PART I

Chapter 3

Greening the economy in the context of sustainable development

In Brazil, economic growth is inseparable from sustainable use of natural resources, poverty alleviation and better access to essential services. This chapter presents Brazil's progress in mainstreaming environmental concerns into economic and sectoral policies to green its economy on the path to sustainable development. It examines the use of tax policy to pursue environmental objectives and progress in removing subsidies and other incentives that can encourage environmentally harmful activities. The chapter analyses public and private investment in environment-related infrastructure such as that for water and sanitation, waste, clean energy and transport. It reviews the promotion of environmental technologies, goods and services as a source of economic growth and jobs. The role of Brazil as both a recipient and provider of environment-focused development co-operation is also discussed.

1. Introduction

In 2014, Brazil was the world's seventh largest economy. Strong economic growth in the 2000s increased per capita income and helped halve the share of the population living in extreme poverty (Chapter 1). Sustained growth has also helped Brazil make progress towards other Millennium Development Goals, including increasing literacy rates, reducing gender disparities and child mortality, and improving housing conditions and access to basic services (Annex 3.A). Growth began decelerating in 2012, however. Low investment, persistent infrastructure bottlenecks, and domestic firms' low productivity and competitiveness are constraining growth prospects.

The country's economic growth is inseparable from sustainable use of natural resources in both the economic and social sense. Natural assets contribute to significant economic activities, such as agriculture and food production, energy generation, mining and the use of forest resources and biodiversity; they are also a primary source of employment and income for much of the rural population. Managing the trade-offs between socio-economic development and environmental sustainability has proven difficult, and growth has come at a cost to the environment.

Brazil has made remarkable progress in fighting deforestation, although agricultural expansion and intensification continue to exert pressures on forests and native vegetation, as well as on water and soil quality (Chapter 4). Population growth, urbanisation and rising income levels have resulted in increased water, energy and transport demand. Greenhouse gas (GHG) emissions from energy use have increased; the vehicle fleet doubled over the past decade, which is reflected in traffic congestion and air pollution in most major cities. Sanitation and wastewater treatment infrastructure is inadequate to meet growing volumes of industrial and domestic sewage, resulting in water and soil contamination, particularly in densely populated areas (Chapter 1). The 2014-15 water crisis in the South-east has shown how unsustainable natural resource use constrains economic development.

Brazil now faces the challenge of restoring strong, sustainable growth while continuing to eradicate poverty, reduce inequality and social exclusion, broaden access to social services and ensure conservation and sustainable use of environmental assets. Tackling these objectives in an integrated way will provide an opportunity to advance in the development of a resilient, inclusive and green economy.

2. The policy framework for sustainable development and the green economy

The government, supported by civil society and the private sector, has launched several initiatives that aim at addressing the economic, social and environmental aspects of sustainable development in an integrated manner. Several sectoral programmes integrate environmental dimensions, including the Low-Carbon Agriculture programme (Section 4.2), the Growth Acceleration Programme for infrastructure development, the Energy Expansion Plan (Section 5) and the national industrial and innovation policies (Section 6). These positive initiatives, however, do not add up to a coherent policy framework for a green and

inclusive economy. With a few exceptions, integration of environmental, social and economic objectives has been ad hoc and environmental impacts are still being dealt with *ex post* rather than at the early stage of policy development.

2.1. The strategic framework for sustainable development

Brazil's president signed the sustainable development strategy, Agenda 21, in July 2002 in preparation for the World Summit on Sustainable Development. Developed through years of extensive consultation across all sectors of society, it is referred to as a social pact rather than an official government document. It notes that "the common objective … is not restricted to the preservation of the environment alone, but to progressive and expanded sustainable development, which brings into discussion the search for balance between economic growth, social equity and environmental preservation". The pact outlines 21 objectives, including actions and recommendations in such areas as urban and rural sustainability; protection of water, biodiversity and forests; governance and ethics for the promotion of sustainability; and social inclusion.

Agenda 21 placed the onus for implementation directly on the various sectors of society, including government at all levels, private sector companies and civil society organisations. The federal government committed itself to integrating the Agenda 21 priorities throughout public policy, but this has not fully happened. In 2004, the government established the Sustainable Development Policies and Agenda 21 Council, with equal numbers of representatives from the government and civil society, to co-ordinate implementation, but it has been inactive for years. Within the framework of Agenda 21, the government has been tracking a wide range of indicators characterising sustainable development's environmental, social, economic and institutional dimensions (Box 2.7). As no quantitative targets are associated with the indicators, however, they are difficult to use in performance measurement and policy making. Agenda 21 is no longer a reference point for activities of the Ministry of the Environment (MMA) or other line ministries. At the local level, however, Agenda 21 seems to have been a successful instrument for consultation on environmental, social and economic issues in over 1 000 municipalities.

The government is looking to reinvent Agenda 21 to reflect current environmental challenges that were not seen as priorities at the time of its original adoption, including climate change and urban issues such as waste management and sustainable transport. In addition, in 2011 it approved the National Plan on Sustainable Production and Consumption (2011-14), which aims to promote green practices in public administration and the business sector. The plan set six priority areas: green commerce (promotion of eco-labelling), waste management, sustainable construction (particularly for government-funded social housing), sustainable public procurement, environmental education and the Public Administration Environmental Agenda (Chapter 2).

2.2. Aligning social policies with environmental objectives

Poverty reduction and social inclusion are pillars of sustainable development and have been priorities in Brazilian policy since the early 2000s. Several poverty reduction, income redistribution and social inclusion programmes have been introduced or expanded. These include the social protection programme Bolsa Família (Box 3.1; *bolsa* means grant or stipend), which serves as a best-practice example for poverty reduction and social inclusion and is being replicated in other countries. The government works to mainstream

Box 3.1. **Brazil's flagship social protection programme, Bolsa Família**

In 2003, the federal government launched the social protection programme Bolsa Família to consolidate four programmes into one unified conditional cash transfer programme. Beneficiaries receive, on average, BRL 70 per month in direct transfers conditional on school attendance and regular health checks. To ensure that all poor Brazilians benefit from the programme, the government launched an active search policy and established a unified social programme registry to consolidate information and statistics about income and living standards from municipal registries. In 2011, as part of Brasil sem Miséria, a new programme to eradicate extreme poverty, Bolsa Família was expanded to increase beneficiaries' income, expand access to public goods and services, and provide support for finding jobs and other income opportunities. It is now the world's largest social protection programme: in 2013 it reached 11 million families, or 50 million people, over a quarter of Brazil's population.

Bolsa Família is generally found to have made an important contribution to improvement in living standards for Brazil's poorest families. It is estimated that the programme contributed to between 33% and 50% of the drop in extreme poverty and helped reduce inequality (as measured by the Gini coefficient) by 15% to 20%. It has also been found to have a significant multiplier effect on household consumption (2.4) and GDP (1.8), and to have helped reduce regional inequality. Beneficiaries tend to have better health care provision, and children under the programme tend to have lower dropout and higher progression rates in education. Moreover, the unified social programme registry has consolidated fragmented regional and local data, allowing for identification of the municipalities with the greatest concentration of poor people and gaps in public service delivery. Despite its significant expansion, the programme's targeting remains good, and its overall cost is about 0.5% of GDP.

Source: IPEA (2014), *Bolsa Família Program: A Decade of Social Inclusion in Brazil – Executive Summary*, Institute for Applied Economic Research, Brasília.

social issues throughout public policies, including those concerning the environment, particularly for forest conservation.

Social and environmental issues are frequently addressed simultaneously, notably in forest communities. Bolsa Floresta, for example, provides monthly cash payments of about BRL 50 (about USD 20) to families living in protected areas in exchange for forest conservation efforts (e.g. for limiting the amount of forested land converted for farming). Launched in 2007 by Amazonas state, Bolsa Floresta was the first of its kind, and is now the world's largest programme of payments for ecosystem services (PES), reaching more than 35 000 people in 15 protected areas in 2013. Building on this initiative, the federal government launched Bolsa Verde in 2011 as part of the anti-poverty programme Brasil sem Miséria, extending the federal social protection system to include payments for ecosystem services and to provide an incentive to adopt environmental practices (Chapter 4).

Bolsa Floresta and Bolsa Verde are part of a wider government effort to increase income and improve living conditions of rural populations by scaling up sustainable economic use of environmental assets. Other major programmes have similar aims. One is the 2009 National Plan to Promote the Production Chain of Socio-Biodiversity Products, providing facilitated access to credit and markets, as well as technical assistance, to traditional and rural communities to promote sustainable use of biodiversity (Chapter 4). The plan, which includes minimum pricing for products such as açaí fruit, natural rubber and Brazil nuts, was recently linked to the large-scale federal Food Acquisition Programme, one of the world's largest institutional procurement programmes for smallholders' or family

farmers' products. Similar initiatives have been launched at state level, e.g. in Amazonas state, where public purchasing is used to boost value chains for rural products (MMA, 2015). While there are good examples of policies and programmes that simultaneously address environmental and social objectives, many have thus far proved hard to scale up. This may be due to insufficient infrastructure and high production costs, and in many areas also to a lack of producer associations.

3. Greening the system of taxes and charges

3.1. Brazil's tax system and the environment: An overview

The tax system

Total tax revenue has increased steadily since 2000, reaching 36% of GDP in 2013 – above the OECD average and the highest share in Latin America (OECD et al., 2015). The tax system is fragmented, complex and characterised by a low degree of progressivity. Tax compliance costs are exceptionally high, largely due to a system of six indirect taxes, some with differing tax rules and rates across states (OECD, 2013a).

Exploitation of non-renewable natural resources such as minerals and hydrocarbons is an important source of fiscal revenue (through various forms of income and revenue taxes and royalties), although not as much as in some other Latin American countries. In 2013, fiscal revenue from non-renewable natural resources accounted for 2.4% of GDP, compared to 8% in Mexico (OECD et al., 2015). Part of this revenue is used for environmental purposes (Box 3.2).

Box 3.2. **Using oil and gas revenue for environmental purposes**

Brazil uses part of its revenue from oil and gas exploitation to fund environment-related expenditure. Until 2010, two types of oil and gas revenue accrued to the government (besides corporate income taxes): royalties and a windfall profit tax known as the Participação Especial (PE), which is applied to highly productive fields. Revenue from both sources is roughly equal, and reached over USD 16 billion in 2012 (Goldemberg et al., 2014). By law, 10% of the PE goes to the MMA, where it is an important source of National Climate Change Fund revenue (Chapter 2). The Ministry of Mines and Energy receives 40% of the revenue, state governments a further 40% and municipalities the remaining 10%. The royalty rate is 10% of gross revenue; 28% of royalty revenue is allocated to the Ministry of Science, Technology and Innovation (MCTI) and to the Navy (for coastal protection). The MCTI uses royalty revenue in sectoral funds for research and development (R&D) in various areas, including environmental ones (Section 6).

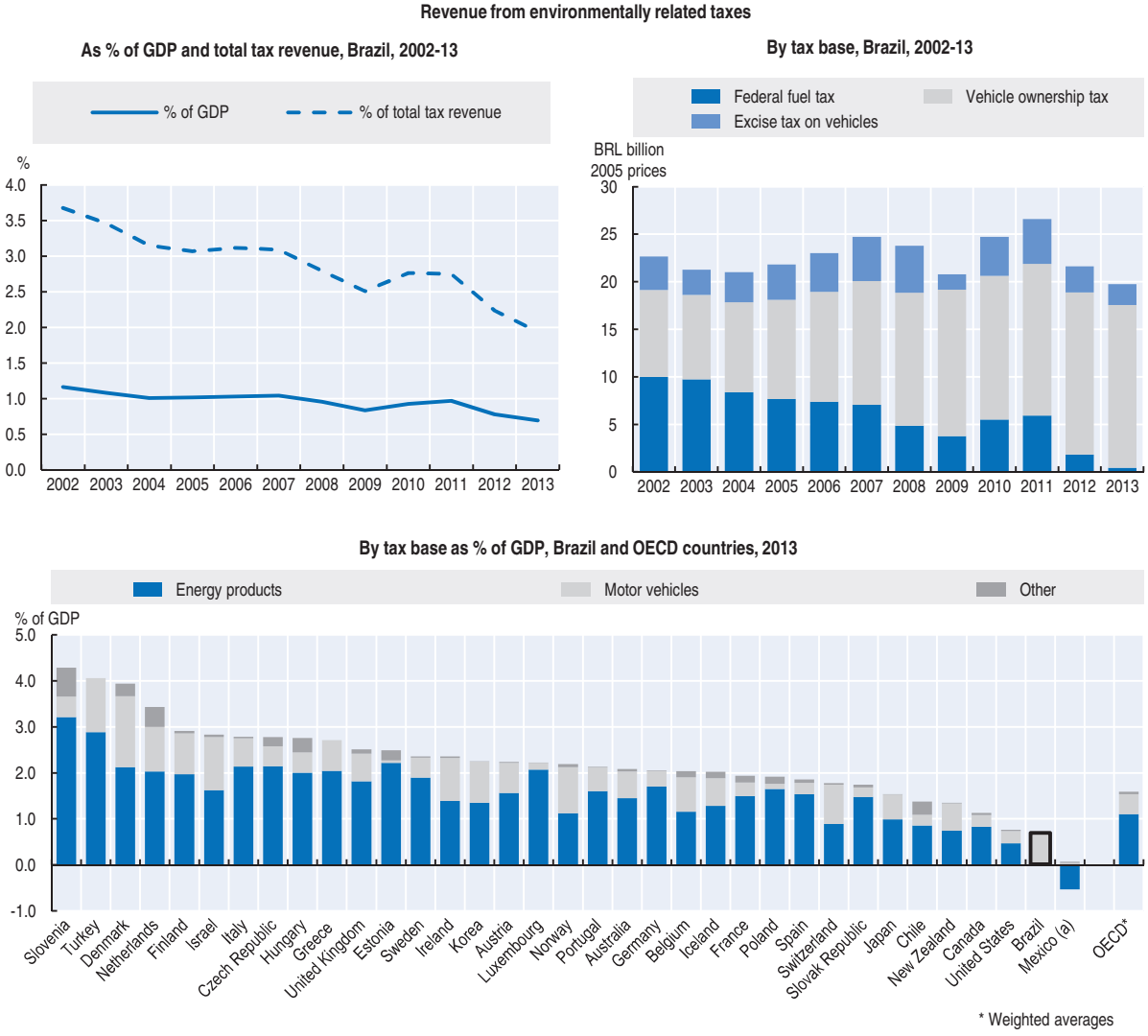
While this system has been maintained for existing production, from 2010 a new legal framework was developed for new oil exploration areas (currently pre-salt oilfield discoveries). A production sharing contract divides revenue from future petroleum discoveries between the operator and the government (aside from a portion for cost recovery), removing the PE but maintaining royalties. Given the potential increase in oil production from pre-salt fields and related revenue, discussions about revenue sharing among states – including those that lack oil production – have been animated (World Bank, 2013). Brazil established a social fund to manage a share of the expected revenue, inspired by the Norwegian model of a sovereign wealth fund. The return on investments is to be used mostly to finance education. In practice, about half the fund would be used for immediate social spending, primarily on education but also on health. The rest would be used in other areas, including environment, science and technology.

In contrast to other federal Latin American countries, a large share of revenue is collected at state level, especially through the state value added tax, called the ICMS (OECD et al., 2015). About half the states redistribute some ICMS revenue to municipalities according to environmental indicators, generally related to the extension of protected areas (Ecological ICMS, or ICMS-E; Chapter 5).

Environmentally related taxes

Revenue from environmentally related taxes is low by international comparison. In 2013, it equalled 0.7% of GDP or 1.9% of total tax revenue, below the levels in all OECD countries except Mexico (Figure 3.1; Annex 3.B). Revenue from environmentally related taxes has decreased in real terms since 2000, notably over 2011-13, when the fuel tax rate was set to zero and vehicle sales declined (Figure 3.1). As in all countries, environmentally

Figure 3.1. **Revenue from environmentally related taxes has declined**



a) Until 2014, the system used to stabilise end-use prices of motor fuels caused tax revenue to turn negative (i.e. become a subsidy) in years when the international oil price was high. Mexico's 2013 Tax Reform corrected this mechanism and introduced a tax on fossil fuels based on their carbon content, which will yield positive revenue.
Source: Based on OECD (2015), *OECD Database on Instruments Used for Environmental Policy and Natural Resources Management.*

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related taxes are mainly taxes on consumption of energy products and on vehicles. Several fossil fuels are exempt, however (Sections 3.2 and 4.1). Vehicle taxation accounts for over 95% of environmentally related tax revenue but is only partially linked to environmental performance of vehicles (Section 3.3). There are no taxes on natural resource use and pollution. Water abstraction and pollution charges and fees for public services such as sanitation and waste collection are inconsistently applied and often too low to stimulate efficient resource use and to finance service provision (Section 3.4).

As the 2013 OECD Economic Survey indicated, Brazil should move forward with reforming its complex tax system and shift taxation towards less distorting taxes to alleviate the burden on productivity and competitiveness. In this context, there is scope to extend and improve the use of environmentally related taxes and remove potentially harmful tax exemptions and subsidies so as to stimulate efficient and sustainable resource use. This would generate revenue that could help the government in its fiscal consolidation efforts or fund infrastructure and other high-priority areas such as education and poverty alleviation. Environmental fiscal reforms could help reduce poverty by addressing environmental problems that threaten the health and livelihood of the poor (e.g. water and air pollution) and generating resources to extend access to basic services such as electricity and sanitation (OECD, 2013b).

In addition to restructuring taxes on energy products and vehicles, Brazil could consider introducing taxes on fertilisers and pesticides to limit water pollution, on waste disposal and packaging materials, and on use of natural resources such as minerals. Such measures should be introduced in clearly defined stages to minimise uncertainty about future tax rates, help the economy adapt to changes in relative prices and facilitate long-term investment. Cash transfers in Bolsa Família could be used to address the potential impact of taxes on the large number of low-income households.

