all but two of the CDM projects within this sector have focussed on exporting to the grid excess electricity produced from bagasse. As of February 2009, 61 projects in this sector have started the CDM process, mostly developed by Econergy and Ecoinvest, but also by various other developers.

Part of the explanation lies in the expectation of the industry in relation to the commercial availability of second generation ethanol. As this technology allows for the increased output of ethanol from the same input base (by making full use of cellulosic material) there could be some competition between ethanol production and other forms of energy production. Although cellulosic ethanol does not allow for the production of sugar, with the lignin leftover being used for electricity generation, the remaining potential for electricity generation of this leftover is obviously considerably lower than the energy obtained from the whole residues.

According to UNICA[23], sugar-cane production in Brazil is expected to grow from 490 million tonnes in 2007/8 to over 1 billion tonnes in 2020. It has been suggested that this total could be achieved as early as 2017 by BNDES[24]. The installed capacity for electricity from biomass should

[22] UNICA
[23] Producers association
[24] National Development Bank

grow to 15GW in this period, considering that until 2010/11 only 75% of the bagasse is used and that by 2015, 50% of the straw is used for electricity generation[25].

The main advantages of such projects in Brazil lie in the relatively short lead time needed to implement them (around 24-30 months) and in the way they seasonally complement hydroelectricity, as bio-electricity is produced during the dry season. The recent global economic crisis will surely reduce the waiting list at equipment suppliers but also the availability of equity and willingness to invest in anything that is not core business, especially for a sector that has traditionally been very conservative and reluctant in seeing this diversification of income as beneficial.

Table 15: Reduction potential trough Biomass in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	6.35	9.90	14.63	21.72
Methodology coverage	80%	90%	90%	90%
PDD potential (MtCO2e/yr)	5.95	8.25	11.23	15.70
Current volume in the UNFCCC pipeline (MtCO2e/yr)				5.45
Fraction of the technical potential that will become CDM/JI				70%

Source: New Carbon Finance

Past problems of transmission to the grid and environmental licensing are improving, as governments of Sao Paulo, Mato Grosso do Sul and Goias have, recently reduced the burden to access the grid in different manners.[26] The 61 CDM projects are only a slim fraction of the more than 350 sugar mills in Brazil, most of which still run the lower efficiency 21 bar boilers, so there remains considerable potential to reduce emissions by developing projects in this sector.

Currently, the Brazilian pipeline in this sector has concentrated in bagasse power projects with smaller participation from other biomass residues, such as rice husk, sawmill dust and forestry by-products. We **estimate a practical potential 9.90MtCO2e/yr in 2012 and we calculate a PDD reduction potential of 8.25MtCO2e/yr in the same year,** as shown on Table 15 above.

Geothermal

Geothermal technologies have no abatement potential in Brazil.

Brazil has commissioned two studies on geothermal activities, the first in 1977 and the latest in 2005. The first study identified the best sites for geothermal energy to be in the younger sedimentary basins, particularly the Parana Basin. A more recent study in 2005, looked at 72 localities in Rio de Janeiro state, and estimated that geothermal gradient values are between 14ºC/km and 26ºC/km in older tectonic areas and between 19ºC/km and 33ºC/km in younger areas[27]. Geothermal energy has yet to be developed extensively in Brazil. The production of electricity from geothermal energy is considered to be uneconomic, and Brazil does not need geothermal heating due to its tropical climate[28].

An overwhelming majority of geothermal energy is used for recreational uses (such as the development of hydrothermal tourism and leisure activities), while the rest is used by two industrial facilities for process heat and to pre-heat water for use in boilers[29]. The International Geothermal Association[30] considers that the theoretical potential for large-scale exploitation of low-temperature geothermal water for industrial use is significant. However, due to the high costs involved, the likely mismatch of locations (industry and geothermal sites) and the abundance of other renewable energy opportunities, which are also more viable we estimate **there is neither practical potential nor PDD reduction potential**.

[25] Ibid
[26] Sao Paulo ended with the ICMS (tax) between the SPC and the mill. Mato Grosso do Sul and Goias, reduced capital costs by implementing a fee based access.
[27] Hamza, V.M et all (2005) Geothermal gradient and heat flow in the state of Rio de Janeiro. Available at www.on.br
[28] Hamza, V.M et all (1977) Geothermal energy prospects in Brazil: A preliminary analysis. Available at www.springerlink.com
[29] Ibid
[30] http://iga.igg.cnr.it/index.php

Hydro

The definition of small hydro in Brazil is to change from < 30 to <50MW. Such projects have an estimated potential of 15GW in the medium term.

Hydropower accounted for 77.4% of the generated electricity in 2007. Large dams make up 98% of the hydro installed capacity, with small hydro making up most of the remaining. The country's total hydro potential is estimated to be 260GW[31]. Small hydro[32] (<50MW) has an estimated potential of 15GW in the medium term and mini hydro (<1MW) 50MW potential[33].

Table 16: Reduction potential of Hydro in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	8.41	20.55	34.26	44.2
Methodology coverage	75%	100%	100%	100%
PDD potential (MtCO2e/yr)	6.36	12.31	17.93	22.24
Current volume in the UNFCCC pipeline (MtCO2e/yr)				5.42
Fraction of these projects that will become CDM/JI (large/ small hydro)				35%/70%

Source: New Carbon Finance

Although the best opportunities for hydroelectricity in Brazil have already been explored, especially in the central-west, south-east and southern regions, there remains a large potential in the northern region within the Amazonian's basin. However, hydroelectric facilities to be built there find two main sets of problems.

The first is related to the transmission costs and losses, due to the great distance between the Amazonian regions and the main centres of electricity demand. The second barrier is that the Amazon area has various environmental restrictions, therefore environmental licensing can take a long time, especially considering the interpretative nature of the Brazilian legislation and the constant judicial interferences from both local and national NGOs. While much of their complain is relevant, NGOs contrary to hydro power are clearly benefiting conventional fuel players, as these sources are set to double their participation in the electricity mix until 2017[34].

In the CDM pipeline there are already 75 projects totalling 4.3GW form both large and small hydro technologies. Though Brazil has been creating 10GW of new hydro power every five years since 1995, the newly published Expansion Plan 2008/2017 envisages a faster build rate of these projects. The plan expects that by 2017 just over 117GW of hydro power will be installed or 40GW more than currently.

Considering large projects may find it harder to prove additionality in the future, we **estimate the practical potential at 20.55MtCO2e/yr in 2012 and we calculate a PDD reduction potential of 12.31MtCO2e/yr in the same year,** as shown on Table 16 above.

Solar

In spite of the various solar technologies and favourable environmental conditions, there is neither practical potential nor PDD reduction potential.

Two studies, the Atlas of Solar Irradiation in Brazil in 1998 and the Atlas of Brazilian Solar Metrics in 2000[35], mapped the potential to exploit solar energy for thermal and electricity use in Brazil. While the latter estimates the solar radiation reaching Brazil through land-based stations, the former does so using satellite images. The highest median annual solar radiation is found in the north-east of the country, especially in the Sao Francisco Valley, where daily sunlight averages between seven and eight hours. In this region, up to 20MJ/m^2 per day can be captured, which represents up to 6100Wh/m^2 per day. Most of the country can, however, capture up to 16MJ/m^2 per day, representing 5300 Wh/m^2 to 5700Wh/m^2 per day[36].

In spite of this potential Solar thermal to electricity (STEG) is not economically interesting, especially for a country that has various other more viable options and we foresee no such developments in the country until 2020.

Medium temperatures collectors, such as small troughs, small Fresnel or evacuated tubes could be applied to a range of industries and processes, including the textile and food and beverage among others. They could also be used for cooling purposes in office buildings, hospitals and malls. Nonetheless, this proven technology has been forgotten and it is hardly used in the

[31] http://www3.aneel.gov.br/atlas/atlas_1edicao/atlas/energia_hidraulica/3_3_potencial.html
[32] Small hydro definition in Brazil is to change from the current 30MW to 50MW.
[33] EPE
[34] National Expansion Plan 2008 - 2017
[35] http://www.cresesb.cepel.br/
[36] Ibid

developed world. According to the IEA, in Portugal for instance up to 4% of the industrial energy requirements could be supplied by these technologies (considering factors such: industrial processes temperature profiles, location, shading and economics)[37].

Although the higher solar irradiation in Brazil could indicate an even large potential, this would depend in many factors, including those mentioned above in addition to the lower energy prices in Brazil. Other barriers include the lack of local manufactures of any of these technologies (Brazil only produces flat plate collectors, which are normally not suitable for industrial processes). Another challenge of this type of use of solar energy is the lack of technical capacity for integration of advanced solar technology with the related industrial processes from both sides (the technology and industrial sides)[38].

Although the take up of solar thermal for low temperature heat purposes (bath and pool water) would have many benefits, including: reduced peak demand (electric showers account for between 18% and 25% of peak demand[39]), job creation (100 times more jobs per TWh than oil, gas or hydro[40]) and increase disposable income for the least active sectors(savings in electricity can account for up to 30% for households receiving up to two minimum-wage salaries per month[41]), developers are aware of the long process involved in gaining approval from the EB for new methodologies and the difficulties in implementing programmatic CDM. Therefore, it is unlikely that the CDM will play a role in deploying such technology.

Most photovoltaic solar projects in Brazil are isolated systems serving poor communities outside the grid system. Since the Light for All programme (detailed in section 4) gives strict targets to energy concessionaries to set up universal access to electricity for the entire population, these difficult CDM projects become unacceptable from an additionality perspective. Some existing projects based on the provision of energy services to low-income rural households (such as those developed by IDEEAS[42]) seem to fail the additionality requirement due to their financial viability, thereby invalidating the need for an extra carbon cash flow. Finally, even if promised legislation provides incentives for grid-connected solar PV, the low grid factor of the country would make such projects very unappealing. We therefore, estimate **there is neither practical potential nor PDD reduction potential**.

