# Renewable Electricity Generation in South America

## Comparative Analysis of the Energy Balances and Forecasts for Bolivia, Chile and Brazil

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### Imprint

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# 1. Energy Systems

## 1.1 Primary Energy

Primary energy production in Bolivia comes to 133,525 KBep and is composed mainly of natural gas at almost 80%, followed by oil production (13%), biomass (6%) and hydropower (1%). 66% of primary production of energy is destined for export, of which 94% is natural gas to be sent to Argentina and Brazil. The transport sector consumes 60% of primary energy production, followed by the industrial sector (21%) and residential (18%).

Meanwhile, Chile has a primary production of energy of 61,530 KBep, which is equivalent to just 54% of primary energy production in Bolivia. Primary production in Chile is composed mainly of biomass (wood) at 52%, followed by hydropower (22%), natural gas (21%), coal (3%), oil (1.5%), wind power and biogas. This is all destined for domestic consumption, with transport consuming the most, much like in Bolivia.

Primary energy production in Brazil comes to 1,969,967 KBep, which is greatly superior to the production of Bolivia and Chile. Comparatively, primary production in Bolivia and Chile is equivalent to 5% and 3% of primary production in Brazil respectively. In this sense, primary production in Brazil is composed mainly of oil at 38%, followed by sugar cane (18%), hydropower (14%), biomass (10%), natural gas (10%), coal (5%), others (4%) and uranium (1%). Moreover, the transport and industry sectors consume almost 70% of total primary production of energy.

Bolivia shows a comparatively higher dependence on non-renewable fossil fuels than Brazil and Chile. This is evident in the country's primary energy production, of which 93% is made up of non-renewable fossil resources, especially natural gas and oil. Chile shows a primary energy production less dependent on non-renewable fossil resources in comparison to the other two countries. Non-renewable resources represent only 25% of Chilean primary production. Primary production in Brazil is more balanced in relation to its dependence on non-renewable resources. In this sense, 53% of primary production there is made up of fossil fuels. Nevertheless, the remaining 47% of its primary production consists of renewable resources, which is equivalent to eight times the total primary production of Bolivia and 15 times the primary production of Chile.

**Table 1: Summary of Primary Energy in Bolivia, Chile and Brazil**

| Country | Bolivia | Chile | Brazil |
|---|---|---|---|
| **Primary energy** | Production: 113,525 KBep | Production: 61,530 KBep | Production: 1,969,967 KBep |
| **Sources** | Natural gas: 79.6%<br>Oil: 13.4%<br>Biomass: 5.6%<br>Hydropower: 1.2% | Wood: 52.0%<br>Hydropower: 22.0%<br>Natural gas: 21.0%<br>Coal: 3.0%<br>Oil: 1.5%<br>Wind: 0.3%<br>Biogas: 0.1% | Oil: 38.0%<br>Sugar cane: 18.0%<br>Hydropower: 14.0%<br>Biomass: 10.0%<br>Natural gas: 10.0%<br>Coal: 5.0%<br>Others: 4.0%<br>Uranium: 1.0% |
| **Destination** | Exports: 66.0% (94.0% natural gas)<br>Domestic consumption: 33.0% | Domestic consumption: 100.0% | Domestic consumption: 100.0% |
| **Sector** | Transport: 59.0%<br>Industry: 21.0%<br>Residential: 18.0% | Transport: > 50.0% | Transport and industry: 70.0% |

*Source: Own elaboration*

## 1.2 Secondary Energy

Secondary energy production in Bolivia comes to 23,029 KBep and represents just 12% and 1.4% of secondary production in Chile and Brazil respectively. In this sense, secondary production in Bolivia consists mainly of diesel at 39%, petrol (26%), electricity (17%), LPG (13.5%) and others (4.6%). By sector, secondary energy production is destined mainly for the transport sector at 35%, followed by industry (25%) and residential (18%). Thus, an extreme dependency on fossil fuels is evident again in secondary production, since non-renewables represent almost 80% of secondary production.

Chile's secondary production of energy comes to 188,000 KBep, which is equivalent to 12% of secondary production in Brazil and is equal to eight times the secondary production in Bolivia. Much like in Bolivia, secondary production in Chile consists mainly of the production of diesel (24%), petrol (20%) and electricity (18%). Furthermore, the transport sector consumes 35% of such energy fuels, followed by the commercial

and residential sectors (25%), industry (24%) and mining (13%). Dependence on fossil fuels is less marked in Chile than Bolivia at 44% of secondary production.

