

# Natural resources within the Union of South American Nations

Status and trends for a regional  
development agenda



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This document was prepared by Hugo Altomonte, Chief of the Natural Resources and Infrastructure Division of the Economic Commission for Latin America and the Caribbean (ECLAC); Jean Acquatella, Andrés Arroyo and Andrei Jouravlev, Economic Affairs Officers with the Natural Resources and Energy Unit; and Jeannette Lardé and René Salgado, Research Assistants with the Infrastructure Services Unit and the Natural Resources and Energy Unit, respectively. The authors wish to express their thanks to Mónica Bruckmann of the Secretariat of the Union of South American Nations (UNASUR) for her comments and observations.

The opinions expressed in this document are the sole responsibility of the authors and do not necessarily reflect the views of the Organization.

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## FOREWORD

The debate on natural resource endowment and more equitable sustainable development is a priority on the public policy agenda of the countries of Latin America, in general, and those of the Union of South American Nations (UNASUR), in particular. South American countries possess some of the world's most extensive mineral reserves: 65% of global reserves of lithium; 42% for silver; 38% for copper; 33% for tin; 21% for iron; 18% for bauxite and 14% for nickel. Their mineral potential is estimated to be even greater since only partial geological information is currently available. The subcontinent is also known to have vast oil reserves, especially since the certification of the extra-heavy crude reserves in the Orinoco Belt in the Bolivarian Republic of Venezuela. It also accounts for approximately 30% of global renewable reserves of water, corresponding to over 70% of the water on the American continent.

This study was prepared by the Economic Commission for Latin America and the Caribbean (ECLAC) at the request of the Secretary-General of UNASUR and as part of the cooperation agreement signed by the two organizations in March 2012.

Natural resource governance is viewed by these two entities as playing a central role within their lines of work and as referring to the set of sovereign policies over ownership and allotment of natural resources and the distribution of productivity gains arising from their exploitation. This document seeks to provide useful information to enable countries to extend their contribution to more inclusive development and to shore up the equality agenda.

This publication identifies the different legal and economic instruments which States invoke in order to assert ownership of and distribute the revenue derived from the exploitation of mineral, water and hydrocarbon resources. These instruments include: legislation and special regulations; sectoral planning policies and regimes for public-private partnerships for investment and development; institutions created for regulatory purposes, mechanisms for the control and distribution of revenue from natural resources between levels of government; direct participation in the development of resources through public enterprises; public management and mechanisms for the resolution of socioenvironmental conflicts in mining sectors; creation of targeted public savings and investment funds (geared to investment in education, innovation and development, among others) and macrofiscal stabilization funds, as well as support for countercyclical macroeconomic management in response to cyclical fluctuations in the international prices for natural resource exports.

The subregion faces challenges and tensions arising from natural resource management and exploitation. In particular, States need to be more progressive in claiming their share of the windfall profits from mining —particularly given the length of the current boom— and in preserving the momentum of investment in this sector, as well as in the hydrocarbon and agricultural export sectors. The nations of our Great Homeland must report on the adjustments applied in the tax policy to the different sectors in order to make it more progressive, seek better coordination and avoid the fiscal competition that has the opposite impact. Lastly, the economic dilemmas implicit in the distribution and public investment of the revenues from natural resources between social groups and different levels of government must also be managed.



Notwithstanding the foregoing, public policymakers of the countries in the subregion should direct their attention to two important issues:

- (1) The need to ensure efficient investment of the windfall earnings from natural resources, now that prices are buoyant, by developing mechanisms such as funds that can be used to avert any future price volatility or promote public investments in education, health, infrastructure and innovation and technological development, which in the final analysis can replace the extracted assets;
- (2) The need to improve public management of socioenvironmental conflicts that arise in the development of natural resource sectors.

South America is a net exporter of minerals and hydrocarbons and has abundant water resources that can be harnessed as a source of hydroelectricity, a clean and sustainable energy source. However, to make the most of their comparative advantages in the future, States must resume their proactive role and articulate with all social stakeholders the objectives of an equitable and sustainable energy policy.

Designed to respond to citizens' demands, apprehensions and concerns, this policy should establish targets for providing access to energy to those economic sectors and social groups where it is lacking today. Thus, in each case the desirable and possible sources of supply must be defined, depending on the availability of resources and strategic economic, social and environmental considerations.

The design of policies to provide access to sufficient, good quality energy at affordable prices should lead to discussions on the incorporation of subsidies—both for facilitating access and for the purchase of modern and efficient equipment—in order to reduce the total energy expenditure of households and help to mitigate climate change.

The challenge in the hydrocarbon sector is to find a balance between public and private interests that will allow the investments needed to supply the domestic market and maintain the region's export position. Institutional, regulatory and contractual innovations are needed to respond to the multiplicity of structural and cyclical factors that affect the current oil market, keeping in view the interests of the community, sovereignty and the public goods and services that this industry needs to contribute in the countries where it operates.

UNASUR countries have the opportunity to prioritize the drinking water and sanitation sector—in terms of both financing and efficient public policies for reducing poverty and indigence and fostering economic development and social inclusion. The improvements attained in this sector will also present new opportunities for the agricultural industries geared to exports and tourism as well as the protection of the environment.

The drinking water and sanitation sector calls for an effective long-term commitment to financing and to the construction of robust and stable institutions. Water has an economic value which must be internalized in the decisions of its users in order to build awareness of the fact that it is essential and scarce. To this end, States should design targeted subsidies to enable low-income users to meet their basic needs and promote in a positive manner fulfilment of access to water as a human right.

The scale of service providers is crucial in lowering costs in the drinking water and sanitation sector. A good decision relating to economies of scale will result in lower prices for consumers.

In terms of natural resources, UNASUR proposes working to improve the sector's capacity to adapt to climate change and higher energy costs.

It is indispensable to launch discussions on the challenges that natural resource-exporting countries in the region face in terms of public policies, the institutional framework and the regulation of ownership and the effective use of income. These challenges involve, among other governance functions, regulatory, fiscal and macroeconomic functions, strategic planning, public policy formulation and implementation and the management of socioenvironmental conflicts. In order to confront them and maximize their social benefit, institutional innovation must be fostered and the capacity for public management strengthened.

ECLAC views UNASUR as the appropriate forum for analysing these issues and for sharing policies and successful experiences or lessons learned. It is also the ideal setting for building the institutional framework needed to satisfy the urgent need to establish mechanisms for measurement and information and for generating precise, robust, comparable data that is consistent, relevant and available on a timely basis. Another significant challenge in this regard is the scant availability of information on certified reserves of non-renewable resources; in this regard, UNASUR countries could contemplate creating a subregional agency, based on current national geological, mining or similar institutions, for certifying reserves and exploring prospectuses, particularly of mining resources.

Information is essential for the adoption of policy and regulatory decisions. It allows for the adoption of management indicators for measuring the performance of providers, assessing their efficiency and detecting best practices, among others.

Any advance towards the sustainable and equitable exploitation of natural resources will reinforce the ability of the countries of Latin America and the Caribbean to tackle the challenges relating to their development agenda, including those relating to fulfilment of the Millennium Development Goals. This is particularly relevant in relation to structural change for equality and includes raising productivity with innovation, employment with rights and protecting strategic resources such as minerals, water and energy.

These reflections are put before member countries of UNASUR in the hope that they will stimulate discussions on the promise of South American integration, which is perceived as indispensable for overcoming the pressing problem of inequality in our region.

We present them in the conviction that change must be sought as a matter of urgency to promote well-being and conditions conducive to development in our region, bearing in mind the centrality of the sustainability and equality variables necessary for reflection and action. Each country will need to seek for itself equilibrium between State, market and society as a basis for a political and fiscal covenant. There is no single model or recipes but a more progressive and more distributive structure and tax burden will undoubtedly strengthen the role of the State and public policy thereby guaranteeing thresholds for well-being.

In the long-term strategic horizon, equality, economic growth and environmental sustainability must go hand-in-hand and be mutually supportive and reinforcing in a virtuous dialectic.

Thus, we advocate valuing and harnessing more efficiently natural resource stocks in order to direct gains towards growth associated with less structural heterogeneity, more productive development and a higher degree of industrialization, which closes gaps and has equality as its core.

**Alicia Bárcena**  
Executive Secretary  
Economic Commission for  
Latin America and the Caribbean (ECLAC)

**NOTE BY THE SECRETARIAT OF THE UNION OF SOUTH AMERICAN NATIONS**

As part of the closer collaboration being pursued by the Economic Commission for Latin America and the Caribbean (ECLAC) and the Union of South American Nations (UNASUR), the Secretary General of the Union requested ECLAC to produce the present report, entitled “Natural resources within the Union of South American Nations: status and trends for a regional development agenda”.

We commend ECLAC on its sterling work in collecting and compiling the extremely relevant information on the status of natural resources in South America, in particular with respect to hydrocarbons, mining and water resources. This document will be of great value for policymakers in their effort to exploit more fully this huge potential for the integrated development of the region.

Indeed, this report opens up a whole agenda of study and research, which will need to be deepened and expanded as we seek a common policy not only for confronting challenges but also for harnessing the region’s immense resource endowment. The success of a project of the scope of UNASUR depends on the ability to pool the strengths of its members, which, in this case, consist essentially in the extent of their natural resources and human potential. Moreover, historically this has been a peaceful region and its peoples are increasingly aware of the need for unity.

It should come as no surprise that this kind of process gives rise to diverse visions and approaches, but the idea is precisely to identify areas of greater convergence and to strive to forge a common strategy.

It should be noted that the views and proposals set forth in this document are the sole responsibility of the authors and do not necessarily reflect the position of UNASUR. A comprehensive process of discussion and debate must now be launched in all UNASUR forums in order to move forward with consensus-building and the formulation of common policies with a view to enhancing the development and management of the subcontinent’s natural resources.

**Alí Rodríguez Araque**  
Secretary-General of UNASUR



## INTRODUCTION

### A. GOVERNANCE OF THE NATURAL RESOURCES SECTORS IN LATIN AMERICA AND THE CARIBBEAN<sup>1</sup>

The value of primary sector exports in Latin America and the Caribbean started to soar in 2003 because of the rise in international prices of metals, crude oil and other commodities, which peaked in 2007. The boom in the international demand for primary goods (minerals, hydrocarbons, soybean and agricultural commodities) largely explains the stronger macroeconomic performance and fiscal position of the region's exporting countries from 2003 onwards.

During the global financial crisis that affected the economy between 2009 and 2010, Latin America and the Caribbean showed the benefits of having built up the capacity to deploy countercyclical policies to cushion the impact of the international crisis, by managing fiscal savings made during the price boom before 2008. There is extensive literature on macroeconomic management as the means of preventing the so-called Dutch disease, which is the negative impact that extraordinary revenue generated by the exploitation of natural resources has on exchange rates and the overall production apparatus. It focuses on the importance of institutionalizing the use of saving mechanisms, such as stabilization funds, investment funds, macrofiscal rules and reserves to mitigate the negative effects of exchange rate appreciation on the rest of the economy during boom periods, like the present, and build up sufficient funds to alleviate the impact during a slump in prices.

According to economic literature, in the long-term countries must turn non-renewable natural resources into sustainable assets (human capital, production infrastructure, among others) in order to maintain the national revenue and further the development process once the resource life cycle has ended. In the past, the countries of the region have found it difficult to transform natural resource export booms (in mining, hydrocarbons and agro-industry) into long-term economic development processes with stable growth that would significantly reduce poverty and increase per capita income.

The short- and medium-term challenge for the countries of the region is to generate and efficiently invest extraordinary revenue from the current price cycle in order to achieve their sustainable and inclusive development goals. This challenge must be underpinned by a firm political consensus that enables the States to effectively channel investments into human capital, innovation, technological development and production infrastructure, and other long-term investments, and withstand political pressure to use up extraordinary resources today.

Each country's sovereign policy on the ownership, appropriation and distribution of natural resources is taken into account in the governance of natural resources in order to maximize its contribution to sustainable development. This undoubtedly involves many political challenges and requires sound public management. An area the region has yet to work on is reviewing and consolidating the institutional framework, regulatory frameworks and instruments used to maximize the natural resource sector's contribution to regional development. This involves the management of government revenues derived from the exploitation of these resources, which the State receives through the tax system, and distribution among different stakeholders and levels of government; mechanisms

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<sup>1</sup> In this document, the concept "natural resources" refers to minerals, hydrocarbons and water resources. It does not include resources such as land or earth, forest resources, fishery resources, biodiversity or genetic assets.

must be created to ensure these revenues are invested efficiently in order to lay the foundations for sustainable development.

States have several means of contributing to the natural resources sector. They include:

- (i) specific legislation and regulation;
- (ii) planning and formulation of sectoral policies, special tax regimes, concessionary regimes and public-private partnerships for investment, and the development of natural resources;
- (iii) creating specific institutions for regulating, controlling and distributing government revenues generated by the exploitation of natural resources among the different levels of government;
- (iv) direct involvement of the State in the development of resources through public companies, partnerships and agreements;
- (v) public administration and socioenvironmental conflict resolution mechanisms in extractive sectors;
- (vi) creating public saving funds for investment in a particular purpose (for example, education, innovation and development) and macrofiscal stabilization funds for countercyclical macroeconomic management to deal with international price movements of exported natural resources, and
- (vii) policies designed to promote industrialization and reform production in the natural resources sector by creating links with the rest of the economy and incorporating technology.

The governance of the natural resources sector involves many challenges relating to regulatory or fiscal aspects, macroeconomic management, strategic planning, the formulation and implementation of public policies, socioenvironmental conflict management and other government functions which require institutional innovation and sound public administration in order to maximize the social benefit of exploiting these resources.

While advances have been made in recent years to ensure that States and subnational governments have a greater share of revenues derived from the exploitation of natural resources, there are still many challenges to overcome, such as achieving efficient organization and establishing the institutional framework needed to maximize the sector's contribution to development.<sup>2</sup> Some of the challenges include:

- (i) institutionalizing mechanisms for countercyclical macroeconomic management in the face of volatile international prices for commodities exported by the region;
- (ii) developing mechanisms which ensure that the revenue generated from the exploitation of natural resources is efficiently invested by the State in education, health, infrastructure, innovation and technological development and is fairly distributed between social groups and levels of government;
- (iii) achieving effective public management of socioenvironmental conflicts which will inevitably arise during development of the natural resources sector;
- (iv) increasing the State's share in revenue from the exploitation of natural resources, particularly during price booms which are becoming more persistent, like the one at present, and

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<sup>2</sup> For example, by creating the Heritage and Stabilization Fund, Trinidad and Tobago became the only country to establish a long-term saving fund, financed by fiscal savings from the hydrocarbons sector.

- (v) sustaining the rise in investments and increasing the State's share in extraordinary revenues. To do this, it may be necessary to make changes to the tax policy applied in these sectors during periods of extraordinary earnings and improve the coordination and harmonization of fiscal treatment between countries receiving investments to avoid fiscal competition, which prevents these objectives from being achieved.

## **B. THE BOOM IN INTERNATIONAL PRICES OF METALS, CRUDE OIL AND OTHER RAW MATERIAL BETWEEN 2003 AND 2011**

The current boom in international prices of metals, crude oil and other raw materials is partly due to the steady rise in the global demand for these goods, which is attributable to accelerated economic growth in Asian countries in the past decade. The increase in global demand stems from the remarkable economic growth in China since the 1990s, which was bolstered by the growth of India and other emerging economies that started in 2000.

The increase in the demand for iron, copper, aluminium and other export minerals is linked with the growth in the construction, infrastructure and manufacturing sectors (which need steel, electrical conductors and industrial metals, among others); these sectors showed rapid growth as the pace of economic development of Asia's major economies increased. The rate of economic growth in these economies has also helped to boost the global demand for crude oil and other primary goods.

The economic outlook presented by several international organizations shows that Asia's principal emerging economies will continue to expand in the medium-term. More moderate growth is expected in China while other countries, such as India and Indonesia, will maintain or increase their current rate of expansion.<sup>3</sup> Given the inertia of economic development in Asia and other emerging regions, the global demand for primary goods is expected to grow and as a result, the current boom in international prices of metals, oil and other primary exports from the region should continue in the medium term.

The fact that the price of metals and crude oil has remained at record highs and has shown a rapid recovery after trending downwards during the subprime mortgage crisis (2008 and 2009) and the European debt crisis (2011) shows the persistence of the current price boom. The price of metals and crude oil in real terms between 2009 and 2011 was particularly favourable compared with the average price over the past 25 years (see figure 1).

From a State perspective, it is crucial to secure the Government's share of increased economic rents from extractive sectors during the present price cycle<sup>4</sup> without affecting the growth of investments in these sectors. This political dilemma is heightened by the fact that the boom in international prices for minerals is expected to continue over the next years.

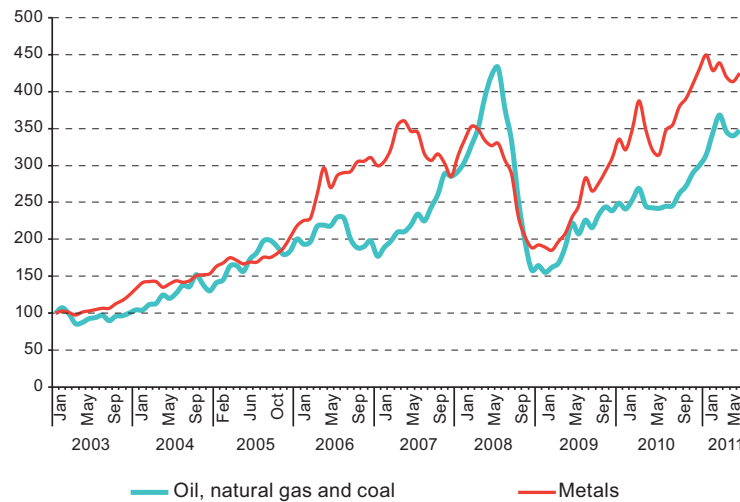
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<sup>3</sup> See World Bank and International Monetary Fund economic projections.

<sup>4</sup> In most of the countries, the law states that any mineral resource extracted belongs to the State.



Figure 1  
**INTERNATIONAL PRICE INDEX FOR RAW MATERIALS,**  
**JANUARY 2003-MAY 2011**  
*(Index: January 2003=100)*



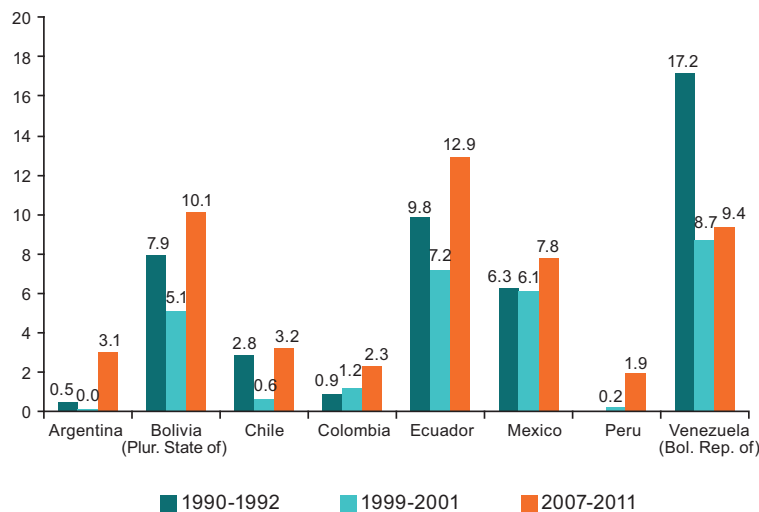
**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of figures provided by the International Monetary Fund.

### C. STATE SHARE IN REVENUE FROM EXTRACTIVE SECTORS

Fiscal revenue from the exploitation of primary products (mining, hydrocarbons and agricultural exports) has increased in terms of GDP as against the period 1990-1992 and, particularly, the start of the 2000s (1999-2001) when low values were observed in all of the countries analysed (see figure 2). The performance of fiscal revenues is in keeping with the evolution of price indices for these products during the same period (ECLAC, 2012d).

The accelerated increase in international prices for commodities over the past years also prompted Governments to strengthen the tax system in order to attract more resources. For example, the Bolivarian Republic of Venezuela, Chile and the Plurinational State of Bolivia created new marketing taxes on these products. In Argentina, devaluation of the national currency following the abolition of the currency-board regime meant that sectors exporting natural products received higher profits. Authorities in Argentina capitalized on this situation by introducing export duties on commodities to generate revenue.

Figure 2  
**LATIN AMERICA AND THE CARIBBEAN (SELECTED COUNTRIES): FISCAL REVENUE  
 GENERATED BY COMMODITIES, 1990-1992, 1999-2001 AND 2007-2011<sup>a</sup>**  
*(Percentages of GDP)*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of official figures.

<sup>a</sup> Figures for 2011 are estimates. Data for Chile does not include tax from private mines.

In the countries that have large endowments of non-renewable resources (gas, oil and minerals), the most direct way in which Governments have tapped into commodity export earnings and turned them into fiscal resources has been by taking a share of operating earnings, either through public enterprises or through equity holdings. Governments have several mechanisms for obtaining revenue, including royalties, usually production-based, which have made it possible to ensure a minimum payment for resources. Most countries have also applied the traditional income tax with differential rates, levied on enterprises engaged in the exploitation of non-renewable resources (ECLAC, 2012d) (see table 1).

During price booms, the State's share in extraordinary revenue generated by commodity exports is proportionately higher. And so, since the recent commodity price cycle has been long, there has been growing political interest with respect to the State's share in revenues from sectors exporting these goods.<sup>5</sup>

The aim of this document is to examine recent trends in the mining, hydrocarbons and water resources sectors as part of the wider agenda on natural resources governance.

<sup>5</sup> Given that it is difficult to operationalize the concept "extraordinary revenue", it is understood as cumulative earnings from surges in international prices, which are significantly higher than the rate of return that the industry demands, in line with international practice, for investing in exploitation projects in these sectors.

Table 1  
**LATIN AMERICA AND THE CARIBBEAN (10 COUNTRIES): CHARACTERISTICS  
 OF TAX REGIMES APPLIED TO NON-RENEWABLE PRODUCTS**

<b>Country and product</b>	<b>Royalties (rates)</b>	<b>Income tax (general rate)</b>	<b>Other taxes on income (rates)</b>	<b>Other levies</b>	<b>Public participation</b>
Argentina (oil and mining)	12%-15%; or 5% for marginal deposits (oil) 0%-3% (mining)	Profits tax: 35%		Export duties (25%-45%, 100% for hydrocarbons and 5%-10% for mining)  Taxes on liquid fuels, natural gas, gas oil, liquefied gas, naphthas and compressed natural gas  Mining duty	YPF (hydrocarbons)
Bolivia (Plurinational State of) (hydrocarbons)	Departmental royalties: 11%  National compensatory royalties: 1%  National royalties (national treasury): 6%	Business profits tax: 25%	Tax on profits-beneficiaries abroad: 12.5% <sup>a</sup>	Direct tax on hydrocarbons: 32%  Special tax on hydrocarbons and derivatives	YPFB (hydrocarbons)
Brazil (hydrocarbons)	10% of the value of production (can be reduced to 5%, depending on geological risk and other factors)	Income tax is 15%, plus a surcharge of 10% if profits are above R\$ 240,000 per year	Special participations: 10%-40%  Tax on profits-beneficiaries abroad: 15% (or 25% for payments to tax havens)	Social levy on net profit: 9%  Contribution for intervention in the economic domain: 10%	Petrobras (hydrocarbons)
Chile (mining)		First category tax on profits: 20%	Tax on profit remittances 35% and tax on interest remittances 4%  Special 40% profits tax (for public enterprises)	Specific tax on operating income from mining activity: progressive rates between 0.5% and 14%  Tax with revenue earmarked for the Armed Forces (Reserved Law): 10% of foreign currency earnings from exports of CODELCO copper production	CODELCO (copper)
Colombia (oil and mining)	8%-25% (oil)  1%-12% (mining)	Company tax: 25%  Income tax for equity: 9% for 2013-2015, 8% thereafter		Oil pipeline transport tax  National gasoline tax and regular grade diesel fuel duties  Economic fees of the national hydrocarbons agency	Ecopetrol (hydrocarbons)
Ecuador (oil)	12.5%-18.5% (of gross crude oil production)	Income tax: 23%	The State retains 25% of gross income from the contract area <sup>b</sup>	Labour share: the State receives 12% of profits (destined for decentralized autonomous governments)	Petroecuador (hydrocarbons)

Table 1 (concluded)

Country and product	Royalties (rates)	Income tax (general rate)	Other taxes on income (rates)	Other levies	Public participation
Mexico (oil and mining)		Oil revenue tax (PEMEX): 30% Income tax (certain subsidiary companies): 30%	Flat rate business tax (certain subsidiary companies): 17.5%	Mining duties Hydrocarbons duties Special tax on production and services (on gasoline) Merchandise import duty	PEMEX (hydrocarbons)
Peru (mining)	1%-12% on operating profit	Income tax: 30%	Dividends and profit distribution: 4.1%	Special mining tax: 2% - 8.4% and special mining levy: 4% -13.12% (on operating profit)	
Trinidad and Tobago (oil)	10% on onshore sales and 12.5% on offshore	Profit tax: 50% of profits obtained from oil production	Additional tax on crude oil sales (the rate varies with the oil price) Green fund tax: 0.1% of gross income	Additional tax on oil production Unemployment tax: 5% of profits obtained from oil production	Petrotrin (hydrocarbons)
Venezuela (Bolivarian Republic of) (oil)	30% of the value extracted	Oil income tax: 50%		Tax on extraordinary prices Extraction duty Export record tax	PDVSA (hydrocarbons)

**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of official information from the respective countries.

<sup>a</sup> The 25% additional tax on extraordinary profits (Surtax) was repealed by the Hydrocarbons Act (Law No. 3058) and replaced by YPFB participation in the new operating contracts.

<sup>b</sup> Following amendment of the Hydrocarbons Act, the oil contracts are being renegotiated and a clause stipulates that the State receives 100% of any increase in the oil price, so the tax on extraordinary earnings no longer applies.

Chapters I and II look at the trends observed in the mining and hydrocarbons sectors, respectively. Both chapters outline the main stylized facts on reserves, production, consumption and indicators of trends. In a number of UNASUR mining countries (Chile, Colombia, Peru and the Plurinational State of Bolivia), the State's share in the economic rent from these sectors during the most recent price boom (2004-2010) is compared with the previous boom period (1990-2003). The results for non-members of UNASUR, such as Mexico, and other mineral-exporting countries located in Central America and the Caribbean are also shown in the tables in chapter I for purposes of comparison. Chapter III analyses the evolution of the water resources sector, particularly the development of hydroelectricity in the region. The concluding chapter, chapter IV, compares the performance of the mining and hydrocarbon sectors during the price boom of 2004-2010 and identifies some of the legal implications for the future. It also highlights the political repercussions drawn from the analysis of the water sector in chapter III.



## Chapter I

**THE MINING SECTOR IN UNASUR COUNTRIES: RECENT TRENDS  
AND DEVELOPMENTS****A. THE IMPORTANT ROLE OF UNASUR COUNTRIES  
IN GLOBAL MINERAL OUTPUT**

Thirteen countries in Latin America are among the 15 largest producers in the world. In terms of the UNASUR countries, Chile has been the largest producer of copper since 1982 when it pushed the United States back into second place after many years at the top spot. Brazil was the leading producer of iron until 2006 and is currently among the top three producers in the world after China and Australia. Peru is one of the foremost producers of silver, copper, gold and lead in the world. The Plurinational State of Bolivia is the fourth largest producer of tin ore and the sixth largest of silver—it also ranks strongly for other minerals. Lastly, Colombia ranks seventh among producers of refined nickel. Outside the UNASUR group, Cuba is the eighth largest producer of nickel ore in the world; Jamaica is the seventh largest producer of bauxite and Mexico is the largest producer of silver and the fifth of molybdenum and lead ore.

Between 1990 and 2010, Latin America and the Caribbean (UNASUR, Mexico, Central America and the Caribbean) saw its share of global output of gold (up from 10.3% to 19.2%), molybdenum ore (up from 15.8% to 31.8%) and copper ore (up from 24.9% to 45.4%) almost double. The region's output of refined copper also increased, but to a lesser extent (from 15.7% to 21.9%). Because the region's share of global output is so great, the value of minerals on the principal international stock markets is affected if interruptions to operations at any major Latin American companies are expected or if a problem occurs such as a strike or an accident.

**B. EVOLUTION OF THE INTERNATIONAL PRICE OF METALS  
AND MINERAL EXPORTS AT THE REGIONAL LEVEL<sup>1</sup>**

Exports from the mining sector in Latin America and the Caribbean started to burgeon in 2002 because of the rise in the international price of metals in real terms, which reached record highs in 2007 (see figure I.1). Although some metal prices were adjusted downward during the global financial crisis of 2008-2009, the value in real terms between 2009 and 2011 was particularly favourable in comparison with the average over the past 30 years. It should be noted that the prices of these products in real terms had declined between 1980 and 2001.

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<sup>1</sup> The figures in the following sections show Latin America and the Caribbean's global position in the mining sector compared with other regions in the world. The text refers specifically to the results of those mining countries that belong to UNASUR and which are analysed as part of this study (Chile, Colombia, Peru and the Plurinational State of Bolivia).