Marine

Although Brazil is deploying locally developed technology, large scale projects face several barriers including legal ones, so we estimate there is neither practical potential nor PDD reduction potential until 2020.

The first wave to energy technology project in Brazil is to be installed in 2009 at Pecém Port in the state of Ceará. The project relies on Brazilian technology and is financed by public and private bodies, including Tractable and Eletrobras among others. The installation of this pilot plant, as Dr. Eliab Ricarte, one of the project researchers, explained to New Carbon Finance[43] is a relatively long process, which involves the environmental licensing and a public bidding period, as the project involves government related bodies, including the research institution itself.

The equipment-building process would take a shorter period of time as all parts are off-the-shelf-products, and another one or two months would be required for installation. The installation, which will comprise 20 modules of 25KW, should be fully operational by the end of 2010 if the initial two modules are successful.

Other technologies (tidal and current) are also being investigated as part of the Brazilian Programme for Ocean Renewable Energy. The research unit is known for its various research and technology developments that have enabled Petrobrás to become a world leader on oil recovery in deep waters. According to Professor Segen Estefen, the research co-ordinator, the theoretical potential of the wave technology alone in Brazil would amount to 114GW, which is higher than the total current installed power generation capacity. Practical potential indicated by Dr. Eliab would be about 15GW, a value that he believes could be achieved within 10 years after the technology has been proven via the current tests and if finance to such a bold project becomes available. The cost of implementing this technology, according to his research, would be about 30% lower than wind farms and about the same as conventional hydroelectric plants.

If the barriers to the proliferation of this technology are overcome including the environmental licensing and the lack of clear regulation pertaining to such maritime activity, small-scale projects in isolated islands and remote coastal villages or military and scientific marine bases are a future

[37] http://www.iea-ship.org/3_1.html
[38] IEA, Task 33.
[39] Green markets International (2005). Available at www.green-markets.org
[40] Rodrigues, D (2007) Building a Sustainable Future (translated). Available at www.cidadessolares.org
[41] Ibid
[42] IDEEAS (Institute of Alternative Energies and Self Sustainability) http://www.ideaas.org.br/id_projetos.htm
[43] Interview with New Carbon Finance in February 2008.

option. At a larger scale, projects could be created in the states of Ceará, Rio de Janeiro and Santa Catarina, where most potential is to be found.

The other technologies mentioned have already raised the interest of local electricity concessionaries of the states of Amapá in the north and Pernambuco e Maranhão in the north-east. Although the theoretical potential to reduce emissions through this type of project in Brazil may be high, we estimate **there is neither practical potential nor PDD reduction potential until 2020**.

Wind

In spite of various advantages for the uptake of this technology, the sector is stalled in a catch-22.

According to the Brazilian Atlas of Wind Potential, the total theoretical potential in the country amounts to 143GW[44]. About 75GW of this potential is concentrated in the north-east of Brazil, especially in the states of Rio Grande do Norte, Ceara and Piaui, where annual average wind speeds range from 8m/s to 9m/s at altitudes of 50m.

Despite its vast theoretical potential, current installed capacity is limited to only 360MW, produced via 26 wind farms. There are however another 14 wind farms totalling 392MW under construction and another 50 authorized totalling 2.4GW, which have yet to start the implementation phase[45].

Country-specific advantages for wind projects centre on the fact that 70% of the Brazilian population lives near coastal areas, where most of the high wind speeds are also concentrated. Furthermore, wind conditions are at their strongest outside the rainy season, so wind generation forms a suitable match for a country with a large dependency on hydroelectric power. This advantage is especially welcomed by both government and industry alike, as both acknowledge that the security of energy supply depends to a large extent in the diversification of the matrix.

However, various difficulties reduce the build rate of this technology, including: the lack of clarity in relation to the promised wind auctions; the low grid factor; poor financing conditions, obtaining environmental licensing, connection to the grid and finally the reduced number of equipment suppliers. Wobben Wind Power (an Enercon subsidiary from Germany) and Tecsis (a Brazilian entrepreneur) are the only two manufactures of wind equipment in Brazil. Other players are know to have plans to get installed in Brazil or are in process of it, such as the Argentinean Impsa.

In spite of that, there are currently 11 wind projects in the pipeline, which will have a total installed capacity of 435MW when they all enter operation.

Though the industry is pushing the government to reserve 1GW per year for specific wind auctions, we believe that half of that maybe more palatable to the authorities.

The government have stated previously that for such targets to be set the industry would have to be installed here, creating a typical catch-22. The industry insists it will move to the country once a clear programme to promote wind is on course.

Nonetheless, other forms of help are already on the way, as the government announced during the writing of this report that it will facilitate the access to the grid by transferring capital costs of transmission from wind developers to distributors. We **estimate the practical potential at 1.98MtCO2e/yr in 2012 and we calculate a PDD reduction potential of 1.57MtCO2e/yr in the same year,** as shown on Table 17**.**

Table 17: Reduction potential of Wind energy in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	0.84	1.98	3.87	5.76
Methodology coverage	95%	100%	100%	100%
PDD potential (MtCO2e/yr)	0.77	1.57	2.89	4.22
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.61
Fraction of these projects that will become CDM/JI				70%

Source: New Carbon Finance

[44] www.cresesb.cepel.br
[45] Aneel

5.3. Agriculture and Waste

Biogas (agriculture)

Though the largest potential would be in abating emissions from cattle, opportunities are limited to mostly those within slaughterhouses, at the moment at least.

Agricultural emissions represented 26% (380MtCO2e) of total emissions (1,470MtCO2e) in 1994[46]. Methane (95% from enteric fermentation) accounted for 213MtCO2e, Nitrous Oxide for 156MtCO2e (46% from cattle grazing and cattle residues) and Carbon Dioxide for only 12MtCO2e.

Enteric Fermentation

Table 18: Reduction potential of Biogas (EF) in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	2.20	11.80	20.40	24.80
Methodology coverage	25%	50%	50%	50%
PDD potential (MtCO2e/yr)	0.72	1.68	2.04	2.48
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.0
Technical potential as fraction of total sector emissions				5%
Annual uptake/build rate as a fraction of technical potential				20%
Fraction of these projects that will become CDM/JI				20%

Source: New Carbon Finance

Though there are ways to abate emissions from this sector: change feedstock, change the animal species, micro flora (internal to the animal) change, inhibitors to metano-genesis and vaccines, various barriers exist. Feedstock change is possible only in intensive systems, which is not the case for Brazil. Animal changing is even more difficult due to local culture.

Although calculated and projected emissions are very high, the other mentioned means of abatement are not yet commercially available and there are no methodologies for enteric fermentation.

Therefore aside opportunities within slaughterhouses and those with the reduced number of confined ranches, we estimate **the practical potential is low at 11.8MtCO2e/yr in 2012 and we calculated an even lower PDD potential of only 1.68MtCO2e/yr during the same year**, as shown on Table 18 above.

Crop Management and Rice Cultivation

The CM & RC sector is responsible for large emissions, but the lack of methodology deters much of the activity, even though such projects occur in the voluntary market.

Rice cultivation and crop management amounted to 85MtCO2e in that year and would be where the next largest potential for abatement lies. However, there no methodologies available and though such projects are common in the voluntary market, it is unlikely, though possible, they will be accepted in the more stringent regulated market, due o the various difficulties including keeping with the principles that reductions must be measurable and verifiable.

Table 19: Reduction potential of CM & RC in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	17.25	89.61	139.77	157.31
Methodology coverage	50%	100%	100%	100%
PDD potential (MtCO2e/yr)	11.36	24.84	27.95	31.46
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.0
Technical potential as fraction of total sector emissions				80%
Annual uptake/build rate as a fraction of technical potential				20%
Fraction of these projects that will become CDM/JI				20%

Source: New Carbon Finance

[46] National Communication

For these reasons, as shown on Table 19, **we estimate there is a practical potential of 89.61MtCO2e/yr in 2012, but much lower PDD potential at 24.84MtCO2e during the same year.**

Manure Management

Biogas projects developed in Brazil predominantly involve the flaring of methane emissions from swine manure with unsurprisingly, due to the country's size, only 4 out of the 64 producing electricity.

Biogas projects developed in Brazil predominantly involve the flaring of methane emissions from swine manure with unsurprisingly, due to the country's size, only 4 out of the 64 producing electricity. Management of swine manure is favoured over cattle for biogas schemes due to the concentration of swine populations. There is only one project involving poultry, even though the potential in terms of energy in poultry ranches is even higher than for swine raising, as indicated on Table 20. This can be explained by the higher technological demands of these projects when compared to projects at swine farms[47].

Projects developed to exploit biogas opportunities from swine manure would need to consider bundling projects, due to the smaller size of remaining ranches. Programmatic projects could also consider taking advantage of the various farming associations present in each state. The first programmatic methodology applies to a number of small farms and is being organized by a local food processing company.

Table 20:Manure emissions and energy potential

	Biogas (m^3 /∆/day)	Population (million)	Total Biogas (Mm^3 /day)	Energy (GWh)
Cattle	0.360	200	72	72
Swine	0.240	35	8.4	8.4
Poultry	0.014	1000	14	14
			Total	**94.4**

Source: Embrapa, IBGE, New Carbon Finance

Note: 1 m3 of biogas = 1KWh

There are three CDM projects involved with reducing emissions from cattle slaughterhouses, and are being developed by Instituto Totum/Key Associados. As the Instituto Totum project is applied to only three of the 21 units of JBS (the largest beef producers in Latin America), there is a large remaining potential to be exploited if the technology is to be applied to the other facilities.