Brazil has a production of secondary energy of 1,577,394 KBep, which is equal to 68 and eight times the secondary energy production in Bolivia and Chile respectively. This production, much like in the previous cases, is made up of diesel and electricity consumption, both at 16% of participation. Following these are Cannot be split. cane production (12%), biomass (8%), natural gas (7%) and petrol (7%). In this particular case, sugar cane alcohol production displaces the petrol production found in Bolivia and Chile, due to the high integration of this energy source in transport sector consumption.

## 1.3 Total Gross Internal Supply (TGIS)

The total net internal consumption of Bolivia comes to 38,050 KBep, in which oil and its derivatives represent 43%. Natural gas accounts for a significant proportion of net consumption at 38% of the total, of which a large amount is destined for thermoelectric generation. Biomass represents 14% and hydropower 5% of the gross internal supply. 97% of total internal consumption comes from internal production, and the remaining 3% from imports, especially

**Table 2: Summary of Secondary Energy in Bolivia, Chile and Brazil**

| Country | Bolivia | Chile | Brazil |
|---|---|---|---|
| **Secondary energy** | Production: 23,029 KBep | Production: 188,000 KBep | Production: 1,577,394 KBep |
| **Sources** | Diesel: 39.0%<br>Petrol: 26.0%<br>Electricity: 17.0%<br>LPG: 13.5%<br>Others: 4.6% | Diesel: 24.0%<br>Petrol: 20.0%<br>Electricity: 18.0%<br>Biomass: 17.0% | Diesel: 16.0%<br>Electricity: 16.0%<br>Sugar cane: 12.0%<br>Biomass: 8.0%<br>Natural gas: 7.0%<br>Petrol: 7.0% |
| **Sector** | Transport: 35.0%<br>Industry: 25.0%<br>Residential: 18.0% | Transport: 35.0%<br>Commercial/residential: 25.0%<br>Industry: 24.0%<br>Mining: 13.0% | Transport: 41.0%<br>Industry: 32.0%<br>Residential: 10.0% |

*Source: Own elaboration*

diesel and oils. Again, dependence on fossil fuel energy sources is high, since 81% of the internal consumption of Bolivia is provided using these sources.

Chile has a total net internal consumption of 246,019 KBep, which is equivalent to more than six times the total net internal consumption of Bolivia. Nevertheless, Chile shows a dependence on non-renewable fossil resources similar to that of Bolivia, since these account for 80% of internal consumption. Breaking the results down, it is possible to see that 53% of consumption is provided by oil and its derivatives, followed by natural gas (14%), wood (14%), coal (13%) and hydropower (6%). An essential aspect of the Chilean energy mix and the country's internal consumption of energy is that more than the 73% of this energy comes from external sources (imports) and only 27% is produced domestically.

**Table 3: Summary of TGIS in Bolivia, Chile and Brazil**

| Country | Bolivia | Chile | Brazil |
|---|---|---|---|
| **Total Gross Internal Supply (TGIS)** | Supply: 38,050 KBep | Supply: 246,019 KBep | Supply: 1,767,120 KBep |
| **Sources** | Oil and its derivatives: 43.0%<br>Natural gas: 38.0%<br>Biomass: 14.0%<br>Hydropower: 5.0% | Oil and its derivatives: 53.0%<br>Natural gas: 14.0%<br>Wood: 14.0%<br>Coal: 13.0%<br>Hydropower: 6.0% | Oil and its derivatives: 37.0%<br>Natural gas: 9.0%<br>Wood and vegetal coal: 12.0%<br>Biomass: 16.0%<br>Hydropower: 15.0% |
| **Origin** | Internal production: 97.0%<br>Imports:<br>Secondary: 3.0% | Internal production: 27.0%<br>Imports:<br>Primary: 51.0%<br>Secondary: 22.0% | Internal production: 92.0%<br>Imports:<br>Secondary: 8.0% |

*Source: Own elaboration*

## 1.4 Electricity Generation

Bolivia's electricity generation comes to 3,973 GWh, which is equivalent to 7% and 1% of the electricity generation of Chile and Brazil respectively. 60% comes from thermoelectric plants with a total installed capacity of 854 MW and the remaining 40% from hydroelectric plants with an installed capacity of 372 MW.