3.2. Energy taxes and charges

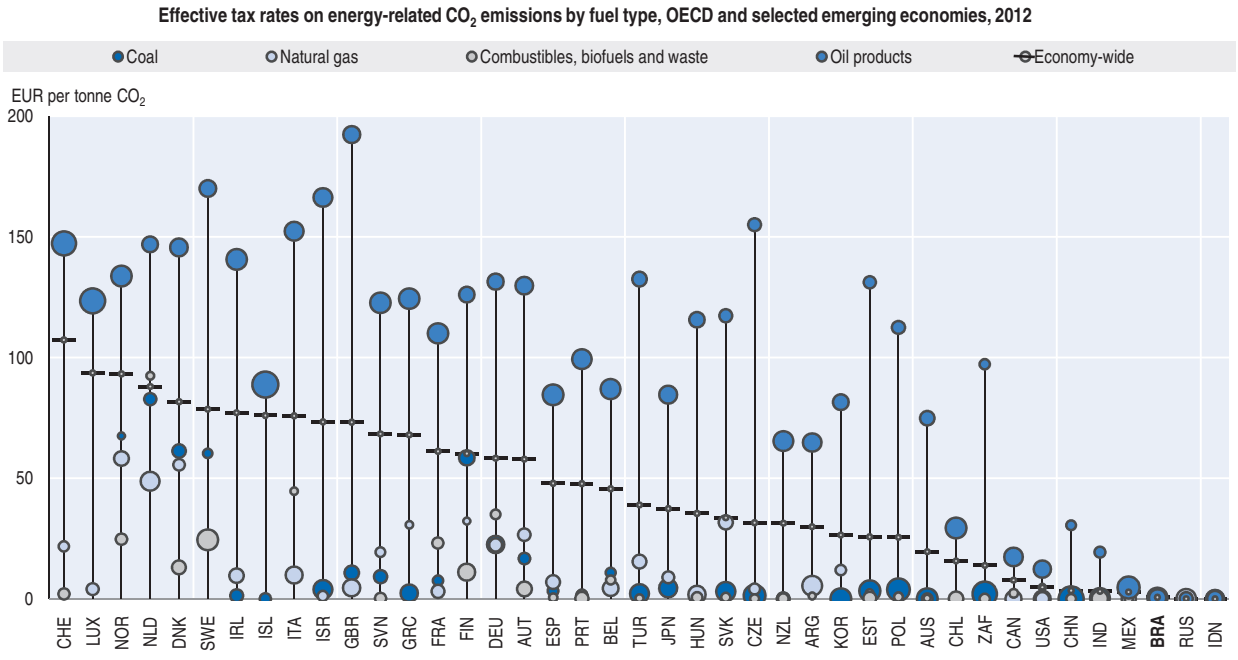
Brazil applies an excise duty to fossil fuels, mainly for use in transport, but the rate has gradually fallen and was set to zero between 2012 and 2015 (see below). Fuels for heating and processes are largely untaxed. Until 2012, Brazil applied relatively high charges on consumption of electricity, which is the lowest-carbon source of energy in the country thanks to the large share of hydro (Chapter 1). All this implies that Brazil's effective tax rates on energy use, expressed in terms of CO_2 emissions (as well as of energy content), are among the lowest in OECD and BRIICS economies, as Figure 3.2 shows (OECD, 2015a).

There is room to raise and restructure taxes on energy products to reflect CO_2 emissions from their consumption, encourage more efficient energy use and help reduce GHG emissions. In 2014, the finance ministry launched a comprehensive economic and regulatory impact assessment for carbon pricing options, including a carbon tax and a GHG emission trading system (Ministry of Finance, 2014). Rio de Janeiro and São Paulo states planned to introduce such system at state-level in the early 2010s, although implementation was put on hold (Chapter 2). Brazil could build on such initiatives to improve the price signal on GHG emissions.

The fuel consumption tax

A specific fuel consumption tax, the federal fuel tax, or CIDE, was introduced in 2001 and is levied on the import and domestic sale of oil and oil products, natural gas and

Figure 3.2. **Effective tax rates on CO_2 emissions from energy use are low**



Notes: Tax rates are as of 1 April 2012 (except 1 July 2012 for AUS and BRA, and 4 April 2012 for ZAF); energy use data are for 2009 from IEA (2011). Data for CAN, IND and USA include only federal taxes.
Source: OECD (2015), *Taxing Energy Use 2015: OECD and Selected Partner Economies.*

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derivatives, and ethanol.[1] The CIDE rate has been mainly used to smooth domestic fossil fuel price fluctuations. It has been zero for all fuels but petrol and diesel since 2004; tax rates for petrol and diesel were gradually lowered and also set to zero in 2012, to offset increases in fuel prices (Table 3.1). This added to the fossil fuel subsidy implicit in keeping domestic fuel prices below the world market level (Section 4.1).

Table 3.1. **Fuel consumption tax rates, 2001-15**

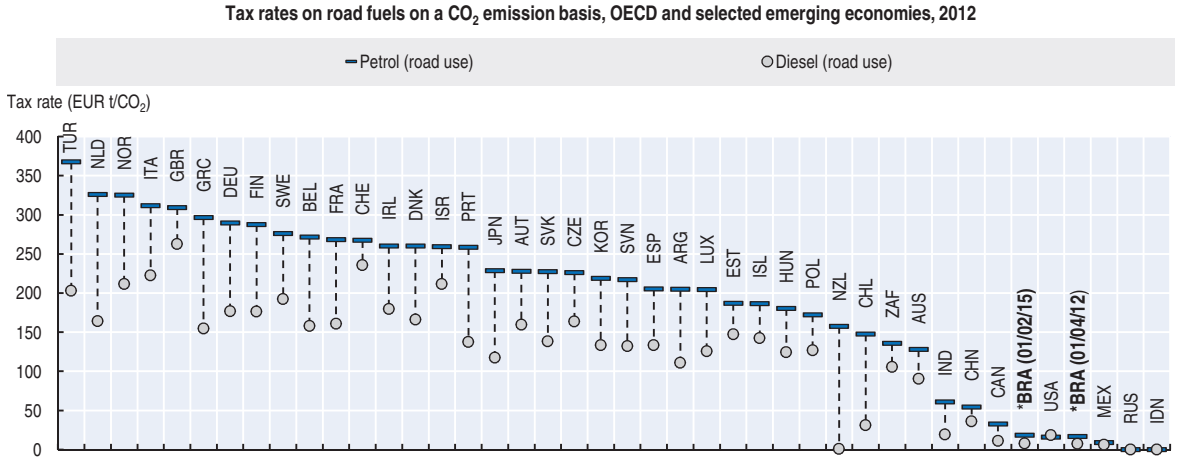
BRL (nominal prices)

	Dec. 2001 (Decree 10.336)	Apr. 2004 (Decree 5.060)	May 2008 (Decree 6.446)	June 2009 (Decree 6.875)	Feb. 2010 (Decree 7.095)	May 2010 (Decree 7.095)	Sep. 2011 (Decree 7.574)	Oct. 2011 (Decree 7.591)	June 2012 (Decree 7.764)	Feb. 2015 (Decree 8.395)
Petrol	860/ m^3	280/ m^3	180/ m^3	230/ m^3	150/ m^3	230/ m^3	192.6/ m^3	91/ m^3	0	100/ m^3
Diesel	390/ m^3	70/ m^3	30/ m^3	70/ m^3	0	0	0	47/ m^3	0	50/ m^3
Kerosene	92.1/ m^3	0	0	0	0	0	0	0	0	0
Fuel oil	40.9/ t	0	0	0	0	0	0	0	0	0
Liquefied petroleum gas	250/ t	0	0	0	0	0	0	0	0	0
Ethanol fuel	37.2/ m^3	0	0	0	0	0	0	0	0	0

Source: Based on Decree 8.395/2015 and previous decrees, available at *www.planalto.gov.br/ccivil_03*.

As part of its fiscal consolidation efforts, in February 2015 the government restored positive tax rates on diesel and petrol at slightly higher nominal levels than those in place prior to June 2012 (Table 3.1). Tax rates remain far below international averages and diesel is still taxed at a lower rate than petrol (Figure 3.3). This discrepancy, common in most

Figure 3.3. **CO_2 emissions from transport fuel use are taxed less than in most other countries**



Notes: Tax rates are as of 1 April 2012, except 1 July 2012 for AUS and 4 April 2012 for ZAF. Figures for CAN, IND and USA include only federal taxes. NZL applies a road-user charge to diesel that is not included in the figure. Tax rates converted using standard carbon emission factors from the Intergovernmental Panel on Climate Change and energy conversion factors from the IEA.
*Brazilian rates are as of 1 April 2012 and 1 February 2015 to reflect changes in the tax system over time.
Source: Adapted from OECD (2015), *Taxing Energy Use 2015: OECD and Selected Partner Economies*.

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countries, is not justified on environmental grounds, given diesel's higher carbon content and emissions of local air pollutants (Harding, 2014). Brazil should gradually raise the CIDE rates and consider linking them to fuel carbon content. The tax base should be gradually expanded to other fuels, including kerosene used for domestic aviation.

Special charges on electricity consumption

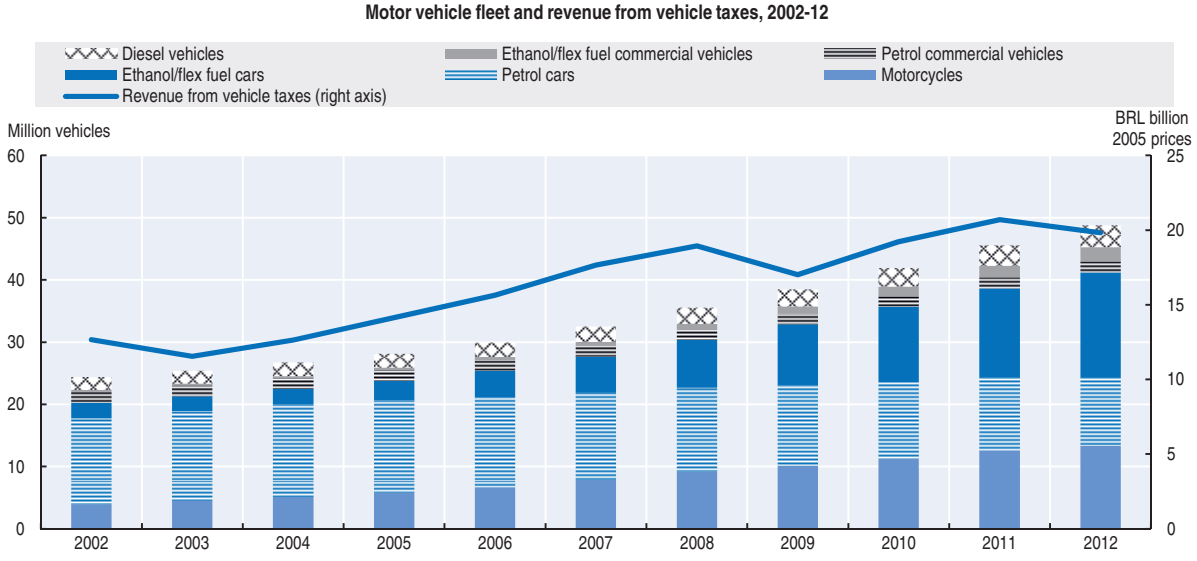
Electricity has traditionally been subject to a range of charges and taxes, in part used to fund socio-environmental objectives such as renewable energy sources and electrification in rural areas. The degree and complexity of taxation on electricity has led to higher end-use electricity prices than in neighbouring countries (IEA, 2013; The Economist, 2012), with taxes accounting for about 50% of final prices. In 2012, the government abolished two charges and greatly reduced the remaining charge on electricity consumption in a bid to reduce electricity tariffs (see below).[2] This can help rebalance taxation of energy products in terms of CO_2 emissions. Electricity prices have risen substantially since early 2015 and are expected to increase further (Reuters, 2015). Recent increases partly resulted from drought in south-eastern Brazil since late 2013, which has reduced hydropower generation and increased reliance on more expensive thermal power supply.

The only remaining charge on electricity consumption is the Energy Development Charge. In place since 2002, it is levied on distributors and passed on to final consumers as part of the electricity bill. The rates were significantly reduced after the 2012 reform (to 73% below the 2012 level). The revenue, managed by the national power company, Eletrobras, has been used for various purposes, including to support renewables and rural electrification programmes, and to subsidise low-income electricity tariffs and some diesel- and coal-fired power plants.

3.3. *Vehicle taxes*

Revenue from vehicle taxes increased between 2002 and 2013 in line with vehicle sales and ownership, though it has slightly declined since 2011 (Figures 3.1 and 3.4). These taxes include an annual motor vehicle ownership tax (IPVA) and a tax on vehicle purchase or registration. None of these taxes is differentiated according to environmental criteria, although the purchase tax is reduced for flex-fuel vehicles, which can run on both petrol and ethanol. The IPVA, levied at the state level, generally ranges from 2% to 5% of vehicle value. Its revenue has nearly doubled in real terms since the early 2000s, reaching about BRL 30 billion in 2013.

Figure 3.4. **Revenue from vehicle taxes grew with the vehicle fleet**



Source: Based on MMA (2013), *Painel Nacional de Indicadores Ambientais;* OECD (2015), *Database on Instruments Used for Environmental Policy and Natural Resources Management.*

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The federal tax on manufactured products (IPI) is a consumption tax levied on manufactured goods, including motor vehicles. Revenue increased in real terms between 2002 and 2012, with a dip in 2009 due to the recession. It has declined since, to BRL 3.8 billion in 2013, because vehicle sales declined and the tax rate was reduced from 2012 to 2014 to stimulate the automobile industry (MMA, 2015).

The IPI is differentiated by engine capacity. It is lowest (7%) for vehicles with a 1 000 cc capacity. Above 1 000 cc, the IPI is 13% or 25% for petrol vehicles, depending on engine capacity, and reduced to 11% or 18% for flex-fuel vehicles (Barros, 2014). This differentiation has helped promote sales of flex-fuel passenger cars, which accounted for 57% of the passenger car fleet in 2012 (Figure 3.4). Electric vehicles are taxed at the same rate as combustion vehicles.

The Inovar Auto programme, aimed at promoting technological innovation in the automotive industry, imposes a 30% to 55% increase in the IPI rate (depending on vehicle engine displacement) between July 2014 and December 2017, but simultaneously grants reductions of up to 30% to manufacturers in exchange for complying with innovation targets related to emissions and fuel efficiency, R&D, safety and domestic production

content (TransportPolicy, 2014). While the programme has helped improve vehicle efficiency, it has mainly boosted investment in the local auto industry, owing to local content requirements (Box 3.5). Vehicle taxes based on fuel efficiency would probably be more cost-effective in stimulating improvement in vehicle technology and would create less market distortions.

Taxes on vehicle ownership are theoretically less efficient than fuel taxes and road charges in reducing emissions of GHGs and air pollutants since they are more disconnected from vehicle use. Yet Brazil should consider differentiating vehicle taxation on the basis of environmental parameters (e.g. fuel efficiency, CO_2 emissions or emissions of local air pollutants such as NO_x), in addition to the current reduced tax rates for flex-fuel vehicles. This would provide vehicle owners with an incentive to choose lower emission vehicles and help further shift the fleet composition towards cleaner vehicles.

3.4. Other environment-related taxes and charges

Property taxes

Brazilian law allows urban property taxes, based on property value, to be raised to account for potential rises in market value resulting from improved provision of public services, including environment-related services. Payment of this so-called "contribution for improvement" can also be passed through via rent increases. The type of investment involved includes construction or expansion of rapid transit systems, drinking water supply systems, sewerage facilities, infrastructure for energy distribution, transport and communications, and infrastructure related to drought and flood protection. It is unknown how extensive the use of such contributions is, and to what extent the revenue is used to finance such investment.

Waste service charges

Municipalities can charge for the provision of environment-related services such as garbage collection, city maintenance and cleaning. Most municipalities that charge for waste collection do so through property and land taxes, with no link to the volume of waste collected, though the charges may be related to collection service frequency. The National Solid Waste Plan foresees expanding the share of municipalities that use specific charges or taxes (other than property taxes) to 75% by 2031, from 11% in 2008 (MMA, 2012). While fixed charges may be easier to administer, they provide no incentive to generate less waste or to sort for recycling.

In addition, the rates of the charges are usually too low to cover service provision costs: the 2008 National Survey for Basic Sanitation found that only 12% of the municipalities that charged for waste services recovered their costs (MMA, 2012; IPEA, 2012). As costs for waste management are likely to increase as Brazil moves from open landfills to controlled and sanitary disposal (Chapter 1), a reform of the charging system seems necessary to avoid an increasing burden on the public budget and to encourage private investment in the sector (Section 5.2).

Water charges

Legal frameworks to allow charging for water use have been in place for several decades. The 1997 National Water Resources Policy Law formally established water charges – for both abstraction and effluent discharges – as instruments that could be used for water resource management. In practice, implementation has been administratively complex (Chapter 2),

and only a few river basin committees charge for water (OECD, 2012). As of March 2015, water charges were in effect in four federal river basins or levied by five state governments (OECD, 2015b). In most states that charge for water, unit prices are low, are not automatically adjusted for inflation, cover little of the water resource management costs and have had limited effect on decisions about water allocation and use (OECD, 2012; Ioris, 2008).