Considering that only 26%[48] of emissions from animal residues came from swine and poultry, we **estimate the practical potential at 5.44MtCO2e/yr in 2012 and we calculate a PDD reduction potential of 5.22MtCO2e/yr in the same year, as indicated in** Table 21**.**

Table 21: Reduction potential of Biogas (MM) in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	3.39	5.44	7.07	8.00
Methodology coverage	88%	100%	100%	100%
PDD potential (MtCO2e/yr)	3.39	5.22	5.76	6.42
Current volume in the UNFCCC pipeline (MtCO2e/yr)				2.92
Technical potential as fraction of total sector emissions				26%
Annual uptake/build rate as a fraction of technical potential				20%
Fraction of these projects that will become CDM/JI				70%

Source: New Carbon Finance

[47] Interview with local developer
[48] National Communication

The size of waste-water emissions does not reflect the size of opportunities, particularly in the industrial sector, within which the ethanol sector provides yet another opportunity.

Waste-water (Industrial and residential)

Emissions from residential and commercial wastewater[49]were 0.9MtCO2e while wastewater emissions from industry were 1.7MtCO2e in 1994. Since then, emissions can be expected to have grown with the population and the economy. Considering these emissions only we **estimate the practical potential at 1.90MtCO2e/yr in 2012 and we calculate a PDD reduction potential of 1.80MtCO2e/yr in the same year** as shown on Table 22**.**

However, the size of the emissions does not reflect the size of opportunities, particularly in the industrial sector. Within the industrial sector the ethanol is particularly attractive, as the harvesting and processing of sugar-cane generates large amounts of residues that can be used to generate heat and electricity both locally and elsewhere.

While bagasse (industrial solid residue) power has been widely developed, vinasse (liquid residue) has been largely overlooked to date. There is just one project (under validation) and in this case the project is claiming to avoid the release of methane from the anaerobic lagoon where the vinasse would be disposed off. However, the disposal of vinasse in open lagoons is not widespread and would depend on various factors, including the distance between the agricultural fields and the plant. Although the organic-rich liquid is used for both irrigation and simultaneously as fertilizer ("fert-irrigation"), the industry produces too much of the vinasse as a by-product to be able to find a use for it all and alternative means of disposal of this waste-water will be increasingly in demand. This is not only because of the growth of the sugar-cane crushing industry but also due to the increased environmental problems associated with both its legal and illegal release in to water systems.

Table 22: Reduction potential of Waste-water in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	0.37	1.90	2.73	2.90
Methodology coverage	88%	100%	100%	100%
PDD potential (MtCO2e/yr)	0.37	1.80	1.91	2.03
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.0
Technical potential as fraction of total sector emissions				80%
Annual uptake/build rate as a fraction of technical potential				20%
Fraction of these projects that will become CDM/JI				70%

Source: New Carbon Finance

There are various possibilities for the use of this residue for CDM projects, one is exemplified by the vinasse project already in the pipeline, and another is the use of the methane collected to be burned in the plant's boiler, thus generating more electricity that can be sold to the grid. It has been estimated by the IPT (Institute of technological research) that this could free up to 28% of the needed bagasse for internal electricity demand within sugar ethanol plants. This surplus of bagasse can be transformed into pellets or briquettes and sold domestically or internationally.

Table 23: Energy potential of residues from sugar cane processing

Typical residues from 1 tonne of sugar cane	Methane (m^3)	Potential methane (Mm^3) production for all 2007/2008 harvest	Electricity potential (KWh)	2007/2008 harvest – Electricity generation Potential (TWh)
10 Kg of Dry Bagasse	-	-	15	7.3
140Kg of Dry Bagasse and Dry Straw	-	-	210	103.5
1m3 of Vinasse *	6	2958	60	29.5
1.8m3 of Vinasse (if cellulosic ethanol is produced from bagasse and Straw)	10.8	-	108	53.2

*Source: IPT, Dedine, New Carbon Finance. * It assumes 12 litres of vinasse per litre of ethanol*

[49] National Communication

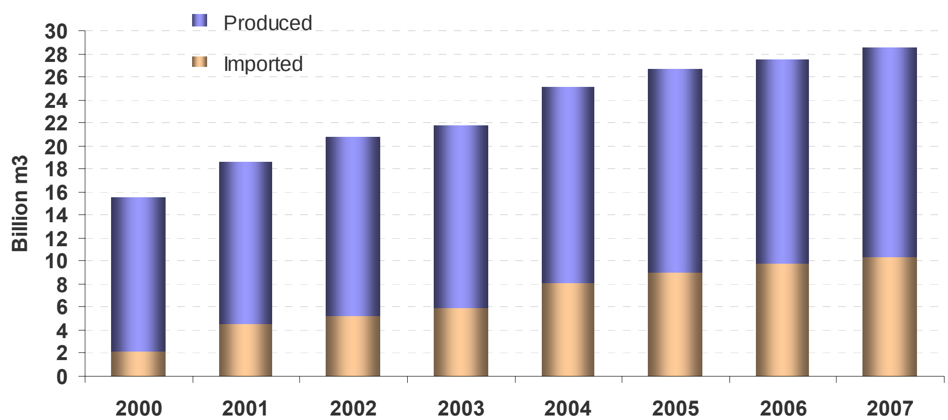
Yet another possibility is the use of the generated methane in other industrial plants or even for distribution in the gas grid. The potential methane production from the vinasse from all the 2007/08 harvest, as shown on Table 23 could have generated nearly 30% of imported gas during 2007, as shown on Figure 8. Independently of the use of the generated methane, it remains an interesting opportunity to be explored.

The number of choices will also increase once cellulosic ethanol reach commercial scale, as bagasse and straw will be able to produce ethanol too and thus making the use of methane from vinasse more attractive.

The choice of these different options will depend ultimately on the strategy of each plant, aside from factors such as location, distance from the grid, ethanol prices and obviously costs. The cost savings with fertilizers will also play a part, as during the treatment of the vinasse fertilizers rich in N, P and K are created.

There should be a very strong argument for additionality as the sole plants using this residue in a way other than 'fert-irrigation' is a single CDM project under validation. The sustainable development benefits are also high, as the excessive production of vinasse and its eventual legal and illegal contamination of water streams are externalities with very high social and environmental costs.

Figure 8: Consumption of natural gas in Brazil



Source: ANP, New Carbon Finance

Landfill

Although project sizes are reducing in size, the potential is still relatively high.

By 1994, Brazil's urban population had grown to 118 million, producing about 17 million tonnes of land-filled waste that emitted approximately 14MtCO2e[50]. Considering that the urban population grew to 147 million people[51] in 2007, we conservatively estimate (based on studies of solid waste[52] in Brazil) that emissions from municipalities' landfills grew to 27MtCO2e in 2007.

Although project sizes are reducing in size (whereas initial projects were reducing emissions by the hundreds of ktCO2e per year, current projects are reducing only by tens of ktCO2e), the potential is still relatively high. Generally, however CDM projects involved with landfills have had CER issuance rates lower than their practical emissions-reduction potential due to overestimated calculations. Though this is still a concern, more pressing barriers to this type of project in Brazil are:

- The risks associated with doing business with the local authorities that are responsible for managing urban solid waste[53]
- The reduction of large-scale opportunities
- The competition among the numerous developers exploiting this type of opportunity

[50] National Communication
[51] IBGE (2007) Population count 2007.
[52] CETESB (2006) State Inventory of Solid Wastes [translated]. Available at www.cetesb.sp.gov.br AND SNIS (2005) Diagnostics of Urban Solid Waste Management [translated]. Available from www.snis.gov.br
[53] IETA (2006) Moving to Action.

The advantages for the development this kind of project in Brazil lies in the relative abundance of potential sites still not developed. However, many of the remaining projects will likely be at non-sanitary landfills (do not have more modern technologies that control waste disposal).

Although this could increase the technical difficulties as well as the costs, some of these projects could be pursued realistically, as evidenced by a project developed by the World Bank in an open dump in Rio de Janeiro and by the research at the Federal University of Pernambuco[54] which indicates that a reformed open dump (that is, the landfill was upgraded with sanitary technology) could generate between 10MW-13MW in the initial years of operation.

The project is estimated to cost about U$13 million over the first seven years of the project (this includes construction times). We **estimate the practical potential at 26.51MtCO2e/yr in 2012 and we calculate a PDD reduction potential of 21.59MtCO2e/yr in the same year,** as shown on Table 24.

Table 24: Reduction potential of Landfill Gas in Brazil

	2008	2012	2016	2020
Practical potential (MtCO2e/yr)	12.76	26.51	30.00	31.51
Methodology coverage	88%	100%	100%	100%
PDD potential (MtCO2e/yr)	12.76	21.59	22.59	23.65
Current volume in the UNFCCC pipeline (MtCO2e/yr)				9.38
Technical potential as fraction of total sector emissions				80%
Annual uptake/build rate as a fraction of technical potential				20%
Fraction of these projects that will become CDM/JI				70%

Source: New Carbon Finance

5.4. Fugitive Emissions

Coal Mine Methane

The concentration of production and thus emissions facilitates projects however; production of coal is small with bleak outlook for the future.

Brazil is not one of the world's main producers of coal, accounting for only 1% of global reserves[55]. Coal production has not fluctuated significantly since the 1990 when total run of the mine production was 11.5Mt of coal[56], with most mining operations concentrated in two states:

- Santa Catarina, with 61% of production
- Rio Grande do Sul, with 38%
- Parana, with 1%

After a few years of declining production, from 1996 production increased again to reach its maximum of 12.4Mt in 2005 just to diminish slightly by the end of the 2007 to 12.1Mt of coal[57].

Though the Brazilian National Development Bank (BNDES) had planned to make the country self-sufficient in coal consumption by investing in the expansion of Brazil's production facilities[58], there is no evidence of the industry going in that direction.

