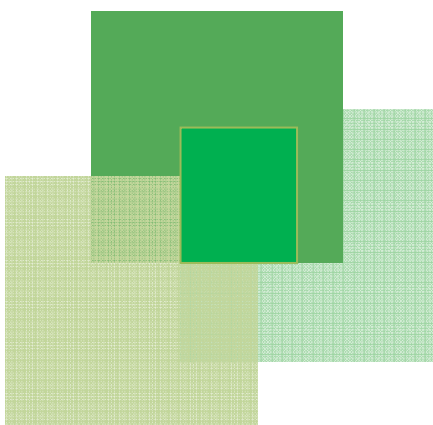




International
Labour
Office
Geneva



Skills for green jobs in Brazil

**Unedited background
country study**

Luiz Antonio Cruz Caruso

ILO Skills and
Employability
Department

2010

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Foreword

The world finds itself in a slow recovery after the deepest recession since the Great Depression. The world is also coping with a host of environmental problems and the urgent need to reduce carbon emissions. A greener future also promises an enormous potential in a much needed employment growth. However, without suitable skills, this potential cannot be realized. Today, skills gaps are already recognized as a major bottleneck in a number of sectors, such as renewable energy, energy and resource efficiency, green building and retrofitting, environmental services, and green manufacturing. Training response measures are successful where they are coherent across policy domains, systemic and systematic, and targeted at disadvantaged groups. These training measures can only be effective if based on timely identification of skills needs. Effectiveness of training measures is decisive not only for the economic recovery but also for a longer-term sustainability agenda.

This report was produced in the framework of the project, ‘Skills for green jobs’. The project was implemented in cooperation between the International Labour Organization (ILO) and the European Centre for the Development of Vocational Training (Cedefop). The project identifies skills needed for greener economies with respect to structural shifts, and new, emerging and changing occupational profiles. The ‘Skills for green jobs’ study is embedded in the Green Jobs Initiative, a joint initiative of the United Nations Environment Programme (UNEP), the ILO, the International Employers Organization (IOE) and the International Trade Union Confederation (ITUC), to assess, analyze and promote the creation of decent jobs as a consequence of the needed environmental policies. The global study was jointly funded by the Skills and Employability Department of the ILO and the Green Jobs Initiative.

The following countries have been included in the study: the ILO covered Australia, Bangladesh, Brazil, China, Costa Rica, Egypt, India, Indonesia, the Republic of Korea, Mali, the Philippines, South Africa, Thailand, Uganda and the United States. In addition, Cedefop covered six European Union (EU) member States: Denmark, Estonia, France, Germany, Spain and the United Kingdom. The ILO global synthesis report,¹ which analyzes the situation in all 21 countries involved in the study, and the European synthesis report,² which covers the six EU countries, as well as all individual country reports, are available at: http://www.ilo.org/skills/what/projects/lang--en/WCMS_115959/index.htm (the ILO website) and <http://www.cedefop.europa.eu> (Cedefop website; look under *Skills Needs* theme). The unedited background country studies have been published in the electronic form in order to make them available quickly. The summaries are published as part of the synthesis reports.

The global project in the ILO was coordinated by the Skills and Employability Department and, in particular, benefited from comments and technical guidance by the team under the leadership of Olga Strietska-Ilina, Christine Hofmann, Mercedes Duran and Shinyoung Jeon. The ILO coordinating team would like to express great thanks to the author of the report, Luiz Antonio Cruz Caruso, for the background country research which contributed to the global study. Special thanks also go to the ILO regional and country field offices for the project support and the ILO colleagues who assisted research at national level.

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¹ Strietska-Ilina, O.; Hofmann, C.; Duran Haro, M.; Jeon, S. (forthcoming 2010). *Skills for green jobs: A global view. Synthesis report based on 21 countries* (Geneva, ILO Skills and Employability Department).

² Cedefop. (forthcoming 2010). *Skills for green jobs: European synthesis report* (Luxembourg, Publications Office of the European Union).

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I owe a debt of gratitude to Maria Ilca for all the time she spent helping me in the English version of part of this document.

It goes without saying that I alone am responsible for all errors and oversight. We hope to contribute to the debate on the transition from our carbon economy to a low carbon economy.

Luiz Antonio Cruz Caruso

Executive summary

Brazil is in transition from a carbon economy to a low carbon economy. The aim of this study is to characterize the demand for green occupations and skills in the current transition phase of the Brazilian economy as well as signal what are the necessary conditions to supply green skills.

In Brazil, forestry and land use are the main components responsible for emissions of greenhouse gases, unlike the so-called developed countries, where industry is primarily responsible for these emissions. According to preliminary version of the Inventory of anthropic emissions (Science and Technology Ministry, 2009) in 1990, 55 per cent of the emission of CO₂ was from forestry and land use and in 2005 these figures reached 58 per cent.

Brazil has a very well-structured environmental legislation and institutional mechanisms to implement such transition. As the use of lands and forests is the major emitter of greenhouse gases, there are lots of specific mechanisms created to solve such problems. At the same time, there is a set of laws and programmes for the following economic sectors: Energy Sector; Transport Sector; Construction Sector; Agricultural Sector; Forestry/Forests Sector; Waste Sector; Steel Sector. Particular attention is given to the Industrial Sector.

Among those sectors it was possible to identify a series of new technologies, most of them, end-of-pipe technologies, that might be diffused to mitigate the effects of gas emissions and therefore, create an impact in a set of occupations such as: Engineering professionals (excluding electrotechnology); Administration professionals; Physical and engineering science technicians; General office clerks; Manufacturing labourers; Agricultural, forestry and fishery workers, for instance.

Considering the actual discussion and recent interviews with specialists, economic activities that contribute directly to reducing emissions of greenhouse gases in the Brazilian economy have been identified based on the following criteria:

- economic activities associated with the generation, transmission and distribution of cleaner energy;
- economic activities related to environmental quality;
- economic activities aiming to avoid costs;
- economic activities associated with fuels based on renewable sources;
- economic activities associated with changes in transport matrix;
- economic activities associated with sequestration of carbon dioxide.

It is possible to identify green economic activities with greater growth expectation for the next five years based on the intention of public and private investment, as well as jobs expectation that are calculated from the demand variation of the SENAI model of prospection. It is willing to include cleaner energy, fuels based on renewable sources and recycling. Therefore, the following occupations are willing to expand: Administration professionals; Agricultural, forestry and fishery labourers; Assemblers; Electrical equipment installers and repairers; Electronics and telecommunications installers and repairers; Engineering professionals (excluding electrotechnology).

At this point, it is important to take the following into account:

1. Vocational educational training institutions are willing to establish retraining programmes for professionals that need to migrate from one function to another. It is due to the fact that the diffusion of end-of-pipe technologies, in economic activities presenting great possibilities of mitigation to occupations related to green economic activities that will be growth in the next five years.
2. In order to measure the quantity of green jobs in Brazilian economy, one should establish a logical interpretation of the demand. In order to do so, I propose that we explore a supposition: There are only two economic activities in Brazil, the first one is considered Green (I): clean energy, for instance. The second one is not considered Green (II): chemicals, for instance. If we also suppose that there are only two occupations: all the skills that occupation A have are Green; while occupation B does not have a Green skill. Workers of this hypothetical economy are proportionally distributed in both activities and occupations: 50 per cent for each case.

The conclusion is that all jobs in the Green economic activity (I) are green. Thus, the final result of the economic activity prevails over the nature of such occupations and skills. Two consequences are to be considered then: all jobs of the occupation B are considered green, even do not show a Green skill, because are related to a green economic activity; and no Green Jobs exist in a economic activity not considered Green (II), even if occupation A present green skills.

Thus, to be considered a Green Job, according to this interpretation, it is necessary that the job itself belong to a green economic activity. As the environmental legislation as well as the incentives and sanctions are directed to economic activities, the growth of economic activities in the market represents growing of green jobs. Using such interpretation and consulting data from year 2008, there were then, 1,405,001 green jobs in Brazilian economy, what comes to a 3.6 per cent of the total formal jobs of that year.

However, when this survey has been concluded there was no consensus among employers, workers and government, on the definition of a Green economic activity. We accomplished a consultation with these agents and the result found, although indicative, revealed that there is no common perception between the government, employers and workers on what turns out to be a green economic activity, what led to the conclusion that the amount of green jobs in Brazilian economy, according to a general perception changed during 2008, from around 134,000 workers to 470,000 workers. It is, therefore, still necessary to deepen the debate over the concept of a green economic activity in Brazilian economy, in order to direct investments, incentives and sanctions.

On the other hand, considering the interpretation that the economic activity determines what a green job is, it actually does not take into account the processes of fabrication, technologies and occupational skills that contribute for the greening of an economic activity. Though workers are not able to modify the final result of the activity itself, there is a set of attitudes, knowledge and abilities that are associated to environmental questions that can also contribute to mitigate environmental impacts.

Regarding the Brazilian case, we consider as green, the occupational family that has at least one occupation related to the environment or to recycling, or that has at least one occupational task that bears these characteristics. We have identified 67 occupational families that fit these two criteria among 596 occupational families (11 per cent). This figure reaches 4,751,435 jobs and accounts for 12 per cent of overall formal employment in 2008 (39,441,566). Thus, it is possible to conclude that the dissemination of green skills in the Brazilian economy reaches 12 per cent.

This estimation demonstrates that there is a significant amount of workers bearing a Green skill in their professional activity. So, if we should incorporate green skills in the curricula of vocational educational training institutions, the process of transition to a low carbon economy would accelerate.

Development and diffusion of cleaner technologies being a fact that turn economic activities greener, specialists consulted for this report, indicated that the basis for such development resides in nano and biotechnologies. The gap of occupations and skills is too large, for that reason, educational actions and research should be considered in order to favour the development and diffusion of nano and biotechnologies.

One conclusion of this study is that the environmental legislation is the main factor that contributes to the transition of the Brazilian economy to a low carbon economy. As a development of this conclusion, we realized that, although the environmental legislation is a strong component of this transformation, some of the environmental issues need to be addressed globally.

The organization of the skills supplies can be done by using the following reasoning: the vocational educational training for occupations related to control and inspection is provided in the environmental legislation. In the production system case, the vocational educational training provision depends on the perception and responsiveness of the public and private schools. This response occurs due to the necessary changes skills are submitted in order to be able to adopt new procedures and technologies for the accomplishment of the legislation. They can significantly vary according to activity, region and company.

To overcome the imbalances between the supply and demand for qualifications, the vocational training institutions are implementing long-term parameters, intending to anticipate the changes in the labour market and the target public behavior. The reason for that derives from the time of the students learning and the time required for the maturation of investments made by the technical, vocational, educational and training institutions in infrastructure, teaching methods, educational resources and teacher training.

Finally, the interviews revealed that there is a huge diversity of governmental actions in the environmental area:

- a) The Ministry of Labour and Employment has several programmes that contribute to the purpose of environment preservation;
- b) The Ministry of Environment acts decisively to make the use of forest resources sustainable and to regulate the emission of greenhouse gases from all other sections of the economy;
- c) The Ministry of Education has a strong base work on environmental education in all levels of teaching and presents a significant offer to Environmental and Forest Engineering courses;
- d) Many other Ministries and governmental agencies have actions related to the environment.

Many actions are triggered within the government and the private sector. It is noticed that there is a series of institutional mechanisms inducing the formulation of plans and programmes in the environmental area. However, it is still necessary to strengthen the institutional exchange of knowledge generated during the implementation of such plans and programmes, it would, hence, lead to better results and the optimization of the resources.

Recommendations to be considered in the Brazilian case:

- a) Create a mechanism for monitoring national environmental legislation and a monitoring of international environmental legislation. Its objective being to identify the following:
 - i. economic activities presenting greater opportunities of mitigation;
 - ii. technologies and procedures that are willing to be adopted by the firms; and
 - iii. impacts in occupations resulting from the diffusion of such technologies and procedures.

- b) Identify as such, specific Green skills belonging to green economic activities presenting large possibilities of mitigation.
- c) Recognize which activities involving different actors can be carried out in order to amplify the consensus on what is a green economic activity. Its objective is to facilitate the formulation and the effective adoption of policies, as well as induce an acceleration of the transition process.
- d) The occupations that satisfy the core competences of economic activities likely to grow, such as cleaner energy and fuels based on renewable sources, could be prioritized in a training strategy. It would also accelerate the transition to a low carbon economy.
- e) Jobs generated by the growth of green economic activities may be filled by different types of workers, especially those displaced from occupations that were or will be affected by the diffusion of cleaner technologies. In this case, the training process is to prioritize occupational groups presenting equivalent mobility standards or sharing the same set of knowledge, abilities, and aptitudes in the labour market.
- f) Identify possible impacts based on prospective studies:
 - i. identification of future diffusion of emerging technologies;
 - ii. new labour organization formats;
 - iii. analysis of the impact of this diffusion in occupational profiles;
 - iv. establish alert mechanisms for the vocational educational training institutions.

Methodology

This report has been elaborated based on estimations regarding the amount of green jobs and 38 interviews and consultations have been done to specialists, worker's representatives, employer's representatives and governmental sources.

Abbreviations and acronyms

ABRAVA	Association of Refrigeration, Air Conditioning, Ventilation and Heating
CBO	Brazilian Classification of Occupations
CCS	Capture and Storage of Carbon
CDM	Clean Development Mechanism
Cedefop	European Centre for the Development of Vocational Training
CENAFLOP	Chico Mendes Institute for Biodiversity Conservation and National Support Center for Forest Management
CENTRE	Human Resources National Development and Training Center
CFC	chlorofluorocarbon
CLIMA	Brazilian Research Network about Climate Changes
CNAE	National Classification of Economic Activities
CNFP	National Register of Public Forests (Cadastro Nacional de Florestas Públicas)
CNIJMA	National Conference on Environment for Youth
CONAMA	National Environmental Council (Conselho Nacional do Meio Ambiente)
CPTEC/INPE	Center for Prevision of Weather and Climate Change
DEA/MMA	Department of Environmental Education
ENCEA	National System of Conservation Units (Sistema Nacional de Unidades de Conservação)
FBMC	Brazilian Forum on Climate Change
GHG Protocol	Greenhouse Gases Protocol
GTZ	German Cooperation Agency
GWP	Global Warming Potential
IBAMA	Brazilian Institute of the Environment and Renewable Natural Resources
ICFTU	International Confederation of Free Trade Unions
ILO	International Labour Organization
IOE	International Organization of Employers
IPCC	Intergovernmental Panel on Climate Change
LBA Programme	A large scale Experiment on the Biosphere-Atmosphere of the Amazon
MDL	Clean Development Mechanism
MEC	Ministry of Education
NGO	non-governmental organization
NPCC	National Plan on Climate Change
OECD	Organisation for Economic Co-operation and Development
PAN Brazil	Programme of National Action of Combat against Desertification and of Mitigation of the Drought Effects

PDE	Plan on Educational Development
PMCMV	Programme My House, My Life (Programa Minha Casa, Minha Vida)
PNHR	National Rural Housing Programme (Programa Nacional de Habitação Rural)
PNHU	National Urban Housing Programme (Programa Nacional de Habitação Urbana)
PPCDAM	Action Plan for the Prevention and Control of Deforestation in the Amazon (Plano de Ação para a Prevenção e Controle do Desmatamento na Amazônia Legal)
PPCDAM	Action Plan to Prevent and Control the Deforestation in the Legal Amazon
PROALCOOL	National Alcohol Programme
PROCEL	National Programme of electricity conservation
PROINFA	Alternative Electricity Sources Incentive Programme (Programa de Incentivo às Fontes Alternativas de Energia Elétrica)
ProNEA	National Programme for Environmental Education (Programa Nacional de Educação Ambiental)
REDD	Reduction of Emission by Deforestation and Degradation (REDD)
SEBRAE	Brazilian Support Service to Small and Medium Size Companies (Serviço Brasileiro de Atendimento às Pequenas e Médias Empresas)
SECAD	Secretariat of Continuous Education, Literacy and Diversity (under the Ministry of Education)
SEMA	Special Secretariat for the Environment
SENAC	National Commercial Training Service (Serviço Nacional de Aprendizagem Commercial)
SENAI	National Service of Industrial Apprenticeship (Serviço Nacional de Aprendizagem Industrial)
SENAR	National Rural Training Service (Serviço Nacional de Aprendizagem Rural)
SENAT	National Transportation Training Service (Serviço Nacional de Aprendizagem do Transporte)
SISNAMA	National Environmental System (Sistema Nacional de Meio Ambiente)
SUS	National Health System
TVET	Technical and Vocational Education and Training
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICA	Sugar Cane Manufacturers Organization

1. Introduction

In Brazil, forestry and land use are the main components responsible for emissions of greenhouse gases, unlike the developed countries, where industry is primarily responsible for these emissions. According to a preliminary version of the Inventory of anthropic emissions (Science and Technology Ministry, 2009) in 1990, 55 per cent of the CO₂ emissions were from forestry and land use, and in 2005 these figures were 58 per cent.

In the most important instrument of environmental policy that the country has, the National Plan on Climate Change, we find the nature of the challenges to be faced: "You can ensure that the core of Brazil's efforts is its commitment to reducing social inequality and increasing income, seeking for the dynamics in the economy in which the emissions' trajectory do not repeat the model and the standards of those countries that have already been industrialized. There are two major elements which are present in this scenario: the difficult task of questioning the issue of changes in land use along with its implications of great magnitude in the Brazilian emissions of greenhouse gases, and the intriguing task of continuously increasing the efficient use of natural resources in the country." (Ministry of Environment, 2008)

Brazil is in transition from a carbon economy to a low carbon economy. The aim of this study is to characterize the demand for green jobs and skills in the current transition phase of the Brazilian economy as well as signal what the necessary conditions to supply green skills are. Such jobs are associated not only with the forest sector but also with all other sectors of the economy.

To achieve this goal, we have analyzed the legislation in order to understand the implications to green jobs and skills. The analysis of legislation and literature along with the field interviews showed that environmental legislation is the main factor that directs and organizes the process of transition to a low carbon economy. Moreover, it was possible to explain the concept of green economic activity and calculate the amount of green jobs. It was also possible to identify criteria to characterize occupations that bear green skills.

As an evolutionary phenomenon, one must consider that due to this transition, what is now considered as a condition that can be accepted with regards to emissions may not have been in the past or may not be tomorrow. Thus, the changing of the workers' profile during the study sometimes became indistinct and led us to further.

The analysis on the skills supply was performed based on the analysis of the National Environmental Education Policy and the actions of renowned training institutions in the country.

At present, we have not yet identified any imbalance between supply and demand of skills, although it is possible to predict the occurrence of such imbalance in the case of the intensification of some processes of legislation and the enforcement of environmental laws. Therefore, the organization of a good system of information on the labour market may be a good start to avoid this probable imbalance.

2. Policy context

2.1 Key challenges and priorities for the green economy

The distribution of greenhouse gas emissions by sectors reveals that agricultural and forestry soil management account, in 1990, for 80 per cent of CO₂ emissions, while enteric fermentation associated with domestic livestock accounts for 80 per cent of methane emissions, and the disposal of animal waste on pasture in conjunction with indirect emissions from soils account for 90 per cent of N₂O emission. In 2005, agricultural and forestry account 80 per cent of CO₂ emissions (Science and Technology Ministry, 2009).

According to the Inventory of anthropic emissions of 1994, the renewable energy sources represent 45.8 per cent of the total energy supply in Brazil. In comparison to the world average of 12.0 per cent, this high percentage indicates that the country benefits from a clean energy sector. Electricity generation is the main product of renewable energy sources: hydropower and biomass contributed to 88.7 per cent of the 484.52 TWh supplied in 1994 (Science and Technology Ministry, 2004).