Table I.1  
**LATIN AMERICA AND THE CARIBBEAN: SHARE OF THE TOTAL GLOBAL  
 MINING OUTPUT, 1990-2012**

Mineral or metal	Percentages of world total						Production in 2011 (thousands of tons, except gold and silver, which are in tons)	Top three producers in the region in 2012 <sup>b</sup>
	1990	1995	2000	2005	2010	2012 <sup>a</sup>		
Bauxite	22.9	26.7	26.0	27.5	21.5	20.1	51 392.9	Brazil, Jamaica and Suriname
Primary aluminium	9.2	10.4	8.9	7.5	5.5	6.1	2 186.9	Brazil, Argentina and Venezuela (Bolivarian Republic of )
Copper ore	24.9	32.2	43.0	46.5	45.2	44.4	7 293.5	Chile, Peru and Mexico
Refined copper	15.7	23.2	25.1	23.7	21.5	19.6	4 134.5	Chile, Mexico and Peru
Gold	10.3	12.5	14.4	18.1	19.2	21.4	541.1	Peru, Mexico and Colombia
Silver	34.2	38.3	38.5	41.8	48.7	49.3	10 512.0	Peru, Mexico and Bolivia (Plurinational State of)
Tin ore	28.3	27.8	26.0	21.2	19.5	20.4	57.6	Peru, Bolivia (Plurinational State of) and Brazil
Refined tin	23.1	15.8	14.9	18.0	16.6	13.9	52.1	Peru, Bolivia (Plurinational State of) and Brazil
Iron	22.6	24.9	26.1	26.0	23.1	n.a.	341.2	Brazil, Venezuela (Bolivarian Republic of) and Mexico
Molybdenum ore	15.8	18.2	35.2	37.3	31.8	23.5	70.9	Chile, Peru and Mexico
Nickel ore	11.5	11.7	14.1	15.1	12.9	13.4	196.5	Brazil, Cuba and Colombia
Refined nickel	9.7	10.1	10.7	13.4	11.6	9.9	139.3	Brazil, Colombia and Cuba
Lead ore	13.3	15.5	14.7	14.6	14.5	11.0	595.1	Mexico, Peru and Bolivia (Plurinational State of)
Refined lead	7.8	7.6	8.4	7.2	7.4	4.1	484.3	Mexico, Brazil and Venezuela (Bolivarian Republic of)
Zinc ore	16.8	20.6	19.0	21.0	21.7	19.8	2 607.0	Peru, Mexico and Bolivia (Plurinational State of)
Refined zinc	7.5	8.5	7.3	7.9	7.0	7.7	969.4	Mexico, Peru and Brazil

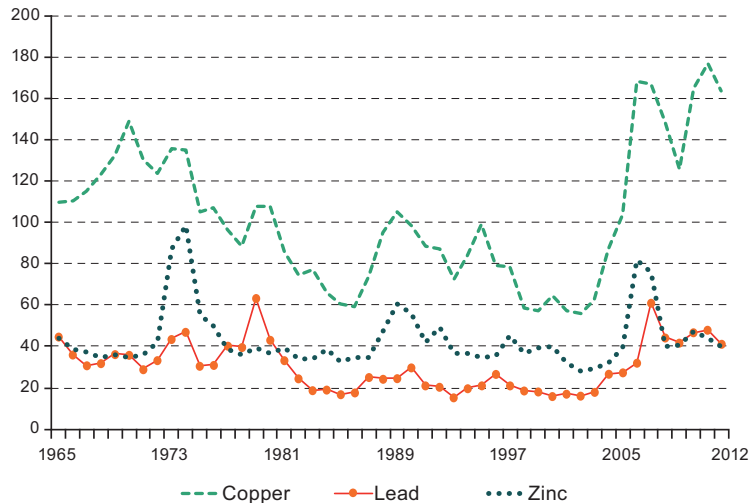
**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of J. Acquatella and J. Lardé, “Panorama regional del sector minero en América Latina y el Caribe”, Santiago, Chile, ECLAC, 2012, unpublished; World Bureau of Metal Statistics, database; Gold Fields Mineral Services; and United Nations Conference on Trade and Development (UNCTAD).

<sup>a</sup> The 2012 data cover up to June or July, depending on the metal.

<sup>b</sup> The data on iron correspond to 2009.

The current boom in international metal prices is largely due to the steady rise in the global demand for primary goods, which is the result of economic growth that has been taking place in China and other Asian countries since the 1990s, particularly over the past 10 years when consumption of metals—aluminium, copper, nickel, lead and zinc—rose by more than 30% each year. The increase in the demand for metals such as iron, copper and aluminium is linked with the growth of construction, infrastructure and manufacturing sectors (which need steel, electrical conductors and industrial metals, among others); these sectors have grown rapidly as the process of economic development in emerging economies has taken off.

Figure I.1  
**INTERNATIONAL PRICES OF COPPER, LEAD AND ZINC, 1965-2012<sup>a</sup>**  
*(United States cents per pound, at constant 1982 prices)*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of data from the Chilean Copper Commission (COCHILCO) and FRED Economic Data.

<sup>a</sup> The year 2012 covers January to September.

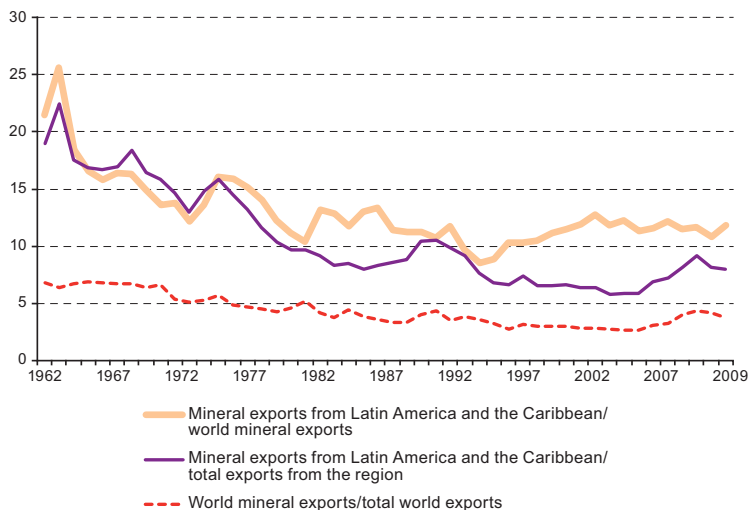
The share of mineral exports in total exports from the region has been rising since 2002 (see figure I.2). However, this is the case not only in Latin America and the Caribbean but also in other countries which have reacted in the same way to the high price of minerals and the huge profits generated from exploitation.

This pattern of growth of mineral exports and other primary goods has been described as “reprimarizing”, because it reduces the share of other goods, such as high-technology manufactures, in total exports. However, when the region’s share of mineral exports is compared with the global trend, there are few differences; the cycles, however, are more marked in Latin America and the Caribbean. What is more, the weight of minerals in the region’s export basket (7.1%) is still higher than the world average (3.3%) (compare the black continuous line with the black broken link in figure I.2).

Figure I.2 shows that Latin America and the Caribbean’s share in global mineral exports was on a downward trajectory between 1964 and 1992. However, it started to trend upwards in the 1990s and reached 12.8% of the world total in 2000. Since then, the trajectory has had ups and downs, but in 2010 and 2011 it hit record highs. The region’s average share in global mineral exports was 11.8% of the world total between 2000 and 2009.



Figure I.2  
**LATIN AMERICA AND THE CARIBBEAN AND THE WORLD: SHARE OF MINERALS<sup>a</sup>**  
**IN TOTAL EXPORTS, 1962-2009**  
*(Percentages)*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank, World Development Indicators.

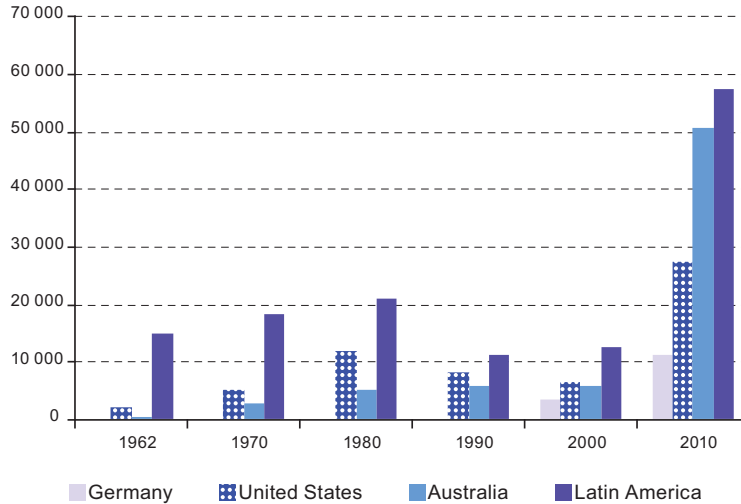
<sup>a</sup> This includes those corresponding to divisions 27 (crude fertilizers and crude minerals), 28 (metalliferous ores and metal scraps) and 68 (non-ferrous metals) of the Standard International Trade Classification (SITC), Revision 3.

The value of world mineral exports grew significantly in the 2000s, not only in the countries of Latin America and the Caribbean, but also in developed countries rich in mineral resources such as Australia, Canada and the United States. This can be observed in figures I.3 and I.4 which show that the value of exports of minerals in the primary stage of processing and exports of higher value added minerals in the manufacturing stage increased considerably.<sup>2</sup>

Although the output of manufactured minerals has increased since 2003, exports of minerals in the primary stages of processing have in fact shown the highest growth, primarily in Australia and next in Latin America. Indeed, Latin America's main exports are of metalliferous ores and metal scraps (division 28 of the Standard International Trade Classification (SITC), Revision 3) and non-ferrous metal-based manufactures (division 68) and iron- and steel-based manufactures (division 67). Since 2000, the strongest growth has been among metalliferous ores and metal scraps (division 28) which grew at an average annual rate of 64%, non-ferrous metals (division 68) at 27% and crude fertilizers (division 27) at 15% (see figure I.5).

<sup>2</sup> The volume of mineral exports from Germany and the progress made in this respect are worth considering and although the country is not rich in mineral resources, it is the second largest exporter of mineral products. According to Sánchez-Albavera and Lardé (2006), the general rule in developing countries was that the production of ore does not necessarily mean that the country had a high smelting and refining capacity. As the level of processing advances, the installed capacity was concentrated mainly in developed countries, and so, for example, countries which do not produce ore, such as Germany and Japan, are among the most important producers of refined minerals in the world, supplying minerals and concentrates to developing countries.

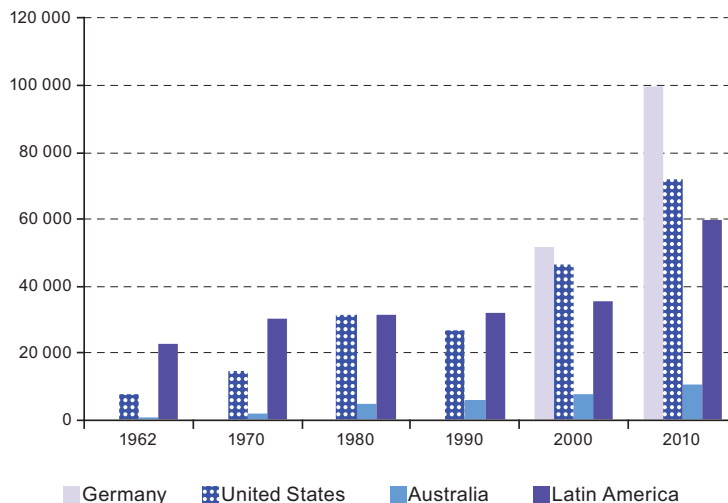
Figure I.3  
**LATIN AMERICA AND THE CARIBBEAN AND MAJOR MINERAL EXPORTERS: EXPORTS OF MINERALS IN THE PRIMARY STAGE OF PROCESSING, 1962-2010<sup>a</sup>**  
*(Millions of dollars, 2005)*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank, World Development Indicators.

<sup>a</sup> This includes those corresponding to divisions 27 (crude fertilizers and minerals) and 28 (metalliferous ores and metal scraps) of the Standard International Trade Classification (SITC), Revision 3.

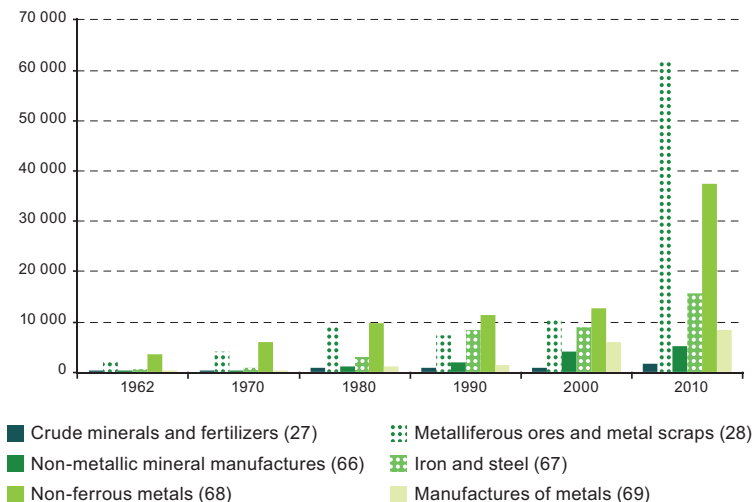
Figure I.4  
**LATIN AMERICA AND THE CARIBBEAN AND MAJOR MINERAL EXPORTERS: EVOLUTION OF EXPORTS OF MINERALS IN THE MANUFACTURING STAGE, 1962-2010<sup>a</sup>**  
*(Millions of dollars, 2005)*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank, World Development Indicators.

<sup>a</sup> This includes minerals in the manufacturing stage corresponding to divisions 66 (non-metallic mineral manufactures), 67 (iron and steel), 68 (non-ferrous metals) and 69 (manufactures of metals) of the Standard International Trade Classification (SITC), Revision 3.

Figure I.5  
**LATIN AMERICA AND THE CARIBBEAN: EVOLUTION OF EXPORTS OF PRIMARY MINERALS  
 AND MINERAL MANUFACTURES,<sup>a</sup> 1962-2010**  
*(Millions of dollars, 2005)*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, United Nations Commodity Trade Statistics Database (COMTRADE).

<sup>a</sup> The numbers in parentheses indicate the corresponding divisions of the Standard International Trade Classification (SITC), Revision 3.

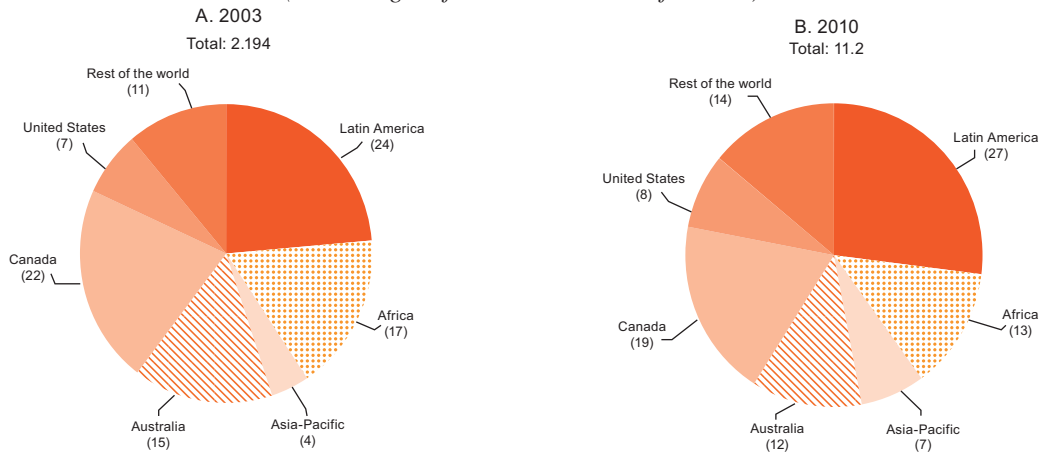
Exports of metals, primary minerals and higher value added minerals in the manufacturing stage have expanded in Latin America as well as in the developed countries examined (Germany, Australia and the United States).

### C. INVESTMENT IN MINERAL PROSPECTING

Investments in mineral prospecting have been increasing worldwide since 2003. The global prospecting budget for non-ferrous metals rose from US\$ 2.194 million in 2003 to US\$ 11.2 billion in 2010 (see figure I.6). However, this upward trend was interrupted in 2009 by the recession triggered by the subprime mortgage crisis during the last quarter of 2007 in the United States, but later picked up again.

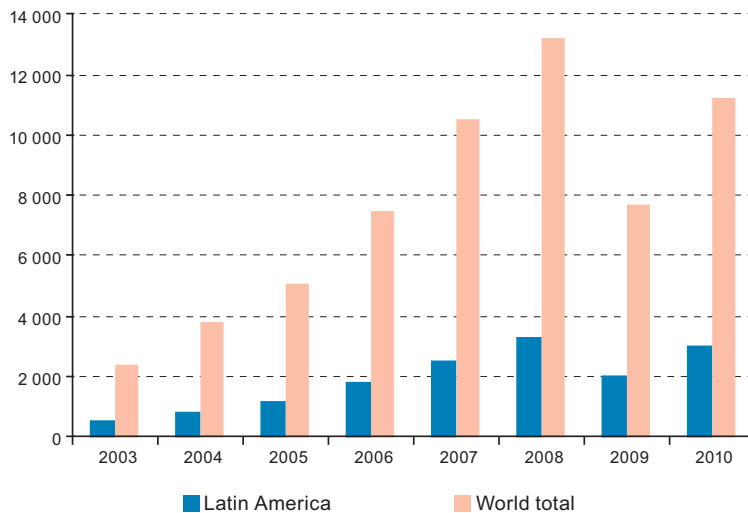
The region of Latin America and the Caribbean has been the main destination for investment in world mineral prospecting since 1994. The budget for exploration in the region increased more than five-fold from US\$ 566 million in 2003 to US\$ 3.024 million per year in 2010. More than half of the budget is for gold prospecting, while copper is allocated the second largest share (see figure I.7).

**Figure I.6**  
**DISTRIBUTION OF GLOBAL MINERAL PROSPECTING BUDGET 2003 AND 2010**  
*(Percentages of total and billions of dollars)*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of the Centre for Copper and Mining Studies (CESCO) and Metals Economics Group, World Exploration Trends.

**Figure I.7**  
**LATIN AMERICA: GLOBAL MINERAL PROSPECTING BUDGET, BY REGION AND WORLD TOTAL, 2003-2010**  
*(Millions of dollars)*

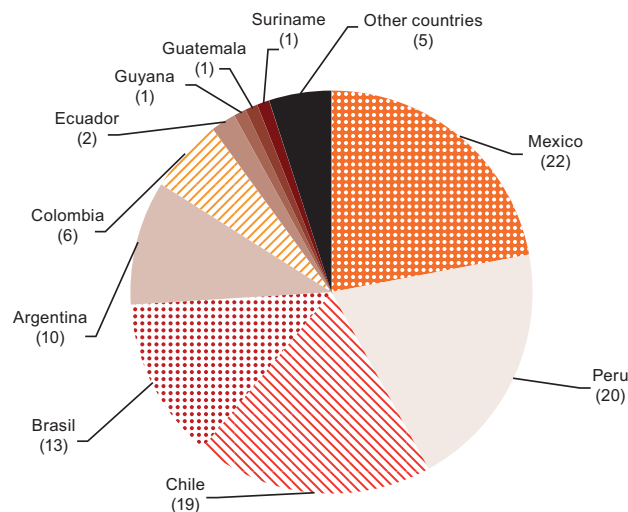


**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of the Centre for Copper and Mining Studies (CESCO) and J. Acquatella and J. Lardé, “Panorama regional del sector minero en América Latina y el Caribe”, Santiago, Chile, ECLAC, 2012, unpublished.

At the start of the 1990s, mineral exploration expenditure for countries such as Australia, Canada and the United States was diverted to Latin America because depleted stocks in some mining areas, the removal of tax incentives and tighter environmental regulations meant that exploration was more expensive in these countries. In addition to these factors, liberalization triggered a sudden rise in Latin America’s budget for exploration, which meant that it was the primary destination for world mineral

exploration for twenty years. Exploration took place primarily in Peru, Mexico, Brazil and Chile and to a lesser extent, in Argentina. The first four countries are among the top ten destinations for world mineral exploration (see figure I.8).

Figure I.8  
**LATIN AMERICA AND THE CARIBBEAN: MAJOR DESTINATIONS  
 FOR MINERAL EXPLORATION, 2010**  
*(Percentages of the regional total)*



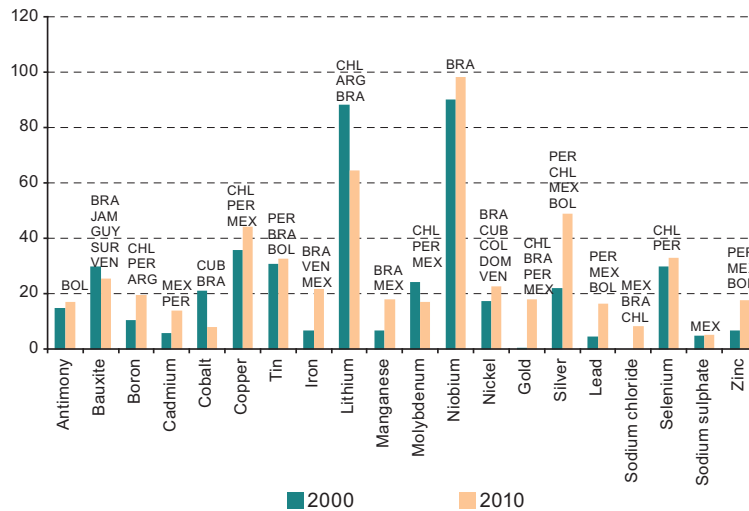
**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of the Centre for Copper and Mining Studies (CESCO), databases; and Metals Economics Group.

#### **D. UNASUR COUNTRIES ACCOUNT FOR AN INCREASING PROPORTION OF WORLD MINERAL RESERVES**

The rise in exploration activities in Latin America and the Caribbean has led to an increase in proven reserves of a large number of minerals. For example, gold reserves in the region, which stood at 200 tons in 2000 and were primarily located in Peru, increased to 9,200 tons in 2010 distributed between Chile, Brazil, Peru and Mexico. Several UNASUR countries hold a major share of the largest mineral reserves on the planet –in particular, they control at least 65% of global lithium reserves (Chile, Argentina and Brazil), 49% of silver reserves (Peru, Chile, the Plurinational State of Bolivia along with Mexico (a non-member of UNASUR), 44% of copper reserves (Chile and Peru, and to a lesser extent, Mexico), 33% of tin reserves (Peru, Brazil and the Plurinational State of Bolivia), 26% of bauxite reserves (Brazil, Guyana, Suriname, the Bolivarian Republic of Venezuela (and Jamaica, another non-member), 23% of nickel reserves (Bolivarian Republic of Venezuela, Brazil and Colombia(along with other non-members: Cuba and the Dominican Republic), and 22% of iron (Bolivarian Republic of Venezuela Brazil and Mexico). The mineral potential is estimated to be even higher since the geological information available is limited<sup>3</sup> (see figure I.9).

<sup>3</sup> Reserves refer to identified resources or mining assets. The economic feasibility of exploiting these reserves depends on a number of factors such as costs and prices, the technology available and the physical characteristics of the mine (ore content, grade, tonnage, thickness, depth and location).

Figure I.9  
**LATIN AMERICA AND THE CARIBBEAN: MAIN MINERAL RESERVES, 2000 AND 2010**  
*(Percentages of world total)*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of data from the United States Geological Survey, Mineral Commodity Summaries, January 2011.

**Note:** The countries with reserves in 2010 are listed above the columns for that year by order of magnitude of their reserves .

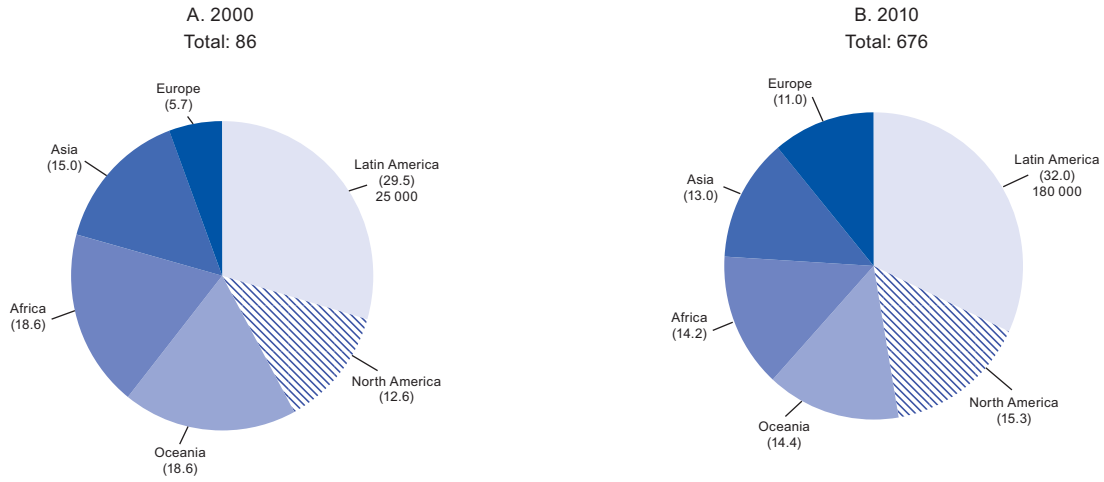
## E. FORECASTS FOR MINERAL INVESTMENT SHOW VIGOROUS GROWTH

The decade of the 1990s in Latin America and the Caribbean was a period known for the political and regulatory reforms introduced to attract private investment. As part of reforms for the mining sector, tax incentives and favourable legal frameworks, which in some countries included long-term tax stability contracts, were created. They also set the ground rules for competitive investment in the sector and created better conditions than those in other mining regions in the world.<sup>4</sup>

At present, Latin America is the primary destination of the world mining investment portfolio. According to the Engineering & Mining Journal's annual survey, the projects for the region stood at US\$ 180 billion in 2010, which accounts for almost one third of world mining investment. This survey of planned (not implemented) projects is an indicator of how attractive the incentives offered by the countries are and what the return on these investments is expected to be. Figure I.10 compares the project portfolio for the region in 2000, which was only US\$ 25 billion, with the portfolio for 2010.

<sup>4</sup> According to a comparative study covering 24 mining countries, Chile and Argentina are among the 20% with the lowest effective tax rates and highest private profitability, while the Plurinational State of Bolivia is among the upper 33%. Mexico and Peru are closer to the international average, ranking 13th and 17th out of the 24 countries (Otto and others (2007) and Otto (2004)).

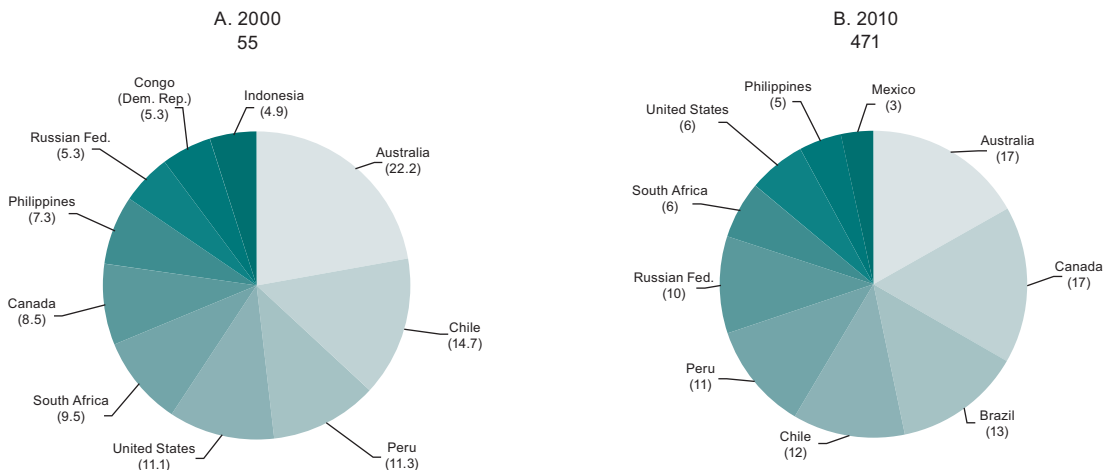
Figure I.10  
**MINING INVESTMENT PROJECT PORTFOLIO, BY REGION, 2000 AND 2010**  
*(Percentages and billions of dollars)*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of data from the Engineering & Mining Journal survey.

In 2011, Brazil, Chile and Peru were among the top ten destinations for mining investments. Figure I.11 shows that 10 years ago, only Chile and Peru were in that group. The metals that attracted the highest investments were iron (27%), copper (27%), gold (16%), nickel ore (14%) and refined nickel (3%), which together account for 87% of the total project portfolio.

Figure I.11  
**DISTRIBUTION OF MINING INVESTMENTS AMONG THE TOP TEN RECEIVING COUNTRIES, 2000 AND 2010**  
*(Percentages and billions of dollars)*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of data published in the *Engineering & Mining Journal*.

## F. STATE SHARE IN ECONOMIC RENT FROM THE MINING SECTOR DURING THE MOST RECENT PRICE CYCLE

The economic rent<sup>5</sup> of the mining sector (World Bank, 2011)<sup>6</sup> increased from 0.54% of GDP in Latin America and the Caribbean between 1990 and 2003 to 2.08% between 2004 and 2009 —almost four times greater.<sup>7</sup> Economic rent received from the sector is used (i) for taxes, royalties and other duties to the State; (ii) as private profits for extraction companies, and (iii) for other production-related activities carried out after extraction, primarily to pay wages for extraction company employees.<sup>8</sup>

Table I.2 shows the changes in mining output and economic rent from the sector as a percentage of GDP in selected UNASUR ore-exporting countries (Chile, Colombia, Peru and the Plurinational State of Bolivia) and other producers in the region. It compares data observed during the price boom between 2004 and 2009 with data for the period 1990-2003. Revenue from the mining sector not only increased almost four-fold between these two periods for the region as a whole, but also doubled in almost all of the countries listed (see the figures in bold). The penultimate column shows the mining sector's fiscal contribution in the form of tax payments, royalties and other duties as a percentage of the sector's revenue and the last column shows the percentage of total fiscal revenue. The following stylized facts were observed:

- (i) The mining sector's average fiscal contribution as a percentage of total fiscal revenue increased in all of the countries studied between 2004 and 2009 compared with the previous period. The Plurinational State of Bolivia's contribution was three times greater (up from 1% to 3.7% of total fiscal revenue) and contributions were four times greater in Chile and Peru (up from 8.2% to 37.5% in Chile and 2.9% to 14.2% in Peru).
- (ii) Despite the significant increase in their contribution to fiscal revenue between 2004 and 2009, the State share in the total economic rent generated by the mining sector did not exceed 35% in countries with a long mining tradition in the region (such as Chile, Peru and the Plurinational State of Bolivia) and was even below 15% in some countries with low mining activity.

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<sup>5</sup> The “pure” economic rent of the mineral resource is the difference between the value of the output in international prices and the cost of production of the ore at the pithead. To calculate the economic rent, the cost of production is the cost of extracting the ore as far as the pithead, which includes the opportunity cost of capital invested in the extraction operation. The per unit economic rent of each mineral exported may be estimated by subtracting the average cost of production at the pithead per ton of mineral exported from the international price. An estimate of the total economic rent of the mining sector is calculated by adding the per unit rents for the whole production process and the types of ore exported. There are some minerals, such as copper, which are traded almost exclusively as concentrates and the concentration process is carried out at the pithead. In such cases, the economic rent of the concentrate is calculated and the cost of production must therefore include the cost of the concentration process.

<sup>6</sup> The mining revenue (in percentages of GDP) is the value of the mining and quarry sector output (metal mining) at the international price minus the relevant production costs (cost of extraction at the pithead and opportunity cost of the capital invested in the extraction process) for a basket of 10 minerals (tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite and phosphate).

<sup>7</sup> Estimate based on mining revenue statistics (as a percentage of GDP) published by the World Bank (2011) for the different countries. Table I.2 shows these indicators for each country and the region as a whole between 1990 and 2003 and 2004 and 2009 (the most recent five-year period for which data are available).

<sup>8</sup> Strictly speaking, private profitability is the economic rent available after taxes and other fiscal duties have been paid in each country and after other post-pithead production-related activities have been paid (wages and selling costs, for example, transporting the mineral, crude oil or gas to shipping ports).