Brazilian coal is generally characterised by high ash and sulphur content and low caloric values, so imported coal is preferred by industry in general. Indeed, the power stations that won the bids in the latest auctions plan to use imported coal[59]. As 85% of consumed coal in Brazil goes to electricity production and only 15% to industry[60], the scenario does not look bright for the sector.

Emissions from coal underground mines were 52kt of CH4 in 1990 and 47kt in 1995[61]. As the cumulative number of mines in Brazil – along with coal production levels – in 2006 is similar to 1990[62], we estimate current emissions to remain at 1.15MtCO2e in 2007.

[54] Juca, J.F.T (2007) Muribeca Landfill Case Study. Available from: www.grs-ufpe.com.br/v3/asp/home.asp
[55] EIA (2004). Available from: http://www.eia.doe.gov/emeu/cabs/Brazil/Profile.html
[56] 86 ABCM (Brazilian Coal Association). Available from: www.carvaomineral.com.br
[57] Ibid
[58] WCI (2005) Coal: Secure Energy. Available from: www.worldcoal.org
[59] Aneel
[60] Ibid
[61] National Communication
[62] Ibid

Currently, there are no coal-mine methane projects in Brazil. Furthermore, there are no government policies in place to reduce fugitive emissions, and the only initiative that caters to such a goal is the global partnership 'Methane to Markets'.

The barriers to this kind of project are the actual assessment of fugitive emissions and the effective integration of mine degasification and utilisation within the mine, which is further compounded by the reduced opportunities for large-scale projects.

Nonetheless, 6 mines produce 80% of coal mined underground, which in turn is responsible for 89% of emissions. Considering this concentration could facilitate projects, **we estimate the practical potential at 0.35MtCO2e/yr in 2012 and we calculate a PDD reduction potential of 0.28MtCO2e/yr in the same year,** as indicated in Table 25.

Table 25: Reduction potential of CMM/CBM in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	0.07	0.35	0.46	0.46
Methodology coverage	88%	100%	100%	100%
PDD potential (MtCO2e/yr)	0.07	0.28	0.28	0.28
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.0
Technical potential as fraction of total sector emissions				40%
Annual uptake/build rate as a fraction of technical potential				20%
Fraction of these projects that will become CDM/JI				60%

Source: New Carbon Finance

Oil

Petrobras dominates the oil market and additionality may be threatened by its own programme to reduce flaring.

The Brazilian oil output has been increasing steadily over the past 30 years. Total production in 2007 was estimated by the National Petroleum Agency (in Portuguese, ANP) at 660.5 mboe (up 42% since 2000). Petrobras, the state-controlled company, alone aims to increase its production by 8.8% per year trough 2020[63].

Emissions from the oil industry coming from venting and flaring were estimated[64] at 1MtCO2e in 1994. This number has certainly increased since then, due to the growth of the sector.

Table 26: Reduction potential of Oil in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	0.04	0.24	0.51	0.71
Methodology coverage	60%	70%	70%	70%
PDD potential (MtCO2e/yr)	0.02	0.03	0.04	0.05
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.0
Technical potential as fraction of total sector emissions				20%
Annual uptake/build rate as a fraction of technical potential				20%
Fraction of these projects that will become CDM/JI				10%

Source: New Carbon Finance

However, the market is dominated by Petrobras, which initiated a programme (the Project Zero Flaring[65]), in 1997 to reduce such emissions. Huge gains have reportedly been achieved since the start of the programme, as emissions have reduced by half despite the near doubling of production. Flared gas has reduced from 6 million m^3/day in 2001 to 3 million m^3 /day in 2004.

There are no projects in the pipeline so far. Even though some project developers are known to be pursuing negotiations with Petrobras, the distance from the offshore platforms form the largest barrier to this kind of project.

63 Petrobras Investment plans 2009-2013
64 National Communication
65 Programa de Queima Zero

Additionality may also be difficult to demonstrate since Petrobras' own programme started before 2000. Although emissions are still significant, and carbon-credit cash flow could be sufficient to overcome the high capital costs involved in developing projects (such as the recovery of gas that is currently being flared), **we estimate the practical potential at 0.24MtCO2e/yr in 2012 and we calculate a PDD reduction potential of 0.03MtCO2e/yr in the same year,** as indicated in Table 26.

Gas Distribution

COMGAS, the largest whole distributor of gas has projects under way through the voluntary market.

Brazil had 10.8 trillion cubic feet of proven natural gas reserves in 2007 and natural gas production has grown slowly so far and so it does not represent yet a large extent of the country's economy. However, this is set to change due to the large new found reserves in Santos basin. Petrobras[66], controls over 90% of Brazil's natural gas reserves and is the largest wholesale supplier of natural gas. Although only 7.5% of energy consumed in Brazil is from natural gas this demand is set to rise to between 12% and 15% of the energy matrix by 2010, especially in thermal electricity generation and vehicular compressed natural gas[67].

Major extensions of pipelines are under way which aim to connect the north and south to enable higher supply, such as the 730-mile Gasene pipeline, the 1,400 mile Gasun, which will link the States of Mato Grosso do Sul and Maranhao and the 240 mile Urucu pipeline that will link Urucu to Manaus, the capital of Amazonas state. Other extensions include a 170 mile extension of Gabsol which links Brazil and Bolivia, a 380 mile extension under construction that will link Uruguayana to Porto Alegre, and an extension of the Buenos Aires (Argentina) to Montevideo (Uruguay) pipeline which is to be extended to Porto Alegre[68].

According to a COMGAS[69], the largest distributor of natural gas, there are no actual measurements of the fugitive emissions in Brazil distribution system. Fugitive emissions would occur, COMGAS explains due to accidents and due to leakages at pipeline joints and other connections, particularly at old cast iron pipelines. The company has joined CCX and is developing projects in the voluntary market[70].

In Brazil there are 27 authorized distributors of gas, of which 22 are operating. Five are privately owned and 22 owned by different states. Five of them are still not operating, as they are still need to get connected. There are no projects in the pipeline and due to baseline and monitoring difficulties as well as high costs associated with this kind of project, **we estimate the practical potential at 0.11MtCO2e/yr in 2012 and we calculate there is no PDD reduction potential in the this year,** as indicated in Table 27.

Table 27: Reduction potential of Gas Distribution in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	0.02	0.11	0.23	0.32
Methodology coverage	20%	30%	30%	30%
PDD potential (MtCO2e/yr)	0.0	0.0	0.01	0.01
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.0
Technical potential as fraction of total sector emissions				90%
Annual uptake/build rate as a fraction of technical potential				20%
Fraction of these projects that will become CDM/JI				10%

Source: New Carbon Finance

66 ANP
67 Petrobras
68 Ibid
69 http://www.comgas.com.br/
70 http://www.fbds.org.br/article.php3?id_article=538

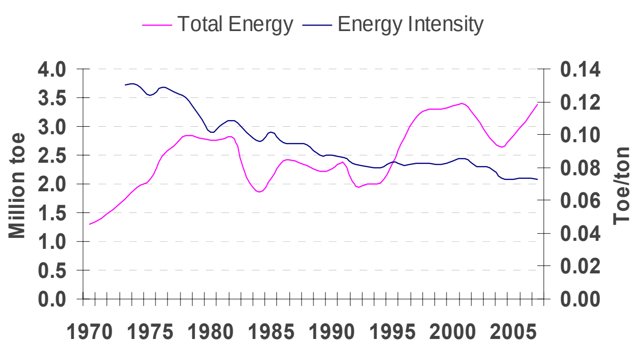
5.5. Industry

Cement

Despite efficiency gains emissions have been growing steadily due to increased production.

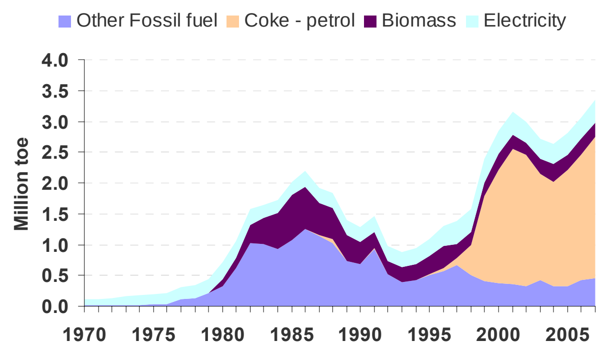
Emissions related to industrial processes were estimated in 1994 at just under 17MtCO2e, of which 9.3MtCO2e originated from the cement industry[71], which produced at the time 25 million tonnes of cement[72]. As it is estimated that 50% of the cement industry emissions come from process, and 40% from burning fuel with the remainder split between electricity and transport uses[73], total emissions from this sector were in 1994 equal to 18.6MtCO2e.

Figure 9: Energy consumption and intensity (Cement)



Source: BEN 2008, New Carbon Finance

Figure 10: Type of fuels (Cement)



Source: BEN 2008, New Carbon Finance

Figure 9 shows that even though total energy usage have increased in the period, energy intensity has been slowly declining since the 70s mainly with some improvements in energy efficiency since the beginning of the decade, thereby counter-balancing to some extent the growth in emissions. Nonetheless and in spite of a 99% prevalence of dry processes[74], emissions have surely grown since then. Aside the period of economic crisis from 2000 production has only increased and reached 46 million tonnes in 2007 from the 62 operating plants[75].

Table 28: Reduction potential in the Cement Industry in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	1.47	6.38	13.91	22.71
Methodology coverage	60%	70%	70%	70%
PDD potential (MtCO2e/yr)	1.47	3.58	4.18	4.90
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.32
Technical potential as fraction of total sector emissions				50%
Annual uptake/build rate as a fraction of technical potential				10%
Fraction of these projects that will become CDM/JI				30%

Source: New Carbon Finance

Emissions related to the use of fossil fuels for energy purposes are considered high in terms of carbon intensity, especially due to the prevalence of petrol coke as fuel, as shown in Figure 10. Total emissions are estimated to be 28MtCO2e in 2007 (assumes emissions growth in line with production minus efficiency gains).