This pattern of emissions and the characteristics of the energy supply sources point out to some main challenges in the environment sector:

- a. to decrease the net loss forest area;
- b. to implement incentives for the adoption, among others, of agroforestry systems, no-till farming, energy efficiency, waste management and clean production measures;
- c. to encourage the replacement of fuel fossils by biodiesel and ethanol for countrywide transportation; and
- d. to actively participate in the Clean Development Mechanism (CDM).

There is a strong correlation between these challenges and the laws, policies and programmes in environment sector, which will be presented in the following sections. The Interministerial Committee of Climate Change has the main function of elaborating the National Policy of Climate Change and the National Plan on Climate Change (see details of composition of the Committee - 2.2.1b). The Ministry of Environment has the responsibility of the implementation, monitoring and evaluation of the National Plan on Climate Change (NPCC). This document was recently published¹ and presents an in-depth scope of the national policy on climate change. It is used as a reference for all policies, programmes and environmental initiatives presented in this document.

Besides the Ministry of Environment, other ministries contribute to the definition of actions related to the environment and have participated in the development of the NPCC. For these reasons, they are particularly referenced in this document. The Ministry of Education, for example, is responsible for the implementation of the National Policy for Environmental Education and supports private and public educational institutions in the development of environmental programmes. This role is very important because, in order to comply with environmental regulations, companies have been adopting clean technologies and processes, therefore contributing to increase the demand for environmental professionals.

The actions that result in environmental education are quite diverse. In addition to the labour market demand, they are also based on policies and programmes and on the direct demand to private and public educational institutions for environmental courses. These actions are discussed on section 2.3 of this document. This section also presents the actions related to the environment that are undertaken by business associations and labour unions.

2.2 The response strategy

2.2.1 General environmental strategy

Brazil's environmental strategy is defined within its environmental laws, which are a reference to other countries. These laws provide the legal basis for territorial planning, environmental licensing and auditing. A summary of the main environmental laws, policies and programmes is presented in 2.2.1a; 2.2.1b introduces the major institutional mechanisms that articulate the social interest in the environment, and 2.2.1c discusses some very important business initiatives towards the environment.

2.2.1a Environmental Laws

An important milestone in the history of Brazil's environmental law is its participation in the United Nations Conference on the Human Environment of 1972, also known as the Stockholm Conference. As a result the participation in this conference, in 1973, the federal government established a Special Secretariat for the Environment (SEMA). SEMA contributed to define the concept of industrial pollution and delegated authority to states and municipalities to establish regulations for environmental quality control within local industries.

In 1981, based on law 6.938/81, which provides for the National Environmental Policy, the federal government established the National Environmental System (SISNAMA - Sistema Nacional de Meio Ambiente) and the National Environmental Council (CONAMA - Conselho Nacional do Meio Ambiente). CONAMA serves as a deliberative and consultative body concerned with the preservation, enhancement and restoration of environmental resources that are essential to life. It aims to ensure the conditions for socio-economic development, while supporting national security interests and protecting life and dignity. This is achieved through governmental actions towards the maintenance of ecological balance. The environment is viewed as a public asset to be preserved and protected. Environmental preservation is ensured through planning and monitoring the rational use of the soil, subsoil, air and water resources. Environmental protection is ensured through controlling and limiting potentially polluting activities and maintaining the ecosystems. CONAMA also provides incentives for the study and research of technologies to improve the rational use and protect environmental resources, and for environmental education and community action programmes that enable the participation in environmental protection.

The United Nations Framework Convention on Climate Change (UNFCCC), popularly known as "Earth Summit" (United Nations Conference on Environment and Development) held in Rio de Janeiro in 1992, a treaty to stabilize greenhouse gas concentrations in the atmosphere, was chosen by the international community as a solution to mitigate the causes of a problem while equally distributing the burden from the mitigation actions. Kyoto Protocol (1997), one of the protocols of the UNFCCC, sets mandatory limits on greenhouse gas emissions for industrialized countries. The Convention recognizes that the share of global emissions originated in developing countries will grow according to their social and economic needs. In many developing countries, emissions can increase as a result of policies to reduce poverty, such as bringing electricity to rural or remote areas. Brazil does not have formal obligations to limit or decrease its greenhouse gas emissions but has been effectively contributing to the international fight against climate change. Brazil is responsible for important initiatives within the UNFCCC, such as the proposal that originated the Clean Development Mechanism (CDM) and the incentive model for the reduction of emissions from deforestation in developing countries.

The increasing consequences of greenhouse gas emissions and the development of national and international debates around climate change contributed to the creation of Brazil's National Plan on Climate Change (NPCC). This plan takes into account the individual perception of the

environment as a public asset for the operationalization of its strategies. This contributes to different interpretations on whether or not a critical threshold for ecosystem condition is being crossed. For this reason, the policies and the programmes implemented by this plan establish limits related to the usage, non-preservation or to the degradation of the natural resources, therefore improving the diffusion and use of clean technologies.

The NPCC sets out actions to mitigate but also do adapt to climate change. This document emphasizes the mitigation actions, due to their impact on green jobs. The NPCC defines mitigation as the technological changes that contribute to reduce natural resources usage and emissions, as well as the implementation of measures to decrease greenhouse gas emissions and to increase carbon sinks. Based upon this concept, NPCC established seven objectives aimed to identify opportunities for mitigation. The analysis presented below aligns the main initiatives of private and public institutions with these objectives. According to the NPCC, adaptation can be defined as 'a series of responses to current and potential impacts of climate change, aiming to minimize possible damage and to seize the opportunities.'" After the seventh objectives we are presenting some plans related to adaptation.

2.2.1a.1 Mitigation

Objective 1: To encourage the economic sectors to efficiently increase their performance through the continuous search and implementation of best practices.

In order to reach this objective it is necessary that the governmental actions support the economic sectors, promoting the efficient use of natural, scientific, technological and human resources.

The efforts to encourage an increase in the performance of the economic sectors, when based on the best practices for each of these sectors, will contribute to decrease the CO₂ emissions per GDP. These efforts will also contribute to greater competitiveness of Brazilian products in the international market, to elevate the income, and to generate economic surpluses that can ensure higher levels of social welfare. (Ministry of Environment, 2008b).

The following is a summary of programmes and plans that are also aligned to Objective 1. These are further details in Annex 1.

- **Brazilian Programme for the Development of GHC Inventories - GHG Protocol.** According to the subject matter experts that were consulted for the elaboration of this document, this programme directly impacts the skills of environmental engineers and technicians.
- **National Plan for the Elimination of CFCs (chlorofluorocarbons).**
- **National Plan for the Logistics of Transportation.** This plan, developed by the Ministry of Transportation, aims to change the logistics of cargo transportation through the increase of the shares of railroads and waterways. This will be a major contribution of the transportation sector towards the achievement of the economic, social and environmental goals for sustainable development.
- **National Policy for Solid Waste Management.** This policy has an extensive set of guidelines² and establishes actions from several governmental institutions. The actions of the following institutions directly impact the labour market:
 - Department of Water Resources and Urban Environment of the Ministry of Environment – maintains a national information system for urban waste management,
 - Executive Secretariat of the Ministry of Labour and Employment – supports the organization and development of cooperatives for solid waste management,

- Executive Secretariat and the Secretariat for Institutional Articulation and Partnerships of the Ministry of Social Development – supports the implementation of local committees for waste management (Recycling & Citizenship Programme).
- National Bank for Economic and Social Development and the Ministry of Development, Industry and Foreign Trade - finance projects for solid waste treatment and disposal.

Objective 2: To maintain a high level of participation of renewable energy sources in the total energy supply in Brazil, preserving the country's position in the international rank.

The expansion of electric energy offer coming from other sources of energy, such as hydroelectricity free of CO₂ emissions is an action that enables objective 2.

Brazil benefits from a clean energy sector. Electricity generation is the main product of renewable energy sources: hydropower and biomass contributed to 88.7 per cent of the 484.52 TWh supplied in 1994. The growing demand for electricity threatens this benefit. The National Energy Policy Plan of the Ministry of Energy was designed to mitigate this threat by promoting energy efficiency. This plan is based on strategies to expand the generation, transmission and distribution of hydroelectric and alternative sources of energy (Annex 1).

The Incentive for Alternative Sources of Energy Programme (Programa de Incentivo às Fontes Alternativas de Energia Elétrica – PROINFA) of the Ministry of Mines and Energy also aligns with objective 2. This programme establishes a new strategy for the sustainable integration of alternative energy sources and enforces the policy on diversification, thus improving the development of renewable energy sources. In February 2005, this programme contracted 144 power plants in 19 states through Eletrobrás, a major Brazilian power utility company. This resulted on a total of 3299.40 MW of installed power capacity, of which 1422.92 MW are wind farms, 1191.24 MW are small hydroelectric plants and 685.24 MW are biomass power stations. In 2009, at the end of the implementation of this programme, a total of 150,000 jobs will be created nationwide.

Objective 3: To foster the sustainable use of biofuels for transportation and to build an international market for sustainable biofuels.

In order to reach objective 3, it is necessary to increase the substitution of fossil fuels in the transport activities and improve technical cooperation with other countries with agricultural potential for developing sugarcane plantations.

Brazilian biofuels such as ethanol and biodiesel are sources of wealth. Their production generates income for rural areas while their usage displaces fossil fuels that impact on climate and air quality. Some of the programmes of the Ministry of Mines and Energy that align with objective 3 are the following: Biofuels Programme, the Programme for Biofuels Certification and Labeling and the National Programme for the Production and Use of Biodiesel.

The National Alcohol Programme (PROALCOOL), implemented in 1975, is the largest global programme aimed at replacing fossil fuels with renewable energy. In 2007, the domestic production of ethanol reached 22 billion liters (an increase of 22 per cent over the previous year), of which 3.5 billion liters were exported. Since the implementation of PROALCOOL, the usage of pure ethanol and of ethanol blend with gasoline for transportation has contributed to avoid the emission of almost 800 million tons of CO₂. This corresponds to 30 per cent of the total automobile emissions. The sugarcane agroindustry is responsible for more than 1 million jobs (Ministry of Environment, 2008).

Objective 4: To support the sustainable reduction of deforestation levels in its four-year periods average in all Brazilian biomes, until the zero illegal deforestation is attained.

The main objective adopting such measures is to reach a consistent reduction of deforestation levels to be verified at every four-year period.

There are several plans and programmes associated to the reduction of deforestation levels. Among them:

- Action Plan for the Prevention and Control of Deforestation in the Amazon (Plano de Ação para a Prevenção e Controle do Desmatamento na Amazônia Legal - PPCDAM). The main objective of this plan is to reduce the pace of deforestation in the Brazilian Amazon by taking the following actions: monitoring and controlling deforestation, promoting sustainable productive activities and establishing partnerships among the federal, state and local government, non-governmental organizations and the private sector. More specific objectives of this plan are described in Annex 1. Its main goals are to reduce deforestation by 40 per cent in the period 2006-2010 for the average of the ten-year period of the Amazon Fund (1996-2005) and 30 per cent more in each of the following two four-year, for the previous four-year periods. Reaching this goals in Brazilian Amazon will avoid emissions of around 4.8 billion tons of carbon dioxide in the period 2006 to 2017, and in the magnitude of 100 tC / ha.
- Policies for mitigation, adaptation, research, development, and innovation and communication for the areas of arid vegetation (Brazilian caatinga).
- Implementation of the Action Plan for the Prevention and Control of Deforestation in the Amazon in other Brazilian biomas (see Annex 1C).
- Setting minimum prices for natural products extraction.

Objective 5: To eliminate net loss of the Brazilian forest cover by 2015.

In addition to preserving the forests at the levels set out in the previous objective, the various plans associated to this objective aim to double the area of planted forests from 5.5 to 11 million hectares in 2020 and, to eliminate net loss, having 2 million hectares of native species.

In Brazil, forestry carbon sequestration is of vital importance to reduce emissions. According to the National Forestry Plan, “native forests intrinsic value and is above the perceived value of the environmental services. They are custodians of a priceless genetic heritage that is still largely unknown. Planted forests, whether for the restoration of ecosystems or for economic reasons, provide environmental services, preserving water sources and native fauna, decreasing or preventing the silting of rivers and lakes and improving the local microclimate conditions. They generate products that replace many non-renewable natural resources, such as coal and raw construction materials, decreasing economic activities in native forests. This plan is organized into two parts; the first is related to the economic use of forests, and the second to its own structure. The first part involves actions for sustainable forest management, such as the creation and implementation of agencies for conservation and sustainable use of forests, the restoration of degraded areas, incentives to reforestation and agroforestry practices, and support to local and indigenous populations and to the production, processing and marketing of forest products. The second part involves actions related to laws and regulation, such as special updates to the Forest Code to support forest monitoring and control, support to the national forest information system and to expand the forest management through investments in human resources, training and education, science and technology.

In addition to this plan, there are very important actions, such as the National Register of Public Forests (Cadastro Nacional de Florestas Públicas - CNFP), the National Forest Inventory, the Annual Forest Land Grant Plan and the Forest Energy Programme.

The Ministry of Labour and Employment launched, within the National Qualifications Plan, the Agroextractivism Programme. This programme also aligns with objective 5. It supports the

development of vocational training in agroextrativism to local communities threatened by the impacts on the environment that have been generated by the construction of the North-South railway, which is fundamental for the development of the country. A total of 2,532 workers will benefit from this programme. They are local agricultural workers, indigenous peoples, self employed and unemployed people and minority groups (including the disabled, women, beneficiaries of social inclusion policies and other actions).

Objective 6 – To strengthen intersectoral actions to reduce the vulnerability of populations.

Main actions concerning objective 6 are: a-identify vulnerable populations that are not ready yet to face the consequences of climate change, and promote actions to reinforce the resilience of such groups.

According to the National Plan on Climate Change, climate change has several causes, varies in its intensity, and impacts, among others, the social, economic, cultural and educational sectors. The evaluation of these impacts is complex and requires a multidisciplinary approach to engage resources from several fields, such as climatologists, social scientists, biologists, physicists, chemists, epidemiologists and educators. These resources play an important role in the analysis of analyze the relationship between the social, economic, biological, ecological and physical fields and their relationship to climate change.

With regards to this specific goal, a series of actions can be highlighted: Incentive to studies, research and capability to enhance the level of knowledge about the climate change impacts on human health; Strengthening of the environmental sanitation measures; Strengthening of the communication and environmental education actions; Identification of threats, vulnerabilities and resources (financial, logistic, material, human, etc.) to elaborate plans of prevention, preparation and answers to public health emergencies; Stimulation and increase of the technical capacity of the National Health System (SUS) professionals regarding health and climate change; Establishment of early warning systems for diseases related to weather events; Creation of an information and indicators panel in order to monitor weather events and their impacts on public health.

Objective 7 – To identify the environmental impacts from climate change and foster R&D to support strategies to minimize the socio-economic costs of the country's adaptation of to climate changes.

Objective 7 implies actions to increase the production of scientific knowledge on all aspects interrelated with climate change, as well as promoting adaptation to climate change while minimizing costs are underway.

Among these efforts, studies to understand the regional dynamics of climate change and its environmental impacts have been recently developed, such as: Studies developed in the country seeking for the comprehension of regional climate dynamics and environmental, social and economic, national and local impacts: Brazilian Research Network about Climate Changes – CLIMA; LBA Programme – A large Scale Experiment on the Biosphere-Atmosphere of the Amazon; GT Coal (TAL) –Analysis of the Charcoal Production Chain; Bio-oil; Hydrogen, Fuel Cells; Capture and Storage of Carbon (CCS); Development of Second Generation Biofuel (Lignocelluloses Material); Studies on the Anthropogenic Emissions of Greenhouse Gases in the Hydroelectric Reservoirs; Study on project activity opportunities of the Clean Development Mechanism – MDL in the electricity section; Vulnerabilities in the Coast of Rio de Janeiro State Due to Climate Changes; Global Climate Changes and its Effects on the Biodiversity; Climate Changes and Possible Changes in the Atlantic Forest Biomes; Desertification; Climate Changes and Energy Safety in Brazil; Global Warming and the New Geography of the Agricultural Production in Brazil; Petroleum and Gas; ATLAS Urban Water Supply; Mapping of Urban

Vulnerabilities in Face of the Global Warming and Greenhouse Effect; Climate Changes Economy in Brazil – EMCB Project.

The Action Plan for the period 2007-2010 of the Ministry of Science and Technology is also aligned with objective 7. This plan is geared towards the definition of a set of initiatives, actions and programmes to enable science, technology and innovation to play a more decisive role in the sustainable development of the country, such as R&D and innovation in biodiversity and natural resources, the Amazon and semi-arid areas, meteorology, climate change, biofuels and other energy sources such as hydrogen, nuclear, oil, gas and coal are the main actions of this plan.

2.2.1a.2 Adaptation

Considering that some of the actions included in objectives 6 and 7 are interwoven with adaptation actions in the National Plan for Climate Change, it is important to stress that adaptation is being developed in two levels:

- Building an adaptation capacity: generation of information and conditions (managerial, institutional and regulatory) in order to support adaptation, including knowledge of possible impacts due to climate change and future options .

Concerning that need, it is useful to consider the example of CPTEC/INPE, (Center for Prevision of Weather and Climate Change) an institute belonging to the Ministry of Science and Technology. CPTEC/INPE has developed a regional model for South America that has got a special resolution of 40 km to obtain projections of future climate (period 2071-2100 and possible extreme scenery: A2-high emission and B2-low emission of greenhouse gas) in South America.

- Implementing adaptation measures: increase actions to reduce vulnerability or those aiming to identify and use new opportunities due to climate change. It includes investments in infrastructure, as well as systems of management of risk and promotion of information.

Among these actions that are being developed with the purpose of adaptation to climate change, we shall highlight:

- Programme of National Action of Combat against Desertification and of Mitigation of the Drought Effects - PAN Brazil
- Framework Programme for Sustainable Management of Water Resources of the River Plate Basin, considering the effects brought about climate variability and change.
- Working Group on Impacts of Climate Change in Brazil and CONAMA's role in the adoption of measures for adaptation

2.2.1b Inter-Institutional Articulation

Environmental matters raise contradictory questions and interests. In an effort to mitigate this, the federal government has established committees and conferences, such as the Interministerial Committee on Climate Change, the Special Committee on Climate Change of the National Congress, the National Conference on the Environment and the Brazilian Forum on Climate Change. This last one has been created by a Presidential enactment in June 2000, aiming to bring awareness and mobilize civil society around the discussion and future decisions over the impacts of gas emissions from human activities that worsen the greenhouse effect. The Brazilian Forum is presided by the President of Brazil and its members are: Ministers of State, Directors of Regulatory agencies, Environmental Secretaries of all States of the Federation, representatives of the private sector, Civil society, scientific community and NGOs (non-governmental organizations). They contribute to facilitate policy formulation, an effort that is undertaken by

Executive Committees that include members of several Ministries and representatives of the population, as in the following examples:

- National Plan on Climate Change. Participants in the Interministerial Committee: House of the Presidency of the Republic; Secretariat of Strategic Affairs; Ministry of Agriculture; Livestock and Food Supply; Ministry of Science and Technology; Ministry of Defense; Ministry of Education; Ministry of Finance; Ministry of National Integration; Ministry of Health; Ministry of Cities; Ministry of Foreign Affairs; Ministry of Mines and Energy; Ministry of Agrarian Development; Ministry of Development, Industry and Foreign Trade; Ministry of Environment; Ministry of Planning, Budget and Management; Ministry of Transportation and the Brazilian Forum on Climate Change.
- National Policy on Solid Waste. This policy is developed in line with the national policies on environment, environmental education (see details on item about educational supply), water resources, sanitation, health, urban, industrial, technological and foreign trade, policies to promote social inclusion, and with solid waste management policies at the federal and local levels. It is guided by the Law 1991/2007.
- Brazil GHG Protocol Programme. This programme is developed in a partnership of the Ministry of Environment with Fundação Getúlio Vargas, Brazilian Business Council for Sustainable Development, World Resources Institute and World Business Council for Sustainable Development.

