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SPECIAL REPORT

Energy transition, national strategies, and oil companies: what are the impacts for workers?

ineep Instituto de Estudos Estratégicos de Petróleo, Gás Natural e Biocombustíveis

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Summary

Presentation

The Institute of Strategic Studies of Petroleum, Natural Gas and Biofuels (Ineep), a research body created by Brazil's United Federation of Oil and Gas Workers (FUP or *Federação Única dos Petroleiros*), conducts research with a focus on labour issues and advises public, private and third sector organisations from the perspective of unions and their members. Studies carried out by Ineep prioritize economic, geopolitical, sectorial and social analysis of the oil, natural gas and renewable energy industries.

In this study, commissioned by IndustriALL Global Union[1], Ineep surveyed recent transformations in the world of energy, seeking to assess the prospects for energy transition based on the actions of the national states (principally the United States, China, Europe and Russia) and the major companies active in the world oil market. The study also devoted significant attention to the possible impacts of these transformations on workers.

From Ineep's point of view, the energy transition will depend on the actions of national states and the largest sources of capital in the energy industry. This capital is currently concentrated in the major oil companies, be they private-sector International Oil Companies (IOCs) or state-controlled National Oil Companies (NOCs). In the case of national states, geopolitical interests, self-sufficiency and energy diversification, sustaining economic growth is an important consideration. In the case of companies, their behaviour is influenced by such factors as financial results, their relationship with their national states and the capacity to coordinate the actions of the energy industry.

Governments are exposed to a range of social demands in favour of the energy transition, as well as to the pressures of sectors that want to halt it. In addition, the emergence of new economic segments (such as solar energy, biopower, etc.) poses major challenges in terms of formulating public policies in areas such as external affairs and regulation.

The resulting trade-offs between renewable energy and non-renewables (mainly oil) also leads to strategic responses from IOCs and NOCs. These responses typically fall into two categories: greater investment by companies in renewable energy and/or; efforts to delay the expansion renewables in relation to oil.

In a more structural sense, the major oil companies have sought to gradually enter the energy transition process in order to maintain their long-term position in the energy industry, while at the same time seeking to strengthen the role of the oil and gas (O&G) sector to maintain their influence and power in the global economy. This "energy dilemma" faced by oil companies must be framed by the following long-term outlook: on the one hand, certainty is increasing about the current and future importance of renewables; on the other uncertainty about the future of oil is rising.

Even though IOCs, NOCs and countries around the world understand that energy transition is a process well underway and on course to expand, the actions and speed of change are quite different in each country and company.

As a result, the international energy transition is unfolding at different rates along separate but largely parallel trajectories. The differences between these courses and speed of change at which they are developing are also unusually stark compared with historic changes in the world energy mix. Some countries still prioritize non-renewable fossil energy while others focus on renewable energy solutions. These choices, as seen throughout the study, depend on the objectives of each national state and the way in which actors in the energy sector use their advantages, confront obstacles and deal with other challenges to position themselves in the international economy.

The oil companies, in turn, influence this transformation by changing their asset portfolios, as they migrate from fossil to renewable fuel projects. Yet, the decision to switch from fossil fuels to renewables also depends on a number of variables, including the strategy of their countries of origin. In other words, in those countries whose energy strategy is more focused on fossil fuels, oil companies are less eager to pursue renewable projects.

This study aims to analyse the energy transition from the following perspective: that is over-all to show that its trajectory is complex and dependent on the action of several actors. In this sense, priority is given to the actions of national states (primarily the United States, China, Europe and Russia) and the world's main oil companies. In addition, the study also seeks to assess the impacts of the transition on the working class. In order to deepen this analysis, this research aims to understand whether the demands and interests of workers – based on the concept of Just Transition – are being considered and met in this transition process.

1 IndustriALL Global Union represents 50 million workers in 140 countries in the mining, energy and manufacturing sectors.

More systematically, this research seeks to analyse:

(i) The current state of and future outlook for international oil and natural gas industry geopolitics in order to understand its short and long-term importance to the global energy sector;

(ii) The performance of national states (primarily the United States, China, Europe and Russia) and oil companies in the energy sector to measure the real weight of renewables in the policies of these actors;

(iii) The current state and future prospects of the energy transition;

(iv) The impacts of the energy transition and the action of the major oil companies in the world on the working class.

In a more detailed way, it aims to:

(i) Detail the geopolitics of oil and natural gas over the last five years and the possible geopolitical changes in years the come with an emphasis on how that outlook may be affected by the Covid-19 pandemic;

(ii) Present the current and future strategies of the main national states and the main IOCs (Chevron, ExxonMobil, Shell, bp and Total) and NOCs (PetroChina, Gazprom and Equinor);

(iii) Assess the energy transition process during the 21st Century;

(iv) Analyse the different scenarios for the inclusion of renewables in the energy mix;

(v) Present the indicators of the renewables sector labour market;

(vi) Explain the inclusion of renewables in the energy strategies of the national states (primarily the United States, China, Europe and Russia);

(vii) Detail the actions of each IOC and NOC analysed in the research;

(viii) Understand the changes in the majors' labour market since their entry into the renewables segment; and

(ix) Analyse the employment/employee issues in the new segments of renewable energy production in which major oil companies have invested.

This research was organized in three parts.

PART I discusses changes in the geopolitics of oil and natural gas in recent years and provides perspectives on current conditions the outlook for the future. To accomplish this task, the study analyses the recent evolution of oil and natural gas supply and demand, the trajectory of prices and an analysis of how Covid-19 can change future scenarios. Finally, it analyses how the reorganization of the world oil and natural gas industry can influence the energy policies of countries and oil companies.

PART II begins by presenting Ineep's understanding of the different forms and visions of energy transition, as well as the possible scenarios for its future development. In a second step, it analyses the main obstacles and uncertainties of facing the energy transition process and the resulting wide variation in projections for long-term changes to the world energy mix. Part II concludes with a discussion of the impact of energy transition on workers and the high level of uncertainty over the manner and speed in which it will occur.

PART III analyses the energy strategies of the major oil companies. First, it discusses the influence of national states (primarily the United States, China, Europe and Russia) on the business plans of these companies in show that their entry into the renewables segment is linked ultimately to the actions of government action in their home countries. Second, it surveys the performance to date of these companies in the renewables segment. Finally, it details the impact of these companies' actions on workers to determine – based on the principles of transition Just Transition concept – whether or not the interests of labour are being taken into account in the energy-transition process.

Executive summary

- The world energy transition is not occurring on a single path. Instead, it is characterized by a plurality of processes and motivations that cause it to move ahead at different velocities and along a variety of trajectories depending on each country's social, environmental, geopolitical and economic-financial conditions.
- The oil-and-gas sector plays a central role in the energy transition because it provides essential resources upon which a wide variety of production chains depend. The energy output of this industry is also concentrated in a limited number of geographical regions, thereby guaranteeing great power for some countries. In the short term, the expansion of renewable energy depends upon investments made by the oil majors themselves and on solutions firmly linked to the uses of fossil fuels.
- The United States and its northern neighbour Canada have seen oil and natural gas output increase and along with that rising potential as exporters. Between 2016 and 2019, the two countries' share of world oil production rose from 18.5% to 23.8%, and in their share of natural gas output grew from 25.4% to 27.4%. Meanwhile, the Organization of Petroleum Exporting Countries (OPEC), saw its share decline, primarily as a result of a decline in output from members Venezuela and Iran.
- China has become the world's largest consumer and importer of oil and natural gas. Between 2016 and 2019, China's demand for natural gas rose 46.7% and demand for oil rose 14.8%.
- In recent years, the United States has become Russia's competitor in the international natural-gas market and OPEC's competitor in the oil market. Meanwhile, China overtook the United States to become the world's largest hydrocarbons importer and has seen its impact on oil and natural gas trade flows rise. The result has been increased competition between these countries to dispute the control of oil supply, trade and prices.
- The sharp fluctuations in oil and natural-gas prices between 2016 and 2020 reflect competition between these countries and general uncertainties in the international hydrocarbons market, especially in the wake of the Covid-19 pandemic. During that period, the price of oil reached a high of $81.03 a barrel in October 2018 and a low of $18.38 in April 2020.
- Covid-19 has increased uncertainty in the oil and natural-gas industry. The sharp drop in demand – an estimated from 6% to 10% in 2020 – intensified competition between major producers over production cuts, and, even more, over where resumptions in output will occur.
- In the light of these changes, the countries' strategy for the energy sector is increasingly associated, in the short term, with the preservation of local industries, energy self-sufficiency and the maintenance of oil production.
- In general, the major oil companies have made significant cuts in investment and jobs during the pandemic. At the same time, they are attempting to preserve their most-profitable assets, which are concentrated in oil and natural-gas exploration and production. While there are no targets for cutbacks in their most-profitable assets there is also no expectation of a major expansion of their renewable energy programmes with the exception of some European majors primarily Total.
- There is great uncertainty about the future weight of renewables in the world energy mix. The projections for renewables share of energy output by 2040 vary from 7.7% to 27.4%.
- Geopolitics play an important role in decisions affecting the energy transition. The dependency relations between energy importers and exporters, the search for energy self-sufficiency and the ability to control key energy sector variables in a global perspective are aspects that undoubtedly influence the energy policies of national governments and, consequently, the actions taken to achieve energy transition.
- The unpredictability of renewable energy supply and power generation dependent upon it causes constant mismatches between the supply and demand curves, leading to uncertainties in planning, increased investment risk and inadequate price signals for the electricity market. As a result, the increase in the share of renewables share in the energy mix demands changes in the technical and operational paradigms the world's energy systems.
- Current projections indicate that there will be a concentration of future job creation in Asia. Through 2050, about two-thirds of all new jobs in the oil and natural-gas sector will be created on the Asian continent.
- In general, regardless of state-control or private ownership, oil companies' strategies are deeply connected to the economic and geopolitical goals of their countries of origin.
- International Oil Companies have developed diverse strategies for the inclusion of renewables, with the approaches of European companies and large oil companies based elsewhere showing the most significant differences. Part of the majors' decarbonisation movement is focused on maintaining access to investment capital rather than promoting a more sustainable environment.
- In the case of U.S. companies, the role of rising output from unconventional oil and natural gas fields is of great importance due to the country's efforts to reposition itself as an oil exporting nation and increase its influence over the geopolitics of energy. U.S.-based Chevron and ExxonMobil are focused on decarbonisation of their own production.

- In China, the priority is energy security or, in other words, guaranteeing energy supply. State-controlled PetroChina and Sinopec, for example, refer to "energy security" as a priority aim when describing corporate strategy. This helps explain efforts to increase the role of natural gas exploration and production in their operations.
- In Europe, the Russians have a very similar focus. The country's government and oil companies still focus their strategies on exploiting the potential of natural gas.
- In Western Europe, renewables are at the centre of the energy agenda. However, in countries where the oil and natural gas industries play an important role in the local economy, governments are not abandoning efforts to exploit the potential of fossil fuels.
- The European Green Deal (EGD), unveiled by the European Commission in December 2019, proposes spending 750 billion euros on economic recovery programs, a budget that could expand to 1.1 trillion euros over the 2021-2027 period. EDG spending aims to allow the European Union (EU) to raise its target for cutting cut greenhouse gas emissions in 2030 to between 50% to 55% of 1990 levels from the EU's previous goal of a 40% reduction.
- This goal is also reflected in the strategic plans of Western European oil companies. The U.K.-based oil company bp, for example, names low-carbon energy and electricity based on renewables as one of its three investment priorities, although its other two guidelines are markedly focused on traditional fossil-fuel segments, especially the production and commercialization of oil and natural gas.
- In the case of Norway's Equinor, three of the four strategic goals that the company has adopted for the coming years are related to oil and natural gas.
- France's Total, despite a renewable-energy strategy that is one of the most ambitious, still has a strong presence in the oil and natural gas chain, especially in the liquified natural gas (LNG) segment.
- Despite efforts to expand into renewable energy, oil and natural gas operations continues to overwhelmingly dominate these companies' investment plans. The percentage of capital expenditure on renewables is still extremely low, less than 5% for all of the major oil companies.
- The majors' renewable-energy activities and investment strategies are on a far smaller scale than those related to oil and natural gas. They are restricted to the creation of venture-capital funds, research and development (R&D) spending, the acquisition of start-ups and projects associated with hydrocarbon operations.
- Not only do renewables and low-carbon investments play a small role in the majors' project portfolios, but these projects' production capacities are also smaller than those in their traditional operations. The installed renewable-energy capacity of these companies represents a very small share of their total installed capacity in the countries where they operate.
- Renewable energy generation at the main International Oil Companies represents less than 1% of their total installed capacity in the countries where they operate.
- By 2030, oil output is expected to grow by at least 10% at all the majors except of bp, according to the Oil Change International (2020) At ExxonMobil, production is expected to rise by more than 50% and output at Shell, Repsol and Equinor is projected to increase by more than 20%.
- These projections suggest that the long-term path to energy transition remains quite uncertain, regardless of the renewable energy profile of the companies involved. This "distance" between current energy transition activities and future goals is even greater when looked at through the lens of Just Transition principles. Even at those companies pushing toward energy transition most aggressively, their largest capital projects related to renewables are still in their early or preliminary stages. As a result, the discussion about a Just Transition is still in its infancy.
- Interviews with a group of union representatives conducted as part of this project found that the concept of Just Transition is a little-known and barely explored issue in the oil and natural gas industry. The union members' lack of knowledge about Just Transition can be accounted for by their belief that the coming decades will bring no significant change to the world energy mix. Nor do they believe that the companies for which they work are making the important changes necessary for the transition.
- Changes in the energy mix will have a direct impact on the labour market. Some the expected effects are: the generation of new "green" jobs; the risk of job losses in traditional non-renewable energy and manufacturing sectors; and redefinition or destruction of some job positions.
- The number of jobs created varies according to the location on the value chain where new enterprises re-developed; some positions in the oil and natural-gas sector intersect with those in the renewable industry and can offer mobility and reallocation for those affected by changes, especially those individuals with a high level of experience and training.

Abbreviations

ACP	Colombian Petroleum Association
AI	Artificial Intelligence
ANH	Colombian National Hydrocarbon Agency
ANP	Brazilian National Petroleum, Natural Gas and Biofuels Agency
BCM	Billion Cubic Metres
BNEF	BloombergNEF
bp	British Petroleum
CBM	Coalbed Methane
CCS	Carbon Capture and Storage
CCUS	Carbon capture, utilisation and storage
CEIP	Clean Energy Incentive Program
CEO	Chief Executive Officer
CES	Chevron Energy Solutions
CNOOC	China National Offshore Oil Corporation
CNPC	China National Petroleum Corporation
CO2	Carbon Dioxide
COP21	Paris Climate Change Conference
CPECC	China Petroleum Engineering & Construction Corporation
CPP	Clean Power Plan
CPS	Current Policies Scenario
CTV	Chevron Technology Ventures
D&I	Diversity and Inclusion
DME	Dubai Mercantile Exchange
DOE	Department of Energy of United States
E&P	Exploration e Production
EC	European Commission
EIA	Energy Information Administration
ENI	Ente Nazionale Idrocarburi
ES-2035	Russia's Energy Strategy program for 2035
ESG	Environmental, Social, and Corporate Governance
ETS	Emissions Trading Systems
EU	European Union
EUR	Euro
FTE	Full-time-equivalent
FUP	Federação Única dos Petroleiros
FYP	Five-Year Plan
G20	Group of Twenty
GDP	Gross Domestic Product
GHG	Greenhouse gas
GW	Gigawatts
GWP	Global Wind Power
HCC	High Council on Climate
ICFTU	International Confederation of Free Trade Unions
IEA	International Energy Agency
IEEJ	Institute of Energy Economics of Japan
INE	Shanghai International Energy Exchange
Ineep	Instituto de Estudos Estratégicos de Petróleo, Gás Natural e Biocombustíveis
IOC	International Oil Companies
IRENA	International Renewable Energy Agency
IRR	Internal Rate of Return
ITUC	International Trade Union Confederation
JTRC	Just Transition Research Collaborative
KPI	Key Performance Indicator
kW	Kilowatt
LGBTQ+	Lesbian, Gay, Bisexual, Transgender and Queer (or Questioning) plus
LLC	Limited Liability Company
LNG	Liquefied Natural Gas
LP	Limited Partnership
MCS	Mid-Century Strategy
MHRSS	Ministry of Human Resources and Social Security (China)
MME	Brazilian Ministry of Mines and Energy
MPE	Multiannual Energy Program
MW	Megawatt
NEA	National Energy Administration (China)
NECP	National Energy and Climate Plan (United Kingdom)
NGO	Non-Governmental Organization
NOC	National Oil Company
NREL	National Renewable Energy Laboratory (USA)
NSS	National Security Strategy (United States)
O&G	Oil and Gas
O&M	Operation and Maintenance
OCI	Oil Change International
OECD	Organisation for Economic Co-operation and Development
OGCI	Oil and Gas Climate Initiative
OPEC	Organization of the Petroleum Exporting Countries
OPEC+	Organization of the Petroleum Exporting Countries + 10 non-OPEC countries
OXY	Occidental Petroleum Corporation
PEM	Proton Exchange Membrane
POWER	Partnerships for Opportunity and Workforce and Economic Revitalization Plan
PV	Photovoltaics
qBTU	Quadrillion British Thermal Units
R&D	Research and Development
RES	Renewable Energy Systems
RMB	Renminbi
S&P Global	Standard & Poor's Global
SURE	Support to mitigate Unemployment Risks in an Emergency
TCE	Tonnes of Coal Equivalent
Tenesol	Total Énergie Solaire
THAI	Toe-to-Heel Air Injection
TWh/yr	Terawatt-hours per year
UK	United Kingdom
US	United States
USA	United States of America
USW	United Steelworkers International Union
VAPEX	Vapour Extraction Process
WPX Energy	Williams Production and Exploration
WTI	West Texas Intermediate

PART I

The geopolitics of oil and natural gas as the centre of the "energy world": recent changes and post-Covid perspectives

1. Introduction

The energy transition debate often overlooks the role played by the oil and natural-gas industry, not only with regard to its involvement in development and exploitation of today's major energy sources, but also with regard to it role in future components of the world energy mix. The prospect for changing the energy mix to include a larger share of cleaner sources invariably depends upon the events related to this industry.

The oil and gas sector is characterized by its ability to mobilize large volumes of capital, the existence of highly monopolised segments and extremely concentrated sources of production. The control of a source of oil and natural gas provides great power. This power frequently extends far beyond the country where the resource is tapped, sometimes reaching out to all parts of globe. In other words, control of oil and natural-gas resources and infrastructure gives certain countries power over the essential energy supplies of regions where they otherwise would have no influence.

For some countries, accepting the replacement of oil and natural gas by wind, solar, geothermal, and other energy sources means giving up power. Throughout the history of the energy industry, management and control of production and logistics has been fundamental not only to ensure a stable supply energy to countries throughout the world, but also to allow those with such control to put pressure on geopolitical rivals.

As long as oil and natural gas remain fundamental to the world's energy matrix, the energy transition will depend on the actions of national governments, especially those of the major powers such as the United States, China, Russia, United Kingdom, with regard to these energy sources. As will be observed in Part I, the decisions of these countries are strongly influenced not only by national objectives, but also by geopolitical interests. If workers are going to have a more comprehensive view of the transition process, an analysis of this issue is essential.

In addition to this introduction, Part I has three more sections. The first of these, section 2, analyses the changes in the geopolitics of oil and natural gas over the last four years (2016-2019) and is based on production, consumption and price information and is divided, in turn in three subsections. Subsections 2.1 and 2.2 discuss changes in global oil and natural-gas supply. In the case of oil, the growth of production in the Americas that has been gradually occupying the space of OPEC stands out. In the case of natural gas, the role of the LNG export and import infrastructure that has allowed new suppliers of natural gas, such as the United States and Australia to enter the market is analysed. Subsection 2.3 presents the changes in global demand for oil and natural gas, highlighting the role of Asia as a major consumer. Section 3 examines the impact of the Covid-19 pandemic on the global oil and natural-gas industry, addressing the resulting changes in supply, demand and prices. Section 4 looks at the short-term strategies of the main national states in the geopolitics of oil and natural gas (primarily the United States, China, Europe and Russia) and the world's major oil companies through the lens of changes resulting from the Covid-19.

2. Geopolitics of oil and gas before the Covid-19 pandemic (2016-2019)

Over the last five years, the revolution in U.S. oil and gas production has rearranged the geopolitics of energy. With the exponential growth of tight-oil and shale-gas extraction, the U.S. government has gained greater autonomy in the supply of energy and, at the same time, more capacity to influence the key decisions of the oil and natural gas industry.

Along with the growth of North American production, the past few years have also seen a slow reconfiguration of oil production around the world. Production in the Americas from countries allied with the United States (mainly Brazil, Canada and Colombia), gained strength at the expense of output from OPEC, especially Venezuela and Iran.

In the natural-gas segment, the expansion of the liquefied natural gas (LNG) industry has also helped to increase the role of the United States in the geopolitics of energy. The expansion of the LNG infrastructure has allowed large natural-gas producers, such as the United States and Australia, to increase exports to countries that are geographically distant, such as those in Europe and Asia. As a result, for example, the United States began to compete for markets that were dominated primarily by Russian supply.

With expanded output from the United States and other new producers, major oil and gas importing nations, mainly in Asia and Europe (regions where domestic production has historically lagged domestic demand) have seen their bargaining power grow in recent years. Such nations were able to diversify their imports as market access oil and natural gas grew.

These movements have changed trade flow, increased the sources of supply and have had an important impact on oil and natural gas prices. The rise of output from the United States and other countries in the Americas has increased economic tensions with traditional oil producers, such as Saudi Arabia, and natural gas producers, especially Russia. These tensions extended to politics, as demonstrated by the economic sanctions imposed on large producers such as Venezuela and Iran.

2.1
Transformations in global oil supply

Since 2016, growth in oil production has been driven by the United States and, to a lesser extent, by other countries in the Americas, especially Brazil and Canada. In contrast, OPEC nations saw production drop over the same period.

As shown in Table 1.1, oil production in Canada and the United States increased from 17.00 million barrels per day (mb/d) in 2016 to 22.70 mb/d in 2019, an increase of 33.5%. In the United States the increase was 4.70 mb/d, going from 12.35 mb/d to 17.05 mb/d. In the same period, production in Brazil and Colombia, which was 3.48 mb/d in 2016, reached 3.76 in 2019, an expansion of 8.2%.

Meanwhile, in the Middle East (Saudi Arabia, Qatar, the United Arab Emirates, Kuwait, Iran and Iraq), production slumped 4.9% from 2016 to 2019, decreasing by 30.53 mb/d to 29.02 mb/d. Iran's poor performance stood out the most as output fell by about 1 mb/d between 2016 and 2019. In Venezuela, the largest OPEC producer outside the Middle East, the drop was even more brutal contracting from 2.35 mb/d in 2016 to 0.92 mb/d in 2019.

These changes saw the main non-OPEC countries increase output by more than 6 mb/d between 2016 and 2019 as the largest OPEC markets recorded a drop in production plunge of 2.5 mb/d.

TABLE 1.1
Oil production by groups of nations (2016-2019). In thousands of barrels per day and %

	2016	2017	2018	2019	2016-2019 (%)
Major Non-OPEC countries (Thousand barrels per day)					
U.S. and Canada	17.004	18.172	20.861	22.695	33,5%
Russia and Kazakhstan	12.924	13.093	13.365	13.471	4,2%
China and Malaysia	4.725	4.564	4.505	4.486	-5,1%
Brazil and Colombia	3.477	3.575	3.544	3.762	8,2%
Norway and United Kingdom	3.006	2.970	2.937	2.848	-5,2%
Total	**41.136**	**42.374**	**45.212**	**47.263**	**14,9%**
Major OPEC countries (Thousand barrels per day)					
Middle East 6+	30.533	30.238	30.556	29.023	-4,9%
Africa 4+	5.634	6.110	6.202	6.240	10,8%
Venezuela	2.347	2.096	1.475	918	-60,9%
Total	**38.513**	**38.444**	**38.232**	**36.181**	**-6,1%**
Other countries	**12.423**	**11.980**	**11.810**	**11.748**	**-5,4%**
World	**92.072**	**92.798**	**95.254**	**95.192**	**3,4%**

Source: bp Statistical Review of World Energy 2020, as presented by Ineep.
Notes: 1. Middle East 6+ is made up of the United Arab Emirates, Kuwait, Iraq, Iran, Saudi Arabia and Qatar; 2. Africa 4+ is made up of Algeria, Angola, Libya and Nigeria.

As Table 1.2 shows, in the four years analysed, U.S. and Canadian participation in global oil production expanded by 5.4 percentage points. In 2016, the participation of the two North-American producers was 18.5% and by 2019, it was 23.8%. The two largest producers in Eurasia saw a small increase in their contribution to global oil production, from 14.0% in 2016 to 14.2% in 2019. The two South American countries also followed suit. Brazil and Colombia's share of global production increased from 3.8% to 4.0% in the same period (BP, 2020a).

Meanwhile, the major OPEC producers saw their share decrease from 41.8% in 2016 to 38.0% in 2019. The Middle Eastern nations in the table, which held 33.2% of global production in 2016, saw their participation drop to only 30.5% in 2019. Venezuela's share, fell from 2.5%, to 1.0% in the same period. The only OPEC sub-group that increased their role in global oil production were the African countries. Their share jumped from 6.1% in 2016 to 6.6% in 2019.

The U.S. production revolution was associated with the development of the unconventional oil industry (shale gas and tight oil). Between 2010 and 2019, unconventional oil accounted for about 8 mb/d, or about 85%, of the country's 9.49 mb/d growth in output. The current American position in the market is the result of a long process of technological innovation and investments[2] dependent on the combined involvement of the private sector and U.S. federal and state governments. For example, policies starting in the late 1970s promoted by the U.S. Department of Energy (DOE) and the resulting measures and programs to encourage energy efficiency and alternative fuels enabled the development of 139 new alternative or unconventional energy sources decades before the current movement toward energy transition.

However, the significant expansion of unconventional production occurred only in the 2000s. In the past decade, there was a rapid expansion of the use of hydraulic fracking and horizontal drilling technologies. The rise of shale gas was made possible by conditions unique to the United States, in particular the existence of an extensive natural-gas pipeline network with spare capacity as well as a highly developed market for the supply of the drilling, profiling and completion equipment and services needed to develop and flexibly operate the large number of technically complex wells needed to tap shale resources. The expansion gained strength from 2008 onward when producers realized such technologies could also be applied economically to tap tight and other unconventional oil reservoirs as well (BOFF, 2017; ROOS, 2019).

TABLE 1.2
The share of global oil production by groups of nations (2016-2019). In %

	2016	2017	2018	2019
Major Non-OPEC countries				
U.S. and Canada	18,5%	19,6%	21,9%	23,8%
Russia and Kazakhstan	14,0%	14,1%	14,0%	14,2%
China and Malaysia	5,1%	4,9%	4,7%	4,7%
Brazil and Colombia	3,8%	3,9%	3,7%	4,0%
Norway and United Kingdom	3,3%	3,2%	3,1%	3,0%
Total	**44,7%**	**45,7%**	**47,5%**	**49,6%**
Major OPEC countries				
Middle East 6+	33,2%	32,6%	32,1%	30,5%
Africa 4+	6,1%	6,6%	6,5%	6,6%
Venezuela	2,5%	2,3%	1,5%	1,0%
Total	**41,8%**	**41,4%**	**40,1%**	**38,0%**
Other countries	**13,5%**	**12,9%**	**12,4%**	**12,3%**
World	**100,0%**	**100,0%**	**100,0%**	**100,0%**

Source: bp Statistical Review of World Energy 2020, as presented by Ineep.
Notes: 1. Middle East 6+ is made up of the United Arab Emirates, Kuwait, Iraq, Iran, Saudi Arabia and Qatar; 2. Africa 4+ is made up of Algeria, Angola, Libya and Nigeria.

2 The fracking investments were made possible by the low interest rates available in the American market.

The rapid advance of the U.S. unconventional oil industry, especially in Texas and Pennsylvania, served the interests of American energy policy. These regions has taken advantage of the existence of a highly flexible equipment and service industry to drill and complete wells and the existence of idle transportation infrastructure connected to reservoirs in adjacent regions. Taking advantage of these structures and an existing skilled workforce as well as limited environmental regulation and support for technological innovation by the U.S. government producers quickly expanded this new exploratory frontier, as Roos (2019) states:

> **(...) the idle capacity and increased availability of labour prevalent in the U.S. economy in the post-financial crisis years also contributed to the rapid expansion of oil and gas production. This observation, however, cannot be disconnected from the vast demand available to be met preferably by domestic sources, since it is the explicit objective of U.S. energy policy to support domestic over external supply. In other words, an import substitution trend has been established as a result of a combination of factors: technical change (innovation), macroeconomic circumstances (interest and low wages), loose environmental regulation and political support (ROOS, 2019, p. 92).**

In the post-financial crisis, the intensive advance of the unconventional oil industry also served the interests of U.S. energy policy by favouring domestic supply over foreign supply, increasing energy independence and revitalizing the labour market in the oil and gas belt.

The rapid growth of unconventional oil secured the role of hydrocarbons at the centre of the domestic market supply, even leading to the prospect of energy self-sufficiency in the country for the first time in decades. In 2019, the United States approached that goal, as production broke through the 17 mb/d barrier and consumption stood at 19.40 mb/d. The 2019 OPEC World Oil Outlook points out that unconventional oil will likely bring American daily output to a level of 20 mb/d in five years.

As a result, U.S. dependence on imports from OPEC countries has decreased. In 2019, the participation of traditional producers in the Middle East and North Africa as a share of total U.S. imports was only 14.3%, according to bp data. This low participation was explained by the growing share of imports from producers in the Americas. In 2019, this region provided 76.7% of U.S. imports, with Canada alone accounting for 56.1% (BP, 2020a).

From 2016 to 2019, oil production in South and Central America plus Canada grew 9.66 mb/d to 10.91 mb/d. The bulk of this came from three countries (Brazil, Canada and Colombia) which together recorded an increase in output of 8.13 mb/d to 9.41 mb/d. As consumption in this region remained stable at 7.90 mb/d over that period, the surplus of oil available for export increased significantly. In 2016, the difference between production and consumption in the region was 1.67 mb/d, reaching 2.94 mb/d in 2019 (BP, 2020a).

Canada, Brazil and Colombia have become important players in the new geopolitics of oil. Canada's rise was associated with the development of oil sands. According to bp data (2020a), Canadian oil production grew by about 0.5 mb/d between 2000 and 2009. In the period from 2010 to 2019, the increase was 2.20 mb/d. Canadian Energy Research Institute data, presented by Healing (2019), point out that about 75% of Canadian production in 2018 came from oil sands reserves.

New technologies, such as the vapour extraction process (VAPEX) and toe-to-heel air injection (THAI), have allowed the successful exploration of oil sands in Canada (BARTOLOMEU, 2014). In addition, capital investments in the oil and gas industry showed great growth, mainly between 2009 and 2014. According to Globerman and Emes (2019), the share of capital investments in this segment rose from 14.0% to 28.0%. After a great contraction between 2014 and 2016 due to the drop in the price of oil, investments have gone up again.

With the fall in oil prices, there are doubts about the medium-term potential of oil sands, but production should still grow in the coming years. An important aspect that favours the permanence of investments in the Canadian oil and gas industry is its importance to supply the American market and also the fact that Canada sits on a gigantic volume of reserves (CUNNINGHAM, 2018).