Two projects which were to blend cement with blast furnace slag and fly ash were rejected as these practices are considered to be common in the project's region and thus the technical barrier was not evident (ACM5 methodology). A further project, current at the validation stage is using the methodology ACM33 at Lafarge's plant in Minas Gerais state.

[71] National Communication
[72] BEN 2008
[73] PDDof the CDM project "Use of blast furnace slag in the production of blended cement at Votorantim Cimentos"
[74] Ibid
[75] ABCP - Brazilian Association of Portland Cement

Researchers from the COPPE/UFRJ[76], developed a cement mix that they believe could reduce emissions from process by 40%, indicating thus a large practical potential in this sector. However, such new mixes are usually seen with scepticism by the industry, as the long term impacts on durability and other important characteristics are not known and few would like to be the first to try out. We **estimate the practical potential at 6.38MtCO2e/yr in 2012 and we calculate a PDD reduction potential of 3.58MtCO2e/yr in the same year, as indicated in** Table 28**.**

Industry – energy efficiency

The largest potential in this sector relates to changing fuels, as increasing electricity productivity faces the challenge of a very low grid emission factor.

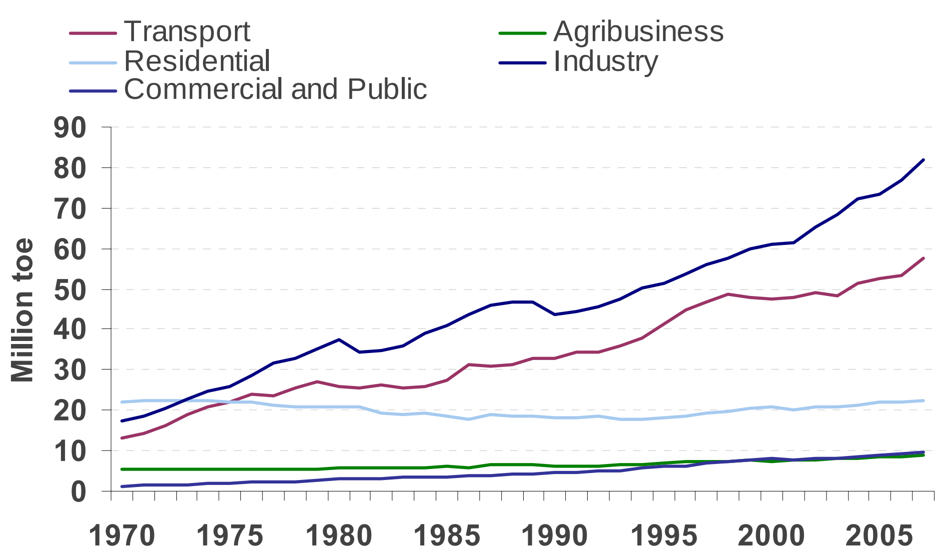
The industrial sector has historically consumed most of energy produced in the country, including electricity as shown on Figure 11 and Figure 12. As such it is the sector with the largest potential for emission reductions related to the efficient use of energy, especially for process heat, as shown on Figure 13 only 20% of the industry energy matrix is from the use of electricity purchased from the grid.

In addition to that, the clean nature of the Brazilian matrix (emission factor of 0.18t/MWh) poses a great barrier for projects related to increasing the productivity of electricity usage. As carbon credits gained per unit of energy is small, the savings with electricity become much more relevant threatening the additionality of such projects.

The electricity shortage that was looming over Brazil, due to its sustained economic growth in the last few years and also due to the lack of investment to keep up with the additional growth in demand from all sectors, has been delayed for now. This is not only because of heavy rains providing sufficient hydro electricity, but also due to the increased use of gas fired power stations to allow for the replenishment of dams throughout much of 2008.

The impending economic slowdown to a maximum of 1.3% in 2009, according to Credit Suisse [77] or 3% according the government[78] will further reduce the pressure on the electricity sector, reducing the recent high prices of electricity and thus decreasing interest and viability of efficiency measures in the short-term at least.

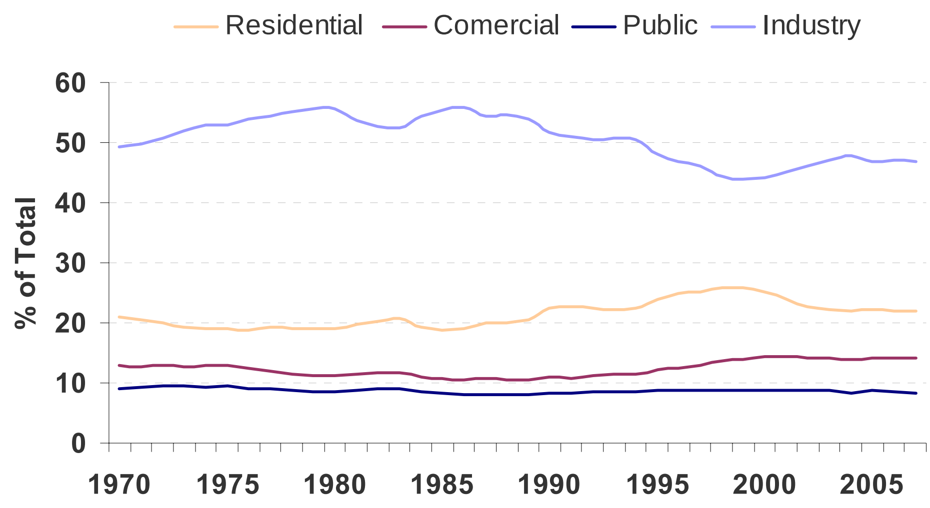
Figure 11: Energy by Sector



Source: Ben 2008, New Carbon Finance

[76] COPPE. Available from: http://www.planeta.coppe.ufrj.br/artigo.php?artigo=937
[77] Reversão do ciclo de crescimento em função da crise global
[78] Ministry of Finance

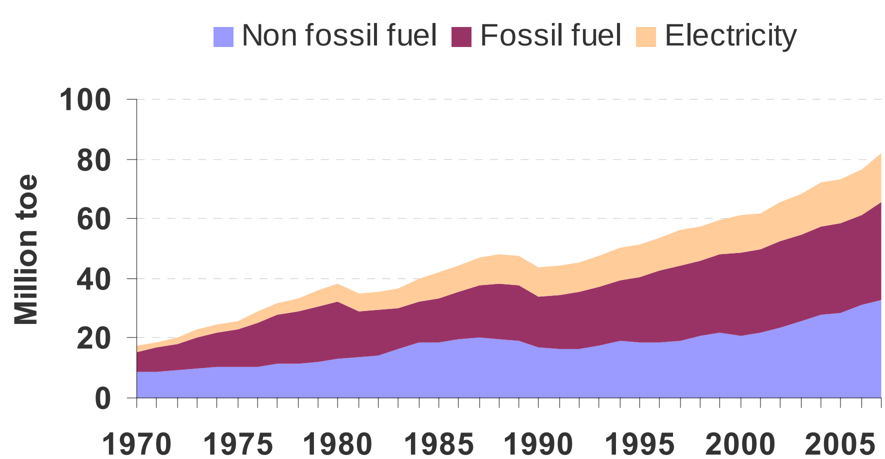
Figure 12: Electricity by sector



Source: Ben 2008, New Carbon Finance

As it can be seen on Figure 13, the industrial sector has also an already relatively low-carbon energy matrix with biomass representing 40% of total energy consumption, as opposed to only 8% from OECD countries[79].

Figure 13: Industrial energy matrix



Source: Ben 2008, New Carbon Finance

However, it must be mentioned that half of the biomass comes from the sugar-ethanol use of bagasse (no emissions), 4% from the pulp and paper (all industry have managed forests, so no emissions) with a high share of the remaining coming from the unsustainable use of charcoal and wood (high emissions due to deforestation).

Total emissions (processes and energy use) from the sector equalled 82.4MtCO2e in 1994[80]. Considering the relative stable mix of fossil fuel and non-fossil fuel sources of energy, we estimate emissions have grown in line with energy consumption and calculate they were 134MtCO2e in 2007.

[79] Ben 2008
[80] National Communication

Iron and Steel

The iron and steel industry accounted for 46% of the total emissions in 1994 and as such provides the largest opportunities.

Metallurgy, particularly the iron and steel industry accounted for 46%[81] of the total emissions in 1994 and as such provides the largest opportunities. As Figure 14 indicates total energy use has increased significantly, but only minor gains in the productivity were accrued since late 70s in the iron and steel sector, thus indicating possible efficiency gains.

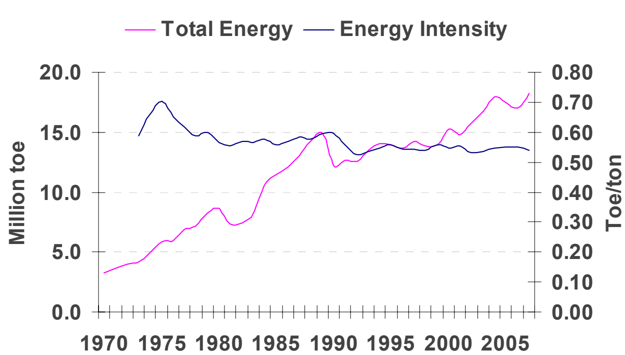
35%[82] of the 32Mt of pig iron produced in 2006 used charcoal as the thermo-reduction agent. Although charcoal would be preferred as the thermo-reduction agent for the iron and steel industry, 50%of the charcoal used by the industry was from native forests in the same year[83]. Due to the archaic and inefficient way charcoal is generally produced, 600m^2 of native Amazon forest are needed to produce 1t of pig iron[84].