- (iii) In Chile and Peru, the main mining countries that belong to UNASUR, and Colombia and the Plurinational State of Bolivia, the State's direct share and fiscal revenue represents between 30% and 35% of the estimated economic rent from the sector. This is similar to the percentage received by the State in mining countries which are members of the Organisation for Economic Cooperation and Development (OECD), for example, Australia (26%) and Canada (38%), and almost the benchmark rate of 33%, estimated using data on fiscal payments made by 10 major transnational mining companies between 2005 and 2010.<sup>9</sup>
- (iv) By way of contrast, the State share in the estimated economic rent from the hydrocarbons sector was between 45% and 65% in the region's exporting countries. This trend is also observed at the international level and shows that the State's direct share in output, through public oil companies and joint ventures, was higher, as was the role of oil taxation systems in designing fiscal mechanisms and contractual agreements to boost the State's share.<sup>10</sup>
- (v) In the case of Chile, fiscal contributions made by the State company CODELCO (22.1%) were key to achieving the State share of 35.7% in the sector's estimated economic rent between 2004 and 2009.
- (vi) The fiscal contribution made by private mining companies in Chile (GMP-10, table I.2 shows the top 10 private mining companies) is almost half of the contribution made by the State company, CODELCO, and less than a third (11.1%) of the State share (35.7%) in the economic rent from the sector.
- (vii) The fiscal contribution made by CODELCO is much more significant than that of private mining companies, since it produces only one third (31.2%) of the country's copper,<sup>11</sup> while private companies account for the rest. In other words, the one third share of copper production held by CODELCO contributes almost two thirds of the State's share in the economic rent from the sector.
- (viii) Before 2004, in all the countries analysed, with the exception of Colombia, the State's share in economic rent from the mining sector averaged less than 25%.

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<sup>9</sup> The aggregate data of tax payments made by 10 major transnational mining companies were provided by the auditing firm, PricewaterhouseCoopers (2011).

<sup>10</sup> The Extractive Industries Transparency Initiative (EITI) publishes the payments received by Governments and those made by extractive industries (mining, oil, gas) in the member countries which have voluntarily joined the organization. A review of data published by EITI for 29 member countries (19 in Africa, 4 in Asia and the rest in Europe, the Middle East and Oceania and Peru—the only EITI member representing Latin America and the Caribbean) proves that, overall, the States receive a higher percentage of the total economic rent from the hydrocarbons sector than from that of the mining sector.

<sup>11</sup> CODELCO produces 31.2% of fine copper in Chile. See table 2.2 in COCHILCO (2011).

Table I.2  
**INDICATORS AND FISCAL CONTRIBUTION OF THE MINING SECTOR**  
**IN SELECTED COUNTRIES, 1990-2009**  
*(Percentages)*

Country	Mining production as a percentage of GDP		Mining rent as a percentage of GDP <sup>a</sup>		Fiscal revenue from mining <sup>b</sup> as a percentage of mining rent		Fiscal revenue from mining as a percentage of total fiscal revenue	
	1990-2003	2004-2009	1990-2003	2004-2009	Before 2004 <sup>c</sup>	2004-2009 <sup>d</sup>	Before 2004	2004-2009
Argentina	1.80	1.54	<b>0.05</b>	<b>0.48</b>				
<b>Bolivia</b> (Plurinational State of)	3.96	5.73	<b>0.30</b>	<b>2.28</b>		57.7		2.2
Bolivia (Plurinational State of) not including duties to COMIBOL							<b>34.6<sup>e</sup></b>	1.3
Brazil <sup>f</sup>	0.52	0.66	<b>0.64</b>	<b>2.24</b>				
<b>Chile</b> (total GMP-10. CODELCO with dividends)	6.58 (copper)	16.07 (copper)	<b>6.47</b>	<b>17.29</b>	<b>21.8</b>	<b>35.7</b>	<b>8.2</b>	<b>37.5</b>
Chile (CODELCO with dividends)					17.8	22.1	6.7	23.2
Chile (only private mines, GMP-10) <sup>g</sup>					4.0	13.6	1.5	14.3
<b>Colombia<sup>f</sup></b>	1.73	2.42	<b>0.17</b>	<b>0.91</b>	<b>36.9<sup>h</sup></b>	<b>37.1<sup>h</sup></b>	<b>1.9</b>	<b>2.1</b>
Ecuador <sup>f</sup>	6.96	14.71	<b>0.01</b>	<b>0.03</b>				
<b>Guatemala<sup>i</sup></b>	0.85	1.44	n.a.	0.24 <sup>j</sup>	n.a.	<b>12.2</b>	n.a.	<b>0.3<sup>k</sup></b>
Guyana <sup>i</sup>	16.22	11.28	5.62	5.34				
<b>Honduras</b>	0.47	0.86	<b>0.25</b>	<b>0.69</b>	<b>10.2</b>	<b>10<sup>l</sup></b>	<b>0.05</b>	<b>0.5</b>
Jamaica <sup>m</sup>	4.99	2.8	3.43	1.67				
Mexico	0.80	1.02	<b>0.14</b>	<b>0.34</b>				
Nicaragua <sup>m</sup>	0.74	1.19	<b>0.07</b>	<b>0.63</b>				
Panama <sup>n</sup>	0.49	1.14	n.a.	n.a.				
<b>Peru</b>	4.02	8.5	<b>0.79</b>	<b>7.16</b>	n.a.	<b>27.4</b>	<b>2.9</b>	<b>14.2</b>
Dominican Republic	0.75	0.41	<b>0.69</b>	<b>1.96</b>				
Suriname <sup>m</sup>	6.17	12.92	7.26	5.07				
Venezuela (Bolivarian Republic of)	1.97	2.11	0.32	0.83				
Latin America	n.a.	n.a.	<b>0.54</b>	<b>2.08</b>				
Australia <sup>m</sup>	4.85	7.53	<b>1.17</b>	<b>4.12<sup>o</sup></b>	<b>18<sup>p</sup></b>	<b>26.1<sup>q</sup></b>		
Canada <sup>m</sup>	4.7	6.8	<b>0.2</b>	<b>0.69</b>		<b>38.6</b>		
United States <sup>m</sup>	1.2	1.8	0.0	0.08				
South Africa <sup>m</sup>	7.3	8.1	<b>0.9</b>	<b>2.47</b>				

**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, United Nations Commodity Trade Statistics Database (COMTRADE), World Bank and official data and official figures.

<sup>a</sup> Mining rent (as a percentage of GDP): World Bank, World Development Indicators (WDI).

<sup>b</sup> Includes income tax and royalties.

<sup>c</sup> The figures for Chile correspond to the period 1994-2003. The figures for Honduras correspond to the period 2001-2003.

<sup>d</sup> The figures for Guatemala correspond to the period 2004-2009.

<sup>e</sup> Corresponds to the period 2000-2009 and includes royalties, profit tax and tax on remittances from mining companies to the State. Does not include duties to the Bolivian Mining Corporation (COMIBOL).

<sup>f</sup> Mining production as a percentage of GDP corresponds to the period 2004-2006 in Colombia and 2004-2007 in Ecuador.

<sup>g</sup> Includes duties and special taxes or royalties from major private copper mines (GMP-10).

<sup>h</sup> Corresponds to the periods 2000-2003 and 2004-2006. Includes taxes and royalties paid by mining companies.

<sup>i</sup> The figures referring to GDP in the mining sector include mining, oil and natural gas.

<sup>j</sup> Corresponds to the period 2006-2009.

<sup>k</sup> Corresponds to the period 2006-2010. The data corresponds only to the Marlin gold mine, the most important in the country, which accounted for 95.5% of mining exports from Guatemala in 2008.

<sup>l</sup> Estimate based on 10% of the data on mining rent published by the World Bank, World Development Indicators (WDI).

<sup>m</sup> The figures referring to GDP in the mining sector include mining and oil.

<sup>n</sup> The data on the mining sector's share in GDP corresponds to the period 2004-2008.

<sup>o</sup> Includes metal and non-metal mining, oil and natural gas extraction and coal mining, on the basis of World Bank and the Australian Bureau of Statistics (ABS), in Hogan and McCallum (2010).

<sup>p</sup> Approximate value for 1993-2003, on the basis of Hogan and McCallum (2010); only metal mining.

<sup>q</sup> Approximate value for 2004-2007, on the basis of Hogan and McCallum (2010); only metal mining.

In terms of the UNASUR countries, the State's share in mining revenue in percentages was estimated for Chile, Colombia, Peru and the Plurinational State of Bolivia on the basis of disaggregated data available on taxes paid by the mining sector. The main results are presented in table I.3:

Table I.3  
**STATE SHARE IN THE MINING SECTOR'S ESTIMATED ECONOMIC RENT AND THE TOTAL FISCAL REVENUE IN SELECTED COUNTRIES, 1990-2003 AND 2004-2009**  
*(Percentages)*

Country	State share in the economic rent from the mining sector (yearly average, by period)			Mining sector's fiscal contribution to the total fiscal revenue (yearly average, by period)		
	Before 2004	2004-2009	Complete period	Before 2004	2004-2009	Complete period
Bolivia (Plurinational State of) (ECLAC data)	(*)	<b>39.8</b>		<b>1.0</b>	<b>3.7</b>	3.1
Bolivia (Plurinational State of) (PIEB data)			57.7			2.2
Bolivia (Plurinational State of) (not including duties to COMIBOL, PIEB data)			34.6			1.3
Chile (copper, GMP-10 and CODELCO)	21.8	<b>35.7</b>	32.1	<b>8.2</b>	<b>37.5</b>	23.0
Chile (CODELCO, includes dividends)	17.9	22.1	21.0	6.7	23.2	15.0
Chile (only GMP-10 private mines and special tax or royalty)	3.9	13.6	11.1	1.5	14.3	8.0
Colombia	36.9	<b>37.1</b>		1.9		
Guatemala		12.2			0.4	
Honduras	10.2	10.0	10.1	<b>0.05</b>	<b>0.5</b>	0.4
Peru	(*)	<b>27.4</b>	30.0	<b>2.9</b>	<b>14.2</b>	10.1
Australia (metal mining)	17.9	<b>26.1</b>	20.2			
Canada			38.6			
Gross income tax paid at the international level by the 10 largest transnational mining companies		<b>33.6</b>	<b>33.2</b>			

**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, United Nations Commodity Trade Statistics Database (COMTRADE) and World Bank. Calculated as the average of the annual share percentages (using nominal prices). PIEB data on the Plurinational State of Bolivia was taken from the study by Jordán and others (2010).

**Note:** COMIBOL: Bolivian Mining Corporation; CODELCO: National Copper Corporation of Chile; GMP-10: Major commercial mines.

(\*) The percentage share cannot be calculated during this period because of statistical errors.

## Chapter II

### **THE HYDROCARBON SECTOR IN THE UNASUR COUNTRIES: TRENDS AND RECENT DEVELOPMENTS**

#### **A. OIL AND NATURAL GAS: EXPLORATION AND PRODUCTION**

The oil and natural gas production sector is organized in a variety of ways in the region. In the 1990s, countries such as Argentina, the Bolivarian Republic of Venezuela, Ecuador and the Plurinational State of Bolivia promoted private-sector participation in exploration and production activities and reforms to transport, refining and distribution systems. During the last decade, these countries have moved towards greater State control of the hydrocarbon sector, something that has included price controls, renegotiation of contracts, nationalization of assets and a stronger role for the State enterprise in the organization of the sector, among other aspects.

Since 1993, 1997 and 2004, respectively, Peru, Brazil and Colombia have operated a policy of price liberalization and encouragement of competition and foreign direct investment in the hydrocarbon sector, regulated by a national supervisory authority. Bidding and allocation rounds for exploration areas have been open to both State oil firms (such as Petrobras of Brazil and Ecopetrol of Colombia) and private-sector firms.

By and large, countries with an exporting tradition or favourable geological prospects under conditions of high prices —like those that have prevailed since 2003— have tended towards greater State control. Conversely, importing countries with a need to develop their industry and attract investment have inclined towards liberalization of the sector.

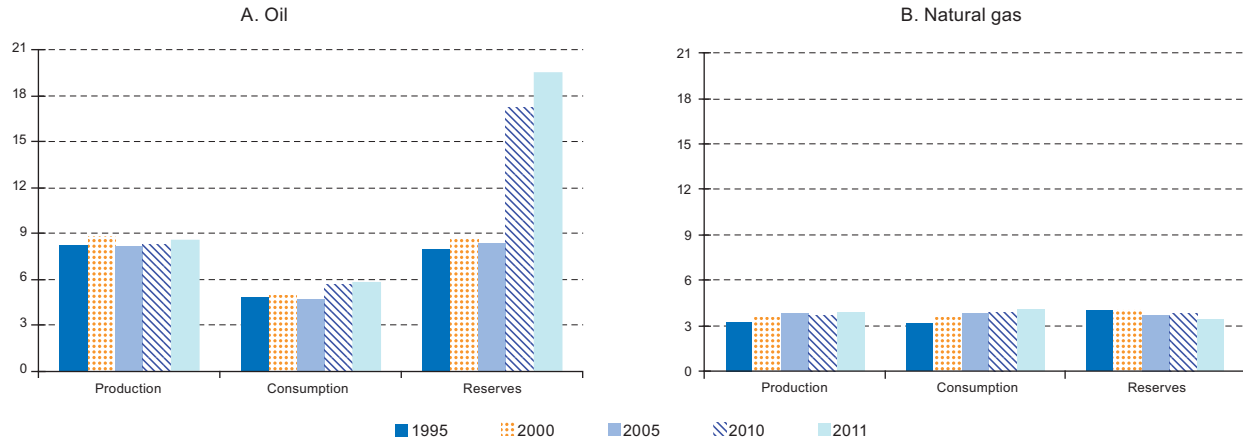
In practice, both the countries that control resources and reserves and the oil firms that possess the technology and capital, far from acting unilaterally, interact in a global market that is unquestionably proving to be uncertain, dynamic and competitive. In this international context, and in the face of unremitting price volatility, Governments are trying to reconcile a variety of objectives that range from maximizing their appropriation of oil revenues to attracting investment for the sector's development, supplying the domestic market and producing hydrocarbons efficiently, among other policy goals. The region's position in the global context as regards cumulative reserves, production, consumption, trade and tax regimes for hydrocarbons will now be examined.

#### **B. RESERVES, PRODUCTION, CONSUMPTION AND TREND INDICATORS**

##### **1. SOUTH AMERICA IN THE GLOBAL CONTEXT**

In 2011, South America had the second-largest oil reserves of any region (after the Middle East), with a share of 20%. The growth of oil and natural gas stocks since 2008 has been due to the certification of reserves in the Orinoco Belt by the Bolivarian Republic of Venezuela as part of the Magna project, and to successful exploration, mainly in Brazil and Colombia (see figure II.1).

Figure II.1  
**SOUTH AMERICA: SHARES OF THE OIL AND NATURAL GAS SECTORS,**  
**1995, 2000, 2005, 2010 AND 2011**  
*(Percentages)*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP p.l.c., “Statistical Review of World Energy”, 2011 and 2012 [online] <http://www.bp.com/statisticalreview>.

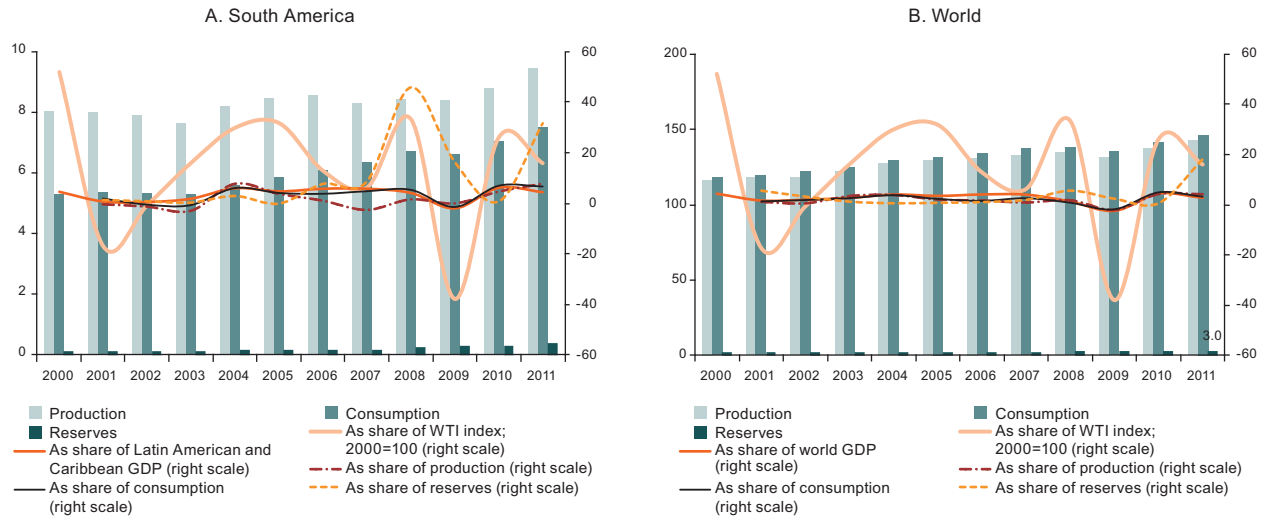
The region’s gas reserves have declined as a share of the world total in the last five years, to 3%. Growth has been strongest in regions such as North America, Central Asia and the Middle East. Among individual countries, the United States (with its proven reserves of unconventional gas), Turkmenistan and Qatar have seen the largest increases.

The region’s and the world’s output of all hydrocarbons has been increasing in recent years. South America has lost ground as an oil producer, however, to regions such as North America, Eastern Europe, Central Asia and Africa, where greater development activity has boosted production from deposits of tar sands in Canada and others such as those of Kashagan in Kazakhstan, Sakhalin in the Russian Federation and Girassol and Mondo I in Angola.

The rise in international prices since 2003 has had a substantial influence on the supply of and demand for hydrocarbons in the UNASUR countries. In the first case, higher prices have driven oil exploration, drilling and enhanced recovery, thus increasing supply (albeit to a limited extent) in response to the growth in demand.<sup>1</sup> In the second case, demand has responded only slowly to rising prices, and this may be related to the levels of fuel subsidies maintained in some of the region’s countries. Since 2004, regional consumption growth (averaging 5% a year) and its correlation with GDP growth have been greater than the average annual increase in hydrocarbon production (3%) (see figures II.2 and II.3).

<sup>1</sup> At the global level, for example, the impact of prices has been reflected in increased hiring of drilling equipment (rigs).

Figure II.2  
**SOUTH AMERICA AND THE WORLD: OIL AND NATURAL GAS RESERVES, PRODUCTION AND CONSUMPTION VERSUS ECONOMIC GROWTH AND PRICES**  
*(Specific units<sup>a</sup> (left scale) and percentage annual change (right scale))*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank, “World Development Indicators (WDI)” [online] <http://databank.worldbank.org/ddp/home.do>; BP p.l.c., “Statistical Review of World Energy”, 2011 and 2012 [online] <http://www.bp.com/statisticalreview>; and ECLAC, *Economic Survey of Latin America and the Caribbean 2012* (LC/G.2546-P), Santiago, Chile, 2012. United Nations publication, Sales No. S.12.II.G.3.

<sup>a</sup> Reserves are expressed in trillions of barrels of oil equivalent; production and consumption are expressed in millions of barrels of oil equivalent per day.

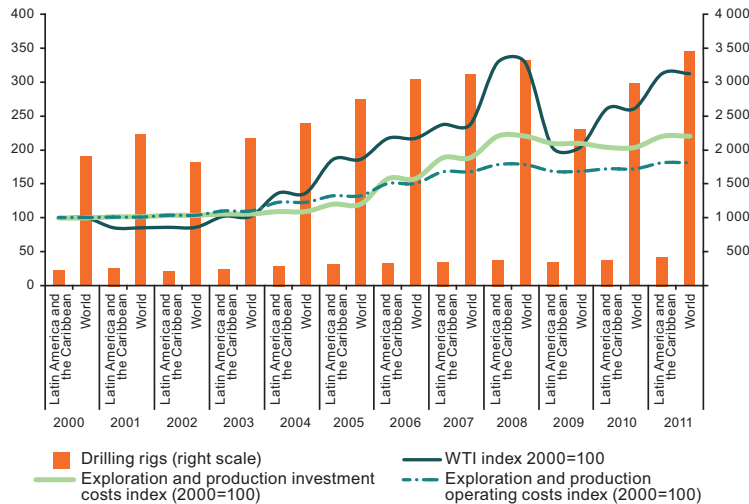
The trend towards lower growth in the supply of oil relative to demand in the region may create energy supply and security problems and lead to a decline in the volume available for export in future. It could also increase the risk of trade deficits, greater domestic and external borrowing and a reduction in net international reserves in countries whose fiscal spending is closely tied to hydrocarbon revenues.

Reserves, production and consumption have grown for natural gas as well as oil. The unit used in this case is the barrel of oil equivalent, with an average worldwide conversion factor for natural gas, calculated by BP p.l.c., of 5,610 cubic feet per barrel equivalent. The nominal West Texas Intermediate (WTI) price has been deflated by the United States Consumer Price Index for All Urban Consumers (CPI-U) with base 2000=100. The GDP growth figures given for South America are those of Latin America and the Caribbean.

Both investment costs and operating and maintenance costs display a clear upward trend since 2004 (see figure II.3). The rise has not been offset by price increases to the same extent as in the mining sector, where these have far outstripped growth in mineral exploitation and processing costs.<sup>2</sup>

<sup>2</sup> Consequently, the increase in economic rent between the pre-2003 period and the 2004-2010 period was proportionally smaller in the hydrocarbon sector than in the mining sector. In absolute terms, however, regionwide revenues remained substantially higher in the hydrocarbon sector (averaging US\$264.032 billion in 2005 dollars from 2007 to 2009) than in the mining sector (about US\$ 77 billion in 2005 dollars during 2009).

Figure II.3  
**LATIN AMERICA AND THE CARIBBEAN AND THE WORLD: PRICES, COSTS  
 AND ACTIVITY IN THE HYDROCARBON INDUSTRY, 2000-2011<sup>a</sup>**



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Baker Hughes, “International rig counts”, 2012 [online] [http://investor.shareholder.com/bhi/rig\\_counts/rc\\_index.cfm](http://investor.shareholder.com/bhi/rig_counts/rc_index.cfm); BP p.l.c., “Statistical Review of World Energy 2012” [online] <http://www.bp.com/statisticalreview>; International Energy Agency (IEA), *International Energy Outlook 2011*, Washington, D.C., September 2011; IHS CERA, “IHS-CERA: Capital Costs”, 2012 [online] <http://www.ihs.com/info/cera/ihsindexes/index.aspx>.

<sup>a</sup> The operating and investment costs indices were prepared on the basis of nominal costs for a portfolio of exploration and production projects considered to be globally representative that are calculated periodically by IHS-CERA, a consultant. The number of drilling rigs is the average number of active oil and natural gas rigs. This is calculated periodically by Baker and Hughes, an oil services firm.

The global economic crisis that broke out in mid-2008 resulted in consumption and production falling by about 1% in Latin America and the Caribbean in 2009. The shrinking of the global market, the difficult financing environment, the drop in oil prices and the rise in investment and operating costs not only reduced activity in the sector but led to delays and cancellations in exploration and development projects throughout the world, a 15% reduction in the value of investment plans over the year before, and possibly an increase in the rate of decline in Latin American fields (IEA, 2009).

In the last decade or so, production and consumption have grown by more for natural gas than for oil. Both globally and in Latin America, there has been a gradual tendency for primary solid fuels to be replaced by natural gas, which, being less polluting, has a far more moderate impact on the environment (see figure 1 in the annex).

The evolution of the oil market since 2000 has been characterized by rapid demand growth in emerging markets (such as China and India), and this, together with supply constraints, has pushed oil prices up to the US\$ 100 a barrel mark. Prices have remained within historically high ranges despite the fragile macroeconomic and financial situation of the OECD countries during 2011 and 2012.

The natural gas market has decoupled from the oil market. In the United States, the unconventional gas (shale gas) “revolution” is at its height, translating into prices equivalent to half those paid in Europe and Asia, where gas markets have narrowed. Demand for natural gas in the main regions has recovered to levels higher than those seen before the financial crisis.

Energy markets are going through one of the most uncertain periods of recent decades, owing to the repercussions the Arab Spring has been having on exploration and production and the macroeconomic consequences of the eurozone crisis. The pick-up in prices since 2010 (see figures 2 and 3 in the annex) has coincided with the political problems of the Arab countries, especially Egypt, Libya and the Syrian Arab Republic. However, it has also been due to structural factors interacting with the political situation: the pressure of growing demand from China, the likely increase in demand for electricity generation (owing to a reduced share for nuclear power) and rising oil production costs.<sup>3</sup>

## 2. Reserves

There are two definitions of reserves in the industry: deterministic and probabilistic. They are complementary and are estimated on the basis of geological, technological, economic and legal conditions. For a resource to be treated as a reserve and classified as proven, development and production over the lifetime of the reservoir have to be profitable and commercially attractive for the State or oil firm. Profitability does not only depend on selling prices and investment and operating costs but is subject to prevailing legal conditions, which affect both exploration and production contracts and marketing contracts, and to the fiscal regime for taxes and royalties, among other things. Reserves are accumulated and then certified as deposits are explored and resources discovered (mainly by means of seismic, gravimetric and stratigraphic analysis and the drilling of exploration wells), in the light of technical and economic conditions and legal regimes as discussed.<sup>4</sup>

In 2011, the Bolivarian Republic of Venezuela had the world’s largest reserves of oil (ahead even of Saudi Arabia), with 297 billion barrels, and of natural gas, with 194 trillion cubic feet (see figure II.4).

With the Magna project, which began in the Bolivarian Republic of Venezuela in 2005 and involved the division of the Orinoco region into 27 blocks, reserves were quantified in situ. The accumulation of reserves between 2005 and 2011 was 270%. According to some analysts, however, this increase owed more to the certification of existing extra heavy crude reserves than to any particularly successful exploration activity (Fundación Bariloche, 2012).

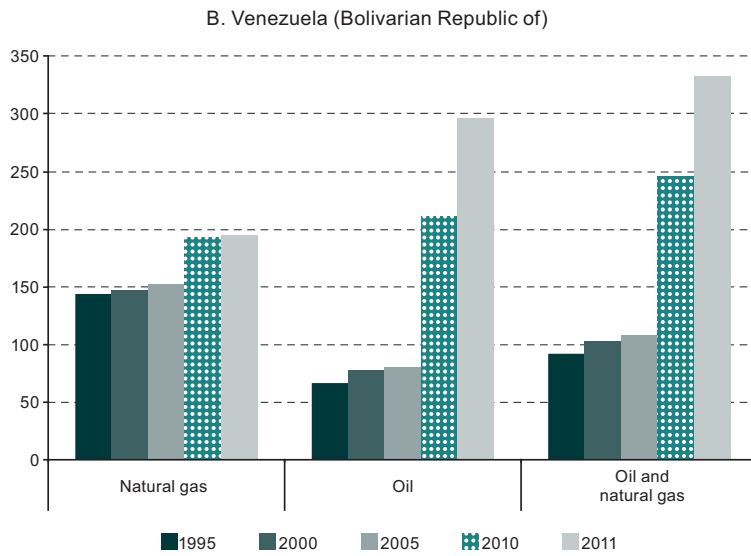
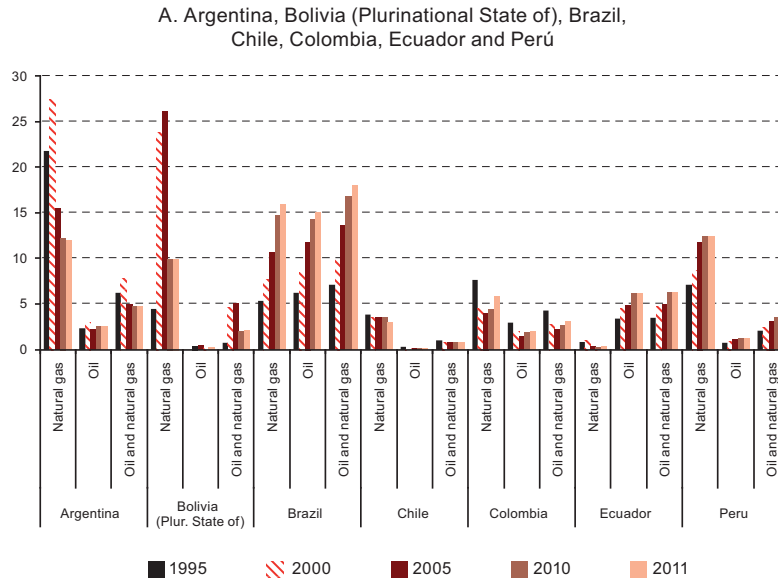
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<sup>3</sup> On 5 May 2011, for example, the price of Brent crude fell by US\$ 10 in a day. No analyst would suggest that this was due to structural factors, major alterations in exploration costs or the depletion (in physical units) of the resource on the basis of the Hubbert curve. Indeed, none of these explanations was put forward. The price change was put down to a factor as apparently remote from the oil market (although it is not so remote if the effects on economic recovery and aggregate demand are considered) as the expectation that the European Central Bank would not raise interest rates, meaning that the steady rise of the euro against the dollar would presumably be halted.

<sup>4</sup> As well as reserves being able to rise because of new finds, modern oil accounting suggests that this stock variable can rise or fall each year because of other flow variables. Consequently, account needs to be taken of revisions to earlier estimates (for example, when greater certainty exists about variables such as pricing, costs, the porousness of the reservoir or the recovery rate), enhanced recovery techniques (including the injection of natural gas or CO<sub>2</sub> into reservoirs), the net balance of reserves transactions (in countries where reserves can be bought and sold by buying or selling the land they are under) and production during the year.



Figure II.4  
**LATIN AMERICA (SELECTED COUNTRIES): OIL AND NATURAL GAS RESERVES, 1995, 2000, 2005, 2010 AND 2011**<sup>a</sup>  
*(Billions of barrels of oil, billions of barrels of oil equivalent for total hydrocarbons, and trillions of cubic feet of natural gas)*<sup>b</sup>



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP p.l.c., “Statistical Review of World Energy”, 2011 and 2012 [online] <http://www.bp.com/statisticalreview>; ENI, “World Oil and Gas Review 2010”, 2010 [online] <http://www.eni.com/world-oil-gas-review/pages/home.shtml>; Energy Information Administration (EIA), “Country analysis briefs”, 2011.

<sup>a</sup> At year’s end.

<sup>b</sup> Taking an average worldwide conversion factor for natural gas, calculated by BP p.l.c., of 5,610 cubic feet per barrel equivalent.

Reserves fell everywhere in the region except the Bolivarian Republic of Venezuela, Brazil, Colombia, Ecuador and Peru. Argentina had total reserves of about 7.9 billion barrels of oil equivalent in 2000 but no more than 4.7 billion barrels in 2010, a decline of 40% over the period.

In the case of Brazil, reserves estimates do not take account of all the resources in the Brazilian pre-salt layer<sup>5</sup> discovered in the Tupi field in 2007 or of others in the Santos reservoir. These are expected to total 50 billion barrels of oil equivalent between them, and if treated as reserves in future they will almost treble current estimates.

As regards reserves of unconventional natural gas,<sup>6</sup> both Argentina and Latin America as a whole could have the opportunity to certify technically recoverable gas resources<sup>7</sup> once technology or regulatory frameworks make hydraulic fracturing and horizontal drilling techniques economic and potentially applicable in the region's countries.