With regard to investments, Canada has spent heavily since 2010 on the construction of pipelines to supply oil to the United States. By 2019, there were five pipelines (Keystone, Express, Trans Mountain, Rangeland/Milk River and Enbridge Mainline) with a capacity to export almost 3.5 mb/d mainly to refineries in Texas, Missouri and Illinois. The forecast is that by 2025 four more pipelines to the United States will be built, increasing export capacity to nearly 6 mb/d. Even with Canada's 5.1 mb/d of oil exports, U.S. buyers continue to seek to increase their imports from neighbours. Therefore, the construction of these new pipelines has become essential to serve American refiners, as well as Canadian producers (GLOBERMAN; EMES, 2019 and BP, 2020a).

With regard to resources, the bp says that Canada had the third largest proven oil reserve in the world (169.8 billion barrels), behind only Venezuela and Saudi Arabia. However, when looking at the Canadian scenario, it is important to consider that if oil prices remain at levels close to $40, the oil-sands industry is likely to face difficulties in the medium term.

As in Canada, the Brazilian hydrocarbons industry has also undergone big changes in the last fifteen years. These changes are due to the discovery of the offshore area known as the pre-salt. According to bp data, from 2016 to 2019, Brazil's oil output increased 11% from 2.59 mb/d to 2.88 mb/d (BP, 2020a). The pre-salt growth, in turn, was much more significant (70.0%), going from 1.02 mb/d in 2016 to 1.73 mb/d in 2019, according to Brazil's National Petroleum, Natural Gas and Biofuels Agency, commonly known as the ANP *(Agência Nacional de Petróleo, Gás Natural e Biocombustíveis).*

The pre-salt has emerged with the potential to consolidate itself as one of the largest oil reserves in the world. Although Brazil's proven reserves in 2019 were only 12.7 billion barrels, a study showed that the pre-salt could holds at least 176 billion barrels of undiscovered and recoverable oil and gas resources (GANDRA, 2019).

This discovery of such a large amount of recoverable oil in the pre-salt was only possible due to a long evolutionary process of development of the technological and geological capacity of Petrobras to conduct deep-water exploration activity as well as a political/strategic bet that was not subordinated to strictly microeconomic logic despite enormous technological and financial obstacles (LEÃO; NOZAKI, 2019). Thus, the Brazilian state-owned company centralized efforts on the project, enabling exploratory success.

In recent years, this trajectory has allowed Brazil, in a context in which the country has increased its imports of oil products, to become a net exporter of oil. According to the ANP, between 2016 and 2019, Brazilian oil exports rose from 0.84 mb/d to 1.23 mb/d. The share of exports as a portion of total production increased from 32.2% in 2016 to 42.8% in 2019.

Unlike Canada and Brazil, Colombia has not experienced a large growth in oil production and reserves in recent years. Between 2016 and 2019, oil reserves were stable at 2 billion barrels and oil production was close to 0.9 mb/d. Despite this, the Colombian case deserves attention for two reasons: by the end of 2019 Colombian production had already surpassed Venezuelan output; and investment in the sector is projected to be leveraged by the greatest discovery of natural gas in the country's history and by good prospects for unconventional oil development.

Colombia's National Hydrocarbons Agency or ANH *(Agencia Nacional de Hidrocarburos)* leased new concessions for offshore areas, with extremely favourable conditions. This motivated the expansion of exploratory investments by 11% between 2018 and 2019. This trend is expected to continue, with investment in the Colombian oil industry forecast to grow 23% from $4.03 billion in 2019 to $4.97 billion in 2020, according to the Colombian Petroleum Association (ACP). Investment in production is expected to retain the vast majority of total projected spending, with an increase of 25% in 2020 compared with 2019. This year, Colombia signed 31 contracts with the objective of boosting its energy sector.

The formation of a regional oil market has "flooded" the greater oil world market in recent years. More important, it has increased pressure on traditional global oil producers, mainly Russia and OPEC. This "flood" allowed large importers – mainly the United States – to become less dependent on supply from these countries, putting downward pressure on oil prices.

As a result, the OPEC nations and Russia have cut production in the last four years. Before this, despite a fall in prices between 2014 and 2016, OPEC and Russia did not adjust production since they had expected that the very-low price of oil would affect the shale gas and tight oil businesses. However, throughout 2016, prices did not recover and instead declined from $102.07 in April 2014 to $40.75 in April 2016.

Traditional oil producers, led by Russia, Saudi Arabia and the United Arab Emirates, initiated cuts in production in order to stabilize prices. At the end of 2016, they set a cut of 1.8 mb/d, with OPEC countries being responsible for 1.2 mb/d, while non-OPEC countries, captained by Russia, agreed to reduce production by 0.6 mb/d. Despite this, the Russians and their partners did not reduce their production. As a result, the weight of the adjustment was carried by the OPEC countries, mainly Saudi Arabia and the United Arab Emirates.

After a rebound in the following two years, prices fell again at the end of 2018, forcing a further cut in production by the same countries. Since 2016, OPEC and its oil-producing allies, such as Russia, have agreed to reduce production by 1.2 mb/d. The cut, which would be divided into 800,000 barrels for OPEC members and 400,000 for countries outside the cartel, was not honoured by all parties to the agreement, with some receiving exemptions and others, such as Saudi Arabia, having to bear a large part of the cut again.

Between 2016 and 2019, Iran and Venezuela, even with these exemptions, have seen their production fall by 1.4 mb/d and 1.0 mb/d, respectively, according to data from bp (2020a), due to economic sanctions imposed by the United States. Oil production in Saudi Arabia, the United Arab Emirates, Iran and Venezuela fell by 3 mb/d from 2016 to 2019. The production of the four countries, which was 23.4 mb/d in 2016, dropped to 20.3 mb/d in 2019.

In the Americas, the rise of a regional oil market favours the geopolitical position of the United States, which has taken the opportunity to influence decisions taken by the oil industry in Brazil, Colombia and Canada in favour of its own energy-policy interests. Furthermore, in addition to forcing countries in the Middle East to cut production to hold oil prices[3], the context has allowed the United States to raise tensions with rival producers, such as Iran and Venezuela.

Therefore, the new geopolitics of oil has guaranteed greater energy autonomy to the United States, increasing its capacity to influence the trajectory of prices and the pace of global production. On the other hand, it also made room for a shift in the relations between the traditional large producers led by the Saudis and Russians by establishing better coordination to compete with higher U.S. production.

Several countries with geopolitical importance have become major producers, such as the United States. Others, such as China, have worked to form a regional oil and gas economy. It is unlikely that they will open this window of opportunity which should lengthen the period that oil and gas will be important to the global energy matrix.

3 It is worth mentioning that Saudi Arabia increased its production in order to limit the loss of market share for the Americans in some periods.

2.2
Transformations in global natural gas supply

As in the case of oil, natural-gas production has grown in the last four years due to the strong expansion of the industry outside the traditional OPEC and Russian axis. The production of the United States and Canada together increased 21.7% between 2016 and 2019, from 899.2 billion cubic metres (bcm) to 1,094 bcm. China and Australia had an even more significant increase in gas production in the same period: combined output rose 41.2%, from 234.4 bcm in 2016 to 331.0 bcm in 2019. In Eurasia, the two largest producers – Russia and Turkmenistan – showed a more-timid expansion, growing 13.7% from 652.5 bcm in 2016 to 742.2 bcm in 2019. Europe was the only non-OPEC region that had a drop in production in the period (-9.3%) (see Table 1.3).

From 2016 to 2019, OPEC's most relevant markets saw an increase in natural gas production of only 6.6%, driven by member in the Middle East. Even so, the 11.1% growth in this region was less than the world average of 12.7%. On the other hand, Indonesia[4] and Venezuela output fell by 10.0% and 29.0%, respectively.

Due to these asymmetric performances, the contributions of the United States, Canada, Australia and China to global natural-gas production increased by almost four percentage points in the period analysed by Table 1.4. In the aggregate, the participation of the four nations rose by 32.0% in 2016 to 35.7% in 2019.

In 2019, all groups of OPEC countries held a lower percentage of global natural gas production than in 2016. The largest producers in the Middle East saw their share fall from 16.0% to 15.7%. Among African members, the world shared dropped from 4.1% to 3.9%. However, the sharpest decline occurred in Indonesia and Venezuela. In both countries the fall was 0.4 percentage points. In the aggregate, the share of these OPEC markets decreased from 23.2% in 2016 to 22.0% in 2019. The two Eurasian countries (Russia and Turkmenistan) maintained their participation close to 18.5% in the first and last years of the series as shown in Table 1.4.

TABLE 1.3
Natural gas production by groups of nations (2016-2019). In billions of cubic metres and by %

	2016	2017	2018	2019	2016-2019 (%)
Major Non-OPEC countries					
US and Canada	899,2	921,8	1.014,9	1.094,0	21,7%
Russia and Turkmenistan	652,5	694,2	730,6	742,2	13,7%
China and Australia	234,4	262,0	291,6	331,0	41,2%
Europe	259,9	262,8	251,2	235,9	-9,3%
Total	**2.046,0**	**2.140,8**	**2.288,4**	**2.403,1**	**17,5%**
Major OPEC countries					
Middle East 6+	564,9	586,1	615,7	627,6	11,1%
Africa 4+	145,3	151,9	160,0	155,5	7,0%
Indonesia	75,1	72,7	72,8	67,5	-10,0%
Venezuela	37,2	38,6	31,6	26,5	-29,0%
Total	**822,6**	**849,4**	**880,1**	**877,1**	**6,6%**
Other countries	**671,9**	**682,4**	**689,0**	**709,2**	**5,6%**
World	**3.540,4**	**3.672,5**	**3.857,5**	**3.989,3**	**12,7%**

Source: bp Statistical Review of World Energy 2020 as presented by Ineep.
Notes: 1. Middle East 6+ is made up of the United Arab Emirates, Kuwait, Iraq, Iran, Saudi Arabia and Qatar; 2. Africa 4+ is made up of Algeria, Angola, Libya and Nigeria.

4 Despite a growing economy with increasing demand for energy, the oil and gas sector in the country is shrinking, with its glory days long past. According to a Bloomberg analysis of Indonesia's oil and gas sector last August, investment for oil and gas exploration in Indonesia contracted to US$100 million in 2016, down from US$1.3 billion in 2012. PwC's Oil and Gas in Indonesia 2017 report also highlighted that Indonesia is facing a depletion in oil resources, and is facing difficulty discovering new reserves as well.

TABLE 1.4
Shares of world natural gas production by groups of nations (2016-2019). In %

	2016	2017	2018	2019
Major Non-OPEC countries				
US and Canada	25,4%	25,1%	26,3%	27,4%
Russia and Turkmenistan	18,4%	18,9%	18,9%	18,6%
China and Australia	6,6%	7,1%	7,6%	8,3%
Europe	7,3%	7,2%	6,5%	5,9%
Total	**57,8%**	**58,3%**	**59,3%**	**60,2%**
Major OPEC countries				
Middle East 6+	16,0%	16,0%	16,0%	15,7%
Africa 4+	4,1%	4,1%	4,1%	3,9%
Indonesia	2,1%	2,0%	1,9%	1,7%
Venezuela	1,1%	1,1%	0,8%	0,7%
Total	**23,2%**	**23,1%**	**22,8%**	**22,0%**
Other countries	**19,0%**	**18,6%**	**17,9%**	**17,8%**
World	**100,0%**	**100,0%**	**100,0%**	**100,0%**

Source: bp Statistical Review of World Energy 2020, as presented by Ineep.
Notes: 1. Middle East 6+ is made up of the United Arab Emirates, Kuwait, Iraq, Iran, Saudi Arabia and Qatar; 2. Africa 4+ is made up of Algeria, Angola, Libya and Nigeria.

Among the most important markets, the greatest absolute output growth occurred in the United States and, in relative terms, in Australia. From 2016 to 2019, production in the U.S. grew by 193.5 bcm, accounting for 26.6%. In Australia, the expansion corresponded to an amount of 57.0 bcm, equivalent to 59.2%. This scenario associated with the growth of the liquefied natural gas industry (LNG) has allowed both nations to become major exporters of natural gas.

The LNG market has developed greater flexibility in the international commercialization of natural gas. The LNG market has experienced an important structural change by making the process of gas transportation and distribution more flexible and integrated, allowing a vigorous expansion of its use[5]. The gas liquefaction process allows its transportation to be carried out by ships and land-transportable tanks instead of gas pipelines (LEÃO; NOZAKI, 2018). As stated by Clara (2019), this allowed a greater adaptability of natural gas supplies to the eventual abrupt changes in demand, ensuring more flexibility in the market between liquefaction and regasification plants and local gas markets.

As Table 1.5 shows, among the six major exporters of LNG, the trajectories of the United States, Russia and Australia must be observed in the proper context. The United States, which exported practically no LNG in 2016, shipped 47.5 bcm of LNG abroad in 2019, a formidable growth rate of 1,081.6%. As for Russia, which exported nearly four times as much LNG as the U.S. in 2016 and saw its shipments increase 163.3% to 39.4 bcm in 2019, it was still surpassed by the United States over the same period. Australian LNG exports rose from 60.4 bcm in 2016 to 104.7 in 2019, an increase of 73.4%. By 2020, this Pacific-rim country has already become the largest exporter of LNG in the world.

The entry of Australia and the United States into the global natural gas market has enabled the main importers to diversify their sources. In this sense, Russia has faced greater competition in its main import markets, mainly Europe and Asia. Opportunities coming from these specific markets have enabled U.S. and Australian producers to invest in LNG infrastructure[6].

5 As will be seen later, this type of transformation in the energy industry changes working conditions, including for workers in the fossil sectors. Not only will the transition bring changes for the future of work, but also innovations in the oil and gas sector

6 Located in Oceania, Australia struggled to exploit its large reserves of natural gas. On the one hand, because of their isolated location, Australians have "natural" logistical barriers to exporting natural gas through pipelines. On the other hand, due to the relatively small domestic market, the country also did not have sufficient demand to develop its exploratory borders (LEÃO, 2020a).

TABLE 1.5
Major LNG exporters (2016-2019). In billion cubic metres and %

	2016	2017	2018	2019	2016-2019 (%)
Top 6 LNG exporters					
Qatar	107,3	103,6	104,9	107,1	-0,2%
Australia	60,4	76,6	91,8	104,7	73,4%
U.S.	4,0	17,1	28,6	47,5	1081,6%
Russia	14,6	15,4	24,9	39,4	169,3%
Malaysia	33,6	36,1	33,0	35,1	4,6%
Nigeria	24,6	28,2	27,9	28,8	16,9%
Total	**244,5**	**277,0**	**311,2**	**362,6**	**48,3%**
Other countries	**113,7**	**116,3**	**119,4**	**122,5**	**7,7%**
World	**358,3**	**393,3**	**430,6**	**485,1**	**35,4%**

Source: bp Statistical Review of World Energy 2020, as presented by Ineep.

Opportunities coming from Asian markets, especially from Japan and China, as well as from European markets (that have built several regasification terminals) enabled U.S. and Australian producers to invest in LNG infrastructure. Before this, they could not export natural gas through gas pipelines due to geographical distance.

The new regasification terminals allowed the expansion of LNG import capacity in large markets, primarily in Asia and Europe[7]. From 2016 to 2019, the global regasification capacity jumped from approximately 710 million tonnes per year (mtpa) to 824 mtpa, an expansion of approximately 16%.

The number of LNG receiving units built or expanded grew rapidly between 2004 and 2014. While in 2004 only two terminals were constructed and/or expanded, six to twelve terminals were built and/or expanded each year from 2011 to 2016 (LEÃO; NOZAKI, 2018). Although the over-all rate of construction of LNG terminals is expected to fall in the coming years, the United States and Australia will probably continue to invest in this segment. It is important, therefore, to address both cases when looking at transformations in global natural gas supply.

Until 2018, the United States had only three LNG terminals. In the last two years, four more were inaugurated. Expansions of the four new terminals planned for the coming years have already been approved and three new terminals are under construction. In this sense, the prospects are that by 2040, U.S. LNG exports will surpass the total exports transported by gas pipelines to Mexico and Canada. More than half of the additional production of U.S. shale gas might be transformed into LNG and exported (LEÃO, 2020b).

The dispute over markets, as well as the decline in global imports of natural gas, has changed the role of the United States in natural-gas geopolitics. The growth of U.S. exports to Europe created a process of "competition and cooperation" between the United States, European countries and Russia. According to Guo and Hawkes (2018), the entry of the United States into this market could increase protectionism and reduce Russian influence in Europe.

However, the marginal cost of Russian gas supplied by pipelines has remained lower than the cost of American LNG (RICHMAN; AYYILMAZ, 2019). Russia (through Gazprom) has started the construction of the Nord Stream 2 gas pipeline, set to be concluded in 2021. It is expected to double the direct supply of natural gas to Western Europe via the Baltic Sea to Germany. This cost advantage associated with the expansion of the logistics infrastructure puts therefore pressure on the American position in the European continental market (AGENCE FRANCE-PRESSE, 2020)[8].

In 2019, LNG exports from United States to Europe reached 18.3 bcm, while those from Russia to Europe were of 20.5 bcm. Last year, Russia was responsible for 59.0% of such energy exports to the European market. However, it is important to note that, until 2016, the United States did not export LNG to the European market at all and, by 2019, had already built an 8.8% market share (LEÃO, 2020b).

Regarding the Australian case, the investments in Australia's LNG infrastructure, in turn, have been linked to import growth from the Asian markets. Australian development took advantage of the great exploratory potential of conventional and unconventional gas from coalbed methane (CBM). This is because the exploratory

7 Of the seven new regasification terminals commercially inaugurated in 2018, five were located in Asia-Pacific and one in Europe. In the first region, terminals were completed in China (Shenzhen, Tianjin (Sinopec), and Zhoushan), Japan (Soma), and Bangladesh (Moheshkhali). In the second, Turkey began operations at the Dortyol terminal in early 2018 after construction was completed in 2017.

8 "U.S. President Donald Trump enacted a law on December 20 that imposes sanctions against companies associated with the construction of the gas pipeline, considering that it will increase European dependence on Russian gas and contribute to reinforcing Moscow's influence. Russia, on the other hand, denounces "unfair competition" and an attempt to get Europeans to resort to imports from the United States, which are more expensive than Russian gas" (AGENCE FRANCE-PRESSE, 2020).

frontiers and the LNG terminals, which made it possible to export part of the natural gas, leveraged Australian production. From 2000 to 2019, Australia jumped from the seventeenth to the seventh position among the world's largest producers of natural gas.

It is interesting to note that the process of expanding natural gas exploration in Australia, which is concomitant with the construction of new LNG terminals, was sponsored by oil majors such as Shell, Chevron and Total and concentrated in the period after 2015. From that year until 2019, natural-gas production in Australia more than doubled, and installed LNG export capacity grew by more than 165%. Of the ten LNG terminals in Australia, seven were built after 2015: four for conventional gas and three for CBM. CBM currently accounts for 73% of all natural-gas liquification capacity in the country. From 2015 to 2018 total installed capacity increased by 83.5 bcm reaching a total of 115 bcm in 2019. In all seven units, the majors are either operators of the assets or financial partners (LEÃO, 2020a).

Such terminals were built in the 2015-2016 period in order to export 41.3 million cubic metres of natural gas produced on Australia's east coast, where there are coal reserves with large amounts of methane. This was an innovative project, since for the first time the exploration of CBM was developed with the objective of exporting LNG to Asia (LEÃO, 2020a). According to data from bp (2020a), all exports from Australia headed to Asia, mainly China and Japan. Between 2016 and 2019, such exports grew from 60.4 bcm to 104.7 bcm. In 2019, 47.0% of these exports headed to China and 38.9% to Japan.

In view of these recent transformations, the expansion of the LNG market in the United States and Australia has changed the international trade in natural gas, reducing the relative importance of the Middle East and, to a greater degree, Russia. Although the Russians are still central players in the gas industry, the LNG growth trend tends to make it possible to observe the increase of the importance of other countries in the geopolitics of natural gas.

2.3
Transformations in global oil and natural gas demand

The big news of the last two decades was the change in the "axis" of oil and natural gas consumption in the world. Until the beginning of the 21st century, the United States and Europe were the largest oil consumers worldwide. However, China, India and Saudi Arabia, led by the Asian dragon, have gradually occupied the space left by Europeans concerning oil. In the case of natural gas, China was notably the biggest market to boost global consumption.

In the last four years, there have been no major changes in this scenario. As shown in Table 1.6, the growth of oil consumption in the world remained concentrated in China and India.

From 2016 to 2019, Chinese and Indian oil demand expanded by 14.8% and 13.8%, respectively. Compared to these countries, the United States shows growth rate was lower of 4.2%. The other regions either showed even smaller increases or declines in production. Japan was the country with the greatest retraction in demand in the period (-4.8%). Chinese and Indian participation in global oil consumption grew from 17.9% in 2016 to 19.7% in 2019. The other countries or regions saw their percentage of consumption fall in relation to the world's total consumption.

In the same period, global consumption of natural gas was driven, to a large extent, by China, although almost all countries have increased their use of natural gas. Chinese demand increased by 46.7%, rising from 209.4 bcm to 307.3 bcm. After the Asian country, as shown in Table 1.7, the United States, Iran and Canada grew in the range of 13%. In absolute terms, Chinese and American natural gas demand increased the most to 97.9 bcm and 97.5 bcm, respectively, from 2016 to 2019.

TABLE 1.6
Major oil consumers (2016-2019). In thousands of barrels per day and %

	2016	2017	2018	2019	2016-2019 (%)
U.S.	18.618	18.883	19.428	19.400	4,2%
China	12.248	12.842	13.375	14.056	14,8%
Europe	14.669	14.991	14.936	14.896	1,6%
India	4.632	4.860	5.112	5.271	13,8%
Japan	4.006	3.971	3.855	3.812	-4,8%
Saudi Arabia	3.875	3.838	3.769	3.788	-2,3%
Russia	3.219	3.195	3.282	3.317	3,0%
Total	**61.266**	**62.581**	**63.756**	**64.539**	**5,3%**
Other countries	**33.138**	**33.431**	**33.593**	**33.734**	**1,8%**
World	**94.404**	**96.013**	**97.348**	**98.272**	**4,1%**

Source: bp Statistical Review of World Energy 2020, as presented by Ineep.

TABLE 1.7
Major natural gas consumers (2016-2019). In thousands of barrels per day and by %

	2016	2017	2018	2019	2016-2019 (%)
U.S.	749	740	820	847	13,0%
Europe	537	559	548	554	3,1%
Russia	421	431	454	444	5,6%
China	209	240	283	307	46,7%
Iran	196	209	224	224	13,9%
Canada	106	109	118	120	13,3%
Saudi Arabia	105	109	112	114	7,9%
Japan	116	117	116	108	-7,1%
Total	**2.324**	**2.398**	**2.560**	**2.610**	**12,3%**
Other countries	**1.235**	**1.260**	**1.292**	**1.319**	**6,9%**
World	**3.559**	**3.659**	**3.852**	**3.929**	**10,4%**

Source: bp Statistical Review of World Energy 2020, as presented by Ineep.

Until the beginning of the 21st century, there was a relatively consolidated pattern in the relation between supply and demand for hydrocarbons. On the demand side, the major net importers of hydrocarbons were the United States, Europe and Japan. On the supply side, the main suppliers of oil were the OPEC countries, mainly in the Middle East; and in the case of natural gas, Russia (which supplied much of the European market) and the United States (which attended to its own consumption but had no spare capacity to export).

Although it is still the world's largest consumer market for oil and natural gas, the United States has reached a condition of self-sufficiency. In other words, its production is now able to meet its domestic demand. This aspect, added to the decline in European consumption, placed Asian demand at the "dynamic centre" of the global oil and natural gas trade.

The rise of Asian demand in the context of the emergence of new oil and natural gas producers/exporters has fostered the diversification of the oil and natural gas supply market. In the case of China, for example, no country or region was responsible for more than 20% of its oil imports in 2019. The largest supplier of oil was Saudi Arabia responsible for 16.4%, followed by Russia and the west African coast countries with 15.3% each and South and Central America with 13.2%. India followed suit: in 2019, the largest exporter to the country was Iraq (22.2%), followed by Saudi Arabia (19.2%), the West African coast countries (13, 6%) and South and Central America (8.4%) (BP, 2020a).

In the case of natural gas, the option of importing LNG allowed large Asian and European consumers to import an increasing share of gas as LNG compared with natural gas imported via pipelines. In 2016, the volume of international trade in LNG (358.3 bcm) was 74.7% of the international trade volume of natural gas through gas pipelines (479.7 bcm). In 2019, the international trade in LNG rose to 485.1 bcm, 97.1% of the 499.4 bcm of natural gas imported via pipeline.

In 2016, Europe imported 287.0 bcm of natural gas, of which 230.6 through gas pipelines (80.3%) and 56.4 in the form of LNG (19.7%). In 2019, of the total 353.3 bcm of imported natural gas, 233.5 bcm occurred through gas pipelines (66.0%), and 119.8 through LNG terminals (34.0%). In China, the share of LNG imports increased from 50.0% of total natural-gas imports in 2016 to 64.0% in 2019. This increase in LNG imports from Europe and Asia, in particular China, gave access to new suppliers such as United States, Qatar and Australia.

In addition to helping supply the needs of its gigantic population, the rise of in Asian LNG imports was essentially related to the country's economic-growth process and the associated increase in urbanization. An econometric study by Yang et al. (2019) shows that, in China, urbanization has generated positive effects on energy consumption in the country.

> China's urbanization process has always had a significant positive impact on residents' energy consumption, and the intensity of its impact increased significantly when the urbanization rate reached 55%. When the urbanization rate was less than 55%, an increase of 1% in the urbanization rate resulted in a 0.09% increase in residents' energy consumption. When urbanization was greater than 55%, an increase of 1% in urbanization led to a 0.16% increase in energy consumption by residents. (...) The urbanization process has a positive impact on the electricity consumption. The global influence coefficient is 1.1, but when considering the eight major economic circles, the influence coefficients in the west and east areas are negative, and the influence coefficient in the central region is positive (YANG et al., 2019, p. 177).

The expansion of energy consumption in China was not only due to the acceleration of economic growth, but also to the investment structure of the country, which is concentrated on heavy industry, especially civil construction. The continued strengthening of heavy industry toward the level of economic importance of lighter industries – the result of efforts to support investments in infrastructure and construction – has required great efforts by the Chinese government to increase the domestic supply of energy (LEÃO, 2010).

These factors, among others[9], have made China an "energy hog" in recent years. For this reason, the issue of energy security has been increasingly central to the country's strategic priorities. In this sense, the diversification of energy suppliers has assumed great importance in the country's energy policy[10].

China has also taken measures to help its financial system increase its capacity to intervene in the global oil market, as shown by Rioux, Galkin and Wu (2019):

> **A growing reliance on crude imports and continued integration into foreign trade, investment, finance and international energy governance will require better alignment of China's domestic regulations with its strategic targets, as well as with domestic and global market drivers. The emergence of Singapore-based Chinese trading houses and their dominance on the Dubai Mercantile Exchange (DME), and more recently the launch of crude oil futures contracts on the Shanghai International Energy Exchange (INE) in March 2018, demonstrate efforts by China to strengthen its role in the global oil market. The INE contracts are based on medium sour crude oil similar to Dubai and Oman crude markers. The shortest term INE contract emerged as the third most traded oil futures contract globally in 2018 with a 16% market share, overtaking the volume for similar contracts traded on the DME. However, the INE contract still tracks the better-known and more liquid Brent and West Texas Intermediate (WTI) benchmarks and is unlikely to become a regional benchmark for refineries in the near future. So far the INE crude futures contract is being used primarily by local speculators, and has yet to attract major international players. The success of the contract depends not only on the ability to attract a sufficiently large pool of traders and provide the necessary tools to manage price volatility, but also on a predictable and non-adverse policy environment (RIOUX; GALKIN; WU, 2019, p. 219-220).**

Due to this gigantic volume of oil imports and the greater involvement in the international financial market, China has been able to have an increasing influence on the price of a barrel of oil. This process was not restricted to China. The new oil suppliers, mainly the United States, also play a major role in defining oil prices. As a matter of fact, the OPEC countries and Russia, which traditionally played an almost exclusive role in setting prices, have lost relative importance in this process.

2.4
Oil-price evolution

Between 2014 and 2019, oil prices have varied widely. This period can be split into two phases: the first, from late 2014 until mid-2016, a period marked by declining prices; and the second, starting in the second-half of 2016, a period of price recovery in the wake of OPEC's production-cut agreements with other countries, including Russia.

The plunge in prices after 2014 was the third-biggest since futures-market transactions began to influence world oil prices 30 years ago. Several factors contributed to this drop: (i) policy changes by OPEC and Saudi Arabia; (ii) rising political risk; (iii) the strengthening of the U.S. dollar against other currencies; (iv) changing production conditions in the United States; and (v) expectations of demand contraction outside developed countries.

Oil-price declines after 2014 were associated with Saudi Arabia's abandonment of its traditional role as the world's "swing producer". The country has changed its objective of guaranteeing price stability in order to try to gain greater market share, displacing higher-cost producers. In addition, production growth outside OPEC, mainly due to the excellent performance of U.S. shale-gas and tight-oil production, Canadian Oil Sands development and the expansion of Brazilian pre-salt output in the second half of the 2010's (as noted in the previous section) also raised the global oil supply while pushing prices down.

Feeling threatened by these producers, whose increasing importance was made possible by high oil prices in previous years, OPEC decided to change from a policy of sustaining prices to a policy of market dispute, increasing its lower-cost production in order to displace higher-cost producers. From 2014, prices fell faster and there was an important change in the role of the swing producer. Given the cost flexibility of domestic producers who managed to maintain production growth, even at much lower prices, the United States sought replace Saudi Arabia as swing producer.

OPEC's decision at the position at the end of 2014 to expand rather than cut of not cutting its production occurred in a context of weakening global demand and output production growth outside OPEC. This quickly caused, which would soon cause prices to fall, as it did. From $105.79 a barrel in of oil in June 2014, prices fell to $37.19 in December 2015 (BEHAR; RITZ, 2016). Speculation in oil futures markets grew as consumers accumulated stocks expecting prices to increase and financial resources invested in oil contracts to expand. It should be noted that the main consumers were also interested in reducing oil prices. This was particularly true in China, which in 2017 became the world's largest oil importer. To this end, the Asian country exercised its dominant bargaining power over suppliers to seek price reductions.

9 Medeiros (2010), for example, recalls the change in the land regime to encourage energy consumption: "The commercialization of land lease rights (recently introduced in China) led to an aggressive policy by municipal governments for the transformation of rural land (with compensation proportional to the lower value of the rural establishment) and its transformation into an urban area (with much higher rent) with a view to appropriating differential rents. As a result of this investment boom, another fundamental change occurred in China: an acceleration in energy consumption, altering the previous growth trajectory with major economic and environmental impacts" (MEDEIROS, 2010, p. 12-13).

10 In addition to oil, China has also sought greater diversification for its natural gas imports. Although Australia and Turkmenistan account for more than half (53.9%) of natural gas sales to China, the remaining suppliers don't have a share of more than 9%. According to data from bp (2020a), at least 20 countries exported LNG to China in 2019. In addition, there has been a clear redirection of China as it seeks to increase its natural gas purchase from its neighbours, where China's capacity to influence is significantly greater. Malaysia and Indonesia sold 7.5% and 4.7% of the natural gas imported by the Chinese, respectively.

However, during the OPEC's 170th Meeting on 28 September 2016, the cartel announced that member countries had agreed to cut their production for the first time in the past eight years. At the 171st meeting, Russia, Mexico, Azerbaijan and even Brazil, added to the production-cut movement by signing a declaration of cooperation. Under these agreements, member countries, with the exception of Iran, would cut their production reducing total output by OPEC and its cooperating partners by 1.2 million barrels a day in 2017. More than half the cut came from Saudi Arabia (0.448 million barrels a day) and Russia (0.3 million barrels per day) (BERK; ÇAM, 2019).