2.2.1c Business Initiatives in alignment with the environmental challenges and government strategies.

As part of the environmental challenges of the countries and coping strategies, notably the recent initiative of 20 major companies in Brazil (August 2009), which was a letter signed and delivered to the Minister of Environment, have undertaken to reduce emissions per ton of production or per unit of revenue.

2.2.2 Green response to the current economic crisis

The responses to the economic and financial crisis faced anti-cyclical measures such as credit expansion and an increase in government spending. In addition to credit expansion through federal banks, the government has waived taxes to increase demand and production.

A set of measures directed towards the construction sector were organized by the Programme My House, My Life (Programa Minha Casa, Minha Vida – PMCMV), created by the Provisional Measure No. 459 of 25 March 2009. These are: the National Urban Housing Programme (Programa Nacional de Habitação Urbana – PNHU), the National Rural Housing Programme (Programa Nacional de Habitação Rural – PNHR), an authorization for the transfer of federal funds to the Residential Lease and to the Social Development Funds, an authorization for the participation of the federal government in the Popular Housing Guaranteed Fund, and an authorization for federal grants to the National Bank of Economic and Social Development. The Programme My House, My Life aims to foster housing construction and sales for families with income of up to ten minimum wages. The National Urban Housing Programme is targeted to families with low income than and the National Rural Housing Programme to agricultural workers and to the countryside population.

The Programme My House, My Life will facilitate, in partnership with local governments and the private sector, the construction of one million houses for families with income of up to ten minimum wages. This programme will boost the economy through job creation and positive impacts on the society. The following measures are associated to it:

- Construction Quality Assurance – This measure aims to increase the quality of construction companies, material suppliers, building systems and components, by funding the following: conformity assessment, technical training and implementation of quality management technologies, processes and products. The beneficiaries are micro, small medium size companies.
- Use of Prefabricated Construction Systems – This measure aims to promote investments in alternative materials of low cost, fast delivery, low environmental impact and improved construction quality. It provides funds to the deployment, upgrading and expansion of prefabricated houses, to the development of prefabricated construction systems, to technical training, and to the acquisition of construction machinery and equipment.
- Environmental Licenses – This measure aims to decrease the time necessary to provide environmental licenses for projects up to 100 hectares to 30 days. The evaluation criteria are the commitment to preserve environmental areas under permanent protection, project location out of hazard areas and the commitment to invest in sewage and water infrastructure, among others.

Construction waste as a percentage of the total amount of purchased construction material in Brazil is of 30 per cent. Sixty per cent of the total sold construction material is for home projects, which have even higher percentages of construction waste. Construction quality measures can contribute to reduce emissions from landfills and the use of raw materials. Among these, an agreement between the Ministry of Environment and a Federal Bank (Caixa Econômica Federal) will facilitate the use of solar panels in projects for low income families. This should increase the demand for solar panels installation workers. According to estimations from the Brazilian Association of Refrigeration, Air Conditioning, Ventilation and Heating (ABRAVA), between 2009 and 2010 the foreseen necessity of project managers and installers of solar panels is estimated at around 800 for project managers and 7,000 for installers.

2.3 The skills development strategy in response to greening

Labour market demands that result from environmental policies cause various types of impacts on the educational system. Brazil has a National Policy for Environmental Education (Law 9795 of 1999). In 2003, the Ministry of Environment and the Ministry of Education established the National Programme for Environmental Education (Programa Nacional de Educação Ambiental - ProNEA). This programme is managed by the Committee for the National Policy for Environmental Education. The organism that manages the National Policy of Environmental Education is also responsible for the coordination of the policy and implementation of the ProNEA. It is the SECAD, Secretariat of Continuous Education, Literacy and Diversity, belonging to the Ministry of Education to act at the formal system level.

Actually, in Brazilian schools, climate change is a subject treated by the National Conference on Environment for Youth (CNIJMA), that is already a consequence of the National Conference on Environment of 2003. It is a system in which environment is approached through conferences that lead to study related topics in the curriculum.

The second CNIJMA, (2005/2006), gathered 11,475 schools and communities, of which 2,897 had actually chose the topic “climate change”. From the 3,801,055 participants, 943,722 people debated the subject (768,743 students, 43,367 teachers, 131,612 from school communities) in 2,865 districts. The result of it, the Letter of Responsibilities, called “Vamos Cuidar do Brasil” (Let’s take care of Brazil), was handed to the President and Ministers of Education and Environment. It listed the responsibilities and regional actions necessary to face climate change.

In 2008/09, the Third CNIJMA is challenged by two topics: The first one, being planetary, aims to research and find civilizatory options for global environmental changes; the second one,

is educational and concerns the Plan on Educational Development, (PDE), it searches improvements in the quality of teaching-learning process and solutions to keep students in schools.

In addition to this, Brazil's vocational education system is very responsive to labour market demands, and has been dedicating special attention to the environmental sector. For this reason, this section is organized in six main items that highlight the main actors and actions in the educational sector, as follows:

- **Ministry of Environment and Ministry of Education**

The Ministry of Environment views environmental education as a set of processes by which individuals and communities build social values, knowledge, skills, attitudes and skills aimed at environmental conservation, which is essential to the quality of life and its sustainability. Environmental education is an essential and permanent part of the national education system and, therefore, must be present in all educational levels, whether through formal or non-formal processes. The Ministry of Environment established important educational actions, as follows:

- **COLECIONA:** Launched in partnership with the Ministry of Education, in 2008, this collection of specialized information on environmental education and educational communications is available on the website of the DEA/MMA - Department of Environmental Education.
- **National Strategy for Environmental Communication and Education.** This strategy aims to broaden social participation in public policies related to protected areas and environmental education. It facilitates the partnership of the federal and local governments in the development of the National Strategy for Environmental Communication and Education within the National System of Conservation Units (Sistema Nacional de Unidades de Conservação (ENCEA).
- **Green Room Project.** This project supports the development of interactive spaces for information, education, training and environmental action, within schools or other educational institutions. It also funds publications on environmental matters. A total of 390 Green Rooms have been created.

- **Environmental Ministry**

Training Programme for County Managers

The Environmental Ministry is elaborating orientation manuals to the municipalities. Its purpose is to offer a support on the necessary methodology to study GHG emissions and to elaborate possible plans and actions related to climate change.

Green Lounge Project

Developed since 2003, the Green Lounges are interactive spaces of information, education, training and socio-environmental action, located inside an institution, and dedicated to the design and development of educational character activities focused on environmental issues. Publishes and disseminates publications on environmental, cultural, social, research and communication subjects. The partnership between institutions is encouraged as a way to strengthening the actions and potential of the Green Lounges, as well as a guarantee of the proposal sustainability.

- **Ministry of Education**

The Ministry of Education (MEC), through the General Coordination for Environmental Education, which is part of its Department for Continuing Education, Literacy and Diversity,

establishes guidelines for the general and formal education. It is proposing the implementation of sustainable educational programmes to be housed in retrofitted school and university buildings, in addition to teachers training and the introduction of climate change in the educational curriculum. (Ministry of the Environment, 2008a).

Human resources training actions aligned to the National Policy of Environmental Education aim to train instructors for all educational levels, add environmental matters to the training curriculum and provide training for management and other environmental professions and to meet the demand of the social segments with respect to environmental matters.

Environmental education in elementary schools has risen from 72 per cent to 95 per cent of the total enrollments in the period 2001-2004. In 2001, 25.3 million students were enrolled in elementary schools that offer environmental education while, in 2004, these schools registered the enrollment of 32.2 million students. These results refer to the three types of implementation of environmental education in elementary schools, which in 2004 were the following: projects (64,300 schools), special subjects (5,500 schools) and introduction of environmental education as a subject (110,000 schools). (Veiga and Others, 2006)

In addition to the establishment of guidelines to the formal education, the Management Committee for the National Environmental Educational Policy coordinates the following projects and programmes:

- **CONPET Schools Programme:** The CONPET develops projects in the education area in order to present the importance of rational use of energy, with the perspective of creating a future generation aware of the natural resources and environmental preservation, stimulating students and teachers to become defenders of the rational use of these resources and, in particular, petroleum and natural gas.
- **PROCEL Schools Programme:** Acting in the primary and secondary level schools and in universities, the PROCEL Schools Programme has benefited, from 1995 to 2006, approximately 18 million students through the project “The Nature of Landscape – Energy,” developed to attend basic education, and the discipline “Energy Conservation,” developed for the upper level.
- **COLECIONA Project:** binder of the Environmental Educator: The Ministry of Environment – MMA implements many environmental education actions of highly significance and national coverage. Among them, we can highlight the so-called COLECIONA: binder of the Environmental Educator, launched in 2008 in partnership with the Ministry of Education. This is initially an electronic and bimonthly material, specialized in providing information on Environmental Education and Educational Communication, which can be found on DEA/MMA’s – Department of Environmental Education – website and it is also available in PDF format.
- **National Strategy for Communication and Environmental Education:** It aims to increase the social participation in the public policies related to the protected areas and environmental education, starting a participatory elaboration of the National Strategy of Communication and Environmental Education within the National System of Conservation Units (ENCEA), which includes the federal, state and local Conservation Units.
- **Educators Groups.** Group of institutions that acts in permanent, participatory, continued training processes focused on the totality and diversity of determined territory inhabitants and has as a goal the training of critic popular active social workers/environment educators. This goal is reached by a qualified process and straightening with training and dialogue in the territories, which can make people can feel as part of a world where they can interfere in the decisions and paths chosen by their country, state, city, and neighbourhood.

- **Actions for vocational education based on governmental policies and programmes**

There are actions related to vocational education in many of the programmes and policies that were previously introduced. The following are of great importance:

- **National Environmental Policy.** This policy targets all educational levels. It aims to incentivize the participation of individuals and communities in environmental protection, ensuring that ecology is included as a mandatory subject in the curriculum. In addition, it supports the implementation of sustainable educational spaces in retrofitted buildings of existing schools and universities, training for teachers, and the inclusion of climate change in the curriculum and training material.
- **National Forest Policy.** This policy supports the development forest management research projects and studies and training resources to environmental related occupations, such as: Forest Protection Agent, Environmental Inspection Agent, Environmental Analyst, Environmental Projects Analyst, Environmental Inspector, Forest Inspector, Environmental Police Officer, Forest Policy Officer, Parks Policy Officer and Agricultural Inspector. It also promotes public awareness of environmental issues and contributes to strength the relationship of institutions in the environmental sector.
- **National Water Resources Plan.** The federal government actions related to this plan focus on training to meet with various demands, such as those from the National Council for Water Resources, Federal River Basin Committees and respective agencies. The main objective is to support the diffusion of the National Water Resources Policy. Other objectives are to promote training for occupations in water resources management, to assist policy makers in decision making processes, and to provide training to traditional and indigenous communities in water resources preservation.
- **National Policy on Solid Waste.** This policy supports training for occupations in solid waste management, such as Agents for Environmental Management of Urban Solid Waste. It also provides support to the efficiency and continuity of urban cleaning public services, through the adoption of mechanisms to maintain its economic and financial viability. These relate to the acquisition of recycling products and the provision of environmental training to collectors of recyclable materials.
- **Brazilian Space Agency Programme in Schools.** The Brazilian Space Agency designed the AEB School Programme in 2003. It is through its programme that the Agency spread its activities in Brazilian schools in order to awaken the interest of children on science and technology, as well as develop future vocations. Based on such experience, the Brazilian Fórum on Climate Change (FBMC) established a partnership with AEB, to use its programme as another vector of consciousness about climate change and its consequences.

- **Technical and Vocational Educational Training (TVET)**

In Brazil, TVET is offered by public and private institutions.

The most important public vocational educational institutions are universities and Federal Educational Institutes, Science and Technology administered by the Federal Government, while the private are: the National Industrial Training Service (Serviço Nacional de Aprendizagem Industrial – SENAI), the National Commercial Training Service (Serviço Nacional de Aprendizagem Commercial – SENAC), the National Transportation Training Service (Serviço Nacional de Aprendizagem do Transporte – SENAT) and the National Rural Training Service (Serviço Nacional de Aprendizagem Rural – SENAR). These are funded by contributions based on percentages on companies' payrolls.

The various qualifications demanded by the environmental sector are distributed among the vocational education institutions such as SENAI, SENAC, SENAT, SENAR, Universities and

Federal Educational Institutes. The private vocational educational institutions have developed management actions that ensure continuous monitoring of the labour market demands, and demands from technological changes and environmental policies.

SENAI and SENAC are responsible for meeting most of the demand for vocational education. In 2009, SENAI offered 78 environmental courses at the qualification and training, technical, college and graduate school levels, which represent 44,137 enrollments. Environmental courses were introduced in vocational education by SENAI in the early 1990s, and 19,451 enrollments, in 2007. SENAC offers courses in management, conservation and environmental education that aim to enable individuals to decide and act upon environmental matters, following the principles of sustainability.

The Brazilian Support Service to Small and Medium Size Companies (Serviço Brasileiro de Atendimento às Pequenas e Médias Empresas - SEBRAE) is another important institution that develops actions in the environmental sector. It supports, among others, environmental courses and consulting, tree planting and other environmental preservation actions, such as the research of alternative energy sources. These are developed through partnerships among industries, commerce and service companies and the government.

- **Final considerations**

The Brazilian educational system has been expanding its activities in the environmental area. Environmental education reaches almost 100 per cent of all elementary school. This has been significantly contributing to the raising of environmental awareness and responsibility among children and youth.

Environmental education has also been very important at the university level, with the increasing demand for environmental engineers.

Several educational policies and programmes are developed within the guidelines of the National Environmental Education Policy and aim to provide training for occupations related to environmental inspection and control. Specialized training results from the demand of companies and workers that are subjected to these policies. The educational institutions have to be prepared to meet these demands.

3. Anticipation and provision of skills

This chapter aims to characterize a future demand for skills on green jobs, as well as a possible response plan on professional qualification that could come from Brazilian public and private education system. A series of analysis have been done based on secondary source data and interviews made for the case studies. The results presentation followed the structure provided by ILO.

3.1 Green structural change and (re)training needs

According to specific literature, we are in a transition from a carbon economy to a low carbon economy. Predominantly, at this stage, green economic activities use end-of-pipe technology (which reduces environmental impacts) and some cleaner technologies (whose emissions, or water and soil contamination are considered acceptable at present). European Commission studies indicate that "the expansion of domestic markets for end-of-pipe technologies" on carbon reduction has probably reached maturity and is now expected to decline by the end of the decade." (Hewett and Foley, 2000)

Therefore, investments are necessary in order to generate and make cleaner technologies available, which are essential to move toward a low carbon economy or, according with Pfeiffer and Rennings (1999), investment in preventive technologies against environmental damages rather than healing technologies.

In order to make a range of cleaner technologies available, a paradigm shift is necessary - from a carbon economy to a low carbon economy – in which changes in the institutional framework are necessary so that it can regulate and provide support to economic activities. In addition, it urges the redesigning of education policies as well as of science and technology along with the integration of environmental policies with those of other areas. (Kemp and Soete, 1992b)

Brazilian economy can also be considered in transition toward a low carbon economy. The environmental legislation is the main reason why changes aroused creating a need for green jobs as well as new skill requirements for such jobs. Thus, the identification of the impacts caused by the environmental legislation will be the main axis for a labour market analysis. In order to study the (re)training needs, the following types of analysis have been adopted:

- a) analyze the identification of economic activities presenting a potential of adopting end-of-pipe or cleaner technologies in order to adapt to the environmental legislation.
- b) analyze studies of technological prospectives that evidence which economic activities will be more impelled to adopt emerging cleaner technologies, including those that might disseminate faster during the next decade.

Firstly, economic activities that present the greatest opportunities of mitigation have been identified (3.1.1). Secondly, the occupations that will be impelled to change or adapt as a consequence of the adoption of such technologies in those economic activities have been identified. Then, the necessary skills are characterized in order to define the (re)training (3.1.2).

3.1.1 Green restructuring and its impacts on the labour market

In this section, we will examine the two types of analysis that identify the economic activities willing to adopt cleaner technologies: a) Analysis which identifies economic activities presenting a potential of adopting end-of-pipe or cleaner technologies in order to adapt them to the environmental legislation; b) Analysis that identify economic activities bound to suffer impacts from the dissemination of cleaner technologies in the next ten years.

3.1.1a Analysis which identifies economic activities presenting a potential of adopting end-of-pipe or cleaner technologies in order to adapt them to the environmental legislation

The economic activities that generate significant emissions of greenhouse gases and that have significant opportunities for mitigation will be the subject of this item. Such economic activities, which currently have major opportunities for mitigation, are encouraged by public policies and societal pressures for the development of health, social and environmental responsibilities to reduce emissions of greenhouse gases through the adoption of new mechanisms of management and the changing of its technological source. The National Plan on Climate Change gives us the first list of such economic activities:

- **Energy Sector:** Improving the efficiency of supply and distribution of energy, replacing carbon-intensive fuels with lower-carbon or renewable fuels, and capturing and storing carbon.

- **Transport Sector:** Use of efficient vehicles, railway systems, public in place of private transportation, and planning for land use and its transport system. The targets set for the change in the transportation matrix will lead to the following changes: in 2005, 58 per cent of the country's transportation was carried out by road and 38 per cent by rail and waterways. The goal states that by 2025 road transport should be of 33 per cent and rail and water transport, 61 per cent altogether.
- **Construction Sector:** Use of efficient appliances and solar power, and the adoption of an integrated planning system that allows efficiencies in energy use (Ministry of Environment, 2008).
- **Industry Sector:** Use of efficient equipment, adoption of recycling practices and substitution of materials, control of gas emissions, capture and store carbon.
- **Agricultural Sector:** Adequate management to increase ground carbon storage, land recovering, strengthening of cattle farms, improvements in crops and fertilization to reduce emissions of CH₄ and N₂O and the establishment of energy crops. In the agricultural sector, we also highlight the following plans and programmes: Gradual reduction of sugar cane straw burning; Sustainable Agribusiness Programme; New Agricultural Practices; Sugar Cane Zoning Programme; National Agro Energy Plan.
- **Forestry/Forests Sector:** reducing deforestation, encouraging sustainable forestry management, forestation and reforestation and the use of forest products and by-products which are obtained on a sustainable basis for energy generation.
- **Waste Sector:** Recovery of methane from dumping areas, energy recovering and recycling through incineration.
- **Steel Sector:** Brazil is one of the few countries in the world to use charcoal to produce pig iron and steel. Currently, the use of charcoal in the total production of the sector ranges from 5 per cent to 10 per cent. According to Plantar, a pioneer enterprise in Clean Development Mechanism projects in forestry connected to ironworks, each ton of iron processed with the use of renewable charcoal promotes the removal of 1.1 tons of CO₂, generating a positive emission account. Considering that the same amount of processing using coal produces emissions of 1.9 tons of CO₂, the replacement of coal by renewable charcoal has the potential to reduce emissions by 3 tons of CO₂ per ton of raw iron in the steel industry. (Ministry of Environment, 2008)

Therefore, these are the economic activities which present great opportunities for mitigation. As those economic activities present high probabilities of adopting end-of-pipe or cleaner technologies, item 3.1.2 (Identification of (re)training needs) identifies the occupations that will suffer the strongest impacts as consequence of new technologies that are willing to be adopted, and therefore, will need appropriate skills programmes.