Considering that all native forest charcoal came from the Amazon region, a total of 3,360km^2 or 24% of the total Amazon deforestation, as indicated in Figure 5 was due to this sector's demand. However not all production is around the Amazon region, in other important ecosystems, such as Cerrado and Caatinga the area needed per ton of pig iron is even larger due to density of forest and type of vegetation. In these areas, sectors like the ceramic and plaster are also causing deforestation to use wood as an energy source[85].

To supply the sector solely with charcoal from dedicated plantations therefore it would be need 19,371km^2 or 1.9 million hectares (it assumes all producers follow the same technological route). At an estimated US$4000 per hectare, this would require investments at the order of US$7.6bilion for the forest plantation only.

There is one project, which was developed by Plantar, a local pig iron producer in conjunction with the World Bank, in the pipeline. This project in fact consists of three methodologies, encompassing the whole production process, starting with the methodology for reforestation for industrial use, moving on to increasing the efficiency of charcoal production and thus reducing methane emissions, to finally substitute non-renewable biomass or coal, which as shown on Figure 15 dominates the energy requirements at the production sites with 52%.

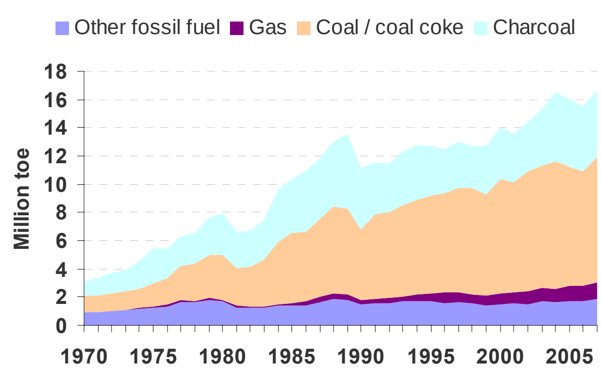
Figure 14: Energy consumption and intensity (Iron and Steel



Source: BEN 2008, New Carbon Finance

Note: Includes iron, steel and others metals

Figure 15: Type of Fuels (Iron and Steel)



Source: BEN 2008, new Carbon Finance

Note: Only main sectors included

This project was developed by Plantar, a local pig iron producer in conjunction with the World Bank. Not accounting for the avoidance of methane in charcoal production, once all three separated PDDs are registered, the PPs claims that moving from the baseline (use of unsustainable charcoal or coal) to the project scenario would avoid the emissions of 3tCO2e per ton of pig iron produced. If only 5% of production followed suit 4.5MtCO2e could be abated per year.

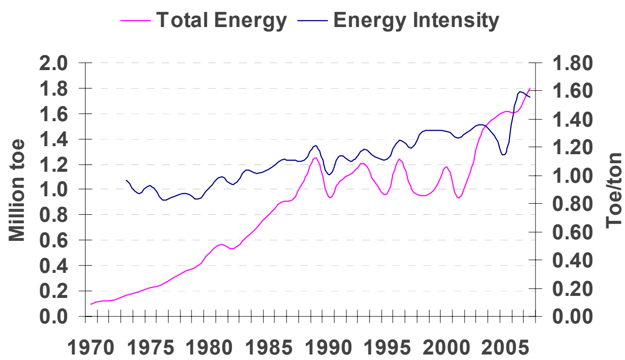
[81] Ibid
[82] INEE (National Institute of Energy Efficiency)
[83] Ibid
[84] Ibid
[85] Ibid

The recovery and use of basic oxygen gas is also a possibility and it may also present a large potential, as 76% of steel production (23 million ton[86]) in the country is from this type of technology. There is one such project already in the pipeline.

The Figures below indicates the energy demand, intensity and type of fuels used within the other industries in the metals sector. It is evident from Figure 17 and Figure 19 that demand for electricity is very important in these two sectors and also that the use of biomass, particularly in the production of non-iron metals is very low.

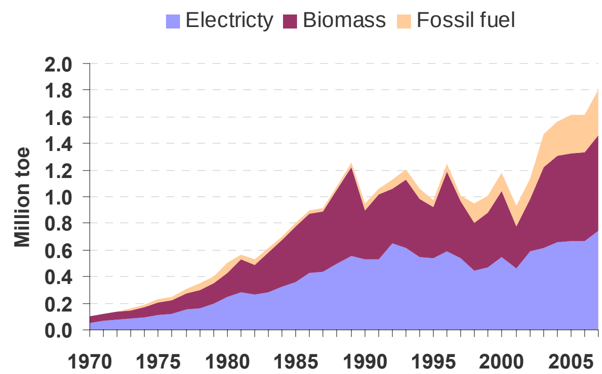
It is interesting to note that, as indicated in Figure 16 the intensity of energy use in the production of iron alloys has been mostly increasing, as opposed to most other sectors and indeed the production of non-iron metals, as depicted in Figure 18, has followed suit for most of the time series, even though from early 2000 it finally started to subside, probably due to the electricity shortages of that time.

Figure 16: Energy consumption and intensity (Iron Alloys)



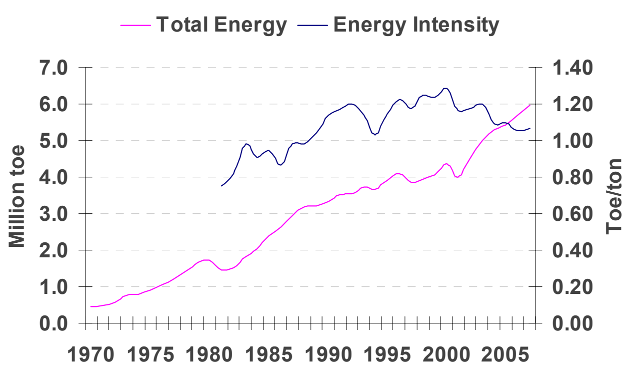
Source: BEN 2008, New Carbon Finance

Figure 17: Type of Fuels (Iron Alloys)



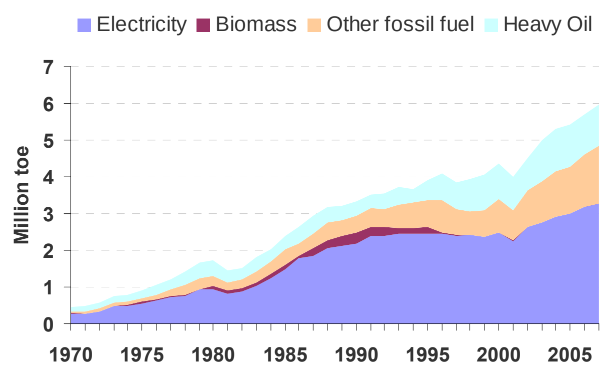
Source: BEN 2008, new Carbon Finance

Figure 18: Energy consumption and intensity (Other Metals)



Source: BEN 2008, New Carbon Finance

Figure 19: Type of Fuels (Other Metals)



Source: BEN 2008, New Carbon Finance

Other Industries

The industrial sector offers a large potential of mitigation, particularly via the increased use of biomass technologies in the short term and switching to gas in the medium term.

In the short-term the industrial sector offers a large potential of mitigation, particularly via the increased use of biomass technologies form a diversity of agri-business residues and also sustainable dedicated plantations. The recent economic downturn is to affect this potential, as oil is becoming increasing cheap due to lower demand. There are 42 projects currently in the pipeline doing exactly that in a variety of industrial sectors, such as textile, food and beverage, cement, ceramic among others.

[86] BEN 2008

In the medium term opportunities for switching to gas will increase due to the predicted increased production of through the newly discovered reserves and also due the investment that are being made in pipelines, which has been so far a great deterrent to these projects. As shown on Table 29 process emissions (aside cement and pig iron production) accounted for only a fraction of total emissions in 1994, and as such do not represent as large opportunity as fuel switching does.

Table 29: Process emissions in 1994

	MtCO2e
Lime	4.1
Ammonia	1.3
Aluminium	1.9
Others	0.187

There are currently 12 projects in the pipeline switching from higher emissions fuels to gas in a range of more energy intensive industries such as the petro-chemical and chemical, but also in the cement and steel industry. Another 16 projects involve the recovery of waste heat and pressure and two of renewable electricity generation. **We estimate the practical potential at 30.95MtCO2e/yr in 2012 and we calculate a PDD reduction potential of 19.56MtCO2e/yr in the same year.**

Table 30: Reduction potential of Industry in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	7.43	30.95	66.95	109.07
Methodology coverage	70%	80%	80%	80%
PDD potential (MtCO2e/yr)	7.43	19.56	22.89	26.77
Current volume in the UNFCCC pipeline (MtCO2e/yr)				1.93
Technical potential as fraction of total sector emissions				50%
Annual uptake/build rate as a fraction of technical potential				10%
Fraction of these projects that will become CDM/JI				30%

Source: New Carbon Finance

Power sector – energy efficiency and fuel switch

The already clean electricity matrix offer few opportunities for CDM.

The electricity market in Brazil has experienced many structural and institutional changes over the past 15 years, transitioning from a state monopoly to a market-based model. The immediate effect of privatisation was higher electricity prices and lower investment in electricity generation, mainly due to the complexity of the system itself and the difficulties in obtaining environmental licensing[87]. This has led to power shortages in the recent past and the consolidation of the sector's regulation is much awaited by local players.

The Brazilian National Electric System is formed by the National Interconnected System (in Portuguese, SIN) and by Isolated Systems. While the SIN covers most areas in the country, the isolated systems cover mostly areas in the north and north-east, and consume about 3% of the electricity used in the country.

There are 8 fuel switching projects in the CDM pipeline, 3 are switching to natural gas and 5 to biomass. There are also another three projects: two are connecting a plant in the isolated system to the SIN and the other is the conversion from single to combined cycle.