At the global level, rising reserves of unconventional gas are expected to lead to its consumption increasing in the energy mix, to the point where it could even equal oil consumption in the next 20 years. This process will also allow natural gas price formation to reflect the costs of developing and producing reserves, irrespective of price formation and fluctuations for oil or oil derivatives deemed to be substitutes. This situation in fact arose recently, with a decoupling since 2009 between the almost steady price trend for Henry Hub natural gas and the upward trend in the WTI oil price (Bourland and Gamble, 2011).

#### (a) Replacing reserves

The effort made by countries to replace reserves over time is measured by the reserve replacement index.<sup>8</sup> An index value below 1 would signify inadequate (or zero) replenishment of reserves, a value of 1 would signify that reserves were exactly replenished and a value greater than

<sup>5</sup> Reservoirs of crude that are beneath thick layers of salt under the ocean bed, deposited 150 million years ago. Extraction requires maritime drilling to more than 3,000 metres through water, rock and over 1,500 metres of salt.

<sup>6</sup> Unconventional natural gas is in hard-to-find underground locations and is characterized by high production costs. It is encountered, for example, in impermeable deposits (needing maximum stimulation and requiring substantial investment), in hydrate deposits or dissolved in formation water. It can also derive from in situ gasification of coal. The category of unconventional gas includes: (i) shale gas, which is natural gas encountered in clayey detritic sedimentary rock that is rich in organic matter and characterized by low permeability and migration; (ii) gas in low-permeability deposits (tight gas), which is the natural gas found in very compact sedimentary rocks of fine-grained sandstone, with low-permeability, low-migration calcareous, ferruginous or siliceous cement, requiring the use of techniques such as hydraulic fracturing; (iii) coalbed methane, the methane-rich natural gas found in coal deposits (ENI, 2002; IEA, 2012).

<sup>7</sup> These are resources in situ, discovered and undiscovered, that are recoverable (economic considerations aside) with current technology. These resources become reserves if they are discovered and prove marketable. The sum of reserves, contingent resources and prospective resources may also be treated as "remaining recoverable resources" (SPE, 2009).

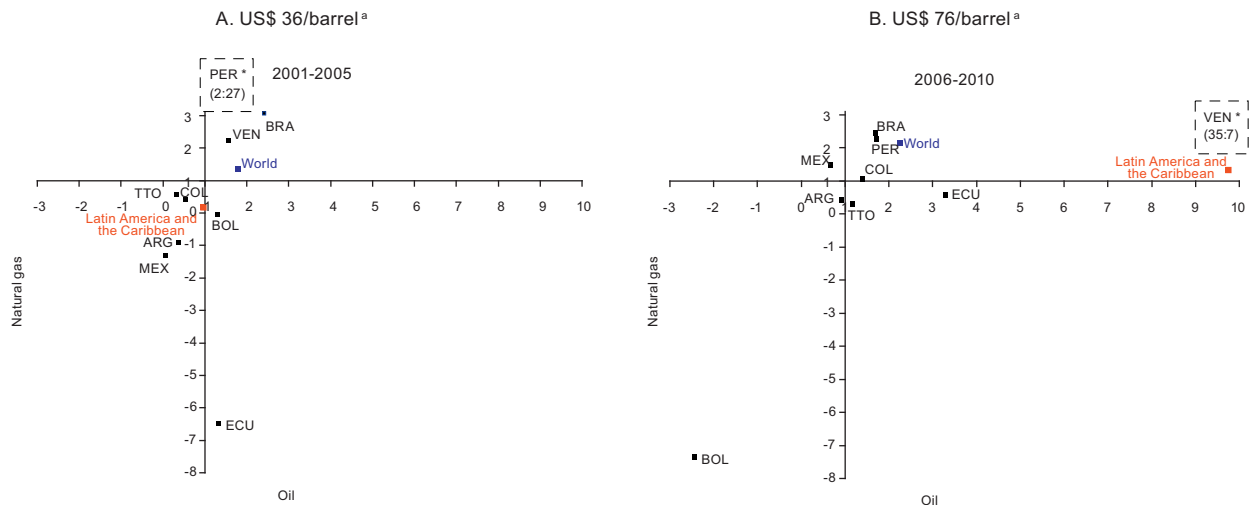
<sup>8</sup>  $RRI_t = ((R_t - R_{t-1})/P_t) + 1 = ((R_{t-1} - P_t + DIS_t + REC_t \pm REV_t - R_{t-1})/P_t) + 1 = (DIS_t + REC_t \pm REV_t)/P_t$  where:

RRI = Reserve replacement index  
 t = Period  
 R = Reserves  
 P = Production  
 DIS = Discoveries and extensions  
 REC = Enhanced recovery  
 REV = Revisions to earlier estimates

1 would mean that replenishment was more than adequate given production levels. The optimum situation for a country is to have a ratio of 1 or over so that it is replenishing reserves by at least the levels of production consumed and is not losing wealth or assets.

Figure II.5 compares the behaviour of the oil and natural gas reserve replacement indices between the two halves of the decade from 2001 to 2010, which is a consistent period for the certification of reserves. In the 2001-2005 period, with a price of US\$ 36 per barrel, it can be seen that replenishment of natural gas and oil reserves in Latin America was inadequate (index values of 0.16 and 0.97, respectively, which means that just 16% and 97% of production in the five-year period was replaced by new finds or adjustments to earlier estimates). Replenishment of both was more than adequate in the Bolivarian Republic of Venezuela, Brazil and Peru and inadequate in Argentina and Colombia.

Figure II.5  
**LATIN AMERICA AND THE CARIBBEAN (SELECTED COUNTRIES): FIVE-YEAR EVOLUTION OF THE OIL AND NATURAL GAS RESERVE REPLACEMENT INDICES, 2001-2010**



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP p.l.c., “Statistical Review of World Energy 2011” [online] <http://www.bp.com/statisticalreview>; ENI, “World Oil and Gas Review 2010” [online] <http://www.eni.com/world-oil-gas-review/pages/home.shtml>.

<sup>a</sup> Prices are the simple average of WTI for the reference period.

In the following five-year period, 2006-2010, the average price rose to US\$ 76 a barrel despite a drop in 2009, and this served to increase technically and economically recoverable resources and improve the region’s situation. The replacement index for the region stood at 9.75 for oil and 1.32 for natural gas, with the main impetus coming from the Bolivarian Republic of Venezuela, Brazil, Peru and, to a lesser extent, Colombia.

By contrast, Argentina and the Plurinational State of Bolivia were unable to take advantage of the price surge to accumulate reserves. This may have been due to different factors, such as revisions to earlier reserves estimates in the Plurinational State of Bolivia in 2010, rising investment, operating and financing costs (exacerbated by the global economic crisis) and regulatory aspects, such as the setting of fixed selling prices for the domestic market.

**(b) Resource reserve life: the relationship between reserves and production**

The abundance of non-renewable natural resources has traditionally been measured by the ratio between reserves and production or the estimated life of reserves (expressed as the number of years reserves would last at the production rate of the current period). This indicator reflects the reserve life of the resource at a given point in time, while changes over time indicate whether the reserve life thus measured is increasing or decreasing.

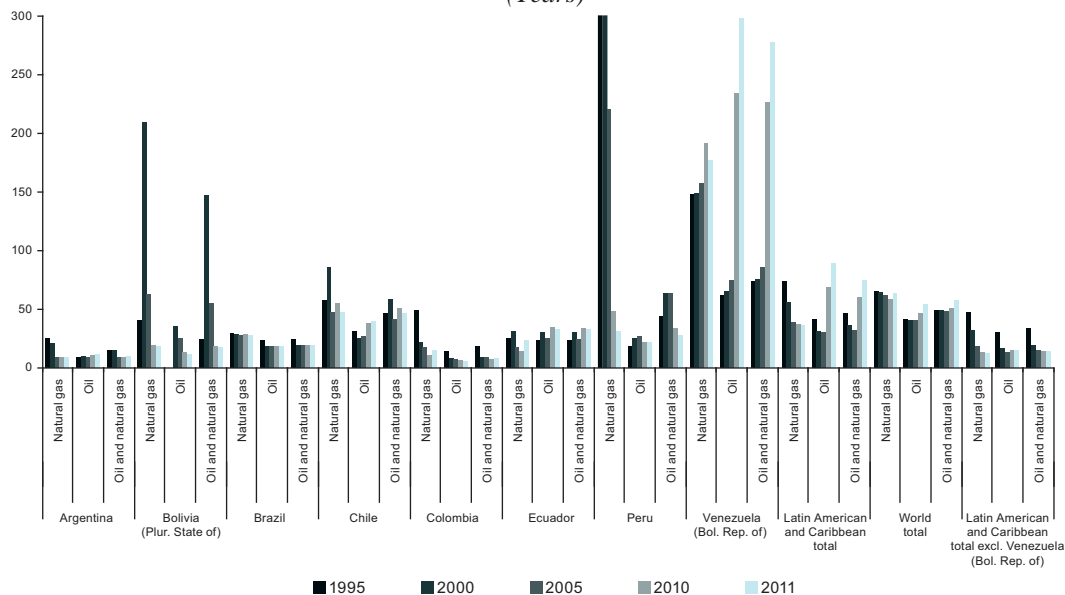
The reserve life of oil and natural gas in South America increased in the last five-year period, so that in 2011 it stood at 108 years, well above the world average of 58 years (see table II.1 and figure II.6). Without certification of the extra heavy crude from the Orinoco Belt, i.e., without the Bolivarian Republic of Venezuela, reserve life in South America would have been only 17 years, according to 2011 data.

Table II.1  
**LATIN AMERICA AND THE CARIBBEAN: OIL AND NATURAL GAS RESERVE LIFE**  
(Years)

Region or subregion	1995	2000	2005	2010	2011
Latin America and the Caribbean	46.6	36.1	32.3	60.2	74.6
Latin America and the Caribbean excluding the Bolivarian Republic of Venezuela	34.0	19.5	14.6	14.1	14.0
South America	47.2	46.3	45.7	87.8	108.2
South America excluding the Bolivarian Republic of Venezuela	20.5	20.9	18.7	17.2	17.0

**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP p.l.c., “Statistical Review of World Energy”, 2011 and 2012 [online] <http://www.bp.com/statisticalreview>.

Figure II.6  
**LATIN AMERICA AND THE CARIBBEAN (SELECTED COUNTRIES): RATIO BETWEEN RESERVES AND PRODUCTION OF OIL AND NATURAL GAS<sup>a</sup>**  
(Years)



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP p.l.c., “Statistical Review of World Energy”, 2011 and 2012 [online] <http://www.bp.com/statisticalreview>.

<sup>a</sup> The natural gas data for Peru in 1995 and 2000 give figures of 501 and 715 years, respectively.

Colombia and the Bolivarian Republic of Venezuela are at opposite extremes where reserve life is concerned, with figures of 7 and 278 years, respectively. In recent years, however, rising Colombian production has been balanced by rising reserves, allowing reserve life to be maintained, albeit at a low level. Private- and public-sector investment flows in Colombia are expected to increase this indicator in future.

In 2000, Peru had the highest ratio between natural gas reserves and production, at over 700 years, owing to the quantity of undeveloped resources in the Camisea gasfield, totalling some 8.7 trillion cubic feet, which amply covers the country's production of 33 million cubic feet a day (0.9 million cubic metres a day). The indicator dropped to 200 and 50 years in 2005 and 2010, respectively, owing to the rise in reserves and production from 2004, which was the result of higher demand for electricity generation and a liquefied natural gas (LNG) export project in 2010.

The evolution of prices in international markets over time is another indicator of the relative abundance or scarcity of resources, reflecting in turn the behaviour of global crude supply and demand. The upward trend in international hydrocarbon prices over the last decade suggests that resources are becoming increasingly scarce.

### 3. Production and consumption

In 2011, the Bolivarian Republic of Venezuela was the largest producer of oil (2.7 million barrels a day) and Argentina of natural gas (3.8 billion cubic feet a day). However, production decreased in both countries (by about -3% a year) during the 2005-2010 period.<sup>9</sup> Meanwhile, production in Brazil, which was South America's second-largest producer for both products, increased by about 4% a year (see figure II.7). Peru, Colombia and Brazil have all been successful in offsetting the natural decline of fields with higher production, recording growth of 13%, 8% and 4%, respectively.

In the case of oil, higher prices and greater drilling activity in the Bolivarian Republic of Venezuela and Ecuador were apparently not enough to offset the decline in output from mature fields, still less when production was subject to limits like those set as a condition of Organization of the Petroleum Exporting Countries (OPEC) membership, with quotas of about 2 and 0.4 million barrels of oil a day, respectively, for the two countries named.

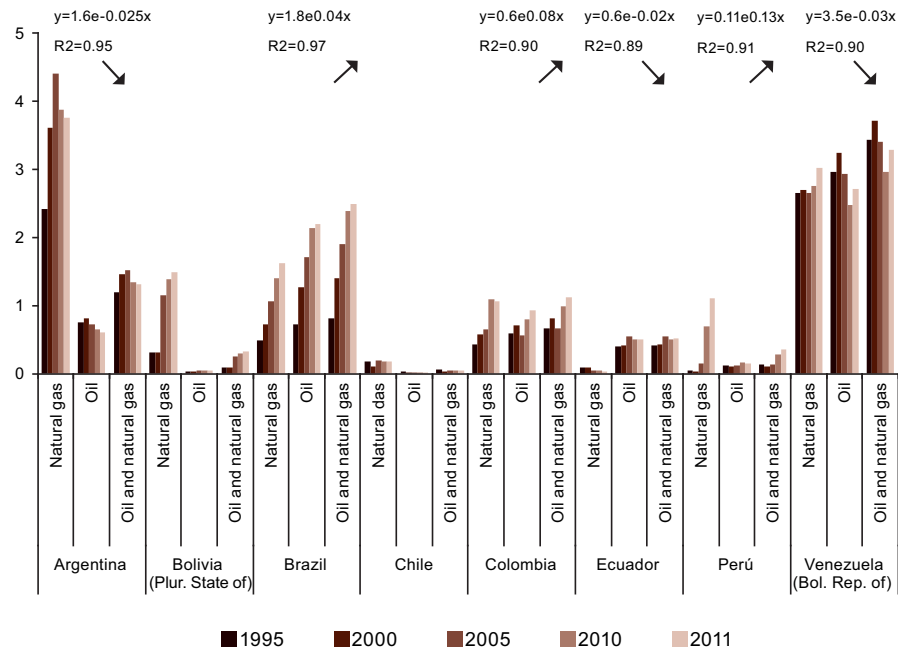
However, the stance of Saudi Arabia, which is one of the leading global producers and thus has substantial influence over OPEC decision-making (and on the UNASUR countries belonging to the organization), has been manifested in pressure not only to moderate production but also to increase it to stabilize crude prices. Some analysts have pointed out that a situation in which prices exceed US\$ 100 a barrel could be a harbinger of economic recession and thus of a reduction in world oil consumption, with potential medium- and long-run risks for the fiscal revenues of some producer countries whose economies are heavily dependent on their raw materials. Conversely, prices below US\$ 70 a barrel are a disincentive to investment in projects with high development costs, such as extra heavy oil projects in the Bolivarian Republic of Venezuela and ultra deep water projects in Brazil and Mexico, whose unit costs are put at US\$ 115, US\$ 60 and US\$ 55 a barrel, respectively (Bourland and Gamble, 2011).

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<sup>9</sup> There are other methods of quantifying the decline of wells or fields, based on harmonic and hyperbolic approaches.

Figure II.7  
**LATIN AMERICA (SELECTED COUNTRIES): OIL AND NATURAL GAS PRODUCTION, 1995, 2000, 2005, 2010 AND 2011<sup>a</sup>**

(Millions of barrels of oil, millions of barrels of oil equivalent for total hydrocarbons and billions of cubic feet of natural gas per day)



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP p.l.c., “Statistical Review of World Energy”, 2011 and 2012 [online] <http://www.bp.com/statisticalreview>.

<sup>a</sup> The exponential adjustment is for production of both natural gas and oil in the 2005-2010 period.

<sup>b</sup> Taking an average worldwide conversion factor for natural gas, calculated by BP p.l.c., of 5,610 cubic feet per barrel equivalent.

Another reason for the decline of production in some countries might be the inadequacy and slowness of the public-private investment response to higher prices. Furthermore, one factor in this response appears to be the difficulties created by technological and geological conditions, given the declining number of exploitable fields and the challenges involved in exploiting unconventional hydrocarbons, drilling offshore in deep water and developing extra heavy oil reserves. Accordingly, some analysts estimate that the price elasticity of the hydrocarbon supply is low in the region, at between 0.1 and 0.25 (Jenkins, 2011).

According to the international classification, the Bolivarian Republic of Venezuela, Colombia and Ecuador produce heavy sour crude, while Brazil produces a medium sour heavy crude. These products have to be processed at special refineries, which is the main reason why they tend to command lower prices on the international market than light sweet crudes.<sup>10</sup> Many of these countries’ investment plans for the coming years are focused on expanding and modernizing refineries to process and improve the quality of crudes of this type locally. While this would require heavy investment, it would reduce imports of derivatives, especially intermediates.

<sup>10</sup> The denser oil is, the higher its carbon content, the lower its quality and the greater the proportion of heavy products derived from it. The oil produced in the Plurinational State of Bolivia is a special case because, while it is a very light, sweet blend, this is because it is mainly composed of condensate and natural gasoline, components that are associated with the extraction of natural gas from gasfields.

In the production of natural gas, by contrast, other liquid hydrocarbon chains such as ethanes, propanes and butanes are obtained in most of the countries. This is an important parameter in international trade, which operates in terms of energy, as it generates a greater sales value for the region's gas production and opens up the prospect of industries such as petrochemicals being developed. Natural gas production has been increasing in almost all the countries in the area, the exceptions being Argentina and Ecuador.

Natural gas and oil consumption in the region has remained almost unchanged as a share of total primary consumption, although there has been a progressive substitution of oil by natural gas in the past 20 years. Although oil consumption has fallen from 55% to 47% of total energy consumption, however, this is still well above the world average, which was 35% in the five-year period from 2006 to 2010 (see figure 4 in the annex).

In South America, the largest consumer of hydrocarbons in 2011 was Brazil, with over 3 million barrels of oil equivalent a day. In that economy, oil and natural gas are used mainly for haulage and industry. The next largest users are Argentina and the Bolivarian Republic of Venezuela, which consume about 1.4 million barrels of oil equivalent a day. In the former, natural gas is used for electricity generation and residential consumption. In Venezuela, oil is used for haulage, which is one of the main destination sectors for hydrocarbons (see figure 5 of the annex).

### C. THE TRADE IN HYDROCARBONS

The countries' primary energy consumption is met from primary production, net imports and changes in stocks.<sup>11</sup>

The ratio between production and consumption indicates whether a country is an exporter or an importer. An index value above 1 indicates that the country or region is an exporter, a value of 1 indicates that domestic production meets local demand and a value below 1 indicates the extent of imports required. The decline in the average ratio from 1.5 to 1.3 in South America over the past 15 years is due to two factors: (i) the decline in (exportable) production levels mentioned in the previous point and (ii) the growth of domestic demand.

By comparison with what has happened in the rest of the world, domestic demand growth has responded fairly inelastically to rising international prices for hydrocarbons. This may possibly have a connection with the various mechanisms used to subsidize fuels for automotive transportation and natural gas for residential consumption, which have dampened the transmission of international price changes to domestic markets in a number of the region's countries. On average, Latin America and the Caribbean is a net exporter of oil and almost self-sufficient in natural gas, although decreasingly so (see table II.2 and figure II.8).

Revenue from hydrocarbon production is essential to the financing of the public budget in countries such as the Bolivarian Republic of Venezuela, Colombia, Ecuador and the Plurinational State of Bolivia. In 2010, the sector accounted for 41% of total exports in Colombia and the Plurinational State of Bolivia, 93% in the Bolivarian Republic of Venezuela and 55% in Ecuador, and the surge in prices enabled these economies to improve their terms of trade by 35%, 56%, 68% and 30%, respectively, during the 2005-2011 period (ECLAC, 2012a).

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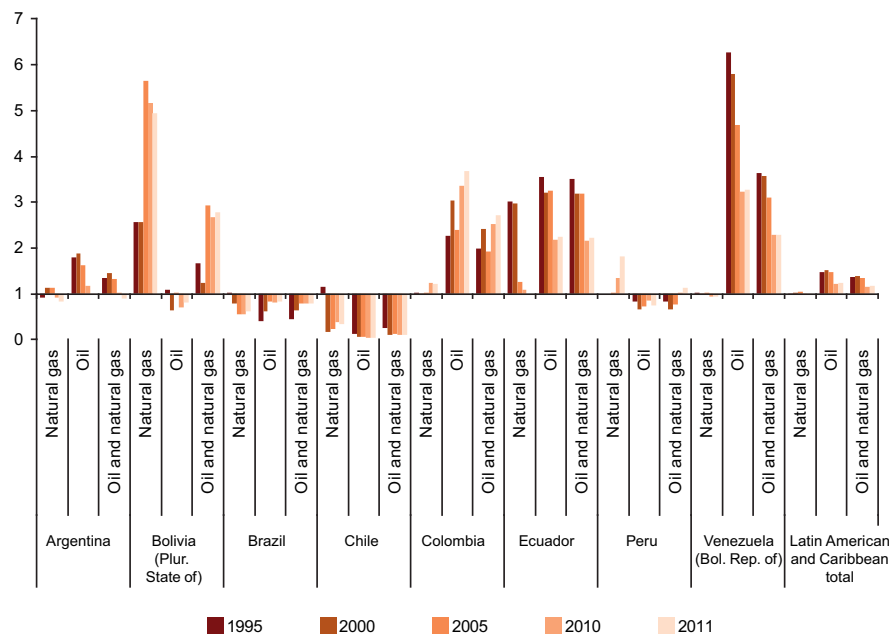
<sup>11</sup> The IEA has established that the total primary energy supply (TPES) is equal to the sum of primary production plus imports, minus exports, plus any change in stocks of primary energy resources such as coal, oil, natural gas, nuclear energy, hydroelectricity and biofuels, among others.

Table II.2  
**LATIN AMERICA AND THE CARIBBEAN: RATIO BETWEEN PRODUCTION AND CONSUMPTION OF OIL AND NATURAL GAS, 1995-2011**

Region or subregion	1995	2000	2005	2010	2011
Latin America and the Caribbean	1.4	1.4	1.4	1.2	1.2
Latin America and the Caribbean excluding the Bolivarian Republic of Venezuela	1.0	1.1	1.1	1.0	1.1
South America	1.5	1.5	1.4	1.2	1.3
South America excluding the Bolivarian Republic of Venezuela	0.9	1.0	1.1	1.0	1.0

**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP p.l.c., “Statistical Review of World Energy”, 2011 and 2012 [online] <http://www.bp.com/statisticalreview>.

Figure II.8  
**LATIN AMERICA AND THE CARIBBEAN (SELECTED COUNTRIES): RATIO BETWEEN PRODUCTION AND CONSUMPTION, 1995, 2000, 2005, 2010 AND 2011**



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP p.l.c., “Statistical Review of World Energy”, 2011 and 2012 [online] <http://www.bp.com/statisticalreview>.

The decline in production levels in the last decade was amply offset by the effect of prices on export values. Whereas in the 1991-2000 period the volume effect accounted for 78% of annual growth in the value of raw material exports from the countries of South America, in the 2001-2010 period the share fell to just 35%. China is a leading destination, and increasingly so, for South American exports,<sup>12</sup> as it has contributed about 22% of the increase in the value of commodity and commodity-based manufacturing exports in recent years (ECLAC, 2012b).

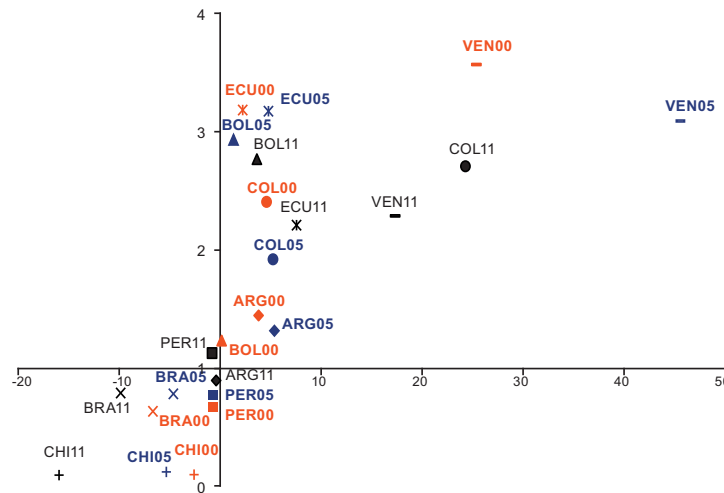
<sup>12</sup> Having taken only a very small share of exports by value in early 2000, a decade later China accounted for 2%, 5% and 8% of the exports of oil-producing countries such as Ecuador, Colombia and the Bolivarian Republic of Venezuela, respectively.



Of the 185% increase in crude prices in the 2002-2007 period, the effect of oil demand from China is estimated to have contributed a share of between 10.8% and 27.1%, something that was reflected in an increase of about US\$ 20 billion in the value of oil exports in 2007.<sup>13</sup> Thus, crude exporting countries such as the Bolivarian Republic of Venezuela and Ecuador were able to improve their overall trade balance that year by between 10.1% and 21.4% in the first case and between 7.9% and 17.4% in the second (Jenkins, 2011).

The “China effect” also contributed to Ecuador increasing its hydrocarbon trade surplus from US\$ 2 billion to US\$ 8 billion between 2000 and 2011 even as its production to consumption ratio fell from 3.2 to 2.2, with exports continuing to go to traditional markets such as the United States (see figure II.9).

Figure II.9  
**LATIN AMERICA (SELECTED COUNTRIES): HYDROCARBON TRADE BALANCES  
 AND PRODUCTION TO CONSUMPTION RATIOS, 2000, 2005 AND 2011**<sup>a</sup>  
*(Billions of dollars and index values)*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP p.l.c., “Statistical Review of World Energy”, 2011 and 2012 [online] <http://www.bp.com/statisticalreview>; ENI, “World oil and gas review 2010”, 2010 [online] <http://www.eni.com/world-oil-gas-review/pages/home.shtml>; and United Nations Conference on Trade and Development (UNCTAD), UNCTAD Stat, 2012 [online] [http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx?sCS\\_referer=&sCS\\_ChosenLang=en](http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx?sCS_referer=&sCS_ChosenLang=en).

**Note:** Arg=Argentina, Bol=Plurinational State of Bolivia, Bra=Brazil, Chi=Chile, Col=Colombia, Ecu=Ecuador, Per=Peru, Ven=Bolivarian Republic of Venezuela, 00=2000, 05=2005, 11=2011.

<sup>a</sup> The free on board (FOB) trade balance of exports minus imports (horizontal axis) corresponds to item 3 of the Standard International Trade Classification (SITC) Revision 3 covering “Mineral fuels, lubricants and related materials” other than coal.

During the last five-year period, declining production and rising consumption in both Argentina and the Bolivarian Republic of Venezuela had a greater impact than the rise in prices, something that was reflected in a reduction of the energy surplus from US\$ 46 billion to US\$ 18 billion in the latter case and in a shift from a US\$ 5 billion surplus to a US\$ 1 billion deficit in the former. Thus, Argentina imported more liquid hydrocarbons and natural gas from the Plurinational State of Bolivia (by pipeline) and from Trinidad and Tobago (in the form of LNG), which resulted in a currency outflow of about US\$ 9 billion in 2011<sup>14</sup> and was one of the factors leading to the nationalization of Repsol-YPF equity in 2012.

<sup>13</sup> The value of crude exports from Latin America and the Caribbean was over US\$ 129 billion in 2007.

<sup>14</sup> Other estimates put the amount at about US\$ 5.4 billion (UNCTAD, 2012).

In Brazil, despite a production to consumption ratio of about 0.8 and a growing hydrocarbon trade deficit (US\$ 10 billion in 2011), consumption for haulage was offset by ethanol production of about 0.6 million barrels a day. Meanwhile, Colombia, with a ratio of 2.7, strengthened its position as an exporter to the United States and attained the largest hydrocarbon trade surplus of any South American economy, with a figure of about US\$ 24 billion in 2011. Peru, although an importer of crude from Ecuador, is meeting a greater and greater proportion of its consumption from local production every year. However, currency inflows from the export of LNG from the Camisea field is not yet enough to offset imports of liquid hydrocarbons.

Thanks to an increase in its output of natural gas for export to Brazil and Argentina and to high natural gas prices (which were indexed to oil derivatives prices), in the last decade the Plurinational State of Bolivia achieved one of the greatest improvements in production to consumption indices, so that in 2011 it had an energy trade surplus of close to US\$ 4 billion. Nonetheless, the country is faced with the challenge of reducing rising fuel imports by increasing production and cutting its consumption subsidy, which cost about US\$ 740 million last year.<sup>15</sup>

The countries worst affected by the price shock have been hydrocarbon importers such as Chile and Uruguay. In recent years, Chile has been a substantial importer of oil from Ecuador and LNG from Equatorial Guinea, Egypt and Trinidad and Tobago, something that is reflected in an index value of 0.1. This dynamic has resulted in a growing hydrocarbon trade deficit, which stood at US\$ 16 billion in 2011 (see figure II.9).

The region has further diversified its natural gas supply sources in the last five years thanks to LNG (see figure 6 in the annex). The traditional method of supply via gas pipelines was not sufficient to guarantee energy security, so sea transport was turned to, contributing to an increase in world trade and, in some cases, making the energy supply less integrated. Because of this rise in consumption, natural gas now behaves like a commodity in much the same way as any oil derivative.

Brazil, the main producer and a leading importer of natural gas, has increased its supply of gas from the Plurinational State of Bolivia (via pipelines) and of LNG from Trinidad and Tobago and Nigeria. The situation regarding trade in gas has changed for Argentina and the Bolivarian Republic of Venezuela on the one hand and Peru and Colombia on the other. From being an exporter to Chile, Argentina has now become an importer from the Plurinational State of Bolivia and Trinidad and Tobago. Colombia and Peru have moved from a situation of balance in their domestic markets to being exporters via pipelines to the Bolivarian Republic of Venezuela and in the form of LNG to Spain and Mexico, respectively.

The Plurinational State of Bolivia produces the highest proportion of exportable natural gas, with a ratio of 5 in long-term contracts with Argentina and Brazil. This has made it the leading exporter via pipelines, with volume having grown from 1 billion to 1.3 billion cubic feet a day, representing a 4% yearly increase in the last five years (see figure 6 in the annex).

#### **D. INVESTMENT**

Given that high prices (or low production costs thanks to propitious technical and geological conditions in some countries) may not be a sufficient incentive to attract the capital needed for a subsequent increase in reserves and production, other factors need to be taken into account.

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<sup>15</sup> UNCTAD, 2012.