The cuts in the first half of 2018 were considered very high due to the production decline from other countries outside the agreement. So, OPEC+[11] decided to increase its production by an additional million barrels per day in the second half of the year (BOBYLEV, 2019). In terms of compliance with the agreements, OPEC countries maintained the cuts as planned for most of 2017 and 2018, with Russia cutting less than expected over time and increasing its production in the last two quarters of 2018.

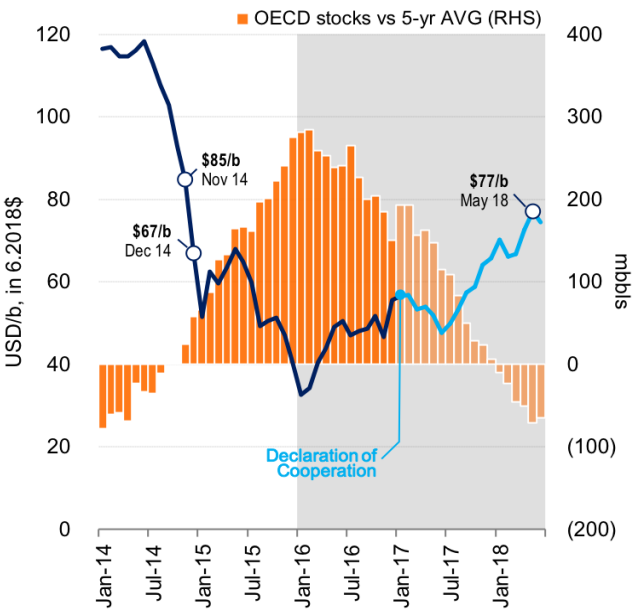
After the OPEC+ cooperation agreements, oil prices recovered and stocks in the hands of developed consumer countries (OECD) fell below the average of the last five years, as shown in the left panel in Chart 1.1. On the other hand, after the cut agreement, drilling activities in the U.S. leaped, following the Brent prices rebound. American production is more price elastic, and its investment projects are of shorter duration. The data in the right panel in Chart 1.1 also seem to indicate a slight recovery in drilling activities in "other OPEC countries" and "the rest of the world" (FATTOUH; ECONOMOU, 2018).

From a geopolitical point of view, it is worth noticing that the decision made by Saudi Arabia and OPEC in December 2018 to expand production cuts happened despite pressure from the Trump administration in the United States for its Saudi ally to maintain the previously agreed output levels. Trump even worked to ease pressure on Saudi Crown Prince bin Salman after he was accused of ordering in the murder of Saudi opposition journalist and legal U.S. resident Jamal Khashoggi. The Saudis did not reverse their position and together with Russia increased the cuts for 2019.

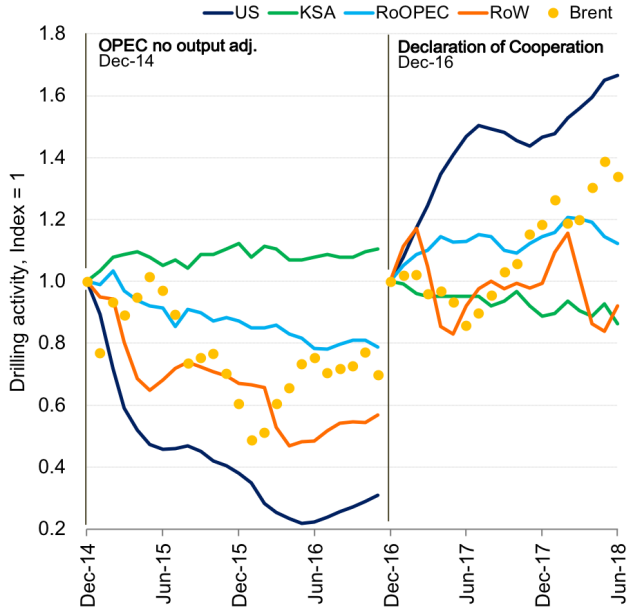
The United States and Persian Gulf countries were willing to let prices rebound. The United States intended, to avoid pressures on higher-cost producers, even though still better off than other OECD countries. In the Persian Gulf, especially Saudi Arabia, the aim at appropriating oil revenues resulted from the difference between current prices and the region's low extraction costs.

As previously noted, U.S. dependence on Saudi oil has decreased. Canada and Brazil are growing as U.S. suppliers, allowing the U.S. administration to change its policy towards the region. Unlike other times, in November 2016, Saudi Arabia was only able to exercise its power to achieve united cartel behaviour and impose a high degree of compliance with production quotas, because of the Venezuela crisis and Russia's fiscal situation.

CHART 1.1
Brent price, OECD stocks and drilling activities (2014-2018)



Source: IEA, OIES.



Source: Fattouh and Economou (2018).

11 OPEC+ is a group of oil-producing nations, made up of members of OPEC, and ten other non-members of OPEC (Russia, Azerbaijan, Bahrain, Brunei, Kazakhstan, Malaysia, Mexico, Oman, Sudan and South Sudan). "The OPEC bloc is nominally led by Saudi Arabia, the group's largest oil producer, while Russia is the biggest player among the non-OPEC countries. The format was born in 2017 with a deal to coordinate oil production among the countries in a bid to stabilize prices. Since then, the group has reached deals for members to voluntarily cut and ramp-up production in response to changes in global oil prices." (CORDELL, 2019).

In fact, before the Covid-19 pandemic, these new actors, Brazil, Canada, China and, especially, the United States, began to play a more decisive role in setting prices, causing a shifting in the role of the OPEC+. The formation of this wider cartel was, in a way, a response to these pressures. Undoubtedly, the pandemic was a new element in tremendous recent disruptions in the oil industry, which was already facing the challenges of energy transformation. The future of the industry has become more uncertain in view of the collapse of demand, melting prices and market imbalances. This scenario can accelerate or delay the participation of each country in the geopolitics of oil[12].

3. The Covid-19 oil collapse: changes in supply, demand and prices

The global Covid-19 pandemic demanded an interruption in the flow of people, products and services. The spread of the virus has required governments to adopt social isolation measures to reduce the number of people infected. These measures have had disruptive effects on the oil and natural gas industry worldwide.

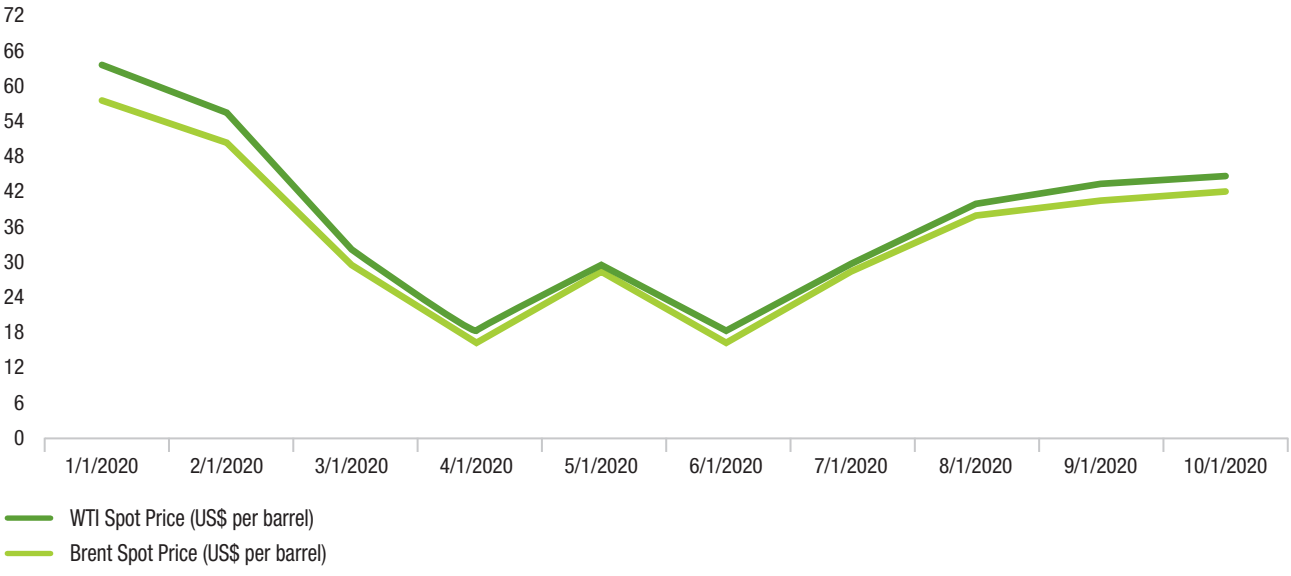
The use of oil fell sharply on account of the interruption of the movement of people and international trade. In April and May 2020, according to Rystad Energy's estimates, the consumption fell by 27.5 mb/d and 19.1 mb/d, respectively, compared with the same months of the previous year. The International Energy Agency (IEA), in August 2020, estimated a fall of 8.1 mb/d in average consumption in 2020, compared with 2019. If that outlook comes true, average oil demand will be between 91 mb/d and 94 mb/d at the end of the year (LEÃO, 2020c).

The IEA's forecasts also expect the volume of oil processed by the world's refineries to fall by about 7.6 mb/d, with widespread stoppages in all regions despite a growth in stored inventories in the first half of 2020.

In a scenario in which no major adjustment of supply was made the sharp drop in demand caused oil prices to collapse, starting in February 2020. The price of a barrel of Brent crude oil fell from $63.65 in January 2020 to $18.38 in April of the same year. The price of a barrel WTI crude declined from $57.52 to $16.55 in the same period.

This collapse in prices, shown in Chart 1.2, prompted a rapid reaction by OPEC+ to balance the mismatch between oil supply and demand. In April 2020, an OPEC meeting was held to define a gigantic production cut capable of facing the contraction in consumption. With demand declines hovering around 20 mb/d, expectations were that OPEC+ would establish an initial production cut agreement of at least 15 mb/d. But the agreement was of just 10 million barrels a day.

CHART 1.2
WTI and Brent prices (Jan.2020-Oct.2020). In US$ per barrel



Source: EIA (2020).

12 The pandemic had direct repercussions on the dynamics of the global labor market, including wage reduction, working hours reduction and job losses. In addition to the energy sector, the trade, food and manufacturing sectors were greatly affected (ILO, 2020). In this sense, the countries' recovery packages can provide guidance on the policy to be adopted even in the energy transition process, either in accelerating the achievement of a zero carbon economy, or in strengthening new ways of sustaining the fossil system (HEPBURN et al., 2020).

In effect, the OPEC+ effort has been unable to rebalance the international oil market. World oil production was still at a much higher level (around 90 mb/d) than oil consumption (around 80 mb/d). The cut below expectations was explained primarily by the fact that some countries, mainly Iran and Mexico, made it difficult to achieve even this modest reduction of 10 million barrels per day. According to a report in the Wall Street Journal, Mexican representatives left the meeting before the agreement was reached. Achieving production cuts was made more difficult as a result of OPEC+'s desire to force the United States, Canada, Brazil, Colombia and Norway join them in cutting production in order to balance global oil supply and demand[13].

On the one hand, large importers, such as China and India, invested throughout the Covid-19 period in storage infrastructure and financed storage to acquire oil and its products at extremely attractive prices. On the other hand, large producers, such as the United States and Russia, suffered from a limitation of storage and pipeline capacity.

The Chinese government carried out a coordinated effort to stockpile oil, with an initial goal of maintaining a state stock equivalent to 90 days of net imports in the country's strategic reserves, but this amount could reach 180 days if the commercial reserves of the Chinese oil companies were included. Nozaki and Leão (2020) pointed out that China likely had 928 million and 996 million barrels of oil in storage between March and April 2020. As the current size of China's state reserves is not fully known, the Wood Mackenzie group estimates that throughout 2020 the volume of oil purchased by the Chinese could be equivalent to the purchase of 80 million to 100 million additional barrels above domestic demand (NOZAKI; LEÃO, 2020).

In India, the Minister of Petroleum, Dharmendra Pradhan, announced in May that the country's refineries were storing around 234 million barrels, with 183 million barrels in tanks and pipelines and another 51 million barrels aboard ships and floating facilities. In order to support companies that were struggling to find storage locations and were impacted by collections due to delays in unloading new deliveries, the Indian government acquired about 5 million tonnes of oil from some state refineries to fill its strategic reserves. Despite this, according to Florian Thaler, CEO of the consultancy OilX, in August, India's storage capacity was already close to its limit, since it had already reached somewhere between 90% and 95% (NOZAKI; LEÃO, 2020).

In the United States, according to the U.S. Energy Information Administration (EIA), in September 2020, oil storage reached 500.4 million barrels, which represented more than 95% of the country's maximum storage capacity of 522 million barrels. Since June, there has been expectation of a gradual decline in U.S. stockpiles. However, this process has been hindered by the country's slow economic recovery.

In Russia, the situation was no less dramatic. According to Dmitry Perevalov, former vice president of the oil company Slavnet Oil & Gas, storage reservoirs were already starting to reach capacity in May. The operator of the Russian oil-pipeline network, Transneft, is responsible for the country's largest storage capacity, about 145 million barrels. In May, it had oil stockpiles above what is considered adequate to maintain the flow of shipments and landings (NOZAKI; LEÃO, 2020).

On the supply side, OPEC+'s "conservative" strategy proved insufficient to deal with falling demand. On the demand side, the storage-related difficulties of the United States and the purchase of cheap oil by China and India left doubts about a rapid short-term recovery. These aspects show that there is a current dispute between the OPEC+ countries, the United States and China for the control of oil prices. The Chinese bargaining power and the recent U.S. position as a net exporter began to threaten OPEC's historic role in coordinating oil prices.

This dispute reflected in discussions about cutting production in the short term, and also expressed long-term tension. OPEC's projections indicate that in the coming years that output from America+1 should be similar to that of the cartel. This group of producers in the Americas plus Norway, led by the United States, can acquire greater power to influence the pace of production and control prices over the next decade.

This competition is likely to intensify in the coming years, as OPEC is likely to lose space in global oil production to countries in the Americas+1 group (see Table 1.8).

TABLE 1.8
Oil production and projected output by groups of nations (2016-2019). In thousands of barrels per day and %

	OPEC production		OPEC production		America+1 production	
	Thousand b/d	%	Thousand b/d	%	Thousand b/d	%
2013	38.530	40%	53.785	56%	22.631	24%
2019	35.230	35%	49.720	49%	28.290	28%
2025*	**35.230**	**34%**	**49.410**	**47%**	**32.480**	**31%**

*Source: OPEC, as presented by Ineep. *Projections.*

13 It was in that April that an unusual episode occurred in the American oil industry. For the first time in history, the oil price traded in the United States closed at a negative territory. "The contracts for delivery in May of the WTI type oil – reference in the American market – collapsed 305.9% on the New York Stock Exchange yesterday and closed at a negative price of $37.63" (FROUFE; COSTA, 2020). Two factors explained this movement: (i) the decrease in American demand; (ii) the excess inventories of the product in the United States. Although it does not have as much influence on the WTI, the stocking of cheap oil by China signalled to the international market that the recovery of global oil demand would be slower.

For this reason, it is unlikely that OPEC+ will passively watch the rise of those countries as protagonists in the oil world. Instead, the cartel will continue to manage its production and the impacts on oil prices in order to hinder an increase in non-OPEC market power. There are growing several signs of OPEC+ nations' unwillingness to accept a decline in market power after cutting production in the wake of the early-March decline in oil prices. Iran's Minister of Petroleum, Bijan Zabganeh, said in early April that the next OPEC+ meeting to set production levels should only take place after the United States and Canada signalled the level of output reductions they are willing to make. The resulting postponement of the meeting was additional evidence that the expanded OPEC cartel led by the Saudis, Russians and Iranians is not willing to lose its ability to coordinate global oil production and prices.

In this scenario, it's worth highlighting the relevant role of China. Just before the OPEC+ meeting, the country bought a gigantic volume of oil, mainly from Saudi Arabia, and signed an engineering contract through its state-owned China Petroleum Engineering & Construction Corp. (CPECC) for the development of the gigantic Majnoon field in Iraq. As a result, besides to transferring a considerable amount of money to the two nations in the Middle East, the Asian country has contributed to the outlook for a further reduction in future oil demand (LEÃO, 2020c).

Apparently, despite the differences in the geopolitical positioning of Russia, Iran and Saudi Arabia, the development of an at least temporary alliance between OPEC+ and China has caused the United States and its allied neighbours lose, or at least fail to increase their influence on key decisions in the world of oil. The agreement itself already imposes new challenges on U.S. producers.

At the time of these developments, Brazil had already announced (in March) plans to reduce output by 200 thousand barrels per day, a target that has yet to be reached. The United States has not pledged to make any cuts, but the low oil price has made much of its oil production unviable. Canada asserted it would reduce its production. In fact, Canada's Minister of Natural Resources, Seamus O'Regan, present at the conference of the G20 group of nations in April 2020, acknowledged that, regardless of the outcome of the agreement, Canada would be forced to continue slowing production in Newfoundland, Alberta and Saskatchewan.

These movements highlighted the transformations in the oil geopolitics. On the one hand, non-traditional producers – America+1 – have sought to increase their influence in determining prices bearing in mind their interests in raising production and ensuring profitability. On the other hand, OPEC+ has sought to maintain its role as swing producer and, therefore, regulator of the international oil price. China, as a major importer, has been working to acquire oil at increasingly lower prices. The tension between these regions will change the strategy of their companies in the oil segment in the medium term, in addition to their positioning in the industries of other sources of energy.

4. National and corporate energy strategies in the pandemic context

4.1 National energy strategy and policy of the principal oil and gas powers in the pandemic context

The repositioning of the leading oil and natural gas producers in the world should increase in tensions related to the oil price setting process and production adjustments in the medium term. In a context of immense uncertainty due to the Covid-19 pandemic, especially in terms of the long-term global energy demand, energy policies might show significant changes in direction. Understanding such changes is more than a matter of simply analysing how they result in the intensification or mitigation of the energy transition, but showing how the energy strategies of countries tend to increasingly obey narrow national interests while at the same time requiring varying degrees of international coordination to achieve them. Often, energy policy goals based on national interest can result in conflict between members of the country that adopts them and have negative side effects on other important national interests such as environmental protection. In the end, however, all these policy impacts are subordinated to the geopolitical power struggle over control of the energy market.

In a scenario of profound geopolitical change and economic uncertainty, the future of the energy mix and the forms of energy supply each country develops tends to prioritize greater control by national states. This means that countries are likely to develop strategies based on reducing foreign dependence (be it in the supply or sale of energy), increasing diversification of supply sources, seeking self-sufficiency and placing greater focus on their competitive advantages, among others goals.

In Asia, China and India are the countries where fossil-fuel demand has been greatest. At the moment they are also the first countries to show signs of post-pandemic recovery, reinforcing previous geopolitical changes in the energy market. Even so, uncertainties about the strength of the recovery are likely to make it difficult for these countries to sustain their commitment to their goals of reducing coal consumption and accelerating measures to increase the use of low-carbon energy sources (XU; KELLY; OBAYASHI, 2020).

Although some bet that the opportunities to advance in renewables will expand due to the recovery of the Chinese economy, there is greater certainty that natural gas will play a strategic role at least in the medium term for Chinese energy policy. Also, the impacts of the Covid-19

pandemic are expected to foster greater energy intensity in China. Beijing has launched infrastructure packages and increased the use of energy to boost the economy, including high-carbon fuels. In this sense, S&P Global (2020) shows that the geopolitical concern about possible shortages and the existence of abundant coal reserves will make the Chinese government choose to use dirtier energy sources at least in the short term.

- **While the effects of COVID-related stimulus will dissipate as the economy gets back on track, two pandemic legacies may endure. First, China may be left with increased coal-fired power generation and industrial capacity. Second, less predictable geopolitics with higher risks of supply-chain disruptions will prompt China to focus on energy security. Given China's abundant coal reserves and the role coal plays in providing consistent power, this could mean a turn back toward fossil fuel. China's progress toward an energy mix less reliant on fossil fuels has also stalled since COVID struck (S&P GLOBAL, 2020).**

India, in turn, experienced dramatic moments because of the pandemic, with electricity, gasoline, and diesel facing a lowering consumption around 10% to 19% in June 2020 compared with the end of 2019.

To offset the fall in oil price, the government is increasing taxes on gasoline and diesel fuel. As a result, pump prices were maintained as refiners' margins retracted, making it difficult for a demand rebound to previous levels in a climate of falling family income and an overall contraction in economic activity. Still, the Indian government seeks to protect its local industry to ensure that it supplies the domestic market.

Along with the tax hike, according to Viswamohanan (2020), the Indian government provided a support package for the coal industry to reduce needs in 2020. Therefore, the government announced, measures to loosen existing environmental safeguards and improvement of logistics infrastructure for the coal segment[14]. Most of these measures cannot be quantified, but investment commitments amount to some $6 billion. This shows that the Indian authorities continue to have "self-sufficiency" as a central value of their energy policy.

In Russia, where oil and natural gas have always played a key role in its local economy, fossil fuels will most likely remain at the centre of its energy strategies. As noted before, the country has worked to undermine the rise of new producers. To this end, Russia has sought to maintain production and control prices in ways that hinder the growth of competitors, mainly the United States, which is competing with it to supply demand in the European market.

A key problem for Russia is the fact that most of its 1,800 active fields are mature, with the largest 20 accounting for one third of Russian production. In addition, the recovery of the country's own demand is linked to the natural gas industry. These two factors make the Russian energy strategy combine: (i) the preservation of its status as a major gas supplier to Europe while expanding exports to China, and (ii) the maintenance of production and export volumes in order to earn the foreign exchange necessary for economic growth.

The great post-pandemic challenge for Russia is in the refining segment. The processing capacity of its refineries exceeds the domestic consumption and fuels output in excess of local demand must compete for buyers in an oversupplied world market. In addition, tax changes are underway in Russia to reduce export subsidies from refineries. This could further reduce Russia's ability to compete in international fuels markets as its refining costs tend to be higher than that of its competitors.

The surplus capacity of refineries in Russia has increased since 2019. With the consumption declined caused by the pandemic, the gap between the refining capacity and the apparent consumption of oil products in the country has widened further. Any solution, therefore, involves an increase in exports or a reduction in capacity utilization at refineries, which, in the latter case, would increase operating costs.

As already noted, the novelty in the United States was its returns after many decades to the status of a major oil and natural gas producer. This transformed the United States from oil consumer to oil supplier in the international market. The expectation is that it will become a net exporter of oil and natural gas in the coming years.

As a result, the melting of oil and gas prices during the Covid-19 pandemic puts the execution of this strategy at risk. Due to the high costs of producing unconventional oil and gas, very low prices make the operations of many small and medium-sized companies whose activity is concentrated in this segment unfeasible. Consequently, tight oil and shale gas companies are deeply indebted and are beginning to receive financial support from the Trump administration:

- **American oil and gas companies were often in financial trouble well before the coronavirus economic crisis, and now many are asking for taxpayer assistance to cushion their fall. Texas-based Battalion Oil, which recently changed its name from Halcón, has taken a $2.2m coronavirus relief loan, after going bankrupt twice within the last four years and facing accusations of excessive spending on an executive pay, private planes and luxury vehicles. Despite a history of financial woes, Battalion is receiving assistance under the paycheck protection program (PPP), the US government's strategy for getting cash to small businesses so they can continue to pay workers during the coronavirus shutdown as part of a more than $2tn aid package. The company will not have to return the money if it spends it on approvable expenses, including payroll, rent and utilities (HOLDEN, 2020).**

14 This has meant maintaining coal as one of the main energy sources to this day. According to data from bp (2020), in 2019, coal was responsible for supplying 54.7% of primary energy in India. Therefore, Joshi and Powell (2018) state that: "The use of domestic coal strengthens 'self-reliance', one the most consistent energy security values reiterated most in India's energy policy documents. This has continued even as investment promotion policies admit that regulated prices compromise the resilience vital for energy security and jeopardize transition towards a low carbon economy" (JOSHI; POWELL, 2018, p. 7).

In addition, there was an increase in acquisition of unconventional oil and natural gas companies by American majors. In 2020, onshore producers Noble Energy, Concho Resources and WPX Energy were purchased by Chevron, ConocoPhillips and Devon Energy respectively.

Despite pressure from Democrats and environmental groups opposed to measures to support the oil and natural gas industry, the threat of widespread bankruptcy puts thousands of jobs at risk and a threatens a banking crisis linked to the high indebtedness of many oil and gas companies. For this reason, Covid-19 encourages the American government to create programs to support hydrocarbons, mainly in regions where tight-oil and shale-gas operations are widespread.

Even with the defeat of Trump in the presidential election, it is unlikely that Democrats will withdraw support from the tight-oil and shale-gas industries, given its importance to U.S. economic recovery.

In the case of the European Union, dependence on oil imports drives political will to develop regional policies aimed at replacing oil with renewable energy. However, there is also a perception that such policies signal the further decline of European power in oil geopolitics. This situation provides additional urgency to efforts to focus EU energy policy on increasing the use of renewable energy. Low regional oil reserves and great reliance on the energy supplies from a small number of producing countries puts the continent an increasingly fragile market position.

The European Union is more committed to expanding the use of renewable energy than other regions of the world. From the point of view of global governance, it plays a front-line role at energy-transition forums, reinforcing its position as a leader in energy transition geopolitics. As a result, the capacity of some energy-market stakeholders, such as environmental agencies and investment funds, to influence the energy-transition agenda is significantly greater in Europe than in other regions in the world.

Hence, the Europe has the potential to change the global energy agenda and foster debate on energy transition. A scenario of falling energy demand, rising climate-change risk and low financing costs increase the possibility of a "clean-and-green" recovery.

In this context, the pandemic offers opportunities to deepen the European Green Deal. Launched in December 2019, it proposed a package of 750 billion euros for economic recovery under a planned in a long-term (2021-2027) budget of 1.1 trillion euros. A quarter of the long-term budged is committed to energy transition with the goal of making Europe carbon neutral by 2050. In other words, this program, which was already important for Europe's energy transition ambitions, has also acquired strategic importance for the resumption of the post-Pandemic economy.

- **The European Green Deal, it is a strategic package of policy measures that are currently being shaped by EU member states and the European Parliament. The Green Deal is cross-cutting and impacts many economic sectors and industries, such as agriculture, energy, and infrastructure. It also includes an investment plan and a just transition mechanism (IISD, 2020).**

In general, especially at the time of the pandemic, the countries' strategies are associated with their particular interests, their condition of reliance/self-sufficiency and the way Covid-19 impacts each of them. At the moment, the energy transition, undoubtedly important, seems to be subordinated to these elements.

4.2
The strategy of oil majors in the pandemic context

Even though their executives public statements pledge to continue investing in renewables, the oil majors' principal concern during the pandemic crisis has been short-term financial preservation. Almost all oil companies in the world have cut their investment budgets, especially for oil and natural gas exploration projects. The expectation is that these investments cut will reduce the replacement of oil reserves in the medium term, foreshadowing difficulties in meeting an eventual rebound in demand. At the same time, most major oil companies have preserved existing projects and plans to reduce carbon intensity in their activities without committing to the expansion to their scope.

Four major European oil companies (bp, Total, ENI and Shell) have announced strategies to reach net-zero greenhouse gas (GHG) emissions. Equinor, Shell and Total also announced plans to build of the world's largest carbon capture and storage (CCS) project which will be located south of the Troll field in the Norwegian North Sea. However, the majors have sharply reduced capex spending and it is very difficult predict which projects may be affected, despite these companies' guarantees to maintain of their clean energy investment plans.

The positioning of each of these companies in the face of the crisis, however, is directly linked to their perceptions of how and when a recovery in energy demand will occur and upon the governmental regulatory measures being implemented in support of energy transition. Looking at the recent measures taken by the majors it is clear that they share no unified outlook for the future. The ways that they are trying to position themselves to meet future challenges include diversification of activities, a drive for energy efficiency and devaluation of assets

Overall, companies adjusted investments by cutting production and optimizing their assets in the upstream and downstream. In this sense, a possible relative rise in renewables is much more associated with a reduction in exploration and production (E&P) projects than cuts in other business segments.

Although U.K.-based bp shows interest in accelerating the transition, in its current strategy, two of the four key points relates to the oil and gas industry:

(i) Increase energy efficiency in oil and gas production;

(ii) Increase downstream processing conditioned to market dynamics and the introduction of innovations in the refining process and the final product;

(iii) Increase exposure to new low-carbon projects using new technologies;

(iv) Modernisation of the entire business group and advancing in digitalization.

During the pandemic, bp's clear priority is to improve the margins of its E&P business by giving up assets with lower profitability. Renewables, although they may continue to receiving investments in the medium term, appear to have a secondary role bp's plans for pandemic recovery.

In the E&P segment, bp sold a stake in its Alaska assets to Hilcorp for $5.6 billion and moved ahead with negotiations to divest itself of assets in the San Juan, Arkoma and Anadarko fields in the United States. In addition, it announced the reduction of its U.S. tight-oil and shale-gas production as a result in the collapse of the price of WTI and the huge drop in demand in the country (BOUSSO, 2020a).

The strategy of reducing production has already had its first effects on operating results. In the first quarter of 2020, its production fell 2.9% (77 thousand barrels per day), from 2.65 million to 2.58 million barrels per day (BP, 2020b).

In the refining segment, the company announced at the beginning of the crisis that it would maintain a high utilization rate of refineries (from 95% to 96%) in the first quarter of 2020, but that it would then revise this stance depending on the behaviour of demand. In the United States, it reduced refining activities by 15% (BP, 2020b).

This demonstrates that bp opted to adjust the production of oil and derivatives in the U.S. market primarily in response to the rapid drop in demand and the high cost of tight-oil and shale-gas production. However, it has not yet signalled any more severe adjustments in European production and refining and, in addition, it has maintained investments in the renewables segment in Asia and Oceania (BP, 2020b). In this way, the company is promoting a selective adjustment that seeks to preserve its local-market position, taking advantage of existing opportunities mainly in China and start reducing its presence in the United States, one of the markets that are suffering the most from the current global oil crisis.

Shell, in turn, announced that it intends to drastically change its strategic plan and operating procedures to meet the requirements of shareholders and environmental regulations towards a low carbon economy. In the second quarter of 2020, the major reported a net loss of $18.1 billion. According to the company itself, "significant uncertainty in the macroeconomic condition", in the context of the pandemic, was decisive to explain the result.

In response to the crisis, Shell announced some resilience measures. The first was to reduce operating costs by about $3 billion to $4 billion over the next twelve months, a 9.5% reduction compared with 2019, when operating costs were $36.99 billion. The second was to reduce planned 2020 cash capital expenditure from $25 billion to $20 billion, 20% lower than projected before the pandemic. According to Shell, these initiatives are expected to contribute to a pre-tax free cash flow of $8 billion to $9 billion (SHELL, 2020a).

The investment cut compromises the development of the company's future projects. For the next three months, the company's average production is expected to be 1.75 million to 2.25 million barrels of oil equivalent per day (boe/d), compared to 2.71 million boe/d first quarter. Part of this reduction is expected to be in Shell operated fields in Nigeria, which is committed to reductions as an OPEC+ member.

In the refining segment, Shell plans reduce the utilization rate of its refineries in the second half of 2020 from 81% to between 60% to 70%, reducing oil processing volumes to 3 to 4 million barrels per day. According to Reuters, the pandemic lockdown, which affected more than 3 billion consumers, or about 40% of the world population, led to a reduction of demand that will force Shell to cut its production of fuels and other refined products by more than 13% (BOUSSO, 2020b). As a result, Shell now plans to cut its number of refineries from 14 to 6 and total refining capacity by 57%.