**Table 4: Summary of Electricity Generation in Bolivia, Chile and Brazil**

| Country | Bolivia | Chile | Brazil |
|---|---|---|---|
| **Electricity Generation** | Generation: 3,973 GWh | Generation: 60,138 GWh | Generation: 482,600 GWh |
| **Sources** | Thermoelectric: 60%<br>Hydroelectric: 40% | Thermoelectric: 60%<br>Hydroelectric: 40% | Hydroelectric: 67%<br>Thermoelectric: 30%<br>Nuclear: 2%<br>Wind: 1% |
| **Capacity** | Thermoelectric: 854 MW<br>Hydroelectric: 372 MW | No information available | Total: 117,135 MW |

*Source: Own elaboration*

Chile generates 60,138 GWh of electrical power, composed of 60% thermoelectric generation and 40% hydroelectric generation, much like in Bolivia.

The quantity of electricity generation in Brazil is vastly superior to the levels in Bolivia and Chile, coming to 482,600 GWh, which is equivalent to more than 100 times the Bolivian generation and eight times the Chilean generation. The total installed capacity of Brazil comes to 117,135 MW, of which 67% comes from hydropower, 30% from thermoelectricity, 2% from nuclear and 1% from wind. In this sense, Brazil has the cleanest electricity generation out of the three countries, with 68% of electricity generation coming from renewable sources. Moreover, it is the only country under analysis in which electricity generation from NCRE is significant.

## 1.5 Exports and Imports

As mentioned before, Bolivia exports 69,469 KBep of primary energy, of which 94% is natural gas, destined for Argentina and Brazil, and 6% is oil. The main energy imported into Bolivia is diesel, which represents 80% of total energy imports (5,213 KBep). The remaining 20% is made up of petrol, oil and fats. This makes it clear that Bolivia is a net exporter of energy.

Chile's secondary energy exports come to 7,490 KBep. Mainly, these exports are focused on the production of methanol and some oil derivatives. Chilean energy exports are small in volume in comparison to those from Bolivia or Brazil and the country's primary energy imports reach significant volumes of 127,189 KBep, which breaks down into 50% crude oil, coal (30%) and natural gas (20%) imports.

**Table 5: Summary of Exports and Imports in Bolivia, Chile and Brazil**

| Country | Bolivia | Chile | Brazil |
|---|---|---|---|
| **Exports** | 69,469 KBep | 7,490 KBep | |
| Primary energy | Natural gas: 94.0%<br>Oil: 5.8% | None | |
| Secondary energy | | Methanol<br>Oil derivatives | |
| **Imports** | | | |
| Primary energy | None | 127,189 KBep<br>Crude oil: 50.0%<br>Coal: 30.0%<br>Natural gas: 20.0% | 326,463 KBep<br>Natural gas: 23.0%<br>Coal: 34.0% |
| Secondary energy | Total: 5,213 KBep<br>Diesel: 80.0%<br>Petrol, oils and fats: 20.0% | 56,621 KBep<br>Diesel: > 60.0% | 143,641 KBep<br>electricity |

*Source: Own elaboration*

Furthermore, secondary energy imports account for the considerable volume of 56,621 KBep, of which more than 60% is diesel. In this way it is possible to see Chile's profile as a net importer of energy, since the exports represent only 5% of the imports of primary energy, 13% of secondary imports and 4% of total imports. Finally, we note that there is not up-to-date data about Brazil's energy imports and exports. Nevertheless, it is known that the country is a significant exporter of oil and a huge importer of electricity (especially from the bi-national Itaipu), natural gas (from Bolivia) and coal.