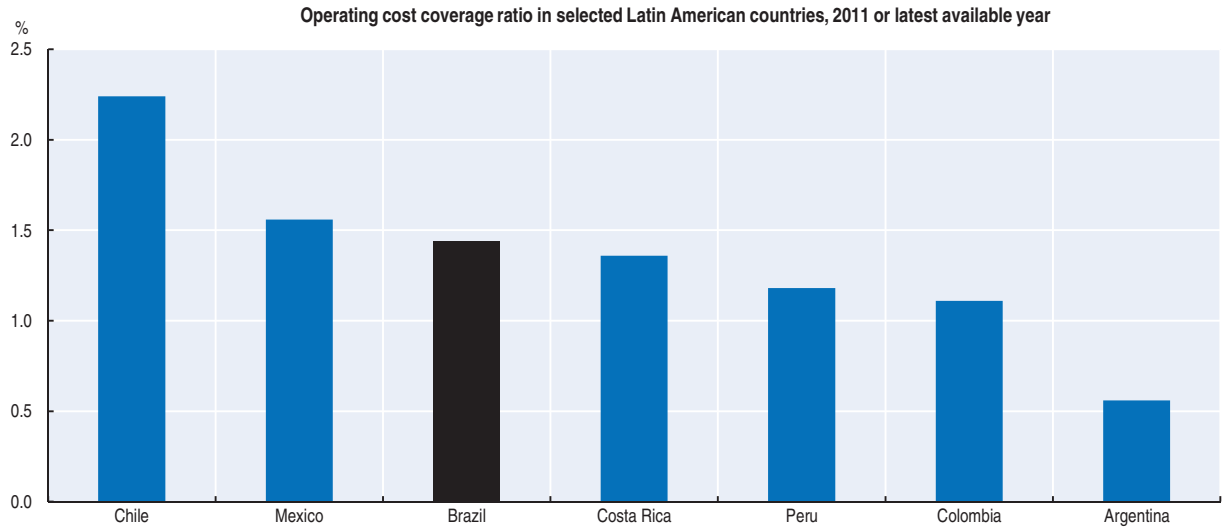
Rio de Janeiro is the only state in which water use is charged universally. Charges are applied by river basins for each category of water use and centralised into a water management fund, though 90% of the resources are redistributed to basins. Revenue from charges increased from BRL 3 million in 2007 to BRL 35 million in 2013. State regulations require at least 70% of the funds to be invested in collection and treatment of municipal wastewater until the target of 80% of sewage collection and treatment is reached in each hydrographic region. Nevertheless, water charges represent less than 15% of the funding needed for investment in Rio de Janeiro (OECD, 2015b). There is some evidence that water charges had a positive impact on water use efficiency in the industrial sector, though not for other users (Martinez Júnior, 2011).

In addition, the National Water Agency (ANA) receives the revenue of a 0.75% charge on the value of hydropower produced, as a compensation for flooding areas and using water resource for power generation.[3] This represents over half of its budget (OECD, 2012). The charge, however, does not reflect scarcity of water and competition to access it in the basin and does not contribute to efficient water resources management (OECD, 2015b). There is significant scope to use economic instruments in areas of water scarcity or high competition among water users. This includes water charging, used as a policy tool and not just a revenue generating mechanism, but could also include some form of trading/transferring water entitlements or allocations between users. Such measures can be accompanied with mechanisms that recognise sensitivities and legal constraints, and meet public policy objectives, such as compensation or government-facilitated transfers (OECD, 2015b).

Regulatory agencies define the watery supply and sanitation tariff regime and specify the mechanisms to periodically revise tariffs. Water supply tariffs must be set at cost-recovery levels and should allow for the necessary investment to expand service coverage and guarantee appropriate return on investment. Sanitation tariffs are often the same for collection/disposal and treatment, which tends to discourage investment in wastewater treatment services (Costa and Côrtes, 2014). Water tariffs are higher in Brazil than in other Latin American countries. On average, tariffs allow recovery of operating and maintenance costs but very little investment in new infrastructure (Figure 3.5 and Section 5.2). However, there are wide variations in tariffs and operational efficiency across states, municipalities and service providers (Ministry of Cities, 2014). As in other Latin American countries, a large share (about 40%) of distributed water does not generate revenue, due to unbilled consumption, water theft, metering inaccuracies and physical water losses (IBNET, 2015).

In most municipalities, low-income households benefit from a low social tariff on the first block of water consumption. However, this subsidy is seldom well targeted, as poorer households do not always have access to the network, especially in remote northern areas. In some places targeting has been improved using registers from the Bolsa Família programme (Box 3.1). However, the resulting cross-subsidies can hinder network expansion in rural and poor areas, as revenue may not cover associated costs (OECD, 2011). In general, a greater use of existing cash transfer programmes would be more cost-effective in supporting low-income households.

Figure 3.5. **Tariffs for water and sanitation are high enough to cover operating costs**



Note: Total billed revenues as percentage of total operational expenses.
Source: The International Benchmarking Network for Water and Sanitation Utilities (2015), *IB-NET Database*.

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4. Reforming environmentally harmful subsidies and incentives

4.1. *Support to fossil fuel consumption and production*

Support to fossil fuel consumption

Brazil has a long history of subsidising production and use of energy to promote industrialisation and achieve social objectives. In the 1990s, it launched a reform agenda aimed at liberalising the energy sector and removing subsidies. The reform process culminated in the liberalisation of transport fuel prices in 2002, but has since all but stalled (De Oliveira and Laan, 2010).

In practice the government has continued to intervene in the market to limit fluctuation in domestic fuel prices: it froze prices for petrol, diesel fuel and liquefied petroleum gas (LPG) between 2006 and 2012 and repeatedly reduced fuel tax rates (Table 3.1). Fuel prices were kept below the international prices at which the stated-owned company Petrobras imported them, causing it to incur growing financial losses (OECD, 2015a). Fuel prices were raised in 2012 and 2013, but the increases were partly offset by reducing to zero the CIDE rate in June 2012 (Section 3.2). OECD (2015a) estimates that this tax adjustment resulted in BRL 5.6 billion of forgone revenue in 2012 (Table 3.2). Positive tax rates for petrol and diesel were re-established in early 2015, but the rate remains zero for other petroleum products and natural gas (Table 3.2).

The combination of government fuel pricing decisions and temporary CIDE exemptions resulted in *de facto* fossil fuel support, which has encouraged private car ownership and use and increased demand for petrol at the expense of ethanol (since flex-fuel vehicle owners tend to use the cheapest fuel). This has ultimately depressed investment in the ethanol industry (OECD, 2013a) and runs counter the government's objective of promoting ethanol production and use (Section 5.4). Other countries have implemented similar fuel price smoothing mechanisms, with different levels of government intervention and impact on prices.[4] Their experience shows that, in addition to weighing on public finances and

Table 3.2. **Examples of fossil-fuel support and related tax expenditure**

In BRL million

Support measure	Details	Type of support	Estimated support, 2011	Estimated support, 2012[a]
Petroleum				
CIDE fuel tax reductions	Exemption for imports and retail sales of petrol, diesel, kerosene, aviation kerosene and natural gas	Consumer	817	5 632
Tax reduction on the import and retail sale of naphtha	Exemptions from PIS/COFINS	Consumer	364	429
Fuel Consumption Fund	Refunds diesel-fired power plants in the North to offset the region's high costs of electricity generation (costs of buying and transporting diesel fuel; exemptions from customs duties)	Consumer	5 482	4 854
Energy Development Fund	Support for energy consumption for low-income households, diesel- and coal-fired power plants, expansion of the natural gas network, Luz Para Todos programme	Consumer	32	36
REPENEC (tax incentive for oil company infrastructure development in the North, North-east and Centre-West regions)	Temporary exemptions from PIS/COFINS, IPI and customs duties on imports of certain capital goods	Producer	1 458	2 781
REPETRO (special tax regime for goods used in the exploration and production of oil and natural gas fields)	Exemptions from PIS/COFINS, IPI, customs duties and a tax on goods imported by sea	Producer	8 824	7 655
REPEX (special tax regime for imports of crude oil and petroleum products)	Exemptions from PIS/COFINS, IPI and customs duties	Producer	1 365	4 003
Natural gas				
REPETRO	See above	Consumer	1146	n.a.
REPENEC	See above	Consumer	189	n.a.
Coal				
Tax exemptions for coal and natural gas used in electricity generation	Exemptions from PIS/COFINS for purchases of coal and natural gas	Consumer	329	153
Energy Development Fund	See above	Consumer	547	627

a) Provisional data.

Source: OECD-IEA (2015), "Fossil Fuel Subsidies and Other Support", *www.oecd.org/site/tadffss*.

encouraging wasteful energy use, such mechanisms are inefficient as poverty-alleviation measures and tend to be highly regressive (OECD, 2013c). Benefits are largely captured by higher income groups which spend a larger share of their earnings on driving cars, while low-income households tend to use public transport (Section 5.3).

The CIDE rate for LPG has been set to zero since 2004. Previously, there was a targeted LPG allowance programme for low-income households, which was incorporated into Bolsa Família in 2003 (Box 3.1). As with water tariffs (Section 3.4), low-income households generally benefit from a low electricity tariff on the first block of consumption. Removing such tax exemptions and price discounts and replacing them with direct cash transfers, as was done for LPG, would provide better energy efficiency incentives.

Support to fossil fuel production

Natural gas and coal used in electricity generation – about half the total supply of these fuels – are exempt from several taxes. Oil and gas producers enjoy special tax regimes, including one for operators investing in infrastructure in certain regions (REPENEC), one for goods used in oil and gas exploration and development (REPETRO) and

one for crude oil and petroleum product imports (REPEX). These regimes exempt operators from the social contributions called PIS and COFINS[5] as well as IPI and customs duties, and provide potential ICMS reductions.[6] Government budget transfers related to these programmes are significant (Table 3.2).

Sugar cane sales for ethanol production, and all ethanol fuels, are exempt from PIS/COFINS payments. Reductions and exemptions are also available to biodiesel producers, depending on the fuel source and inputs (e.g. lower taxes are applied for palm and castor oil to encourage their use), and are designed to benefit biodiesel supply from family farmers, particularly in the North and North-east regions (Barros, 2012; La Rovere et al., 2011).[7]

Investment in oil and gas exploration and extraction has increased significantly since the discovery of vast off-shore oil and gas reserves in 2006. ODI (2014) estimated public support for oil and gas exploration and extraction at USD 530 million, through subsidies such as tax exemptions and direct support measures for R&D or skill development in the oil and gas industry. The Brazilian Development Bank (BNDES) also provides substantial finance to the domestic oil and gas sector (e.g. an estimated USD 3.9 billion in 2012), and subsidises credits for companies in the Petrobras supply chain.

4.2. Incentives to agricultural production

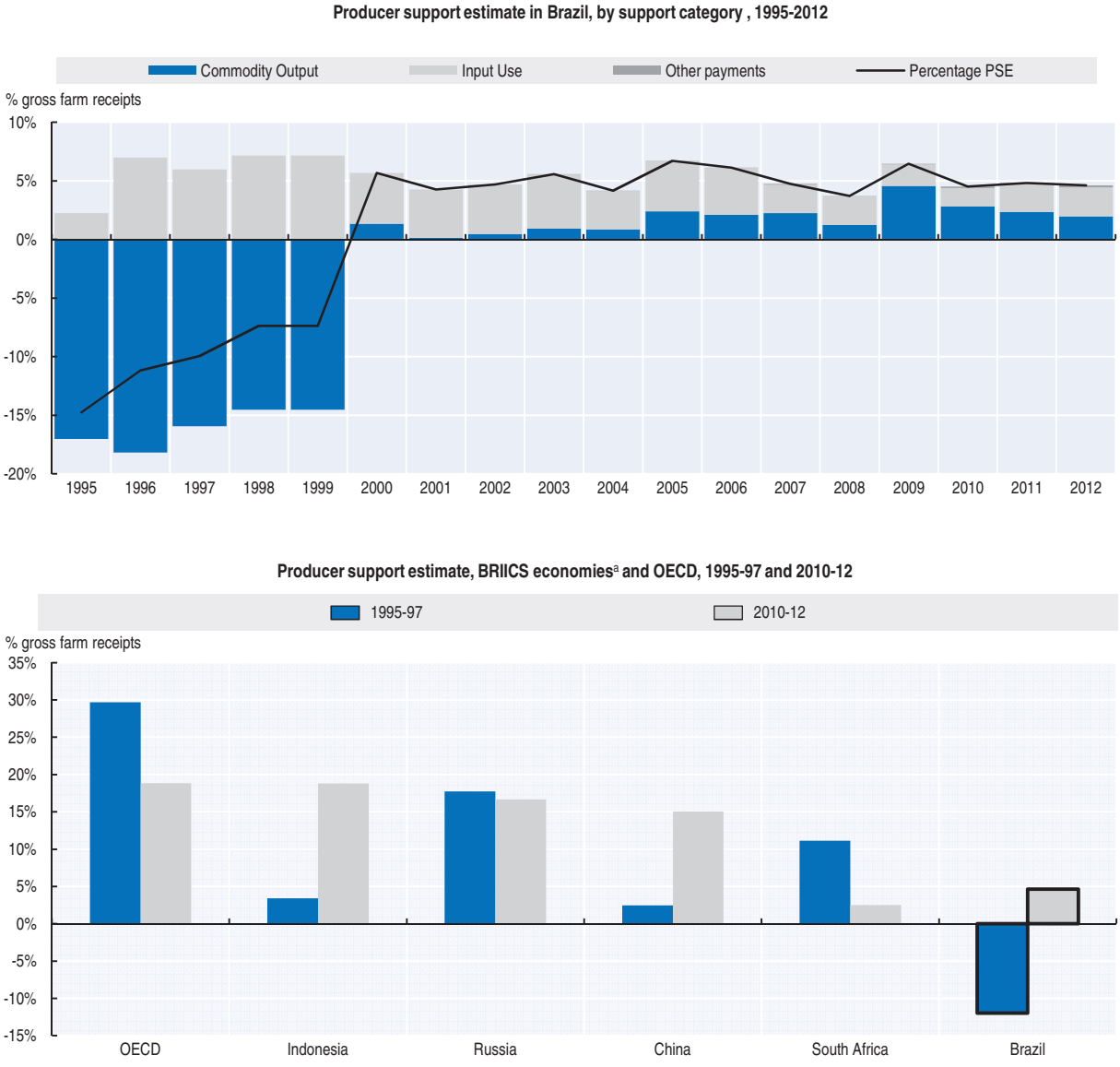
Agricultural support

Agriculture remains one of the pillars of the economy, accounting for 5.7% of GDP and about 15% of employment (Chapter 1; also see Basic Statistics). Brazil has moved from taxing the sector in the 1980-90s to a moderate level of support. In 2000-12, support for farmers as measured by the OECD Producer Support Estimate (PSE)[8] fluctuated around 5% of gross farm receipts, far below levels observed in OECD and other BRIICS countries (Figure 3.6), reflecting Brazil's position as a competitive agricultural exporter.

Nevertheless, a wide range of agricultural support measures are in place. The vast majority of support is based on commodity output and input use and takes the form of market price support (43% of PSE in 2012) and input subsidies (54%) (OECD, 2013d). These are the most distorting and potentially environmentally harmful forms of agricultural support, because they are tied to production. Market price support is provided through guaranteed minimum prices for a wide range of commodities,[9] as well as through direct government purchases.

Farmers have also long benefitted from concessional credit programmes, mostly under the National System of Rural Credit (SNCR).[10] Total SNCR loans reached a record BRL 111.4 billion (about USD 57 billion) in 2012, of which 85% was allocated to large-scale farmers (OECD, 2013d). Since 2008, access to subsidised rural credit in the Amazon biome has been conditional on the legitimacy of land claims and provision of information to demonstrate compliance with environmental regulations, which has effectively helped reduce deforestation. In addition, from October 2017, rural credit will be conditional on land registration in the Rural Environmental Cadastre (Chapter 4). Several policies support small family farms, including subsidised loans and insurance and special minimum price and procurement guarantees under the Food Acquisition Programme. Existing mechanisms for social protection such as Bolsa Família – or the expansion of Bolsa Floresta – could protect farmer income more effectively. Special programmes are in place to support families that sustainably extract forest products, notably under the National Plan to Promote the Production Chain of Socio-Biodiversity Products (Chapter 4).

Figure 3.6. **Support to farmers has grown but is moderate in international comparison**



a) Data for India are not available.
Source: OECD (2015), "Producer and Consumer Support Estimates", *OECD Agriculture statistics* (database).

StatLink http://dx.doi.org/10.1787/888933279600

By stimulating production and input use, and thereby agricultural intensification and expansion, these support and credit programmes risk increasing pressures on the natural resource base. Most of these measures are based on conventional agriculture (hybrid seeds, chemical fertilisers and pesticides), with potentially negative impacts on soil and water. These policies reduce incentives to use production factors more efficiently and to innovate so as to become more competitive. They also tend to encourage agricultural production over other land uses, such as conservation, restoration and sustainable forestry. Special programmes support socio-biodiversity and organic products and sustainable production, such as the Low-Carbon Agriculture programme (Chapter 4), but their volume seems small

compared to total support provided. Transfers to general services for the agriculture sector (such as research, training and infrastructure) are also much lower than support given to individual farmers. Agricultural support could be more strongly oriented to encouraging environmental improvement and efficient use of inputs, as well as to addressing infrastructure gaps that constrain agriculture development (producers are typically far from their principal markets). This could trigger agricultural growth, for both commercial farms and smallholders, more efficiently (OECD, 2015d).

Tax exemptions and other incentives

Implicit subsidies exist for input factors such as water, pesticides and fertilisers. Water is a key agricultural input: the sector consumes more than 60% of water resources (Chapter 1). Yet water abstraction is not charged for in many regions. Where charges exist, they are often too low to stimulate efficient resource use (Section 3.4). Fertilisers and pesticides are exempt from some federal and state taxes, which has increased their use and related health problems (Chapter 1). In 2010, a constitutional amendment (still under discussion) proposed to fully exempt agricultural inputs, fertilisers, agrochemicals and chemicals used for the production of food for humans and livestock from federal and state taxes, though agrochemicals were excluded after public hearings.[11] Tax exemptions for fertilisers and pesticides should be reconsidered with a view to encouraging more rational use of products that can harm human and animal health and ecosystems. Additionally, the current regulation on pesticide approval should be revised to require periodic renewal of approvals, rather than these being granted permanently.