The act of determining and defining the ownership of hydrocarbon reserves and production implies that the owner will be free to exploit the asset and, furthermore, will be able to appropriate the revenues generated and access financing sources. At the same time, accumulating reserves serves to demonstrate efficiency and credibility in both public- and private-sector management.

From the standpoint of the State, a good oil contract is one that not only facilitates the development of resources but generates economic benefits through the appropriation of economic rent, venture capital financing and technology transfer by the private-sector party. The motivation of the private-sector firm, meanwhile, is to create financial value from globally diversified and profitable projects or assets.

Investment decisions are based on a country's geological potential, access to favourable markets, judicial and legal aspects, the degree of institutional development and a stable and progressive fiscal framework,<sup>16</sup> and on a positive relationship with interest groups. Insofar as these factors help to reduce risk, they will have a beneficial effect in attracting investment. Two trends have been seen in the sector over the last decade as regards policies on foreign capital participation, with different effects on regional investment volumes (see figure II.10).

On the one hand, Brazil, Colombia and Peru have been taking measures to attract private-sector capital as a way of ensuring investment in exploration and thus restoring their levels of reserves and production, which began to decline in the late 1990s. These countries allowed greater private-sector involvement in production by signing concession contracts with strategic private-sector partners; they allocated traditional and non-traditional areas by international auction (with local oil companies such as Ecopetrol and Petrobras among the bidders); they carried out fiscal reforms involving tiered royalties; and they issued exploration licences for longer periods.

On the other hand, countries such as the Bolivarian Republic of Venezuela (since 2000), Ecuador (in 2010) and the Plurinational State of Bolivia (in 2006) have undertaken nationalization or expanded State control. The situation has been characterized, among other things, by the establishment of public-sector ownership of oil production and assets, renegotiations giving rise to operating, service and mixed contracts, increased participation by State oil companies and a rising tax burden.

In addition, a number of firms, particularly European and United States ones, have sold off their assets in the region. Set against this, firms from China, India and other emerging economies (most of them State-owned) have shown an increasing interest in investing in the region.

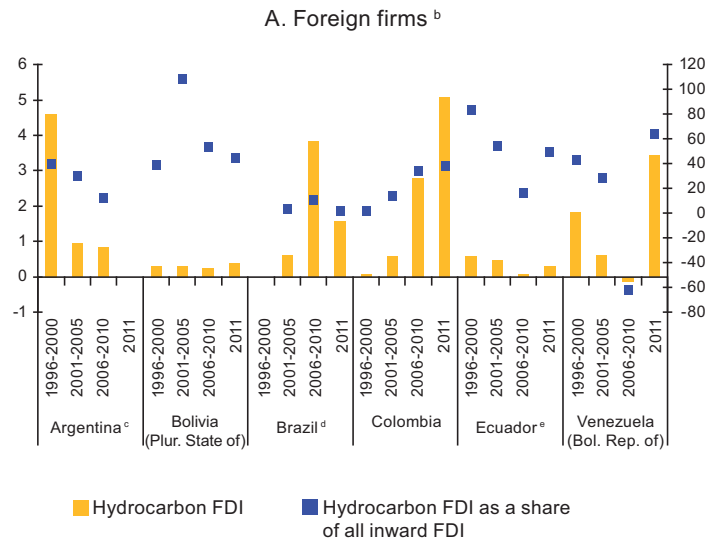
The partnerships between private-sector and State-owned companies in projects relating to unconventional hydrocarbons in Argentina, pre-salt deposits in Brazil and extra heavy crude in the Bolivarian Republic of Venezuela, among others, will find it challenging to make good on substantial exploration and production investment commitments, totalling some US\$ 500 billion for the next five-year period (see table I.3). For comparison purposes, it is estimated that sustainably developing natural gas alone would require some US\$ 500 billion to be spent on exploration and production processes and US\$ 100 billion on distribution, refining and marketing over the next 23 years.<sup>17</sup>

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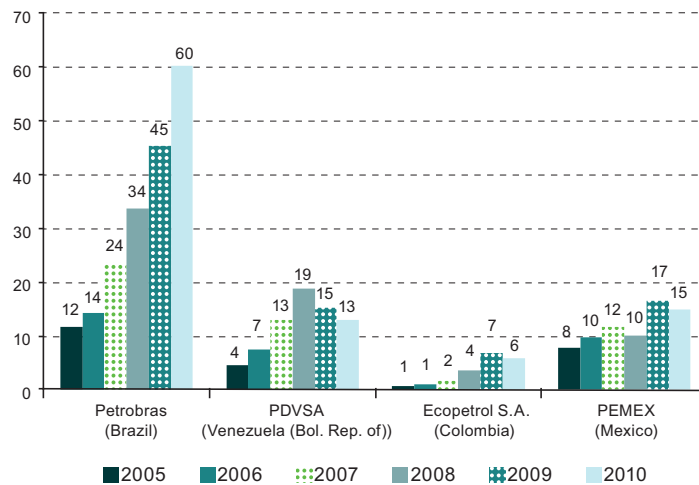
<sup>16</sup> By a progressive fiscal framework is meant a more than proportional increase in the tax burden (X) in response to increases in oil revenue (Z), the latter being defined as the value of production at the international price net of production costs. A complementary definition of progressiveness is the increase in the effective tax rate or Government take ( $A = X/Z$ ) when Z increases.

<sup>17</sup> IEA, 2012.

Figure II.10  
**LATIN AMERICA (SELECTED COUNTRIES): FOREIGN AND STATE INVESTMENT IN HYDROCARBONS, 1996-2011<sup>a</sup>**  
*(Billions of dollars and percentages)*



B. State firms<sup>f</sup>



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of official information from the countries concerned; United Nations Conference on Trade and Development (UNCTAD), UNCTAD Stat, 2012 [online] [http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx?sCS\\_referer=&sCS\\_ChosenLang=en](http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx?sCS_referer=&sCS_ChosenLang=en); and Standard & Poor's, "Big spenders: Latin America's national oil companies, Petrobras and PEMEX", December 2011.

<sup>a</sup> Brazil and the Plurinational State of Bolivia consider investment received but not disinvestment in the sector, whereas the other countries consider net investment received, which explains the negative values for the Bolivarian Republic of Venezuela in 2004, 2006 and 2007 and Ecuador in 2006. No information is given for Peru because the data for the period are incomplete.

<sup>b</sup> The foreign direct investment (FDI) amounts given are annual averages for the periods. They include greenfield investment plus mergers with and acquisitions of firms or assets by firms that are not resident in the declaring country.

<sup>c</sup> No information is available for 2011.

<sup>d</sup> No information is available for the 1996-2000 period.

<sup>e</sup> The data on Ecuador are for all natural resources.

<sup>f</sup> The figures on investment by State firms cover capital spending on worldwide exploration, production, refining, distribution and marketing.

Table II.3  
**LATIN AMERICA (SELECTED COUNTRIES): FUTURE INVESTMENT PLANS TO 2017<sup>a</sup>**  
*(Billions of dollars)*

	Exploration and production		New production to 2020		Refining, transport and liquefied natural gas (LNG)		Partners
	Item	Value	Item	Value	Item	Value	
Argentina	Development of unconventional resources (794 tcf of natural gas) in Neuquén, Chubut and Santa Cruz Recovery of mature wells	35-49	0.2 mbpd (increase of 29%) in oil and liquids 24 mcmppd (increase of 23%) in natural gas		North-east Argentina gas pipeline Full utilization of refineries	1	YPF CNOOC Chevron Petrobras Sinopec
Bolivia (Plurinational State of)	Development of Caipipendi, Itaú and Incahuasi fields Exploration in Itaguazurenda, Camiri and elsewhere Gran Chaco and Río Grande liquid separation plants	4-6	0.04 mbpd (increase of 80%) in oil and liquids 30 mcmppd (increase of 70%) in natural gas		Urea and ammonia petrochemical plant Expansion of transport networks Refinery expansion and construction	3-4	YPFB Petrobras Repsol Total
Brazil	Development of pre-salt offshore oilfields (50 000 mbbbl of crude) in the Campos, Espírito Santo and Santos reservoirs	280 (118 for Petrobras, 45% for pre-salt)	3 mbpd (increase of 140%) in oil and liquids 70 mcmppd (increase of 150%) in natural gas		LNG regasification plants in Ceará and Rio de Janeiro Refineries for pre-salt crude	95	Petrobras BG Exxon Mobil Statoil Repsol Sinopec Shell BP
Colombia	Ecopetrol, with over 16 million hectares of exploration concessions	27 Ecopetrol	0.25 mbpd (increase of 30%) in oil and liquids 7 mcmppd (increase of 22%) in natural gas		Expansion of refineries in Cartagena and Barrancabermeja	6 Ecopetrol	Ecopetrol
Ecuador	Drilling in Auca, Shushufindi and Cuyabeno Enhanced recovery in mature fields	3	0.1 mbpd (increase of 20%) in oil and liquids		Construction and expansion of refineries in Manabí and Esmeralda	n/a	Petroecuador Petroamazonas ENI Repsol

Table II.3 (concluded)

	Exploration and production		New production to 2020		Refining, transport and liquefied natural gas (LNG)		Partners
	Item	Value	Item	Value	Item	Value	
Peru	Development of fields: Lot 67 (Paiche, Dorado, Piraña), Camisea, Block Z 2B (offshore) and Blocks 39,143, 76 and 64, among others	8-10	0.3 mbpd (increase of 200%) in oil and liquids 20 mcmppd (increase of 70%) in natural gas	7	South Andean gas pipeline North Andean gas pipeline Expansion of Talara refinery Petrochemicals	Modernization at Talara petrol and diesel refinery and increase of 0.03 mbpd (increase of 45%)	Petrobras Perenco Hunt Oil Repsol Pluspetrol Petroperú Talisman
Venezuela (Bolivarian Republic of)	Development of the Orinoco Belt in the Junín and Carabobo regions Offshore development of natural gas fields in the Deltana Platform and Mariscal Sucre areas	143	2 mbpd (increase of 75%) in oil and liquids 35 mcmppd (increase of 40%) of natural gas for LNG		LNG in Mariscal Sucre and Deltana Platform areas		PDVSA CNPC ENI Chevron Repsol Statoil Total Consortiums with various Russian and Indian companies

**Source:** Economic Commission for Latin America and the Caribbean, on the basis of official information from the countries, companies and print media.

**Note:** mcmppd: million cubic metres per day; mbpd: million barrels per day; tcf: trillion cubic feet; mbbl: million barrels.

<sup>a</sup> The exploration and production data for Argentina and the Bolivarian Republic of Venezuela are estimates and may include investments in refining, distribution or marketing. The Petrobras data are the sums allocated to Brazil, totalling US\$ 250 billion, as established by the 2010-2015 global investment plan. The amount for Colombia only covers Ecopetrol, although it is significant as the firm controls about 70% of the Colombian market. No information is available for other operators.

## **E. MAIN TRENDS: PRODUCTION, CONSUMPTION AND RESERVES**

- (i) Rising prices and activity in the industry were not enough to yield a sustained increase in reserves or output to match consumption growth in the region. Further incentives need to be sought to boost investment (both public and private) in exploration and production activities. Brazil and Colombia were two of the countries that went counter to this regional trend, as they succeeded in attracting investment for exploration and production activities that improved their reserves position and the production to consumption ratio.
- (ii) Declining output and continuous consumption growth could lead to a drop in export volumes. Regional consumption is showing signs of being less elastic in the face of price changes, particularly in countries such as the Bolivarian Republic of Venezuela, Ecuador, the Plurinational State of Bolivia and Argentina.
- (iii) For countries that have a high level of fiscal dependency on hydrocarbon exports, matched by substantial spending, this trend could bring a greater risk of fiscal deficits, higher debt and a potential decline in net international reserves, among other things.
- (iv) With the exception of the Bolivarian Republic of Venezuela and Brazil, the decline in reserves to production ratios in Latin America and the inadequate rate of reserves replacement over the decade have been jeopardizing the reserve life of the resource and the region's export position for the future. Colombia has a low hydrocarbon reserve life as it is, and the challenge for it is to invest to increase this.
- (v) A task that still lies ahead is to create regulatory, technological and investment conditions that allow the development of unconventional reservoirs in Argentina, pre-salt deposits in Brazil and extra heavy crudes in the Bolivarian Republic of Venezuela.

## **F. CONTRACTUAL FRAMEWORKS, ECONOMIC RENT AND FISCAL REVENUES**

The fiscal regimes applied to oil under the concession system and the contract system<sup>18</sup> differ from one another in aspects associated with the ownership of production, the type of tax instruments applied and the profit share of the State enterprise. Under the concession system, the Government obtains revenue by levying royalties and taxes. Under the contract system, conversely, the State is the owner of production and not only levies royalties and taxes but, via the State enterprise, shares the earnings from the business with the private sector.

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<sup>18</sup> The contract system is subdivided into service contracts and production-sharing contracts; contractors are paid in cash with the former and in oil or natural gas with the latter. In addition, service contracts may be subdivided into pure service contracts and risk service contracts; payment is fixed with the former, whereas with the latter it varies with profitability and market conditions.

To make the system progressive, use is made of mechanisms such as tiered royalties whose rates vary with production volume or value, or with the share of the State enterprise, with a profitability ratio being applied in cases where service or production-sharing contracts are in operation. Applying fixed royalties and high levels of taxation that are inelastic to price or profitability makes the system fiscally regressive (Johnston, 1994). All this means that fiscal systems face serious challenges and are complex to design.<sup>19</sup>

With a view to maximizing appropriation of economic rent, States may require producing firms to pay taxes or duties on top of those payable under the general regime. Instruments for taxing hydrocarbon exploitation revenues can be divided into two: (i) those applied to gross production (or gross revenue) from the oilfield or gasfield and (ii) those applied to operating profits.

The main advantage of the first group (which royalties generally fall into) is ease of collection. However, there may be the problem that fixed rates are not conducive to efficient operation of the field, as the fiscal obligation arises irrespective of profits. Furthermore, in exploration investment decisions based on probabilistic analysis,<sup>20</sup> a dynamic that is characteristic of exploration risk, modelling a fixed royalty for a prospecting project that has the potential to be successful in future may turn the present value of cash flow from the project negative, causing development of the reservoir to be cancelled or postponed.

Conversely, instruments applied to operating profits do allow fields to be operated efficiently, as market conditions and production costs are taken into account when calculating them. The core problem in this case, though, is the difficulty of oversight because of problems with information on operators' costs structures.

Some countries such as Brazil, Colombia and Peru have been trying to secure the benefits of both mechanisms by applying production taxes and royalties at rates that vary in accordance with easily verifiable criteria, such as production level, selling price, well depth or some other variable related to the cost structure (see table II.4) (Medinaceli, 2010).

Oil revenues are determined by three variables: the price the hydrocarbon is sold at, the volume of production that can be achieved at any given time, and extraction costs (capital and operating costs). It follows that the higher hydrocarbon prices and production volumes are, the greater a country's oil revenues will be. Conversely, revenues will decline as extraction costs rise. In summary, different combinations of price, output and extraction costs give rise to different levels of oil revenue. Over the last decade, however, the price shock has been the main determinant, driving up not only oil revenues but also exports and fiscal revenues even in countries where output has dropped.

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<sup>19</sup> There is also evidence from the region and the rest of the world that applying the same fiscal conditions to small and large fields, onshore or offshore, whether they are just beginning to produce or are at their peak, makes the system fiscally regressive. Consequently, both royalties and taxes ought to be lower for small, offshore and newly producing fields. See Khelil (1995).

<sup>20</sup> Decision tree or real options.



Table II.4  
**LATIN AMERICA AND THE CARIBBEAN (SELECTED COUNTRIES): FISCAL SYSTEMS FOR HYDROCARBON  
 EXPLOitation AND EXPLOitation, 2011**

Country	Types of contract	Contractual payments to the State	Objective	Taxable event	Tax base	Rate	Other taxes
<b>Argentina</b>	Current contracts in Argentina are of the concession type, so a firm wishing to undertake a venture has to make a down payment to the State when the exploration contract is signed or when the production stage begins, in addition to paying a royalty to the State and meeting all operating and capital costs	Royalties	To compensate the State financially for the exploitation of its non-renewable natural resources	"Computable" hydrocarbon production (net of own use, impurities, wastage, etc.)	Computable production at the wellhead price	General rate of 12%, although it can be higher in some provinces	There is a 35% profits tax. There is also a stamp duty of 0.5%, a bank account tax (Impuesto sobre los Créditos y Débitos Bancarios) of 1.2%, a personal assets tax (Impuesto sobre los Bienes Personales) of 1.25% and value added tax (VAT) levied at 21%
		Exploration taxes or duties	To tax exploration and prospecting for liquid and gaseous hydrocarbon reserves	Exploration in concession areas	Square kilometre allocated in each concession	The economic value per square kilometre is determined each year	
		Export duties	To tax sales of liquid and gaseous hydrocarbons to the external market. These are not offset against the value of production for royalty payments. They are used to reduce the export parity price, with this obligation being deducted from the international benchmark price	Exports of the liquid and gaseous hydrocarbons produced	Quality-adjusted final export price	Rates are variable and progressive with respect to the benchmark price of crude. There are two steps in applying them: (1) The nominal rate is calculated in the light of a regulated benchmark price of US\$ 60.90 per barrel. When the international price is below this benchmark, the nominal rate applied is 45%, and when the international price falls below US\$ 45 a barrel the rate will be determined in 90 days. When the international price is higher than the benchmark, the rate is set by obtaining the percentage difference and adding this to the 45% minimum rate applicable (2) The effective rate to be applied is calculated from the following expression: $1 - (1 / (1 + \text{nominal rate}))$ , and the result is applied to the tax base	

Table II.4 (continued)

Country	Types of contract	Contractual payments to the State	Objective	Taxable event	Tax base	Rate	Other taxes
<b>Bolivia (Plurinational State of)</b>	Production-sharing, operation and partnership. There are currently 44 operating contracts for exploration and exploitation activities. However, there are also public-private joint venture contracts in exploration areas	Royalties and levies payable to the national treasury	To compensate the State financially for the exploitation of its non-renewable natural resources	Exploitation and production of hydrocarbons	For the domestic market: total amount produced by field and product, whether liquid or gaseous, times the weighted average selling price in the domestic market, times the percentage share of such sales in the total. For the external market: total amount produced by field and product, whether liquid or gaseous, times the weighted average selling price in the external market, times the percentage share of such sales in the total	A rate of 18% is applied to the tax base (the value of output at the point of inspection). This percentage is to be divided up as follows: (a) 11% for the department where production took place (b) 1% compensatory royalty for the departments of Beni and Pando (c) 6% for the national treasury	There are also licence payments, value added tax (VAT) (13%) and the transactions tax (3%) for sales in the domestic market
		Direct Hydrocarbon Tax					
		YPFB share	The State firm's share of the profits generated by operating contracts	Exploitation and production of hydrocarbons	Profits to be distributed in accordance with annex F of the contracts	A percentage that is variable and progressive with respect to prices and the operator's revenue and cost factor (factor B). The higher the operator's output, the lower the percentage	
		Licences	Exploitation of Bolivian-owned hydrocarbons	Exploitation of Bolivian-owned hydrocarbons	Area exploited		
<b>Brazil</b>	The concession system is used, entitling private investors to explore and exploit the resource, and oil areas are put out to tender or auction	Royalties	To compensate the State financially for the exploitation of its non-renewable natural resources	Exploitation and production of hydrocarbons	Wellhead production value, payable on the basis of market prices for the oil, natural gas or condensate concerned, product specifications and field location	Between 5% and 10%, depending on the geological risks, the production outlook and other factors that have to be considered by the National Agency of Petroleum (ANP), which sets the definitive value in the concession contract	

Table II.4 (continued)

Country	Types of contract	Contractual payments to the State	Objective	Taxable event	Tax base	Rate	Other taxes
		Special levies	To impose a special levy on highly productive or highly profitable fields	Profitability greater than set by the ANP	Value of production after discounting royalties, investment in exploration, production costs, depreciation and other taxes. As in the previous case, the exact amount will be established in the concession contract. Progressive rates will be applied to the net quarterly output of each field in accordance with its location, the number of years it has been producing and the volume of output	Between 10% and 40%	
		Contract award payments	The amount concession-holding firms offer to acquire the right to exploit hydrocarbon resources in the areas tendered for	Award of areas put out to tender	Financial amount offered at the tendering stage to obtain the natural gas or oil concession	Cannot be less than the value set by the National Agency of Petroleum (ANP) in its call for tenders	
		Area occupation rate	Payment for use of the land specified in the concession	Resource exploration and exploitation activities	Square kilometre awarded in each concession	Expressed in reais per square kilometre at the exploration and production stages, as set out in each contract	
		Payment to the landowner	Payment for use of the land specified in the concession	Hydrocarbon production on Brazilian territory	Gross oil and natural gas production	1%	
<b>Chile</b>	Oil operation special agreements (CEOP), either exclusively or in partnership with the State firm ENAP. Contractors acquire ownership of the hydrocarbon once it has been produced. However, marketing is subject to regulation by the State, which pays the contractor a fee for its services once production has started. This fee is paid out of the hydrocarbon produced	Corporation tax	To tax annual profits from the exploitation and production of hydrocarbon derivatives	The earning of profits by CEOP signatories on Chilean territory	The sum arrived at by deducting total expenses from total revenues (reported in the annual results as taxable profit)	17%	The Sales and Services Tax Act, contained in Decree Law No. 825 of 1974, also applies; this sets the VAT rate at 19%

Table II.4 (continued)

Country	Types of contract	Contractual payments to the State	Objective	Taxable event	Tax base	Rate	Other taxes	
Colombia	Partnerships contracts. Exploration is carried out at the private-sector partner's risk and takes place over a period of joint commercial exploitation of 22 years, in cases where Ecopetrol decides to participate in the exploitation of fields. Concession contracts, with Ecopetrol also able to participate in the block auction or tendering process	Royalties	To compensate the State financially for the exploitation of its non-renewable natural resources	Production of liquid or gaseous hydrocarbons	Wellhead value of the hydrocarbons	Tiered rate of between 8% and 25%, depending on the volume of oil produced. Natural gas royalties, likewise tiered, are calculated as a percentage of oil royalties and depend on the origin of production (onshore or offshore, for example) and reservoir depth		
		Duties for use of the subsoil	Use of Colombian territory for exploration and exploitation operations	At the beginning of each exploration phase and half-yearly during the exploitation stage	Dollars per unit of surface area	The fixed amount payable is published annually		
		Windfall duty	To tax operations exceeding margins and operations exceeding production parameters	When cumulative output of liquid hydrocarbons from each area, including the volume associated with royalties, exceeds 5 million barrels and in the event that the crude price exceeds the base price or when gas has been produced for export for five years and the United States Gulf Coast Henry Hub price exceeds the base price	Production net of royalties	Rate of between 30% and 50%		
		Duty calculated as percentage share of output	Bidders are asked at the time of the tender to specify a percentage of hydrocarbon production. This is an important factor when concessions are awarded	Any type of production, including extended production tests carried out at the exploration stage	Production net of royalties	Fixed or variable depending on what the private-sector firm offered in the tendering process		

Table II.4 (continued)

Country	Types of contract	Contractual payments to the State	Objective	Taxable event	Tax base	Rate	Other taxes
<b>Peru</b>	Licence contracts, involving a concession for hydrocarbon exploration and exploitation, entered into between PERUPETRO and the contractor	Royalties	To compensate the State financially for the exploitation of its non-renewable natural resources	Production of liquid or gaseous hydrocarbons	Wellhead value of officially verified hydrocarbon output	Sliding scale from 5% to 25%, depending on the methodology chosen by the contractor (production scale or financial result) and estimates of investment and potential costs in the area specified by the contract	Corporation tax, applied at a rate of 30% to the operation's profits
<b>Venezuela (Bolivarian Republic of)</b>	Organic Law on Hydrocarbons and reforms establishing the public-private joint venture contract format with a PDVSA equity stake of at least 60%. Organic Law on Gaseous Hydrocarbons. There is no limit on private-sector stakes in natural gas exploration and exploitation contracts	Royalties	To compensate the State financially for the exploitation of its non-renewable natural resources	Production of liquid or gaseous hydrocarbons	Wellhead production value, with adjustments for gravity and sulphur content	The royalty rate on oil is currently 30%, but a lower rate of 20% can be applied in mature fields or the Orinoco Belt. The rate for natural gas is 20%	
		Surface tax	Payment for non-use of the area awarded for exploration and exploitation operations	Non-utilization of areas awarded after signing of the relevant contracts	Unexploited area of the concession	One hundred tax units (about US\$ 1,767) per year and square kilometre. Increased annually if the situation persists	
		Extraction tax	To tax the exploitation and production of liquid and gaseous hydrocarbons	Production of hydrocarbons on Venezuelan territory	Same basis as royalties	Rate of 33.33%, subject to deduction with payment of royalties and special benefit	
		Export registration tax	To tax operations that generate higher revenues for concession-holders	Export of hydrocarbons	Value of all hydrocarbons exported from any port in the country, on the basis of the actual selling price	One per mille (0.1%)	

Table II.4 (concluded)

Country	Types of contract	Contractual payments to the State	Objective	Taxable event	Tax base	Rate	Other taxes
		Special benefit	To obtain 50% of gross revenues generated by the marketing of hydrocarbons	Production of liquid or gaseous hydrocarbons in delimited areas	Annual payment of the difference between 50% of gross revenues and fiscal payments by public-private joint ventures (in the form of royalties, special levy, corporation tax, extraction tax, export registration tax and investment in endogenous projects, among others)		
		Special levy on extraordinary and exorbitant prices in the international hydrocarbons market	To tax the difference between the international crude price and the budgeted price or maximum benchmark price	Export or transportation abroad of liquid hydrocarbons or sale of these to PDVSA or any of its subsidiaries for more than the amount budgeted	Volume of hydrocarbons exported, after deduction for imported hydrocarbons used in the production process	Dollar amount per barrel, calculated as a proportion of the difference between the international price and the budgeted price or the maximum benchmark price (US\$ 70/bbl). The share is calculated cumulatively by applying tiered rates ranging from 20% to 95% of the price differentials established using ranges and assumptions for extraordinary and exorbitant prices. The higher the international price, the larger the share of the price difference to be levied	
<b>Ecuador</b>	Service contracts and marginal field reactivation contracts. Among their main characteristics is active participation by the State firm Petroecuador, which is a partner in a number of service contracts	Royalties	To compensate the State financially for the exploitation of its non-renewable natural resources	Hydrocarbon production	Wellhead production value as given by the price invoiced, with calculations differentiated by hydrocarbon quality	Between 12.5% and 18.5%	

**Source:** Economic Commission for Latin America and the Caribbean.

## G. THE STATE SHARE OF ECONOMIC RENT FROM THE HYDROCARBON SECTOR DURING THE LATEST PRICE CYCLE

Because of the favourable cycle that began in 2003, economic rent per barrel of crude exported (the international price minus the wellhead unit extraction cost) has increased steadily, albeit to a lesser degree than rents in the mining sector. Table II.5 shows the evolution of rents in the sector and their appropriation via the fiscal and contractual regimes of the different countries. The period of strongest price growth (2004-2009) is contrasted with the previous period (1990-2003) for a group of countries in the region, including the largest exporters. The first two columns show the change in sectoral GDP and economic rent in the sector as a percentage of total GDP in the two periods.

Table II.5  
**LATIN AMERICA (SELECTED COUNTRIES): HYDROCARBON SECTOR INDICATORS  
AND FISCAL CONTRIBUTION, 1990-2009**  
(Percentages)

	GDP share of the hydrocarbon sector		Hydrocarbon sector rent as a share of PIB		Fiscal contribution of the hydrocarbon sector to economic rent in the sector <sup>a</sup>		Fiscal contribution of the hydrocarbon sector to total Government revenues	
	Prior to 2004	2004-2009	Prior to 2004	2004-2009	Prior to 2004	2004-2009	Prior to 2004	2004-2009
Bolivia (Plurinational State of) <sup>b</sup>	2.6	6.0	6.4	28.9	42.7 <sup>c</sup>	33.9	11.5 <sup>c</sup>	27.4
Brazil <sup>b,d</sup>	0.9	1.4	1.1	3.1	...	90.3	8.2	9.0
Colombia <sup>b</sup>	2.9	3.7	4.9	7.1	23.6	30.2	9.4	14.2
Ecuador <sup>e</sup>	0.5	0.2	12.8	24.2	58.4	38.4	30.7	29.4
Mexico <sup>f</sup>	5.1	7.0	4.7	7.7	...	...	30.0	35.8
Peru <sup>b,g</sup>	0.7	1.5	1.5	2.0	55.2	28.6	3.7	3.2
Venezuela (Bolivarian Republic of) <sup>b</sup>	14.7	26.6	26.8	31.0	42.1	41.7	56.3	44.9

**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), CEPALSTAT database, 2012.

<sup>a</sup> Calculated as an average of annual values (at nominal prices).

<sup>b</sup> Government revenues are for general government.

<sup>c</sup> Data since 1997.

<sup>d</sup> Data prior to 2004 are not considered because of statistical errors. Only data on hydrocarbon production as a percentage of GDP in the 2000-2007 period are taken. Data on the contribution of the hydrocarbon sector have been available since 1997.

<sup>e</sup> Hydrocarbon production data include the 1993-2007 period. Government revenues are the total revenues of the non-financial public sector.

<sup>f</sup> Data prior to 2009 are not considered because of statistical errors. Hydrocarbon production data include the 2003-2009 period. Government revenues are all public-sector budgetary revenues and include tax and non-tax revenues.

<sup>g</sup> Data since 1998.

The third and fourth columns show, respectively: (i) the fiscal contribution of the hydrocarbon sector as a percentage of estimated rent in the sector and (ii) the same fiscal contribution as a percentage of all fiscal revenues in each country. In both cases, the fiscal contribution of the hydrocarbon sector includes taxes and royalties paid to the State for oil and natural gas exploration and production, not including taxes on domestic fuel distribution and marketing.<sup>21</sup>

<sup>21</sup> It is worth mentioning some assumptions and peculiarities in the calculation that could give rise to overestimation or undervaluation or be an indication of greater volatility in the State share of economic rent (Government take).

In some cases, such as that of Brazil, it has been impossible to separate out the fiscal contribution of the refining, transport, storage and distribution (downstream) stage from total fiscal revenues.