## 2. Trending Scenario (Business as Usual) and Mitigation Scenario

The energy consumption forecast by sector in Bolivia shows that the total consumption of energy will reach 57,908 KBep in the year 2025 using the trending scenario, or 53,210 KBep using the mitigation scenario. This means an increase in total energy consumption of 82% in the trending scenario, or an increase of 67% using the mitigation scenario, both in comparison to consumption in the base year, 2007. The implementation of energy efficiency policies would achieve a reduction in energy consumption to 4,698 KBep, which represents 15% of consumption in the base year. For Brazil, there is no change in consumption or demand, as the effects of the LEAP

**Table 6. Net Energy Consumption Forecasts by Sectors 2007–2025** (KBep)

| Country | Bolivia | | | Chile | | | Brazil | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sectors** | Base Year 2007 | Forecast 2025 | | Base Year 2007 | Forecast 2025 | | Base Year 2010 | Forecast 2030 | |
| | | Trending | Mitigation | | Trending | Mitigation | | Trending | Mitigation |
| Residential | 5,586 | 9,283 | 7,069 | 37,100 | 43,700 | 41,600 | 174,087 | 253,244 | 253,244 |
| Commercial and service | 839 | 1,658 | 1,396 | 7,400 | 15,400 | 14,700 | 74,399 | 183,250 | 183,250 |
| Own consumption | 2,846 | 6,507 | 6,507 | 7,100 | 16,900 | 16,900 | 183,250 | 419,642 | 419,642 |
| Industry and mining | 10,744 | 21,328 | 19,008 | 66,500 | 151,800 | 139,700 | 628,547 | 115,447 | 115,447 |
| Transport | 11,225 | 17,853 | 17,951 | 62,900 | 172,300 | 172,300 | 513,100 | 1,099,500 | 1,099,500 |
| Agriculture and livestock | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 72,933 | 148,433 | 148,433 |
| Non-energetic | 631 | 1,279 | 1,279 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| **Total** | **31,871** | **57,908** | **53,210** | **181,000** | **400,100** | **385,200** | **1,646,316** | **2,219,516** | **2,219,516** |

*Source: Results of LEAP model*

integrated attenuation model are produced by technological change (processing power) and fuel substitution. That is why the 'consumption' value is the same for both scenarios. The actions implemented, especially in the countryside, are often efficiency strategies not measured in LEAP.

Chile has an energy consumption seven times higher than that of Bolivia, as for the year 2025, total energy consumption in the trending scenario reaches 400,100 KBep or 385,200 KBep in the mitigation scenario. This implies an increase in total energy consumption of more than 120% using the trending scenario and 113% using the mitigation scenario for the period 2007–2025. In terms of energy savings as a consequence of energy efficiency measures, a reduction in energy consumption of 14,900 KBep would be achieved in comparison to the trending scenario for the year 2025. This reduction represents 8% of total energy consumption in the base year in Chile and 46% of total energy consumption in the base year in Bolivia.

Brazil shows total energy consumption in the base year reaching 1,646,316 KBep and it is estimated that in the year 2030, this will reach 2,219,516 KBep. This is a growth of 35% in total energy consumption during the period 2010–2030. The energy consumption of Brazil in the base year is equivalent to 51 times

**Table 7. Energy Savings Forecast by Sector 2007–2025**

| | Bolivia | | Chile | |
|---|---|---|---|---|
| **Sectors** | KBep | % Base Year | KBep | % Base Year |
| **Residential** | 2,214 | 40 | 2,100 | 6 |
| **Commercial and service** | 262 | 30 | 700 | 9 |
| **Own consumption** | 0 | 0 | 0 | 0 |
| **Industry and mining** | 2,320 | 33 | 12,100 | 18 |
| **Transport** | –98 | –1 | 0 | 0 |
| **Non-energetic** | 0 | 0 | n.a. | n.a. |
| **Total** | 4,698 | 15 | 14,900 | 8 |

*Source: Own elaboration*

the consumption of Bolivia and nine times the consumption of Chile.

Breaking this down, it is possible to see that the most significant energy savings in terms of percentage in comparison to the base year can be made in the Bolivian energy mix and the most significant energy savings in terms of volume (barrels equivalent of petroleum) can be made in the Chilean energy mix.

In this sense, the savings as a consequence of energy efficiency and mitigation measures in the residential sector in Bolivia would represent 40% (2,214 KBep) of base year consumption towards the year 2025. Likewise, the savings in consumption in the commercial and service sector, as well as in industry, will reach 31% (262 KBep) and 22% (2,320 KBep) of base year consumption towards 2025. An interesting aspect is that the transport sector will not reduce its consumption (although it only increases by 1%, or 98 KBep, in comparison to the base year) in the mitigation scenario. In part, this is due to the constant increase in the number of vehicles and the transition from petrol to vehicle gas, which implies greater fuel consumption due to inferior efficiency.