The Rural Land Tax (ITR), although not very significant, also incentivises agricultural production over conservation. The ITR is higher for "unproductive" land than for land under agricultural production. Permanent Protection Areas and Legal Reserves on rural properties and Private Natural Heritage Reserves[12] benefit from ITR exemption (Chapter 4), which partly compensates for the opportunity cost of not engaging in more intensive land use; however, the value of the exemption is so low that the incentive is negligible (MMA, 2015). There is evidence that expansion of the agricultural frontier has been traditionally driven by the very low cost of converting areas to agriculture, rather than a need to satisfy increasing demand for food, fibre and fuels (Gurgel and Paltsev, 2013). More recently, however, agricultural output growth has been based on productivity improvements rather than on the abundance of cheap land.

5. Investing in environmental and low-carbon infrastructure

5.1. *Overview*

Brazil needs to extend and upgrade its infrastructure to ensure strong, sustainable growth and improve service delivery. In 2014, the World Economic Forum ranked Brazil 120th of 144 countries for quality of overall infrastructure, and found inadequate infrastructure to be the second most important barrier to doing business (WEF, 2014). The relatively poor state of infrastructure, including environment-related infrastructure, follows several decades of underspending (Amann et al., 2014; OECD, 2013a).

Investment in extension and renewal of infrastructure increased with the 2007 federal Growth Acceleration Programme (PAC). PAC comprised a large-scale infrastructure investment programme (BRL 504 billion) primarily targeting energy and logistics but also involving new investment in urban and social infrastructure, such as for water supply,

sanitation and urban rail transport. Disbursements remained below planned investment volumes in many areas, notably in sanitation, renewables, rail and energy transmission (TCU, 2011). While massive, PAC investment appears to have been much lower than the country's needs, especially in the North-east region (OECD, 2011).

PAC was succeeded by PAC 2, which envisaged BRL 955 billion in public and private investment over 2011-14 and included a stronger environmental dimension, with increased resources for water and sanitation and a stronger emphasis on rail (Table 3.3). Project delivery and spending improved: total investment was over 70% higher than under the first plan (MPOG, 2015). Still, environmental and sustainability criteria were not systematically integrated into PAC 2, for instance in the design and location of infrastructure projects.

Table 3.3. **Investment under PAC 2**

BRL billion

Sectors	Planned spending 2011-14	Completed projects as of end 2014	Main outputs
Transport	**104.5**	**66.9**	
Road	50.2		5 188 km of highways 1 088 km of railways 19 waterways 30 port projects 37 airport projects
Rail	43.9		
Ports and water transport	7.4		
Airports	3.0		
Energy	**461.6**	**253.3**	
Electricity generation and distribution	140.3		15.9 MW generation capacity 15 312 km transmission lines and 52 substations
Oil and gas	281.9		28 oil and gas exploration and development projects 21 refinery projects 11 natural gas projects 3 biofuel projects
Other[1]	39.4		
Urban development	**57.1**	**10.7**	
Sanitation	22.1		600 sanitation projects 86 drainage projects and 27 slope stabilisation projects 31 urban mobility projects 46 paving projects
Urban transport	18.0		
Urban roads	6.0		
Other[2]	11.0		
Urban social development	**23.0**	**5.5**	3 326 basic health units and 39 intensive care units 786 day care units and pre-schools 53 art and sport centres
Housing (Minha Casa, Minha Vida programme)	**278.2**	**449.7**	2.75 million contracted housing units 1.92 million contracts for financing housing 1 605 urbanisation projects in precarious settlements
Water and light (Agua/Luz Para Todos)	**30.6**	**10.3**	
Light	5.5		58 sewerage projects 1 150 urban water supply projects 538 518 connections to water network
Urban water supply	13.0		
Water resources	12.1		
Total	**955.0**	**796.4**	

1. Includes industrial shipping, renewables, energy efficiency and mineral exploration.
2. Includes control and prevention of floods, landslides and coastal erosion.

Source: OECD (2011), *OECD Economic Surveys: Brazil*; MPOG (n.a.), "PAC 2" (presentation); MPOG (2015), PAC 2: Balanço 4 Anos.

Investment in environment-related infrastructure significantly increased through lending from the BNDES, the main provider of long-term finance in Brazil (Box 3.3). Its environment-related lending increased more rapidly than its overall spending to reach BRL 28 billion in 2014, or 15% of its total lending for the year. The strongest increase

occurred in the area of renewables, with large hydro projects receiving most of the support (Section 5.4). Since 2009, disbursements for water and sewerage, as well as public transport, have increased; funds have also been allocated to climate adaptation and disaster risk reduction since 2010 and, more recently, to forest restoration (Figure 3.7).

Box 3.3. **The Brazilian Development Bank's environmental safeguard policy**

The Brazilian Development Bank was founded in 1952 to stimulate the expansion of industry and infrastructure. The BNDES provides loans for long-term investment projects at below-market rates (which are generally high) for sectors such as agriculture, industry, infrastructure, trade and services.[13] The funding comes from various sources. Since 2009, the national treasury has been the largest single funding source. Brazil would benefit from gradually reducing government support to the BNDES, thereby facilitating the emergence of private lenders and the development of the private long-term capital markets. When specific government-supported lending is needed, for example to meet social objectives and develop infrastructure that the market would not serve, it should be explicit and available to all lending institutions (OECD, 2013a).

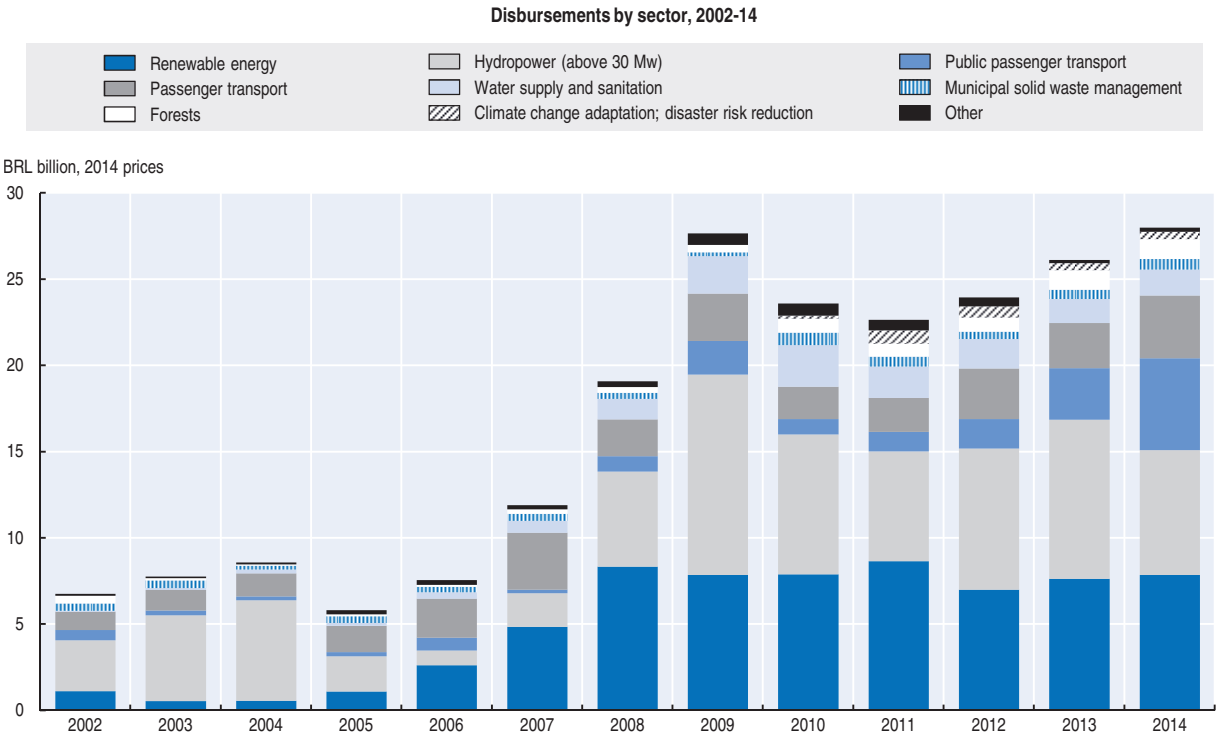
The BNDES has had an environmental policy since 2005, and has undertaken social and environmental screening of all direct and large indirect lending projects since 2010. For lending in sectors considered to have a significant environmental impact, it developed sector-specific policies, such as the 2009 environmental safeguard policy for the meat processing industry, requiring a traceability system to ensure that the ranches from which cattle are purchased meet labour laws and do not drive deforestation. Similar criteria to ensure that agri-business loans do not encourage deforestation have applied to the sugar and ethanol industries since 2010, and to soya growers since 2011. An environmental safeguard policy for loans for fossil-fuelled power plants has applied since 2009. Social and environmental guidelines were put in place for water supply and wastewater treatment in 2011.

Source: BNDES (2015), "Social and Environmental Responsibility" website.

The legal framework for private participation in infrastructure investment is in line with those observed in most OECD countries. Private investment in infrastructure appears to be higher in Brazil than in other Latin American countries (OECD, 2011). To minimise budgetary cost for infrastructure development, the government has sought to promote private participation through the use of concessions, supported by subsidised credit, tax-free infrastructure bonds and other tax incentives.[14] Private participation has increased significantly in the energy and transport sectors, but remains low in water and sanitation. It has mostly taken the form of concessions rather than public private partnerships (PPPs) (OECD, 2011).[15] PPPs have been successfully developed for health and education sectors in Brazil.

Despite the recent massive infusion of funds and incentives for infrastructure investment, problems persist in project delivery. Weaknesses in planning, implementation and monitoring, as well cumbersome regulations and procedures for project selection and evaluation and environmental licensing (Chapter 2), delay the execution of investment programmes and discourage private-sector engagement. This is especially true for environment-related infrastructure, such as sanitation and urban transport, which is the responsibility of local governments. Often municipalities are unable to spend the federal funds allocated for infrastructure development and maintenance, partly due to weak administrative capacity and insufficient finance at local level.

Figure 3.7. **BNDES environment-related disbursements have increased significantly**



Notes: Amounts disbursed prior to 2007 may be underestimated due to changes in the expenditure classification. 2014 data for renewables include investment in the energy efficiency programme PROESCO.
Source: Based on BNDES (2014), *Annual Report 2013*; BNDES (2013), *Annual Report 2012*.

StatLink http://dx.doi.org/10.1787/888933279614

5.2. *Investment in water supply, sanitation and waste*

Water supply and sanitation

Access to water and sanitation has improved markedly over the past two decades (Annex 3.A). Nevertheless, water and sanitation remains the sector where investment is probably the most needed. Coverage and quality of sanitation need to be expanded and improved, particularly in rural areas and the North and North-east regions (Chapter 1). Water and sanitation began to receive more funding under PAC and, especially, PAC 2 (Table 3.3). Disbursement has been met with delay, however.[16] Under PAC 2, investment in water and sanitation was integrated in the second phase of the public housing programme Minha Casa, Minha Vida (My House, My Life), under which funds were successfully disbursed. Water supply in rural areas was extended under the Agua Para Todos (Water for All) programme, which installed more than 750 000 water tanks in 1 200 municipalities under PAC 2.

Investment in water infrastructure is largely public (notably from the BNDES); concessions to private water companies and PPP agreements are used for individual water systems but cover less than a third of the urban population (WWC and OECD, 2015). To support investment in wastewater treatment, ANA introduced Brazil's first output-based aid programme in 2001: under the River Basin Clean-up Programme (PRODES), public funds were granted to wastewater treatment facilities only after construction was completed and operations were under way, with environmental requirements achieved. From 2001 to 2011,

55 sewage treatment plants were contracted. Similarly, the Water Producer Programme, launched the same year, financially compensates investment in the protection and restoration of water sources (Chapter 4). As of 2011, 14 projects had been implemented in nine states (Solutions for Water, 2011).

Ensuring a stable source of funding to expand water supply and sewerage networks and manage water resources has proved challenging. While the 2007 National Sanitation Law mandated independent regulatory agencies and defined rules for service provision and tariff setting, revenue from water and sanitation tariffs does not cover the large investment cost of new infrastructure (Section 3.4). This contributes to discouraging private participation in the sector.

Waste management

Investment in municipal solid waste has increased under the 2010 Municipal Solid Waste Policy (Chapter 2) and PAC, but remains well below needs. States and municipalities were supposed to prepare solid waste plans by 2012 as a condition for federal financial support for landfill construction, but only about a quarter complied. Over 2 200 municipalities (less than half) met the 2014 deadline for having an environmentally sound landfill. The governments in compliance are mostly concentrated in the south-east. For example, Rio de Janeiro state launched an ambitious project to replace irregular landfills with licensed ones through partnerships between the state government, municipalities and private entities. However, most states do not have enough properly engineered landfills, and illegal waste dumping is an acute problem, particularly in the North and North-east regions (Chapter 1). Some recently constructed sanitary landfills have degraded into dumps due to a lack of local capacity to maintain them. Moreover, there is a lack of hazardous waste landfills, and many municipalities tolerate the illegal practice of disposing of hazardous waste in municipal landfills. Most states also lack recycling infrastructure.

The BNDES has stepped up efforts to disburse funds in this area, and is focusing on developing municipal capacity for them to better access these funds. Most solid waste management costs are associated with maintenance of disposal sites, underlining the importance of an effective cost-recovery mechanism (World Bank, 2010a). As Section 3.4 indicates, most municipalities do not charge for collection and disposal, while others charge too little. Lack of cost recovery means there is little incentive for investment in proper operations, as private concessionaires cannot generate sufficient profit. The formation of municipal consortia needs to be encouraged for achieving economies of scale, the lack of which is another key barrier to private investment. The development of more specialised business lines in the waste sector, such as recycling and treatment of special waste, could make waste operations more financially attractive (World Bank, 2010a). The potential business opportunity is large: it is estimated that Brazil loses as much as USD 3.5 billion a year by landfilling waste that could be recycled (IPEA, 2010a).

As in many developing or emerging economies, waste recovery is dominated by waste pickers (*catadores*), who earn their living by collecting and selling waste to private recycling companies. The activity is legally recognised as a profession, but most of Brazil's 400 000 to 800 000 *catadores* (including the 10% organised in informal associations or co-operatives) lack access to workers' rights. The 2010 National Solid Waste Law, which requires municipalities to adopt selective waste collection, supports the involvement of *catadores* in shared responsibility for product life cycles and prioritises recycling co-operatives in formal programmes. The Pro-Catador programme aims to strengthen co-operatives

through capacity building and technical training, improve working conditions and expand opportunities for social and economic inclusion (MMA, 2012).

5.3. *Investment in sustainable transport*

Road transport

Road infrastructure in Brazil is inadequate, with a limited share of paved roads and wide disparity among states. This hurts competitiveness and economic development, particularly since a large share of freight is transported by road. Investment in road infrastructure has increased since the 1990s, when the government introduced concession agreements with private operators to manage the road network. However, concessionaires have little incentive to invest in improvement and expansion of roads, partly because concession contracts are awarded on the basis of the lowest tolls charged to recover investment and operating costs (OECD, 2011). On all tolled road stretches (mostly in São Paulo and Rio de Janeiro states) tolls are based on vehicle size and weight, but do not take account of environmental parameters (ABCR, 2015).

Rail transport

Privatisation of the railway network from the late 1990s stimulated investment in the network (which averaged some BRL 1.8 billion a year over 1997-2009) and an increase in the volume of goods transported (OSEC, 2010). However, the railway sector is underdeveloped and long-distance rail services are currently used exclusively for freight transport, with commuter passenger rail transport concentrated in the megacities of São Paulo and Rio de Janeiro. This poses economic constraints and has contributed to the acute pressure experienced by the highway and airport infrastructure (Amann et al., 2014).

In a welcome move, expanding the rail network has recently been included in infrastructure investment programmes. The National Logistics and Transport Plan sees rail-related investments shifting from 31% of total transport investment to 65% by 2015. In the long term, this could help Brazil reduce road network congestion, with benefits in terms of reduced accidents and emissions of GHGs and air pollutants. Future investment should ensure the long-term sustainability of the rail system. Current rail freight transport is diesel-based, and expanding the use of diesel fuel entails environmental and economic consequences. Full consideration should be given to options regarding biodiesel blending, hybrid diesel-electric engines and the potential for electrification, particularly for passenger transport.

Urban public transport

Insufficient urban public transport infrastructure and rising user costs, combined with a strong domestic automotive industry and the relatively low taxation of vehicle ownership and use (see below and Section 3.3), have led to greater private vehicle use (Figure 3.4). In most urban areas, the growth of private car use has been greater than that of buses (Amann et al., 2014). There are significant socio-economic discrepancies in vehicle ownership; in 2012, 28% of the poorest households had an automobile, whereas 88% of the richest households owned at least one. Underinvestment in public transport has, therefore, penalised low-income households and led to negative social outcomes.

Urban mobility infrastructure is primarily a municipal responsibility. Cities of more than 500 000 are supposed to develop integrated urban transport plans. Most, however, lack the necessary financial resources and technical capacity. This has delayed investment and project delivery for decades (Amann et al., 2014). In response, injection of federal funds

and lending from the BNDES for urban mobility projects increased in the late 2000s and early 2010s, including for subway systems (Table 3.3).[17] The host cities for the 2014 FIFA World Cup also received funding to upgrade their public transport. Investment needs remain large, however. The BNDES (2012b) estimated that BRL 113 billion was needed for public transport in 38 metropolitan areas simply to make up for deficiencies, not counting future needs.

While increased investment in urban railways and subways is welcome, more emphasis may also be given to bus rapid transit (BRT) systems, which can deliver a high-quality mass transport service with much lower capital costs. The development of a comprehensive and integrated BRT system in Curitiba has proven effective in expanding public transport at moderate costs (Box 3.4). Most existing bus corridors in Brazil need renovation and BRT systems may offer an opportunity of increasing transit productivity. However, Lindau et al. (2014) identified several barriers to BRT expansion, many common to other infrastructure investment, including insufficient local technical capacity, conflicts among stakeholders and regulatory uncertainty (Section 5.1).