3.1.1b Analysis which identifies economic activities bound to suffer impacts from the dissemination of cleaner technologies in the next ten years

Another way to identify needs for retraining may be based on models that anticipate the diffusion of cleaner technologies which, in turn, will change the labour market considerably.

SENAI (National Service of Industrial Apprenticeship) has developed alongside with major universities in the country the SENAI Foresight Model. Among other aspects, this model allows SENAI to identify changes in the profiles of industrial workers in ten years. To identify changes in occupational profiles, a technological and organizational foresight needs to be executed (Delphi panel of experts) and an occupational impact analysis (expert panel) realized.

Many of the emerging technologies and organizational forms that have been identified by the SENAI model and that will spread over the next 10 years will cause the displacement of

workers from their duties, a situation that is likely to be more frequent for production workers, who will need to be retrained. Activities such as shoemaking and foundry are among those in which retraining will be intensely required.

The following Item 3.1.2 aims to identify the occupations and positions that will be affected by the adoption of emerging cleaner technologies in the above mentioned economic activities.

3.1.2 Identification of (re)training needs

The identification of needs for retraining used in this study is based on the economic activities described in the previous item. It has considered the following methodological instruments: (a) identification of employments and occupations in specific economic activities that are bound to adopt cleaner technologies, (b) identification of occupations in economic activities that will spread new cleaner technologies, with high probability of being disseminated in the next ten years.

3.1.2a Identification of occupations in economic activities with high potential of adopting end-of-pipe or cleaner technologies.

This analysis allowed the identification of occupations that will go through a retraining process according to the adoption of cleaner technologies determined by the industries. The instruments of study were established as follows:

- i) Once the economic activities with the highest potential of mitigation have been defined by the National Plan on Climate Change, we selected those that have been named at the McKinsey report (2008), such as: agriculture, building, oil and gas, chemicals, energy, ironworks and waste treatment.
- ii) The McKinsey report identifies a range of technologies as having greater opportunities for mitigation. Based on this list of economic activities and technologies, we consulted specialists on the occupations that could suffer the impacts resulted from the diffusion of such technologies. Regarding the Agricultural sector we also used the results of the UNICA report of 2008.

Sector: Agriculture

Technologies: management of pasturages, management of nutrients in pasturages and plantations, improvement of straight plantation and management of waste. Furthermore, as a result of environment questions and technological innovation, the manual work is being substituted by mechanized processes of seeding and harvesting sugar cane. In Sao Paulo, there is a state law that determines the prohibition of burning to be applied until 2021. UNICA and the State of Sao Paulo Environment Secretary, signed a protocol agreeing to advance it to 2014. (UNICA, 2008)

Occupational groups most impacted: Agricultural gramineous workers, including sugar cane workers, agricultural and cattle raising workers in general, as well as those working with mechanization methods, Agronomists, Engineers and Forest Technicians.

Sector: Buildings

Technologies: improvements in lighting systems, exchange systems for heating water in both residential and commercial buildings.

Occupational groups most impacted: Engineers Professionals, Physical and engineering science technicians and Electrical equipment installers and repairs (Occupations: civil engineers,

construction engineers and construction workers of manufacturing operators and general construction workers).

Sector: Oil and Gas

Technologies: energy efficiency programmes, maintenance of compressors, improvements in maintenance and process control.

Occupational groups most impacted: Engineers Professionals, Physical and engineering science technicians and Electrical equipment installers and repairs (Occupations: engineers, architects and other related level technicians in industrial operations).

Sector: Chemicals

Technologies: Engine systems (ventilation, adjustment to national labeling), ethylene cracking, fuel switching, catalyzer optimization.

Occupational groups most impacted: Engineers Professionals, Physical and engineering science technicians and Electrical equipment installers and repairs (Occupations: chemical engineers and chemical technicians, engineers and research and development technicians).

Sector: Cement

Technologies: replacement of clinker by other industrial components (blast furnace slag and ashes), alternative fuels (biomass and waste).

Occupational groups most impacted: Engineers Professionals, Physical and engineering science technicians and Electrical equipment installers and repairs (Occupations: engineer and technician in ironworks, research and development engineer).

Sector: Energy

Technologies: wind, solar, biomass, small hydroelectric plants, large hydroelectric plants.

Occupational groups most impacted: Engineers Professionals, Physical and engineering science technicians and Electrical equipment installers and repairs (Occupations: mechanical engineer, electrical engineer, civil engineer, maintenance technician, electrical engineer and electrical technician, engineers and research and development).

Sector: Ironworks

Technologies: increasing use of renewable energy, increasing energy efficiency, increasing processes and machine efficiency.

Occupational groups most impacted: Engineers Professionals, Physical and engineering science technicians and Electrical equipment installers and repairs (Occupations: metallurgical engineer and ironworks technical work, engineers and research and development technicians).

Sector: Waste treatment

Technologies: direct use of landfill gas, electricity generation in landfills. Occupational groups most impacted: Engineers Professionals, Physical and engineering science technicians and Electrical equipment installers and repairs (Occupations: environmental engineer, recycling specialist, engineers and research and development technicians).

This analysis shows that the most occupational groups (three digit occupational groups in the Brazilian Classification of Occupations) that will suffer greater impact when end-of-pipe or cleaner technologies are implanted in these economic activities, are those that require low and medium skills (Table 1). The consultations at specialists revealed that the occupations directly linked to production will be highly affected in terms of employment. Impacts on higher education professionals and middle level technicians will be particularly noticed upon the incorporation of green qualifications to their job profile

In order to quantify the employments that could exist in the occupations qualified as green, we studied the formal jobs in the Brazilian economy, since those are the ones that approach to the standards required by ILO (including protection and social security). The source from which the data has been recollected is the “Relação Anual de Informações Sociais”. It is a register that all officially established businesses are obliged to fulfill and sent yearly to the Brazilian Ministry of Employment. Regarding the occupations, it has been based on “Classificação Brasileira de Ocupações”.

Table 1. Occupational groups impacted by the dissemination of end-of-pipe or cleaner technologies in industries with great opportunities for mitigation. 2008

Minor groups definitions	Employees
Engineering professionals (excluding electrotechnology)	10,095
Administration professionals	9,405
Physical and engineering science technicians	14,989
Sales and purchasing agents and brokers	17,345
Business services agents	11,747
General office clerks	47,741
Building and housekeeping supervisors	7,955
Street and market salespersons	9,427
Protective services workers	6,317
Sheet and structural metal workers, moulders and welders, and related workers	32,880
Machinery mechanics and repairers	19,269
Electrical equipment installers and repairers	25,868
Metal processing and finishing plant operators	59,805
Chemical and photographic products plant and machine operators	61,058
Mobile plant operators	21,511
Mining and construction labourers	6,412
Manufacturing labourers	59,696
Total	421,520

Source: Relação Anual de Informações Sociais – Ministério do Trabalho e Emprego. 2008

In what concerns the Case Study, a group of agricultural workers have been selected, since they represent a large range of occupational classification (4 digits in the Classificação Brasileira de Ocupações) bearing green requirements. Classified as Gramineous Workers, is the occupation of sugar cane cutters which is a occupation under high impact of the environmental legislation as well as the recent introduction of mechanization in its process.

3.1.2b Identification of occupations in economic activities that will spread cleaner technologies, with high probability of being disseminated in the next 10 years

Among such technologies there is a set of cleaner technologies. With the sole purpose of illustration, we have highlighted some occupations that will be affected by the dissemination of such technologies:

- Moulding and casting workers of melting furnaces and steel (casting sector) will be affected by the spread of robotic systems in production stages.
- Technicians in environmental control (which operate in the casting sector): there will be an increase of the demand for these professionals as a response to a higher number of certification systems for environmental management and due to technologies for reuse of casting waste during the waste treatment stage.
- Shoe finishing workers: will be affected by the spread of clean technologies that reduce waste production in the manufacturing process.

The case study contemplates Shoe finishing occupation, since the footwear industry is going through deep changes required by international competitiveness. The transformation in this activity includes the dissemination of new and cleaner technologies.

3.1.3 Skills response

The responses given by general and vocational educational training vary significantly. Given the diversity of actions, many courses and programmes are developed because they are under the enforcement of the federal law, while others stem from private initiatives, which are associated or not to government institutions.

When it comes to retraining, the actual tendency is that the companies identify together with the vocational educational training institutions, what needs are to be attended, in order to develop specific programmes. Furthermore, this identification can be designed by two types of analysis:

3.1.3a Analysis of the set of occupations concerning green economic activities whose demand will increase

As observed, the level of employment of some economic activities is bound to be affected by end-of-pipe or cleaner technologies. Meanwhile, it is possible to foresee a growth perspective in groups of occupations related to green economic activities depending on governmental investment (item 3.2). Some retraining processes will follow the mentioned dynamic whether workers move to the green economic activities.

3.1.3b Analysis of occupations tending to absorb displaced workers as a result of the introduction of end-of-pipe or cleaner technologies

Employments belonging to occupational groups created by the growth of green economic activities are bound to be fulfilled by the workers displaced from occupations affected by the dissemination of end-of-pipe or cleaner technologies. The groups presenting similar patterns of mobility in the labour market – or sharing the same set of skills – could have priority in the retraining. For instance, take the possibility of relocating an agricultural worker (group with a high probability of growth) in the basis of a retraining applied to sugarcane cutters. Those workers share a similar occupational mobility, as well as knowledge, abilities and attitude. Such study is called occupational cluster analysis, and is defined through the study of an occupational path of a worker (Pero, V.; Caruso, L. 1998)

3.1.4 Case studies

The case studies involve two occupations: sugar cane cutters (classified as farm workers in grass crops) and footwear finishing workers. Sugar cane cutters were chosen because of the impacts this occupation has suffered as a result of mechanized cut as well as the rules that prohibit the burning of sugar cane – a procedure traditionally used to accelerate the cleanup of soil. Footwear finishing workers were chosen because of the introduction of new materials and the use of cleaner technologies, which has enabled the footwear industry to face international competition.

3.1.4a Sugar cane cutters

Some preliminary data (2008): The Sugar cane cutters is an occupation classified in the occupational family Gramineous Workers that have employed 803.690 employees. Age composition: 54 per cent more than 30 years old. Gender composition: 90 per cent male. Education level: 86 per cent elementary education (not complete). Geographical reach: 51 per cent work in the northeast.

The case of sugar cane cutters depicts a situation in which the law indirectly leads to changes in the labour market and, at the same time, the initiative of an organized sector to tackle the issue. In this regard, the Sugar Cane Manufacturers Organization (UNICA), representing companies in the sugar and ethanol sector, states, "Due to environmental concerns and the increasing technological innovation, the manual work is being replaced by mechanized processes of planting and harvesting sugar cane. In the São Paulo state, there is a law that determines the end of sugar cane burning by 2021. UNICA and the Secretariat of Environment of the State of São Paulo signed a protocol (2007) that anticipates the end of burning for 2014. As a result of this process, a significant portion of rural workers, currently involved in sugar cane cutting, will have to migrate to other activities." (UNICA, 2008)

Despite the fact that the business sector has already developed several initiatives to retrain these workers, providing better job opportunities within their own plants or in other segments of the economy, UNICA has created a programme of retraining sugar cane workers, which seeks to retrain up to 7,000 sugar cane and ethanol workers every year by offering courses such as sugarcane driver, harvester-operator electrician, tractor mechanic, beekeeping and reforestation, among others.

Thus, although there is the prospect that the number of farm workers has grown, the number of sugar cane cutters (one of the occupations that belong to the agricultural occupational group) will decline in some areas of the country. Despite the expected expansion of ethanol production, which will require increasing amounts of sugar cane production, the sugar industry will suffer strong restructuring in the labour force because of the advance of mechanization, resulting in the reduction of the labour force tied to sugar cane cutting.

In the case study, we have analyzed the retraining of sugar cane cutters for agricultural machinery operators, one of the occupational categories of farm workers. Interviews were held with representatives of a company and with sugar cane cutters who have undergone retraining courses.

Interview with the director of a sugar cane processing plant:

The Company said that, given the tendency not to realize the burning of sugar cane and the mechanization of the sugar cane cutting process, they tend to reduce the labour force of manual cut. Aware of this and of his own need for qualified professionals to act in their mechanized processes, the company decided to make an investment and identify within its framework of

sugar cane workers those with potential interest in obtaining qualifications as to fulfill the requirements of this new mechanized model.

It is a model that the company has already run for many years and due to legal requirements and voluntary commitment with the state government (eliminating the burning of sugarcane straw), the tendency of mechanization should happen in a very short period. As a result, the company decided to contact the SENAI in Limeira to develop a training programme. The company has identified a demand for professionals to operate tractors, trucks (most of them), and to work on maintenance and some industrial activities -centrifugal operators, extraction operator, vessel operator (sugar).

Interviews with the administrative staff of the sugar plant

In case the company does not have the suitable worker to fill the vacancy, it then goes to search for the suitable one in the market. As the labour market of skilled labour is very scarce, in-house training becomes very important "because you know what you are building". Due to the difficulty in finding high-skilled labour workforce, the company sets up a programme in partnership with SENAI aiming at the training of sugar cane cutters. Hence, the company has a policy of filling vacancies in which it announces the posts available internally so that employees such vacancy.

According to respondents, the "sugar cane field driver needs to work with heavy trucks and one must be skilled to do so: he/she has to be a different driver, because he/she will be driving up and down unpaved hilly steep roads. It is also required that such professional develop strong ties with leaders and machine operators."

The Farm Equipment Operator uses sugar cane harvesters and shipment tractors. "Note that this is a complex work as those machines work side by side and that they are always moving. Security is an issue never to be forgotten and shall be part of their daily routine. The shipment tractor moves in front of the machines while other trucks are kept ready to unload sugar cane. One has to ensure proper cutting of sugar cane and the overall quality. One cannot simply cut and carry dirt all along. In sum, proper procedures require specific techniques. The farm machine operator is not left without cutting cane; however, he just changes the way to do it. "

Interview with workers: first worker

Born in Ceará State, his parents are also sugar cane workers. He has been working for the company for the past four years. He considers himself a classic example once he was about to leave the company when he was offered the training driver course. He filled out the driver registration form (he longed for that), and after completing the course he managed to secure the vacancy ("... and I'm there: not only the service and the work conditions, but also and the quality of the service have improved considerably, and so have the earnings.") At present, this worker is a truck and roadtrain driver that carries chopped sugar cane in the plant.

Interview with workers: second worker

Born in Pernambuco State, he went to work in sugar cane cutting out of necessity ("I am a married man and the family's breadwinner.") He wanted a career change ("but for a career change, one has to invest in it, one has to go for it") and the company's benefits such as market basket, health insurance for the family; the worker has remained in the company. Then the opportunity to take the company's driving course came and he currently holds the post of driver.

Interview with workers: third worker

"My family is from São Paulo State. We are from Leme, where most of my family is. For many generations, my grandfather, my parents, everyone has worked in the sugar cane cutting. We went to school but we were somehow aware that our future would be in the sugar cane fields. We turned on the TV and saw the never-ending story that such a situation would come to an end. So, I knew I had to change, but did not know what direction to take. When we become fathers, the idea of being unemployed is terrifying; we get really scared." Then the opportunity to take the farm machine operator course came. The company provided us with transportation to the training site. The respondent's current expectation lies on job security, "because it is the sector that tends to grow, and it has shown the highest growth rate, if you take the indicators and the everyday news on newspapers and TV, you will see that it is the sugar & ethanol industry that has grown considerably. Nevertheless, once the worker has obtained qualifications after proper training, he will not experience difficulties nor will lose his job."

3.1.4b Shoe finishing workers

Some preliminary data: The Shoe finishing workers have employed 46,948 employees in 2008. Age composition: 81 per cent between 18-39 years old, (2008). Gender composition: 55 per cent female (2008). Education level: 68 per cent elementary and secondary education. Geographical reach: 83 per cent work in the southeast and south region (2008).

The addition of new materials is associated with the composition of different products and it is a way to keep seeking for innovation to the final product aesthetics and performance. For instance, one can mention a combination of leather and synthetic or textile and the monitoring of trends in colors and textures. It will also play an important role on the final product appearance. Moreover, the technological development in the footwear sector will pay special attention to the increasing growth of environmental requirements, and the addition of cleaner technologies tends to occur in parts of the process (recycling and waste treatment) and in the final products (use of cleaner inputs in footwear).

The shoe finishing phase, which employs a large amount of workers, will be affected by these trends. In 2007, there were 24,841 workers in the Brazilian finishing footwear industry. The spread of technologies in products and processes is now occurring. Included are: a) equipment and products that eliminate the process of aspiration/mechanical fixing; b) files that use thermo-transfer adhesives in the bonding phase c) water-based adhesives the bonding process.

Owing to such spread, the displacement of workers can happen either because of unemployment or in order to fill other functions within the company. To see how these processes are occurring in practice, we ran in-company interviews, vocational school interviews, and we also visited a plant whose main activity focuses on the treatment given to waste generated in the manufacturing process of shoe companies.

Interview with Miucha Calçados industrial manager: There are new technologies that generate less waste, such as the machines that make the cut using the Computer Aid Design. Such activity was in the past done with the use of a razor. We have also implemented the use of more distinct and cleaner processes, such as those that use water-based adhesives and thermo-transfer in the bonding phase. "As for thermo-transfer adhesives and aspiration processes, only 7 per cent of workers were affected. The two machines that eliminate the cutting cover 30 per cent of stage-cut. At present, I do not need to model shoes anymore, and we produce 5,000 pairs of shoes on a daily basis, which added a much greater use of raw materials to the process as a whole.

No employee of the company was dismissed as a result of these technologies, yet some have been relocated: the company offers training and workers are being relocated. The company's

philosophy is not to have an employee who knows how to do one thing only but several different jobs. "The company evaluates the employee's profile (a profile of leadership helps the company place the employee as a leader), on-site working time, affinity with the company, and attendance among other factors. Usually people are relocated where the opportunity exists.

Interview with a vocational school principal

Here at the Technology Center we have developed the "Projeto Ecocalçado [Ecoshoe Project], which has been developed since 2004. Since then, the entire manufacturing process is environmentally friendly and all materials used in the footwear manufacture are also environmentally friendly. The school applies the European directives "eco label" to all materials for the manufacture of footwear testing in order that the shoe does not have heavy metals or forbidden substances and therefore be able to meet European environmental standards. This project was developed as a pilot version to work with our students; we obtained a patent for a project developed by the Financiadora de Estudos e Projetos (Brazilian agency for research support) and this technology was developed for three companies here in the region "Calçados Paulina," Ricarely "and" Divalesi.

Interview with Tres Coroas Footwear Union representatives

The Union has developed the Amanhã Mais Feliz Project - Innovative solutions in the allocation of industrial solid waste. This project aims at recycling and reusing footwear waste of companies located in Tres Coroas. The starting point is the Central Screening for Industrial Solid Residues (ISR), which receives 250 tons of ISR per month. These residues are generated by 93 shoe companies, which check, label and press all the material collected. The process is software-controlled, which identifies the origin of each item, pointing whether the companies are making full use of their materials. At any sign of misuse, companies are informed. The Union collects the residues and an extension of the project collects material in schools and local communities.

As of a next step, the waste is sent to recycling companies (68 per cent of the material is recycled), generating income for the Union. Funds are reinvested in the project and in social activities to benefit the local community. There are also environmental education activities that are carried out in schools and communities, handicraft workshops with recycled materials and community garden. According to the experts interviewed, "this is a sustainable development enterprise, ecologically sound, economically viable, socially just and culturally accepted."