The behaviour of the State share of hydrocarbon sector rents, in combination with other indicators for the sector's fiscal contribution, is characterized by the following stylized facts:

- (i) Generally speaking, the Government take as a percentage of economic rent is higher in the hydrocarbon sector than in the mining sector. In other words, the State succeeds in taking a larger percentage of sectoral economic rent in most oil-producing countries than in mining countries.
- (ii) During the 2004-2009 period, the dependency of total fiscal revenues on contributions from the hydrocarbon sector relative to the pre-2004 period increased in Brazil (from 8.2% to 9%), Colombia (from 9.4% to 14.2%), Mexico (from 30% to 35.8%) and the Plurinational State of Bolivia (from 11.5% to 27.4%). It barely changed in Ecuador (declining from 30.7% to 29.4%) and Peru (from 3.7% to 3.2%), while in the Bolivarian Republic of Venezuela it dropped from 56.3% to 44.9%.
- (iii) In the Plurinational State of Bolivia, the average fiscal contribution of the hydrocarbon sector as a percentage of total tax revenues rose by over 100% between 1990-2003 and 2004-2009, increasing from 11.5% to 27.4%. This indicator is connected to the change in the tax regime applied to the hydrocarbon sector with the creation of the direct hydrocarbon tax and an expanded royalties scheme, accompanied by higher prices and larger contractual volumes of natural gas exports to Argentina and Brazil.
- (iv) In Colombia, the fiscal contribution of the hydrocarbon sector as a share of total fiscal revenues increased by about 50% between 1990-2003 and 2004-2009, from 9.4% to 14.2%. These indicators are consistent with the development undergone by the country's oil sector and with the expansion of crude output in the last few years.
- (v) The fiscal contribution of the hydrocarbon sector as a percentage of the sector's estimated economic rent ranged from 24% to 58% in the period prior to 2004 and from 30% to 42% in the latest period (2004-2009) for all the countries taken together, with the exceptions of Brazil and Mexico. In Peru, the Plurinational State of Bolivia and, to a lesser extent, Ecuador, on the other hand, this share, expressed as a percentage of the sector's total economic rent, was lower during the latest period (2004-2010) than in the period prior to 2004.

Given that the latest period was marked by high prices and an increase in hydrocarbon rents as a percentage of GDP, it would seem that the fiscal regime in the countries observed displayed regressive characteristics. In other words, the Government take from hydrocarbon rents, measured as a percentage of economic rent, fell despite fiscal revenues and economic rent increasing in almost all the countries.

This behaviour may be due to various causes, including rising production costs, which may have prevented the profits of oil companies (and particularly those that pay corporation tax) from rising as strongly as the economic rent estimated for the sector.<sup>22</sup> It could also be due to the existence of non-tiered fixed royalties or tax rates that are inelastic relative to price (or profitability), as this could result in the fiscal regime applied to the sector adjusting much more slowly to market-driven changes in the sector's economic rent.

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There is also a mismatch between the fiscal year and the calendar year. The former is used for the fiscal take from royalties and taxes, while the latter is used to calculate economic rent. Consequently, the fiscal take in a period may be associated with tax bases (and thus economic rents) from earlier periods.

<sup>22</sup> A high level of depreciated investment and large interest payments because of reliance on debt financing are among the factors weighing on both corporate profits and corporation tax receipts.





## Chapter III

**PUBLIC POLICIES FOR THE DEVELOPMENT OF DRINKING WATER  
AND HYDROELECTRICITY IN UNASUR****INTRODUCTION**

The UNASUR countries possess about 30% of the world's renewable water resources. This represents over 70% of the water in Latin America and the Caribbean. Precipitation is distributed very unevenly across UNASUR, which means that there are some extremely arid areas. The seasonal distribution and annual variation of precipitation are also irregular, so that there are areas with too much water in some seasons and severe droughts in others. Another important general characteristic of UNASUR is the concentration of economic activities and population in dry and subhumid zones.

Although there is no case for speaking of a shortage of water in the UNASUR countries in a physical sense, it is important to realize that water management systems are often poor or non-existent. This situation is confirmed in the fourth United Nations World Water Development Report (2012), which points out that, notwithstanding its tradition of water management, the region has not yet shown itself able to establish institutions capable of dealing with water issues under conditions of increasing scarcity and conflict.

Climate change and anthropogenic demand have called the renewability of water resources into question. Droughts are intensifying along the continent's Pacific seaboard. This has led to a reduction in water availability for a variety of uses in the affected areas. Conversely, the excess precipitation brought by storms, cyclones and hurricanes, if not properly managed, will result in complex problems for the operation and maintenance of installed infrastructure.

Development in the UNASUR countries is water-intensive. If the region's development pattern emulates that in the developed countries, industrial demand should increase and agricultural demand diminish. Add in higher energy demand and pressure for it to come from renewable and sustainable sources, and water resources will come under heavy pressure.

Drinking water in the UNASUR countries accounts for between 10% and 20% of total extraction, and access to and enjoyment of drinking water are recognized as a human right since its main function is to sustain human life.<sup>1</sup> Water is just as essential for ecosystems, which also capture and produce it. Thus, in the allocation of water resources, drinking water and water for ecosystems normally have priority over agricultural, tourism, mining, industrial and energy uses.

Once priority uses have been attended to, questions arise about the allocation of the remaining water. Multiple solutions exist, but there is a global consensus that water should be allocated in such a way that the interests, interrelationships and impacts of all uses and users are taken into account in the decision-making process, in what is known as integrated water management (IWM) (Solanes and Jouravlev, 2005).

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<sup>1</sup> On 28 July 2010, under resolution 64/292, the United Nations General Assembly explicitly recognized the human right to water and sanitation, reaffirming that clean drinking water and sanitation were essential to the realization of all human rights.

Hydro power has started to come to prominence on the public agendas of the UNASUR countries, given the availability of water resources with technically and economically exploitable hydroelectric potential and the prospect of volatile oil prices in future. The region's hydroelectric generating potential is 590 GW, of which almost half is in Brazil. Hydroelectric potential in the Bolivarian Republic of Venezuela, Colombia and Peru is more modest but still substantial. Installed capacity is currently 137 GW, or 23% of the hydroelectric potential of the UNASUR countries.

Institutional weaknesses and shortcomings (deficient legal frameworks, regulatory bodies and systems of governance) have been hindering the delimitation and coordination of the economic, social and environmental needs of different users and interested parties, and the situation with water use for hydroelectric generation has been unstable as a result. This is being compounded by water laws that have not taken account of the growing competition for the resource, especially in basins that have been heavily developed and have a concentration of economic activity. One manifestation of this has been the increase in socio-environmental conflicts over major hydroelectric and mining projects. It is thus pressing for the UNASUR countries to start mounting integrated responses to the challenge represented by the development of the hydroelectric sector, with consolidated water governance and participation by all interested parties, and to establish institutional methods for solving and preventing these conflicts.

Some 95% of the population of UNASUR has access to improved water sources, with the leading countries in this respect being Uruguay (100%), Brazil (98%), Argentina (97%) and Chile (96%). The lowest coverage is in Peru (85%), Paraguay (86%) and the Plurinational State of Bolivia (88%). The situation with basic sanitation is far worse, as only 80% of UNASUR inhabitants have access to it. The countries with the highest coverage levels are Uruguay (100%) and Chile (96%), while the lowest levels are in the Plurinational State of Bolivia (27%), Paraguay and Peru (both with 71%). It is important to note that coverage levels are systematically lower in rural areas and among low-income groups, and that the data accessed do not take account of service quality (potability, intermittency and technology), which varies considerably between and within countries.

Here it is worth recalling that service quality in the UNASUR countries, even in extensive areas of the main cities, is not always good. For example, many drinking water supply systems have problems of intermittency, and the coverage of adequate water quality monitoring and control systems is very limited in cities and virtually non-existent in the countryside. Other than in Chile (and, to a much lesser extent, Uruguay and Brazil), wastewater treatment levels are low or nil. Untreated sewage is often discharged into watercourses, leading to water pollution in rivers, lakes and coastal areas.

UNASUR as a whole has already met target 7.C of the Millennium Development Goals (MDGs) regarding coverage of improved water sources. Although some countries have not yet reached their national targets, all of them are very likely to have done so by 2015 (with the possible exceptions of the Bolivarian Republic of Venezuela and Colombia). By contrast, the outlook for basic sanitation is not so positive: just five countries (the Bolivarian Republic of Venezuela, Chile, Ecuador, Paraguay and Uruguay) have met the MDG target for this, while the others are very unlikely to do so.

The present document reviews the situation with respect to drinking water and sanitation services provision and to the hydro power sector, then proposes concrete measures to deal with the challenges that remain to be met.

## **A. EFFICIENT, EQUITABLE AND SUSTAINABLE PROVISION OF DRINKING WATER AND SANITATION SERVICES**

Drinking water and sanitation services play a fundamental role in the preservation of life and health, as well as in the struggle against poverty and indigence, the equalization of social conditions, economic development in the countries and protection of the environment.

The satisfaction of people's essential need to drink safe water and dispose of their bodily wastes in an environmentally sustainable way has been recognized as a human right (see box III.1). States exist to serve human beings and are therefore obliged to make their best efforts to reduce differences and deficiencies in access to drinking water and sanitation, particularly for groups that are marginalized or restricted in their ability to use services, with a view to generating greater equity (De Albuquerque and Roaf, 2012). Internationally, and in the national constitutions and laws of a number of UNASUR countries (examples being Ecuador, the Plurinational State of Bolivia and Uruguay), the human right to water is explicitly recognized.

### Box III.1

#### **THE HUMAN RIGHT TO DRINKING WATER AND SANITATION**

The human right to water creates an obligation for States to ensure that their inhabitants have an adequate supply of safe, acceptable, physically accessible and affordable water to meet their personal and domestic needs. This last stipulation does not mean that drinking water and sanitation services need be free of charge for all but that their price can be afforded by most inhabitants. Thus, those who are able to should pay charges that reflect the efficient total cost of the service, and those who are not should be given access to a system of subsidies that progressively guarantees them basic minimum consumption levels.

The human right to water cannot be satisfied simply by a subsidy, however, as the construction of efficient, stable regulatory institutions is also required. Similarly, efficient service provision is essential to meet the human right to water, as availability increases when costs are lowered. Conversely, when costs are driven up by inefficient providers, whether public or private, it is to the detriment of the human right to water. Some of the most common forms of inefficiency include political interference in technical decision-making, high transaction costs, the loss of economies of scale when services are decentralized without proper analysis of local capacity, capture of the service by interest groups (whether investors, bureaucracies, unions or politicians), manipulation of accounting and transfer prices, and excessive debt. In short, efficiency and equity are not mutually exclusive, but complementary.

Efficiency in the sector depends on how services are managed, and regulatory frameworks, institutional oversight and control, political will and the economic, social, cultural and political conditions in each country are vital factors in the ability to promote it. Thus, the weight Governments assign to the human right to water is reflected in the seriousness and care with which they develop regulations and institutional frameworks.

**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), *Circular*, No. 31, Network for Cooperation in Integrated Water Resource Management for Sustainable Development in Latin America and the Caribbean, Santiago, Chile, 2009.

The political decision to prioritize drinking water and sanitation services not only fulfils a moral and legal duty to protect and secure a human right, distributive justice, social peace and environmental sustainability, but is also an economic imperative, as it contributes to countries' development and their participation in globalized markets.

The efforts of UNASUR to increase access to improved drinking water sources as required by the MDGs have borne fruit. At the subregional level, the countries as a group have more than met the 2015 target and have achieved 95% access to an improved source (JMP, 2012). Although some UNASUR countries have not achieved their national targets as yet, it is very likely that they will all do so by 2015 (with the possible exceptions of the Bolivarian Republic of Venezuela and Colombia).

By contrast, the MDG compliance situation as regards basic sanitation falls well short of the success achieved with access to improved drinking water sources. By 2010, the UNASUR countries as a group had achieved 80% coverage, with the Bolivarian Republic of Venezuela, Chile, Ecuador, Paraguay and Uruguay having already exceeded their national targets. At the same time, almost 80 million inhabitants of UNASUR still suffer the indignity and insecurity of having no access to basic sanitation, and over 17 million of these have to defecate in the open (JMP, 2012). A number of UNASUR countries (Argentina, Brazil, Colombia, Guyana, Peru, the Plurinational State of Bolivia and Suriname) are unlikely to meet the MDG sanitation target by 2015.

UNASUR has the highest levels of improved drinking water coverage of any of the world's developing subregions. Where basic sanitation is concerned, on the other hand, this group of countries ranks fourth behind the Caucasus and Central Asia (96%), North Africa (90%) and West Asia (85%) (JMP, 2012).

The countries have achieved what they have because the political will to invest in drinking water and sanitation has been there. The coverage figures show a major expansion during the 1980s and 1990s, followed by a slowdown in the early 2000s (JMP, 2012). This slowdown contrasts with the rapid economic growth experienced by the UNASUR countries since the start of the new century. This might indicate a certain lack of interest on the part of the countries, despite the challenges that remain.

The good coverage indicators of the UNASUR countries need to be looked at in detail, as they take no account of service quality (intermittency, quality of the water supplied, etc.) but only deal with the availability of infrastructure. This means, for example, that even when a house is connected to an improved water source or is close to one, the water thus supplied may not be fit for human consumption without further treatment, or may be available only intermittently.

There are no homogeneous service quality indicators for UNASUR, even though the Association of Water and Sanitation Regulatory Entities of the Americas (ADERASA) has made an effort to generate comparative statistics. For example, its data indicate that in a universe of just 16 service providers, about 90% of drinking water analyses meet national standards (ADERASA, 2012). Unfortunately, statistics are only available for a very small group of the better (and usually larger) service providers, and almost never in a systematized, consistent or comparable form.

### **1. The contribution of drinking water and sanitation services to economic development, social equity and environmental sustainability**

Drinking water and sanitation services are an integral element in the current and future development of the UNASUR countries.

Both Lentini (2011) and Hantke-Domas and Jouravlev (2011) have highlighted the influence, both positive and negative (when access is lacking or quality poor), that these services can have on public health, poverty, social inclusion and cohesion, trade, agriculture, tourism, implicit public debt, the gender divide and social peace.

From an economic perspective, investing in the sector stimulates an increase in family income by diminishing the incidence of waterborne diseases, reducing absenteeism from work and school (particularly among females) and cutting supply costs. The effect of all this is to reduce poverty and indigence<sup>2</sup> and free up time to invest in other activities (leisure, education and work, for instance), which increases a country's productivity (Hantke-Domas and Jouravlev, 2011).

Where health is concerned, it is clear that consuming unsafe (i.e., polluted or unpurified) water increases morbidity and mortality. The worst affected are the poorest groups and children, particularly the latter, owing to the high morbidity and mortality caused by waterborne diseases. Polluted water is also a direct cause of malnutrition, as diarrhoea and other dietary infections prevent nutrients from being properly absorbed by the intestine (Lentini, 2010).

On top of all this, there is the cost burden placed on the health-care systems that treat these diseases. From the perspective of users, particularly the most vulnerable groups, the money spent to mitigate these diseases has a major impact on the household budget. For one thing, controlling waterborne diseases is usually expensive, since bottled water or distribution by tanker truck are the only options when there is no water supply or it is of poor quality.<sup>3</sup> The need to buy safe water cuts into the family budget, so that there is less money available for other goods such as education or work. For another, it takes a long time to recover from a waterborne disease —time that could have been spent on other activities— and this affects labour market participation. Furthermore, money has to be spent on medicines and doctors (Hantke-Domas and Jouravlev, 2011).

The purpose of investing in sanitation and control of liquid household and industrial waste is to dispose of these wastewaters in a way that is environmentally compatible with surface and underground waters. This gives a country a direct competitive advantage by increasing health security and improving the quality of the water used for agriculture and irrigation. Positive externalities arise because health security opens up access to highly demanding external markets with greater purchasing power and improves domestic trade. Tourism also benefits from health security, as safer destinations have an extra comparative advantage (Hantke-Domas and Jouravlev, 2011).

Large-scale access to high-quality drinking water and sanitation services reduces political instability and contributes to social peace. This is because of the essential role these public services play in people's lives, as those who lack access to them —because they are unavailable or of poor quality, unaffordable or inefficient due to weak regulatory systems and capture— are frustrated in their expectations. This frustration can sometimes lead to political and social explosions like the “water war” in Cochabamba in 2000 or the social conflict in Tucumán in 1997 (Hantke-Domas and Jouravlev, 2011).

Drinking water and sanitation services are perceived as essentially infrastructure-driven, so that all problems arising with them tend to be viewed through the prism of increased investment in public works. More carefully considered, however, water resources —and ecosystems— are an essential input requiring protection.

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<sup>2</sup> In Lima, being connected to the public drinking water system is associated with a rise of 5% in the incomes of families in extreme poverty (Garrido-Lecca, 2010). Since non-discretionary costs take up as much as 50% of nominal incomes, however, this represents an increase of 10% in disposable incomes. Furthermore, there are additional health-care savings (owing to the disappearance of episodes of acute diarrhoea) of about 4% of disposable income, giving an overall disposable income increase of 14% each month.

<sup>3</sup> These sources of supply can be as much as 10 or 20 times as expensive as a mains supply without providing the same level of quality or safety.

In the work of governments, the public debate and international water conferences alike, it is very common for the emphasis to be placed almost exclusively on drinking water and sanitation services and for this sectoral concern to be decoupled from the broader need to improve the capacity for managing water as a natural resource (Dourojeanni and Jouravlev, 2002; Jouravlev, 2002). Expanded service coverage will mean increased use of water, a resource for which there is already intense competition in many basins, particularly from irrigated agriculture on the outskirts of cities located in the subregion's arid and semiarid zones. The same is true of discharged wastewater, which is one of the main sources of water pollution and has now reached critical proportions, particularly downstream of major urban areas. This is why good water management systems are an indispensable requirement for progress towards sustainable and lasting solutions to drinking water and sanitation problems, something that entails, among other things (Solanes and Jouravlev, 2005):

- (i) modern water legislation that adequately responds to the nature of the problems involved in exploiting this resource and that is in tune with the thinking and practices of society;
- (ii) a water authority that is independent of sectoral interests, with a remit, powers and resources commensurate with its responsibilities;
- (iii) an efficient system of observation and monitoring, registration and logging of water uses and users, and of conflict resolution;
- (iv) a water allocation (and reallocation) system that promotes investment in development and conservation of this resource while at the same time ensuring efficient and orderly use, preventing monopolization and allowing public interest oversight to be exercised;
- (v) a water pollution control system capable of mobilizing financial resources to fund the major investments in wastewater treatment systems that are required.

Linking drinking water and sanitation services to important ecosystems in this way guarantees not only the sustainability of large investments but the very existence of human settlements. To put it another way, unless the sustainability of ecosystems and water catchment sources is guaranteed, any investment to meet the MDGs risks being wasted, at great economic and social cost.

Since drinking water and sanitation services benefit from the positive externalities that ecosystems generate (water-related environmental services), they should also contribute to their preservation, as should all other activities that benefit from them, such as irrigated agriculture and industry (mining, tourism and hydroelectric generation, among others).

A comprehensive water resources protection policy is needed to forestall and reduce environmental impacts and to repair damage accumulated in the past. Payment for environmental services may be treated as a complementary tool here, especially in countries with weak systems of governance, as it generates price signals for users, who thus recognize the opportunity cost of water and contribute to the financing of basin management activities. This is consistent with principle 4 of the 1992 Dublin Statement on Water and Sustainable Development, which establishes that "water has an economic value in all its competing uses and should be recognized as an economic good".

There are a variety of initiatives aimed at basin conservation, based on payments for environmental services in UNASUR countries, including Brazil, Colombia, Ecuador and Peru. Institutionally, Colombia is a special case in that its tariffs for drinking water and sanitation services include an environmental charge for protection and decontamination of drainage basins and water sources. In Chile, charges incorporate the cost of acquiring the water rights needed to meet demand for the service.

## 2. Public policies for service efficiency, equity and sustainability

Drinking water and sanitation services produce positive externalities, and maximizing these should accordingly be a public policy goal. Economic regulation is the best mechanism known for achieving this.

Drinking water and sanitation services are a natural local monopoly. The characteristics of the technology used in the production process makes provision by a single service provider in a given geographical area the most efficient solution. Without proper oversight, the service provider, whether public or private, will tend not to do its utmost to provide a high-quality service at the lowest possible cost. In addition, experience shows that service providers are extremely vulnerable to capture by interest groups, be these unions, political groupings, bureaucracies or investors. This sector consequently needs to be regulated to ensure that providers make services available at the lowest possible cost (productive efficiency) and consumers are given access to these services at rates that accurately reflect those minimum costs (allocative efficiency).

The performance of the drinking water and sanitation system in general, and the effectiveness of economic regulation in particular, are influenced by both exogenous and endogenous factors. Among the main exogenous or external factors are general macroeconomic policies, the priority given to the sector in Government policymaking, the management of water resources and the quality of institutions. The main endogenous or internal factors include the institutional, industrial and ownership structure, the regulatory framework, financing, charging and subsidy policies, and the sequencing of reforms (Lentini, 2011).

### (a) The importance of non-regulatory factors

The provision of drinking water and sanitation services is part of the whole functioning of a country, and is therefore not immune to a variety of external events that may influence the sector's policies and performance. Thus, for example, macroeconomic stability combined with socioeconomic growth normally results in higher incomes for a country's inhabitants. In turn, the greater availability of financing means that States can invest in infrastructure and people can pay for essential services. The general performance of the economy also affects service operating and maintenance costs and financing policies. Service provision starts to be underfunded and to deteriorate when costs increase and people are unable to afford them, so that the deficit has to be met by the State or outside donations, which on the whole have never been a major source of sustainable funding for the sector. All this makes the sector more dependent on political decision-making and the public finances (Lentini, 2010). The usual result is that technical decisions become highly politicized, which undermines the economic regulation function and the productive efficiency of service providers.

Poverty and indigence are another exogenous influence on the sector, as the poor cannot afford services. If States do not subsidize these for low-income groups living in situations of extreme vulnerability, service providers will be unable to finance themselves, which means that they will no longer have the financial capacity to provide a high-quality service and expand their coverage. This produces a vicious circle, as lack of financing results in the State failing to meet its obligation to implement the human right to water and sanitation by doing its utmost to provide services to the whole population.

Another exogenous factor is institutional strength and governance structure. Drinking water and sanitation services are provided in the context of a State that not only oversees, inspects and regulates them, but relates to them in a number of other spheres. For example, regulatory frameworks have been created to set the ground rules for service providers, generate institutional structures to enforce these rules, and subject providers' actions to judicial and administrative oversight. The sector also relates to the



State in the tax, budgetary, political, housing and health spheres, among others. This is why the quality of its institutions is crucial to good sectoral performance. For example, the State needs to be able to rely on the technical capabilities of its authorities, which have to be honest and transparent, while allowing public participation and being accountable, these being fundamental conditions if service providers are to have an incentive to provide an efficient, universal service of high quality.

Other issues include the political priority the sector has for the government and the stability of public policies over the long term. Unfortunately, the drinking water and sanitation sector is not given high enough political priority in many UNASUR countries. If the necessary support is not forthcoming, then investment, regulation, oversight, efficiency and service quality give way before the day-to-day pressures that service providers face. This lack of priority, can be seen as a failure to implement the human right to water, as it means the State is not doing everything in its power to universalize the service and guarantee its quality.

**(b) The regulatory situation and efficiency incentives**

Drinking water and sanitation services in the UNASUR countries present different states of institutional development. Some countries have adopted special institutional frameworks in which they have separated out the different functions: service provision and system operation; sectoral policymaking; and oversight, inspection and regulation. In most of the UNASUR countries, service providers are part of the public sector and operate nationally (as in Suriname and Uruguay), at the regional, provincial or federal state level (as in Argentina, Brazil and Chile) or at the municipal level (as in Colombia, Ecuador, Guyana, Peru and the Plurinational State of Bolivia), but always with large differences within countries. Meanwhile, sectoral policymaking is carried out at the ministerial level and oversight, inspection and regulation functions are assigned to autonomous agencies.

During the 1990s, the sector underwent radical reforms designed to attract private-sector investment and management, with the twofold objective of releasing public funds for other areas of social policy such as health and education and improving efficiency through private-sector operation.

Since the 2000s, the sector has undergone a new transformation as private-sector participation has ceased to be pursued in a number of countries, while in some cases firms that were formerly privatized have been taken back into State hands. This has not led to any institutional reforms, however, and in some cases, it has weakened the regulatory framework.

*(i) Countries that have regulatory frameworks in place and have sought private-sector participation*

This group of countries restructured the sector during the 1990s with the specific aim of creating the conditions necessary to attract private-sector investment. The rationale for this strategy was to create a reliable legal environment for private investors to be able to take control—and in some cases ownership— of drinking water and sanitation service providers. Common to this rationale was the perception that service provision by public-sector firms was inadequate.<sup>4</sup>

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<sup>4</sup> Although there are many arguments to suggest that private-sector drinking water and sanitation firms ought to be more efficient than their public-sector counterparts, the evidence from empirical studies on the efficiency effects of the different types of ownership is debatable (Renzetti and Dupont, 2003). The most important conclusion is that when the level of competition is low and firms are heavily regulated (as inevitably happens in the sector), there are not many empirical elements to justify, in general terms, a preference for one type of ownership or the other (Vickers and Yarrow, 1988). In other words, efficiency in this sector depends more on institutional and

The dominant ideology at the time the sector was being restructured and private investment sought was the supposed superiority, where management and investment were concerned, of private-sector provision over the public model. England and Wales, which had completely privatized their drinking water and sanitation industry in 1989, were seen as an example to follow. Other countries that inspired the sector's restructuring were the United States, which had over a century's experience in regulating private-sector service provision, and France, which devolved management—but not ownership of assets—to the private sector under contracts of various kinds.

To bring in the private sector, Anglo-American models were used, albeit in a simplified form and with fairly light regulation. There were a number of structural reasons for this. First, Governments took the view that they themselves were irremediably inefficient and corrupt and that their powers therefore needed to be limited, while private-sector participation was seen as a goal to be achieved at any cost, as it would be immune from these difficulties.

Second, the political priority in a number of countries was to sell off assets, as this was considered an essential macroeconomic tool for economic stabilization, which meant that regulatory frameworks—whose main goal is to ensure efficiency of provision—were not a priority for governments.

Third, in a number of countries the development of regulatory frameworks and the involvement of the private sector occurred in a context of weak or poor-quality institutions and structural problems in State finances. For this reason, governmental structures had little negotiating power vis-à-vis the transnational economic groups that were supplying substantial funding for the sector.

Fourth, there was the belief, when stemmed from an orthodox and inflexible application of ideological models, that in modern systems regulators could manage with fairly limited and basic information on costs and demand, so that there was no call for them to measure the tariff base and rate of return. There was thus no need to develop the information access methods commonly applied in countries with a long tradition of regulation. Another factor was the belief that competition—through contract tendering, for example—would reduce the level of regulation required, so that there was no need to worry about developing traditional regulatory procedures.

A number of UNASUR countries opted to introduce economic regulation (Argentina, Brazil, Chile, Colombia, Guyana, Paraguay, Peru, the Plurinational State of Bolivia and Uruguay) even though most service providers were still in the public-sector orbit. In Argentina, Chile and the Plurinational State of Bolivia, the decision was taken to privatize the main service providers. In all cases other than Chile, some provinces in Argentina and, albeit from a position of much more limited private-sector participation, the Bolivarian Republic of Venezuela and Uruguay, private-sector operators pulled out during the 2000s, whether because of social or political conflicts (caused in some cases by tariff increases or non-fulfilment of commitments to expand coverage to more vulnerable sectors), disruption of the economic and financial balance of contracts, strategic global decisions by controlling groups or changes in policy towards the sector in the country concerned (Ducci, 2007).

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structural conditions in the environment than on ownership type. The region's experience confirms that there are some cases in which different models of provision, public and private, function reasonably well and without major conflicts, and others in which, for whatever reason, neither model seems able to deliver acceptable performance in the medium or long run.

In countries that did not privatize in the way that Chile and Argentina did, private-sector participation was confined to a few cities or municipalities, as in Brazil (Manaos, Paraná, Petrópolis and Ribeirão Preto), Colombia (with public-private joint ventures in a number of cities), Ecuador (Guayaquil) and Peru (Tumbes); and to build-operate-transfer (BOT) contracts, especially for wastewater treatment and desalinization of seawater. For example, Colombia uses leasing and management contracts that usually entail no investment obligations but are limited to the operational aspects of service management. The country has also experimented with other types of contract and thereby succeeded in bringing in small local businesses.

In many cases, service provision was decentralized to the municipal level. This trend, which had already begun in the 1980s, was due to the belief that local matters—such as drinking water and sanitation services—should be resolved locally, with communities themselves taking decisions about matters benefiting or affecting them, the idea being that this would result in greater efficiency, accountability and social acceptance (Lentini, 2010).

The experience with decentralization has not been entirely positive (Vergès, 2010; Jouravlev, 2004). Investment and operating costs for drinking water and sanitation services are very high, making it hard for small communities to finance them or run them to even a moderately high standard. Furthermore, decentralized service operation results in efficiency losses that can only be made good if service providers integrate or merge with one another to generate operational savings and take advantage of economies of scale, which are very substantial in the sector. Such decentralization tends to make local governments dependent on financial transfers from other levels of government (national, provincial or regional). While there are exceptions, these generally go only to service providers in large municipalities with high incomes or a high level of political importance, such as Empresas Públicas de Medellín in Colombia and the Municipal Department of Water and Sewage in Porto Alegre, Brazil. These exceptions notwithstanding, municipal service providers are not well placed to provide an efficient service, and this situation has often caused serious problems. Conversely, the most successful sectoral experiences are those in which services are provided on a more aggregate scale (nationally or by administrative region), as in Chile and Uruguay.

(ii) *Countries that have regulatory frameworks and predominantly public-sector provision*

This group of countries includes those that have created regulatory frameworks but have since renationalized services (many provinces in Argentina, Guyana, the Plurinational State of Bolivia and Uruguay) or have not succeeded in attracting significant private-sector participation (such as the Bolivarian Republic of Venezuela, Paraguay and Peru).

These countries adopted regulatory frameworks originally designed to regulate and oversee private-sector service providers, which, according to neoclassical economic theory, seek to maximize their own welfare, so that regulation has to incentivize desirable behaviour (such as service providers reducing their excess costs) or disincentivize undesirable behaviour (by penalizing poor service quality, for example). The problems arise when these regulatory frameworks are applied to public-sector (municipal or State-owned) providers without considering its unique set of incentives since the public sector acts out of a variety of motivations, such as the general welfare, altruism and political interests, and does not necessarily seek to maximize profits. Thus, regulatory frameworks incorporating economic tools to control private-sector service providers have not been wholly effective in stimulating efficiency in the public sector.

This in no way means that economic regulation does not make sense when the service provider is public. On the contrary, because these services tend to inefficiency by their very nature, regardless of ownership, independent oversight of their performance is essential. Likewise, there is a need to create tools to incentivize or disincentivize public-sector service providers in particular circumstances. This task is a complex one, as the very State that is providing the services is responsible for supervising and penalizing itself.

Against this background, the weakening of the regulatory frameworks seen in some UNASUR countries is a cause for concern. Monopolies tend to be inefficient unless they are well regulated, and the problem is heightened in the case of public-sector service providers, as the threat of inspection and sanctions is less plausible and effective when the public sector is overseeing itself. Conversely, many public-sector service providers, or their institutional owners, are politically averse to charging tariffs that reflect the true costs of provision (Ducci and Krause, 2012). At the same time, a great many regulators have lacked the technical and financial resources and the authority needed to exercise effective oversight of service providers.