Box 3.4. **Bus rapid transit in Curitiba**

Curitiba's BRT system is renowned as pragmatic, integrated, cost-effective and efficient. Despite the city's above-average rate of car ownership, the BRT service, combined with parking policies, has reduced automobile trips per year, and ambient air pollution is among the lowest in Brazil.

Starting in the 1970s, Curitiba's bus system evolved from conventional buses in mixed traffic to the world's first BRT system with separate bus corridors, at-level boarding, electronic ticketing and high-capacity bi-articulated buses. The Green Line, launched in 2009, incorporated several environmental innovations, including the operation of 100% biodiesel articulated buses.

Bus operations are contracted to private companies. Since 2010, the Integrated Transport Network (RIT) has brought together feeder and inter-district buses, with transfer stations and a single fare, and has considerably improved coverage and efficiency. Fare revenue is pooled and paid to operators on the basis of service provided. The complete RIT system, with its range of buses and integrated flat passenger fare, is reported to operate without subsidy. RIT covers 14 of the 26 cities that make up the metropolitan area.

The development of an efficient BRT system has been the result of successful co-operation between the urban transport planning authority (URBS) and the urban development authority, which is in charge of land use planning. URBS is responsible for the planning, management, operation and control of the system. It defines routes, capacity and schedules, regulates and controls the system, and collects all fares.

Source: Lindau et al. (2010), "Bus Rapid Transit in Curitiba, Brazil – A Look at the Outcome After 35 Years of Bus-Oriented Development".

Public transport revenue derives almost entirely from user fees, with a much smaller share of city budgets allocated to public transport than in most cities in OECD countries.[18] Public transport systems are largely operated by private concessionaires, with routes awarded on the basis of the lowest user fares proposed. However, fares can be automatically raised if costs increase, which does not provide incentives to improve

efficiency and reduce operating costs (Amann et al., 2014).[19] In addition, the financial and operational performance of private bus operators is barely monitored.[20] From 2005 to 2014 the overall cost of vehicle ownership rose by 7% and petrol prices by 16%, while the consumer price index went up by 160% and the average bus fares in six major metropolitan areas increased by 170% (Amann et al., 2014).

Policy changes are needed to attract greater investment in public transport and make it more attractive. This may include politically unpopular measures such as congestion charging and restrictions on circulation, to balance the relative costs of public transport and private vehicle use. Brazil should also ensure that municipalities have adequately staffed regulatory agencies to apply and review rules for public transport and monitor financial and operating performance under concession contracts.

5.4. *Investment in renewable energy sources and energy efficiency*

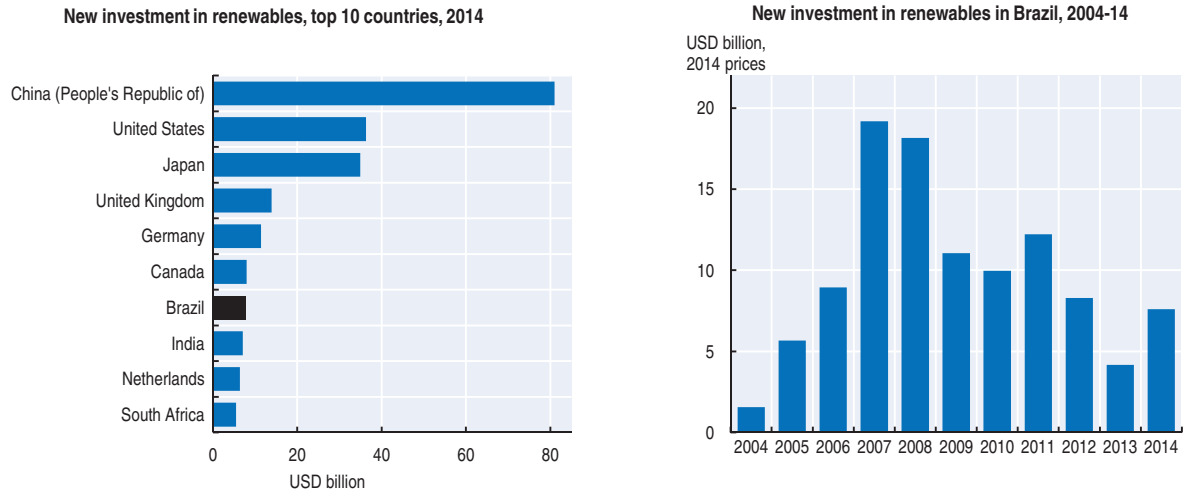
Renewables

The government is committed to maintaining Brazil's clean energy mix. The Energy Expansion Plan 2013-22 (PDE) is the overarching framework for energy policies and investment. While it includes new nuclear, coal and natural gas power plants, it aims to maintain a high share of renewables in the energy mix and to reduce GHG emissions from the energy sector by about 27% by 2020. The PDE relies on significant expansion of large hydro capacity to meet rising electricity demand, but envisages expansion of capacity from other renewables, especially wind.[21] Expansion of large hydro is constrained by location: most potential is located in the Amazon region, which raises difficulties with environmental licensing and public acceptance (Box 2.8). New techniques are being deployed to minimise environmental and social impacts and most new projects are designed as run-of-river, albeit at the cost of generating less electricity (IEA, 2013). Overall, it is estimated that achieving the renewables capacity target will require investment of the order of BRL 120 billion (FEBRABAN, 2014).

In 2014, Brazil was reported to be the world's seventh largest investor in renewables (BNEF, 2015) (Figure 3.8). Total investment, excluding large hydro, reached USD 7.6 billion, a significant rise from 2013 (which had seen the lowest level since 2005). Investment in renewables fluctuated in the last decade following shifts in the biofuels sector, the timing of renewables auctions and infrastructure construction delays (Figure 3.8). Most investment occurred in biofuels until 2009; in 2010 wind power emerged as a significant sector and has dominated investments since 2011 (BNEF, 2014; 2013). In 2014, wind attracted 84% of investment, driven by finance made available to winners of power auctions held in 2013.

Various sources have contributed to investment in renewables, including the BNDES, the Climate Change Fund (Chapter 2) and several state funds and programmes. The BNDES has spent about BRL 6-7 billion annually since 2010 on renewables. Large hydro (above 30 MW) has been the primary beneficiary of BNDES funding, accounting for 25% to 35% of its environment-related spending in 2010-14 (Figure 3.7). Brazil began supporting electricity generation from wind, small hydro and biomass in 2002 through feed-in tariffs, with the cost of the programme being included in electricity tariffs (except for low-income customers). Overall, installing the targeted 3.3 GW of new capacity took over four years longer than planned.

Figure 3.8. **Brazil is among the world's leading investors in renewables**



Source: Adapted from BNEF (2015), *Global Trends in Renewable Energy Investment 2015.*

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Since 2009, power auctions have been used, and have proven more effective than feed-in tariffs in expanding wind power capacity. Average prices of wind power were lower than prices of electricity produced by natural gas plants in 2011, although the lower prices also reflected indirect support measures such as low-interest financing from the BNDES, reduced transmission and distribution costs, and tax reductions (Moarif and Patodia Rastogi, 2012). Brazil's first solar power auction took place in October 2014. There is huge potential for solar photovoltaic, particularly for the residential sector. Microgeneration has been permitted since 2012 but a lack of adequate credit and the incidence of the ICMS tax have made it unfeasible in most states, though tax exemptions exist in Minas Gerais and Tocantins (FEBRABAN, 2014).

Grid inadequacy, however, has led to delays in completing renewables-based power plants and putting them online, particularly in the North-east region, where the wind power potential is strongest. Investment in the national energy grid thus is needed (OECD, 2013a). As with other infrastructure investment, differences in environmental regulations across states and conflicts of jurisdiction between environmental regulatory bodies often result in delays and additional transaction and administrative costs for project developers (OECD, 2015c).

Part of BNDES financing is conditional on local content requirements (LCRs): developers and investors must source a specified share of inputs locally to be eligible for funding (Box 3.5). As almost all wind farms operating in Brazil have benefited from BNDES support, this has led to the creation of a domestic wind power industry, which will likely expand as higher LCRs are phased in to 2016 (Larive International, 2014). The BNDES has also imposed LCRs for solar photovoltaic financing to spur development of local manufacturing capacity and expects to further increase such requirements (Barth et al., 2014). However, in the long term LCRs limit industry productivity and financing capacity (Box 3.5). Brazil should consider gradually phasing out LCRs for renewables and other emerging environmental technology (Section 6.3). Where LCRs are implemented, they should be time limited and carefully designed not to harm long-term competitiveness.

Box 3.5. **Local content requirements in renewable energy markets**

The potential of clean energy to create local employment, added value and exports has led several OECD and emerging economies to impose LCRs as a way to support development of renewables. LCRs typically require developers and investors to provide a specified share of components, equipment, services or total project costs or jobs locally to be eligible for policy support (such as feed-in tariff programmes) or public tenders. As of March 2015, LCRs linked to wind and solar photovoltaic had been planned or implemented in at least 21 countries, including 16 OECD countries and emerging economies, mostly since 2009. This has led to at least five World Trade Organization disputes since 2010.

OECD (2015e) has produced empirical evidence that LCRs have a detrimental effect on global investment flows in renewable energy sectors and hamper the effectiveness of feed-in tariff programmes. They also have a negative impact on local job creation, added value and technology transfer when the full value chain is taken into account. By raising the cost of inputs for downstream businesses, LCRs can lead to increased overall costs, reduced price competitiveness, less international investment and higher wholesale electricity prices.

The OECD therefore advises countries with a nascent or uncompetitive solar or wind-turbine industry that, rather than imposing LCRs, they should address local impediments to the domestic manufacturing sector's competitiveness. Other options include well-targeted R&D support, which can stimulate innovation across segments of the value chains, build local manufacturing capability and encourage technology transfer from imports and FDI; training programmes and promotion measures to improve manufacturers' technological skills, build local capability of downstream firms and encourage innovation; and demand-side instruments, or more cost-effective carbon pricing instruments, to increase domestic demand and eventually support domestic manufacturing.

Source: OECD (2015c), *Overcoming Barriers to International Investment in Clean Energy*, OECD Publishing, Paris.

Biofuels

Brazil first directed public support towards developing sugar cane ethanol in the mid-1970s as a response to the 1973 oil shock. The Brazilian Alcohol Programme largely contributed to the development of large-scale sugar cane ethanol production.[22] The ethanol industry received a significant boost starting in 2003 with the development of flex-fuel cars (La Rovere et al., 2011). A mandatory blending rate is the main measure now supporting demand for ethanol, along with favourable taxation (Section 3.2). The OECD (2013e) estimates the biofuel mandatory blending cost at EUR 200 per tonne of CO_2 abated.

In the early 2010s, the government and the BNDES renewed investment support to the ethanol industry and sugar cane production in response to declining productivity in the sector (Moarif and Patodia Rastogi, 2012). The ethanol industry suffered from higher sugar prices and low petrol and diesel prices, partly due to favourable taxation of these fuels (Sections 3.2 and 4.1). This has depressed investment in the sector and run contrary to tax incentives to promote flex-fuel cars (Section 3.3). The need to improve productivity led to a new emphasis on support for R&D and innovation in the sector (Section 6.2).[23]

In 2004, the government launched the Biodiesel Production and Use programme, including various forms of financing to stimulate biodiesel production, partly with a view

to reducing dependence on diesel imports. The BNDES began offering special credit lines for biodiesel, with preferential rates for biodiesel certified as containing a minimum percentage of raw material from family farms (Moarif and Patodia Rastogi, 2012). This programme was followed by mandatory blending of biodiesel into diesel starting in 2008. Both measures had a significant impact: production was non-existent in 2005 but reached 2.7 million m^3 in 2012 (Castanheira et al., 2014).

Access to electricity

Public investment programmes have provided access to electricity to millions of households over the past two decades under the Luz no Campo (Light in the Countryside) programme since 1999 and Luz Para Todos (Light for All) since 2003. Access to electricity now covers 98.8% of the population (World Bank, 2015); the remaining households lacking electricity are mostly in hard-to-reach rural areas. The cost of providing electricity to isolated communities increased the per household cost of Luz Para Todos by nearly 90% between 2004 and 2010. Technical and financial difficulties have encouraged the use of off-grid solutions such as solar panels, but also small diesel generators, with their associated fuel costs and negative health impacts. The programme has been funded primarily by general public revenue, in part through electricity charges (Section 3.2).

Energy efficiency

Brazil can largely gain from investing in energy efficiency and systematically integrating energy efficiency criteria in sectoral policies, including in the built environment, urban planning and transport (Box 3.6). Energy efficiency is included in sectoral plans under the National Climate Change Policy, and the 2011 National Energy Efficiency Plan set a target of achieving energy savings of 106 TWh by 2030 while the PDE calls for energy savings of 48 TWh by 2022. However, measures to spur investment in energy efficiency have not been significant to date. As in many countries, regulations and labelling programmes have improved the energy efficiency of appliances and equipment, and contributed to shifts in these markets. The PROCEL energy conservation programme (BRL 34 million in 2013), operated and partly funded by Eletrobras, provides energy management training and services in industry, sanitation and municipalities (Eletrobras, 2014).

The main source of funding for these programmes is a share of the net operating revenue of electricity generation, transmission and distribution companies. This obligation, included in concession contracts, requires companies to invest 1% of revenue in energy efficiency or related R&D. Revenue thus raised also supplies the Sectoral Fund for Energy, managed by the Brazilian Innovation Agency (Finep) to fund applied energy research projects with an emphasis on energy efficiency.[24]

The BNDES established a low-interest loan facility in 2006 to stimulate investment in energy efficiency and renewables with a view to encouraging development of energy service companies. Known as PROESCO, the programme at first financed few projects, largely due to its complexity and administrative burden (Moarif and Patodia Rastogi, 2012); it disbursed less than BRL 10 million a year until 2012, though annual disbursements have more than doubled since. Under PAC 2, BRL 1.1 billion was allocated for energy efficiency, though none had been disbursed by the end of 2013 (TCU, 2014).

Box 3.6. **Brazil's energy efficiency potential**

The IEA (2013) analysed energy use in key end-use sectors – industry, transport and buildings – to assess the remaining potential for energy savings using technically and economically viable energy efficiency measures and technologies. In the buildings sector, measures include building codes for new buildings and minimum energy performance standards, enhanced over time, for major appliances and equipment. In industry, measures include adoption of best available technology for new equipment and better energy management. In the transport sector, measures include mandatory fuel economy standards and labelling to promote use of the most efficient vehicles.

The analysis found that final energy consumption in 2035 would be 11% lower than what is projected if Brazil implemented existing measures, including those only announced. The IEA estimated that electricity demand would drop by some 100 TWh by 2035 (roughly equivalent to 2012 production from the massive Itaipu hydropower plant), reducing the need for new capacity. Oil demand would also fall considerably, which would help reduce GHG emissions.

The largest savings would be in transport, mainly through improved fuel economy. The analysis validated the importance of policies to raise the efficiency performance of cars sold in Brazil. Moreover, the study did not reflect all of Brazil's potential in the transport sector, as there is still huge scope to move freight transport off roads and onto rail or waterways (Section 5.3). In industry, significant savings are available in the less energy-intensive sectors such as food processing, where opportunities are often overlooked because of lack of know-how or access to finance. In the residential sector, energy use is already relatively low by international standards, largely because of low heating requirements, so the impact of new measures would be smaller than in the other sectors; the largest impact would come from stringent application of standards for a range of energy-using equipment.

Source: IEA (2013), *World Energy Outlook*, IEA/OECD Publishing, Paris.

6. Promoting eco-innovation and environmental goods and services

6.1. Innovation policy and performance

Innovation gained importance in Brazilian policy over the 2000s. The government recognises it as a critical factor in increasing economic performance and trade competitiveness and has made efforts to expand the R&D and innovation (RD&I) system through legislative, institutional and budgetary changes (Box 3.7). Brazil has well-known leading innovative firms and high expertise in selected high-technology fields such as deep-water oil extraction, aviation, renewables and agro-technology. Agricultural R&D under the public research body Embrapa has contributed to the development of a competitive agribusiness sector, making better technology available to producers and agro-industry, notably tropical technology that allowed for the incorporation of Brazil's *cerrados* (savannahs) into productive use (OECD, 2015d).

This leadership, however, is concentrated in relatively few firms and has so far not spilled over to the overall economy. Small and medium-sized enterprises (SMEs) in particular have very low records of RD&I expenditure and innovate very little. Most RD&I activities focus on basic research and are conducted in public universities and research institutions; there is a wide disconnect between such research institutions and the commercialisation of innovative technology and products. Several bottlenecks constrain

innovation, including restrictive and cumbersome regulations, a complex tax system, high tariffs and expensive long-term credit (OECD, 2015d). As a result, despite increased R&D expenditure (Box 3.7), innovation performance indicators are weak by international standards: the number of patents and trademarks, although increasing, remain significantly below those of OECD countries and BRIICS economies such as China and India (OECD, 2014). The low patent numbers have been related to a lack of incentives for patenting in public institutions as well as to regulatory obstacles and high patenting costs (Frischtak, 2011).

Box 3.7. **General innovation policies**

The Ministry of Sciences, Technology and Innovation (MCTI) plans and co-ordinates national RD&I activities. Several efforts have been undertaken to strengthen the policy framework and improve co-ordination across relevant public institutions and stakeholders. These include the 2004 Innovation Law, which aimed to foster co-operation between research centres and businesses, and the 2005 Goodwill Law, which introduced fiscal incentives to foster innovation in production (OECD, 2014).

The policy framework is set by the National Strategy for Science, Technology and Innovation 2012-15 (ENCTI), which aims to i) close the technological gap with developed economies; ii) support Brazil's leadership in areas of the knowledge economy that take advantage of the country's rich natural resources, such as green innovation, agro-business and other natural resource-based activities; iii) strengthen the internationalisation of the national research system; iv) foster the development of a green economy; and v) address the country's substantial social and regional inequality. ENCTI is integrated into the industrial development plan Plano Brasil Major 2011-14 (aka the Greater Brazil Plan), which gives innovation a central role and includes proposals for significant changes in legislative frameworks.