3.2 New and changing skills needs

In order to introduce an argument about new green qualifications as well as the necessary changes in the existing ones, we should adopt two complementary approaches: a- study the distribution of green qualifications through occupations, and b- identify green economic activities within Brazilian economy.

3.2a Occupations bearing green skills in Brazilian economy

The concepts used to define green skills indicate that there are skills that cannot be distinguished a priori as belonging to either a carbon economy or a low carbon economy. Skills such as leadership, adaptability, and risk analysis can only be identified as green depending on the economic activity of the company.

There is a set of skills that is more specific, for instance, knowledge of sustainable materials, environmental impact assessment, and analysis of carbon footprints among others. (McGrath, J. 2008). Hogarth (2008) emphasizes the skills for the development of environmental policies, the understanding of policies and scientific and technological advances in the environmental area as being green.

In 2008, the World Watch Institute, sponsored by the United Nations Environment Programme (UNEP), International Labour Organization (ILO), International Organization of Employers (IOE) and International Confederation of Free Trade Unions (ICFTU), developed the following concept: "Green Jobs are those that bring the environmental impact of business and economic sectors to sustainable levels. It involves working in agriculture, industry, services and administration, therefore contributing to maintaining or restoring environmental quality." (World Watch Institute, 2008)

In the workshop organized by Cedefop in 2008, "Future skill needs for the Green Economy," Szovics presents a concept of Green Job as one which helps to preserve and restore the environment, protect ecosystems and biodiversity, reduce consumption of energy, materials and water, decarbonize the economy, and avoid the generation of waste and pollution.

In 2009, under the Green Jobs Programme, the ILO has defined as follows: "These are jobs that synthesize the transformation of economies; the workplace and labour market towards a sustainable economy and provide decent work with low emissions carbon "(ILO, 2009).

The ILO concept is broad enough to encompass the diversity of situations in different countries. It is very suitable to characterize the green jobs in this phase of global transition economies.

Another concept used by the ILO in the same programme also explains the need to work with indirect employment.

"Green jobs include direct employment in manufacturing, installation and operation of renewable low emission energy; however, it also includes indirect jobs in the manufacturing of steel for gearboxes and towers, chemicals used for blades, and concrete for mills." (ILO, 2009)

In any case, it is a must to consider indirect jobs. The technology foundation on which the sectorial dynamics lies determines the logic of processing raw materials into finished products, therefore impacting the environment with different intensities along the chains. Nevertheless, it is necessary to use input-output matrix criteria to identify indirect jobs. Having said that, this criteria also allows the identification of the intensity of current transactions and finds the links that bring more impact over a given supply chain. Another way would be to analyze indirect jobs through the identification of economic activities that contribute to reinforce the carbon footprint of a product, thus, indicating, for example, the total carbon dioxide emitted during the product life from stage as early as production and transportation of raw material until its final disposal (including, if any, recycling and reuse of the product at the end of its useful life). The indirect jobs then identified could be considered working tools for a policy aimed at reducing emissions of greenhouse gases in the economy.

There are other situations that frequently appear in literature, but these are difficult to measure, such as: expanding the infrastructure of Information Technology and Communication, encouraging tele-work and reducing home-work shifts, increasing public transportation options, reducing private transportation, increasing rail freight transport, reducing road freight transport.

Having these references as a backbone, we seek to establish the link with the occupations listed on the Brazilian Classification of Occupations (CBO). CBO adopts the concept of occupational family to designate "a set of occupations that share broad areas of activity. A family may contain several occupations. An occupation is composed of large areas of activities, which are broken down into activities and sub-activities." (Ministry of Labour and Employment, 2002) The current Brazilian CBO was drawn in two steps: a) descriptions of activities performed by the workers themselves; b) these descriptions have been validated by representatives of entrepreneurs

and the workers themselves in a later step. The concept of task in the Brazilian CBO is quite similar to the concept of skill.

As the description of the task was spontaneous (not induced) we believe it is quite significant that workers declare that they carry out tasks associated with the environment or recycling. Hence, we consider greening the occupational family that has at least one occupation related to the environment or to recycling, or that has at least one professional task that bears these characteristics.

In order to measure the quantity of employments in the occupations having green skills, we have accounted the formal employments registered in the “Relação Anual de Informações Sociais”, published by the Ministry of Labour and Employment.

We have identified 67 occupational families that fit these two criteria among 596 occupational families (11 per cent). This figure reaches 4,751,435 jobs and accounts for 12 per cent of overall formal employment in 2008 (39,441,566). Thus, it is possible to conclude that the dissemination of green skills in the Brazilian economy reaches 12 per cent. These occupations are related in Annex 2 (Table B). We notice that nearly 50 per cent of occupations are linked to agriculture (farm workers in grass crops - 16.91 per cent; farm workers in general - 14.91 per cent; workers that support agriculture - 9.77 per cent; workers in mechanized agriculture - 4.74 per cent). It is worth noting that Health and Environmental protection professionals represent 3.5 per cent of the total, or 165,872 workers, that include occupations related to monitoring the environment and monitoring the implementation of environmental legislation.

The green skills are spread throughout several economic activities. The influence that its workers might have over the environment depends on the way of acquisition of the skill (if formal, not formal or informal) as well as the procedures and technologies adopted by the company.

The changes that might occur in the degree of the dissemination of green skills in the economy is related to: the way companies are going to adopt cleaner technologies; the environmental legislation; the capacity educational institutions will demonstrate in offering green skills.

3.2b Green economic activities within Brazilian economy

In order to identify green economic activities in Brazilian economy, we verified how this discussion is being developed at OECD (Organisation for Economic Co-operation and Development). Afterwards we defined the criteria and then identified occupations representing 75 per cent of employments in the green economic activities supposed to show higher growth in the next 5 years.

In the long term, many green economic activities will converge from technologies such as nanotechnology and biotechnology. As a result, there will be new occupations and many occupations will either be transformed or simply disappear. However, in this transition phase, boundaries are sometimes very tenuous between economic activities belonging to a carbon economy when compared to those that are part of a low carbon economy. Depending on the concept used to define such economic activities, the amount of green jobs may vary considerably. The next step is to present some definitions to assist us in conceptualization.

That will allow recognizing which economic activities can actually be considered as belonging to a low carbon economy in Brazil. In order to do so, we will go through, a brief presentation of some concepts that have been studied at the EU, so that it can enrich the necessary basis for the conceptualization of economic sectors in Brazil.

In 1997 the OECD presented a proposal that states that "sustainable industry includes the production of goods and services ranging from the use of equipment for end-of-pipe pollution control, clean technologies, to technical and professional recycling services." The relationship of economic activities in the proposal can be summarized as follows: liquid waste treatment; recycling and solid waste management; air pollution control; noise pollution control; environment monitoring and assessment; environmental services; research and development in the area of environment; Eco-tourism.

Another approach is found in ECORYS (2008) establishing a comprehensive typology comprising the following relations between economy and environment: the environment as a resource for economic activity, economic activities related to environmental management, economic activities that depend on the quality of the environment. Although the core concern of the study is not to characterize the green economic activities, it raises some important clues to identify such activities, for example, the emphasis on those related to environmental management, which in a sense already appeared in the OECD's 1997 list.

As the dynamics of the economic activities influence the technologies diffusion, and have a decisive influence on the ways to mobilize worker's skills, we aim to identify criteria that are applicable to the classification of economic activities of enterprises. To the extent allowed by the Brazilian Classification of Economic Activities (CNAE), the framework for economic activities such as green economic activities was then designed.

Thus, considering the above discussion on this in the literature and interviews with specialists, the economic activities that contribute to reducing emissions of greenhouse gases or help to preserve the environment in the Brazilian economy have been identified based on the following criteria:

- Economic activities associated with the generation, transmission and distribution of cleaner energy. Ex: generation, transmission and distribution of electric energy, manufacturers of equipments for distribution and control of electrical energy
- Economic activities related to environmental quality. Ex: dam up water, cleaning and distributing it, activities in botanic and zoological gardens, national parks, ecological reserves and protected areas.
- Economic activities to avoid costs; ex: treatment and disposal of waste (dangerous or not), recycling metallic, plastic and other materials. Ex: maintenance of vehicles, automobiles, rail motors, vessels and aircrafts.
- Economic activities associated with fuels based on renewable sources. Ex: ethanol or biofuels.
- Economic activities associated with changes in transport matrix. Ex: manufacture of vessels and floating devices, locomotives, wagons and other rail material, bicycles and rail cargos.
- Economic activities associated with sequestration of carbon dioxide. Ex: forest production – reforest process, production of seeds and seedling, as well as other forms of certified vegetal propagation.

Table A (Annex 2) presents the results of applying these criteria in the National Classification of Economic Activities (CNAE). As most of the information gathered came from secondary sources of data and the classifications used in these sources were not designed to feature a green economy, we had to work with successive approximations. The same occurs in other countries: "green skill data is poor." (ECORYS, 2008; Executive Office of the President of the United States. 2009).

In 2008, the number of employees in companies listed as performing green economic activities reached 1.405.001. This amount represents the number of the green jobs from a

technical point of view and represents 3.6 per cent of the total formal employment generated by the Brazilian economy in that year. Between 2006 and 2008, employment in green economic activities grew at an annual rate of 7.9 per cent. At the same time, employment in economic activities that producing oils based on renewable resources grew at a annual rate of 15,7 per cent (Table 2).

Table 2. Employments in green economic activities

Criteria	Employees 2006	Employees 2008	Annual average growth
Renewable based fuel source	80,403	107,735	15.7
Avoided costs	386,424	471,763	10.4
Clean energy	296,868	343,655	7.6
Changes in transport matrix	134,605	155,012	7.3
Environmental quality	180,714	193,043	3.3
Carbon sequestration	128,096	133,793	2.0
Total	1,207,110	1,405,001	7.9

Source: Author's calculation based on data from *Relação Anual de Informações Sociais*, 2008

Considering the investments under the Programme of Action for Growth and Multi-Year Investment Plan (both from the federal government sphere) in sectors associated with a low carbon economy, those that will present sound growth over the next 5 years are the ones whose foundations lie on cleaner energy and fuels based on renewable sources. Furthermore, it is estimated that the recycling sector (classified as avoided costs) will present an annual growth rate of 7.4 per cent from 2003 to 2014. This is an estimation from the SENAI Foresight Model, that considers a macroeconomic estimation of production and employment, resulting from a final demand variation, including investment and government expenses among other variables.

We have studied a occupational structure, considering the main occupational groups (three digits in the Brazilian Classification of Occupations) in order to figure out the occupations that will suffer greater impact in the labour market of the following economic activities: fuels from renewable sources, cleaner energy and recycling – Table 3.

Table 3. Occupational groups associated to green economic sectors representing greater growth potential for the next 5 years

Minor groups	Employees 2008
Administration professionals	14,552
Agricultural, forestry and fishery labourers	198,790
Assemblers	12,643
Electrical equipment installers and repairers	125,904
Electronics and telecommunications installers and repairers	82,132
Engineering professionals (excluding electrotechnology)	23,425
General office clerks	80,633
Machinery mechanics and repairers	77,581
Manufacturing labourers	16,683
Mining and construction labourers	110,267
Mobile plant operators	35,546
Other stationery plant and machine operators	37,000
Physical and engineering science technicians	56,295
Sheet and structural metal workers, moulders and welders, and related workers	37,000
Total	908,452

Source: Author's calculation based on data from *Relação Anual de Informações Sociais, 2008*

3.2.1 New green collar occupations

In order to identify new green collar occupations, we have studied the occupations belonging to the recycling industry. The recycling industry presents a high growth level in consequence of the environment legislation and is classified as avoided costs, absorbing the largest quantity of workers among those described in Table 2.

Recycling has been organized nationally and internationally as an economic activity. And as such, it is becoming an important sector in terms of income generation, employment and technology. Like all other sectors of the economy, recycling has been subject to strong technical, economic and environmental regulations. The recycling plants value products that have reached the end of their lives. The materials contained therein have gained great prospects in the market and shows broad growth and globalized potential. This new scenario requires organizational efforts according to the nature of all products and materials involved.

In the recycling sector, the work processes are heterogeneous, reproducing the changes it has gone through. These processes are constituted by low-skilled occupations such as garbage collectors and very complex occupations such as "design for recycling vehicle" and recycling specialist. Those are going to be detailed in item 3.2.3.

3.2.2 Greening existing occupations

In order to identify the occupations that will add green skills in the future, we first identified the economic activity supposed to suffer greater impact from environmental legislation. Then, the changes on occupations have been described.

In Brazil, environmental legislation is the main drive that brings direct and indirect impacts on occupations and skills. Direct impacts occur when environmental legislation points directly to occupations that need to go through vocational educational training processes. In the public sector, among the occupations under impact, as we will see in the next item, the position of Environmental Protection Professionals is willing to be the most representative.

In general terms, the environmental legislation implies the need for a reduction in emissions and the optimization of resources. Indirect impacts occur when the legislation requires the adoption of end-of-pipe or cleaner technologies in some economic activities, which creates the necessity of new occupations and skills.

The economic activities that have greater opportunities for mitigation (as described in item 3.1) besides being the central point of specific policies and programmes have a set of end-of-pipe or cleaner technologies that can reduce emissions. The dissemination of such technologies could significantly affect some occupations and skills.

Among those economic activities we highlight the Building sector, since it will present an important economic growth considering public and private investment destined for it. There also exists a programme intending to expand the building of popular houses with solar panels (Programa Minha Casa, Minha Vida). In November, 2009, a report has been issued by The National Council on Economic and Social Development giving support to the use of solar heating in order to create a sustainable agenda in the building programmes concerning low income population. A growth of installation and maintenance of solar panels will demand vocational educational training for new workers and the development of new skills for a set of occupations in the building sector.

Other economic activities have received indirect impact from the National Plan for Suppression of CFC. The Plan established through a Multilateral fund for the implementation of the Montreal Protocol, a system of regeneration of CFC's enabling that the actual existing amount is recollected, recycled, regenerated and reused. The Plan also foresees new skills for refrigeration mechanicals, through vocational educational training programmes. Besides, government launched a Programme of Replacement and Promotion of access to efficient refrigerators, including regulations intending to support manufacturers of white line to invest in products consuming low energy and no CFC.

Other economic activities to be highlighted are paper and cellulose. Though it has been indicated in the First Brazilian Inventory of Gas Emissions causing Greenhouse Effect that the emissions of this economic activities are acceptable and the energy use is based on renewable fuels, specialists considered it a result of the environmental legislation. The National Policy for Hydric Resources caused great impact in the set of skills and occupations for these economic activities. We will therefore, analyze the position of Hydric Resources Manager.

3.2.3 Identification of skill needs

Once the economic activities have been identified, the next step was to identify (a) new occupations and (b) analysis of changes in skills of existing occupations.

3.2.3a New occupations

Our first procedure is to analyze the National Solid Waste Policy. We focused on the aspects related to the "analysis the product life cycle (technical survey of the aspects and potential environmental impacts associated with the product life cycle); product life cycle evaluation (study of the consequences of environmental impacts on human health and environmental quality as a result of the product life cycle); integrated management of solid waste (actions aimed at finding solutions to solid waste considering the political, economic,

environmental, cultural and social aspects, with broad participation of the society in accordance with the premise of sustainable development), reverse logistics (instrument of economic and social development characterized by a set of actions, procedures and methods that facilitate the collection and recovery of solid waste from their generators. Hence, they are treated or recycled into new products that will become new inputs either in their cycle or as part of different cycles. The main objective is the non-generation of waste) (Bill 2007).

Moreover, the best outlook for growth of recycling as an economic activity lies in the automotive industry and in end-of-life vehicles, which have large contents of useful material both in quantity and diversity. This sector has been consolidated in the world and even in Brazil, owing to external pressure imposed by environmental legislation and corporate social responsibility. However, at present, quality in the automotive recycled material is still poor, which prevents the recycling sector from addressing to their initial functions, one of the strongest international trends in the industry. The recycling of vehicles and auto parts is a cross-sectional activity that takes place both inside and outside the automotive sector. Indeed, it is necessary to build a new chain based on reverse logistics with participating automakers and their suppliers, as well as companies in other industries that are potential consumers of recycled materials.

Considering the potential impacts of the National Solid Waste Policy bill in the skills profiles for the automobile industry, which presents great perspective of recycling, we will identify occupations that are bound to establish and spread within the labour market. Next, we performed thorough in-house research. The work of Naveiro and Medina (2009) on the recycling sector has drawn our attention significantly. We then consulted one of the experts responsible for the study (Ricardo Naveiro), what led to the choice of Eco-conceived designer position, to be our case study.

The automakers are aware that from now on, we need to continuously innovate in order to produce in a "cleaner" way, using cleaner materials and more recyclable and less polluting processes. In either case, you can find the environment variable, which can be the reduction of materials or energy applied in the product manufacturing and/or the improvement of the product recyclability at the end of its life. The Eco-conceived Vehicle Designer (or a professional who performs such functions in the company) is a new green occupation with growth potential and consolidation in the labour market.

Another occupation that has been suggested for case studies is that of Recycling Specialist, who matches supply and demand of waste for companies that need other sources of steady and homogeneous raw material. Such professional is able to identify new processes and even new products from recyclable materials. At present, he can be found in waste and recycling related companies. After consulting two specialists from the recycling sector (Bucco and Ávila, Annex 4) a paper recycling company has been chosen. It is an activity with a very high growth potential in urban centers due to the fact that 40 per cent of domestic waste in developed countries is composed of paper (CETESB, 2008).

3.2.3b Analysis of changes in the skills of existing occupations

To identify changes in the skills of existing occupations, we have studied the economic activities that suffered direct or indirect impact due to environmental legislation

The direct impacts were observed in occupations such as environmental engineers and environmental technicians, followed by occupations associated with environmental control and supervision: environmental analyst, environmental projects analysts, forest protection and environmental monitoring officer, fishing inspection officer, environmental tax fiscal officer, forest officer environmental guard, park rangers and farm inspector. In some items of the legislation the position of Environmental Protection Professionals is mentioned due to its actual relevance. That is the reason why it has been chosen for the case study.

A governmental programme called “My house, my life”, created to reduce the housing deficit, has been launched during the recent economic crisis. It presents a sustainable agenda that includes energy efficiency and rational use of water, by doing so it already impacted skills in the building sector. According to ABRAVA, there will be a intense creation of jobs associated to manufacturing, installation, administration and selling of solar heating. In order to settle the panels, different skills are required depending on the size and position of the building. Therefore, according to ABRAVA, one of the skills that might present unbalanced offer and demand is precisely solar panels installers, which has been chosen for the case study.

One of the actions of the National Programme of Replacement and Promotion of the Access to Efficient Refrigerators originated the formation of refrigeration between GTZ (Germany) and SENAI. In this sense, SENAI with the support from the German Cooperation Agency (GTZ its acronym in German), capacitates workers of the refrigeration area with the objective to guide them into the new techniques and solutions to replace the CFC gas with others that wouldn't affect mechanics that work removing the pipes of CFC gas, giving them the appropriate destination. The formation of these refrigeration mechanics were promoted by a partnership the ozone layer.

Another activity to be highlighted is cellulose and paper, because of its intense use of hydric sources in its processes. The Federal constitution of Brazil establishes that: The State ought to “institute a national system of management for hydric resources and define the criteria that allow its use”. The institutional order is an instrument to manage hydric resources regarding its property and use. In this matter, there are several governmental organizations and NGOs working with this subject. Companies from the cellulose sector are preparing to value the impact of the use of water. Such evaluation includes the use of soil and water, as well as the definition of hydrological basin as a reservoir. In this context, some new skills are required from professionals currently working in the administration of companies in this sector. Naturally the position of Hydric Resources manager is being transformed and presents intense growth potential.