The switch to natural gas is limited by the availability of distribution infrastructure of this fuel. Even though natural gas production is set to increase in the near future due to the recent findings of Petrobras, the long lead time to start production and reduced distribution infrastructure prevents the fast uptake of such projects. The squabble between Brazil, Argentina and Chile over Bolivian gas that lasted most of 2008 only added to these difficulties, with local developers reporting lost/delayed opportunities. Although the weakening of economic activity could make more gas available immediately, the lowering of fuel prices coupled with depressing prices for CERs and lack of finance will not encourage such projects.

Despite the Brazilian potential to further reduce fossil fuel from electricity generation, it already produces 92% of its electricity from non-fossil fuel sources) by taking-up the many opportunities on renewable energy and energy efficiency, the current environment (energy model design; focus on economical growth and lack of appropriate policy direction to overcome both the institutional and implementation barriers) will not lead to this desirable outcome.

On the contrary, the latest auctions, as shown on Table 14 have lead to the increasing use of fossil fuel thermal plants. Furthermore, the recently released National Expansion Plan 2008-2017 foresee the installation of 68 new fossil fuel thermal plants, practically doubling the number of

[87] Aneel

them. Interestingly the plan ignores the sugar-ethanol sector activity in relation to both the CDM and electricity and sees no new entries from 2011 onwards of any biomass, not even bagasse power projects[88]. **We estimate the practical potential is low at only 1.64MtCO2e/yr in 2012 and we calculate a PDD reduction potential of a meagre 0.57MtCO2e/yr in the same year**, as indicated in Table 31.

Table 31: Reduction potential of the Power Sector in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	0.77	1.64	3.03	4.71
Methodology coverage	70%	80%	80%	80%
PDD potential (MtCO2e/yr)	0.57	0.57	0.60	0.72
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.57
Technical potential as fraction of total sector emissions				20%
Annual uptake/build rate as a fraction of technical potential				5%
Fraction of these projects that will become CDM/JI				10%

Source: New Carbon Finance

5.6. Other sectors

Energy Distribution

Low emission factor and continental distances poses great challenges for CDM in this sector.

Although transmission losses are high in Brazil (15%) it is unlikely the CDM will be used for this type of project, especially in a country which has such a low emission factor and continental distances. The **practical potential is considered low at 0.12MtCO2e in 2012 and we calculated there is no PDD potential until 2020,** as shown on Table 32.

Table 32: Reduction potential from Energy Distribution in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	0.02	0.12	0.26	0.44
Methodology coverage	20%	20%	30%	30%
PDD potential (MtCO2e/yr)	0.0	0.0	0.0	0.0
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.0
Technical potential as fraction of total sector emissions				15%
Annual uptake/build rate as a fraction of technical potential				5%
Fraction of these projects that will become CDM/JI				0%

Source: New Carbon Finance

End Use (residential and commercial)

Low emission factor and predominance of emissions from cooking reduce the scope for projects.

Emissions for the residential and commercial sector were estimated in 1994 at 17MtCO2e mainly (97%) from liquid petroleum gas (LPG) for cooking[89]. Currently, there is no methodology that could be applied to reduce emissions from LPG. Substitute technologies, such as alcohol cookers are already available commercially, but the focus has been to replace wood/coal stoves in poorer communities, such as the project from Winrock International in the state of Minas Gerais.

More efficient and high-tech versions have been developed by universities and more recently by Bosch and Siemens, which launched at the end of 2006 the Protos plant-oil stove to help poor communities reduce their dependence on firewood. Nonetheless, the ability to retrofit or upgrading existing LPG ovens to any other fuel seems essential, but not in place. It would be technically possible to replace LPG with biogas, but probably not practically.

The 2001 energy crisis led to electricity rationing through sharp increases in electricity bills, which exceeded pre-determined levels. Although this controlled residential electricity consumption until

[88] Ministry of Mines and Energy
[89] National Communication

2005, usage in 2006 finally exceeded usage in 2000, indicating the potential of the sector for energy efficiency measures.

The government announced in its Climate Change Plan that it intends to promote the replacement of old fridges for newer ones. However, previous attempt to register similar project in Brazil by a local utility proved disappointing and it is unlikely the government sponsored program would pass the additionality test. The low grid factor in Brazil further undermines any such activities, such as replacing light bulbs. Furthermore, the additionality is also threatened by the low grid factor, as the 8 projects in a supermarket chain attests. The **practical potential is considered low at 0.74MtCO2e in 2012 and we calculated there is no PDD potential aside rejected projects**, as indicated in Table 33**.**

Table 33: Reduction potential from End Use in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	0.16	0.74	1.55	2.19
Methodology coverage	20%	30%	30%	30%
PDD potential (MtCO2e/yr)	0.02	0.02	0.02	0.02
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.02
Technical potential as fraction of total sector emissions				10%
Annual uptake/build rate as a fraction of technical potential				10%
Fraction of these projects that will become CDM/JI				0%

Source: New Carbon Finance

Forestry

Though at the moment the government is against a market mechanism for REDD, relying on philanthropy may prove unsustainable in the future.

Brazil emitted about 1,470MtCO2e in 1994 of which 68% originated from deforestation of various ecosystems[90], including the Amazon forest, which in turn occupies about 50% of the Brazilian territory. Figure 5 depicts both the deforestation of the Amazon and the future targets for reductions in deforestation as aimed by the Brazilian National Climate Change Plan, which was released at the beginning of the Poznan talks.

The Brazilian position was and has remained against the inclusion of avoided deforestation in the CDM, as it would allow developed countries to continue growing their emissions. The current proposal from Brazil includes a voluntary compensation for reductions in the rates of deforestation. This will be done through the to-be launched Amazon Fund. The fund will be managed by BNDES (National Development Bank) and expects to collect payments once reduction has been achieved, measure on a year by year basis. Initially the fund will focus only in the Amazon region, but eventually will cover other areas were devastation has been rife. The certificates it will emit are not tradable and it hopes to receive funds from governments, companies and individuals that are willing to offset their emissions voluntarily.

Historically, much of the deforestation is to be blamed in the disorderly and predatory way the occupation of this area of Brazil took place. Propriety titles where given by the Government only when the land was cleared until the end of the 80s. However more recently, cattle ranching, illegal logging and the increasing role of price fluctuations of commodities are noticeable. It is worth mentioning that about 20% of the deforestation is legal, as the law grants this right to land owners.

Obviously this regulation has not been enforced appropriately and now in an attempt to reduce the impact of its non-observance, the Government is proposing an amnesty for those who recover 50% of their land with forests in exchange of agricultural credit lines. The proposal includes an internal compensation mechanism that allows landowners to choose to offset the equivalent size of their propriety by investing in reforestation in other areas and turn them into legal preservation areas or buying land and donating to national, regional or local reserves. In addition to give the wrong signal (non punishment) to landowners, the credit lines may be of little interest to farmers as they would profit more by producing in the whole extent of the land.

As mentioned previously (sub-section Iron and Steel), the A/R methodology for industrial use could create significant amount of credits, though it remains to be seem who will buy those, as

[90] National Communication

such projects have yet to find buyers aside the World Bank, due to the temporary nature of the carbon credits and the exclusion of these credits from the EU-ETS.

Though at the moment the government is against a market mechanism for REDD, relying on philanthropy may prove unsustainable in the future, especially due to the relatively low costs to achieved them. We **estimate the practical potential at 54.79MtCO2e/yr in 2012 and we calculate a PDD reduction potential of 8.44MtCO2e/yr in the same year,** as indicated in Table 34**.**

Table 34: Reduction potential of the Forestry sector in Brazil (AR/REDD)

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	0.26	54.79	354.08	653.37
Methodology coverage (AR/ REDD)	100%	100%	100%	80%/90%
PDD potential (MtCO2e/yr)	0.26	8.44	27.46	67.51
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.26
Fraction of these projects that will become CDM/JI(REDD/AR)				10%/15%

Source: New Carbon Finance

Transport

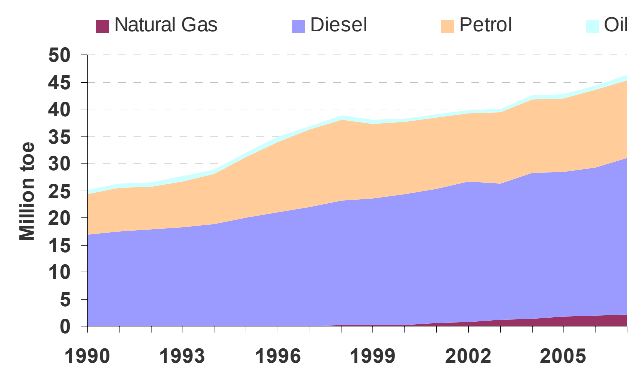
The growth in emissions is offset substantially by the increased penetration of flex-fuels cars, which allow for the car owner to choose between fossil fuels and ethanol at the pump and also by the mandated 25% blend of anhydrous ethanol in petrol.

Emissions from the transport sector were 94.3MtCO2e[91] in 1994 or 41% of the emissions from the entire energy sector. Most of this total or 88.5% was from road transport, followed by only 6.5% from aviation and 5% from other sectors.

As Figure 20 indicates roughly 2/3 of the fossil fuel used was and is diesel and so the equivalent percentile of emissions from transport (minus aviation) was likely from diesel and 1/3 from petrol.