Norway's Equinor, in turn, announced in March the deceleration of production in regions outside its home base with cuts focused on U.S. operations. According to a company statement, "all drilling and well completion activities at Equinor's gas-focused U.S. shale assets are being suspended to cut spending and produce the volumes at a later period" (PERKINS, 2020).

In April, Equinor's Brazilian production from the Peregrino field in offshore the Campos Basin, was suspended and output from the nearby Roncador field – where Equinor owns 25% of the concession – was reduced (SIQUEIRA, 2020; NUNES, 2020). In contrast, the Norwegian oil company continued to invest in increasing production in the North Sea, its home base. These measures were announced shortly after Equinor said it would cut planned 2020 capex budget from $10 billion to $11 billion to $8.5 billion, a reduction of more than 20%.

In addition to project costs and scheduling, another criterion used by the company to define cuts is the location of its investments. One of its priorities is to preserve existing projects in its country of origin at the expense of those abroad. As a state-owned company and controlled by the Norwegian state, it will act to mitigate the oil crisis impacts in the country.

Among the U.S. companies, ExxonMobil sought, at first, to resist any revision in its spending plans for this year. However, in light of the scenario of market conditions deteriorating rapidly, the oil company was forced to take contingency measures. The main one was reducing

this year's capex budget by 30% to $23 billion, a cut of $10 billion from its original plan. The company then announced a 15% cut in projected operating expenses (DILALLO, 2020).

The company's management committee stated that it would "continue evaluating the impacts of decreased demand on its 2020 production levels as well as longer-term production impacts", and that it could exercise additional reduction options if required (EXXONMOBIL, 2020).

Chevron, in turn, released in late March a set of resilience measures in response to market conditions and to deal with the Covid-19 crisis. Chevron's press release (CHEVRON, 2020) indicates that the company is reducing its guidance for 2020 organic capital and exploratory spending by 20% to $16 billion. Reductions are expected to occur across the portfolio.

In addition to reducing capital expenditures, the company is taking other actions to support its industry leading balance sheet including:

(i) The $5 billion annual share repurchase program has been suspended after repurchasing $1.75 billion of shares during the first quarter.

(ii) The company completed the sale of its interest in the Malampaya field in the Philippines with proceeds over $500 million received in the first quarter.

(iii) The company continues to execute its plans to reduce run-rate operating costs by more than $1 billion by year-end 2020.

According to Chevron Chairman and CEO Michael Wirth, "Given the decline in commodity prices, we are taking actions expected to preserve cash, support our balance sheet strength, lower short-term production, and preserve long-term value" (LINNANE, 2020). The company remains focused on growing its core oil and gas business and seems to expect little structural change in the post-pandemic market.

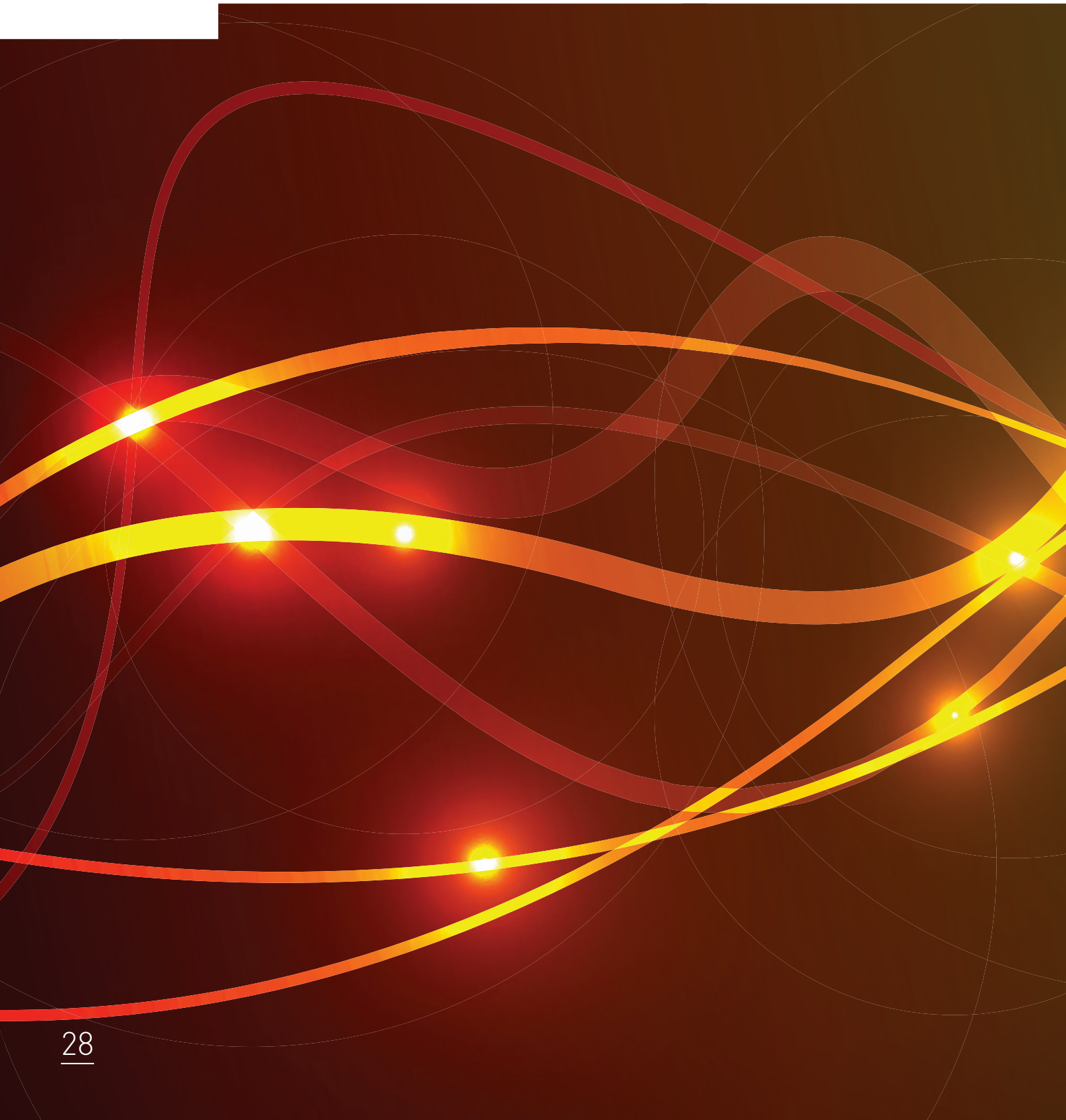
Part I of this Research Report shows how oil and natural gas may continue to play an important role in the energy industry in the medium term. The progress made by U.S. producers, as well as other countries (Brazil and Canada in oil, Qatar and Australia in LNG), and the rise in Chinese demand open opportunities for them to exploit their energy potential.

Covid-19 brings deep uncertainties about the future, making most countries and company more conservative in their actions order to avoid major changes in the energy structure in the short term. Analysing the measures adopted so far, it is observed that, with rare exceptions, national states seek to protect their industries and reduce dependence on energy imports, even if this means increasing the use of dirtier energy sources. The companies, in turn, seek to cut investments in assets with lower profitability to focus on higher return projects, generally concentrated in the oil and gas segment. Even at the European majors the guarantee to preserve renewables projects, increases in the relative share renewables in their investment portfolios are likely to occur over the short term as a result of the reduction oil and gas exploration and production expenses. It is still too early to assess whether this is a long-term trend.

This starting point shows that oil and natural gas are still very important for the energy world. However, this does not mean that there are no actions in favour of the energy transition. Undoubtedly, the cleanest sources are growing in importance in the energy mix of several countries. The important issue for this Research Report is to qualify the meaning of this transition and understand its pace and impact on the implementation process. There are several projections and estimates of impacts related to the replacement of fossil sources by cleaner ones. Still, many of these projections fail to analyse the totality of elements and actors involved in this process.

PART II

Energy transition perspectives and trends: patterns, scenarios and impacts



1. Introduction

One of the main objectives of the energy transition is the decarbonisation of the energy mix through strategies that prioritize, as a rule, the increase of investments in renewable-energy sources (such as solar photovoltaic and wind), gains in energy efficiency, and the development of mechanisms for carbon capture, storage and use (CCUS). In light of this, it is common for companies and countries to propose measures to change the global power generation structure, marked, in theory, by the reduction of the role of coal and oil an in increase in the role of renewable energies.

However, the speed and effectiveness of such measures vary enormously from region to region. Although there is a relatively global discourse in favour of accelerating the change in the energy mix, actions in this direction are still quite disparate. This is because, in addition to the strategic goals of each region, challenges that need to be faced by the energy sectors have emerged, which in turn require improvements in the regulatory, operational and commercial framework of the current model. Examples of such challenges include the growing need for flexibility and security of supply for power systems.

In addition to technical and operational transformations, the energy transition will likely bring about profound changes in the labour market. Effects such as the reduction in the number of jobs and the need for both geographic and professional mobility will cause changes in organization and job security, especially in the fossil-fuel sector and even more in a global scenario of employment precariousness. Although many changes will occur in the long run, current projections of impacts and a qualitative analysis of these can help the union movement to prepare itself more adequately for the future.

That said, Part II of this Research Report has as its central aim the presentation of aspects related to the energy transition process. To this end, we first seek to understand the complexity of the transition movement, identifying the key actors and geopolitical, economic and social conditions involved. Then we seek to identify the consequences of this process in the labour market, with emphasis on the fossil-fuel sector.

Part II is divided into five sections. The first section is this introduction. The section 2 addresses the historical trajectory of the energy transition process, its main trends, peculiarities and the way in which it was received and treated by workers, based on the concept of Just Transition. The section 3 explores the different scenarios and projections made by the principal European and North American oil companies for the energy sector for the medium and long term, as well as Ineep's interpretation of this movement. Given the context of the transition, the section 4 identifies the technical-operational challenges of restructuring and decarbonizing the global energy mix. It also presents some possible solutions to the problem, highlighting the role of natural gas and hydrogen. Finally, the section 5 refers to the impacts of the transition on the labour market, detailing the different types of effects in qualitative and quantitative terms on the life dynamics of workers and labour organizations in the sector.

2. Energy transition: a movement on multiple paths

Since the 19th century, the world's energy systems have been based on the intensive consumption of fossil fuels. However, during the 1970s, a series of economic crises raised oil prices significantly, exposing the vulnerabilities and uncertainties of the oil sector, especially in countries dependent on the import of these fuels.

In parallel, there was an increasing concern about the impacts of economic growth on the environment and the appearance social and counterculture movements questioning the traditional development model. Therefore, it became urgent to define new guidelines for energy planning, aiming at reforming the energy mix around a more sustainable base and reducing dependence on fossil fuels.

Given this background, the debate on the restructuring of energy systems began in the 1970s. The book "Small is Beautiful" and the first report of the Club of Rome, "The Limits of Growth", gained prominence in that decade, pointing out the environmental risks of "dirty" industry. The period also saw the creation of organizations promoting theoretical and ideological perspectives on current affairs, such as the Heritage Foundation, the American Enterprise Institute, the Hoover Institute, the Manhattan Institute, the Cato Institute and the Center for Strategic and International Studies, among others. They began propagating neoliberal ideas, such as the need to reduce the state's role in the economy and the importance of prices and market laws to overcome the resource crisis and the environmental impacts of development. Families with strong ties to the major oil companies, such as the Mellons and the Koch brothers, were instrumental in financing these institutions (MITCHELL, 2011).

In fact, more than the idea of a de facto transition, the 1970s were marked by a dispute over the discourse around the energy future. Although several countries began to organize themselves in order to build new technological alternatives, incentive policies, programs and institutions to support this transformation and make the use of new energy sources economically viable, oil and natural gas would continue to dominate the energy mix in the following decades.

In the 1990s, global guidelines and agendas were defined at a sequence of international conferences, congresses and discussion spaces. The International Energy Agency (IEA) projected three scenarios on the future of the global energy mix by estimating the impacts of greenhouse gas (GHG) emissions up to 2035. In this projection, the emissions reduction would necessarily involve reducing consumption, increased efficiency and increased use of renewables in transport.

Three actions would thereby be important in order to implement a low-carbon economy in the long run: increasing access to electricity; replacing the use of fossil fuels by renewable energies (essentially wind, solar and biofuels) and increasing energy efficiency.

Although the energy transition is a global phenomenon, countries and regions have adopted different methods to its implement its goals. As noted by Sampaio (2017), this process was not initiated in a "natural" way, but always depended on state action in establishing policies to foster new technologies, and to encourage investment in and the use of renewable resources, especially in countries with a production structure based on the fossil-fuel consumption.

As seen in Part I of this report, energy policy ultimately is related to the strategies of national states that obey not only issues concerning the sector, but also geopolitical objectives and political and economic interests. Therefore, from our point of view, the replacement of dirty energy by cleaner sources depends on the priorities set by government policies.

In general, it can be observed that the main driving forces behind energy transition are the reduction of dependence on fossil fuels and the cost viability of renewable energy sources. In other words, the share of renewables in the energy mix is likely to increase in countries where this type of energy can boost national energy self-sufficiency and "geopolitical power" and where economic conditions and costs are most favourable for its use.

The consolidation of a new global energy paradigm is a slow process and requires the encouragement of government policies. Environmental concerns and technological advances are important drivers, but it is essential that government policies converge with the interests of multiple energy-industry agents for the economic and social conditions that can make this process feasible to emerge.

It should be noted that, although the energy transition is considered an irreversible process, the means and paths for this transformation differ significantly between countries and regions. Therefore, the energy transition process does not present a linear logical model, with steps pre-defined and structured in a subsequent order. On the contrary, the energy transition is unique for each country and region. Each moves forward on different time frames and with different advantages linked directly associated to the interests of each nation-state. Thus, the trajectory adopted will meet the particularities and complexities of each country or region's energy mix, available resources and current social, political and technical conditions.

As mentioned in Part I of this report, in addition to the strategic (economic and political) and geopolitical interests of each region, there are a number of actors who also influence the energy transition process. Such influence generally reflects the particular interests of each of these actors in the transition. Green shareholders and investment funds, for example, are concerned with both the environmental impacts and the efficiency and profitability of the sector.

Gradually incorporating renewable projects, some oil companies have a favourable discourse on transition, especially in Europe, but the pace at which they seek to implement transformation is usually relatively slower than that of other energy actors and stakeholders. This is explained by the fact that the financial success of these companies in the medium term still depends and will continue to depend upon fossil-fuel projects. Other companies, such as those in the United States, tend to maintain their focus on the oil and natural gas sector while their responses to environmental impacts are restricted to decarbonisation measures.

In the case of workers, interest in the energy transition considers aspects that are generally neglected by other actors. It is also worth mentioning that within the working class there are differing priorities and objectives depending on the importance of the sector to local economies, labour group's history of organization and local working conditions. For example, workers in the fossil-fuel sector have very different interests depending on their classification as blue collar (a class that often faces poor working conditions), green collar, pink collar and/or service workers associated with the energy segment.

Green collars do not have union protection and their "green" agenda is the same as that of energy workers organized in the 1970s, that is, their demand are related to better working conditions, job security and increased income. From the point of view of public policy, one of the central issues is not exactly the problem related to the elimination of jobs, but the expanded access to better quality jobs in terms of remuneration, working conditions, etc.

In a certain way, there is a conflict between priorities of blue-collar and green-collar labour. The improvement of working conditions is important for blue collars, but their priority is associated with the impact of the energy transition on the structure of fossil-fuel jobs and how to guarantee the preservation of their jobs at income and security conditions close to the current levels.

On the one hand, blue collars focus on defending jobs in the sectors most related to fossil fuels and seek to structure their agenda so that the energy transition does not totally destroy these segments or, at least, transfer these workers to jobs with similar remuneration and quality of employment. On the other hand, green collars are concerned with the set of problems in the lives of these workers, who suffer different forms of discrimination in addition to economic exclusion.

Ii is also important to emphasize the importance of increasing of job opportunities for pink collars. They are workers, primarily women, people of colour and others without strong union representation, in the economic areas of health and education, social assistance and services with scattered workplaces and precarious contractual relations. Although they do not occupy the main jobs in the energy sectors, the changes related to the transition of the energy mix can impact these workers as well.

Even though their work is often classified as a type of "green job", Battistoni (2017) reminds that pink-collar workers still depend on fossil energy due to their highly precarious relationship with their employers. Furthermore, analysing the U.S. case, the author points out that the issue of energy transition for these workers is not at the "centre" of their demands, which are focused instead on improving such factors as working conditions, remuneration and job security.

> To a certain extent, there is a synchrony between the ecological transition and the pink collars, but that does not mean that these two categories are necessarily aligned. Care work can be considered low carbon – but that does not mean that the industries that depend on it are. Hotel workers, for example, are highly unionized, but the hotel industry, dependent on frequent flyers, would suffer without fossil fuels. In Las Vegas there is an organization of service workers, but it is hardly a model for an ecologically sustainable world [mainly because of the priorities of their employers]. (...) McDonald's and Forever 21 are not much more ecologically defensible than ExxonMobil (BATTISTONI, 2017).

The expansion of the precarious work of pink collars and the extreme inequality they face compared with other workers has undoubtedly helped remove concern with energy change and the environment from their list of demands. Hiring of green-collar and pink-collar labour is likely to increase rather than decrease in a low-carbon, post-pandemic society. These employment relations are precarious pay low wages and come with limited social benefits. For this reason, if the "green" agenda of organized workers seeks to attract the support of these groups, it needs to incorporate their demands.

With this in mind, the union movement launched the concept of Just Transition as an instrument to incorporate into the agenda for changing the energy mix issues that meet the most diverse demands of workers, whether organized or not.

2.1
The Just Transition

The main actors involved in the energy transition base their decisions mostly on economic, geopolitical or environmental considerations. Some countries, mainly in Europe, see renewables as an opportunity to reduce their dependence on imports of other forms of energy. Green financial funds seek to influence the policies companies in which they hold investments to leverage these companies' market power to promote environmental change. Non-Governmental Organizations (NGOs) advocate greater use of clean energy to mitigate the environmental impacts of using fossil fuels.

However, none of these actors have the impacts of the transition on workers at the centre of their concerns. Both the destruction of fossil-fuel jobs and the precarious conditions of "green" workers are not addressed by these institutions in their energy transition reports.

In the face of that, union movement developed in the 1990s the concept of Just Transition, with the aim to provide a framework for discussions on the types of social and economic interventions needed to ensure workers' livelihoods during climate change processes.

At the turn of the millennium, thanks to the efforts of national unions and labour federations, the Just Transition was increasingly considered at the international level – especially in relation to the United Nations climate negotiations and discussions on sustainable development. Even so, it was only in the second half of the following decade that there would be more active and coordinated efforts to integrate the Just Transition into the international sphere and to seek the inclusion of the concept in United Nations procedures and agreements.

An important moment in this regard was the merger of the International Confederation of Free Trade Unions (ICFTU) and the World Confederation of Labour in 2006, which gave rise to the International Trade Union Confederation (ITUC). From the beginning, ITUC has put environmental concerns at the centre of its agenda (JTRC, 2018).

Given its growing importance in the international debate, the United Nations climate process has become a privileged place for ITUC and other union organizations to boost the Just Transition agenda. Consequently, and within the international climate community, Just Transition has been increasingly framed and recognized as the contribution of the trade union movement to the international climate debate. In a leaflet produced for the Copenhagen climate conference in 2009, the ITUC presented Just Transition:

> as a tool the trade union movement shares with the international community, aimed at smoothing the shift towards a more sustainable society and providing hope for the capacity of a "green economy" to sustain decent jobs and livelihoods for all (JTRC, 2018).

Based on the growing public awareness and concern about climate change and linking it to the global economic crisis, the ITUC - as well as global union federations such as IndustriALL Global Union, the International Transport Workers' Federation and Public Services International – presented a credible case for further union engagement in the environmental area. Through its efforts, especially in preparation for the Paris Climate Change Conference (COP21), the international trade union movement has managed to get certain UN agencies and programs to adopt Just Transition concepts and language contributing to its greater diffusion in the international community (JTRC, 2018).

The active presence of the union movement in the international negotiating sphere, its sustained efforts to integrate environmental and climate concerns within the union community and its successful efforts to include the language of the Just Transition in the 2015 Paris Agreement on climate change also contributed to further anchoring the concept within and outside the union movement.

The reference to Just Transition in the Paris Agreement's preamble further legitimized the concept and encouraged a wider range of stakeholders to use it. This was complemented by the compatibility of the concept with the theory of voluntary and bottom-up change of the agreement, and the broader narrative about the combined economic, social and environmental benefits of climate action, especially in the field of energy (PINKER, 2020).

In this sense, another moment worth mentioning is the "Solidarity and Just Transition Silesia Declaration", a document prepared by the trade union movement for the 24th Conference of the Parties (COP 24) of the United Nations Framework Convention on Climate Change (UNFCCC), in Katowice, Poland. This document was signed by over 50 countries, emphasizing that "the Just Transition of the workforce and the creation of decent work and quality jobs are crucial to ensure an effective and inclusive transition to low greenhouse gas emission and climate resilient development, and to enhance the public support for achieving the long-term goals of the Paris Agreement".

Given its growing popularity in the international political arena, the term "Just Transition" has gained multiple approaches over the years. Deployed within a wide range of ideological views, the demands for a just transition can vary "from a simple demand for job creation in the green economy to a radical critique of capitalism and opposition to market solutions" (BARCA, 2015 apud JTRC, 2018).

Despite the diversity of meanings attributed to "Just Transition", in general terms, two broad definitions prevail:

(i) The first is based on the term as it emerged from the North American labour movement in the late 20th century, in part in response to the environmental movement. This background shapes the stricter definition of the term – the idea that workers and communities affected by the intentional change in activities related to fossil fuels should receive support from the state;

(ii) A second broader definition of "Just Transitions" requires thinking of justice in more general sense, and not just for affected workers. It emphasizes the importance of not continuing to sacrifice the well-being of vulnerable groups for the sake of others, a practice that has been usual in the fossil fuel economy (EISENBERG, 2019).

Despite these different approaches to Just Transition[15], this report adopts the concept presented by IndustriALL when discussing the Just Transition. At its congress held in Rio de Janeiro in 2016, a report released by the global union federation shows that the transition to a cleaner and more sustainable economy must be economically and socially just for workers and their communities.

The technology revolution and a greater ongoing digitalization of production – that is likely to deepen in the future - cannot exclude workers from this process. Therefore, in IndustriALL's view, the Just Transition must also be characterized by a sustainable industrial policy that promotes much-needed social justice and benefits for workers. Accordingly, IndustriALL proposes that:

(i) Climate change must guarantee broad social participation;

(ii) The transition must consider improving the livelihoods of vulnerable workers and small producers;

(iii) The sustainable and resilient infrastructure to be distributed fairly;

(iv) Access to ecological services and products (is) to be guaranteed at a viable price; and,

(v) Tax reforms must consider progressive ecological taxes.

In order to ensure the implementation of this agenda, greater participation by union representation is crucial, especially in the renewable segments that have a significant share of highly precarious work (as in the case of biofuels). On the one hand, this would allow greater protection of this type of work and a greater capacity for organizing the workforce at the aim that the energy transition does not mean a great precariousness of the employment structure in the energy industry. On the other hand, it would enable greater action with governments, guaranteeing not only an ecologically sustainable future, but also a less socially unequal future for all workers.

These elements could serve to some extent the dispersed interests of different workers. When it comes to energy transition in this report, this dimension is also considered, that is: whether or not this process considers aspects related to the interests and objectives of the working class. This is an important because, in our perspective, the energy transition must be looked at in a much broader than a simple change in the source of energy. It must also consider the negative impacts of transition on different parts of society and the economy and the real possibilities of overcoming them.

15 The Just Transition Research Collaborative (JTRC) developed, based on the academic classifications of the term, a frame of reference for understanding the spectrum of approaches around the Just Transition. They identify four ideal- typical approaches to Just Transition, ranging from those that preserve the existing political and economic system to those that imagine significantly different futures. In general, the types of Just Transition exposed in the JTRC framework are separated by: (i) Status Quo; (ii) Managerial Reform; (iii) Structural Reform and (iv) Transformative. Each of these approaches can be further differentiated depending on the more or less inclusive scope of the transition. That is, they take into account the extent to which the proposed Just Transition policies are exclusive (benefiting a specific group of actors, in terms of how resources are distributed) or inclusive (designed to benefit or modify society as a whole). The table in the Annex shows the main differences between the types of Just Transition.

3. Energy transition: scenarios and projections

In the next sections, the main projections and trends of the global energy transition are presented, with emphasis on some important regions in this process, such as the European Union, the United States and China. Initially, the different perspectives of the major institutions and companies in the world energy sector are explored. Then we move on to present Ineep's understanding and critical analysis of these scenarios and current energy policies.

It should be noted that in general these analyses by the world's major institutions and energy companies concentrate on technical aspects and national policies to examine the future of the transition. They omit, as a rule, the actions of the actors involved in the process and how they are present. Furthermore, they do not analyse social impacts on workers and other stakeholders, an elements that, in our view, can also influence the transition. For Ineep, these are some of the flaws in most traditional analyses.

3.1
The perspective of energy institutions and companies

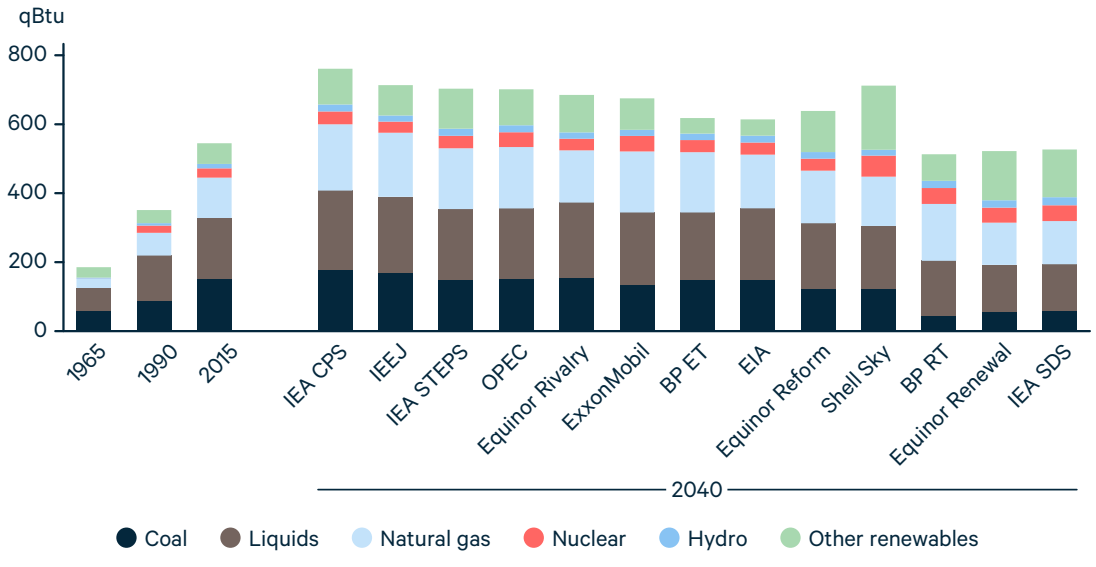
In this section, the scenarios discussed present as reference projections of the world energy mix in 2030, 2040 and 2050 elaborated by IEA, bp and IRENA. All these institutions expect an increase in the share of modern renewable energies and natural gas at the expense of the share of conventional fossil energies in the global energy mix.

The Resources for the Future conducted a study called "Global Energy Outlook 2020 Energy Transition or Energy Addition?" that compares the projections for the transition process by different institutions, such as IEA, Grubler, BloombergNEF (BNEF), bp, Equinor, ExxonMobil, the Institute of Energy Economics of Japan (IEEJ), OPEC, Shell and the U.S. EIA, and their respective variations of potential future scenarios (Chart 2.1 and Table 2.1). In all scenarios, despite the growth in renewable energies at the extent of the share of coal and oil, it is possible to observe the great representativeness of non-renewable energies, mainly due to the share of natural gas.

As shown in Chart 2.1, most institutions project that by 2040 more than half of the global energy mix will still be concentrated in coal, fossil fuels and natural gas. Organizations from oil-producing countries, such as the EIA and OPEC, still estimate that coal and to a greater extent oil and natural gas will continue to represent a significant share of global energy consumption. The EIA, for example, expects that these sources will still supply more than 80% of energy demand. European companies, in turn, such as Equinor and Shell are more optimistic about the use of renewables in 2040. Shell projects that almost half of the energy consumption will be supplied by renewables (including hydroelectric) and nuclear power by then. But, as will be seen later on, this optimism does not necessarily reflect on the actions of the oil companies.

Despite the existence of a baseline scenario, these institutions tend to work with different perspectives due to the great uncertainty and the possibilities for change in energy policy that may occur over time. In this sense, each scenario evidently projects different shares of the consumption of renewables for 2040.

CHART 2.1
The world's projected energy mix for 2040. In qBTU



Source: Resources for the future (2020).

Under "reference scenarios", organizations make assumptions based current policies, without considering the addition of new measures. In these projections, coal use grows modestly, while oil, natural gas and renewables significantly increase their share. This is the case of the IEEJ, IEA Current Policies Scenario (CPS) and EIA (Reference). Among these outlooks, the EIA Reference report predicts the most pessimistic scenario in relation to the entry of renewable energies. By 2040, the EIA foresees the participation of only 7.6% for other renewables, 24.6% for coal, and 33.6% for liquids.

Under *ambitious climate scenarios,* the institutions assume the fulfilment of the Paris Agreement goals. In these projections, coal and oil reduce their participation in absolute terms, natural gas grows modestly and other renewables have an increasing participation in the energy system. Among the scenarios presented, Shell Sky shows the most optimistic projection for 2040, with 26.2% for other renewables.

Finally, under "critical ambitious climate scenarios", global energy demand is declining and the transition process is led by natural gas. As an example, the projection of the bp Rapid Transition report is cited, which foresees a participation of only 8.5% for coal, 31.2% for liquids and 32.2% for natural gas by 2040.

Thus, one can see the heterogeneity of interpretations about the energy transition process. The projections show significant variability among themselves, confirming the uncertainty and the multiplicity of alternatives and strategies that can be adopted. Furthermore, it is possible to note the existence of more optimistic and pessimistic interpretations regarding the growth of the share of renewable energy. In this outlook, it is observed that in general the optimistic scenarios are outlined by companies that historically bet their investments in renewable energies, technological innovation and electricity generation. On the other hand, the most pessimistic projections tend to be made by companies focused on conventional fossil fuels that have adopted timider strategies in terms of incorporating renewables.

Table 2.1 shows, for example, the difference in projections between bp and ExxonMobil. The participation of coal in the matrix for the U.K.-based company is significantly lower (8.6%) compared with the U.S.-based company (19.7%). In the opposite direction, the participation of renewables is a little higher in bp projections (15.0%) than ExxonMobil (13.4%).

According to Carbon Tracker (2020), even in European companies that have strict emission reduction targets, the action strategies were articulated in a way that allows the growth of energy generation and resource exploitation. Thus, in practice, absolute reductions in fossil fuels remain below expectations and limits that would be appropriate to climate-control commitments.

When analysing these scenarios by geographic region, the process is even more diverse, reflecting the current composition and the strategies outlined by each country. According to IEA projections (2020), by 2021, China may become the country with the largest installed capacity of distributed photovoltaic energy in the world, surpassing the European Union. In addition to China, the contribution of Japan, Korea and India to the expansion of renewable energy capacity in Asia is highlighted. Despite the growth of renewables on the continent, Asia has established itself as the largest oil consumer in the world, led by China.