Many UNASUR countries have regulatory frameworks dating from the 1990s that were never amended after the renationalization of the service providers to deal with the new circumstances. Exceptionally, the regulatory framework of the Metropolitan Area of Buenos Aires has been amended and contains some interesting components such as an emphasis on efficiency, insofar as this is consistent with equity, and the application of regulatory tools such as regulatory accounting (Bohoslavsky, 2011).<sup>5</sup> Specifically, this latter instrument has been effective in mitigating a number of availability problems that the regulator had had to cope with in the era of private-sector provision. Following cancellation of the concession contract and the return to public-sector provision, the position was taken that this tool remained fully valid even when the service was run by a State enterprise (Lentini, 2009).

Given the essential role of economic regulation in spurring efficiency and preventing misappropriation of resources, regulatory frameworks have lost none of their relevance. What has changed is the nature of the relationship between regulator and regulated, with some industry problems, which are unique to the sector, such as information asymmetry, worsening as a result. When only meagre, poor-quality information is made available by service providers, regulators cannot discharge their functions properly. Governments struggle to formulate public policies that adequately respond to the nature of the problems entailed in service provision and society has no way of knowing how service providers are really performing. All this has generated serious conflicts that ultimately only harm users. It is paradoxical that renationalization may have led to the abandonment of economic regulation, greater political power for service providers, information opacity and a loss of accountability, while in some cases even affecting financial sustainability.

At the same time, the political power of certain service providers (chiefly enterprises operating on a large geographical scale), sometimes with support from other parts of the executive, has enabled them to simply ignore regulators' instructions (Ducci and Krause, 2012). A weak regulator does not have the

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<sup>5</sup> With this framework, which is laid down in Act No. 26221, what is meant by efficient provision is provision that, "while meeting the goals and targets laid down by the competent authorities, is based on optimization of the resources used in terms both of unit cost and the quantity of inputs used, in accordance with good financial and technical practices and in consideration of the market cost of inputs, both in Argentina and abroad, and the quantity of inputs required by other water and sanitation service enterprises to meet similar goals, both in Argentina and abroad, in the light of consistent and comparable data that are available to the public, service providers, contractors and the public authorities".

power to enforce its orders, since penalty mechanisms have usually been designed for private-sector service providers and are relatively ineffective for public-sector ones.<sup>6</sup>

There are also weak service providers, particularly the smallest ones, which are so underresourced that in practice they are unable to comply with regulators' instructions (Ducci and Krause, 2012). Another common problem is the rigidity of the legal regime to which public-sector service providers are subject because they are handling State funds. Understandable though the aims of fiscal protection rules may be, they are counterproductive to the extent that they trammel the efficiency of service management.

Seen in perspective, the 1990s regulatory frameworks have been unable to cope effectively with renationalized drinking water and sanitation services. The challenge now is to determine how public-sector service providers (and their institutional owners) with political power can be overseen so that they do not lapse into inefficiency, thus harming users. One possible solution is to foment independence, autonomy and self-financing for service providers, as political and budgetary dependence is thereby reduced. Another alternative is to create a competitive investment fund to which service providers must submit their projects, as this can improve their efficiency.

It is also imperative to strengthen the position of the regulator, particularly in its dealings with an empowered public-sector provider, and for this it needs to be given strong information-gathering, oversight and inspection powers. Industry benchmarking is crucial, as it allows both institutional owners and users to understand precisely what kind of service is being provided. This generates reactions among users, who then approach their political representatives to press for improved performance by service providers. Accountability is another mechanism that needs to be strengthened, both for the regulator and for the service provider, but at a much more sophisticated level than is currently the case in the region. A set of annual public accounts is an empty gesture unless it is based on objective and consistent information and there is open discussion of why decisions were taken and how problems are to be solved in future through explicit commitments with the different actors involved.

*(iii) Countries that have regulatory frameworks and sustainable private-sector participation*

The UNASUR countries tried various strategies to attract private-sector participation during the 1990s. After the general exodus of international private-sector operators, this public policy option continued to be applied only in Chile. Private-sector involvement in other UNASUR countries was ultimately confined to what were essentially more minor, isolated situations where the focus was usually more on operation or technology transfer than on investment.

In the case of Chile, the structure of the sector is the outcome of a long-term public policy with goals and targets around which a political consensus has formed, so that it has survived a number of changes of Government. Since this policy was shaped into a regulatory framework (amended substantially on only one occasion since its creation in 1989), its application has always been objective and based on technical criteria. The gradualism with which the new model was applied meant that the economic

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<sup>6</sup> It is essential for sanctions to be substantial enough for the risk of being subjected to them to outweigh the advantages of rule-breaking. To be effective in the case of public-sector enterprises, penalties have to be personal and not institutional (Solanes, 2007). Otherwise, the consequences of the improper act benefit the perpetrator but the costs are met by the State. There is also a place for moral or reputational sanctions, such as the publication and dissemination of comparative performance indices, which can be a good incentive to efficiency and help draw public attention to the sector's problems.

regulator was able to mature and develop institutionally while it oversaw the public-sector enterprises concerned before private capital was brought in (Lentini, 2011).

The high quality of the State machinery in Chile, together with the low level of political intervention in the management of the enterprises, allowed the public-sector service providers to consolidate and improve their efficiency. They enjoyed reasonable autonomy in applying technical criteria, which strengthened their technical and professional teams and was a safeguard against high staff turnover and politically motivated appointments. In addition, efficient human resources management meant that picked managerial and professional staff could be appointed, resulting in a high level of expertise and specialization.<sup>7</sup>

The stability of the regulatory framework has been combined with an adequate level of technical and financial specialization of the regulator, conferring predictability upon the system (Lentini, 2011). Furthermore, the tariff calculation process, while capable of improvement, has not been subjected to interference from outside the regulator. Thus, the tariff model, based as it is on micromasurement and economic regulation, generates signals that prompt users to utilize drinking water rationally and the service provider to manage it efficiently. Neither the regulator nor the service provider is concerned with issues of equity (cross-subsidies are not allowed, for example), as these are dealt with by targeted direct demand subsidies.

The goals and targets to be pursued through private-sector involvement were laid down prior to privatization, and the regulatory framework was strengthened accordingly. The sell-off of the service providers was carried out in an open, competitive way. Because the decision was taken to float shares, the capital structure has been transparent to the market since privatization. The regulator carries out its work of supervision professionally, with more emphasis on incentives for efficient performance than on operational oversight. Another factor enhancing the model has been the transparency of the general information available to the regulator. In addition to all this, a system of regulatory accounting was introduced.

An important characteristic of this experience was that the State enterprises being privatized were already reasonably efficient and profitable providers with close to universal coverage (Jouravlev, 2010). Consequently, there was substantial information available on the state of the infrastructure and its operation, which is not usually the case when service providers are inefficient or in serious financial difficulties. This meant, first, that investors could prepare rational offers and there was less risk (and thus a lower cost of capital) and less need for future renegotiations. Second, the amount of information available meant that the regulator was well placed to set tariffs that reflected efficient costs. As the enterprises were already efficient and profitable and had practically universal coverage, the impacts on tariffs were broadly reasonable (although tariffs have risen steadily and perhaps more than strictly necessary) and uncertainty was reduced in subsequent tariff-setting rounds, as well as in renegotiations and conflicts.

However, the Chilean model presents a number of failings that need correcting. The constant evolution of commercial and financial practices, both among suppliers and in the market generally, means that the regulatory capacity of the State needs strengthening (Espinosa, 2008). The tariff-setting process needs to be made more transparent, as there is still a high degree of information asymmetry favouring

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<sup>7</sup> A virtuous effect of stability in managerial and professional positions is that it preserves institutional memory, professionalizes the business and ensures that long-term objectives are kept in view (Bohoslavsky, 2011). Stability of employment is a guarantee designed to benefit the organization and its goals more than the individual, as its purpose is to protect employees against external pressures and subject them to the standards that guide the work of the service provider in the public interest.

service providers (Jouravlev, 2003). Also essential is the implementation of a system of transfer price controls for transactions between related enterprises, to prevent inefficient costs and the cost of firms' other activities from being passed on to users and to protect free competition in related markets (Hantke-Domas, 2011b). As for investment, there need to be stronger incentives for service providers to renew infrastructure, particularly that which they took possession of when they acquired ownership of the old State service providers (Espinosa, 2008). Lastly, the model enterprise system used to regulate the sector has shortcomings, both because of its complexity and high degree of information asymmetry and because it does not generate enough efficiency incentives (Jouravlev, 2003).

*(iv) Countries that have no regulatory framework or only incipient regulation*

These countries are Ecuador and Suriname. In Ecuador, there is no general regulatory framework for drinking water and sanitation services. However, in the one case of private-sector involvement, a management contract in the city of Guayaquil, a local regulator was set up (this approach is also applied in some municipalities in Brazil). The regulatory framework is set out in a contract, a method of regulation which has been generally abandoned in countries with mature regulatory systems because of its numerous shortcomings (Jouravlev, 2003). Progress in expanding coverage has largely been achieved through Government financing.

Suriname does not have specific legislation for drinking water and sanitation services either. Most institutions in the sector are weak and underresourced in terms of financing and qualified staff (OAS, 2005). The management system in the sector is fragmented between several bodies with little coordination between them, and lacks a clear legislative mandate.

Both Ecuador and Suriname ought to develop specific legislation for the drinking water and sanitation sector. Reforms are needed in both countries with a view to organizing the industry on a basis of greater management autonomy, transparency and efficiency; developing investment plans for service providers; carrying out strategic sectoral planning with the aim of reaping economies of scale; implementing efficient, targeted tariff regimes and subsidy systems with a focus on financial sustainability and equity; managing the sector's financing in a coordinated fashion; establishing regulation and oversight of provision within a framework of incentives for service improvement and expansion; promoting efficiency, transparency and competitiveness in procurement and recruitment; encouraging civil society involvement in the development and oversight of provision; and using communication and education to create community awareness of the benefits of services and their rational use. There is an urgent need to establish a specific legal framework and reorganize the institutional system, with an overseeing agency and an independent regulator that are both independent of service providers.

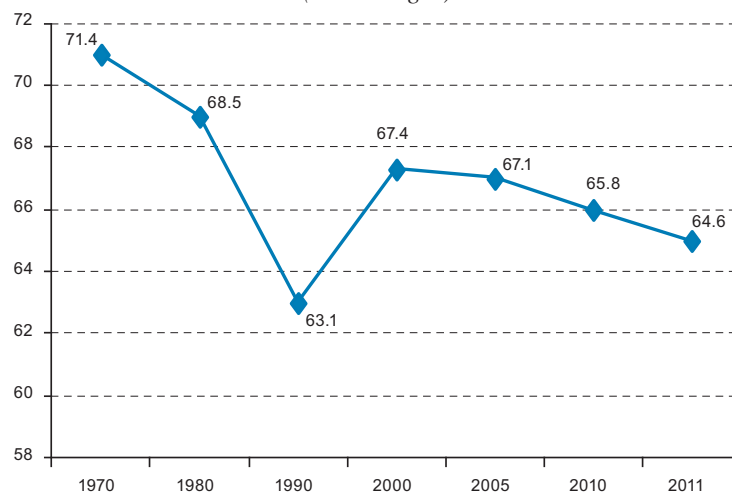
## **B. THE SUSTAINABLE DEVELOPMENT OF HYDROELECTRICITY (THE INTERFACE BETWEEN WATER AND ENERGY)**

### **1. The current situation of hydroelectric generation in UNASUR**

The UNASUR countries have a great opportunity to integrate renewable energies into their energy mix. These energies have a number of advantages, chief among them being the existence of the necessary resources, the ease with which they can be exploited and their availability in nature over time. Of all of them, it is hydroelectric energy that has been gaining ground in the region, which possesses some 30% of the world's water resources.

The UNASUR countries have followed the upward global trend in energy demand, with growth in final electricity use averaging 3.5% a year, which is higher than the increase in total energy consumption (OLADE/UNASUR, 2012).<sup>8</sup> As in the rest of the world, hydrocarbons continue to feature strongly in primary energy production. The trend has been a fluctuating one, however: their share fell steadily from 71% in 1970 to 63% in 1990 before rising back to about 67% between 2000 and 2005, and although it dropped to about 65% during 2010 and 2011, it remains higher than it was 20 years ago, owing to the policies driven by reform processes (ECLAC/IILA, 2010) (see figure III.1).<sup>9</sup>

Figure III.1  
UNASUR: SHARE OF HYDROCARBONS IN THE TOTAL PRIMARY  
ENERGY SUPPLY, 1970-2011  
(Percentages)



Source: Latin American Energy Organization (OLADE), Energy-Economic Information System (SIEE), 2013 energy review.

It is also important to highlight the fact that the share of hydroelectricity in the energy mix rose from 3% to 5% in the 1970s and then to 6% in the 1990s before stabilizing at that level in the 2000s, with a peak of almost 7% in 2008. This growth is explained by the reform process and the dynamics of investment in the electricity sector, and by the commitment of the region's countries to incorporating renewable energies into the total primary energy supply, with the support of regional initiatives such as the Brasilia Platform on Renewable Energies and other initiatives of a global character.<sup>10</sup>

<sup>8</sup> Final energy consumption in South America is about 8 million barrels of oil equivalent a day (OLADE/UNASUR, 2012).

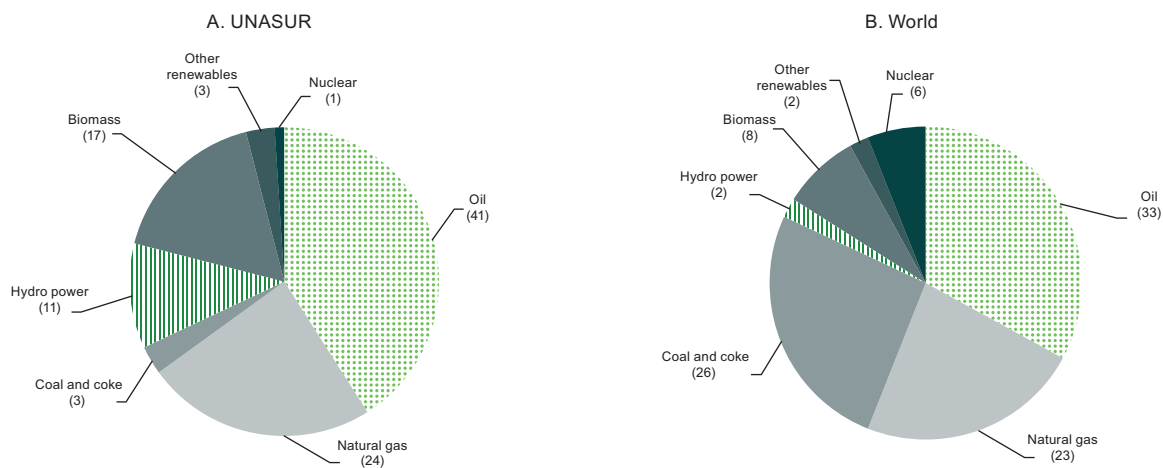
<sup>9</sup> See Hugo Altomonte's paper in ECLAC/IILA (2010) for information on the development of the hydroelectricity sector.

<sup>10</sup> By late 2002, the Latin America and Caribbean region had already met the Brasilia targets, as renewable sources contributed more than a quarter of its total energy supply. Chief among them were hydro power at about 15%, fuelwood at 6% and cane products at 4%. Other renewable sources such as biomass (0.5%) and geothermal energy (0.7%) were marginal, and wind and solar power, although used, were not yet counted as part of the energy supply (ECLAC, 2004).



In 2011, hydroelectricity accounted for 11% of the total primary energy supply in the UNASUR countries, a far higher proportion than the sector's 2% share of the world total (see figure III.2). Hydro power has thus been clearly demonstrating its importance in UNASUR, not only because of the availability of water but because of the sector's development capacity in countries such as Brazil, Colombia and Paraguay. Brazil is something of a special case because, according to the World Commission on Dams, 91% of all the dams built in UNASUR (84% of reservoir capacity) in the last decade (2000-2011) are in this country. These large shares obviously reflect a State policy that has generated a plan to develop and build dams for multiple water uses, especially hydroelectricity. The region has huge technical potential to exploit water energy. Brazil has 12% of the planet's surface water and hydroelectric potential of 260 GW, 41% of it in the Amazon basin.<sup>11</sup>

Figure III.2  
UNASUR AND THE WORLD: ENERGY MIX, 2010  
(Percentages)



**Source:** For UNASUR, Latin American Energy Organization (OLADE)/Union of South American Nations (UNASUR), *UNASUR: un espacio que consolida la integración energética*, Quito [online] <http://www.iadb.org>; for the world, International Energy Agency (IEA), *International Energy Outlook 2011*, Washington, D.C., 2012.

Hydroelectricity, like all other energy sources, has been growing and now ranks fourth in terms of energy equipment and installations in UNASUR. This pattern is repeated in the rest of Latin America and the Caribbean.

## 2. The sustainability of hydro power

Hydro power can be exploited either by means of large hydraulic installations (what is termed conventional renewable energy), involving the construction of dams to exploit a head of water or difference in level, or by using the slope of a riverbed to set up a run-of-river plant (unconventional renewable energy).

<sup>11</sup> See [online] <http://www.brasil.gov.br>.

The largest hydroelectric installations in UNASUR are the hydroelectric plants of Itaipú (jointly operated by Paraguay and Brazil) and Yacyretá (operated by Paraguay and Argentina). The Salto Grande plant (operated by Argentina and Uruguay) is not so large. It has traditionally been argued that hydroelectric reservoirs regulate the water flow and make it more constant downstream, thus ensuring an adequate supply of water in dry periods, controlling spates, allowing fertile land to be farmed and making navigation and water sports possible, as well as generating electricity (Mekonnen and Hoekstra, 2012).

Nonetheless, this type of operation has been heavily criticized from a number of perspectives. For one thing, it is pointed out that large reservoirs force out the populations inhabiting the areas to be flooded; for another, land is lost and water flows and quality are affected. All this has an impact on communities and ecosystems downstream (Mekonnen and Hoekstra, 2012). Another criticism is that the lakes which form behind large dams consume water because of surface evaporation.

By contrast, run-of-river or small-scale hydroelectric generation has been vigorously promoted as a source whose social, economic and cultural impacts are much smaller than those of large dams. The main advantage is that there is less diversion of the natural flow of water, making it unnecessary to flood large areas and avoiding the loss of land. It is also argued that this type of generation is more environmentally friendly, making it a green or low-impact source. At the same time, it must be borne in mind that the installed capacity of projects of this type is normally far less than that of major power plants.

Nonetheless, run-of-river hydroelectric generation also has impacts. For example, it involves the construction of plants, clearing of land, diversion of water and installation of electrical connections (to feed the energy produced into the grid), which can affect ecosystems, the movement of sediments and flooding patterns (IUCN, 2012). As with large dams, run-of-river hydroelectric generation has social impacts associated with the distribution of water between different uses. Thus, in basins where multiple activities are carried out (farming, industry, cultural activities, energy, fishing, tourism and human consumption), tensions tend to arise either over the allocation of water or over land ownership and use.

The sustainability of water as a natural resource is jeopardized by three factors. One is the lack of formal institutions to deal with the problems of water allocation, water management, financial viability and the influence of the political and macroeconomic cycles. Another is climate change, which is expected to result in large alterations in water availability in some parts of the region. A third factor is the vulnerability of ecosystems, since unless determined efforts are made to protect water catchment basins and glaciers that carry water downstream, the resource may become more expensive or even run short as availability and environmental quality decrease.

It follows from this that unless institutional problems are dealt with, management systems adapted to climate change and important ecosystems protected, water resources may become a focus of economic, political and social conflict. Thus, it is vital for these problems to be solved if hydroelectric generation is to be a viable alternative energy source.

**(a) Social conflicts associated with hydroelectricity**

Political and social conflicts over major hydroelectric projects are frequent in UNASUR, examples being Belo Monte in Brazil, Hidroaysén in Chile and El Quimbo in Colombia. Debate has turned on how to meet higher energy demand and minimize the social and environmental impacts that arise.

These conflicts are not something peculiar to UNASUR, but are a global phenomenon. The negative effects of large dams are now regarded as increasingly unjustifiable (WCD, 2000). It is no longer acceptable for the authorities to take decisions about major hydroelectric projects and impose them on the community. Instead, an innovative approach is required to assessing options, managing existing installations, obtaining public acceptance and sharing out benefits.

Another of the problems with large dams is how little they contribute, once construction is over, to the local communities they are situated in. These installations are usually located a considerable way from the centres of demand, so that the energy produced using local resources is transferred to those centres and most of the financial returns go into the fiscal coffers or to shareholders in the form of dividends. Here, criticism has focused not on water use but on the equitable distribution of profits. This is a legitimate complaint that ought to be resolved politically by the authorities of each country.

Another challenge for hydroelectric generation is that it competes for water with other users of the basin. Perhaps the most recurrent complication arises in relation to the allocation of the annual flow over time for other uses that rely on storage in reservoirs. In many places, for example, hydroelectricity generation competes with other water uses because it manipulates flows to meet energy demand, which tends to be out of step with the seasonal needs of other users, mainly for irrigation.

These conflicts are often associated with weak regulatory frameworks for water resource management. The most common problems are a lack of transparency in water allocation systems, limited protection for existing rights, weak accountability mechanisms and lack of governance. The result can be a strategic advantage for hydroelectric generation because of the amount of investment it brings and the strength of its negotiating position relative to other uses. To avoid these conflicts, hydroelectric generation should be considered a matter not just for energy policy, but for integrated water management too.

**(b) The situation with shared use of transboundary waters<sup>12</sup>**

Historically, the legal regulation of transboundary waters in the UNASUR countries has been essentially bilateral. The cooperation agreements signed have turned into a unified body of regulation in the legal regime governing the particular body of water concerned. Multilateral agreements such as the 1979 Tripartite Agreement between Argentina, Brazil and Paraguay, and multilateral ones such as the Amazon Cooperation Treaty of 1978, are the exception. And even then, when disagreements have arisen between the States parties to these agreements over the use of water systems, the countries have opted to seek solutions bilaterally.

This is due to the very nature of the region's river basins. The size of the territories covered by basins and the geomorphological characteristics of these, the different historical and political contexts in which they have been regulated and the different ways in which their waters are employed mean that categorical comparisons cannot be established as regards the state of cooperation in UNASUR.

Nonetheless, this bilateral tradition does evince respect for the customary legal provisions regulating the use of transboundary waters. The prohibition on activities that cause appreciable harm is mainly reflected in the number of environmental conservation and sustainable development projects being implemented in the region.

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<sup>12</sup> This section is based on Querol (2003).

As for the right to equitable and reasonable water use, it has been found that both reasonable exploitation and equitable distribution of benefits have been duly considered in agreements on the construction and operation of hydro power plants, as in the cases of Itaipú and Corpus Christi, and in negotiations over the allocation of irrigation water to each State. Conversely, the shoreline boundary system (i.e., the establishment of frontiers and boundaries along sea, river or lake shores) means that the riparian State cannot exercise sovereignty over or economically exploit the adjacent waters. Usually, the State with sovereignty over the waters supports this system but not the one that possesses the coasts. One of the drawbacks of this type of frontier is that coastlines are constantly shifting because of seasonal phenomena. A State will be ill-placed to exploit a water system it naturally forms part of if it is denied access to the water by a treaty provision. This dichotomy between the customary rule of the right to equitable and reasonable use of waters and treaty rules establishing shoreline boundaries has given rise to controversy between some UNASUR countries.

Turning to the matter of prior consultation (the rights reserved by Argentina in the case of Itaipú being an example), clearly plays a vital role in preventing conflicts between States participating in a particular transboundary water system or body. At the same time, periodic information-sharing between States makes it possible to step up cooperation and successfully conduct coordinated water exploitation activities.

Given all the above, it is safe to say that a willingness to cooperate is what underlies all agreements dealing with the exploitation of transboundary waters. Even where there are unsettled boundary disputes, the UNASUR countries have shown themselves capable of joining forces to implement water ecosystem conservation projects, as has happened in the San Juan river basin. In other cases, States have succeeded in overcoming their differences, making it possible to use water systems for navigation and implement binational development plans in the region, as has happened in Peru and Ecuador in relation to the Amazon.

It should be emphasized that the success of the projects carried out in these waters has mainly depended on financing from international organizations or multilateral financing institutions. Outside funding of projects in the basins of the Amazon (between Peru and Ecuador), the Titicaca and the San Juan highlight the importance that cooperation over the exploitation of transboundary water systems has acquired on the regional agenda.

Another development has been the growing concern of States forming part of water systems in UNASUR to implement projects by means of participatory processes in which special consideration is given to the wishes of local populations. This has been seen in the Corpus Christi hydroelectric project of Argentina and Paraguay. Public involvement is also a factor in the Strategic Plan of Action for the Integrated Management of Water Resources and the Sustainable Development of the San Juan River Basin, among other projects.

Lastly, it is important to stress that the UNASUR member States have expressed the desire to find peaceful solutions to any disputes that might arise between them when applying the agreements signed. The method of solution chosen varies depending on the water system or body involved. Thus, in some cases direct diplomatic negotiations are the preferred means of conflict resolution, as in the case of Itaipú. In other instances, the matter is referred to the rulings of joint committees, as in the case of the Amazon between Peru and Ecuador. Arbitration courts have also been set up to settle any disputes that might arise over the Corpus Christi project or in the Lake Titicaca-Desaguadero River-Lake Poopó-Coipasa Salt Marsh system, and this is indicative of an increasing commitment by the UNASUR countries to ensuring that cooperation is not just an expression of intent but a primary objective translating into concrete measures.

The very nature of transboundary waters makes cooperation between States necessary. The geographical, environmental, social and economic interdependence that is a precondition of their exploitation requires joint actions, even if only at the binational level. The utilization, organization and development of water resources necessitates constant, planned funding to ensure the continuity of the specific projects implemented in the region. Cooperation within the framework of UNASUR, together with genuine, effective coordination of the national policies of its member States, will mean that the sum of bilateral practices agreed upon for transboundary waters can translate into regionwide cooperation with international ramifications.

### **3. A proposal for sustainable hydroelectricity**

ECLAC has been promoting the use of renewable energies in the region for several decades, a commitment that has been manifested in the copious amount of information it has produced and its ongoing presence in national and international forums dealing with the issue, such as the International Renewable Energy Conference (Bonn, Germany, 2004). Since the last decade, ECLAC has been working in international forums, and particularly among the UNASUR countries, to support the measures enjoined by the World Summit on Sustainable Development (Johannesburg, 2002) and the Latin American and Caribbean Initiative for Sustainable Development, which set itself a regional target of raising renewable energy consumption to at least 10% of the total by 2010.

Although UNASUR has comfortably met this target, the region now faces the challenge of achieving homogenization and integration in energy consumption, with a view to narrowing the subregional divides that still persist, namely: the heterogeneity of natural resources, supply structures and energy consumption, and the need to achieve institutional consolidation and establish the basic conditions for renewable energy promotion and penetration policies.

In 2004, ECLAC offered a comprehensive perspective on these issues and a guide to policymaking, and these have since been taken up by the UNASUR countries. They are structured around four major initiatives:

- (i) a renewed appreciation of the environmental and social benefits of hydro power in the context of sustainable development requirements;
- (ii) the contribution of renewable energy sources to the all-round development of rural communities;
- (iii) rational use of fuelwood and energy efficiency;
- (iv) the role of biomass and biofuels.

Owing to strong recent criticism of the hydro power associated with medium-sized and large power stations, this type of energy has been virtually excluded from the renewable energy context, not because it is intrinsically non-renewable but because of its environmental and social impact, i.e., its lack of sustainability. There are four arguments against high-capacity hydroelectric power stations with large reservoirs:

- (i) the displacement of populations owing to the formation of reservoirs and the flooding of large tracts of land;
- (ii) emissions of greenhouse gases (methane in particular) owing to the decomposition of waterlogged vegetation;

- (iii) the slowing of currents and changes in the biota that can further the spread of pathogen vectors;
- (iv) changes in sediment transport affecting coastal regions downstream of the dam.

The region's particular topography and rainfall characteristics hold out great potential for exploitation. These conditions need to be taken into account when renewable sources are being considered so that they can be developed rationally.

As regards the renewability of hydroelectric power stations, perhaps it is less important to settle on a maximum capacity below which they are to qualify as modern renewable or unconventional sources (usually only small power stations with a capacity of between 10 and 30 MW are accepted) than it is to lay down a minimum set of standards for their acceptance as sustainable sources, based on economic, social, environmental and local indicators.

As indicated earlier, using run-of-river hydroelectric plants (which do not require a dam) to produce electricity does not usually have an environmental impact. However, while reservoirs will always have some kind of impact, it is simplistic and often wrong to establish a direct correlation between environmental problems and hydroelectricity. There have undoubtedly been negative impacts at hydroelectric plants, some of them irreversible, but they are not intrinsic to the technology. Often the harm is not substantial or can be mitigated, as the thousands of units that have been operating for decades bear witness. In addition, stress should be laid on the importance of hydroelectric installations that lend themselves to multiple uses and can bring substantial advantages, not only for electricity generation but for fish production, water supply, irrigation, flow regulation (mitigation of spates and droughts), river transport, the promotion of tourism and the use of local resources, among other things.

Perhaps no other electricity generation technology presents such real and proven opportunities for integration and synergies with non-energy uses. Many hydroelectric plants throughout the world, and particularly in the UNASUR countries, have had substantial positive impacts in terms of local development, improved agricultural productivity and retention of population in rural areas. The key point is to ensure that hydroelectric projects adhere to the principles of sustainability and make rational use of a resource that is available and indeed, in the case of UNASUR, abundant. A number of premises can be put forward for this.

From the perspective of national policymaking authorities, project developers and electricity firms, projects based on hydroelectricity are the ones that have potentially the largest contribution to make to the electricity supply in UNASUR. Accordingly, an initiative for water, forests and communities has been proposed with the following premises:

- (i) Water power projects have a clear and beneficial environmental synergy with forestry projects. Any modern development of hydroelectric plants is associated with forest management, potentially a source of environmental synergy that facilitates the reduction of greenhouse gas emissions and capture of the carbon associated with these emissions.
- (ii) Hydraulic projects increase the robustness of electricity systems and offer clear operational synergies with wind power projects.
- (iii) Marginal expansion of existing reservoirs is a very economical way of reducing greenhouse gas emissions.
- (iv) Electricity from hydraulic plants has low unit costs. Hydraulic potential is well assessed and many possible projects have already been identified and specified.

- (v) Projects have to be developed for communities, not against them.
- (vi) UNASUR has a great deal of experience and technical capability in the design and construction of projects of this type, which is an opportunity for business development in the region.

The way hydroelectric projects have been developed when they have relied on large reservoirs and involved the eviction of communities, the destruction of forests and the flooding of large productive areas, and the amortization periods of such facilities (too long in relation to the time frames of the procurement contracts provided for in some local laws) have been an obstacle to their acceptance and thus to their financing by banks. For this reason, there is a case for developing a renewed appreciation of these projects' value to society and making a vigorous public relations effort to give them the positive image they now deserve.

This brief assessment of hydroelectricity in the region highlights the need to give proper consideration to renewable energies and correctly define the concepts of sustainability and renewability in the context of the UNASUR countries, where, alongside solar power (radiation or biomass) and wind power, hydroelectricity must be given a leading role.