The focus of innovation policy has shifted to increasing business participation in RD&I. A major initiative is the 2011 Innovate Company Plan, which targets business innovation in nine strategic sectors.[25] The plan increases support for projects of technological risk and establishes measures to increase public-private co-operation. These include reducing red tape, adding new support modalities such as decentralised credits and grants to better reach microenterprises and SMEs, and providing combined credit, grant and equity financing. In 2013, the government established the Brazilian Research and Industrial Innovation Company (Embrapii) to facilitate the translation of technological research into product innovation. Based on the model of the agricultural research institution Embrapa, Embrapii intends to better link technological research to demand from the productive sector, e.g. by establishing public-private RD&I networks.

Gross domestic expenditure on R&D increased to 1.2% of GDP in 2012. This is higher than in other Latin American countries and all other BRIICS except China, but remains significantly below both the OECD average of 2.4% and the ENCTI target of investing 1.8% by 2014 (OECD, 2014; MCTI, 2011). Public investment has grown slightly faster than private investment and reached 55% of total R&D expenditure in 2012. Sectoral technology funds have been a major source of R&D support since the late 1990s. There are funds for each major sector (fourteen in total) as well as two cross-cutting ones. In 2011, the sectoral funds disbursed BRL 1.6 billion for RD&I projects.

6.2. Eco-innovation policy framework and performance

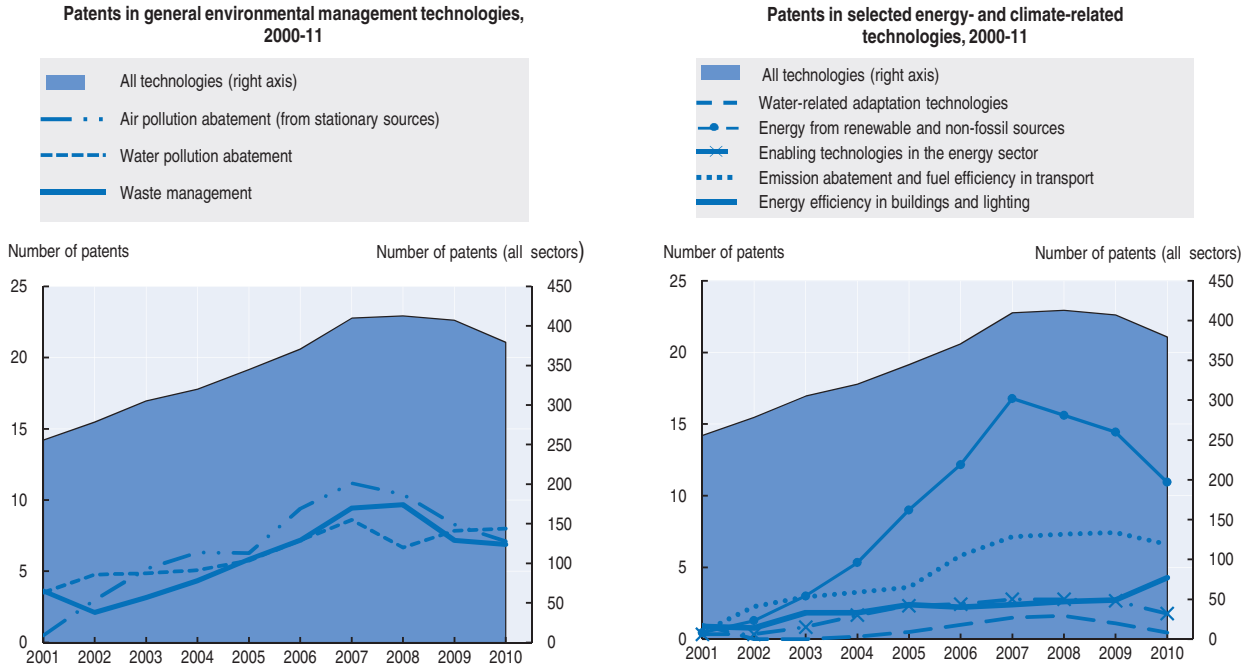
Brazil does not have a formal eco-innovation strategy, even though environmental dimensions are identified in all strategic policy documents on industrial RD&I. Two of the five key objectives of the innovation strategy ENCTI have an environmental focus (Box 3.7). ENCTI targets various areas related to the green economy (e.g. bio- and nanotechnology, renewables, climate change, biodiversity, and oceans and coastal zones) and, for each area, elaborates objectives and key steps, albeit without quantified goals. To strengthen eco-innovation in companies, the government created the Innovate Sustainability programme as one of nine strategic sectoral programmes under the 2011 Innovate Company Plan (Box 3.7). Innovate Sustainability plans to invest BRL 2 billion over 2014-16 in four thematic green innovation areas (BNDES, 2014). As of August 2014, 126 companies had presented business plans. However, links between the strategic planning of industry, innovation, climate change and environmental policies more broadly remain weak.

The overall financial volume devoted to eco-innovation is difficult to determine, as such spending is not explicitly tracked. MCTI estimated public expenditure in "environmental control and protection" R&D at 0.8% of total public R&D disbursements in 2010 (MCTI, 2014a), which is low by OECD standards (though the data are not fully comparable).[26] Some sectoral funds (Box 3.7) are a significant source of funding for the green economy, including those for agribusiness, energy and the Amazon.[27] In 2010, 40% of projects financed by the funds related to the green economy (Frischtak, 2011). However, estimates indicate that total public and private expenditure in green R&D declined from 6% of total R&D expenditure in 2000 to 3% in 2010. The bulk of this volume targets renewables (45%), of which 80% for biofuels; low-carbon agriculture (23%) and sustainable use of biodiversity (17%), largely for natural cosmetics; and ecosystem protection (10%) (Frischtak, 2011).

Following the general pattern of innovation performance in the country, investment in environment-related RD&I primarily occurs in multinationals and very large national companies (Embrapa and Petrobras stand out in this context). An industry survey conducted by the Brazilian statistics institute, IBGE, revealed that the number of industrial companies generating environment-related innovations had grown significantly, but remained small compared to the total number of industrial enterprises (IBGE, 2013). By contrast, several multinationals have established RD&I centres in Brazil, most of them directly or indirectly linked to natural resources (including renewables, minerals, agriculture and biodiversity), according to a survey among multinationals conducted by the OECD with the BNDES in 2011. The survey also found that research in this field tended to be sophisticated and that natural resources and selected green technologies could drive Brazil's participation in global innovation dynamics (Arbache et al., 2012).

Increased policy efforts, partly accompanied by targeted public R&D funding, have helped improve some performance indicators related to environment- and climate-related technology. The number of patent applications per capita filed in these technology fields quadrupled between 2001 and 2010. The growth in environmental patenting has been concentrated in renewables, followed by water and air pollution abatement, waste management, and emission abatement and fuel efficiency in transport (Figure 3.9). Patenting remains very limited in other environment-related fields where Brazil may have a comparative advantage, however (e.g. agro-technologies like soy and sugar cane or biodiversity knowledge).

Figure 3.9. **Patenting in environment- and climate-related technology increased**



Notes: Higher-value inventions that have sought patent protection in at least two jurisdictions. Data refer to fractional counts of patent applications based on the priority date and the inventor's country of residence. Three-year moving average data.
Source: Based on: OECD (2015), "Patents in environment-related technologies: Technology development by inventor country", *OECD Environment Statistics* (database).

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Environment- and climate-related technology accounted for about 9% of all patents filed in Brazil in 2009/11, compared to the OECD average of 11% and the BRIICS average of 7.8%. Brazil's specialisation in environmental technology, as measured by the revealed technology advantage (RTA) index, increased between 2000/03 and 2009/11.[28] Brazil's RTA index in environmental technology is above the BRIICS average but below the OECD median. For bio- and nanotechnology, Brazil displays a revealed technology advantage with respect to both the BRIICS and the OECD (OECD, 2014).

Brazil has effectively used the Clean Development Mechanism (CDM) under the United Nations Framework Convention on Climate Change to encourage good practices, knowledge and technology dissemination and the adoption of more sustainable production standards.[29] It ranks third, after China and India, in the generation of CDM-certified emission reduction credits worldwide, focusing on methane avoidance (27%), hydro (25%), landfill gas (13%) and biomass energy (12%). The CDM has been an important source of technology transfer, notably for biomass energy and biogas recovery in breeding farms and landfills, even though the share of Brazilian CDM projects involving technology transfer, compared to all CDM projects, is lower than in other host countries (25%, compared to an average of 40%); the absolute number of projects involving technology transfer has been declining since the mid-2000s. A significant number of CDM projects were sponsored domestically, which suggests that the CDM has created incentives for endogenous technology-based initiatives (UNFCCC 2010; Seroa da Motta, 2009).

Overall, eco-innovation faces similar barriers as general innovation, including weak science-industry links, skill gaps, regulatory obstacles, high patenting costs and a complex

system of economic and fiscal incentives. Various forms of protection of national businesses, including LCRs (Box 3.5) and high import duties, limit competition and discourage innovation and the adoption of more efficient, cleaner technology. Brazil's innovation and eco-innovation policies have been largely based on supply-side measures such as public support for R&D. However, the link between R&D and industrial development and commercialisation of new technology is particularly weak. As a consequence, the employment impact of eco-innovation activities, for example on the supply chain, is limited (Arbache et al., 2012).

Some demand-side policy measures have recently emerged, including policies that set sectoral environmental performance targets and sustainable procurement requirements. For example, the 2011 Greater Brazil Plan set specific environmental targets (e.g. to reduce energy intensity of the industrial sector by 9% by 2014), the first industrial development strategy to do so. In 2012, the government launched its sustainable procurement policy to prioritise green products, among others, thereby stimulating demand for, and offer of, environmental goods and services (Chapter 2).[30] There is scope to broaden the use of demand-side measures, for example by setting more ambitious environmental performance requirements for economic activities and products (e.g. vehicles and appliances) and promoting environmental labelling (see next section), as well as by ensuring strict enforcement of existing environmental regulations (Chapter 2). This would help expand the markets for environmental technology, goods and services (Section 6.3).

6.3. Expanding the market for environmental technology, goods and services

Brazil could build on international experience to improve its information base about the market for environmental goods and services (EGS) and to develop a clear concept of green economic activities and related indicators. This would help assess the effects of environmental policies and their socio-economic outcomes, and facilitate the development and evaluation of policies aimed at accelerating the transition towards a sustainable and green economy.

According to Environmental Business International, Brazil's EGS market reached USD 15.9 billion in 2010 (0.7% of GDP), which represents 47% of the Latin American or 2% of the global EGS market (ABDi, 2012). A study by the US Commercial Service (2014) suggests that Brazil's market volume in environmental technology (which excludes non-industrial EGSs such as eco-tourism or the use of natural products and biodiversity) amounted to USD 12 billion in 2014. Water, sanitation and solid waste account for the bulk of the market, reflecting the government's efforts to expand the coverage of these services in recent years (Section 5.2).

Few studies have attempted to quantify employment in green sectors. The International Labour Organization (ILO) estimated that about 3 million Brazilians were occupied in the green sector in 2008 (almost 7% of formal employment); other studies point to between 1.4 million and more than 16 million green jobs (ILO, 2010; Nonato and Maciente, 2012). The International Food Policy Research Institute (2006) estimated that Brazil's biofuels programme alone created 1.3 million jobs in rural areas. The World Bank (2010b) estimates that the adoption of low-carbon technologies could increase employment in Brazil by 1.1% annually over 2010-30. The experience of other countries, for example Spain, shows that the expansion of green sectors such as renewables, water and

waste management can create new job opportunities (OECD, 2015e). Yet the large job creation potential, for example linked to Brazil's renewables targets (Section 5.4), is not yet envisioned or adequately reflected in official studies and government policies (Bowen, 2012).

Brazil's EGS market is expected to expand considerably in coming years. The US Commercial Service (2014) estimates the market potential of environmental technology to be between 1% and 7% of GDP. Indeed, the EGS sector seems to have grown faster than the overall economy (ABDi, 2012). Domestic demand for environment-related technology and consultancy services will likely increase along with advancing environmental legislation, more stringent law enforcement and new investment needs related to economic development and urbanisation in areas such as water, air, waste, energy and transport. Brazil can also benefit from increasing foreign demand for certified natural products (e.g. sustainable forestry, sustainable agriculture, natural cosmetics) and position itself as an EGS supplier to Latin America, given the relatively early stage of market development of the sector across the continent.

At present, EGS-related markets in Brazil are extremely heterogeneous. Some are well developed, such as those for hydropower technology, first generation biofuels, biomass to charcoal conversion, biomass gasification, cogeneration, and hydrogen and fuel cell systems for small businesses (Jannuzzi and Poppe, 2014). However, the domestic supply of technology related to emission reduction, energy and resource efficiency, process optimisation, waste treatment and recycling is limited and access to import markets relatively constrained. This results in high costs and discourages businesses from opting for more sustainable technology and production modes. The cost of air pollution equipment, for example, is 45% to 50% higher in Brazil than elsewhere due to the lack of domestic products and to high taxes and import duties (IEMA, 2014).

Responding to growing external demand, Brazilian companies have become more active in product certification and environmental labelling. However, the lack of national certification bodies for several product lines forces companies to seek international certification, and the related costs are often prohibitive, especially for SMEs. The MMA launched the Brazilian Environmental Labelling Programme in 2002 with the aim of contributing to the increased demand for products with less environmental impact. The programme was intended to co-ordinate and better articulate environmental labelling initiatives, but it has not provided many advances (IPEA, 2010a).

Large companies, new companies and those with high productivity tend to invest more in environmental technology (ADBi, 2012). Yet a survey conducted in 2009 among the 100 leading Brazilian companies suggested that they invested only 1% of turnover in sustainable technology, with insufficient availability and high prices, as well as lack of information and knowledge about sustainable technology, being identified as the main barriers (AHK, 2009). This points to a lack of technical capacity in industry, which impedes the development of green industry. Skill development activities related to greening the economy exist, but are not embedded in an overall policy strategy or framework (ILO, 2010). New policies for skills development and better alignment between environmental, industrial and labour market policies are needed to respond to new demands from green sectors and reduce possible knowledge and skills shortages. Labour and social policy systems should accommodate the shift to more environment-related jobs to limit any unintended impact on inequality.

6.4. Voluntary green business practices

Brazilian companies practice corporate social responsibility (CSR) with a high degree of sophistication when compared to other Latin American countries (Scharf, 2009; Galego-Álvarez et al., 2014). The business sector has developed innovative and far-reaching initiatives to address social and environmental impacts, and some fast-growing companies, such as Natura (Box 3.8), are based on innovative, sustainable business models. However, Brazilian business performance is heterogeneous; socially unacceptable labour conditions, resource-inefficient and environmentally harmful behaviour still occur in a non-negligible number of companies. Still, overall CSR activities seem to have increased over the 2000s, particularly but not only in large enterprises (Ethos, 2008).

Box 3.8. **Sustainability as the business model: Natura**

The Brazilian cosmetics company Natura, founded in 1969, ranks among the world's top 20 beauty companies. It has a market share of about 20% in Brazil, operates in a dozen other countries and recorded revenue of BRL 5.5 billion in 2011. Its business strategy is based on innovation for sustainability and market differentiation. The company seeks to minimise its environmental impact throughout product life cycles and works with family producers and traditional communities to promote sustainable income generation.

In 2010, Natura launched a strategic sourcing programme aimed at increasing sustainability of the supply chain. Suppliers are assessed not only on the basis of product prices, but also on a "shadow price" that includes social and environmental costs and benefits (e.g. CO_2 emissions, waste generation, water use, employee education and training, social inclusion, direct investment in society). The sourcing programme initially engaged 50 of the company's largest suppliers and provided them with training on Natura's methodology and data collection. By 2014, the programme had engaged almost 90% of suppliers. Natura estimates that the socio-environmental benefits of selecting suppliers based on high sustainability performance was worth over USD 750 000 in 2012.

To develop new sustainable products, Natura established research partnerships consisting of research institutions, suppliers, local producers and NGOs. The company benefited from public support worth USD 43 million in 2012 for innovation, training, logistics and information technology.

Source: UNEP (2014), *The Business Case for Eco-innovation*, United Nations Environment Programme, Paris; WRI (2013), "Aligning profit and environmental sustainability: Stories from industry", World Resources Institute, Washington, DC.

Brazil's socio-environmental challenges have triggered the creation of associations such as Corporate Commitment for Recycling and the Brazilian Corporate Council for Sustainable Development. There are examples of successful co-operation between Brazilian business associations and public institutions, such as the 2006 Soya Moratorium, which aimed to stop soya cultivation on deforested areas in the Amazon biome. Under the moratorium, the associations for the vegetable oil industry and cereals exporters worked with the MMA and the National Institute for Space Research (INPE) to register Amazonian farms and to map and monitor cleared land areas (Chapter 4).

There has been a marked increase in the number of Brazilian companies with environmental management systems certified as meeting the ISO 14001 standard

(Chapter 2). While such systems do not necessarily lead to better environmental outcomes, there is some evidence that ISO certification has had, on average, a positive impact on the profitability of Brazilian firms (Tognere Ferron et al., 2012).

Brazilian firms, mostly large companies, have also been active in climate change mitigation. In 2009, 20 major companies committed to reducing GHG emissions per unit of production or revenue; this was before a national climate change policy or target was adopted. About 100 Brazilian companies participate in the Greenhouse Gas Protocol initiative[31] and voluntarily prepare GHG emissions inventories; some have gone even further and started assessing and managing their carbon footprints.