It should be noted that historically China's energy mix has been composed essentially of coal and oil. However, its current share held by renewable energy sources is already one of the largest in the world, while oil consumption has seen its share significantly reduced. In 2040, China is expected to be responsible for 40% of the total growth of renewable energies worldwide, a result achieved due to intense investments in infrastructure and the competitiveness of photovoltaic and offshore wind energy. Even so, the share of natural gas in China's energy mix is expected to show the greatest growth in the coming decades.

TABLE 2.1
Primary energy consumption in 2040. In qBTU

qBtu	Country	Total 2040	Coal	Liquids	N. Gas	Nuclear	Hydro	Other renewables
EIA Reference*	US	613	150	206	156	35	20	47
IEA Current Policies**	UE	760	178	230	192	37	20	104
Shell Sky**	Netherlands	711	123	182	143	61	17	186
BP RT*	UK	513	44	160	165	46	21	77
ExxonMobil**	US	675	133	211	177	45	18	91
Equinor Rivalry**	Norway	685	154	218	151	34	18	109
Equinor Reform**	Norway	639	124	189	153	35	19	119
Equinor Renewal**	Norway	522	57	135	122	44	21	143

Source: Resources for the future 2020 as presented by Ineep.
*Notes: *excl. non marketed biomass. **incl. non-marketed biomass.*

According to bp (2019) projections, the share of coal will decrease sharply in China, falling from 60% in 2017 to 35% in 2040. On the other hand, there will be an increase in renewable energy and natural gas consumption. By 2040, primary energy consumption in the country will consist of 18% oil, 35% coal, 14% natural gas, 7% nuclear energy, 9% hydropower and 18% renewable energy[16].

The European Union, a region that has been leading the movement to restructure energy systems towards a low-carbon economy, has seen reduction in oil, coal and nuclear-energy consumption in parallel with the growth in the share of distributed photovoltaic solar energy. Several auctions are already planned for this energy source. Countries that had already exploited wind potential abundantly currently concentrate investments in photovoltaic solar energy.

By 2040, the European community will see the share of renewables in the energy market increase by more than 50%. The projection for primary energy consumption in 2040, in which 27% is allocated to oil, 26.6% to natural gas, while the renewables get 29.1% and the other sources 17.3%.

In the United States, wind and solar energy investors are accelerating project execution, while federal tax incentives for renewable energies are still in place. There is a decline in the share of oil and mineral coal, in contrast to an increase in renewables and natural gas. Currently, the country is the largest natural-gas producer in the world and the great growth of tight oil and shale gas will consolidate the Americas as the major energy exporter in the coming years. According to bp data, the trajectory of U.S. primary energy consumption by 2040, showing the large share of oil, natural gas and coal and the limited contribution from renewable energies: 31% for oil; 37% for natural gas; 6% for coal; 5% for nuclear energy; 3% for hydropower; and 18% for renewable energy.

However, it should be noted that these projections are from a company that sees the energy transition process with some optimism. Yet, even in China and Europe, the use of renewables is likely to come closer to natural gas and oil. In this sense, it is very difficult to believe that in the coming decades, despite probable growth, renewables will have a similar weight to oil and natural gas in the global energy mix.

3.2 Ineep's perspective

In this section, Ineep, as a research entity, presents its views on the energy transition process and its future developments. In its analysis, the institute adopts a political economy perspective, incorporating the view of different social actors and the intrinsic and complex network of interactions and tensions between them. Therefore, in Ineep's view, there is an immense set of uncertainties and coordination between different actors that tend to make this transition process complex and slow.

In general, the phenomenon of energy transition is understood from the perspective of three main social actors: (i) the major players in the energy sector; (ii) government; and (iii) international environmental organizations. However, it is emphasized that there is a set of other actors perceived as secondary in this process that are still little addressed in the academic literature on the subject. As already mentioned regarding the actors who are part of this process, different types of institutions and stakeholders should be considered, such as international NGOs, start-ups, financial funds and workers.

As background, it is worth highlighting the role of geopolitics in decisions on energy transition. From a global perspective, the dependency relations in energy supply between importers and exporters, the search for energy self-sufficiency and the ability to control key variables of the sector are aspects that undoubtedly influence countries' energy policies and actions regarding the energy transition.

For Ineep, the energy transition does not present a single path, but a plurality of processes with different temporalities, trajectories and motivations. Seen in these terms, each process aims to transform the composition of the energy mix, seeking to meet the irreversible changes and technological innovations in energy systems, depending to the social, environmental, geopolitical and economic-financial conditions of each territory.

In this sense, the oil-and-gas sector plays a central role. Despite its often negative stigma in the transition process, oil is currently an essential input, being present in several production chains. Thus, any change in the paradigm of this productive structure happens slowly and requires solid planning integrated with several economically strategic sectors. Furthermore, the very expansion of renewable energies depends in the short term on investments in renewables made by the oil majors themselves and on solutions based on the use of fossil fuels, as it is the case regarding the flexibility of the gas-fired power plants.

Despite its importance in the transition process, the intensive substitution of oil by renewables and the arrival of the peak oil point cannot be considered as central factors in this phenomenon. In other words, it will not be the withdrawal of oil as a hegemonic source that will define the energy transition process, since the decision to restructure energy systems is directly associated with geopolitical positions and objectives that go beyond this aspect. Therefore, the pace of the current transition process is primarily influenced by the cost structure and the interests of those who support it.

In this process of restructuring production chains, International Oil Companies (IOCs) have been presenting diversified strategies for their entry into the renewables sector, with an evident gap between the performance of European companies and large oil companies based elsewhere[17].

16 Renewables in this case include wind, solar, biofuels, geothermal and biomass energy.

17 Part III of this Report details this discussion.

In Ineep's view, in addition to climate change, there are several financial, technological and geopolitical factors that drive the energy-transition phenomenon. It can be said that there is a set of conflicting elements in this process. These include: (i) the different interests of the social actors involved; (ii) technological aspects; and (ii) socioeconomic changes and their multi-scale effects. All of these elements have a strong correlation and dependence on each other, configuring themselves as a condition and conditioning factor of isolated systems, where natural resources are understood as an input reserve to be appropriate for capital accumulation.

Therefore, it can be seen that the guiding forces of productive structures and social relations have continued to influence the transition process. The development category may change and new energy sources can be exploited, but the motivations and logic of the structure remain unchanged. Thus, although there are multiple starting points, the permanence of the traditional thinking and actions can only lead to the maintenance of the same material conditions and developments.

The "environmentalization" process of financial institutions and major players in the energy sector, whose rhetoric of decarbonisation and sustainability are used as a guide to defend the interests of a portion of investors, are also likely to influence the energy transition.

In addition to the factors discussed above, the entry of new sources of renewable energy shows a gradual evolution of performance in technical and economic terms, requiring consolidation of a new network infrastructure and a new mass market. In this sense, public policies can also slow down the speed of the process, as it is the case with oil companies with infrastructure already established in the market.

That said, Ineep believes in the occurrence of a slow and asymmetric transition process. Given the need for complex change in social, political and cultural relations at different scales and time lines dependent on a range of actors, national states being the most important, and with a pace of which will depend on different actors, being the national states the most important of them, the process will be driven by a series of uncertainties. It must be considered that in general the energy decisions adopted by the different actors are not aiming at energy transition.

Therefore, it is natural that over time "comings and goings" will be seen in the changing energy mix, reflecting the ways that the substitution of fossil energies by renewables impacts these actors. If this in any way threatens a certain group of companies and/or group of countries, it is possible that the energy transition process will face setbacks.

Currently, Covid-19 has aggravated the financial crisis through effects such as debt growth and stagnant energy demand. According to the IEA (2020), renewables' growth is expected to slow down in 2020 for the first time in the past 20 years. This reflects delays in construction due to supply chain disruptions, lockdown measures and social-distancing guidelines, as well as emerging financing challenges[18]. The IEA only expects the rate of renewable energy capacity additions to return to 2019 levels in 2021. Despite the possible rebound, the IEA's current expected combined growth outlook for renewable energy in 2020 and 2021 is almost 10% lower than its October 2019 forecast. In 2021, the landscape will depend on government policies to accelerate clean-energy transitions. Without political action by national and regional governments, the use of renewable energy sources may continue to lose strength over the next several years.

The IEA's projections reinforce Ineep's perception that in the post-pandemic world, energy-policy coordination by national states will be even more important for the implementation of energy-transition policies. In this sense, the process related to an increase in renewables becomes even more unpredictable.

In this way, one can say that Ineep's projections fit into the group of more pessimistic scenarios, unfolding in a situation characterized by a reduction of the share of mineral coal, the maintenance of a significant share of liquids, moderate renewables increase (notably, photovoltaic solar energy), and a significant increase in the share of natural gas.

Finally, it can be said that the energy transition is a deeply complex process that involves the interests of multiple actors. Thus, although projections assist in decision making and planning in the energy sector, they are still of very limited use in the face of variables and uncertainties that are difficult to measure.

Another important aspect, from Ineep's point of view, is the existence of an intermediate period where natural gas serves as a bridge between the replacement of coal and oil by renewables. Compared with fossil fuels such as oil and coal, the use of natural gas emits lower levels of greenhouse gases, insignificant amounts of sulphur and no of aromatic compounds. Thus, natural gas can be considered a clean-burning fuel, since its combustion emits only water vapour and carbon dioxide (CO2) – the latter emissions being 25% lower compared with oil and between 30% and 35% lower than coal[19].

For companies using conventional fuels, natural gas appears as a viable alternative to address growing concerns about global warming. In addition to having a more competitive cost than renewable energies, natural gas allows these companies to prolong the exploration of hydrocarbons. In a scenario of expansion of intermittent renewable energies, natural gas brings flexibility and security to power systems. In view of the variability in the generation of these energies, natural gas can be used in open-cycle power plants fired by natural gas to complement the generation by these sources. This type of plant can be built quickly and has high operational flexibility and the ability to operate effectively even when it operates intermittently to supplement other sources of electricity at peak periods times or when the generation by solar, wind and other intermittent renewables may be unavailable.

18 The biggest contraction is expected to occur in biofuels, with a 13% contraction in 2020, as a result of the drop in the consumption of the fossil transport fuels blended with a percentage of biofuels. Thus, the possibility of rebound will depend on the recovery of transport in general and the return of growth in demand for gasoline and diesel.

19 Available at: https://www.gazprom-germania.de/en/all-about-natural-gas/environment/green-energy.html

As noted in Part I, from the point of view of energy importing countries, the flexibility made possible by LNG makes natural gas a desired source for countries that are low-intensive in energy and therefore rely on foreign purchases. LNG is strategic because it allows for the diversification of import sources. Therefore, natural gas is likely to play a role as an energy transition bridge fuel, slowing the rapid growth of renewables.

Besides these issues, there are a number of technical and operational challenges that need to be overcome for a possible acceleration of the change in the energy mix whose time of implementation and especially of widespread growth are still quite uncertain. These elements are covered in the next section.

From Ineep's point of view, it is essential therefore to include in the discussion on energy transition the social effects of changing the energy mix, considering the risk of increasing inequality of work due to the types of jobs generated by the sector renewable energy – quite precarious and informal.

In this sense, the concept of Just Transition is shown as a fundamental element for the inclusion of this issue in the transition agenda, as well as for the consolidation of participation and defence of workers' interests in a discussion that is often restricted to political and business actors. In this respect, the importance of not only disseminating the concept of Just Transition is highlighted, but also of including informal workers, who do not have union protection.

4. Technical and operational challenges and possible solutions

The entry of intermittent alternative renewable energies (wind and solar) brings numerous technical and operational challenges to energy systems, especially with regard to the security of power supply, remuneration and investments.

Unlike renewable energies with predictable generation such as hydro, intermittent renewable energies are characterized by the unpredictability of the output, given their direct dependence on changing climatic conditions. Although hydro generation also depends on climatic conditions, the forecast of the current hydrological series is more reliable when compared to the wind series and solar incidence. Consequently, solar and wind generations tend to show peaks fluctuations in output over short periods of time, reaching high or peak production levels followed by stretches low or no generation. Even when the energy output is very high, it may be necessary to limit production by these sources (IEEE, 2017).

It can be seen, therefore, that the unpredictability of this type of generation causes constant mismatches between the supply and demand curves, leading to uncertainties in planning activities, increased investment risk and inadequate signalling of electricity prices. Thus, the increase in the renewables share in the energy mix requires changes in the technical and operational paradigm of world energy systems. In this scenario, characteristics such as technical flexibility, power supply and reliability become essential for the expansion of energy systems towards a low carbon market.

Regarding the planning segment, operators of variable renewable sources have been transforming and improving the structure of calculations and forecasts, since traditional simulation mechanisms and optimization model are not applicable to the new composition of sources. In this sense, the wide diffusion of renewables requires a new temporality of calculation, based on hourly or sub-hourly time discretization, in order to capture variations in generation and to anticipate power deficit situations.

In face of this scenario, a series of possible solutions for the feasibility of integrating variable renewable energy into the systems has been developed and proposed. Among these, Chen, Liu and Li (2020) highlight: (i) supply management (ii) network solutions; (iii) demand response management; and (iv) large-scale energy storage technologies.

Supply management can be carried out by complementing the capacity of conventional flexible power plants, such as coal and natural gas power plants, during peak periods. In general, this is a solution perceived as transitory since it still depends on the use of non-renewable energies. It is a solution being frequently adopted in countries with a large share of fossil fuels.

Network solutions involve greater investment in expanding interconnection infrastructure and system integration. In this way, the system's flexibility and power are increased, allowing a better match of output to peak demand. In addition, investment in smart grids can make the system more reliable, as it opens up space for better management of consumer behaviour.

The response to demand refers to the management of changes in consumer behaviour, in order to better meet the conditions of energy supply. Thus, it is expected that consumers will naturally react to the changes in price signal shifting load requirements for better system operation. In turn, this mechanism requires the implementation of smart-grid technologies, mainly for measurement.

Finally, among the storage technologies used, there is the use of reversible hydroelectric plants and batteries. Despite the growing need for this type of solution, its implementation is still very restricted due to the lack of incentives and the absence of a regulatory framework that makes it economically viable. In many countries, the current regulatory framework does not adequately remunerate the systemic and operational benefits provided by these technologies and services. Therefore, the development of incentive policies is essential (CHEN; LIU; LI, 2020).

According to IRENA (2020a), from a technological point of view, it can be said that short-term and large-scale storage will be important for increasing flexibility. However, most of this will continue to be obtained through measures such as network expansion, operational measures, demand management and greater sector engagement.

A major change brought about by the massive entry of renewable alternatives is related to the structure of the energy systems. Photovoltaic solar energy, the main expanding source of renewable energy in the coming years, implies the diffusion of a decentralized network structure. Unlike conventional sources, whose value chain is centralized and aimed at economies of scale, photovoltaic energy generates electricity closer to the consumer.

Another point of discussion is the impact of the advance of intermittent renewable energies in the energy market, primarily their impact on the cost structure and electricity pricing. Due to the unpredictability and intermittency of these sources, the supply curve can suffer great variability, increasing price volatility. Thus, while in markets with a large predominance of conventional sources the variable cost is high, in markets with a high share of renewables the variable unit cost is very low or even zero, which may end up providing an economic signal of inadequate pricing.

Besides the challenges mentioned before related to the variability and intermittency issues, there are barriers associated with the very implementation of renewable energy projects and the development of these technologies. According to Komor (2009), in the case of wind and solar energy the following issue stand out:

(i) The high cost of solar photovoltaic (PV) and concentrated solar power (CSP) generation plants, in which each type of PV has a different cost. In the case of solar energy, before technical feasibility the issue of cost is the main barrier to its implementation;

(ii) The scarcity of inputs for the development of solar panels. The production of slabs involves the extraction of a large volume of ores, such as zinc. China is currently the leading producer of solar panels;

(iii) In general, large-scale wind and solar energy complexes are located in more remote areas, which requires investments in the construction of costly transmission lines;

(iv) Uncertainties related to the regulatory framework, once these sources have more current regulatory and institutional structures;

(v) In the case of wind energy, the plants have large areas per MWh, when compared with other electricity generation projects.

In general, the discussion about the challenges of energy transition focus on the greater use of wind and solar energy to replace fossil fuels. However, other forms of energy also face obstacles to their efforts to be incorporated into the energy mix. One of them is hydrogen, an energy source whose use has been growing, mainly in Europe.

Hydrogen[20] can be generated in a variety of ways, each one associated with a colour denoting the relative level of pollutants emitted during the production. These are i) gray hydrogen, made by processing natural gas; ii) blue hydrogen, natural gas sourced from carbon capture and storage (CCS) operations; iii) green hydrogen, produce by electrolysis of water using energy from renewable sources; iv) brown hydrogen, produced by electrolysis of water using energy from non-renewable sources. Among the routes mentioned, the cheapest and the most used is gray hydrogen.

In addition to the aforementioned hydrogen production routes, regions with potential for natural hydrogen supply in terrestrial craters have recently been studied. However, little is known about this segment and the characteristics of these reserves, their lifetime and estimated supply.

Several countries have already adopted national guidelines based on green hydrogen in their social and economic recovery plans. This is the case of Germany and Japan, where the National Hydrogen Strategy and Basic Hydrogen Strategy, respectively, were created.

At the regional level, in 2020, the European Commission launched the “Hydrogen strategy for a climate-neutral Europe”, in which it published its investment guidelines for the production of low-carbon hydrogen in the short term and green hydrogen in the long term. In the current circumstances, the increase of the hydrogen share is intended to contribute to the fulfilment of the European Green Deal and the transition goals established by the European community.

With regard to the global energy market, hydrogen may consolidate itself as a commodity, creating a new segment in the international market. The possibility of exporting hydrogen allows it to be produced in regions far from consumption centres, such as East and North Africa and in countries such as Argentina, Australia, Chile and China.

In this way, countries that produce natural gas and have large reserves of renewable energy can become major producers and exporters of hydrogen. In the first case, green hydrogen can be produced through electrolysis from renewable sources, highlighting the potential of countries such as Brazil, Chile, Australia, Norway, Morocco and Saudi Arabia. In the European Union, trading with other member countries and the North African region due to geographical proximity is the actual trend.

20 Hydrogen is one of the most abundant elements on Earth. However, it is difficult to find it freely in nature. In most cases, hydrogen is associated with other elements, the main one being carbon and oxygen. Thus, the production of hydrogen often occurs in a secondary way, through the process of transforming a primary resource. Due to this characteristic, hydrogen can be categorized as an energy vector of high energy intensity, obtained through the most diverse transformation routes. The primary source of hydrogen production can be a renewable or non-renewable energy resource, so that the greater the participation of carbon in the composition of the primary resource, the greater the amount of greenhouse gas emissions.

On the other hand, green-hydrogen production is still not competitive when compared to fossil-based hydrogen, considering the high cost of alkaline and proton exchange membranes (PEM) electrolyses (MME, 2020). Even considering the prospect of lower prices for renewables and the cost of electrolytes, the price of green hydrogen is not yet competitive. In Chart 2.2, the different costs of hydrogen production are described, in which the high cost of routes from renewable sources is noted.

Thus, it is essential to develop incentive mechanisms to increase the competitiveness of green hydrogen and reduce this cost differential. According to the European Union Commission (2020), it is expected that by 2030 the cost of low-carbon hydrogen will reach become competitive with other energy sources. Australia has recently exported green hydrogen for the first time and has plans to expand its installed production capacity, taking advantage of its potential to exploit wind and solar energy.

In the case of blue hydrogen production through natural gas reforming, countries that are already major producers of this resource could complement the gray hydrogen production with the application of CCS mechanisms. Countries such as Canada, Iran, Norway, Qatar, Russia and the United States have great potential to explore this type of market.

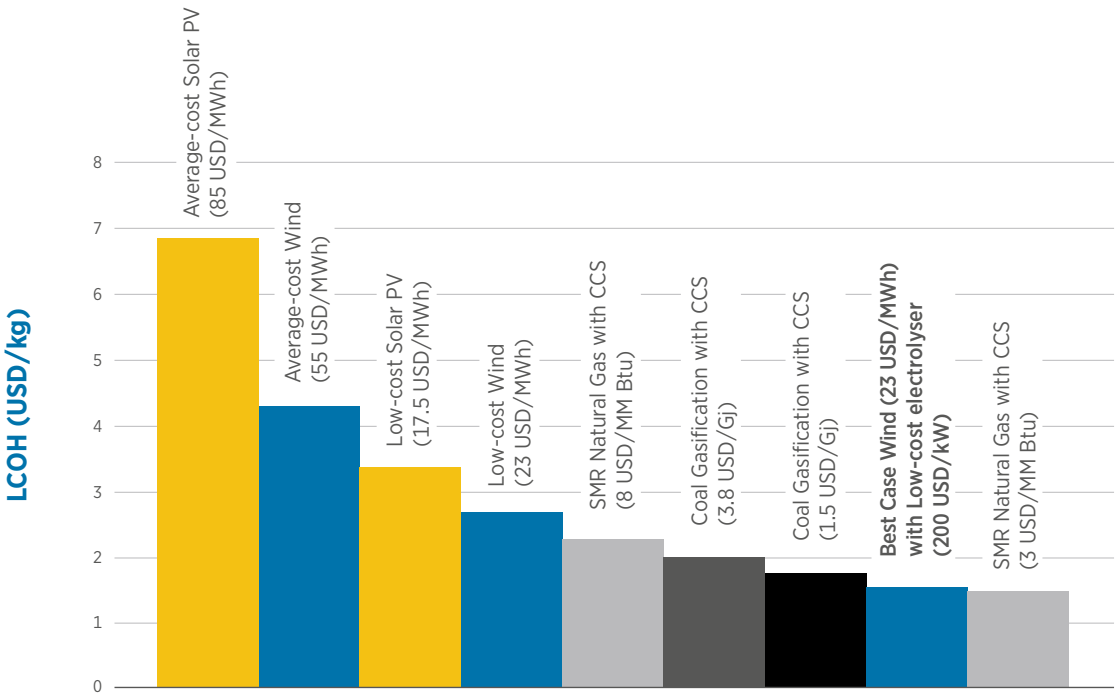
In this scenario, the advancement and improvement of CO2 capture and use technologies, as well as the implementation of the carbon credit markets have the potential to boost blue hydrogen. In addition, the hydrogen chain could benefit from the existing natural gas transportation infrastructure.

Finally, it should be noted that the hydrogen market is still in the consolidation phase and is marked by uncertainties and low forecasting capacity, especially with regard to the cost structure and standardization. As a new energy source, the hydrogen market lacks a regulatory framework, including guidelines for good practices, rules for the use of existing infrastructure, safety standards regarding its high flammability and institutional agents responsible for the development of this market.

Although efforts are already being made to overcome the technical and productive challenges of expanding the use of renewable energies, there is still a long way to go in terms of innovation and investments. In the case of hydrogen, the uncertainties are even higher, as it involves the formation of a regulatory and institutional framework for a market in this commodity to function effectively. As in any nascent industry, development is advancing and reversing in reaction to current and future challenges. In addition, it should be noted that such challenges may be different for each region and/or country depending on their energy structure, their regulatory policies, the actions of each actor involved in the industry, and the way research develops to tackle technical and other challenges.

This reinforces Ineep's perception that in the current technical and productive situation it is extremely ambitious to make an overly optimistic projection about the participation of clean energies in the global energy mix.

CHART 2.2
Hydrogen production costs by type of primary source



Source: IRENA (2019a)
Notes: Electrolyser capex: US$ 840/kW; Efficiency: 65%; Electrolyser load factor equals to either solar or wind reference capacity factors. For sake of simplicity, all reference capacity factors are set at 48% for wind farms and 26% for solar PV systems.

5. Impacts on the Labour Market

Changes in the mix of energy sources in the move towards a low carbon economy will directly impact the labour market in the coming years. The analysis of the impacts on the labour market is still a recent and little explored field in the academic scientific literature (BARCA, 2015).

In general, considering the prospects for the rapid rise of renewable energies and the reduction in the share of non-renewable energies, the main expected effects on the labour market are:

(i) The creation of "green" jobs in the sectors of renewable and energy efficiency;

(ii) The risk of destruction of some jobs, in particular in sectors with high GHG and manufactured emissions;

(iii) The redefinition of some existing jobs through the acquisition of new skills.

In recent years, the sectors of energy efficiency, solar energy, wind energy and electric mobility have expanded the creation of jobs. According to IRENA (2019b), in 2018 the renewable energy sector employed 11 million people, an increase of more than 50% compared with 2012. Most of the jobs generated are located in countries like China, Brazil, United States, India, Japan and Germany.

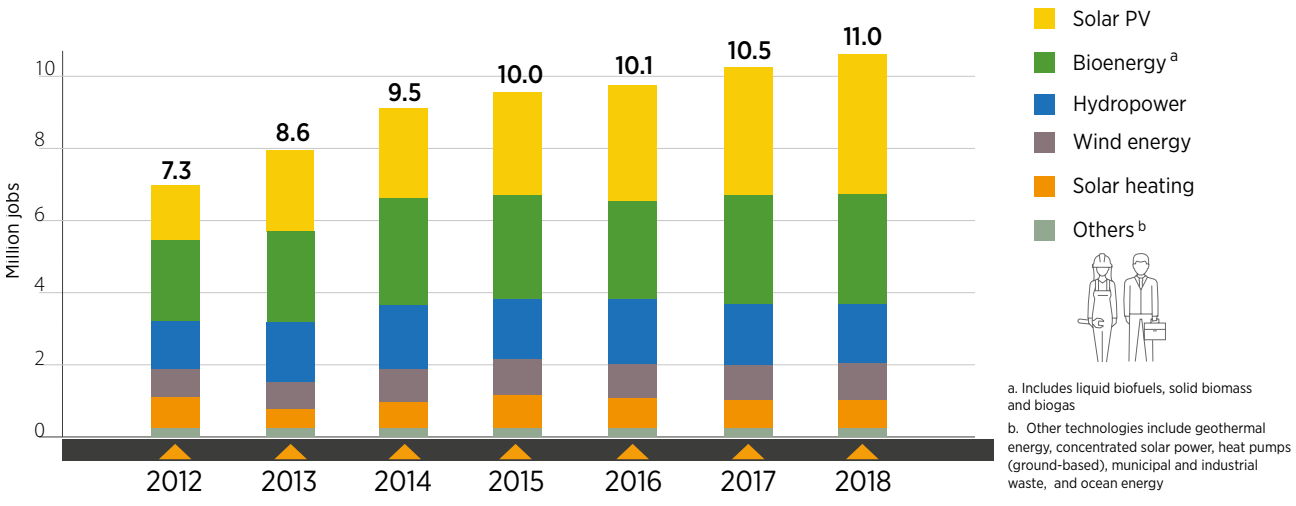
China stands out in its ability to create jobs in the solar-photovoltaic equipment industry, expanding its production of solar panels to other countries Asia. Recently, there has also been an expansion in job creation associated with the planning and implementation of Asian renewables projects[21] (IRENA, 2017a).

Among the renewable energy sectors, solar photovoltaic energy was the sector that employed the most people, registering 3.1 million jobs in 2016, a growth of 12% compared with the previous year. China, the United States and India led the generation of jobs in this sector, while a small contraction could be seen in Japan and the European Union (IRENA, 2017a).

The wind sector showed an increase in job creation of 7%, registering 1.2 million jobs in 2016, led by the United States, Germany, India and Brazil, which together account for 35% of all capacity added in the same year (IRENA, 2017a). Liquid biofuels, solid biomass and biogas also emerge as major job-generating sectors, mainly in the area of raw material supply, with emphasis on Brazil, China, the United States and India.

In the biofuels sector alone, a global generation of more than 1.7 million jobs is estimated, a growth of approximately 2% (mostly associated with agriculture) as well as jobs building fuel-processing infrastructure (IRENA, 2017a). The energy efficiency sector, often underestimated in terms of job creation, also showed an employment increase in 2016.

CHART 2.3
Employment in the renewable energy sector worldwide (2012-2018)



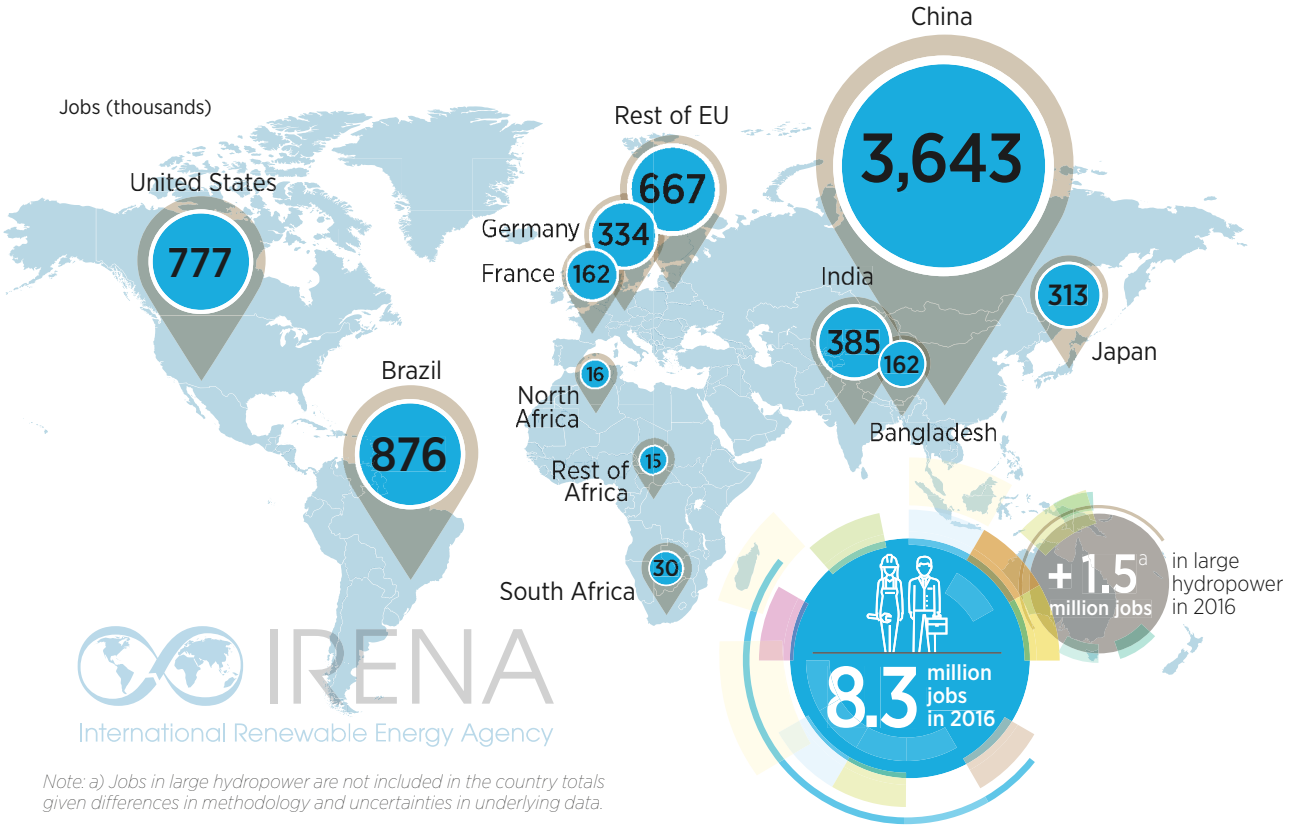
a. Includes liquid biofuels, solid biomass and biogas

b. Other technologies include geothermal energy, concentrated solar power, heat pumps (ground-based), municipal and industrial waste, and ocean energy

Source: IRENA (2019b).