3.2.4 Skills response

The offer of skills can be divided into two spheres: a) skills offered as a consequence of environmental legislation, and b) supply of skills as a consequence of the demand perceived by training institutions.

3.2.4a Skills offered as a consequence of environmental legislation

We can state that the provision of skills as a direct consequence of environmental legislation focusing onto preparing professionals to work in environmental control and monitoring is supported by CENTRE (Human Resources National Development and Training Center), which is linked to the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA), the Chico Mendes Institute for Biodiversity Conservation and National Support Center for Forest Management – CENAFLO, which is linked to the Brazilian Forest Service.

The Environmental Protection Professionals, one of the occupations listed in careers in the environmental area, is linked to the control and monitoring of the environment. Once they join the civil service, they participate in the Environmental Analyst Training Course, which is run by the CENTER.

The skills supply for social actors who are involved in activities for sustainable forest management is vital to the sustainability of certain areas, mainly in the Amazon region. This is of vital importance for the reduction of deforestation and creation of conditions for sustainable use of forest resources.

This skills supply is coordinated by the National Center for Support to Forest Management – CENAFLOR - and aimed at "strengthening sustainable forest management through actions to support the increase and training of local leaders, public administrators, environmental state and federal agencies technicians, rural and timber industries unions, community associations, forest workers and entrepreneurs in the wood and timber sector (CENAFLOR, 2008).

3.2.4b Supply of skills as a consequence of the demand perceived by vocational educational training institutions

The provision of skills as a result of the vocational educational training institutions work can be noticed in the actions of the SENAI, SENAC and other public and private institutions. In this case, the provision of skills depends on mechanisms used by these institutions to identify their needs.

At times, these institutions are called to participate in certain activities, such as the Programme of Replacement and Promotion of the Access to Efficient Refrigerators. The Ministry of Mines and Energy, the Ministry of Development, Industry and Commerce, in association with manufacturers and retailers created the Programme of Replacement and Promotion of the Access to Efficient Refrigerators. The programme aims to replace 10 million obsolete refrigerators, in ten years time, with a reduction of more than 7 million tons of tCO₂ and a removal of 5 million tons of CFC.

The Programme originated the formation of refrigeration mechanics that work removing the pipes of CFC gas, giving them the appropriate destination. The formation of these refrigeration mechanics were promoted by a partnership between GTZ (Germany) and SENAI.

Beside those two types of offer, we could mention 29 occupational groups belonging to green economic activities that are bound to present higher growth perspective in the next five years (fuels based on renewable resources, cleaner energies and recycling). If on one hand those occupational groups are to be taken into account when a policy of vocational educational training is defined since they are the ones that might contribute to lower a carbon economy, on the other hand, the employment growth in those occupational groups will be a parameter to retraining workers that might have been displaced from other industries due to the use of end-of-pipe or cleaner technologies.

3.2.5 Case studies on new green collar occupations

As before mentioned, two occupations will be discussed in the case studies: designer of eco-conceived vehicles and recycling specialist.

3.2.5a Designer of eco-conception vehicle

Two team leaders were interviewed in the designing area of the company (Annex 4).

According to the interviewees, the first criterion that the company uses to make the process of designing the vehicle is associated with the legislation of the country of operation. From that on, the company makes all the developments turned to the engineering design. When talking about eco-conception, the first aspect to be taken into account is the regulations associated with the environment of the country of operation. As there is a worldwide inclination that these regulations become developed worldwide, the company works today focused on worldwide projects.

The need of new professionals to accomplish tasks of eco-conception will depend on the development of the legislation and the consumer market (the costumer begins to have a different view of the manufactured product with an ecologic standpoint). The evolution of the professional

development inside the manufacturers, in terms of environment, is based on the regulations and market requirements.

The company is based on a very large ecological responsibility and attempts to anticipate the market. Based on this focus, we will have in the next years professionals specialized on recyclability and reuse of materials applied to vehicles manufactured by the company. Currently, this professional is called Engineer of Products with ecological focus.

The Engineer of Products with ecological focus is the Materials Engineer that gives support to areas that make the specific application of the parts and has a very strong formation in knowledge related to: Science of materials (structure and behavior of materials); Foreign languages; Mechanical Engineering; Materials Engineering; Chemical and Metallurgical Engineering; Professionals who have post graduation and who have in their formation specific subjects concerned with material recycling.

This professional can work in the industry of Aeronautics, Automotive, Auto parts (which works simultaneously with engineering on project development), Fine Chemistry (which is a very specific industry) and, sometimes, can work in some applications of the Pharmaceutical Industry.

According to the interviewees, “we have a big lapse on the formation of these professionals, because the educational system doesn’t prepare professionals for the labour market but to become an academic. We have excellent teachers, the majority with doctorate degree and post-doctorate degree, we do well in pure research, but in the applied research field we are very weak. For example, we have a problem with the recyclability of the laminated glass for windscreens and I find it difficult to propose projects to the universities because they don’t always have interest in conducting any kind of specific applied research. We don’t have difficulties implementing the environmental policies, because this is a very modern factory built with focus on the eco project. We have an internal project of Ecological Responsibility which has a huge social responsibility, focused on sustainability. In addition, we have environmental monitoring, which is made by an environmental specialist who does all the checking on influents and effluents in the materials laboratory, because the factory uses a lot of water and returns it to the river cleaner than it was before”.

There is also a big array of questions related to the eco-design inside the manufacturer, where the design professionals have done the work and also made specific training in the materials chain, making sure that the whole project from the clipboard and the initial concept of the designing drawing of the car itself be a project that focuses on the reuse and the environment.

3.2.5b Recycling specialist

A recycling specialist from the company Piazzeta - waste paper trading - was interviewed.

The company collects materials for recycling, which can be requested through the Internet (the collect is done only when the amount of materials is over 300 kg). The trade is what sustains the recycling companies in terms of volume and quality of paper, in particular packaging (shoe boxes, office supplies). The advantage of this material is that they come clean, tidy and secured.

When the material arrives at the company, its classification is done manually in order to obtain a better quality in the separation of the types of leftovers. There are many types of paper and they are difficult to separate, which is to say that the workers who select the materials need to know the composition of the papers. However, this knowledge comes with practice. As always have more non-recyclable materials added to papers, it is difficult to identify and classify (a lot of plastic and other products are added), it is often necessary to appeal to professional analysts to identify the paper’s composition.

Those who work in the area of trade must have practice in materials separation, personal nimbleness and also be updated on the technology of paper and recyclable fibers industry.

Currently, there is no training for this type of professional, who could be denominated recycling technician. The basis of this formation process is environmental education and marketing knowledge, and could be trained in other professions such as the environment, quality or work safety technician, or either originated from the administrative areas. According to the interviewed, “the perspective of this professional in the market is excellent and it could become better if the environmental policy were better set up. However, this professional will only become proficient with the practice in recycling, as it’s necessary to know deeply the market of recyclables and be able to identify the quality of the existing leftover in order to make good negotiation. Currently, there is no institution that offers the skills for these professionals to work as recycling specialists.”

3.2.6 Case studies on greening existing occupations

Considering the fact that we have identified at least 67 occupations that are going through the incorporation of green skills, to choose the ones that would compose the case studies, we had to consider the expected impact on the end-of-pipe technologies and cleaner technologies diffusion, associated to environmental policies. The selected occupations are: a) environmental protection professionals, b) solar panel installers, c) refrigeration mechanics; d) administrator with water resources management function.

3.2.6a Environmental protection professionals

Some preliminary data: environmental protection professionals have a very meaningful number of people employed (165,872 in 2008), and more than 90 per cent of them have a work contract in the statutory regime and are therefore mostly public servants. Age composition: 45 per cent between 25-39 years old, 44 per cent between 40-64 years old (2008). Gender composition: 56 per cent female (2008). Education level: 60 per cent secondary education. Geographical reach: 29 per cent work in the northeast region, 34 per cent in the southeast region, and 15 per cent in the middle-west (2008). At least three of the seven specific objectives of the National Plan on Climate Changes will have an impact on their professional profile.

The current denomination of the position is Environment Analyst and, in accordance with the present legislation, the occupants of the environment analyst position are responsible for: “the environmental, organizational and strategic planning to accomplish the national environment policies formulated by the Union, especially the ones related to the follow activities: regulation, control, inspection, licensing and environmental auditing; management; protection and environment quality control, ordering the forest resources and fisheries; maintenance of ecosystems and their specimens, including their handling and protection; improvement and dissemination of technologies, information and environmental education.” (Law 10.410/02, article 4°)

One of the interviews, held by the Executive Manager of Monitoring and Auditing of the Brazilian Forest Service, revealed that almost 90 per cent of the environmental analysts hired after 2002 are forest and environmental engineers and, in a smaller proportion, biologists and geographers.

In the past, according to the advisor of the Executive Bureau of the Ministry of Environment (the first inspection director of IBAMA), these professionals were generically regarded as IBAMA Inspectors. At that time, many of them had little schooling and were not prepared to perform the duties of the position. Their knowledge resulted from practice, reporting also the fact that, to recognize the wood that had been cut illegally it was necessary to use a professional (he was retired at that time) who was a master at recognizing any type of wood in Brazil.

According to the interviewee, "because of the population growth, the pressure on wetlands in the northeast, the deforestation caused by agricultural activities and the actions of wood and steel industries which do not abide by the law, which requires that 70 per cent of the charcoal used in their activities are based on planted forests, the political-institutional frame of the agency was modifying and demanding professionals with another profile. The technological development, such as GPS, also contributed to improving the work of inspection and monitoring, enabling the geo-referencing of the concession areas and sustainable forest handling. You can even, in some cases, anticipate the actions of deforestation by tracking the evolution of the records made by satellites."

Currently, as mentioned before, the Environmental Analyst who enters the public service is formed at the National Center of Development and Empowerment of Human Resources – CENTRE, linked to the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA).

Some companies also have these professionals on their staff, such as VALE. The environmental area of VALE is aimed at the sustainable economic development, which means, to respect the limits of natural resources. "A professional from the environmental area builds a better future for future generations, seeking to balance the action of man when producing wealth from nature." (Margarida Miranda, Environmental Analyst from Vale, in EcoDebate, 9 October 2009)

The environmental professional from VALE develops and applies technologies to protect the environment from the damage caused by human activities. His main duty is to preserve the quality of water, air and soil. He accomplishes studies of environmental impact, proposing solutions that seek the rational use of natural resources. He elaborates and implements plans, programmes and management projects of water resources, sanitation, waste treatment and recovery of infected or degraded areas. He can also deal with the study of many energy sources and the evaluation of the energy potential of a region. This professional can also work with environmental license, waste and water resources management, taking care of emergency circumstances and environmental management projects.

3.2.6b Solar Panel Installers

Those workers are classified as installers of electric equipment. The largest part of them (105,078) work in the building sector. Age composition: 49 per cent between 25-39 years old, 44 per cent between 40-64 years old (2008). Gender composition: 98 per cent male (2008). Education level: 58 per cent secondary education. Geographical reach: 17 per cent work in the northeast region, 54 per cent in the southeast region, and 16 per cent in the middle-west (2008).

A representative from the Brazilian Association of Refrigeration, Air Conditioning, Ventilation and Heating (ABRAVA) and a representative from a school for vocational training institution that offers courses for solar panel installers were interviewed.

The representative of ABRAVA indicated that the elaboration of projects for solar panel installation needs a professional such as an engineer or a technician in order to measure the size and position of the panels.

According to the representative from the school, the course of Solar Heating System Installer aims to enable the student to handle and install the solar heating equipment and its respective supports. This course has existed since 1998, and, initially, the application of panels was made in small buildings and then was introduced to large constructions and industries.

A combination of factors incremented the use of these equipments: legislation (a Decree from the Government of the Sao Paulo State was published stating that 30 per cent of the

consumed energy in each household had to be from an alternative source); people's awareness; technological advancement, and cost reduction of the equipment.

The professional that practices activities of solar panel installation needs to be an hydraulic installer and know: hydraulic principles, types of piping (cold and hot water), basic principles of electricity (to work with digital controllers, pumps, digital panels); how to use auxiliary or support systems, such as making connections with gas heaters, electric resistance, heat pumps, boilers, steam or diesel boilers, or other types of heating; skills to handle equipments for soldering copper pipes, work with pipes and fittings of random polypropylene. With regards to his professional conduct, this type of worker must be aware of the need for safety (he will be working at heights and roofs).

The future perspectives for this professional are the best available as "here in Sao Paulo, after the Law, in any quarter there is a new construction or renovation with a solar heating installation and, in 5 years time, this professional will be very necessary."

3.2.6c Refrigeration Mechanics

Those workers are classified as installers of electric equipment. The largest part of them (17,665) work in commerce and in the building sector. Age composition: 50 per cent between 25-39 years old, 23 per cent between 40-64 years old (2008). Gender composition: 98 per cent male (2008). Education level: 60 per cent secondary education. Geographical reach: 15 per cent work in the northeast region, 58 per cent in the southeast region, and 17 per cent in the south (2008).

Two school representatives and a refrigerator mechanic were interviewed.

According to the interviewees of the school, the activities of Collecting and Recycling of Cooling Fluids, which are substances that destroy the ozone layer, were implemented in the school to initially attend the Montreal Protocol. The country has a schedule to prohibit this fluid after a transition stage when the fluid can be used if it is recyclable, and will finally ban the usage of this kind of cooling fluid. Brazil is going to meet the Kyoto Protocol when we are also worried about global warming and the cooling fluid called GWP - Global Warming Potential. This school is already going to the second step and has projects with ammonia, a natural fluid (with a global warming potential close to zero), with carbon dioxide, and with another natural fluid, isobutene. In addition, the school has its eyes focused on the "reverse manufacturing" of refrigerators.

The second interviewee, a professional that has done the Good Practice of Refrigeration course (Proklima), revealed that one of the main skills that the course brings is the destinations of the cooling fluids: "We knew it had to be collected, but the ones who collected it did not know what to do with it; keep it or sell it if it was in good conditions, and others even released it into the atmosphere, thinking it wouldn't cause any harm. From the moment we do this training, we start to know where to allocate these cooling fluids. Brazil works with two types of destination: Collection Centers and Regeneration Centers. The Regeneration Centers are distributed as follows: two in São Paulo, one in Rio de Janeiro, and one in Bahia. In the rest of Brazil, there are Collection Centers that carry the fluids to the Regeneration Centers to make a kind of purification/cleansing to reuse them."

3.2.6d Administrator with water resources management function

Those workers are classified as managers of production and operations in the extractive and transformation industry. The largest part of them (72,427) work in rubber goods manufacturing; food and beverage; chemical products: machinery and equipments; textile; cellulose and paper. Age composition: 47 per cent between 25-39 years old, 47 per cent between 40-64 years old (2008). Gender composition: 83 per cent male (2008). Education level: 40 per cent secondary

education, 60 per cent superior education. Geographical reach: 79 per cent work in the south and southeast region (2008).

An administrator working as a water resources manager from the company FIBRIA S/A was interviewed. According to the interviewee, the professional who works in this area has an involvement not only with water resources, but also with the biotic element and with socioeconomic as well as with licensing questions and plantation certification. "So, we deal with the biotic element, socioeconomic conflicts and water resources."

The license has been structured in a more orderly way in 2006, when monitoring related to water resources issues was established. There are also demands for certifications as to check if the economic activity could cause some water deficit in the region, which is one of the fears that some communities have. Thus, the administrator has to act in the translation of technical knowledge and evaluations that are made for each region, seeking for a dialogue both in the direct way between the company and the community, such as in the Water Basin Committees. "The premise of the Water Law is the management of conflicts. It starts with the premise that there are conflicts regarding the water use and this determines the need for negotiation, which entails a range of social and production interests, and the demand from the society inside the water basin that need to be reconciled."

To perform these functions, the professional needs knowledge of hydrology, water basins and legislation. It's essential to develop dialogue and communication skills because that's what will enable the professional to use such expertise in the forums in which he will participate.

He can be graduated in: Forest Engineering, Agricultural Engineering, Civil Engineering, and Geology. There is also a very strong participation of the staff from the Law area, because of the legislation. "The technical area professional has to search for such knowledge, to be able to make this link, and the Law personnel have also to run after the technical issues."

4. Conclusions

The diffusion of a cleaner range of technologies is conditioned to a paradigm change – from a carbon economy to a low carbon economy – where changes are necessary in the institutional framework that regulates and sustains the economic activities, refocusing on educational and science and technology politics and the integration of environmental policies with other areas (Kemp and Soete 1992a).

In this sense, the environmental legislation, the governmental mechanisms for valuing natural resources, the consumer pressure and the international agreements work as factors to induce the adoption of cleaner technologies, accelerating the transition to a low carbon economy. According to Kemp and Soete (1992a), the transition to a new paradigm goes through the “overcoming technical, economic and institutional barriers since the new paths did not yet get benefits from dynamic scales and learning effects and because the environment selection is adapted to the old regime.”

The data found in this report lead to conclusions concerning a set of factors willing to contribute for a transition period in Brazilian economy towards a low carbon economy. The first point to be considered is the definition of what is a Green Job in Brazilian economy. In order to measure the quantity of Green jobs in Brazilian economy, one should establish a logical interpretation of the demand. In order to do so, I propose that we explore a supposition: There are only two economic activities in Brazil, the first one is considered green (I): clean energy, for instance. The second one is not considered green (II): chemicals, for instance. If we also suppose that there are only two occupations: all the skills that occupation A have are Green; while occupation B does not have a Green skill. Workers of this hypothetical economy are proportionally distributed in both activities and occupations: 50 per cent for each case.

The conclusion is that all jobs in the Green economic activity (I) are green. Thus, the final result of the economic activity prevails over the nature of such occupations and skills. Two consequences are to be considered then: all jobs of the occupation B are considered green, even do not show a Green skill, because are related to a green economic activity; and no Green Jobs exist in a economic activity not considered Green (II), even if occupation A present green skills.

Thus, to be considered a Green Job, according to this interpretation, it is necessary that the job itself belong to a green economic activity. As the environmental legislation as well as the incentives and sanctions are directed to economic activities, the growth of economic activities in the market represents growing of green jobs. Using such interpretation and consulting data from year 2008, there were then, 1,405,001 green jobs in Brazilian economy, what comes to a 3.6 per cent of the total formal jobs of that year.

However, when this survey has been concluded there was no consensus among employers, workers and government, on the definition of a Green economic activity. We accomplished a consultation with these agents and the result found, although indicative, was very significant (Questionnaire 12, Annex 3):

- According to what was stated in Table 2, after consulting the worker’s representative agency (DIEESE; Brazilian workers agency), recognized as green, the activities that reduce carbon. By doing so, we reached the rate of 9.5 per cent corresponding to the jobs identified as belonging to green economic activities. The concern of the workers’ agency is clearly associated with how to avoid and eliminate environmental impacts.

- According to what was stated in Table 2, after consulting the employers' representative agency (ABIMAQ), recognized as green the activities classified as "avoided costs". By doing so, we have reached the rate of 66 per cent of the jobs identified as belonging to the green economic activities. Though, the agency was sceptical with a few activities, since they considered that there is a need to carry out international agreements, because without them we could have, for example, the exportation of scrap from developed to developing countries like Brazil.
- According to what was stated in Table 2, after consulting the consulted government agency (MMA), recognized as green the activities associated to environmental quality. By doing so, we have reached a rate of 14 per cent of the jobs identified as belonging to the green economic activities.

Thus, the consultation revealed that there is no common perception between the government, employers and workers on what turns out to be a green economic activity, what led to the conclusion that the amount of green jobs in Brazilian economy, according to a general perception changed during 2008, from around 134,000 workers to 470,000 workers. It is, therefore, still necessary to deepen the debate over the concept of a green economic activity in Brazilian economy, in order to direct investments, incentives and sanctions.