Using the mitigation scenario, Chile shows savings of 6% (2,100 KBep) in energy consumption in the residential sector in comparison to the base year. The commercial sector and services show savings of 9% (700 KBep) using the mitigation scenario. Nevertheless, the most significant savings using the mitigation scenario would be made in the industrial and mining sectors, in which savings of 18% are forecast, or 12,100 KBep. In both countries, the most significant savings are made in the industrial and mining sectors and residential sector using the mitigation scenario. In terms of volume, residential sector savings are almost equal: 2,214 KBep and 2,100 KBep for Bolivia and Chile respectively. Nevertheless, the industrial and mining sector savings in Chile are equivalent to more than five times the savings for the same sector in Bolivia.

Natural gas consumption in Bolivia shows an interesting trend since the base year represents 21% of energy consumption. The forecasts show a significant increase in the use of this fuel. Both the forecasts using the trending scenario and using the mitigation scenario show that natural gas is predicted to represent 26% and 36% of energy consumption in Bolivia respectively. This increase in natural gas consumption implies the substitution of other fuels, such as biomass and petrol by natural gas.

## Table 8. Net Energy Consumption Forecast by Source 2007–2025 (in %)

| Country | Bolivia | | | Chile | | | Brazil | | |
|---|---|---|---|---|---|---|---|---|---|
| Source | Base Year 2007 | Forecast 2025 | | Base Year 2007 | Forecast 2025 | | Base Year 2007 | Forecast 2025 | |
| | | Tend-ing | Miti-gation | | Tend-ing | Miti-gation | | Tend-ing | Miti-gation |
| Aviation spirit | 0 | 0 | 0 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| Biomass | 16 | 13 | 8 | 18 | 10 | 10 | 11 | 10 | 10 |
| Bagasse | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 14 | 14 | 14 |
| Biodiesel | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 2 | 2 |
| Diesel | 24 | 23 | 24 | 25 | 30 | 29 | 23 | 15 | 15 |
| Electricity | 10 | 12 | 11 | 19 | 21 | 21 | 19 | 19 | 19 |
| Petrol | 12 | 9 | 7 | 10 | 6 | 6 | 6 | 9 | 9 |
| Jet kerosene | 3 | 3 | 3 | 4 | 6 | 7 | 2 | 2 | 2 |
| Kerosene | 0 | 0 | 0 | 0 | 0 | 0 | n.a. | n.a. | n.a. |
| Ethanol | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | 6 | 8 | 8 |
| Methanol | n.a. | n.a. | n.a. | 0 | 0 | 0 | n.a. | n.a. | n.a. |
| Naphtha | n.a. | n.a. | n.a. | 1 | 1 | 1 | n.a. | n.a. | n.a. |
| Coal bit. | n.a. | n.a. | n.a. | 2 | 1 | 1 | 5 | 4 | 3 |
| Oil | n.a. | n.a. | n.a. | 1 | 1 | 1 | n.a. | n.a. | n.a. |
| Pet.coke | n.a. | n.a. | n.a. | 1 | 1 | 1 | n.a. | n.a. | n.a. |
| Resid. fuel oil | n.a. | n.a. | n.a. | 9 | 15 | 15 | 5 | 6 | 6 |
| LPG | 9 | 8 | 4 | 6 | 4 | 4 | 3 | 2 | 2 |
| Natural gas | 21 | 26 | 36 | 4 | 4 | 4 | 6 | 9 | 9 |
| Non-energy | 2 | 2 | 2 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| Refinery gas | 3 | 4 | 5 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| **Total** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** |

*Source: Own elaboration*

In this sense, biomass and petrol represent 16% and 12% of energy consumption in the base year. Consumption of both fuels shows a significant decrease using either forecast scenario. For example, biomass accounts for 13% of consumption in the trending scenario and 8% in the mitigation scenario. Parallel to this, petrol consumption accounts for 8% of consumption in the trending scenario, or 7% in the mitigation scenario. Diesel consumption has a much more stable share in the energy mix, with 24% of total consumption in the base year, 23% using the trending scenario and 24% using the mitigation scenario. Another significant fuel in the energy mix is LPG, with a share of 9% in the base year, reducing to 8% using the trending scenario or 4% using the mitigation scenario.