21 The rise of the Chinese PV Technological Innovation System can be explained by the interaction of three context factors (the change in Chinese institutions, technology transfer, and the large European market) and specific PV Technological Innovation System dynamics (HUANG et al., 2016).

CHART 2.4
Employment in the renewable energy sector by countries (2016)



Source: IRENA (2019b).
Notes: Jobs in the hydroelectric power sector are not included.

Charts 2.3 and 2.4 present a summary of the amount of jobs generated in the renewable energy sector in the period from 2012 to 2018 (IRENA, 2019b). It should be noted that until 2015, the bioenergy sector, including biofuels, biomass and biogas, was the one that most employed in the renewable sector. Since then, the solar PV sector started to lead the generation of jobs.

By 2050, Irena (2019b) estimates that 41.9 million people will be employed in the renewable sectors. Chart 2.5 presents the institution's projections for different sectors in various locations around the world. It can be seen that of the total jobs generated by renewables, the majority are destined to the solar PV sector, followed by bioenergy and wind power.

The number of jobs varies widely between countries, depending on the different levels of development and exploitation of the value chain. The projection is that the majority of existing jobs in 2050, about 15.0 million (36%) are concentrated in East Asia, mainly in China. As a result, the rest of Asia is expected to contain 11.9 million jobs (28% of the total). In other words, almost two thirds of jobs in renewables are expected to be concentrated in Asia in 2050. The European Union, one of the leaders in the energy transition process, projects only 2.7 million jobs or 6% of the total in 2050.

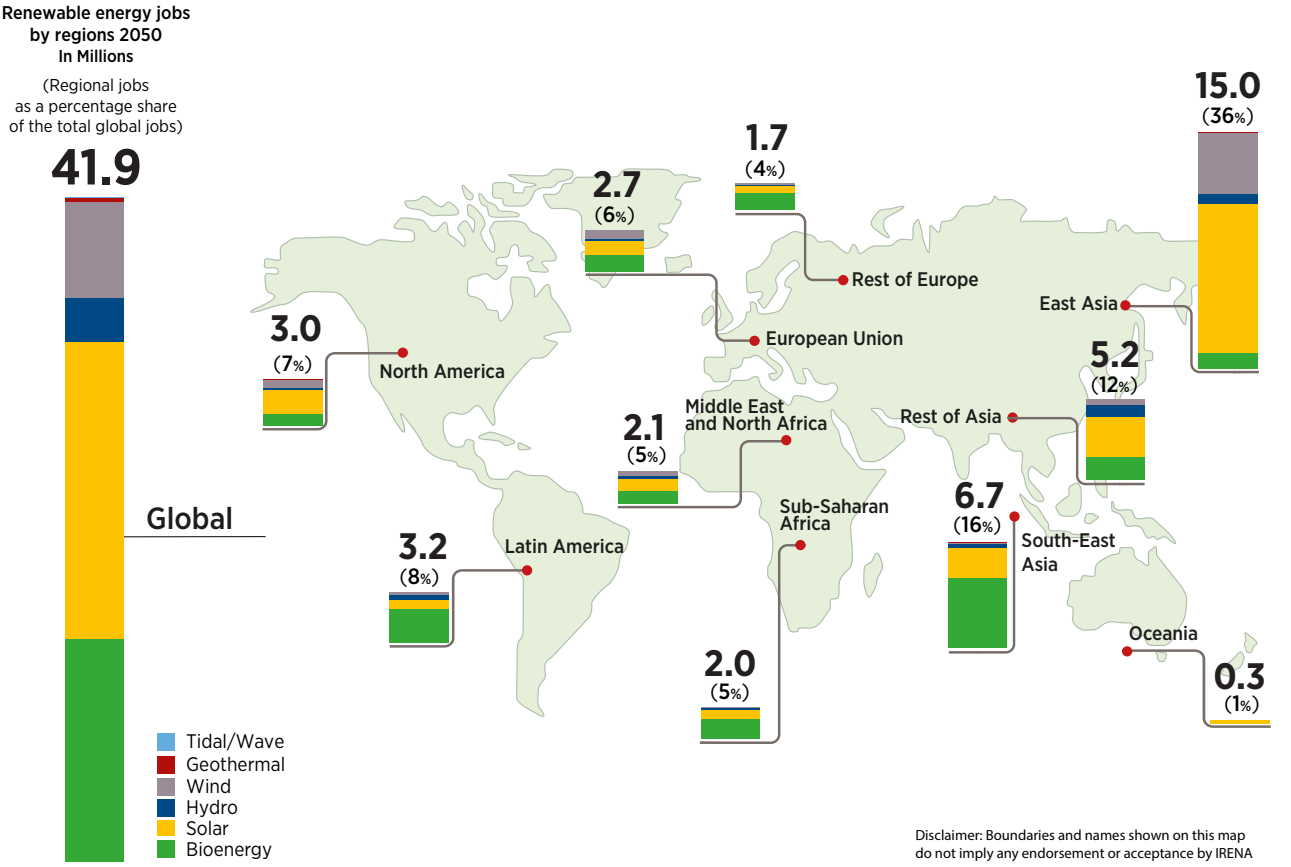
Solar energy has a large generation of jobs concentrated in the Asian continent (with the exception of the southeast region) and North America, which together account for 55% of the total jobs generated. However, in other regions, job creation is largely led by the bioenergy sector.

In the United States, the share of natural gas, wind and solar sectors has been growing in the number of jobs, while those in coal mining have been decreasing. According to DOE (2017), in 2016 there was a 26% growth in the number of jobs in the wind sector and 24.5% in the solar energy sector[22].

In the European Union, according to Notre Europe (2015), between 2008 and 2014, the number of direct or indirect jobs in the renewable energy sector grew by 70%, the majority resulting from wind energy, followed by bioenergy and photovoltaic energy. The European continent as a whole will account for 12% of jobs in the energy sector, with 36% of the continent's energy jobs in renewable energies, 22% in energy efficiency and 26% in fossil fuels.

22 The solar energy sector, the main source of expansion in the coming years, presents in its value chain jobs in the areas of project planning, sales and purchases, manufacturing, transportation, network installation, operation and maintenance and decommissioning. In order to complement and support the chain there are services such as consulting, administration, education, policy formation, financing, research and development. This same basic structure can also be seen in the onshore wind sector value chain (IRENA, 2017b).

CHART 2.5
Employment in the renewable energy sector by energy source and region, according the "Energy Transition" scenario (2050)



Source: IRENA (2019b).

Despite the growth and reduction in the costs of renewable energy in the European community, since 2012, the pace of job creation in these sectors has been slowing down. In 2015, the solar photovoltaic and biofuels sectors registered a reduction of 22% and 8.6%, respectively.

The reduction in the number of jobs in these segments is mainly due to the loss of competitiveness of European manufacturers and the displacement of part of solar photovoltaic energy to China. In 2016, there was a 16% reduction in the production of solar modules (IRENA, 2017b). Thus, there is a trade-off between production costs and stimulating job creation in the local economy.

The conventional energy sector has also been experiencing significant impacts on the number of jobs. In the Netherlands, there was a decrease of about 10,000 jobs in the conventional energy sector between 2014 and 2016, in contrast to the increase of 6,000 jobs in the renewable sector. If by 2030 the five coal plants in the country cease their operation, there will be 2,800 unemployed individuals.

In China, 5,600 coal mines are expected to shut down, resulting in the loss of 1.3 million jobs. This same movement in the coal sector can be seen in some European Union countries, India and the United States. In the oil and gas sector, the United States alone accounts for 40% of all job losses in the coal sector.

Despite job losses in the most polluting sectors, the multiplier effect of clean energy is greater than that of fossil energy. Garret-Peltier (2017) compares the effect of renewable energies and fossil fuels on job creation in the short and medium term, using the Input-Output method. According to the author, $1 million investment in renewables generates almost three times more jobs compared to the same amount of investments in fossil fuels.

> This article presents a method of using Input-Output (I-O) tables to create "synthetic" industries – namely clean energy industries that do not currently exist in I-O tables. This approach allows researchers to evaluate public and private spending in clean energy and compare it to the effects of spending on fossil fuels. Here we focus on employment impacts in the short-to-medium term, and leave aside the long-term comparison of operations and maintenance employment. We find that on average, 2.65 full-time-equivalent (FTE) jobs are created from $1 million spending in fossil fuels, while that same amount of spending would create 7.49 or 7.72 FTE jobs in renewables or energy efficiency. Thus each $1 million shifted from brown to green energy will create a net increase of 5 jobs (GARRET-PELTIER, 2017, p. 439).

It is important to emphasize that the large volume of jobs generated in the renewable sector presents a risk of reduction due to the increase in the automation of the production chain, both in the production of photovoltaic panels, wind turbines and operation and maintenance (O&M), as well as in the area of agriculture and monoculture of biofuels. Factors such as economic instability, changes in regulatory policies and the economic crisis also impact the labour market, a phenomenon that can be seen in Brazil, Japan and France, for example (IRENA, 2017a).

Even in the fossil fuel sector, the expansion of the regasification and LNG market itself may have negative developments in the labour market due to the risk of even greater demands for flexibility. As the terminals used to export and import have very different functions compared to the natural gas infrastructure transported by gas pipelines, new types of work are emerging that require new types of qualification. This creates opportunities, but at the same time, it can lead to job substitution, which often means more precarious work relations with lower salaries. Whiters (2018) explains some of these new ways of working:

> As with many large-scale energy projects, LNG projects require the skills, expertise and experience of a wide variety of people from across multiple disciplines. Across Asia we're seeing a growth in demand for both technical and non-technical professionals to support new LNG projects. Some of these positions are generalised positions which are transferable across industries (think commercial positions such as Business Development Manager, or Marketing Executive), through to highly specialised roles that are unique to the LNG industry (think Vessel Manager (LNG), or LNG Market Analyst etc). With on-shore projects (terminals etc) each phase requires different skillsets. The initial construction phase has job opportunities for construction workers, crane operators, engineering managers, welders and others. Training for many of these construction phase projects is available on-the-job, however the tight deadlines of many projects means experienced workers can gain an advantage in securing positions. Once operational LNG projects require a different set of personnel, including mechanics, electricians, plant operators, as well as white-collar personnel to oversee operational affairs and back office functions such as accounting, compliance, and HR (WHITERS, 2018).

Therefore, despite the fact that the renewable energy and energy efficiency sectors are more labour intensive, this does not necessarily imply greater job creation, given that in the long run the effects on the labour market depend on other macroeconomic variables. In addition, the location of the renewable plants can also cause displacement, negatively affecting certain regions. As mentioned, the concentration of photovoltaic panel production in China has meant job losses elsewhere in the world.

With regard to the redefinition of job positions, this can be applied in some areas of the energy sector. The drilling, geoscience and engineering activities in the O&G sector have a certain level of intersection with those carried out in the geothermal industry, just as the welding and equipment maintenance activities can be applied to wind turbines. Electricity positions, such as engineers, technicians and electricians, are necessary in any energy sector, which offers great inter-sector mobility for these workers.

Therefore, there is a certain availability of jobs in areas surrounding the fossil fuel sector, where relocation is a possibility, especially for individuals with a high level of experience and training. On the other hand, there is a gap in functions, such as project engineers, sales specialists, lawyers and auditors who need specific skills for the renewable sector, considering the existing different social, economic, environmental and regulatory complexities.

The amount of jobs generated says little about the quality of these jobs. In general, the redefinition of some jobs through the qualification of new skills can result in salary gains. However, for jobs that were already categorized as low-qualified, there is a risk of loss of wages, not to mention the precarious working conditions.

Despite the possibility of bargaining for better working conditions, there is in general a certain degree of difficulty in the organization of workers belonging to the green collars. Bearing in mind that this is a relatively recent segment, there is still no large volume of experts in these areas. The vast majority comes from other sectors.

The reduction in the power of collective organizations therefore can impact the remuneration of workers and the obtaining of benefits and guarantees. In this sense, SER (2018) points out the risk of the transition to establish lower wages, temporary contracts, and lack of access to training funds.

In addition to the employment insecurities, new jobs are characterized by the lack of an occupational identity. As emphasized by Standing (2011), the very characteristics of the current labour market, which are increasingly open and flexible, with more fragmented class structures, amplify the precariousness of labour relations. Globalization and the high speed of technological innovations change the basis of forms of job security guarantees, weakening the guarantees of the labour market, the reproduction of skills and mainly representation (STANDING, 2011).

There are in this context the green collars who often come from other careers and are undergoing redefinition in order not to lose their jobs. They gradually become alienated from the essence of their occupations and the engagement of the class collective. The very fragmentation of this class geographically decentralized and distributed across different sectors, without a sense of professional identity and without integration, makes it difficult to build a solid common agenda.

Therefore, it is noteworthy that, despite all the mentioned difficulties, the union organization becomes a crucial actor in this process. Its potential to mitigate the negative consequences of the new dynamics of the labour market, whether providing protection to workers and guaranteeing better working conditions, whether by organizing and enhancing the fight for Just Transition, is of great importance.

In addition to the impacts on workers' remuneration and quality, the restructuring of the energy system will also bring changes in the geographic distribution of job creation, since the exploitation of renewable sources and conventional sources are located in very different regions. For example, in the United States, job losses in the coal sector occur in regions such as western Virginia, Wyoming, Kentucky and Montana, while wind and solar industry jobs are generated in the states of California, Texas, Florida, Colorado[23] and New York.

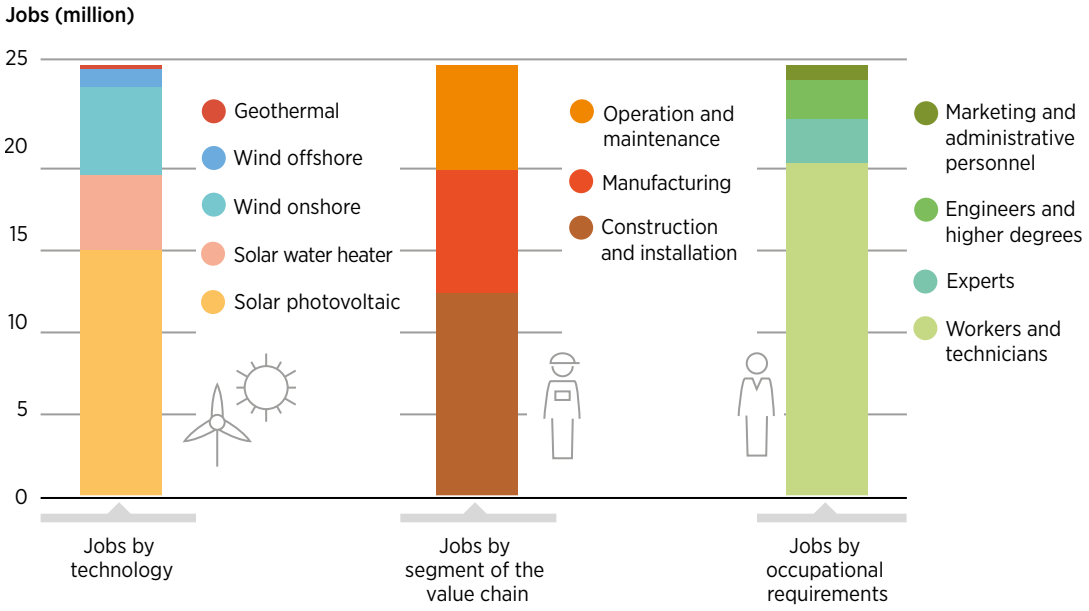
Shifts in terms of occupational profile of the energy sector are also directly associated with the effects on the quality of the activities provided. In general, green jobs encompass high job differentiation. On the one hand, there are jobs of higher qualification and higher remuneration as in high-tech think tanks, consultancies, development of emission reduction technology, decommissioning of nuclear reactors, smart technology, electrical networks, sustainable mobility, energy storage, among others. On the other hand, in some industries, such as biofuel, operational work is extremely precarious with low pay, unsanitary conditions and little organization.

Chart 2.6 and Table 2.2 show the number of jobs in 2050, by technology, segment value chain and occupational requirements. Most jobs will be concentrated in the field of construction and installation and the main occupational needs will be technical positions and less qualified jobs. In Europe, there is already a shortage of suitably qualified engineers and maintenance personnel to sustain the rapid growth of facilities.

In overall terms, the energy transition is a result of the disputes and interests of various agents. Furthermore, this is not a uniform process and will vary in each region of the globe – not only based on these disputes, but mainly due to the action of national states.

The projections themselves point to very large differences in the share of renewables in the energy mix. National energy priorities remain self-sufficiency, reducing foreign dependence and boosting the local economy, but particularly for energy importing countries, renewables can play a big role in decreasing dependence. However, many countries are reluctant to leave behind dirty industries in which they are extremely competitive. In addition, technical difficulties and challenges in the labour market can negatively affect the speed of the transition. This outlook hinges on how the transition is regulated: states need to intervene, and if the state regulates well, through the introduction of training, upskilling and reskilling, these challenges can be mitigated. And, of course, we cannot forget unions, crucial actors whose activities can surely mitigate the negative effects as well.

CHART 2.6
Projection of jobs in the renewable energy by technology and segment (2050)



Source: IRENA (2019b).

23 "(…) a new report says the solar industry's workforce increased nationally by 2.3%. Colorado saw solar jobs increase by nearly 5% in 2019 to a total of 7,174 employees" (KOHLER, 2020).

TABLE 2.2
Projection of jobs in renewable sector by technology and value chain (2050)

Technology		Segment value chain		Occupational requirements	
Solar PV	14.132	Construction & installation	11.639	Workers & technicians	19.044
Solar water heaters (SWH)	4.249	Manufacturing	7.061	Experts	2.541
Onshore wind	5.048	O&M	5.976	Engineers & higher degrees	2.246
Offshore wind	1.009	Biofuel supply	–	Marketing & administrative	846
Geothermal	238				
Total	**24.676**	**Total**	**24.676**	**Total**	**24.677**

Source: IRENA (2020b), as presented by Ineep.

PART III

International and national oil companies strategies for renewables and just transition and impacts on the workforce: what transition is under way?

1. Introduction

As seen in Part II, the transition of the energy mix does not present a single path and is generally interwoven with other broader social processes. In addition to the environmental, technological, and economic challenges of each country, these processes involve intense geopolitical disputes ranging from the interests of the countries that produce fossil fuels to the opportunities of their consuming markets.

Since oil is the main energy source consumed in the world, it is inevitable to think about how this transformation has been seen in the perspective of the major oil companies, and in what ways these companies have seen their role both in the decarbonisation of the world economy and in the search for alternative sources.

This information is extremely important for all workers in this segment. Any change in the energy composition will imply a change in the type of the workforce of these companies. This can lead to serious consequences for the current workers if the unions and organizations representing them are not able to claim for a Just Transition.

Taking this into account, Part III of this Report seeks to analyse the paths of the energy transition from the perspective of the different social actors involved. To this end, in addition to this introduction, Part III has two more sections. In the first section, one analyses the energy policy of the main oil-producing countries, emphasizing how the strategies of the major oil companies find affinities of interests with the long-term goals of these national states. Then, one specifically explores the behaviour of the oil majors in relation to the energy transition, and in what ways this action is being directed in favour of a Just Transition for workers and their communities.

2. The role of International Oil Companies and National Oil Companies in the energy policies of their home countries

2.1 U.S. energy policy and the role of Chevron and Exxon

American energy policy has been radically transformed due to its increased production of shale gas and tight oil. The status of a major global producer allowed the United States government – whether under the Obama administration or the Trump administration – to create an "energy dominance strategy".

The possibility of becoming self-sufficient in oil and natural gas and still obtaining a productive surplus for export shifted the U.S. energy security strategy, initially based on the possibility of a scarcity of supply, towards the maximization of benefits, based on the search to explore the abundance of energy production economically and geopolitically.

According to the IEA, based on this strategic axis, the National Security Strategy (NSS), released in December 2017, still under the Obama administration, detailed the five main objectives of this "energy dominance strategy":

(i) Reducing barriers to promote clean and safe energy development;

(ii) Promoting exports to help allies and partners diversify their energy sources;

(iii) Ensuring energy security, including the protection of global energy infrastructure from physical and cyberattacks;

(iv) Attaining universal energy access, including highly efficient fossil fuels, nuclear and renewables to reduce poverty and promote economic growth and prosperity;

(v) Furthering America's technological edge, including areas of nuclear, batteries, and carbon capture.

To achieve these objectives, the NSS also foresaw the need to eliminate several regulatory barriers, especially in the energy, transport, and oil exploration and production segments. Deregulation occurred from economic to environmental aspects, aiming to leverage in the shortest possible time the energy production to meet domestic demand and to generate exports, especially of LNG. According to the IEA (2019), the American government has acted on six fronts in this sphere:

(i) Withdrawing the United States from the Paris Agreement;

(ii) Directing the EPA to rescind the Clean Power Plan to cut carbon dioxide (CO2) emissions from the power sector;

(iii) Accelerating federal approval of the Keystone XL oil pipeline;

(iv) Ending a moratorium on new coal leases on federal lands;

(v) Rescinding the Stream Protection Rule that restricted coal companies from placing debris from mountaintop coal mining into streams;

(vi) Directing the Department of the Interior to reconsider regulations for hydraulic fracturing on federal lands; and

(vii) The DOE streamlined the government's approach to LNG export approvals in 2014, helping to support the United States' becoming a major global supplier of LNG and a net exporter of natural gas.

Besides the regulatory measures, the IEA (2019) recalls that the United States has been active in creating an integrated energy market, mainly with Mexico and Canada. The American goal is to advance a broad cooperation program with its neighbours, involving sharing of information, development of unconventional areas, reliability and resilience in the electricity grid, and studies for the formation of a regional renewable market.

This integration in fact should not be limited to Mexico and Canada but should involve other countries in the region such as Brazil and Colombia. Since the middle of this decade, these two countries have undergone extensive processes of deregulation and opening their industry to foreign companies, mainly from the United States. This is in line with the American interest in accessing oil reserves in Brazil and natural gas in Colombia. Under the Obama administration, the document launched in 2011, called "Blueprint for a Secure Energy Future", points out that the cooperation between the American and Brazilian governments for the exploration of the Brazilian pre-salt acquires the dimension of a strategic axis of the U.S. energy policy (SAUER, 2015).

Even with the transition from the Obama administration to that of Trump's, most of the strategic guidelines have remained. The current government of the United States maintains as a central focus the development of the unconventional oil and natural gas industry to make the country a major exporter of energy resources. The main difference between the two governments lies in the stance on global warming, as Trump has adopted measures to expand the coal industry and sharpened his rhetoric against renewable energies.

As with the previous transition (Obama to Trump), the victory of Democratic candidate Joe Biden could change the course of U.S. energy policy, though it should not mean a complete break with Trump's administration. Throughout his campaign, despite the interest in expanding investments in clean energy, Biden refuted the claim to reduce production of American shale gas and tight oil. It seems his initiatives should move toward making "oil and gas cleaner" that is, to encourage measures to reduce the emission of polluting gases.

A CNBC report, signed by Patti Domm, points out that Biden himself is relatively evasive about an abrupt transformation of American energy policy. At no point during the campaign did the Democratic candidate say he will adopt prohibitive measures to exploit shale and tight oil given its importance to American energy independence.

That perception is reinforced by the election of the U.S. Congress. Where Democratic candidates have been elected to the Senate and the House, the oil and gas industry and its workers (known as blue collars) carry important weight. Leading industry analysts believe that despite presenting a $2 trillion energy plan that includes several clean energy initiatives, Biden will not act to extinguish oil and gas production. Biden's strategy will be limited to strengthening sector regulation, restricting methane emissions, and fracking in some federal lands.

Before Trump, President Obama's energy policy, though focused on the reduction of greenhouse gases and the use of coal, placed the tight and shale industry as central to energy self-sufficiency and to secure jobs in an important region to the U.S. economy. Nothing indicates that this plan will be altered with the election of Biden. In practice, the discussion of the energy transition has not been addressed by the American political mainstream.

Even so, some government initiatives were made in favour of the energy transition, including some references to the Just Transition during the Obama administration. Among these are the Clean Power Plan (CPP), the Mid-Century Strategy (MCS), and the Partnerships for Opportunity and Workforce and Economic Revitalization Plan (POWER).

Launched in 2015, the Clean Power Plan (CPP) aimed to limit carbon emissions from coal plants and outlined a long-term plan for the decarbonization of the United States economy[24]. In October 2017, under the Trump administration, the U.S. Environmental Protection Agency announced the revocation of the CPP.

In 2015, the Paris Agreement motivated the signatory countries to communicate, by 2020, Mid-Century Strategy (MCS) outlining how they would achieve their decarbonisation objectives. In this sense, the Executive Summary of the United States MCS states that it aims to combine meeting American demand and creating a low emissions path. At the same time, it intends to maintain a prosperous economy and ensuring the Just Transition for Americans whose livelihoods are linked to the production and use of fossil fuels. The document explains that one must assess the impacts on low-income workers and families to execute these strategies:

> **By implementing the MCS over many decades, most American workers and businesses will have ample time to adjust to a changing economy […]. However, additional support may be needed for low-income households and for Americans who are particularly reliant on a high carbon economy (THE WHITE HOUSE, 2016, p. 39).**

One such support is the Partnerships for Opportunities and Workforce and Economic Revitalization (POWER) program, an initiative financed by the U.S. Congress and created in 2015, under the administration of Barack Obama. The goal is to help coal mining communities in the face of coal decline by making federal resources available to support communities and regions that have been affected by job losses in coal mining[25].

24 To this end, the United States Environmental Protection Agency established the Clean Energy Incentive Program (CEIP), a federal program that gave states incentives to reward their first investments in solar and wind power generation projects, in addition to energy efficiency programs to be implemented in low-income communities.

25 In this sense, POWER is an initiative that offers government subsidies that seek to provide retirement to miners and their families and help communities to organize themselves and respond on behalf of affected workers and companies. These activities aim to: (i) diversify local economies; (ii) create jobs in new or existing industries; (iii) attract new sources of investment for job creation; (iv) and provide a variety of workforce services and skills training, including work-based learning opportunities, resulting in high-quality and on-demand jobs. Currently, the POWER Initiative finances more than 230 projects that help empower communities to create more diverse and sustainable economies in 312 counties in 11 states (PINKER, 2020).

While these programs have had some relative success in the coal regions, critics consider these initiatives to be localized and largely reactive – responding only to an existing decline in the underground mining industry. That is, rather than creating a comprehensive vision for the transition of all types of fossil fuels the initiatives neglected a transition plan involving other related industries such as oil, gas, and surface coal mining (PIGGOT et al., 2019). Moreover, the programs have a low level of investment (in 2015, these programs' budget was between $28 and $38 million), which denotes the lack of priority that these policies have had since the Obama administration.

Regarding the oil companies, although the American IOCs are private, one can say that the strategies of these companies are based on these goals of the U.S. energy policy. The energy business expert, Clifford Krauss wrote in an article for the New York Times how the plans of European and American IOCs have a deep connection with the energy strategies of their countries of origin:

> As oil prices plunge and concerns about climate change grow, BP, Royal Dutch Shell and other European energy companies are selling off oil fields, planning a sharp reduction in emissions and investing billions in renewable energy. The American oil giants Chevron and ExxonMobil are going in a far different direction. They are doubling down on oil and natural gas and investing what amounts to pocket change in innovative climate-oriented efforts like small nuclear power plants and devices that suck carbon out of the air. The disparity reflects the vast differences in how Europe and the United States are approaching climate change, a global threat that many scientists say is increasing the frequency and severity of disasters like wildfires and hurricanes. European leaders have made tackling climate change a top priority while President Trump has called it a "hoax" and has dismantled environmental regulations to encourage the exploitation of fossil fuels (KRAUSS, 2020).

The strategic plans of the two largest American oil companies, Chevron and ExxonMobil, confirm Krauss' assessment (2020). In its latest "Annual Report", Chevron defined strategic goals only for the upstream, midstream, and downstream segments in the oil and natural gas area. Regarding climate change, Chevron's concerns are only focused on reducing the emission of greenhouse gases and water consumption. In the Investor Report published by Exxon, in May 2020, the company lists as strategic pillars the exploration sectors with low cost of extraction, production in the most different types of assets, and petrochemical and downstream projects. In this document, renewables also do not appear as a priority for Exxon.

2.2
Chinese energy policy and the role of PetroChina and Sinopec

As already noted in Part I of this report, Chinese condition of high dependence on external energy sources to meet its growing demand creates other priorities for its energy policy. For the specialized website, Iceberg Energy, the document "Energy Sector Work Guiding Opinions for 2020" released by the Chinese National Energy Administration (NEA) shows that the central goal of China's energy policy is energy security (YUKI, 2020).

According to the assessment of Iceberg Energy, the document marks the return of energy security as "China's number one energy policy priority". In recent years, the priority was concentrated on the economic optimization of supply through the adoption of sustainability measures and market reform. However, current concerns about access and energy sufficiency, amid challenges raised by geopolitics and global market issues, explain this return (YUKI, 2020). Some of the examples that motivate the Chinese government to reintroduce energy security as the axis of its sectoral policy include the United States' export ban on specific nuclear equipment, the expanded list of entities, and supply bottlenecks.

Furthermore, the Chinese government continues to pursue the three main goals defined in its 13th Five-Year Plan (FYP) (2016-2020) for the energy sector:

(i) A 15% reduction in energy consumption per unit of Gross Domestic Product (GDP) by 2020 relative to the 2015 level;

(ii) A new cap on total energy consumption of 5 billion tonnes of coal equivalent (TCE) by 2020;

(iii) A 15% increase in the share of non-fossil fuel energy (already set in the 13th FYP), with the share of natural gas rising to 10% (as previously set at the ministry level) and that of coal falling below 58% (a new objective) by 2020.

The plan establishes consumption targets for the three types of energy as proportions: 15% for non-fossil fuels, 10% for natural gas, 58% for coal, and 17% for oil. Although the steady share increase in non-fossil fuels is essential to ensure energy security under a green transition scenario, this plan, however, requires a significant increase in the consumption of natural gas. One of the main reasons for the increase in gas consumption is the fact that its use as a fuel for process heating can reduce local air pollution in China, compared to coal heating. Moreover, the FYP establishes that the Chinese transition to a cleaner economy is centred on greater use of natural gas.

Given the importance in the medium and long-term, the Chinese government has adopted several measures to guarantee the supply of natural gas. First, China has made investments abroad – mainly in its neighbouring countries – to guarantee access to natural gas reserves. In Indonesia, for example, the companies Sinohydro,

Gezhouba Group, and China Power International are betting on hydroelectric and thermal energy projects, in addition to the Chinese oil companies being positioned in areas with significant potential for natural gas exploration.

Second, China has developed domestic projects to expand the natural gas industry. In this sense, the country has expanded its capacity to import LNG. In 2015, China planned to build 60 new LNG carriers and expand the number of LNG terminals in the country from five to fourteen, totalling an investment of more than US$ 12 billion in this segment.

Along with the investment in infrastructure to import, China has used its state-owned companies to explore the gigantic potentials of unconventional natural gas in the country. Chen (2017) shows that all proven shale gas reserves in 2017 belonged to two state-owned companies, with Sinopec standing out with about 70% of the reserves. Sinopec has its main exploration in the Sichuan Basin through two subsidiaries: Sinopec Huandong Oilfied Company and Sinopec Jianghan Oilfield Company. Besides, according to the Shale Gas Development Plan 2016-2020, the government has adopted two more important measures to support the local shale gas industry: the maintenance of subsidies for companies that produce shale gas – although there is a schedule of reduction of these subsidies over the years – and the encouragement of cooperation between state-owned companies and foreign capital, as has already happened in some previous bidding rounds in which PetroChina has established partnerships with foreign operators.