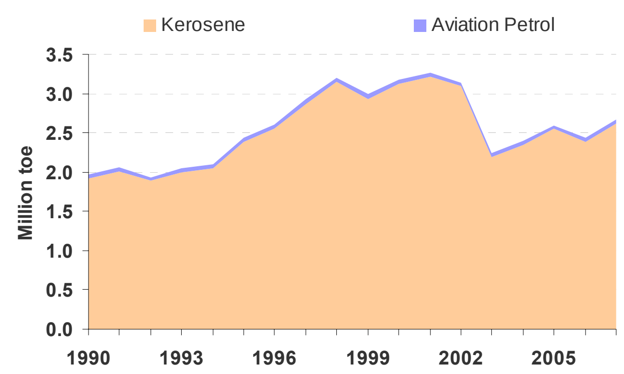
As the ratios of consumption have been maintained throughout the period, as shown on Figure 20 and aviation, as indicated in Figure 21 has not had such great increases as some developed countries have seen in the last 10-15 years, we calculate emissions at 146MtCO2e in 2007. This growth can be explained not only because of economic growth, but also increased private car ownership due to both a car culture and also the lack of adequate public transport.

Figure 20: Non- Aviation Fossil Fuels



Source: BEN 2008, New Carbon Finance

Figure 21: Aviation Fossil Fuels



Source: BEN 2008, New Carbon Finance

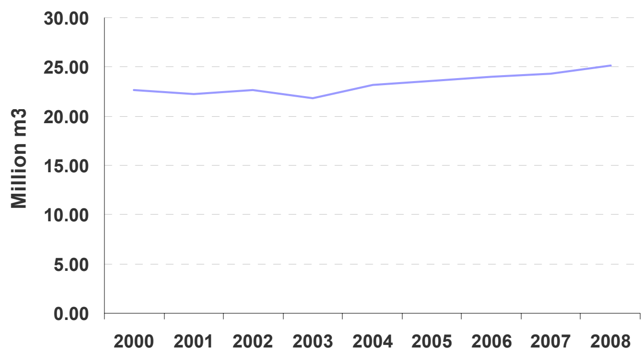
Nevertheless, the growth in emissions is offset substantially by the increased penetration of flex-fuels cars, which allow for the car owner to choose between fossil fuels and ethanol at the pump and also by the mandate 25% blend of anhydrous ethanol in petrol.

Taking these factors into account and by comparing Figure 22 with Figure 23, it is possible to note that ethanol production has already surpassed the production of gasoline. According to EPE,

[91] National Communication

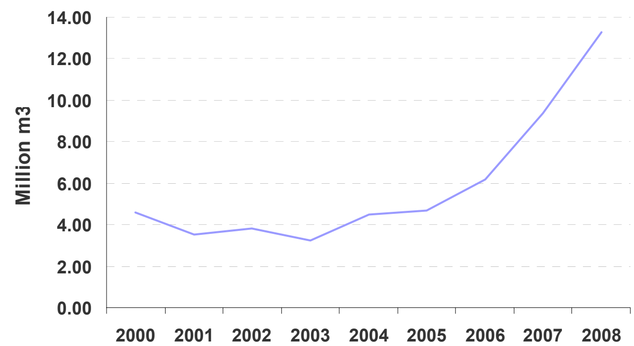
by 2017 80% of liquid fuels of non-diesel cars should be using ethanol, decreasing the current non-blended petrol sales by a third during the same year[92].

Figure 22: Blended Petrol Sales



Source: BEN 2008, New Carbon Finance

Figure 23: Hydrous Ethanol Sales

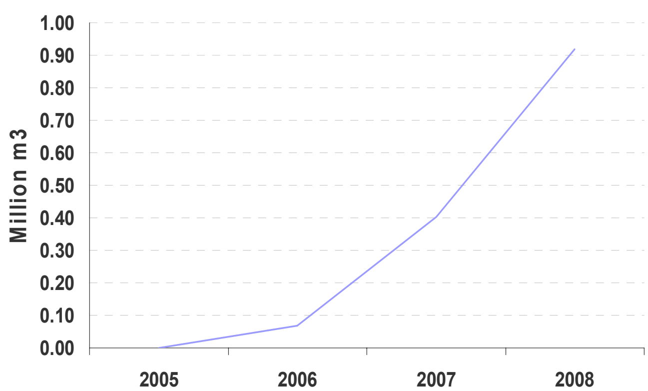


Source: BEN 2008, New Carbon Finance

As seen Figure 24 production of biodiesel has increased rapidly in an attempt to meet the mandated blend of biodiesel into diesel entered that entered into force in July 2008.

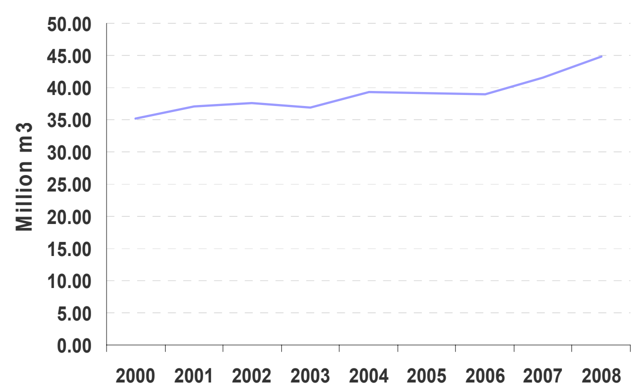
This will allow for some offsetting of the emission growth rate due to the increased consumption of diesel, which as seen in Figure 25 has remained stable between 2004 - 2006, but has sped up in the last couple of years, mainly due to cargo transport attached to faster rates of economic development.

Figure 24: Biodiesel Production



Source: BEN 2008, New Carbon Finance

Figure 25: Diesel Sales



Source: BEN 2008, New Carbon Finance

There are no clear methodologies for the transport sector. Furthermore, the increase in biodiesel consumption, due to mandated blending (5% blend is likely to be anticipated from 2013 to 2010), will decrease the amount of CO2 emitted by this sector, thereby decreasing the margins for further emission reductions under a business-as-usual scenario.

Nonetheless, these emissions remain high and the revision requested by the EB to the current methodology of biodiesel production from vegetable oils waste could if approved be widely deployed in Brazil.

The methodology revision is to include the possibility of dedicated plantations if is to be used in controlled fleets of vehicles. **We therefore estimate the practical potential at 29.47MtCO2e/yr in 2012 and we calculate a PDD reduction potential of 5.03MtCO2e/yr in the same year,** as indicated in Table 35.

[92] National Expansion Plan 2008 - 20017

Table 35: Reduction potential of the Transport sector in Brazil

	2009	2012	2016	2020
Practical potential (MtCO2e/yr)	5.50	29.47	67.42	113.55
Methodology coverage	20%	30%	30%	30%
PDD potential (MtCO2e/yr)	2.90	5.03	6.12	7.43
Current volume in the UNFCCC pipeline (MtCO2e/yr)				0.0
Technical potential as fraction of total sector emissions				45%
Annual uptake/build rate as a fraction of technical potential				10%
Fraction of these projects that will become CDM/JI				20%

Source: New Carbon Finance

6. Conclusion

There is a large PDD potential in Brazil up to 2012, as only 27.1% of it has been developed to date. The countries' abundance of natural resources, large agricultural and industrial economies provides various but normally smaller scale opportunities than one would expect from such a large country. This is explained by the already clean nature of the energy matrix, particularly electricity generation.

Although the energy sector is the third largest emitter, behind forestry and agriculture, this is where the richest opportunity lies. While A/R methodologies are greatly restricted by demand and REDD opportunities by supply, much of the agricultural sector emissions are restricted by lack of methodologies and technologies.

Within the energy sector, projects targeting electricity generation or increasing efficiency are condemned to a low grid factor and thus projects require scale and/or replication potential. Luckily the country is blessed with an abundance of renewable energy options with very favourable natural conditions. Large potential lies also where agriculture meets industry, particularly through biomass in its wider sense including: biogas technologies, such as agricultural and industrial waste water, and energy conversion technologies (electricity, heat, thermo-reduction) for a range of uses, including transport.

As the National Climate Change Plan is now being taken seriously by the Brazilian government and there are a large number of opportunities, we believe that Brazil should be very attractive to CDM investors. However, the unfolding of the global economic crisis will have a negative influence on investment and it is likely that renewed confidence in a market post-2012 will be needed if the potentials detailed in this report are to be fully realised.

Appendices

Appendix A. Primary Sources

Government

Aneel – National Agency of Electric Energy www.aneel.gov.br

EPE – Energy Research Agency www.epe.gov.br

IBGE - Brazilian Institute of Geography and Statistics http://www.sidra.ibge.gov.br

Ministry of Science and Technology www.mct.gov.br

Ministry of Mines and Energy www.mme.gov.br

NGO

IPAM - Amazon Institute for Environmental Research www.ipam.org.br

Methane to Markets www.methanetomarkets.org

CENBIO – National Centre of Biomass Reference www.cenbio.org.br

Cement:

ABCP - Brazilian Association of Portland Cement www.abcp.org.br

Gas / Oil Sector:

ABEGAS - Brazilian Association of Gas Distributors www.abegas.org.br

ANP – National Petroleum Agency www.anp.gov.br

COMGAS - www.comgas.com.br

Petrobras - www.petrobras.com.br

Power Sector:

Eletrobras State Controlled Electricity Company - www.eletrobras.gov.br

Coal:

ABCM - Brazilian Association of Coal www.carvaomineral.com.br

Other Industries:

ABAL – Brazilian Association of Aluminium www.abal.org.br

ABIQUIM – Brazilian Association of the Chemical Industry www.abiquim.org.br

ABRAVA - Brazilian Association of Refrigeration, Air Conditioning, Ventilation and Heating www.abrava.com.br

ANFAVEA – National Association of Car Manufacturers www.anfavea.com.br

BRACELPA - Brazilian Association of Paper and Cellulose www.bracelpa.org.br

Appendix B. Acronyms/abbreviations

Country study regions

AGU – Azerbaijan, Georgia and Uzbekistan

GCC – Gulf Corporation Council

(Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates)

TVP – Thailand, Vietnam and the Philippines

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