On the other hand, considering the interpretation that the economic activity determines what a green job is, it actually does not take into account the processes of fabrication, technologies and occupational skills that cooperate for the greening of a economic activity. Though workers are not able to modify the final result of the economic activity itself, there is a set of attitudes, knowledge and abilities that are associated to environmental questions that can also contribute to mitigate environmental impacts.

For the purposes of the Brazilian case, we consider greening the occupational family that has at least one occupation related to the environment or to recycling, or that has at least one professional task that bears these characteristics. We have identified 67 occupational families that fit these two criteria among 596 occupational families (11 per cent). This figure reaches 4,751,435 jobs and accounts for 12 per cent of overall formal employment in 2008 (39,441,566). Thus, it is possible to conclude that the dissemination of green skills in the Brazilian economy reaches 12 per cent.

This estimation demonstrates that there is a significant amount of workers bearing a Green skill in their professional activity. So, if we should incorporate green skills in the curricula of vocational educational training institutions, the process of transition to a low carbon economy would accelerate.

Development and diffusion of cleaner technologies being a fact that turn economic activities greener, specialists consulted for this report, indicated that the basis for such development resides in nano and biotechnologies. However, the dependence on technological trajectories is a factor that heavily influences the economic decisions to adopt cleaner technologies. Thus, it is necessary to identify the factors that contribute to overcoming the dependent trajectories and accelerate the transition process.

One conclusion of this study is that the environmental legislation is the main factor that contributes to the transition of the Brazilian economy to a low carbon economy. As a development of this conclusion, we realized that, although the environmental legislation is a strong component of this transformation, some of the environmental issues need to be addressed globally.

Brazil has a very well-structured environmental legislation and institutional mechanisms to implement such transition. As the use of lands and forests is the major emitter of greenhouse gases, there are lots of specific mechanisms aimed at solving this problem. At the same time,

there is a set of laws and programmes for the other economic sectors, particularly the industrial one.

Regarding the use of lands and forests, we can highlight two types of actions: the first is to restrain, inhibit and prevent the practice of deforestation and encourage the reforestation. There is a set of laws aimed at this activity, where the control and inspection occur normally under IBAMA's coordination. The second type of action seeks to create a new culture for land and forest usage, through sustainable forest management and biodiversity conservation, which are coordinated by the Brazilian Forest Service and by the Chico Mendes Biodiversity Conservation Institute.

The reduction of greenhouse gases in the industry sectors are induced mainly by the environmental legislation and the companies, in order to comply with it, adjust themselves to the procedures and adopt technologies.

Currently, almost all countries have environmental laws and policies. However, these policies are not only part of a very heterogeneous whole, but also adequate to the national context of each country. In this sense, we verified that the policies proposed by the OECD (2008) suggests that the adoption of standards that avoid, reduce or mitigate the emission of greenhouse gases is done by all countries in the bloc. This is because some dilemmas and challenges need to be faced by all countries to ensure the success of these policies. We can illustrate this point with an example: as much of the main energy source of OECD countries is based on fossil fuels, one of the guidelines approved by the member countries is to change it, expanding the energy generation based on renewable resources (solar, wind, among others) and reducing the dependence on petroleum. Thus, as the price of petroleum would tend to reduce gradually in the coming years, those countries that did not perceive a bigger benefit than the costs of changing would not feel encouraged to change their main energy source (OECD, 2008).

This same reasoning should apply at a global scale, which means that it's important that the advances in the Brazilian environmental legislation somehow have a reference from the international agreements so we can deal with similar dilemmas as those found in the example above.

Besides the legislation, we must consider that the initiatives from some Brazilian companies, expressed in the search to reduce the emission or mitigation of its effects, also contribute to the acceleration of the transition process to a low carbon economy.

From the standpoint of the demand for green occupations and skills, the environmental legislation presents both a direct and an indirect effect. The direct impact occurs in the occupations related to control and inspection; in order for such occupations to be performed under the requirements of the legislation, the State needs, among other actions, to hire and prepare professionals. The indirect impact occurs when the companies, to accomplish the legislation, must change procedures and adopt technologies, which results in changes in the occupations and skills.

The organization of the skills supplies can be done by using this same reasoning: the training for occupations related to control and inspection is provided in the environmental legislation. In the production system case, the training provision depends on the perception and responsiveness of the public and private schools. This response takes place because the changes on the occupations and skills are due to the adoption of new procedures and technologies to accomplish the environmental legislation and vary significantly from economic activity, region and company.

We know that the skills imbalance between supply and demand can compromise the economic and social development and also affect the unemployment and wage rates. Throughout

this study, it was not possible to obtain sufficient information to indicate any eventual imbalance between supply and demand for green jobs. The classic indicators used – wages behavior and unemployment rate – is not statistical significance in the necessary disaggregation levels for this analysis.

To overcome the imbalances between the supply and demand for qualifications, the vocational training institutions are implementing long-term parameters, intending to anticipate the changes in the labour market and the target public behavior. The reason for that derives from the time of the students learning and the time required for the maturation of investments made by the technical, vocational, educational and training institutions in infrastructure, teaching methods, educational resources and teacher training. We can verify an example of this action form in the Cedefop work, which systematically seeks the imbalances identification between supply and demand for occupations, using parameters of the future. (Cedefop, 2008, 2009).

Although we have shown in this study no systematic estimation of variables that interferes with the future behavior of the demand for occupations, there is a trend that points to an increase in the green occupations demand. We can add some other reasons for this tendency: a) the expected acceleration of international agreements, development of business on the Clean Development Mechanism (MDL) and mechanisms of Reduction of Emission by Deforestation and Degradation (REDD); b) the planned investments in the Growth Action Programme and the Multi-Year Investments Plan (both from the federal government). Among the sections that will present a strong growth in the next five years, the cleaner energy and the fuel based on renewable sources sections are associated with a low carbon economy.

Considering these movements, we can expect that the increase in the demand for green occupations could be verified in all levels of skills. If this increase actually takes place the current institutional occupations supply will resent from a labour market information system capable of providing information about the future behavior of relevant variables that influence the green skills demand.

Finally, the interviews revealed that there is a huge diversity of governmental actions in the environmental area:

- a) The Ministry of Labour and Employment has several programmes that contribute to the purpose of environment preservation;
- b) The Ministry of Environment acts decisively to make the use of forest resources sustainable and to regulate the emission of greenhouse gases from all the other sections of the economy;
- c) The Ministry of Education has a strong base work on environmental education in all levels of teaching and presents a significant offer to Environmental and Forest Engineering courses;
- d) Many other Ministries and governmental agencies have actions related to the environment.

Many actions are triggered within the government and the private sector. It is noticed that there is a series of institutional mechanisms inducing the formulation of plans and programmes in the environmental area. However, it is still necessary to strengthen the institutional exchange of knowledge generated during the implementation of such plans and programmes, it would, hence, lead to better results and the optimization of the resources.

5. Recommendations

Recommendations are presented by subject.

5a. Recommendations associated with the environmental legislation

- Monitoring of national environmental legislation.
- Monitoring of international environmental legislation.
- Follow up of trends of application of the Clean Development Mechanism
- Follow up of the mechanism of Reduction of Emissions by Deforestation and Degradation (REDD).

5b. Recommendations to make new estimates for the green jobs

We used different methodological approaches to estimate the number of green jobs and skills from secondary sources and consultations with specialists. Through the consultations with specialists, it was possible to identify a group of occupations that would be impacted by the legislation and by the diffusion of some cleaner technologies. Through the secondary sources, we came to the following estimates: Occupational groups impacted by the dissemination of cleaner technologies in industries with great opportunities for mitigation. 2008 (Table 1); Employments in green economic activities (Table 2); Occupational groups associated to green economic sectors representing greater growth potential for the next five years (Table 3).

- Deepen the studies to know how the skills will effectively be modified by an analysis of technological impacts and procedures that will be introduced in the production processes.
- Identify which are the end-of-pipe technologies and the cleaner technologies that could spread in the economic activities with great mitigation opportunities; develop strategies to facilitate and stimulate the diffusion of these technologies (technological information and technical and technological support services); anticipate the impact that these technologies will bring to the workers professional profile in order for their training process to be put in practice in rapid fashion.
- Consider the indirect jobs in the calculation of green jobs. The technological foundation on which lies the dynamic sector determines the logic of transforming the raw materials into finished products and impacts the environment with different intensity along the productive chains. To identify the indirect jobs, it is initially suggested the use of technical.

Carry out activities involving different actors in order to amplify the consensus on what comes to be a green economic activity, which will facilitate the formulation and the effective adoption of policies and will also help to accelerate the transition process.

- Identify specific green qualifications in all economic activities.
- Make an estimation of green jobs, considering those that occur in the context of payments for environmental services (“Almost all payments for existent environmental services are associated with one of the four categories: carbon retention or collection; biodiversity conservation; hydro-services conservation and scenic beauty conservation.”) (Wunder, 2009)

5c. Recommendations for the qualifications supply

- The occupations that satisfy the core competences of the activity sections that are likely to grow more (cleaner energy and fuels based on renewable sources) could be prioritized in a training strategy in order to accelerate the transition to a low carbon economy.
- Amplify the offer of engineers, technicians and electrical equipment installers and repairs, after the identification of the work contents related to the environment. These occupations are at the intersection of a green economic activity with the economic activities with great mitigation opportunities.
- The expansion of the skills offer presents a difficulty related to the professional training institute's capacity of attracting and retaining good professional education teachers aimed at the environment area.
- Review the professional profile of some occupations, because the case studies showed that there is a tendency of some existent skills in the environmental analyst position migrating to other occupations such as the ones associated with the development of environmental policies, comprehension of policies and scientific and technological advances in the environment area.
- Set a training strategy to the two new occupations identified: designer of eco-conception vehicle and recycling specialist. Therefore, it is suggested that the development of the following activities be taken into consideration: identify the institutional format which sustains or will sustain each one of these occupations; verify the attribution field that they will share with other professions; map the perception that different workers have of these new professionals; conduct a detailed study on the professional profile and potential demand.
- Jobs generated by the growth of green economic activities may be filled by different types of workers, among them those displaced from occupations that were or will be affected by the cleaner technologies diffusion. The occupational groups that present occupational mobility standards equivalent in the labour market or share the same set of knowledge, abilities, and aptitudes could be prioritized in training process.

Work for the purpose of TVET (Technical and Vocational Education and Training) policies design, with a core of occupations, formed by the intersection of occupations that are green and belong to green economic activities and economic activities with great opportunities for mitigation. These occupations, connected to occupational groups of engineers, technicians and electrical equipment installers and repairs, should have their profiles more detailed, from the perspective of the environment.

5d. Recommendations to reduce the chances of imbalances occurrence between skills supply and demand

- Make a large survey of the green skills offer and create a system of permanent follow up of this offer;
- Identify possible impacts from prospective studies (identification of the future diffusion of emerging technologies and new work organization formats, as well as analysis of the impact of this diffusion in professional profiles) and create alert mechanisms for the professional training institutes.

5e. Complementary recommendations

- Follow up the consumer market behaviour and create indicators that show the consumers preference tendencies for green products and services.
- Define and monitor the performance of a Brazilian company's panel that is at the forefront of incorporating end-of-pipe technologies and cleaner technologies.

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Annexes

Annex 1. Details of Plans and Programmes (item 2.2)

A) Plans and Programmes associated with the specific goal 1

The Brazilian Elaboration Programme of Voluntary Industry Inventories - GHG Protocol: The Brazilian GHG Protocol Programme aims to build technical and institutional capacity of business and public sections representatives in Brazil with the intention of analyzing and managing the emissions through sources and removal through sinks of greenhouse gases via the development and dissemination of inventories, based mainly on the Greenhouse Gases Protocol – GHG Protocol and the ISO Rule standards, as well as methods described by the IPCC (Intergovernmental Panel on Climate Change).

National Plan for the CFC Elimination: Drawing on resources deriving from the Multilateral Fund for the Montreal Protocol implementation, the PNC established a system of collection and recovery of CFCs, allowing part of the present stocks of equipment to be collected, recycled, regenerated and reused, avoiding then the emission into the atmosphere.

National Logistic Transportation Plan: The National Logistic Transportation Plan of the Ministry of Transportation deserves distinction in the transportation section, and it aims to “make changes in the cargo transportation matrix of the country, associated to a more intensive and adequate use of the trains and waterways. Thus, the transportation section could contribute for Brazil’s reaching economical, social and ecological marks, towards a sustained development.”

National Policy on Solid Waste: The National Policy on Solid Waste has the following guidelines: public health and environmental quality protection; non-generation, reduction, reuse, recycling and treatment of solid waste, as well as its final environmentally adequate destinations; development of processes that seek to change the patterns of production and sustainable consume of products and services; adoption, development and enhancement of environmentally healthy technologies as a way to minimize environmental impacts; encouragement of the use of raw materials and inputs derived from recyclable and recycled materials; integrated management of solid waste; joint between the different spheres of the Federal Government, aiming at the technical and financial cooperation for integrated management of solid waste; regularity, continuity, functionality and universal provision of public services such as urban sanitation and management of solid waste, with the adoption of managerial and economical mechanisms to ensure cost recovery for services rendered in order to guarantee their operational and financial sustainability; preference, in the governmental acquisitions, for recyclable and recycled products; transparency and social participation; adoption of practices and mechanisms which respect to the local and regional diversities; integration of recyclable materials collectors in the actions that involve the flow of solid waste and environmental education. (National Policy on Solid Waste, 2007)

B) Plans and Programmes associated with the specific goal 2

National Energy Plan: Expansion of the hydroelectric generation; Incentive programme to alternative sources of electricity (PROINFA); Energy purchase auctions proceeding from alternative sources; Transmission expansion; Electricity for all programme; Nuclear energy expansion; Solar photovoltaic expansion; Use of urban waste for energy purposes; Industrial policy for efficient equipment and renewable technologies; Energetic use of biomass; Use of wood waste for energy purposes; Brazilian labeling programme; National Programme of electricity conservation PROCEL; National programme to rationalize the use of petroleum and

natural gas; Energy efficiency programme of the distribution agencies; Energy efficiency law; Substitution and promotion to the access of efficient refrigerators programme; Incentive programme for the use of solar water heating; Efficient public purchases decrees; Voluntary labeling of the efficiency level of commercial, service and public buildings; Strategic programme of energy efficiency; Cogeneration in the Brazilian industrial section; Petroleum production and exploration; Natural gas: production increase and network expansion.

C) Plans and programmes associated with the specific goal 4

Action Plan to Prevent and Control the Deforestation in the Legal Amazon (PPCDAM), which has the following specific goals: reduction of deforestation and forest fire rates in the Brazilian Amazon, especially in terms of illegal practices that generate significant environmental damages and social problems; reduction of illegal appropriation of public lands in critical areas, associated with illegal deforestation; reduction of illegal wood exploration rate, associated with an expressive growth in the forest management for wood and non-wood products; increase in the adoption of fire prevention and control practices, pasture management and sustainable agricultural and agro-forestry practices among rural producers; significant reduction in the percentage of rural properties with environmental liabilities regarding the Legal Reservation and Permanent Preservation Areas, associated with an increase in the number of cases in observance of the Conduct and Adjustment Terms and the number of degraded areas recuperation practices; progress in achieving rural settlements on sustainable basis for the Brazilian Amazon, with significant implications for reducing deforestation; progress in the creation and implantation of conservation unities and indigenous lands in priority areas as fundamental elements of a forest conservation strategy and the sustainable development of the Amazon; increase in the institutional capacity of environmental agencies and other partner institutions, including the civil society, for the integrated implementation of deforestation prevention and control standards, and the viability of sustainable productive activities.

Policies of mitigation, adaption, research, development, innovation and communication to the Caatinga: Forest Management of Multiple Usage (Wood and Non-wood Forest Products); Improve of the Energy Efficiency in coal production ovens (improved oven) and in the plaster and ceramic calcinations industries; Conservation and Sustainable Use of natural resources Actions in Ecological Corridors; Identification of existent fomentation mechanisms and support on the creation of new ones; multisectorial strengthening, in both governmental and non-governmental sections that work in the conservation area and the sustainable use of biodiversity; systematization and dissemination of the demonstrated good practices, as well as the creation of a Data Base to serve as a reference for the knowledge on the Caatinga.

Annex 2. Tables

Table A. Economic green activities: Number of employees 2008

ISIC	Description	Employees
200	Forestry, logging and related service activities	82,474
240	Support services to forestry	52,376
2011	Manufacture of basic chemicals	108,586
2710	Manufacture of electric motors, generators, transformers and electricity distribution	60,564
2732	Manufacture of other electronic and electric wires and cables	25,065
2733	Manufacture of wiring devices	9,794
2829	Manufacture of other special-purpose machinery	3,835
3011	Building of ships and floating structures	26,970
3020	Manufacture of railway locomotives and rolling stock	3,103
3092	Manufacture of bicycles and invalid carriages	5,775
3311	Repair of fabricated metal products	2,680
3312	Repair of machinery	58,057
3313	Repair of electronic and optical equipment	94,432
3314	Repair of electrical equipment	7,815
3315	Repair of transport equipment, except motor vehicles	12,837
3319	Repair of other equipment	3,322
3510	Electric power generation, transmission and distribution	248,349
3520	Manufacture of gas; distribution of gaseous fuels through mains	2,598
3600	Water collection, treatment and supply	118,965
3700	Sewerage	36,178
3710	Recycling of metal waste and scrap	8,336
3720	Recycling of non-metal waste and scrap	19,666
3811	Collection of non-hazardous waste	74,382
3812	Collection of hazardous waste	965
3821	Treatment and disposal of non-hazardous waste	21,709
3822	Treatment and disposal of hazardous waste	1,961
3900	Remediation activities and other waste management services	1,156
4220	Maintenance and repair of motor vehicles	23,467
4520	Maintenance and repair of motor vehicles	165,081
4540	Sale, maintenance and repair of motorcycles and related parts and accessories	3,090
4912	Freight rail transport	21,169
4911	Passenger rail transport, interurban	26,267

ISIC	Description	Employees
4930	Transport via pipeline	877
5011	Sea and coastal passenger water transport	1,118
5012	Sea and coastal freight water transport	8,792
5021	Inland passenger water transport	5,335
5022	Inland freight water transport	45,732
8130	Landscape care and maintenance service activities	9,250
9103	Botanical and zoological gardens and nature reserves activities	2,873
Total		1,405,001

Table B. Occupational families in greening processes

ISCO 2008 Code	ISCO 2008 Title	Employees	Per cent
6114	Mixed crop growers	805,976	0.170
9.213	Mixed crop and livestock farm labourers	708,389	0.149
7233	Agricultural and industrial machinery mechanics and repairers	577,886	0.122
8153	Sewing machine operators	504,288	0.106
9211	Crop farm labourers	467,067	0.098
7.523	Metal working machine tool setters and operators	308,902	0.065
2.320	Vocational education teachers	174,770	0.037
2.133	Environmental protection professionals	165,872	0.035
7.212	Electrical mechanics and fitters	143,243	0.030
3.111	Chemical and physical science technicians	108,003	0.023
9212	Livestock farm labourers	93,160	0.020
2.142	Civil Engineers	85,497	0.018
3139	Process control technicians not elsewhere classified	84,036	0.018
7421	Electronics mechanics and servicers	59,345	0.012
8.154	Bleaching, dyeing and fabric cleaning machine operators	47,853	0.010
2.141	Industrial and production engineers	35,035	0.007
8.112	Steam engine and boiler operators	34,393	0.007
2.631	Economists	34,319	0.007
3.133	Chemical processing plant controllers	30,454	0.006
8143	Paper products machine operators	27,340	0.006
2149	Engineering professionals not elsewhere classified	24,254	0.005
3131	Power production plant operators	22,194	0.005
9611	Garbage and recycling collectors	18,751	0.004