All this has provided material for a variety of proposals for the UNASUR countries, most particularly (ECLAC, 2004):

- **Comprehensive environmental assessment of hydroelectric projects.** Over and above their potential impact in terms of reducing greenhouse gas emissions, hydroelectric projects also have to be evaluated in terms of their indirect contribution to forest management, not only because of the way they are constructed but also because of the way they help to sustain nearby communities.
- **The establishment of a code of conduct towards communities.** It is urgent and necessary to spell out a set of universally accepted, locally and nationally supervised rules committing developers to a fresh approach in their dealings with communities affected by hydroelectric projects.
- **Payment for environmental services.** One way of supporting communities is to make payments to developers for the environmental services provided by forests and see that they are passed on as incentives to those living in these areas.
- **Modification of energy procurement contract time frames.** The value of water projects can be recognized by amending regulations to extend the time frames permitted in electricity procurement contracts for plants of this type so that better financing terms can be obtained.
- **Establishment of mechanisms to recognize the synergy between wind and hydroelectric projects.** At present, electricity market rules are designed for individual power stations and not for comprehensive energy and capacity supply packages. The recommendation is that these rules should be revised and amended to recognize the synergy between wind and water projects and enhance their profitability by making them more cost-competitive.

- **A comprehensive approach to basins.** The multiple uses and effects of water are typically integrated in river basins. Accordingly, water systems should be treated as basins where it is necessary to optimize the benefits and minimize the negative effects of temporary and local variations in water flows. This requires the establishment of measurement, monitoring and decision-making systems and a major effort of inter-institutional coordination between central Government agencies and regional governments.
- **Provision for social liabilities and resolution of existing conflicts.** It is necessary, firstly, to finish meeting the social liabilities resulting from the construction of dams and, secondly, to resolve the most important conflicts associated with the construction of hydroelectric plants, or at least those with characteristics that are acceptable under this new approach.
- **Public outreach and information transparency.** For a renewed appreciation of hydro power in society, it is necessary for an intensive public relations effort to be integrated into the initiative so that projects of this kind acquire the positive image they deserve.

Lastly, successful governance of natural resources, including hydro power, requires the revenues from their exploitation to be redistributed fairly among all the actors involved, including an adequate allocation to local populations in the areas where facilities are sited.





## Chapter IV

**CONCLUSIONS AND POLICY IMPLICATIONS****A. THE RESPONSE OF THE MINING SECTOR TO THE PRICE CYCLE**

The behaviour of the metals price cycle has resulted in the region's mining sector enjoying a profit and investment boom, to judge by the rapid rise in repatriated profits, exploration budgets and newly announced investment projects.

The share of revenues taken by the State in this boom has been rising in absolute terms, but is clearly far from progressive, as most of the countries do not have adequate fiscal instruments to make it so under the fiscal regimes currently applied to the sector. While it is common practice in the oil sector to apply instruments (such as windfall profit taxes) that enable States to progressively capture windfall earnings during periods of high prices, the same is not true of the mining sector.

The current tax treatment of the mining sector in most of the countries is based on corporation taxes levied on declared earnings, marginally supplemented by royalty payments. These instruments do not ensure progressiveness in the State's share of mining revenues, particularly during periods of high prices and windfall profits. A huge auditing effort, beyond the scope of most States, is required to minimize the temptation in the private sector to conceal profits and artificially inflate costs, particularly in periods of high prices. A more progressive fiscal treatment in the mining industry would require an overhaul of tax instruments to bring them closer to the theoretical model of taxes on the economic rent generated by a resource over its life cycle (resource rent tax). Aligning mining sector tax regimes more closely with these principles would enable States to capture windfall earnings during periods of persistently high international prices like the present and to introduce the progressiveness needed to ensure that the wealth generated by the exploitation of their natural capital is captured for the public benefit in boom periods.

However, the share of sectoral revenues appropriated by the region's main mining countries is close to the international average (about 33% for countries operating typical private concession mining regimes, with no State enterprise). As for the small countries of the region, where mining activity is incipient, the multiplication of mining GDP and economic rents in the sector in the period since 2004 indicates a growing untapped potential for higher tax receipts.

In Chile, a review of the relative contributions of the State enterprise and private-sector mining firms to the tax take from the sector reveals that the strategy of having a State enterprise can be crucial to raising the public-sector share of the sector's economic rent, as more is achievable in this way than through progressive adjustments to the fiscal regime, which will always be influenced by tax competition between countries to attract new investment.

### **Several conclusions about regulation can be drawn from these findings**

The fact that taxation of the declared profits of mining firms is the State's main revenue-raising instrument highlights the importance for Governments of having independent mechanisms and specific indicators that can transparently represent the sector's profitability and costs over the course of price cycles. These have yet to be put in place in most of the countries. The need could be partly met by a State enterprise acting as a control to reveal profit and cost levels. As things stand, Chile is the only country in the region with a State mining firm large enough to fulfil this function. Without it, the Chilean State's appropriation of mining rent would be below 15%, or half the international average. This shows that the fiscal regime applied to private-sector mining firms in Chile is laxer than the international average. Peru seems to be similarly placed as regards the fiscal treatment of the international mining sector.

### **B. THE RESPONSE OF THE HYDROCARBON SECTOR TO THE PRICE CYCLE**

Despite the apparent similarity between the metals and crude oil price cycles during the 2003-2011 period, there are marked differences between the region's mining and hydrocarbon sectors in the dynamics of prices, costs, rents and the State share of these. It is not possible to generalize about the behaviour of these non-renewable natural resource sectors or the results obtained by them during the international price boom of the last decade.

Since the upturn in the price cycle, rents in the hydrocarbon sector have increased in absolute terms, as has its fiscal contribution. In the hydrocarbon sector, however, the price boom has not led to a corresponding boom in investment and development, as it has in the mining sector; nor does it seem to be helping to remedy structural shortfalls in investment to expand petroleum output (which includes exploration as well as production itself) that date back to at least 1995 in Argentina, the Bolivarian Republic of Venezuela, Ecuador and Mexico.

In some countries, whether the sector is run by State enterprises (Petroecuador, PEMEX, PDVSA) or private-sector firms (as in Argentina until the recent nationalization of Repsol-YPF) has made no difference in terms of reversing the investment shortfall. Conversely, it has made a difference in oil activities undertaken much more recently in Brazil and Colombia, with Petrobras and Ecopetrol, respectively.

However, public-sector oil firms have played a key role in bringing the State share of the sector's rent up to between 40% and 60% in hydrocarbon-exporting countries, a much larger proportion than has been achieved in mining countries. Attaining these levels of appropriation requires a direct majority equity stake or control of the country's production through the State enterprise, or the use of progressive fiscal instruments (such as windfall taxes or tiered royalties) designed to appropriate extraordinary earnings in periods of high prices.

### Several conclusions about regulation can be drawn from these findings

Neither State ownership of oil firms in the region nor the regulatory or contractual frameworks introduced to bring private-sector firms into hydrocarbon production have mobilized the exploration and development investment needed to maintain the ratio between reserves and production and expand supply to match the pace of regional consumption.

The challenge now is to strike a balance between public and private interests with a view to achieving the investment needed to ensure that domestic markets are supplied and the region's export position is maintained.

This challenge will require innovation in institutional arrangements, in regulation and in contracts to respond to the multiplicity of structural and cyclical factors affecting today's oil market. There will also be a need to deal with policy distortions (demand subsidies) that militate against the efficiency of domestic consumption in the face of supply constraints that will surely be prolonged over the medium run, while the countries find solutions to these dilemmas.

### C. SUSTAINABLE DEVELOPMENT OF WATER RESOURCES

The countries of UNASUR have adopted different institutional solutions in the drinking water and sanitation sectors. Among the results obtained, emphasis should first be laid on the success achieved in meeting the Millennium Development Goals target for narrowing the divide in access to improved drinking water sources. Nonetheless, there are still persistent regulatory shortcomings that need correcting.

- Prioritizing the drinking water and sanitation sector, in terms of both funding and efficiency-oriented public policies, could translate into major social benefits for the UNASUR countries, not only because of its decisive influence on public health, and child health in particular, but also in the struggle against poverty and indigence, efforts to foster inclusion and social peace, the promotion of economic development (especially with new opportunities for export-oriented agroindustries and tourism) and environmental protection.
- Regarding **investment**, the fact that large-scale funding is needed to attain universal coverage and improve service quality, particularly for the most vulnerable groups, means that the UNASUR countries need to make an effective, long-term commitment to both financing and the development of strong, stable institutions. Accepting this responsibility will not only bring about the hoped-for universalization of services but will also constitute an important tool for invigorating the countries' economies and combating poverty and indigence.
- With a large volume of public money committed to drinking water and sanitation projects, particular attention must be paid to supervision and **oversight of budgetary appropriations**, as the infrastructure sector suffers from a high level of corruption throughout the world. Furthermore, transaction costs are high, particularly in procurement and contracting processes.
- The economic value of water needs to become a larger factor in user decisions, as there is a need to generate awareness of how scarce and essential this resource is. An effective mechanism for preventing waste is to charge the full economic and financial cost of water. Thus, public policy in the UNASUR countries should aim to make its provision **self-financing** by moving towards tariffs that increasingly internalize the cost of services.

- Given that some population groups will be unable to afford a water supply at self-financing tariffs, States need to devise mechanisms for direct or cross-**subsidies** to enable these users to meet their basic needs. If this is done, subsidies will become a vehicle for positive advancement in fulfilling the human right to water. Recognition of this right entails limits on cost recovery, so that the most vulnerable are not deprived of access. However, it is not to be an indiscriminate benefit whereby water is provided free of charge to all sectors of society, as this would seriously militate against the equality and sustainability of the system.<sup>1</sup>
- As regards **institutions**, the UNASUR countries should work towards an industry structure in which responsibilities are clearly demarcated, in addition to designing effective incentives for all actors in pursuit of an affordable, high-quality universal service. This can be achieved by separating out provision, regulation and public policymaking into three different and independent spheres. Practice shows that this type of institutional arrangement makes it possible to establish the formalities that are needed to create incentives for service providers.
- As regards the **public model**, the regulatory agencies overseeing service providers at the state and municipal level should initiate an appraisal process to ascertain the effectiveness of their incentive instruments (fines, publicity or personal sanctions, for example). For their part, public-sector providers need to become more independent of other public bodies that control them financially and politically. However, it is also advisable to use a number of enforceable practices to modernize what has been called the “open firm” (Bohoslavsky, 2011), an approach that is designed to prevent distortions in the operation of the business and abusive behaviour by the authorities through measures to bolster the independence of regulation and oversight bodies and, in particular, through user participation in the internal management of firms and in the external functions of planning, regulation and oversight.
- User **participation** ought to be expanded at all levels and in all roles at both the regulator and the provider when the latter is a public enterprise. Promoting bodies that represent drinking water and sanitation users is a good initiative, as it enables them to convey their concerns and uphold their rights and interests more effectively vis-à-vis institutions.
- The human right to water implies recognition of sectoral efficiency (both economic and social) as a correlate of the duty to devote the maximum of available resources to guaranteeing this right. Consequently, where **economic regulation** is concerned, the UNASUR countries should enshrine in their general legal frameworks (and not just in contracts, which have serious shortcomings as a means of oversight and regulation) the general principles of fair and reasonable profit, good faith, due diligence, the obligation of efficiency and the transfer of efficiency gains to consumers. Likewise, there is a need for systems of regulatory accounting that enable regulators to obtain information on technical and operational performance, the administration of property, business management and the quality of economic and financial decision-making in the regulated concern, as these aspects are not covered by the financial information which conventional accounting provides to the market.

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<sup>1</sup> The Constitutional Court of Colombia (rulings T-546 of 2009 and T-150 of 2003) has reaffirmed that the human right to water does not encompass indiscriminate free provision of public services and that users who do not pay for the service they receive are acting as though other users had to meet their personal costs and temporarily or permanently finance their debt. This clearly goes against the principle of solidarity (which, among other things, requires all users to meet any reasonable charges they incur) and makes it hard for firms to apply efficiency criteria in their service provision.

- It should also be noted that the scale of service providers is important in lowering costs, with the ultimate outcome of lower prices for consumers. There is ample empirical evidence that major economies of scale can be obtained by medium-sized and small service providers, while among those serving between 100,000 and 1 million inhabitants (and in some cases up to 4 million) there is a tendency for economies of scale to remain constant (Ferro and Lentini, 2010). Furthermore, creating a more consolidated industry structure in this sector provides a great many other benefits in terms of financial sustainability, social cohesion, management of catchment sources, reductions in transaction costs and improvements in regulation and oversight. This assertion runs counter to many of the decentralization initiatives that have been undertaken in the UNASUR countries. However, given the soundness and abundance of the evidence supporting it, the recommendation is to **promote aggregation and consolidation in the industry structure of the sector**.
- Similarly, emphasis should be laid on the urgent need for **full, accurate, comparable, consistent, relevant and timely information**. Information is essential for political and regulatory decision-making. It shows what is working and what is not so that the performance of the actors involved in the sector can be evaluated. Without information, there is only intuition to go by, and that is not a good guide in this area. Information regarding not only drinking water and sanitation services but water resources in general is in short supply in the UNASUR countries. It is urgent for these countries to have accurate and reliable water information, and accordingly resources need to be made available for this at the national level. Information is no use unless it is transparent, however, and the same is true of public policymaking and the decision-making of regulatory agencies. The region has already made progress in this direction, but all remaining areas of opacity and non-disclosure need to be dealt with as a matter of urgency.
- In particular, the UNASUR drinking water and sanitation sector needs to adopt **management indicators** to measure the performance of providers with a view to evaluating their efficiency and detecting best (and worst) practices. If possible, a nationwide **performance comparison exercise** should be carried out, both within firms over time and with other providers. “Historical comparison within a firm allows the ongoing service impact of management decisions to be visualized, while comparison with other providers replicates the conditions of a competitive marketplace and makes it possible to identify areas in which management can be improved and, potentially, to identify and analyse best practices so that they can be implemented for the purpose of improving services, subject to whatever adaptation is required by the circumstances of each particular case” (ADERASA, 2012).
- Likewise, the UNASUR countries need to be called upon urgently to **link the management of water resources to mechanisms for the economic regulation of drinking water and sanitation services**. In the region, the work of sustainable water management (involving, for example, the protection of ecosystems and management of forests and surface watercourses) is usually dissociated from the work of regulating drinking water and sanitation. It is also dispersed across a multitude of agencies. This separation has to disappear as soon as possible. Service users should begin to internalize the cost of water production in ecosystems, since otherwise they will find themselves in a situation of scarcity sooner rather than later, and not because of management problems.
- Lastly, another concern is the sector’s ability to adapt to **climate change and rising energy costs**.

All of this, together with what has already been achieved within the UNASUR context, will provide a platform for responding to the Millennium Development Goals challenges that will have to be faced by the countries after 2015. Looking ahead, what are contemplated are not just commitments but genuine imperatives to protect and fulfil the human right to water and sanitation, and a renewed emphasis in the subregion on further progress with sustainable development, efficiency and anti-poverty efforts.

Lastly, the experience of past decades with the development of hydroelectric projects around large reservoirs (entailing the eviction of communities, the destruction of forests and the flooding of large productive areas) and the long amortization times of installations of this kind made it hard for them to obtain social acceptance and secure financing from the commercial or multilateral international banking system. Consequently, there is a need for the UNASUR countries to emphasize the social and environmental benefits of these projects and implement a vigorous public relations effort to give them the positive image they now deserve.

Evaluation of the contribution of hydroelectricity and a correct definition of the concepts of sustainability and renewability in the context of the UNASUR countries needs to be guided by the following: (i) a comprehensive environmental assessment of hydroelectric projects; (ii) the establishment of a code of conduct towards communities; (iii) payments for environmental services; (iv) modification of time frames in energy procurement contracts; (v) the establishment of mechanisms that recognize the synergy between wind power and hydroelectric projects; (vi) a comprehensive approach to river basins; (vii) provision for social liabilities and resolution of existing conflicts; (viii) public outreach and information transparency.

Lastly, successful governance of natural resources, including hydro power, requires the revenues from their exploitation to be redistributed fairly among all the actors involved, including an adequate allocation to local populations in the areas where facilities are sited.

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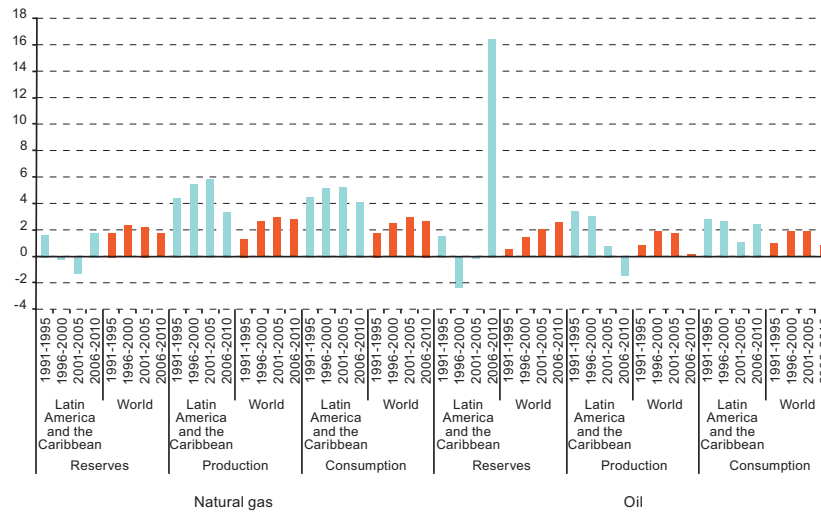
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ANNEX

Figure A.1  
**LATIN AMERICA AND THE CARIBBEAN (SELECTED COUNTRIES): RESERVES, PRODUCTION AND CONSUMPTION OF OIL AND NATURAL GAS, BY FIVE-YEAR PERIODS, 1991-2010**  
*(Percentage variation)*

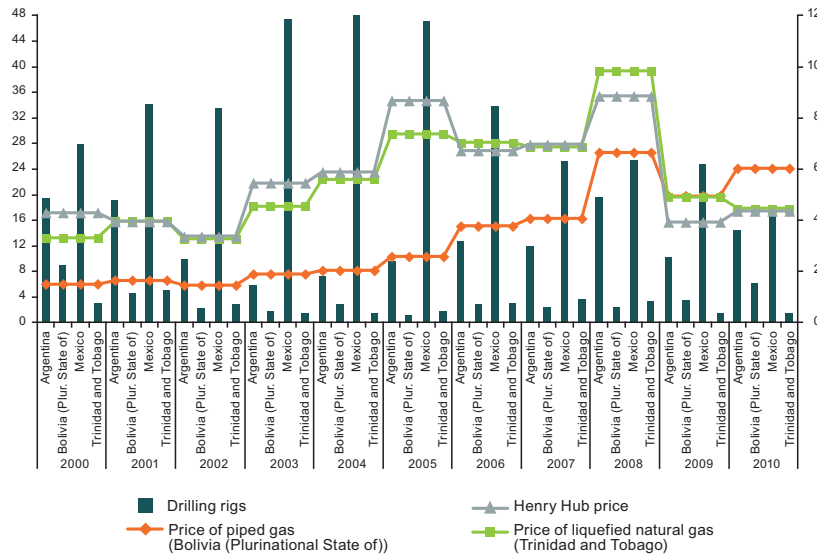


**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP, “Statistical Review of World Energy 2011”, 2011 [online] <http://www.bp.com/statisticalreview>; ENI, “World Oil and Gas Review 2010”, 2010 [online] <http://www.eni.com/world-oil-gas-review/pages/home.shtml>.



Figure A.2  
**LATIN AMERICA AND THE CARIBBEAN (SELECTED COUNTRIES): DRILLING ACTIVITIES  
 AND NATURAL GAS PRICES, 2000-2010<sup>a</sup>**

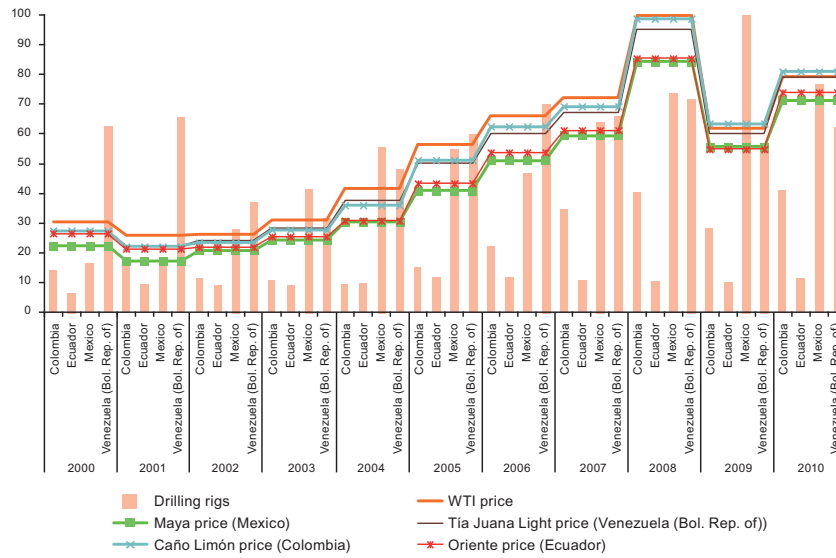
*(Number of drilling rigs (left scale) and dollars per million  
 British thermal units (right scale))*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Baker Hughes, “International rig counts”, 2012 [online] [http://investor.shareholder.com/bhi/rig\\_counts/rc\\_index.cfm](http://investor.shareholder.com/bhi/rig_counts/rc_index.cfm); EIA, “Country analysis briefs”, 2011 [online] <http://www.eia.gov.us>; Yacimientos Petrolíferos Fiscales Bolivianos (YPFB) [online] <http://www.ypfb.gob.bo>.

<sup>a</sup> The price of natural gas from the Plurinational State of Bolivia corresponds the country’s piped gas supply agreement with Brazil at the point of delivery. The price of natural gas from Trinidad and Tobago corresponds to the contract for exporting natural gas to the United States at the reception terminal. The conversion from volume to energy units was performed using a calorific value of 1.04 MMBtu/Mpc, which reflects the average for 2009 production. The Henry Hub price is equivalent to that of the Gulf Coast.

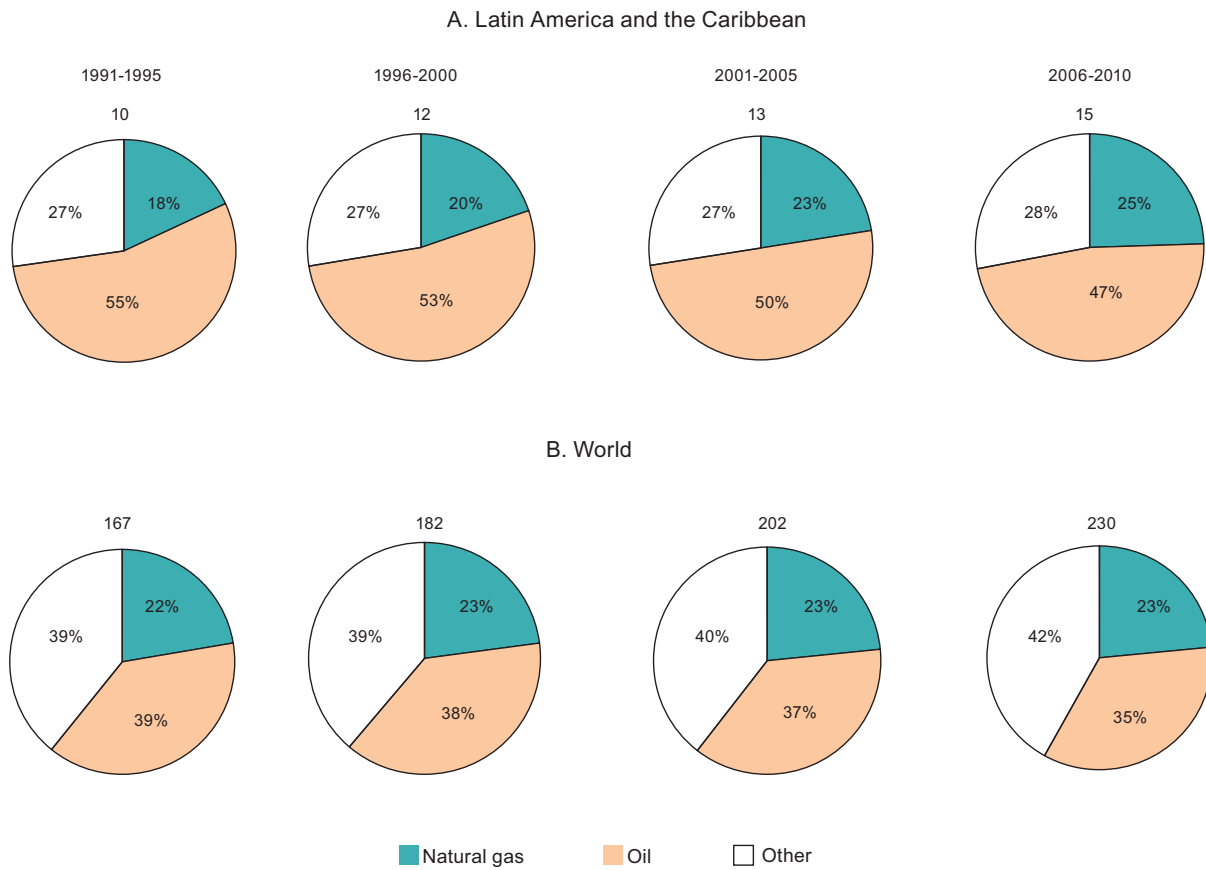
Figure A.3  
**LATIN AMERICA (SELECTED COUNTRIES): DRILLING ACTIVITIES AND OIL PRICES, BY CRUDE OIL TYPE, 2000-2010<sup>a</sup>**  
*(Number of drilling rigs and dollars per barrel of oil)*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Baker Hughes, “International rig counts”, 2012 [online] [http://investor.shareholder.com/bhi/rig\\_counts/rc\\_index.cfm](http://investor.shareholder.com/bhi/rig_counts/rc_index.cfm); EIA, “Country analysis briefs”, 2011 [online] <http://www.eia.gov.us>.

<sup>a</sup> Prices f.o.b. (free on board).

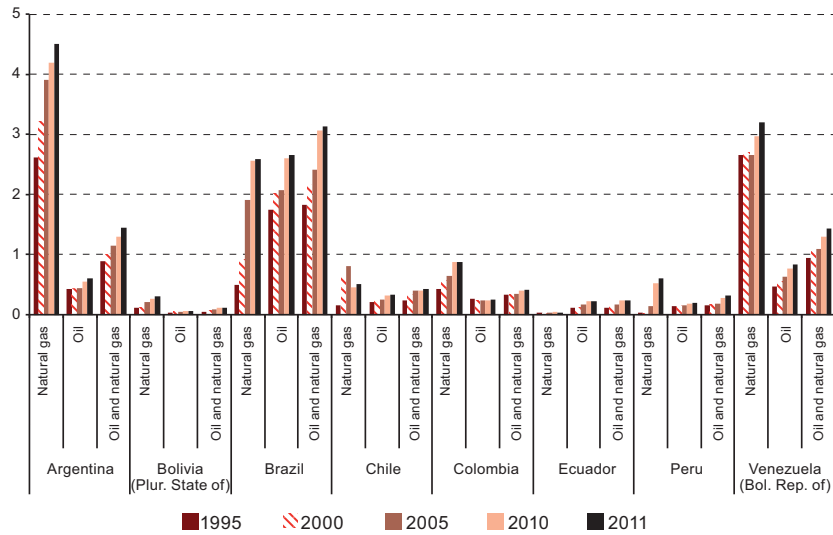
Figure A.4  
**LATIN AMERICA AND THE CARIBBEAN AND THE WORLD: PROPORTION OF HYDROCARBONS  
 IN THE PRIMARY ENERGY CONSUMPTION MATRIX, BY FIVE-YEAR PERIODS**  
*(Millions of barrels of oil equivalent per day and percentages of the total)*



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP, “Statistical Review of World Energy 2011”, 2011 [online] <http://www.bp.com/statisticalreview>.

Figure A.5  
**SOUTH AMERICA (SELECTED COUNTRIES): OIL AND NATURAL GAS CONSUMPTION,**  
**1995, 2000, 2005, 2010 AND 2011**

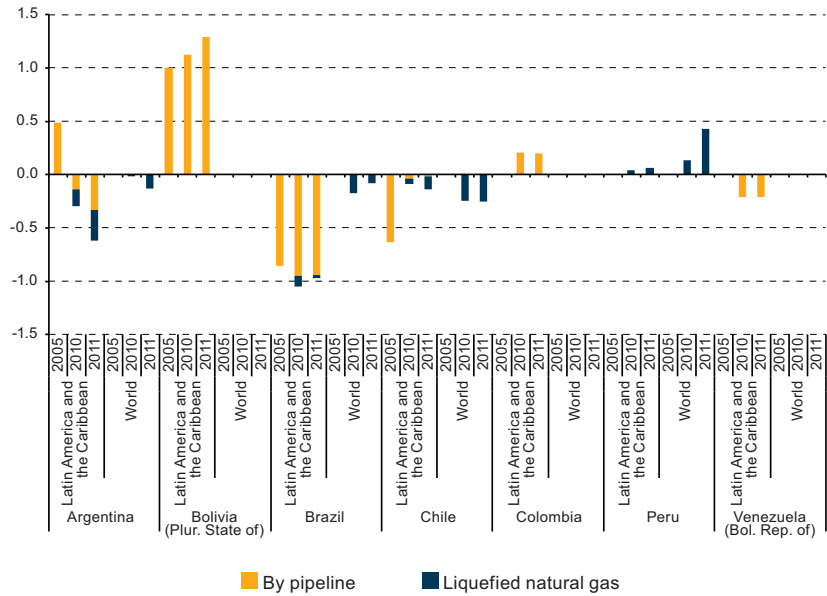
(Millions of barrels of oil, millions of barrels of oil equivalent<sup>a</sup> for total hydrocarbon and billions of cubic feet of natural gas per day)



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP “Statistical Review of World Energy 2012” and “Statistical Review of World Energy 2011” [online] <http://www.bp.com/statisticalreview>; ENI, “World Oil and Gas Review 2010” [online] <http://www.eni.com/world-oil-gas-review/pages/home.shtml>.

<sup>a</sup> An average global conversion factor calculated by British Petroleum was used to convert cubic feet of natural gas to barrels of oil equivalent, at a rate of 5,610 cubic feet per barrel equivalent.

Figure A.6  
**LATIN AMERICA AND THE WORLD: BALANCE OF TRADE IN NATURAL GAS,**  
**2005, 2010 AND 2011<sup>a</sup>**  
*(Billions of cubic feet per day)*



**Source:** Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP “Statistical Review of World Energy 2012”, “Statistical Review of World Energy 2011” and “Statistical Review of World Energy 2006” [online] <http://www.bp.com/statisticalreview>.

<sup>a</sup> The trade balance refers to the difference between imports and exports.



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