In order to achieve the goal of optimizing energy use, China is betting on a program to reduce carbon emissions through emissions trading systems (ETS). China's provinces and regions receive individual carbon intensity targets that add to the national 18% reduction target, in addition to eight sectors and fifteen subsidiaries of state-owned companies that also need to meet these targets. The sectors included in the program are petrochemicals, chemicals, building materials, iron and steel, non-ferrous metals, paper production, electricity generation, and aviation (REKLEV, 2016).

Renewable investments also play an important role in reducing China's energy intensity, as shown by Kejun and Woetzel (2018):

> In its 13th Five-Year Plan, the Chinese government intends to reduce energy intensity by a total of 15% between 2016 and 2020 (...). [In 2017,] Chinese Premier Li Keqiang reported that China's energy intensity had dropped by 5%. Renewables are one of the reasons for China's drop in resource use. In the hope of becoming a world leader in this field, China is already investing more than $100 billion in domestic renewables. (...) It is estimated that Chinese solar panel collectors have a 20% cost advantage over their American counterparts, due to economies of scale and more advanced supply chain development (KEJUN; WOETZEL, 2018).

These facts indicate that natural gas plays a central role in the Chinese energy transition, both to reduce the country's energy intensity and to make its energy mix cleaner. Also, the potential for exploiting natural gas in China itself and its neighbours meets the Chinese geopolitical interest of not being so dependent on resources from countries outside its area of influence. While important for reducing the use of dirty energy, renewables still play a secondary role within Chinese energy policy.

Even so, there are some government initiatives to mitigate the effects of decarbonization policies among workers, especially in the coal industry. In order to prevent mass unemployment, the Ministry of Human Resources and Social Security (MHRSS) proposed in 2016 four measures to provide for the relocation of the workforce: (i) internal reemployment of companies, (ii) reemployment outside the company, (iii) retirement and (iv) reemployment in public positions. In view of these measures, the Ministry of Finance made available RMB 100 billion of special funds (about $15 billion) to encourage local governments and state companies to reduce carbon emissions more quickly, and this fund could only be used to finance capacity building and employee relocation (RONG, 2020).

According to these policies, the central government published figures claiming that 1.21 million layoffs caused by decarbonization targets have been relocated. However, reliable and open statistics are still lacking on where these jobs are located and under what conditions this relocation in mass has been carried out. This fact associated with low investments in the Just Transition to Chinese standards shows that the impact on workers in the transition process is not a priority for the central government.

These guidelines influence directly the actions of Chinese state-owned oil companies. PetroChina, for example, when describing its strategy, explicitly refers to the 13th Five-Year Plan pointing out that the operational focus of the company is on innovation for the recovery of mature oil fields in the country, on the greatest importance to the natural gas exploration and production, including unconventional ones, and on carrying out mergers and acquisitions abroad to explore areas of great oil and natural gas potential. The renewables segment does not appear as a priority area in PetroChina's strategy. Sinopec, in turn, signals that its general strategy is guided by a new philosophy that focuses on "energy security" and strengthening governance. In the business areas, Sinopec's goals are not so different from PetroChina. Although there is a greater focus on downstream and petrochemicals and, therefore, a more emphatic mention of the importance of the sale of renewables, the company's core business remains in the oil, natural gas and biofuels sector.

2.3
Russian energy policy and the role of their state oil companies

As highlighted in Part I, the major challenge for Russia at the moment concerns the production of fossil fuels, which in recent years has been facing problems due to the decline in the volume of its production units. Despite the desire to expand its assets and exploration fields, regions with potential reserves are located in areas of difficult economic-financial and geopolitical viability, such as the region above the Arctic Circle, the Continental Shelf, and eastern Siberia. In addition to this issue, it stands out the economic sanctions of the Atlantic powers, which have been motivating the withdrawal of important Russian partners and reducing investments in these areas.

Facing a scenario of lack of discoveries of significant oil and gas reserves, it is expected a gradual reduction in oil and gas exploration and production in Russia in the coming years. In 2040, the domestic O&G sector tends to reduce production to 9.4 million bpd. The sector's strategy focuses on increasing the recovery factor of the production fields and maintaining the productive structure.

Given this scenario, Russia's Energy Strategy program for 2035 (ES-2035), approved in April 2020 by Russian Prime Minister Mikhail Mishustin, aims literally to be "the central pillar of the economy in the next decade". For this purpose, the program puts forth five key objectives:

(i) Improving the efficiency, availability and quality of service to national demand for oil products, fuel for gas engines and electricity;

(ii) Increasing the diversification of the exports market, with emphasis on LNG investments, whose production is expected to increase 3 to 4 times by 2024. For this purpose, two LNG poles should be completed on the Yamal and Gyda peninsulas, and six petrochemical clusters. Moreover, ES-2035 foresees that Russia will develop domestic production of hydrogen and helium-3 with the aim of becoming one of the global leaders in the hydrogen market;

(iii) Modernizing the gas transport infrastructure in Eastern Siberia and the Far East with the possibility of integrating it into a single gasification network, as well as the commercial development of the Arctic region and the Northern Sea Route;

(iv) Achieving technological independence and increase the competitiveness of the national industry through the import substitution strategy adopted by the country's energy sector since 2014;

(v) Implementing digital technologies, based on several essential pillars: the digitization of the energy system; increasing the role of artificial intelligence (AI), creating and implementing intelligent systems for measuring and managing the electricity grid; and the realization of the National Technological Initiative (launched in 2014) which aims to develop a national cyber market by 2035.

Russia's focus at the moment is to maintain its role as a major global player in the natural gas segment meeting international demand. The Russian government's projection is for energy exports to grow from 10.7% to 13.9% by 2024 and from 16.1% to 32.4% by 2035. Since natural gas is the main item of these exports, Russia estimates that by 2035 it will send approximately 319.5 bcm of natural gas abroad, via pipeline, and 127 bcm via LNG, which in comparison to 2018 represents a respective growth of 45% and 372%. In addition, the Russian government aims to expand the share of natural gas in the local energy mix as a means to increase the sector's resilience, in case international demand falls. The projection is to increase the share of natural gas from 41% in 2018 to 46% - 47% in 2035. The greater use of natural gas would even allow the Russians to meet the commitments proposed in the climate agreements. For this reason, the Russian government so far has no strategic guidelines focused on the development of renewable energy and, therefore, no clear action considering the Just Transition[26].

Considering the limits of these new energies and the possibilities that still exist related to the use of traditional ones, Russian state oil and gas companies have sought to balance their strategies with the objectives of Russia's energy policy. Centring the Russian energy sector on Gazprom, Rosneft, Transef and Gazpromexport, these companies are planning for 2030 an expansion of oil and gas production via offshore projects in the Russian Arctic, aiming unconventional shale oil and gas production and greater liquefied natural gas (LNG) production and commercialization destined for the Asian market.

2.4
European energy policy and the role of their oil and gas companies

Unlike the United States, China and Russia, for the European countries renewable energies have a pivotal role in their energy policies, including where the continent's oil companies are located. Besides, increasing energy efficiency and security is also a key issue due to the high dependence on external suppliers to meet the consumption of most European countries.

In the United Kingdom, for example, the UK National Energy and Climate Plan (NECP) published in 2019 presents three guidelines of the British energy policy:

(i) Decarbonisation of the energy mix, which has two goals: reduction of 40% in greenhouse gas emissions by 2030, compared to 1990 levels, and a share increase of renewable sources in primary consumption (50% in Scotland and 70% Wales) by 2030;

(ii) Increase in energy efficiency, aiming to reduce the consumption of electricity by optimizing energy efficiency;

(iii) Guarantee of energy security that seeks, on the one hand, to diversify the sources of energy supply to meet national demand and, on the other hand, to explore the potential of the oil and natural gas segment.

26 With the exception of hydroelectric energy, which represents about 17% of the Russian energy mix, Russia has low performance in wind and solar energy, with an installed capacity of 7.5 GW, which represents less than 0.05% in the total energy consumed in the country (LOHSE et al., 2019). In the case of wind energy, although the country has one of the highest potentials in the world (the estimated total potential is 80,000 TWh/yr, of which 6,218 TWh/yr are economically viable), most of these potential areas are located in the southern steppes and on the coastline, agricultural regions and with low population density, making it difficult to integrate with the large distribution chains. In the case of solar energy, although there is a certain energy potential in the most populated regions of the south, solar coverage tends to be low (estimated between 14 to 17 GW), making this energy less competitive compared to other energy sources in the region, such as coal and natural gas.

Despite the importance of clean energy, oil and natural gas also play a central role in British energy policy. In this regard, the region seeks to explore and develop long-term partnerships with energy-producing countries close to the United Kingdom, especially Norway and Iceland. This is to maximize the economic recovery of mature oil and natural gas fields, reducing external dependence on hydrocarbons and increasing the incentive for the exploration and unconventional production of oil and natural gas.

To achieve these goals, the government is already adopting economic stimulus, such as the elimination of the Petroleum Revenue Tax and tax benefits in regions with unconventional exploration potential (Bowland-Hodder in England and Midland Valley in Scotland).

On the other hand, parliamentary initiatives have sought to implement a major change in British energy policy by proposing a Green New Deal applied to the UK's reality in the next decade[27]. Even so, the political debate around the agenda is still incipient and its supporters claim the lack of political will of the large sectors of British society as one of the barriers to greater popular support in favour of a more effective transformation towards a low-carbon economy.

According to the IEA (2017), the oil and gas industry is also strategic for Norway basically because it guarantees both energy security and the country's tax revenues. Also, oil and natural gas exports increase the power of influence in foreign affairs. "Norwegian oil and gas exports help ensure the security of supply in many IEA countries. (...) Oil and gas are produced in an environment-friendly manner with low emissions of GHGs" (IEA, 2017, p. 22).

In addition to the oil and natural gas industry, limiting the emission of greenhouse gases and generating domestic supply to meet energy demand constitute the other two priorities of Norwegian energy policy.

Norway is a country that is intensive not only in oil and natural gas but also in hydropower. According to data from bp (2020a), oil and natural gas and hydropower are responsible for 63.2% and 31.0% of Norway's primary energy consumption, respectively. And the entire generation of these two energy sources comes from national resources. Therefore, the priority of the Scandinavian nation's energy policy is to sustain the production of these sources in the medium-term.

Regarding the objective of limiting the emission of greenhouse gases, the IEA (2017) presents the instruments adopted by the Norwegian government:

- **The Norwegian power sector is nearly emission free and based on RES. The government will facilitate the transition from fossil fuels to renewable energy in areas in which energy consumption results in GHG emissions, such as transport, industry, oil and gas extraction, and heating. The polluter-pays-principle is a cornerstone of the Norwegian policy framework on climate change. Cross-sectoral economic policy instruments (e.g. CO2 tax) are the basis for decentralised, cost-effective, and informed actions. Today, more than 80% of Norwegian GHG emissions are covered by taxes and/or the EU Emissions Trading Scheme (EU-ETS) (IEA, 2017, p. 24).**

Norwegian climate policy's main action is to buy carbon emission quotas abroad, through projects that seek to finance countries with large areas of tropical forest to prevent deforestation. Paradoxically, since Norway became involved in international climate policy, the country has increased oil production without restricting domestic emissions (PINKER, 2020).

In the mid-2000s, the government coordinated the elaboration of a proposal for a general strategy to raise green competitiveness and make a low-carbon society. At the same time, the government intended to create value and new jobs, involving the union movement in this debate. Unions and employers worked together to develop long-term scenarios for 11 key sectors, to move these sectors to a low-carbon growth model while maintaining competitiveness.

Based on this proposal, in October 2016, the Committee published a series of recommendations on how the country can reduce greenhouse gas emissions while maintaining high levels of production and employment. The committee's recommendations and the contributions it received from stakeholders contributed to the Norwegian Government's Strategy for Green Competitiveness, published in 2017.

The Strategy reiterated existing commitments to reduce emissions by at least 40% by 2030 while committing to job creation and ensuring welfare standards. However, it placed emphasis on investments to allow growth in new and greener industries, rather than phasing out fossil fuel production. There is also no mention of creating policies to ensure a Just Transition for Norway's oil and gas workers.

Instead, the government asserts in the document that it intends to keep the country's oil and gas sector as "Norway's largest industry" and maintain the Norwegian platform as the world leader in terms of low CO2. Carbon capture and storage technologies (CCS) are often referred as the means by which this will be achieved. Although the document acknowledges the "transition to a competitive low emission society" and slightly discusses "green jobs" and the need to "make the job market green", neither does it define a specific policy nor does it mention the "Just Transition".

27 The program foresees five principles of action: (i) fully decarbonize the UK economy; (ii) create well-paid, safe and unionized jobs for workers in high-emission sectors today; (iii) transform the economy into a more inclusive and ecologically responsible one; (iv) protect and restore natural habitats; (v) promote social justice by supporting other countries to decarbonize quickly and fairly.

Unlike Great Britain and Norway, France has with low fossil energy intensity and is highly dependent on imports to guarantee the consumption of this energy source. This explains either partially or fully why the energy transition towards greater use of renewables is at the heart of French energy policy.

The Multiannual Energy Program (MPE), approved in November 2018, defined the country's key goals: the reduction of fossil fuel consumption and the guarantee of a sustainable energy transition.

As for fossil fuels, the government expects that by 2030 it will be able to achieve a 40% reduction in the consumption of this type of energy. To this end, the government main targets for the fulfilment of the program are the sectors of civil construction and transportation sectors. Since they are responsible for more than half of energy consumption and greenhouse gas emissions in France, the government has proposed the following measures:

(i) Investing in the energy refurbishment of public buildings and implement an energy-saving requirement for tertiary sector buildings (a 40% reduction target by 2030);

(ii) Developing new forms of mobility (car-pooling, "soft " transport, electric mobility, driverless cars);

(iii) Investing to replace all our everyday items that use too much fossil energy. For boilers, a conversion bonus of up to €3,000 will lead to the replacement of one million oil-fired boilers over the five-year term, with the aim of phasing out oil heating in the next ten years;

(iv) For cars, the conversion bonus will be revised upwards, with one million recipients over the five-year term and a "super-bonus" for French people on lower incomes or those who have to travel long distances to get to work;

(v) Shutting down all coal plants by 2022;

(vi) Developing a new offshore wind energy sector, triple onshore wind energy, and increase fivefold in photovoltaic energy by 2030. To this end, the government will invest €71 billion over the next ten years; and,

(vii) Reducing nuclear energy to 50% by 2035.

Regarding the sustainable energy transition, France aims to increase diversification in the generation of renewable energy, since there is currently a greater weight in the hydroelectric segment than in the wind and solar sectors. A report by Planete Energies (2020) shows that there is a long delay in the French renewables industry compared to other European countries[28]. To this end, France has the following objectives in this area:

(i) Developing technology and a floating wind turbine prototype off the French coast;

(ii) Increasing the share of renewable energies to 23% of gross final energy consumption by 2020 and 32% by 2030;

(iii) Increasing the amount of renewable heat and cold delivered by heating and cooling networks by 500% by 2030; and

(iv) Reducing the volume of waste going to landfill by 50% by 2050.

Concerning the Just Transition, the government announced in 2017 a Climate Change Solidarity Package, from which a series of compensatory measures and bonuses were created to ensure that climate action would benefit low-income families[29].

To fund part of these resources, however, the French government added a tax on fossil fuels consumption, making gas and diesel prices more expensive – especially among the poorest – which triggered a wave of protests in the main French cities that became known as "Yellow Vests movement". According to the protesters, although energy transition initiatives are important for climate change, the fuel tax penalized especially the poorest. Even with government incentives, they were the most penalized by the fuel mounting prices.

As a reaction to the turmoil, President Emmanuel Macron authorized the creation of the High Council on Climate (HCC), an independent body tasked with issuing advice and recommendations to the French government on the delivery of public measures and policies aimed at reducing France's greenhouse gas emissions.

Compared to American, Chinese, and Russian companies, in the strategies of European companies, renewable investment projects have a significantly greater weight — both in terms of figures and in what concerns the profile of the projects. These companies focus not only on decarbonisation and/or reduction of greenhouse gas emissions, but also on the operation of renewable energy assets, such as wind and solar. However, oil and natural gas operations remain strategic for all of them.

For example, British bp's strategy has three guidelines. The first is related to the investment in low carbon energy and electricity focusing on the segments of renewables, bioenergy, and hydrogen. The other two, in turn, are concentrated in traditional segments. Norwegian Equinor has four strategic axes, three of which are related to oil and gas. Only one seeks to develop new businesses with high added value in the renewables segment. Among European companies French company Total has the most diversified business strategy. The company wants its operations to be fully embedded in the oil and gas chain and to profit from it., To this end, it shall invest considerably in the electric energy segment in the medium and long-term and to enter in the renewables sector to increase its resilience.

28 France does not yet have any offshore wind turbines, whereas six other European countries have already installed a combined total of more than 4,000. The United Kingdom and Germany are in the lead, with more than 1,700 and 1,100 wind turbines, respectively, ahead of Denmark, the Netherlands, Belgium and Sweden. Several tenders have been launched in France, but the new wind farms will not come on stream until 2020 due to red tape (PLANETE ENERGIES, 2020).

29 Four measures in the "Climate Change Solidarity Package": (i) A vehicle conversion premium to facilitate the large-scale transition of the French vehicle fleet, financially encouraging the purchase of electric vehicles in exchange for diesel-powered cars; (ii) An "energy cheque" that partially pays the energy bills of the poorest families; (iii) Tax credit to finance part of the solar energy installations in low-income family homes; (iv) "Energy saving certificates" that generate discounts for the poorest households in energy consumption.

In general, regardless of whether they are state or private, oil companies' strategies are deeply connected to the goals of their countries of origin. In the case of American private companies, the role of unconventional oil and natural gas is of great importance due to the American repositioning that seeks to become an exporter and increase its power of influence in energy geopolitics.

As China's priority is energy security, its state-owned companies work to guarantee reserves and maintain an energy supply capable of meeting its growing demand. The reason why natural gas is strategic is because it is abundant in China and its neighbours. Also, it helps the country in the debate on climate change.

In Europe, Russia has a very similar picture. The country's government and oil companies still focus their strategies on exploiting the potential of natural gas. In the western part of the continent, in turn, renewable energies are at the centre of the energy agenda. However, in countries where the oil and natural gas industries play an important role in the local economy, governments do not give up exploiting their potential. In these countries, this is also reflected in the strategic plans of the oil companies.

3. The energy transition strategy of oil and gas majors

As noted in the previous section, although the strategies of the IOCs and NOCs are intertwined to the business interests of their shareholders and/or owners, they respond to the energy goals of their countries of origin. For this reason, the role of clean energy for the States' geopolitical and economic strategies is connected to the way in which those oil companies operate in the area of clean energy.

Compared to those of Western Europe, the limited placement of American, Chinese and Russian oil companies in the renewables segment relates to a large extent to the dispute and control of the energy market led by their countries of origin. Besides, as seen in Part I of this report, other actors also influence the oil companies' strategies, such as their shareholders, workers, their operational partners, among others.

For instance, financial funds, for example, that are engaged in the green agenda, as well as partnerships with renewable start-ups, may have a greater capacity to influence the policies of IOCs. Social movements that are involved with governments, such as workers' movements may have the capacity to mobilize NOCs to adopt actions towards the renewables. In any case, the relationship between the national states and the oil companies seems to be decisive in the strategic planning of these companies in the medium and long term.

There is a difference in performance between the European and American IOCs, as well as between the NOCs of the major producing countries when one analyses the strategy of the oil majors. This reveals not only how these companies have faced the pace and intensity of the energy transition from within their businesses, but also how these processes are being conducted according to their interests.

From a historical angle, large international oil companies showed interest in the energy transition almost simultaneously with the emergence of government policies in industrialized countries in favour of oil alternative sources in the mid-1970s. Nevertheless, the strategies adopted by American and European oil companies present very different discourses and practices when compared to each other in the following decades.

In the case of American companies, there were pioneering initiatives in the field of renewables since the second half of the 20th century. However, in the early 1980s, after Reagan was elected president and with the sharp slowdown in international oil prices, the interest of U.S. oil companies in the diversification of new sources of energy reduced dramatically. The main reasons were: i) the end of federal incentives to finance clean energy projects, which began to burden energy companies almost exclusively with the costs of energy transition, and ii) the loosening of regulations for the concession of oil exploration blocks, which ended up encouraging the big oil companies to reallocate their investments in favour of their core business.

That movement was opposed to the one practiced by European oil companies. In the meantime, these companies kept their projects focused on new energy sources. They also sought to associate their image with environmental guidelines, especially those involving the reduction of carbon emissions in the atmosphere.

Certainly there was more to this effort than mere environmental awareness. Key issues have led companies (especially large polluters) to be more attentive to environmental causes. The first one is the concern about the decline of new oil discoveries in Europe, which may in the long-term compromise the continent's energy self-sufficiency. The second relates to the political environment, which has been stimulating ecological discussion in society for decades. Companies' decision to comply with environmental causes was made either to improve their image before public opinion or to divert attention for the inevitably negative aspects of their core business.

In any case, all these different scenarios led to contrasting historical performances of European and American oil majors. In part, this explains why some of the main European companies tend to be more sensitive to the issue of energy transition, while the American ones adopt discourses and strategies that are still more conservative.

In addition to the international oil companies, the different scenarios of the energy transition also face NOCs. Motivated by their specific geographical and climatic conditions, these companies seek to exploit the opportunities found in their home territories, while seeking to align them with national political interests. This surely becomes a complex geopolitical issue as the access to these energy resources can in many cases change the balance of power between countries.

To understand how the major oil companies have acted in relation to the energy transition, the next sections first point the paths taken in recent years by the North American IOCs (ExxonMobil and Chevron) and European (bp, Shell and Total). Then, the study presents the different strategies adopted by the following NOCs: Equinor (Norway), Gazprom (Russia), and PetroChina (China).

3.1 North American IOCs and renewables: timid performance associated with the oil and natural gas chain

ExxonMobil's trajectory in the renewable sector is marked by contradictions. As one of the first oil companies to publicly express concern about the risks of fossil fuel emissions to society, in a short time Exxon has become one of the companies most engaged in climate change denial. The company has even going so far as to finance scientific bodies that are refractory to global warming and to openly criticize international initiatives to reduce greenhouse gases, such as the Kyoto Protocol.

After decades of suffering with the media wear-out due to the controversies of climate denial, in addition to the company's notable lack of interest in the renewables segment, it was in 2010 that the Exxon management finally decided to enter the research and development on clean energy. Since then, ExxonMobil has been dedicated to studies that develop biofuels from algae. In partnership with Synthetic Genomics, a private company specialized in genetic research, the plan is that with the collection of algae in puddles or oceans, a fuel 100% derived from algae can be commercialized in the coming years. To this end, Exxon's investments currently total more than $1 billion per year (HIRTERSTEIN, 2017).

In 2016, the company entered into a partnership with Renewable Energy Group to use microbes that transform non-edible crop residues, such as straw, into biofuels. It also created a strategic alliance with the Georgia Institute of Technology to develop a more efficient method of refining crude oil to make plastic using membrane and osmosis instead of heat, halving carbon dioxide (CO^2) missions.

Moreover, in the following year, the American giant surprised as it showed support for the Paris Agreement. Albeit symbolic, it meant a public recognition of the company on the climate change caused by global warming and served as a "mea culpa" to the performance of the company in the past decades, when the company publicly questioned environmental activism.

In the same direction, in 2018, ExxonMobil, along with Chevron and other giants in the sector (bp, CNPC, Eni, Equinor, Exxon, Oxy, Petrobras, Repsol, Saudi Aramco, Shell and Total), joined Oil and Gas Climate Initiative (OGCI), a consortium that brings together the main oil and gas companies and aims "to increase the scope, speed, and scale of actions taken by each company to reduce greenhouse gas emissions in their activities of oil and gas". The entry of the North American giant represented in practice an investment of $100 million for OGCI Climate Investments (BACH, 2018).

Exxon's big breakthrough in renewables, however, would only occur in November 2018, when the company announced that it will power its operations in an oil field in the Permian Basin with electricity from wind and solar projects (EGAN, 2018). Through agreements with Danish company Orsted, Exxon purchased 500 megawatts of wind and solar energy expected to go into operation by 2021. Although the terms of the agreement have not been revealed, this is the largest renewable energy contract in history signed by an oil company, according to Bloomberg NEF.

Still, Exxon believes that it is not yet the time for the company to enter the renewables market. The company is betting on the prognosis that demands for oil and gas will increase until at least 2040. This bet is driven, above all, by the economic growth potential of China and India. Therefore, the company's strategy continues to revolve around reducing greenhouse gas emissions, advancing biofuels, and carbon capture and storage (CCS).

Chevron's way in clean energy also occurred in the most recent period, precisely in 2000, when the company founded Chevron Energy Solutions (CES). This subsidiary dedicate to the development of energy efficiency solutions for buildings, central plants, and infrastructure projects from public services; and renewable energy solutions, such as solar, geothermal and biomass.

Resulting from a greater concern of Chevron management with technological innovation, the creation of CES followed that of Chevron Technology Ventures (CTV), founded in 1999 with the aim of experimenting and integrating emerging technologies with the potential of improving basic business operations of the oil industry. Thus, Energy Solutions was in charge of commercializing the renewable energy solutions that Technology Ventures tested internally in Chevron's operations.

Some projects were developed through this partnership. Between 2006 and 2014, the company invested on several fronts, ranging from biofuels to solar and wind energy projects. In 2007, Chevron and the United States Department of Energy's National Renewable Energy

Laboratory (NREL) initiated a collaborative program to develop and produce algae fuel, which could be converted into aviation fuel. The following year, in 2008, Chevron and Weyerhaeuser created Catchlight Energy LLC, a joint venture that researched the conversion of cellulose-based biomass into biofuels. The partnership between Chevron and Weyerhaeuser was publicized with great enthusiasm by the media at the time, as it united around "green energy" the second-largest American oil company with the largest landowner in the United States.

At the same time, between 2006 and 2011, CTV contributed to a strategic research alliance with the Georgia Institute of Technology to develop cellulosic biofuels and create a process to convert biomass, such as wood or switchgrass, into fuels. Furthermore, Chevron tried other insertions in the biodiesel market, such as the purchase of a minority stake in Galveston Bay Biodiesel LP in 2007, a plant in Texas that produced up to 420,000 m^3 of renewable biodiesel per year. Such a partnership, however, was disbanded in the courts less than a year later, when the oil company was accused by the other partners of contractual fraud and negligent misrepresentation, since the investments made by the company were relatively lower than expected (SMITH, 2008).

Also in 2007, Chevron decided to invest in solar energy. That year, the oil company announced that it was investing in the Solarmine Project, a 500 kW photovoltaic demonstration project that would provide daytime power to the Midway-Sunset oil field in Fellows, California. In 2010, it was the turn of the Brightfield Project – a photovoltaic demonstration project with a capacity of 740 kW in Bakersfield, California – to also explore the possibilities of using solar energy to power Chevron facilities. The company was considering using it for commercial purposes as well.

Besides, Chevron built a concentrated 1 MW photovoltaic plant in Questa, New Mexico, and also launched a 29 MW solar thermal for steam generation in the Coalinga field in the San Joaquin Valley, aimed at recovering mature oil fields. In wind energy, since 2009, Chevron has had a single farm in Casper, Wyoming, with a power generation capacity of 16.5 MW. According to the company, the wind farm produces enough capacity to supply approximately 13,000 homes in the U.S. for one year.

Although Chevron has shown a very active management with regard to renewable energy since 2000, investment winds seem to have taken a different direction from 2014. A sample of what was to come had already occurred in 2013, when the Catchlight plan was shelved by Chevron due to the profitability of other fossil fuel projects.

The big change, however, would come the following year, in 2014, when Chevron sold its renewable energy subsidiary, Chevron Energy Solutions, in addition to other businesses that worked with renewables, such as energy-saving projects for U.S. federal agencies and a pair of giant solar farms in Hawaii. At the time, many media outlets understood Chevron's departure from renewables as a gesture by the big American oil companies announcing the removal of these companies from working towards a cleaner future (GALUCCI, 2014).

It was also at this time that the oil giants became interested in the unconventional production of U.S. shale oil and gas, which ended up requiring new risky and expensive techniques that, in one way or another, forced these companies to shift their investments in "clean" technology towards innovations in drilling, underground mapping, and hydraulic fracturing.

Nowadays, Chevron has adopted new initiatives in renewables, focused on the generation of solar energy, as a result of investments made at CES time, and in partnerships with start-ups. Currently, the oil company maintains in its portfolio solar installations in Questa and the San Joaquin Valley, including projects in California, Arizona and Texas, which, at full capacity, generate a combination of 73 MW of renewable energy. There is also the 16.5 MW Casper wind farm and the stake in a 49 MW geothermal joint venture in California.

The company has resumed its activities in the renewable segment since the launch by CTV of a Future Energy Fund, a new venture capital fund "established to invest in breakthrough technologies that enable the ongoing energy transition to a greater diversity of sources", in June 2018. With a contribution of $ 100 million, the company is betting on a wide range of start-ups, ranging from companies that work in carbon capture, such as Carbon Engineering, to electric vehicle charging companies, such as ChargePoint, and energy storage companies, such as Natron Energy.

Despite these specific initiatives, Exxon and Chevron's activities remain almost 100% concentrated in the oil and gas supply chain. In fact, the most recent change can be seen in the companies' discourse, signalling now some interest in participating in the clean energy industry.

Yet, the measures adopted are very restricted to institutional actions, financial support to partners, and small investments in solar and wind power plants in the regions where they have hydrocarbon production. Although pressures for greater involvement with the green agenda are a kind of "institutional response", such initiatives are deeply associated with the oil and natural gas activity. The funds for financing clean energy originate from the hydrocarbon business, as well as from renewable operations located where there are oil and natural gas assets[30].

3.2
European IOCs and renewables: the recent interest could mean a change in the long run

Bp's trajectory in the renewables segment goes back a long way, and starts in the 1980s, when the sharp decline in oil prices and debates about the use of fossil energy gained relevance in Europe. The decisive milestone for the British company's entry into the renewables segment, however, only occurred in 1996.

From that moment on, bp revised its strategic position recognizing the importance of the debates on greenhouse gas emissions and climate change for the decision making of energy companies. The company's speech in the energy market also started to underline the need to

30 So one can call many activities as an attempt to greenwash their image (cf. also their CSR activities).

create value in the renewables sector due to the inevitable transformation of the energy mix towards clean energy. This, in the company's view, would become effective in the global economy sooner or later. The perception of the bp management was that, in the long run, coal and oil would lose relevance in the composition of the global energy supply and, therefore, a previous move by the company would be necessary to "be at front line" and adapt to the new market trends.

In this new scenario, in addition to the commitment to lower greenhouse gas emissions, bp incorporated two other objectives within its strategic plan: (i) to participate in global efforts to reduce emissions in other locations and; (ii) placing solar energy in the company's integrated company portfolio along with the traditional oil and gas segments (E&P, refining, commerce, and chemicals). Along with changes in operational activities, the corporation has intensified its participation in forums and multilateral organizations, with the entry into the Pew Center on Global Climate Change being perhaps the most important measure[31].

In order to accelerate its operations in the renewables sector, in 1999, bp acquired the company Solarex, the largest manufacturer of photovoltaic modules in the world at the time, and integrated it into bp's Gas, Energy, and Renewables business, creating bp Solar. Two years later, the company started long-term work to improve its energy efficiency by launching the UK Emissions Trading Scheme program in which bp controlled greenhouse gas emissions and, in return, received financial incentives from the British government.