ISCO 2008 Code	ISCO 2008 Title	Employees	Per cent
3.132	Incinerator and water treatment plant operators	18,158	0.004
9313	Building construction labourers	17,354	0.004
1.311	Agricultural and forestry production managers	16,242	0.003
2.131	Biologists, botanists, zoologists and related professionals	15,907	0.003
3.112	Civil engineering technicians	14,443	0.003
2.145	Chemical engineers	11,949	0.003
3152	Ships' deck officers and pilots	9,988	0.002
7231	Motor vehicle mechanics and repairers	9,651	0.002
8.211	Mechanical machinery assemblers	8,922	0.002
3.143	Forestry technicians	8,273	0.002
3135	Metal production process controllers	7,630	0.002
2.113	Chemists	7,507	0.002
9215	Forestry labourers	7,189	0.002
2.114	Geologists and geophysicists	6,165	0.001
8181	Glass and ceramics plant operators	5,954	0.001
7523	Woodworking machine tool setters and operators	5,702	0.001
8112	Mineral and stone processing plant operators	5,094	0.001
1.120	Managing directors and chief executives	3,758	0.001
3.115	Mechanical engineering technicians	3,623	0.001
9216	Fishery and aquaculture labourers	2,685	0.001
3134	Petroleum and natural gas refining plant operators	2,542	0.001
1223	Research and development managers	1,025	0.000
3.142	Agricultural technicians	647	0.000
Total		4,751,435	1.000

Annex 3. Questionnaires

Questionnaire 1: Sugarcane Cutters

Company Leaders

1. What changes have been occurring in the “Sugarcane cutters” profile?
2. Which factors have been causing these changes (incentive police on the ethanol production, technological implementation and innovation)?
3. With the advance of the sugarcane cut mechanization, what is the average percentage of demobilization of “Sugarcane cutters”? And what is the average percentage of professional who are directed to integrate requalification actions?
4. The accomplishment of the requalification programme for “Sugarcane cutters” was the result of which factor (corporate policy, governmental incentive focused on the workers requalification, negotiation with employers or employees representative entities)?
5. What is the profile of these “Sugarcane cutters” professionals reclassified on “Agricultural Machinery Operators and Drivers”: (age, education, and other prerequisites)?
6. What are the organizations involved in the requalification programmes definition (company, governmental agencies, universities, professional training institutions, representative organizations – employers and employees)?
7. Does it have any research/diagnosis to support the formation of the requalification programme of “Sugarcane cutters” to “Agricultural Machinery Operators and Drivers”?
8. Does the company have any difficulties to develop the requalification programme? What kind of difficulty?
9. What are the programme characteristics (work time, contents, professionals who minister it)?
10. Any partnership with other institutions? What are the responsibilities of each institution in the programme execution?
11. What is the return for the company with the requalification programme?
12. What is the return for the professionals who participate in the requalification?
13. What is the labour market growth expectation of this professional in the next 2 (two) years?

Questionnaire 2: Sugarcane Cutters

Professional

1. How did the professional become a “Sugarcane cutter” (origin, formation)?
2. What is the prospective that the professional had on keeping his job if he didn’t have the requalification activity?
3. What is the prospective related to the course for “Agricultural Machinery Operators and Drivers?”
4. Which are the criteria to participate in the requalification course?
5. Did the professional have difficulties to do the course for “Agricultural Machinery Operators and Drivers”?
6. What is the return of the requalification (better work conditions, others)?
7. What is the future expectation regarding the occupation of an “Agricultural Machinery Operator and Driver?”

Questionnaire 3: Shoe Finishing Workers

Company Leaders

1. What are the company motivations for adopting cleaner technologies and less polluting products/insumes (governmental incentive and/or consequence of the application of the specific legislation for environment preservation)?
2. Since the introduction of the cleaner technologies, what percentage of “Shoe Finishing Workers” was redirected to work with these new process and products?
3. How is this requalification organized (institution, partnership, knowledge, clients, others)?
4. Once identified the need of requalification, which requalification programmes have been developed to the “Shoe Finishing Workers” (to work with the new technologies/products or in new areas)?
5. How is the requalification programme for “Shoe Finishing Workers” accomplished?
6. What are the necessary prerequisites for the worker to participate in this requalification?
7. What are the technical competences offered by the requalification programme?
8. What is the level of difficulty that the “Shoe Finishing Workers” have to perform the new activities?
9. Are these technical competences offered to other professionals of the company? Which ones?
10. What knowledge, abilities and attitudes are given to these professionals?
11. What are the benefits for the company with the requalification of these professionals?
12. What is the professional training institutions involvement in the requalification programme?
13. What is the return for the professionals that participated in the requalification (better work conditions, others)?
14. What is the expectation regarding the labour market growth for this professional in the next 2 (two) years?

Questionnaire 4: Designer of Eco-conception Vehicles

Company Leaders

1. At what criteria has the company been identifying the need of “Designers of eco-conception vehicles?”
2. From which processes and products does the company feel this need, which means, how does the company work to identify the need of new professionals?
3. How does the company describe the professional that works as a “Designer of eco-conception vehicles”?
4. Which professionals can perform the function of “Designer of eco-conception vehicles?”
5. What are the specific characteristics of the occupation (activities, knowledge, abilities, conduct)?
6. Which sections and market niches these professionals work or may work? (for example: automobiles, airplanes, or other durable consumable goods).
7. Which other knowledge, abilities and attitudes this professional will need to continue performing this profession in the future? Will this profession have new developments? Which ones?
8. What is the growth potential for this professional in the labour market?
9. What is your evaluation about the education and professional qualification system potential to training this professional?
10. Have the politic responses to the relevant environmental questions regarding the materials or energy reduction and the improvement of the product recyclability at the end of its life been adequate? Why?
11. What are the company difficulties to apply the environmental policies in the production process?
12. Once identified the new occupational profile, how is the Professional Training organized (institution, partnership, knowledge, clients, others) ?
13. Which other occupations/formations can be the sustainable basis for this occupation?
14. What is the labour market growth expectations for this professional in the next 2 (two) years? Would it be suitable an specialized training?

Questionnaire 5: Refrigeration Mechanics

Professional Training Institute

1. Have the activities of gas change in refrigeration equipments already meet its goal?
2. Which professionals were required in the market to perform the demand activities of refrigeration equipment changes in the commercial and home refrigeration section: Electricians or Refrigeration Mechanics? What is the best denomination for professionals that perform these activities? Justify.
3. More specifically, what are the professional profiles engaged to these activities?
4. What is the initial formation needed?
5. Which are the activities, knowledge, abilities and attitudes performed by this professional?
6. Are the activities performed today different from the previous ones?
7. Can the new profile for this professional (Mechanic and/or Electrician) be classified as an ecological profession (The greening of existent occupations)? Why?
8. What are the returns for these professionals (better work conditions, environmental conscience, others)?
9. Have the “National Training Programme for Refrigeration Mechanics” been implemented in all the Federation States? If positive, is the programme similar in other states? Has the programme been updated and how often? What is the prevision for the end of the Programme?
10. What are the possible developments for this programme?
11. What is the labour market growth expectation for this professional in the next 2 (two) years?

Questionnaire 6: Refrigeration Mechanics

Professional

1. How was the selection to participate in the programme? How the need to participate in the programme was defined? What are the functions that have been developed?
2. What is your prior professional formation before this training, Electrician or Mechanic?
3. What is the greatest incidence of professionals who have participated in the training programme: Electrician or Mechanic?
4. Which are the activities, knowledge, abilities and actions performed today?
5. After the completion of the course, what are the differences in the work performance?
6. Is the Refrigeration Mechanic aware of the importance of his activities (the change of refrigeration that avoids the emission of gases that destroy the ozone layer)?
7. Which professional improvements this professional obtained with the completion of the course (improvements in the work conditions, environmental conscience, others)?
8. Does the gas change on refrigeration activities have a market in the future?

Questionnaire 7: Administrator with Water Resources Management Function

Professional

1. What is your initial training for professionals who work as an “Administrator with Water Resources Management function”?
2. What are the characteristics of an “Administrator with Water Resources Management function”?
3. Can the professional profile of an “Administrator with Water Resources Management function” be found also in the public administrations or in other places?
4. What are the differences and similarities of these professionals in relation to the other professionals in this area?
5. What are the activities, knowledge, abilities and attitude needed for the development of this function?
6. What is different between this group of activities, knowledge, abilities and attitudes and the other administrators that perform environmental management functions in other companies?
7. Based on the initial profile, what are the qualifications that can be considered new, i.e., specific for the function performance?
8. How long have you been in this profession?
9. Which courses (qualifications) have to be made to assume the position/function responsibilities?
10. What are its components that are more related to environmental issues?
11. What is the level of difficulty that the professionals have to carry out the activities related to the job when they assume this position of Administrator of the water resources management?
12. Are these technical competences offered to other professionals in the company? Which ones?
13. How will this occupation evolve in the future?
14. What is the labour market growth expectation for this professional in the next 2 (two) years?

Questionnaire 8: Solar Panel Installers

Professional Training Institution

1. Is there any programme in a state or national level for training the “Solar panel installers”? If positive, are the programmes similar in the other counties/states? Has the programme been updated and how often? What is the prevision for the end of the Programme?
2. What is the profile of the professionals who perform these activities? What is the initial formation needed? What are the activities, knowledge, abilities and attitudes performed by this professional?
3. Can this professional profile be classified as an ecological profession (The greening of existent occupations)? Why?
4. What are the returns for these professionals (improvement in the work conditions, environment conscience, others)?
5. Once identified the need of a specific professional for the solar panel installation activity, how did the companies forwarded the formatting of qualification programmes?
6. What are the new competences that will be demanded for this professional?
7. How and with which institution was established partnerships for the course implementation?
8. What is the growth prospective for the solar panel installation activity?
9. What is the labour market growth expectations for this professional in the next 2 (two) years?
10. How and with which Institutions were defined the partnerships for the “Solar panel installers” training?

Questionnaire 9: Recycling Specialist

Company Leaders

1. Have the companies identified the need for “Recycling specialists”?
2. Who are the “Recycling specialists” (initial formation needed, what is the new knowledge, abilities, attitudes needed to the function performance)?
3. What are the gaps (other knowledge, abilities and attitudes) that these professionals would have to acquire considering the technology advances and the search for a cleaner production?
4. What is the best denomination for these professional activities? Justify.
5. Is this profession already delineated and recognized in the labour market? If positive, is it easy to find this “professional” in the labour market? Which other professionals can work or may work as “Recycling specialists”?
6. What is the growth prospective of this professional in the labour market?
7. Was the emergence of activities that originated the mentioned professional a result of any specific legislation?
8. Have the political responses to the related environmental issues been adequate? Why?
9. What are the difficulties of the companies to apply the environmental policies in the recycling process?
10. Once identified this new occupational profile, how is the Professional Training organized? (institution, partnership, knowledge, clients, others)

Questionnaire 10: Recycling Specialist

Professional

1. What are the functions, activities, knowledge, abilities and attitudes of the Recycling Specialist in the company?
2. What is your original formation?
3. Is this original formation sufficient to perform the required activities for “Recycling specialists”? Why?
4. What are the gaps (other knowledge, abilities and attitudes) that this professional needs to acquire considering the technology advances and the search for cleaner products? And which other knowledge, etc, are still necessary to be acquired?
5. How is this occupation/profession denominated in the companies? What is the characteristic of this occupation? (section, new knowledge)
6. Which factor influenced in the choice of this occupation/profession?
7. Has this choice been satisfactory? Why?
8. Will this professional have a specialized training in the future?
9. Which other occupations/formations could be a sustainable basis for this occupation?
10. Which institutions offer professional training for professionals engaged in the occupation of “Recycling specialist”?

Questionnaire 11: Environment Analyst

Governmental Agency

1. Around which period/decade this professional has been requested in the labour market?
2. Which legislations have bigger impact for the emergence of “Environment agents”?
3. What are the qualifications that the Environment Agent needs to perform the duties relevant to the position?
4. What is the professional profile specificity of the Environment Agents?
5. Where do the Environment agents work?
6. What are the activities, knowledge, abilities, attitudes needed to perform this function?
7. Based on the initial profile of these professionals, which qualifications can be considered new, i.e., specific for the function performance?
8. What is the difficulty level that professionals who work as Environment agents have to perform the activities related to the job?
9. What is the return for professionals who work as Environment agents (salaries, improvements in the work conditions, environment conscience and others)?
10. How can the preservation actions developed by the “Environment Agent” evolutes?
11. Is there still a labour market growth expectation for this professional? (Specify closing a timeline of 2 (two) years).

Questionnaire 12. Worker's perception about the green economic activities

ISIC	Description	Employees	I totally agree	I partially agree	I partially disagree	I totally disagree
200	Forestry, logging and related service activities	82,474				
240	Support services to forestry	52,376				
2011	Manufacture of basic chemicals	108,586				
2710	Manufacture of electric motors, generators, transformers and electricity distribution	60,564				
2732	Manufacture of other electronic and electric wires and cables	25,065				
2733	Manufacture of wiring devices	9,794				
2829	Manufacture of other special-purpose machinery	3,835				
3011	Building of ships and floating structures	26,970				
3020	Manufacture of railway locomotives and rolling stock	3,103				
3092	Manufacture of bicycles and invalid carriages	5,775				
3311	Repair of fabricated metal products	2,680				
3312	Repair of machinery	58,057				
3313	Repair of electronic and optical equipment	94,432				
3314	Repair of electrical equipment	7,815				
3315	Repair of transport equipment, except motor vehicles	12,837				
3319	Repair of other equipment	3,322				
3510	Electric power generation, transmission and distribution	248,349				
3520	Manufacture of gas; distribution of gaseous fuels through mains	2,598				
3600	Water collection, treatment and supply	118,965				
3700	Sewerage	36,178				
3710	Recycling of metal waste and scrap	8,336				
3720	Recycling of non-metal waste and scrap	19,666				
3811	Collection of non-hazardous waste	74,382				
3812	Collection of hazardous waste	965				
3821	Treatment and disposal of non-hazardous waste	21,709				
3822	Treatment and disposal of hazardous waste	1,961				
3900	Remediation activities and other waste management services	1,156				
4220	Maintenance and repair of motor vehicles	23,467				
4520	Maintenance and repair of motor vehicles	165,081				
4540	Sale, maintenance and repair of motorcycles and related parts and accessories	3,090				
4912	Freight rail transport	21,169				
4911	Passenger rail transport, interurban	26,267				
4930	Transport via pipeline	877				

ISIC	Description	Employees	I totally agree	I partially agree	I partially disagree	I totally disagree
5011	Sea and coastal passenger water transport	1,118				
5012	Sea and coastal freight water transport	8,792				
5021	Inland passenger water transport	5335				
5022	Inland freight water transport	45,732				
8130	Landscape care and maintenance service activities	9,250				
9103	Botanical and zoological gardens and nature reserves activities	2,873				
	Total	1,405,001				

Annex 4. List of interviewed specialists

I) Specialists consulted in phase 1 of the study

- Vicente Andreu Guillo – Secretary of Water Resources and Urban Ambient of the Ministry of Environment
- Samyra Crespo – Secretary of Articulation and Environmental Citizenship of the Ministry of Environment
- Ezequiel Sousa do Nascimento – Secretary of Public Employment Policies of the Ministry of Labour and Employment
- Clemente Ganz Lúcio – Technical Director of the Inter Union Department of Statistics and Socio-economic Studies
- Joel Delgado – Technical Director of the Brazilian Association of Machinery and Equipments
- Rachel Trajber – General Coordinator of Environmental Education – Ministry of Education
- Paulo Sergio Muçouçah – ILO Brazil
- Sergio Travassos - ILO Brazil

II) Specialists consulted about the classification of economic activities into green activities

- Clemente Ganz Lúcio – Technical Director of the Inter Union Department of Statistics and Socio-economic Studies
- Silvano Silvério da Costa – Director of the Department of Urban Ambient. Ministry of Environment
- Daniel Gustavo Casemiro da Rocha – Brazilian Association of Machinery and Equipments - ABIMAQ
- Marcelo Mesquita – Manager of the Department of the Solar Warming of the Brazilian Association of Refrigeration, Air Conditioning, Ventilation and Heating – ABRAVA.

III) Specialists consulted for occupations that incorporated green qualifications

- Alexandre D'avignon – Institute of Economy, Federal University of Rio de Janeiro.
- Paulo Tigre – Institute of Economy, Federal University of Rio de Janeiro.

IV) Specialists consulted for new occupations

- Ricardo Naveiro (COPPEE, Federal University of Rio de Janeiro)
- Luiz Henrique Bucco – SENAI Consultant of the Tocantins State.
- Luciano Ávila. ECO REG do Brasil. Consultoria e Serviços Ambientais.
- Cristina Alves – Head of the National Centre of Support to the Forest Management – Ministry of Environment.

V) Interviews on the case studies

- A) Occupation: Designer of eco-conception vehicles
- Company: vehicles manufacturer (multinational)

Interviewee: Marcelo Schroeder Stevan – Head of Project – Engineering School – RTA – Americas Engineering Direction – RTA

Interviewee: Adriano Rogério Kantovischi – Engineering Supervisor – DIMAT (Materials Division) – America Plate

B) Occupation: Recycling specialist

- Company: processor of scrap paper.

Interviewee: Janaina Simão

C) Occupation: Solar heating system installer

- Company: SENAI "Orlando Laviero Ferraiuolo" School

Interviewee: Leandro Arrabal

- Company: Escola SENAI de Tatuapé

Interviewee: Abílio José Weber

- Company: Brazilian Association of Refrigeration, Air Conditioning, Ventilation and Heating – ABRAVA

Interviewee: Marcelo Mesquita – Manager of the Department of Solar Warming

D) Occupation: Sugarcane Cutters

- Company: São Martinho Group S.A. – Iracema Usine - Iracemapolis – Sao Paulo.

Interviewee: Ângelo Aloísio Denadai – Administrative Coordinator

Interviewee: Antonio Francisco Nascimento - Driver

Interviewee: Antonio Jose Gomes - Driver

Interviewee: Renato Ferreira dos Santos – Agricultural Machinery Operator

- Company: Escola SENAI de Limeira

Interviewee: Caetano José de Santis Jr.

E) Environment Analyst

- Institution: Ministry of Environment – Executive Bureau

Interviewee: Suely Monteiro – Executive Bureau Advisor

- Institution: Ministry of Environment – Brazilian Forest Service

Interviewee: Anna Fanzeres – Executive Manager of Monitoring and Auditing

F) Occupation: Refrigeration Mechanic

- Institution: Senai Oscar Rodrigues Alves School

Interviewee: Eduardo Macedo Ferraz e Souza (Director)

Interviewee: Leandro Wagner – Instructor

Interviewee: Willian Nonato – Refrigeration Mechanic

G) Occupation: Administrator with Water Resources Management function

- Company: Fibria

Interviewee: Mauren Kayna (Forest Engineer)

H) Occupation: Shoe finishing workers

- Company: Shoe Technological Centre - Senai – Novo Hamburgo - Rs

Interviewee: Arlete Accurso – Director

- Company: Muicha – Tres Coroas County, RS.

Interviewee: Jairo Fabiano Blauth – Industrial Manager

- Company: Tres Coroas Shoe Industry Union

Interviewee: Manager of the project AMANHÃ MAIS FELIZ