## 3. Conclusions

The analysis of these energy systems shows several similarities in the production and consumption of energy in Bolivia, Chile and Brazil. The analysis of primary energy shows that Bolivia has a high capacity for production, especially of natural gas, that exceeds its consumption and is destined mainly for exportation. Chile showed energy consumption higher than that of Bolivia, but its production of primary energy is very limited, which forces the country to import high volumes of energy (more than 50% of its energy consumption is imported). Brazil produces a significant amount of primary energy that nevertheless does not completely satisfy demand and therefore requires the country to import fuels. An interesting aspect of primary production in Brazil is that it is highly diversified in terms of renewable and non-renewable sources.

Even though primary energy production in Chile is less than in Bolivia, consumption of secondary energy in Chile is much higher than that in Bolivia. Generally, the consumption of secondary energy is dominated by diesel, electricity and petrol, except in Brazil, where the consumption of these fuels is destined primarily for the transport sector, followed by the industrial sector and the residential sector in all three countries. At the same time, it was possible to verify the high dependence in the domestic consumption of these countries upon non-renewable fossil fuels, since they account for over 80% of total consumption.

Electricity generation in Bolivia and Chile currently has a very similar structure, since in both countries, 60% of

generation is thermoelectric and 40% is hydroelectric. This implies a style of electricity generation that is intensive in the use of fossil fuels (gas, diesel and coal) and affects the environment. Nevertheless, the most remarkable aspect of the Brazilian energy mix, besides its high sugar cane alcohol consumption by vehicles, is its high capacity for hydroelectric generation and the introduction of wind power generation, which combined, represent almost 70% of total electricity generation in the country. Compared to the rest of the world, the electricity generation mix in Brazil is highly clean and efficient.

According to the forecasts made using the mitigation scenario, it is expected that Bolivia, Chile and Brazil will experience an increase in total energy consumption of 67%, 113% and 35% respectively towards 2025. Even if different energy efficiency policies within the sectors of the economy are applied

**Table 9. Electricity Generation Forecast by Source 2007–2025** (in %)

| Country | Bolivia | | Chile | | Brazil (approx.) | |
|---|---|---|---|---|---|---|
| **Sources** | 2007 | 2025 | 2007 | 2025 | 2010 | 2030 |
| **Trending Scenario** | | | | | | |
| **Thermoelectric** | 60 | 60 | 60 | 57 | 25 | 21 |
| **Hydroelectric** | 40 | 40 | 40 | 41 | 73 | 75 |
| **Geothermal** | 0 | 0 | 0 | 1 | 0 | 0 |
| **Wind** | 0 | 0 | 0 | 1 | 1 | 3 |
| **Nuclear** | 0 | 0 | 0 | 0 | 1 | 1 |
| **Total** | 100 | 100 | 100 | 100 | 100 | 100 |
| **Mitigation Scenario** | | | | | | |
| **Thermoelectric** | 60 | 41 | 60 | 55 | 23 | 23 |
| **Hydroelectric** | 40 | 50 | 40 | 43 | 73 | 73 |
| **Geothermal** | 0 | 9 | 0 | 1 | 0 | 0 |
| **Wind** | 0 | 0 | 0 | 1 | 2 | 2 |
| **Nuclear** | 0 | 0 | 0 | 0 | 2 | 2 |
| **Total** | 100 | 100 | 100 | 100 | 100 | 100 |

*Source: Own elaboration*

as a part of these scenarios, these reductions in consumption are not considerably important in the context of net global consumption and the consequent reduction in GHGs. At the same time, the forecasts made using the mitigation scenario focused on energy efficiency measures and increased the use of more efficient fuels, such as natural gas and some derivatives of oil, like diesel. This is to the detriment of the participation of some renewable energy sources, especially biomass. This situation amplifies the crescent dependence on the consumption of non-renewable fossil energy resources in the long term. Except in matters related to electricity generation, it is not possible to see a reduction in the consumption of oil derivatives and, on the contrary, a continuous increase in the consumption of such products is expected, which has significant implications for the environment.

For this reason, more thorough energy efficiency and mitigation measures than the ones proposed in this study are necessary. For such an enterprise, the support of international cooperation will be required, not only in financial matters, but also in terms of technology transfer and training. Collaboration between private and public sectors will also be extremely important, since significant amounts of economic resources are required to allow investment in programmes with a significant impact on energy consumption reduction and GHG emissions.

## Partnership


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