7. Environment and development co-operation

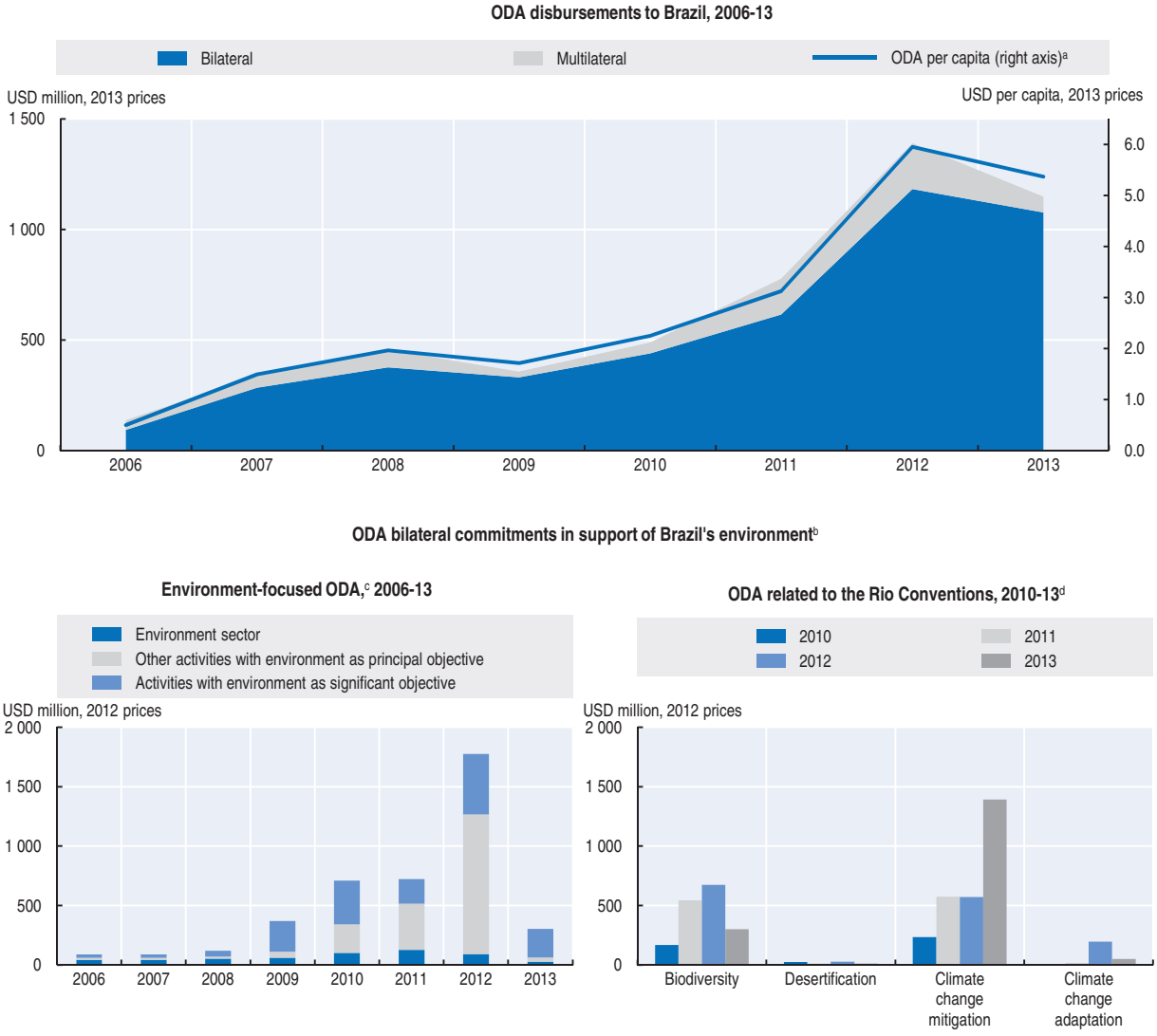
7.1. Brazil as a recipient of development assistance

Despite being a middle-income country, Brazil receives significant volumes of official development assistance (ODA). The volume of ODA disbursed increased over the 2000s, peaking at USD 1.4 billion in 2012, making Brazil the largest ODA recipient in South America in that year (Figure 3.10). However, due to the size of its domestic economy, Brazil's relative dependence on foreign aid is low. Between 2000 and 2013, ODA fluctuated between 0.01 and 0.06% of gross national income (GNI) per year; per capita ODA averaged roughly USD 2 per year and just recently increased to over USD 5 in 2012-13 (OECD, 2013e).

Environment and the green economy are key areas for ODA to Brazil. In 2013, USD 300 million was channelled to the Amazon Fund alone; projects targeting renewable energy and water and sanitation amounted to more than USD 400 million each (OECD, 2015f). The OECD Creditor Reporting System[32] shows that about 60% of bilateral ODA commitments to Brazil over the past decade targeted environmental sustainability. Total environment-related ODA commitments reached about USD 1.8 billion in 2012, though they decreased in 2013. A rather small share of these resources is devoted to the environment sector per se[33] (on average USD 83 million in 2011-13); most of the aid is aimed at other sectors but has environmental co-objectives (Figure 3.10). The latter category more than tripled between 2011 and 2012, driven by large-scale projects in the water supply and sanitation, forest, transport, and energy sectors. Overall, ODA related to objectives of the Rio Conventions increased in recent years, especially for climate change mitigation (Figure 3.10). The largest donors for environmental sustainability were Germany, Norway and the United Kingdom.

Brazil has also received substantial financial support from multilateral funding mechanisms established under international environmental initiatives, such as the Global Environment Facility (GEF).[34] Some major environmental projects, such as the National Biodiversity Project and the Amazon Region Protected Areas programme (Chapter 4), are financed through the GEF, though Brazil's project portfolio is large and diverse. Of the current 55 national projects, 23 target biodiversity (accounting for 45% of total GEF grants received) and 13 climate change (24% of grants); the rest involve international waters, land degradation and persistent organic pollutants. Brazil has participated in 34 GEF-sponsored regional and global projects in Latin America. The GEF Country Portfolio Evaluation attested that such funding had sustainably helped develop institutional capacity and that it triggered significant private sector involvement in climate change projects (GEF, 2012).

Figure 3.10. **Environment is a key area for official development assistance to Brazil**



a) Bilateral official development assistance from DAC members.
b) The marker data do not allow exact quantification of amounts allocated or spent in support of the environment. They give an indication of such aid flows and describe the extent to which donors address these objectives in their aid programmes.
c) Environment sector: aid in direct support of general environmental protection activities. Other activities with environment as principal objective: aid activities where environment protection is an explicit objective of the activity and fundamental in its design. Activities with environment as significant objective: aid activities where environment protection is an important, but secondary, objective of the activity.
d) Most activities targeting the objectives of the Rio Conventions fall under the definition of "environment-focused aid" but there is no exact match of the respective coverages. An activity can target the objectives of more than one of the conventions, thus respective ODA flows should not be added.
Source: OECD (2015), *OECD International Development Statistics* (database).

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7.2. Brazil as a provider of development co-operation

Brazil plays an increasing role as a provider of development co-operation. According to official estimates, federal expenditure on development co-operation increased from BRL 384 million in 2005 to BRL 724 million in 2009, and this may underestimate expenditure from all public institutions (IPEA, 2010b).[35] About two-thirds of the volume spent over 2005-09 consisted of contributions to international organisations, with regional funds, notably the Mercosur Structural Convergence Fund, being the main channels. New, more complete estimates indicate that Brazil's development co-operation reached

BRL 1.6 billion (USD 927 million) in 2010 (IPEA, 2014).[36] The OECD estimated that USD 500 million of the 2010 flows may qualify as ODA, and 60% of this was channelled through multilateral organisations (OECD, 2015g).[37] Overall, the number of projects increased from 69 in 2005 to over 400 in 2010. Bilateral projects concentrates on technical co-operation. While Latin American and Portuguese-speaking African countries were initially the focus, Brazilian co-operation now extends to some 70 developing countries in Africa, Asia and Latin America.

Technical co-operation is overseen and co-ordinated by the Brazilian Co-operation Agency (ABC) of the Ministry of External Relations, with delivery carried out by more than 170 federal institutions (IPEA, 2014). Brazilian public institutions are increasingly involved in the negotiation and design of technical co-operation projects, often through their own international affairs units, and sometimes with limited ABC involvement. Collaboration between the ABC and MMA seems to be looser than in other policy areas, such as health and social protection.

Thematically, Brazil's co-operation has focused on health, agriculture and education, which accounted for about half of its technical co-operation in 2003-10. Environment has been less prominent, with environmental projects accounting for 7.5% and energy projects for 3.5% in 2010 (Cabral and Weinstock, 2010). The number of environment projects has recently expanded, and prospects of this growth accelerating in the near future are good; the government plans to expand south-south co-operation on forest recovery, for example (MCTI, 2014b). There is no provision ensuring systematic screening of technical co-operation projects for potentially negative environmental impacts.

Many of Brazil's flagship initiatives have been in agriculture. The largest is ProSavana, a programme by Brazil, Japan and Mozambique for agricultural development of Mozambique's savannah, based on Brazil's *cerrado* development. Several other agricultural projects have been launched in Africa and elsewhere, many of which aim to stimulate agro-energy. The 2010 Africa-Brazil Agriculture Innovation Marketplace is a joint research initiative aimed at stimulating agricultural innovation in Africa in areas including pasture rehabilitation, natural resource management and clean energy production. Brazil also signed various bilateral biofuel co-operation agreements with African countries, providing technology transfer enabling them to develop their own biofuel industries.

Brazil is engaging with other countries to share its expertise in forest and land use monitoring. The National Institute for Space Research, which developed remote sensing techniques for monitoring deforestation in the Amazon (Box 4.4), runs a training centre on satellite rainforest monitoring in Belém (INPE, 2014). In addition, Brazil's Amazon Fund has begun funding projects outside Brazil, providing about USD 10 million to the Amazon Cooperation Treaty Organization for a project to expand systematic monitoring of forest coverage to the other seven countries sharing the Amazon biome.

Brazil is one of the most active partners in triangular co-operation (OECD, 2013f). The government considers such co-operation a key tool to scale up and improve the impact of Brazilian technical co-operation. Its main partners in triangular co-operation are bilateral providers and international organisations (OECD 2013f; OECD, 2015g). An example of environment-related triangular co-operation is Amazonia Sem Fogo (Amazon Without Fire), a project of Brazil, Italy and Bolivia to reduce deforestation by developing alternatives

to the use of fire in agriculture, thus contributing to environmental protection and improvement of living conditions in rural communities. The BNDES signed agreements in 2013 with development institutions in the BRIICS countries to promote collaboration among them, including "initiatives to foster a low-carbon economy and to develop infrastructure on the African continent" (BNDES, 2013b).

Recommendations on greening the economy in the context of sustainable development

Greening the system of taxes and charges

- Reform the system of environmentally related taxes and charges, possibly within the context of a broader fiscal reform, including:
  - maintaining positive rates for the federal CIDE tax on petrol and diesel and adjusting them to reflect fuel carbon content and emissions of local air pollutants; applying the CIDE to fuels used for aviation and stationary purposes (e.g. industry);
  - introducing taxes on pollution (e.g. air emissions), waste (e.g. packaging materials) and resource use (e.g. minerals), and aligning vehicle taxation to environmental performance;
  - ensuring that water abstraction and pollution charges reflect scarcity and pressures on the environment and are consistently applied across river basins and throughout the country (as required by law).
- Pursue the assessment of carbon pricing options; consider testing GHG cap-and-trade systems at state level to gain the experience needed to implement a countrywide system linked to international carbon markets.

Investment in environment-related infrastructure and services

- Systematically integrate environmental objectives into sectoral policies and public investment programmes, which should feature environmental sustainability criteria for implementation and indicators to monitor progress.
- Simplify administrative procedures and support capacity development to improve the execution of environment-related infrastructure investment programmes, especially at local level; encourage stronger intermunicipal collaboration to achieve economies of scale in providing sanitation and waste treatment services.
- Extend the use of user charges for water supply, sanitation and waste services and enforce their collection, with a view to encouraging efficient use of resources, increasing cost recovery, improving investment financial viability and leveraging private sector resources; use social transfers to ensure that low-income households have adequate access to these services.
- Strengthen measures to improve energy efficiency by introducing energy standards for buildings and appliances, integrating them into social housing programmes and using mandatory fuel economy standards and labelling to promote a shift towards more efficient vehicles.
- Continue to scale up investment in railways and urban public transport systems; consider extending the use of instruments such as road tolls, congestion charges, parking fees and restrictions on car circulation to moderate the use of private vehicles.

Recommendations on greening the economy in the context of sustainable development *(cont.)*

Eco-innovation and environmental goods and services

- Stimulate the production and diffusion of environmental technology, goods and services by:
  - raising awareness about best practices and available technology, particularly in small and medium-sized enterprises;
  - facilitating access to finance for investing in environmental, renewables and energy-saving technology;
  - monitoring the effects of local content rules on the long-term competitiveness of the emerging environmental technology industry (e.g. wind and solar);
  - regularly updating the catalogue of sustainable products for green public procurement, and training procurement managers;
  - further streamlining environmental labelling initiatives.

Notes

1. The revenue raised through the CIDE is collected by the federal government, with about 30% being allocated to states in shares proportional to the length of their roads, their fuel consumption and their population.
2. The 2012 reform eliminated the Fuel Consumption Charge (CCC) and General Reserve Reversion Charge (RGR). The CCC was paid by electricity distributors and passed on to end customers. Its revenue was used by the state electricity company, Eletrobras, to subsidise electricity generation using diesel fuel in isolated systems in the North. The RGR was not levied on electricity consumption, but paid by electricity generators and transmitters at a rate of 2.5% of the value of fixed assets in service or up to 3% of annual company revenue. It was earmarked to fund the rural electrification programme Luz Para Todos (Section 5.4) and an efficient public lighting programme.
3. This is part of the Financial Compensation for Use of Water Resources: hydroelectric power generators are charged at 6.75% of the value of electricity produced. The revenue from the 6% part of the charge rate is shared between the federal government and the state and municipal governments affected by the plants. Revenue are not earmarked for water infrastructure and environmental purposes (OECD, 2012). In 2013, revenue from this source was about BRL 1.5 billion.
4. For example, prior to the 2013 tax reform, Mexico applied a floating-rate excise tax on petrol and diesel. The tax rate varied according to a formula linked to international benchmark fuel prices. In practice, when this international price was high, the tax rate became negative so that domestic prices fell below the import cost of petrol and diesel. Conversely, a lower international price triggered an increase in the tax rate (OECD, 2013b).
5. The PIS/COFINS social contributions are levied on gross revenue from fuel sales, generally at rates higher than the standard.
6. The ICMS is the state-level value added tax, levied on imports and on intra- and interstate transactions of goods and services. The standard rate varies between 17% and 19%. In general, electricity is subject to a higher rate (25%), while oil and gas operations are subject to the standard intrastate rate and natural gas at a rate of 12%. Petroleum and its derivatives are exempt from interstate operations, while natural gas is generally taxed at 12%, though in the North and North-east regions this falls to 7%. Rates for ethanol and biodiesel vary by state and may be reduced for interstate operations.
7. Biodiesel producers can opt for fixed PIS/COFINS rates per cubic metre of fuel.
8. The PSE is the annual monetary value of gross transfers to agricultural producers arising from policy measures that support agriculture, including market price support, budgetary payments and budget revenue forgone. It is expressed as a percentage of gross farm receipts.
9. Market price support arises from policy measures that create a gap between domestic market prices and border prices of a specific agricultural commodity. In Brazil, price levels vary by year and by region, with support often targeting regions that are distant from main consumer markets; they usually do not diverge much from international prices.

10. The SNCR incorporates federal, state and co-operative banks providing government-supported credit to agriculture.

11. Constitutional Amendment 491/2010.

12. The Forest Code obliges rural landowners to set aside a percentage of their land to be maintained as a permanent forest reserve (Legal Reserve) and forbids the clearing of primary vegetation on steep slopes and along the margins of rivers and streams (which are classified as Areas of Permanent Protection) (Chapter 4). Private Reserves of Natural Heritage are private areas declared as conversation units (Chapter 5). To qualify, the property must meet certain environmental requirements, such as high biodiversity, scenic looks or ecological relevance.

13. The BNDES lent at a subsidised rate of 5.5% in January 2015, compared to the central bank's short term rate of 11.75% (Financial Times, 2015).

14. The special incentive regimes for infrastructure development (Regime Especial de Incentivos para o Desenvolvimento da Infraestrutura, REIDI) grant tax exemptions for infrastructure projects in areas of public interest (e.g. transport, ports, electricity, sanitation, irrigation). The 2012 law on infrastructure bonds introduced tax breaks for buyers of bonds issued to finance approved transport and energy infrastructure. While the tax breaks have proved successful in areas such as telecommunications and renewables, the infrastructure bonds have had a slow start and are still a small part of the corporate debt market.

15. Concessions are awarded for projects that are financially viable without any public payment to the private operator (i.e. they rely on user charges alone); PPP agreements are used for projects requiring public subsidies to be financially viable.

16. In PAC's first phase only 4% of planned investment for sanitation was disbursed; by 2013 about 20% of funding was disbursed and 54% of sanitation projects scheduled as part of PAC 2 had been granted formal approval (Amann et al., 2014; TCU, 2014).

17. The BNDES has increased low-interest lending for urban mobility projects, and total lending volumes have grown since 2008. In addition, PAC channelled special funds to urban mobility projects starting in 2011, targeting both medium and large cities (Table 3.3). Since 2010, the Ministry of Cities, working with Brazil's second largest public bank – Caixa Econômica Federal, has run a low-interest loan programme for urban transport investment, financed by a levy on wages.

18. São Paulo city's budget covers about 20% of the funds needed for bus and subway transport (Amann et al., 2014).

19. The fare-setting model is based on a profit margin applied to baseline costs per passenger kilometre. Any increase in input costs (such as fuel or salaries), or reduction in number of passengers, automatically leads to a fare increase.

20. The automatic adjustment in bus fares and the lack of regulatory control sparked mass demonstrations in São Paulo and other cities in 2013 (The Economist, 2013).

21. The PDE expects to add 22.7 GW of power capacity from renewable sources other than large hydro by 2022. Wind will account for the bulk of this (15.6 GW), followed by biomass (5 GW) and small hydro (2 GW); an expansion of solar photovoltaic capacity (2 GW) was recently added.

22. The Brazilian Alcohol Programme included price control measures, investment support, preferential financing and fiscal incentives. The state oil company, Petrobras, has facilitated blending, storage and distribution.

23. In 2011, the BNDES and the Brazilian Innovation Agency (Finep) launched a programme to support RD&I in the ethanol sector, funding 42 projects for a total of USD 1.6 billion (BNDES, 2013a).

24. Established in 2002, the Sectoral Fund for Energy had launched seven public calls for tender by 2009, the majority focusing on increasing electricity supply efficiency (BRL 47.8 million), education and dissemination (BRL 1.3 million), demand-side energy management (BRL 4 million) and small-scale solar PV and wind power (BRL 4 million).

25. The sectoral programmes under the plan are i) sustainable production (energy efficiency, solid waste and wastewater treatment in industry); ii) recovery of biomes and sustainable production of forest-based activities; iii) environmental sanitation (energy generation from waste, reverse logistics and municipal waste management, and contaminated soil); and iv) monitoring systems.

26. As a benchmark, in 2011, government budget appropriations and outlays for R&D with environmental objectives was 2% of the total, on average, in OECD countries (OECD, 2014). However, Brazil does not report to the OECD Research and Development Statistics Database, and the data cannot be directly compared.

27. The sectoral funds that provide finance for environment-related innovation are CT-Agribusiness (BRL 5 million disbursed in 2010), CT-Amazônia (BRL 1.7 million), CT-Waterways (BRL 1.6 million), CT-Biotechnology (BRL 1.3 million), CT-Energy (BRL 2.7 million) and CT-Hydro (BRL 2 million).

28. The "revealed technology advantage" is defined as a country's share of patents in a particular technology field divided by its share in all patent fields. The index is equal to zero when the country holds no patents in a given sector; 1 when the country's share in the sector equals its share in all fields (no specialisation); and above 1 when a specialisation is observed (OECD, 2014).

29. The CDM was developed following a Brazilian proposal in the 1997 Kyoto Protocol negotiations.

30. The value of sustainable public procurement more than tripled over 2010-13, but sustainable products still account for less than 0.1% of government purchases (MMA, 2015).

31. The GHG Protocol, developed by the World Resources Institute and the World Business Council on Sustainable Development, sets the global standard for how to measure, manage and report GHG emissions. More information can be found at www.ghgprotocol.org.

32. Within the OECD Creditor Reporting System Aid Activity Database, countries use a policy marker to identify activities that have environmental objectives. Over the past decade, roughly 80% of projects have been screened under the Creditor Reporting System.

33. The category "environmental sector" includes ODA flows directed towards environmental policy and administrative management (e.g. regulations, institutions and practice), biosphere protection, biodiversity, site preservation, flood prevention and control, environmental education and training, and environmental research.

34. The GEF has provided USD 427 million in grants to Brazilian environmental protection since its establishment in 1991 (complemented by USD 1 400 million of co-financing) (GEF, 2014).

35. The 2005-09 estimates were a first attempt to quantify official Brazilian development co-operation and there is a general idea that this number underestimates the actual volume devoted to international co-operation due to the loose co-ordination of data collection and the dispersed pattern of project delivery (most of Brazil's technical co-operation projects are implemented by public institutions which do not charge for their participation and expertise); moreover, IPEA's estimates only include federal government expenses and exclude concessional loans by federal banks like the BNDES, as well as credit exports and debt relief.

36. The 2010 estimate attempted to include technical co-operation projects implemented by public institutions, which partly explains the significantly higher number. The rise over 2009-10 is also linked to a BRL 460 million increase in expenditure for peacekeeping operations.

37. The significant divergence between the official estimate for Brazil's development co-operation in 2010 and the OECD estimate is linked to different accounting methodologies. The OECD estimates are based on Brazil's official data, which may exclude some activities that would qualify as development co-operation in OECD statistics. In addition, the OECD estimates include only activities in low and middle-income countries and contributions to multilateral agencies whose main aim is promoting economic development and welfare of developing countries, and they exclude bilateral peacekeeping activities.

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ANNEX 3.A

Progress towards the Millennium Development Goals

Table 3.A.1. **Selected Millennium Development Goals, targets and indicators**

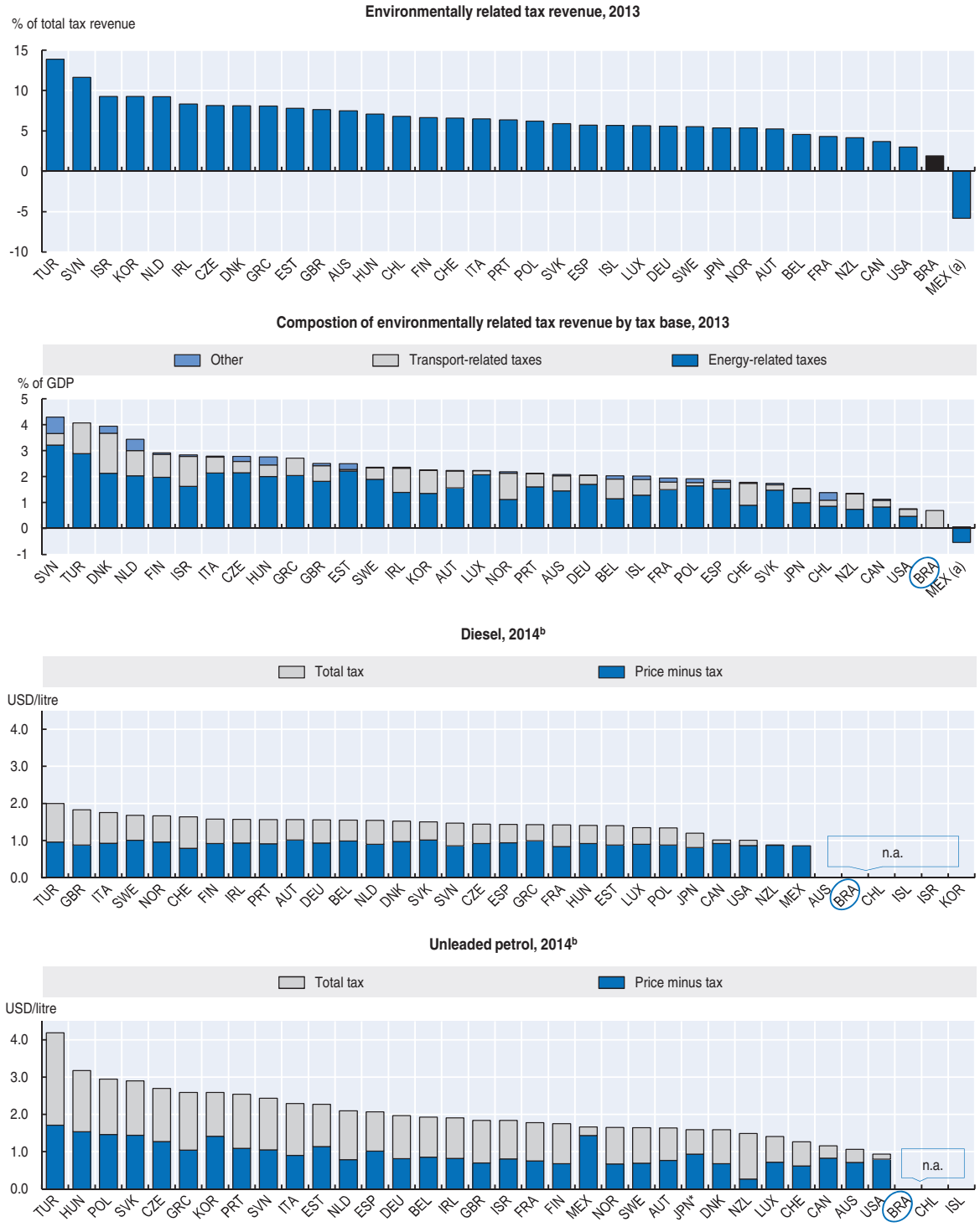
Selected Millennium Development Goals, targets and indicators		Brazil, baseline		Brazil, latest available year		LAC, latest available year
GOAL 1:	**Eradicate extreme poverty and hunger**					
Target 1.A:	***Halve between 1990 and 2015 the proportion of people whose income is less than USD 1.25 a day***					
Indicator 1.1	Population below USD 1.25 (PPP) a day (%)	1990	17.2	2010	6.1	5.5
Indicator 1.2	Poverty gap ratio (%)	1990	7.2	2009	3.6	2.9
Indicator 1.3	Share of income or consumption to the poorest quintile (%)	1990	2.2	2009	2.9	. .
Target 1.B:	***Achieve full and productive employment and decent work for all including women and young people***					
Indicator 1.4	Annual growth rate of GDP per person employed (%)	1993	2.82	2009	-0.7	
Indicator 1.5	Employment-to-population ratio (%)	1990	54.7	2011	61.7	62.1
Indicator 1.6	Proportion of employed people living below USD 1.25 a day (% of total employment)	1992	10.1	2009	3.3	2.9
Target 1.C:	***Halve between 1990 and 2015 the proportion of people who suffer from hunger***					
Indicator 1.9	Proportion of population below minimum level of dietary energy consumption (%)	1991	14.8	2013	5	7.9
GOAL 2:	**Achieve universal primary education**					
Target 2.A:	***Ensure that by 2015 children everywhere boys and girls alike will be able to complete a full course of primary schooling***					
Indicator 2.2	Percentage of pupils starting grade 1 who reach last grade of primary (%)	1992	70.3	2009	53.7	76.7
Indicator 2.3	Literacy rate of 15-24 year-olds both sexes (%)	2000	94.2	2012	98.6	97.8
GOAL 3:	**Eliminate gender disparity in education and empower women**					
Target 3.A:	***Eliminate gender disparity in primary and secondary education preferably by 2005 and in all levels of education no later than 2015***					
Indicator 3.2	Women's in wage employment (non-agricultural sector) (%)	1990	40.2	2012	47.2	43.8
Indicator 3.3	Proportion of seats held by women in national parliament (%)	1990	5.3	2014	8.6	25.9
GOAL 4:	**Reduce child mortality**					
Target 4.A:	***Reduce by two thirds between 1990 and 2015 the under-5 mortality rate***					
Indicator 4.1	Under-5 mortality rate (per 1 000 live births)	1990	61.5	2013	13.7	19
Indicator 4.2	Infant mortality rate (per 1 000 live births)	1990	51.4	2013	12.3	16
GOAL 5:	**Improve maternal health**					
Target 5.A:	***Reduce by three quarters between 1990 and 2015 the maternal mortality ratio***					
Indicator 5.1	Maternal mortality ratio (per 100 000 live births)	1990	120	2013	69	85
Target 5.B:	***Achieve by 2015 universal access to reproductive health***					
Indicator 5.4	Adolescent birth rate (per 1 000 adolescent women aged 15-19)	1996	83.9	2011	64.8	75.9
Goal 6:	**Combat HIV/AIDS malaria and other diseases**					
Target 6.A:	***Halt by 2015 and begun to reverse the spread of HIV/AIDS***					
Indicator 6.9	Incidence prevalence and death rates associated with tuberculosis (cases per 100 000 population) (mid-point)					
	Incidence	1990	84	2012	46	43
	Prevalence	1990	140	2012	59	61
	Death	1990	7	2012	2.5	3
Goal 7:	**Ensure environmental sustainability**					
Target 7.A:	***Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources***					
Indicator 7.1	Forest area (% of land area)	1990	68.8	2010	62.4	47.4
Indicator 7.3	Consumption of Ozone-Depleting Substances (ODP metric tonnes)					
	All Ozone-Depleting Substances	1990	3 9337	2012	1 388	5 166
	Ozone-Depleting CFCs	1990	8 539	2012	0	
Indicator 7.6	Terrestrial and marine areas protected (% territorial area)	1990	7.06	2012	25.97	20.3
Target 7.C:	***Halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation***					
Indicator 7.8	Population using an improved drinking water source total (%)	1990	88	2012	98	94
	Urban (%)	1990	96	2012	100	97
	Rural (%)	1990	68	2012	85	82
Indicator 7.9	Population using an improved sanitation facility (%)	1990	67	2012	81	82
	Urban (%)	1990	79	2012	87	87
	Rural (%)	1990	31	2012	49	63
Target 7.D:	***By 2020 to have achieved a significant improvement in the lives of at least 100 million slum dwellers***					
Indicator 7.10	Urban population living in slums (%)	1990	36.7	2009	26.9	23.5
Goal 8:	**Develop a global partnership for development**					
Indicator 8.12	Debt service as a percentage of exports of goods and services (%)	1990	18.6	2012	4	6.6
Indicator 8.15	Mobile-cellular subscriptions (per 100 inhabitants)	1990	0	2013	135.3	109.1
Indicator 8.16	Internet users (per 100 inhabitants)	1992	0.01	2013	51.6	43.4

Source: UN (2015) *Millennium Development Goals Indicators* (database); UN (2014) *The Millennium Development Goals Report 2014*.

ANNEX 3.B

Data on green growth performance

Figure 3.B1. **Environmentally related taxes**



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.

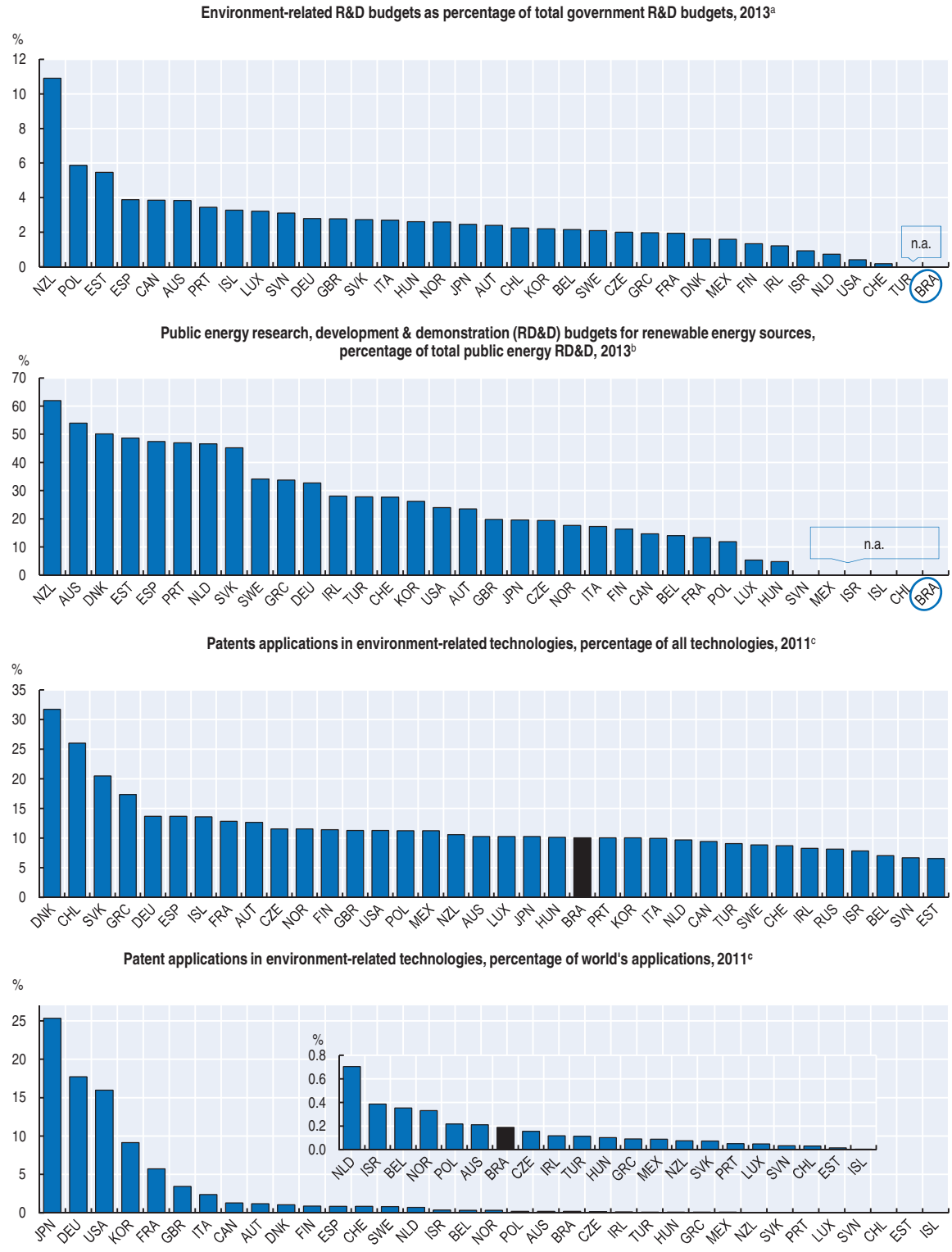
a) Until 2014, the system used to stabilise end-use prices of motor fuels caused tax revenue to turn negative (i.e. become a subsidy) in years when the international oil price was high. Mexico's 2013 Tax Reform corrected this mechanism and introduced a tax on fossil fuels based on their carbon content, which will yield positive revenue.

b) Diesel: automotive diesel for commercial use, current USD; unleaded petrol: unleaded premium (RON 95), except Japan (unleaded regular), USD at current prices and purchasing power parities.

Source: IEA (2015), *IEA Energy Prices and Taxes Statistics* (database); OECD (2015), *OECD Database on Instruments Used for Environmental Policies and Natural Resource Management* (database).

StatLink http://dx.doi.org/10.1787/888933279963

Figure 3.B2. **Green innovation**



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.

a) Government budget appropriations or outlays for R&D; breakdown according to the NABS 2007 classification.

b) Public energy technology budgets for research, development and demonstration (RD&D).

c) Higher values inventions that have sought patent protection in at least two jurisdictions. Data are based on patents applications filed under the Worldwide Patent

StatLink http://dx.doi.org/10.1787/888933279973