Therefore, even though bp had diversified its shares in renewables throughout the first decade of the 21st century, the company's focus was on the commercialization of solar energy. Not surprisingly, between 2000 and 2010, this segment was expanded on a global scale, mainly in California. Through this strategy, bp Solar established itself as a world leader in the supply of photovoltaic cells in the 2000s. Throughout that decade, bp leveraged its volume of sales and investment in the solar energy segment. "This expansion of investments and sales allowed the consolidation of its own business model, which had around 1,700 employees and served not only residential, but also commercial and industrial markets around the world" (LEÃO, 2018, p. 51).

Even so, investments were not limited to solar energy, but also occurred in other segments. In the biofuels sector, for example, an investment program was launched in 2006, which was relatively more modest ($500 million over 100 years), focused on conducting research for production. In wind energy, the company already operated two farms in the Netherlands, in 2007, and had five more projects in the United States – the company aimed to invest in wind farms close to its refining and petrochemical units (BP, 2009).

With the 2008 international financial crisis, however, the oil price collapsed along with the drop in sales prices for photovoltaic modules. This scenario compromised the commercial viability of solar energy projects, culminating in the sale of bp Solar in 2011[32].

Another defeat for the company would come with the British government's strategic change concerning low carbon energy policies. In 2014, Ed Davey, the UK's energy and climate change secretary, bitterly opposed the renewable energy target. In a meeting with other members of the Union, he said that "British consumers aren't paying over the odds to go green" (HARVEY; TRAYNOR, 2014).

As a result, bp's action came to depend more on its own efforts and on European governance than on articulation with the British government. The movements of the bp renewables industry were much more sensitive to the company's own business dynamics than to the management of public policies and British government action. As a result, in 2011, although bp's investments grew by only 3%, there was a significant rise in renewable energy (around 45%), with spending on renewable energy reaching $1.6 billion. In that year's report, the British corporation highlighted the expansion of the biofuels market in Brazil and the 401 MW growth in wind generation capacity during the year with stakes in more than 1,000 wind turbines in the United States (BP, 2011).

In 2015 the energy market faced a sharp decline in oil prices, which invariably ended up affecting bp's investments in general and in the renewables segment in particular, as occurred with the other oil majors. In 2014, investments in renewables were below $1 billion (a drop of more than 40%). On the one hand, it helped preserve activities in the biofuels segment in Brazil and, on the other, it cautiously expanded wind farms. In the following year, there was an even higher cut in investments, which were below $300 million. Without new forecasts for new investments, bp simply remained in the renewables market with the existing assets since 2011 (BP, 2015).

Despite this, in 2015, bp participated along with nine other major oil companies in the foundation of the Oil and Gas Climate Initiative (OGCI), whose objective was to convince different global players who were increasingly sceptical about the real interest of oil companies in supporting initiatives favourable to the development of clean energy. The ten companies of the group said they were engaged in efforts for the climate conference to reach a global agreement on climate change at the Paris conference.

However, bp's big return on renewables would happen only two years later, when it announced a wide and diversified investment package that would involve biofuels and wind and solar energy. In addition, it signalled that the company would contribute to the transition process of the energy mix of the transport sector through the development of "new efficient fuels and lubricants that can help our customers and consumers to reduce their emissions" (BP, 2017).

31 Based on these new guidelines, already in 1997, bp increased its investments in research and development (R&D) and in renewable operations, as well as established an energy transition program, joining efforts with international organizations such as the U.S. Electric Power Research Institute, which aimed to "develop a technical strategy to accelerate the development and diffusion of low-carbon and low-cost technologies" (RIBAS, 2008, p. 110). In this sense, in 1998, a 10% reduction target for greenhouse gas emissions was imposed to be achieved by 2010.

32 According to the company's CEO, Bob Dudley, "global challenges have significantly impacted the solar industry, making it difficult to sustain returns for the company in the long run. […] We are no longer able to make money with bp Solar. The sector has become commoditized. There is no more space for specialized companies" (LEÃO, 2018, p. 52).

To this end, in the 2017 and 2018 biennium, the British oil major bolstered its expenditures in the renewable sector and, through the construction of joint ventures, re-entered the solar sector and entered the American biofuels market. Accordingly, some investments were made: the acquisition of 43% of the company Lightsource, one of the largest solar energy start-ups in Europe; the purchase of Nesika Energy, LLC and its modern ethanol plant in Scandia, Kansas; and the merger and acquisition of the electric car charging companies FreeWire and StoreDot.

Since then, bp has maintained its intention to expand annual investments in renewables to $500 million in order to increase its wind and solar power generation capacity to 15 gigawatts (in 2010, it was 774 megawatts), as well as to integrate operations to cleaner energies.

According to the company, the goal by 2025 is to reach the amount between $3 and 4 billion and, by 2030, $5 billion. Bearing this in mind, the oil company aims to increase its capacity for renewable energy generation from the current 2.5 GW to 50 GW in 2030. According to bp, a large part of this additional energy capacity generated must come from Lightsource. In September 2019, the start-up announced that it will spend $8 billion to generate 10 GW of solar energy by 2023 (LEÃO, 2020d).

Despite the current ambitious renewables strategy, initiatives in this segment are more recent. After the closure of bp Solar, the British major saw its participation in the renewables industry decrease. Since then, the company has reorganized its operations, focusing initially on the biofuels sectors and later on wind and solar. However, this occurred through partnerships with smaller companies (start-ups, for example) to dilute the risks and, at the same time, participate more specifically in this type of activity.

For example, in the case of solar energy, the big bp project took place in partnership with Lightsource and, in biofuels, it was focused on ethanol production in Brazil. As a result, analyst Maxx Chatsko said that bp's investments were lagging behind its peers. In the biofuels sector, for example, which is one of bp's priorities, he recalls that its production of about 205 million gallons of ethanol from three facilities in Brazil – which also burn agricultural waste to generate a decent amount of electricity renewable – "compared to American production of 15.5 billion gallons of ethanol per year, does not make the major oil company an important global player in renewable fuels" (CHATSKO, 2020). In a way, bp's ambitions still do not correspond with its performance quite concentrated and very associated with smaller companies.

As in the case of bp, Shell also has a long history in the renewables industry. In the 1980s, the oil company made the first inroads in solar energy and biomass. In the following decades, the company acted marginally in this segment. Despite this, the company's investments in renewables were insignificant until the early 2000s (0.6% of the total). For this reason, several international environmental agencies accused the company of practicing "greenwashing", since neither the investments were in fact expressive in favor of environmental causes, nor did their practices reflect such concern.

Moreover, the oil company has had a dubious relationship with climate change for years. As the reports leaked by the Climate Files foundation showed. Shell recognised in internal documents that the carbon emission into the atmosphere has potentially serious consequences for the environment due to "climate change caused by global warming through man-made increases in gases like carbon dioxide". However, publicly, it acted in line with challenging climate science by stating that "man-made carbon dioxide is only a small fraction of the flow in natural systems (...) we are not yet in a position to know if any effect will be good, bad or indifferent, whether it will last or whether the Earth's natural processes will restore stability"[33].

Only in 2016 did the Anglo-Dutch oil company officially create its subsidiary in new energies (Shell New Energies), with the aim of gathering and exploring clean energy opportunities and enabling the sale of products made from wind and solar energy, in addition to biofuels and hydrogen transformations.

To this end, the company has invested in partnerships (joint ventures) with start-ups in each of these sectors. According to Shell, the total value of these investments varied in the period of 2016 until 2020 between $1 billion and $2 billion per year and estimates that between 2021 and 2025 it will increase its investments to $2-3 billion per year.

Within Shell New Energies, the projects are divided into two major areas: new transport fuels and electricity. Among the new fuels, Shell has been active in the production of ethanol extracted from sugar cane in Brazil (through the Raízen joint venture) and in the transformation of organic waste into fuels such as gasoline and diesel in Bangalore, India. New biofuel plants are under development in the United States, Canada, the United Kingdom and the Netherlands. Another initiative that Shell has invested in recent years is the commercialization of hydrogen for automobiles in China, Germany, the United Kingdom, the Netherlands, Canada and the United States. Also concerning electric vehicles, Shell acquired stakes in three important companies in the sector in 2017: Sonnen, a German energy storage company and leader in the domestic battery market; Greenlots, an American start-up specialized in charging electric vehicles; and finally, EV NewMotion, a provider of electric car charges in the Netherlands.

Meanwhile, in the electric power industry, Shell New Energies' operations have been integrated, from generation to energy distribution, always with a focus on renewable electricity. In solar energy, the company is partner of a manufacturer of photovoltaic panels in the United States (Silicon Ranch) and other developers of solar projects in India (Sunseap Group) and Southeast Asia (Cleantech Solar).

33 Uncovered internal documents are available at: https://climateinvestigations.org/shell-oil-climate-documents/

In the wind segment, Shell has an important onshore plant in the United States with machinery that have a power generation capacity higher than 1GW, distributed in operations in the states of Wyoming, Texas and California. Keeping an eye on the potential of offshore winds, Shell is also developing large offshore wind projects in New Jersey and Massachusetts, in areas that promise to jointly generate more than 4GW and in the North Sea, notably present in the Netherlands and the United Kingdom.

In short, Shell's strategy in renewables goes through two distinct phases: (i) 2000s-2010s: when Shell decided to create its international subsidiary in renewable energies, intending to invest in commercially viable clean energy technologies; and, (ii) 2010s onwards: when the oil company started to participate effectively in the energy transition by commercializing projects in new transport fuels (biofuels and hydrogen) and electric energy (offshore wind and solar) for the final consumer.

This strategy, however, has not yet become a massive investment program. According to Ambrose and Jolly (2020), spending by the Anglo-Dutch oil company on renewables in the 2016-2020 quadrennium is well below what was forecast at the beginning of the period. This indicates that clean energy projects are much slower than the one announced by the company and that a supposed energy transition will be left for the long term.

Shell currently runs the risk of not meeting the investment targets for green energy projects set for the period 2016 to 2020. Slow progress in the renewable sector raises concerns about oil companies' performance in climate change control strategies. Since 2016, with the creation of the "New Energies" Division, Shell has invested around $2 billion on building a low-carbon energy and electricity generation business. This investment is well below the forecast for the period 2016-2020, estimated at $4 billion and $6 billion. In this context, it should be noted that despite public support from major oil companies for global climate targets, they continue to invest in clean energies, only about 1% of their annual spending budget, while maintaining the production of fossil fuel products above the limits defined in the Paris Climate Agreement (AMBROSE; JOLLY, 2020).

The history of the French company Total is even longer compared to the British oil companies. Its trajectory in the renewable sector began in the 1970s, when the company developed its first solar panel projects on farms in the Middle East, Africa, and Mexico. Throughout the 1980s, Total not only maintained its research in the clean energy sector but founded, in 1983, Tenesol (Total Énergie Solaire), a subsidiary dedicated exclusively to the manufacture, installation, and commercialization of photovoltaic modules in Asia, Africa, and Latin America.

With operations in 18 countries and supplying energy to more than 100,000 homes (500 MW), Total's subsidiary in solar energy existed until 2011, when the French major carried out its first major merger in the renewable sector, with the acquisition of control of U.S. solar cell manufacturer SunPower, for $1.4 billion.

The entry into the United States solar market was an indication that Total was adopting a more aggressive stance in its renewable energy business, especially with regard to solar energy and biomass. As of 2010, Total extended its expertise in biofuels beyond the European continent, when it bought a stake in the North American start-up Amyris, a biotechnology company.

Other renewable energy companies would be incorporated into Total's business in the following years. In 2016, it was its turn to enter the energy storage segment. That year, Total bought the century-old French battery manufacturer Saft for $1.1 billion and acquired the Belgian green energy utility Lampiris for $224 million. With the acquisition of these two companies, Total automatically became the international leader in the lithium battery market, an important piece in the puzzle of the company since it intends to become one of the giants in the electric supply sector for vehicles, industries, and residences in the coming years.

For this reason, in the following year Total acquired control of Eren, a French company with great experience in the generation of clean energy, specialized in the development of solar, wind and hydroelectric projects. With a strong presence in Europe and expanding to countries in Latin America, Africa, and Southeast Asia, Total Eren has an electric plant with renewable energy generation counting with a potential higher than 2.8 GW. Finally, in 2018, the oil company acquired Quadran, an integrated energy company for renewable energy supply in the French retail market, and also operating in other segments such as the manufacture of biomass and biogas transformation units, in addition to power generation through wind turbines.

Regarding this last aspect, it was in 2019 that the French giant became significantly interested in wind energy. In August of last year, the company acquired Vents d'Oc, a company specialized in planning and installing onshore wind farms in France. Seven months later, in March 2020, Total bought GWP (Global Wind Power), a developer of onshore wind turbines with a portfolio of projects equivalent to 1,000 MW (EDWARDES-EVANS, 2020).

In other words, with all these mergers and acquisitions in view, Total's strategy for renewables in the 21st century goes through three main phases: (i) 2010-2016: when the company invested in the first major international solar energy projects and biofuels, notably concentrated in the United States and the Middle East; (ii) 2016-2018: when Total integrated its clean energy generation and energy storage businesses, turning to the European retail market; and, (iii) 2018 onwards: when the oil company started to diversify its solar projects to Latin America and Asia and invest in large wind energy projects in Europe (TOTAL, 2019).

In short, European IOCs have a more aggressive position than their American counterparts in the renewable segment. In addition to concerns about decarbonisation, these companies have carried out operational projects in the renewables industry in different segments and have more ambitious long-term programs. The three

cases analysed here have activities in several areas, such as biofuels, solar, and wind. However, mainly in British companies, the weight of clean energy in the assets of these companies is still relatively small and their investments occur in partnership with start-ups. This indicates that companies still invest a relatively small amount of capital in this segment and prefer acting in an associated mode so as to dilute risks. Not by chance, until the end of the past decade, more than 90% of the investments of these companies were still concentrated in oil and natural gas.

3.3
National Oil Companies and renewables: performance conditioned to the interests of national states

Concerning the energy transition in the 1990s Equinor began its trajectory through projects associated with the carbon capture and storage. This was how the agenda about controlling global warming and emission of greenhouse gases came into the Norwegian company's operating portfolio.

Despite this, until the mid-2000s, Equinor had not yet bet in more structured renewable energy ventures. Kapranov (2018) assessed both Equinor's discourse and actions about the climate change between 2001 and 2007. According to the author, the company leaned towards the "reduction of emissions". This means its efforts were concentrated in that period in the mitigation of the negative impacts of oil exploration and production activities on the environment, especially outside Norway.

To achieve this goal, Equinor advocated that a kind of "emissions trading" should be implemented. It would be a fund in which countries and companies could have access to credits related to the volume of reductions that were made.

As of 2007, however, Equinor's new position on the energy transition issues became clear in virtue of three events: (i) the merger of the company with another energy giant, Hydro; (ii) a new guideline formulated in the 2008 Strategic Plan on the subject and (iii) the change of Norway's energy policy conception.

First, the merger with Norsky Hydro in 2007 made Equinor one of the largest offshore oil companies in the world. As a result, Equinor gained strength to enter the renewables sector, since at the time Hydro "was an important player in the development of energy sources, a segment that it believed to be a fundamental asset for the company's future" (MICHAELSEN, 2008).

For this reason, as of 2008 Equinor started to adopt a more aggressive stance regarding renewables in its Business Plan. In other words, instead of remaining distant from greenhouse gases issues, the Norwegian state company started to strengthen its activities concerning cleaner ways of energy generation. Equinor's sustainability reports for 2007 and 2009 illustrate this imitative direction, when the company exposed its intention to invest in offshore wind energy projects.

Yet, Equinor's intention to invest in cleaner energy is supported by Norway's new energy policy launched in 2005. That year, Åslaug Haga's arrival at the Ministry of Energy – a well-known enthusiast of Norwegian potential in offshore wind segment – influenced the debate in favour of this energy source. In his view, this would be fundamental to solving the problem of climate change[34].

As a consequence, Equinor increased its investments in renewable energy, with greater emphasis on offshore wind energy. Between 2006 and 2016, the Norwegian company invested in six projects in this segment (NILSEN, 2017). The first project, called Hywind, began production in 2009. Other four projects were planned for Great Britain, three of which (two in England and one in Scotland) since 2017 have already supplied clean electricity to 650,000 homes in the region. The fourth project, called Dogger Bank, is scheduled for construction in 2022 and has the potential to supply energy to up to five million British households. The last project was built in Germany, whose supply capacity is up to 400 thousand households in the country.

Even though offshore wind remains the priority sector for the energy transition, Equinor has also diversified its operations to other segments, such as solar and onshore wind, in addition to the carbon capture and storage. Hence, since 2015 the company owns its subsidiary "New Energy Solutions", in order to formulate new profitable solutions in renewable and/or low-carbon energy and combine them with Equinor's oil and gas portfolio. Aligned with the new subsidiary, Equinor's other major initiative was to set up a $200 million venture capital fund to invest in clean energy companies in a period between four and seven years.

As a result, Equinor acquired in 2017 part of the Apodi solar project in Brazil through the purchase of a stake in Scatec Solar. Also, state-owned Statkraft transferred all of its offshore wind assets to Equinor. In the following year, the oil company bought offshore wind development projects in an initial phase located in Poland, the United States, and Argentina. All of these actions boosted R&D spending on low-carbon energy, which reached $66 million (an increase of more than 30% compared to 2016) representing 21% of all company spending. Investments in renewable energies reached 5% of the total, about 500 million in 2018.

In what concerns investments, Equinor takes its management very carefully if compared to other is c oil majors. Thus, Equinor's entry into the renewables business in recent years tends to be less aggressive than that of its European peers. However, the stability of investments reveals the strategic consistency of the company around the clean energy market.

34 In his administration, Haga sought to articulate state-owned companies Equinor and Enova to develop the first floating turbine for use in offshore oil installations on the Norwegian coast, in addition to advocating the creation of a licensing for the use of these new technologies. Even with the replacement of Haga by Riis-Johansen in June 2008, the ministry continued to work on the construction of a law that would encourage the production of offshore renewable energy. In addition, in 2009 the Ministry of Energy granted the license to implement the project that consisted of installing 70 turbines with an installed capacity of 350 megawatts and costing €900 million, of which about 25% was financed by companies and/or public funds.

PetroChina, in turn, is a subsidiary of China National Petroleum Corporation (CNPC), characterized as one of the largest producers and distributors of oil and natural gas in the world and the largest in market value. Founded in 1999 and headquartered in Beijing, over the past few years PetroChina strengthened its role in exploration and production; refining and transportation; storage and marketing of crude oil and natural gas, as well as its derivatives.

PetroChina has an essentially onshore portfolio, with reduced assets in deep waters and LNG. In the context of the energy transition, unlike the trajectory of European companies, Chinese state-owned companies invested little or nothing in increasing the share of renewable energies. They opted to preserve their core activities, that is, the fossil fuel exploration and production.

Given the company is China's largest supplier of natural gas, the Chinese government has sought to increase the share of clean fossil fuel, in order to match it with the use of mineral coal and oil. Thus, natural gas becomes China's main transition fuel, dominating PetroChina's domestic production and investments in the coming years.

The significant investment in the expansion of Chinese gas pipeline networks, in particular those connecting the country to Central Asia, uncovers the natural gas' relevance. In this sense, PetroChina accelerated the construction of national and international gas pipelines, contributing to the transportation and the commercialization of natural gas and LNG.

Although still at a slow pace, CNPC, PetroChina's parent company, has been taking its first steps towards establishing a cleaner economy. The company is a member of the "Oil and Gas Climate Initiative" (OGCI) and one of the members and sponsors of the "International Science and Technology Cooperation Program for New and Renewable Energy", where it seeks to expand and improve knowledge about clean technologies.

Following this same trend, PetroChina has issued development plans for low-carbon and green technologies in the past two years. In 2019, the oil company began the development and use of geothermal resources in northern China and participated in the development of geothermal resources in Kenya. In addition, the company built the hydrogen refuelling stations along with the Haipoer Hydrogen Technology Company. Also, PetroChina prepared the "Action Plan for Green Development", in order to develop cleaner oil and gas production, as well as the exploration of new energies, in particular geothermal energy and hydrogen, two areas associated with the company's exploration and refining activities.

In line with the national goals under the Paris Agreement, PetroChina has initiatives related to strengthening the management of carbon emissions and increasing energy efficiency. By 2020, they commit to reduce CO2 equivalent emissions per unit of operating revenue by 25% compared to 2015. In 2019, the company's CO2 equivalent emissions per unit of operating revenue decreased by 25.17% compared to the level of 2015.

More recently, PetroChina began to turn its activities to natural gas, repositioning itself as a producer and trader of natural gas and selling part of its pipeline assets. In 2020, the company announced that part of this revenue – from the sale of its gas pipelines, storage, and terminals, about $38 billion – will be used to initiate investments in wind, solar, geothermal, and hydrogen assets.

Indeed, investments in renewables and new energies depend on the evolution of these sectors in the economy. Thus, the company's key goal is still oil and gas exploration so as to meet the growing Chinese demand.

Finally, in the face of the energy transition process, Chinese NOCs have sought to individually adopt the strategies that are closest to their main activities. In this sense, PetroChina has repositioned itself as a major producer and trader of natural gas, as well as to search for new energies (geothermal and hydrogen). CNPC leads the development of technologies for the production of "clean" hydrocarbons, such as CCUS. CNOOC is focused on biodiesel and offshore wind segments, building its first 300 MW wind farm in Jiangsu. And Sinopec is dedicated to expanding the hydrogen market through the construction of pilot projects and research, among other activities. Even so, these companies remain focused on oil and natural gas.

As PetroChina, Gazprom's strategy is centred on natural gas. First, because the Russian oil company is considered the world's largest natural gas exporter. Second, because the company has a central role in the natural gas market, due to its ability to build an energy bridge between the Asian and European markets.

In 2017, the Russian state-owned company produced around 470 KWh of electricity, counting with a portfolio of non-renewable and renewable energy generation assets, which include hydroelectric, wind, and solar plants, and continues to expand its assets. Gazprom uses renewable energy sources and secondary energy sources for auxiliary needs and sale to external consumers.

For production, gas trunk line transmission facilities, and gas distribution networks, one applies 2358 power generation units (solar and wind generators, gas flow heat and energy power converters). Solar and wind generators accounted for 1399 of this number in 2019, in contrast to 1220 units in 2017. Also, a 102 MW wind farm is under construction with the company NIS Energowind.

In regards to energy transition, one can notice that Gazprom's strategies primarily relates to the expansion of the use of natural gas. After all, there is a direct correlation between the increase in the share of natural gas at the expense of the use of coal in the total supply of primary energy and the decrease in carbon intensity of the Russian energy sector.

With regard to investments in renewables segment, in 2019, in partnership with Hevel, Russia's largest integrated solar energy company, the construction of a solar power plant with a capacity of 1MW (first project phase) at the Omsk oil refinery of Gazprom was completed. This investment project was unique for the Russian industry as it adopted green technologies.

Gazprom is also developing renewable energy technologies in Serbia. Together with Switzerland's MET Renewables AG, the Russian company is implementing a project to build a windfarm in Plandište, in Serbia, involving the installation of 34 wind turbines, with a total capacity of 102 MW. A further area of interest concerns geothermal energy[35].

Despite this, the Russian company's activities in renewables are still quite incipient and there is no indication that in the medium-term the renewable energy industry will become strategic for it.

Among the NOCs selected, PetroChina and Gazprom have specific projects in the area of renewables. Most of them are either concentrated in the area of decarbonisation or to meet the energy demand of their own facilities. The two companies focus their activities and strategies primarily on natural gas. Natural gas plays an important role in meeting the geopolitical and economic interests of their countries of origin, in addition to helping to make their energy mixes cleaner.

Equinor has a more prominent role in renewables, meeting the strategic objectives of its region. The company combines operations in the oil and natural gas exploration in Norway to become a global player in renewables, mainly in offshore wind energy. Even though, this process has only gained more strength since the middle of the past decade.

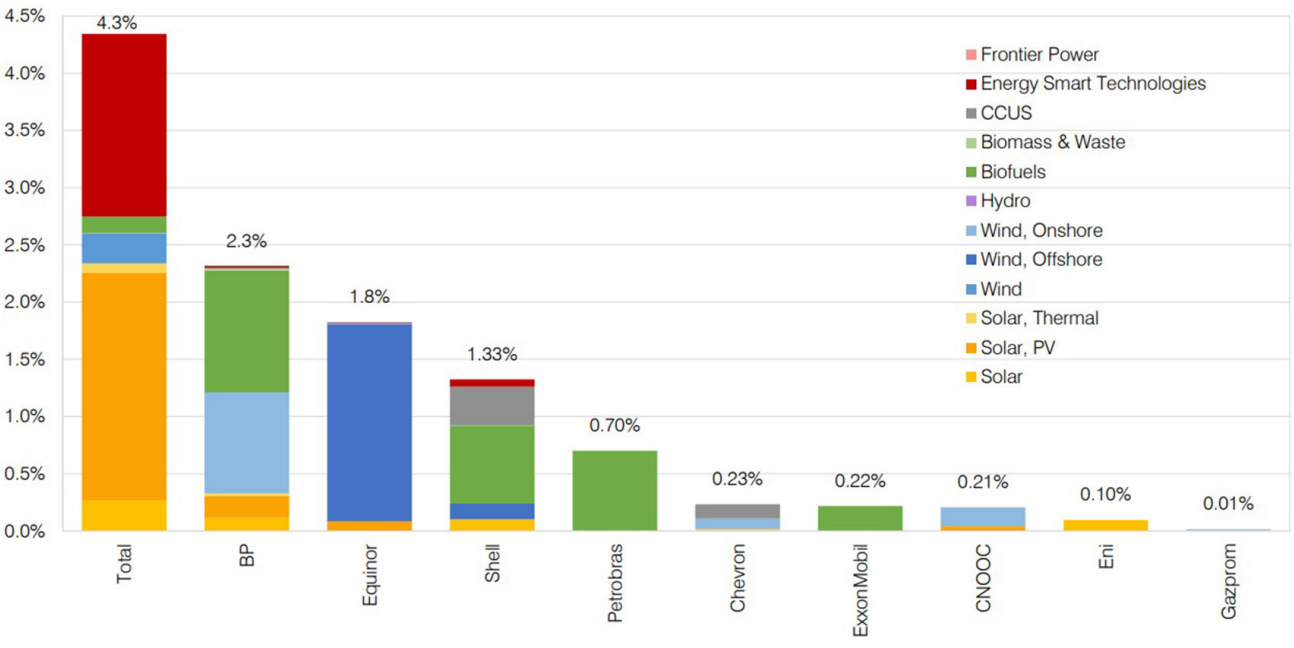
3.4
The "real" entry of oil companies in the renewables segment

The previous section leaves no doubt that there is a considerable difference between the oil companies' strategies for the clean energy segment. In general, European companies have been more aggressive in the role of the renewables industry in comparison to the American IOCs and Chinese and Russian NOCs. In these latter companies, mainly due to the interests and potential of their countries, investments in the renewables segment irrelevant and there is no sign of a change in this scenario in the medium-term.

Even in Europe, there are important distinctions. Members of the original "Seven Sisters", bp and Shell, are more eager to maintain their position as major producers of oil and natural gas than Equinor and Total, which already position themselves globally in several renewable chains.

Despite these differences, there is no doubt that, in all of these companies, the oil and natural gas industry continues to overwhelmingly dominate their investment projects. The survey by Shojaeddini et al. (2019), which brings together investments by IOCs and NOCs in renewable and low-carbon energy between 2010 and 2018, shows that the percentage of capital expenditure in renewables is still extremely low, below 5% in all of them. Although the companies promise and make a speech that they will be aggressive on their performance on the clean energy segment, the strategy adopted by the majors was not guided by a massive investment program.

CHART 3.1
Disclosed low-carbon investment by IOCs (2010-2018). As a proportion of total CAPEX



Source: Shojaeddini et al. (2019)

35 The company also operates in the mobility sector, especially in the development of alternative fuels, such as EcoGas, and in the expansion of infrastructure for natural gas vehicles. In 2019, the company increased about 30% of its domestic sales of natural gas for vehicular use. In addition to the mobility sector, hydrogen production is mentioned in the scope of clean energy strategies, in which the Omsk refinery stands out with an annual production capacity of 12,300 tons of hydrogen.

According to Chart 3.1, oil companies Total and bp dedicated more than 2% of their investment to renewable and low-carbon energy; Shell and Equinor, between 1% and 2%; while American companies did not even reach 0.5%. In this analysis, the percentage of investments by American companies was only higher than that of Russian Gazprom, Italian ENI, and Chinese CNOOC, which practically did not make any investments in this segment in the last decade.

When analysing the investments of these companies, the authors conclude that their strategies are still relatively conservative. This is because they are moving into the renewable energy sector through four categories of passive strategies: acquisitions and minority investments; venture capital investments; direct ownership of renewable generation assets; and research and development (R&D) (SHOJAEDDINI et al., 2019). That is, excluding some specific actions, the companies do not have major operational projects in renewables compared to the ones in the oil and natural gas segment. In fact, they are restricted to the creation of venture capital funds, R&D expenses, acquisition of start-ups and projects associated with hydrocarbon ventures.

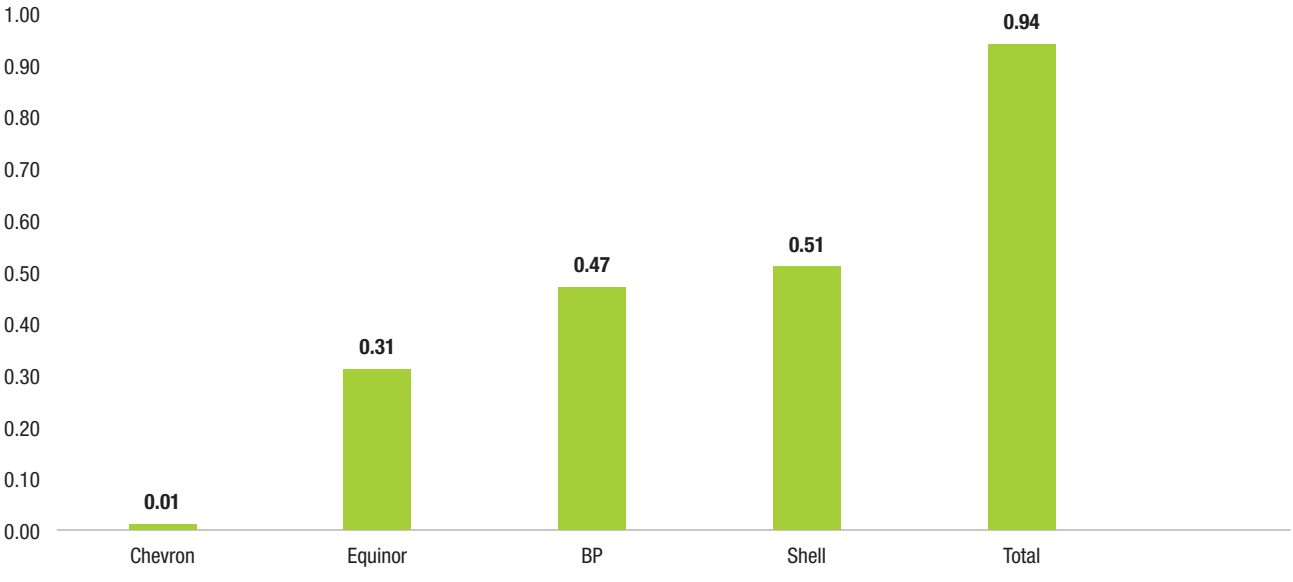
In this sense, Zhong and Bazilian (2018) also reinforce this perception by showing that the path of action of global oil companies in renewables is concentrated on: (i) extending the operational expertise of the offshore exploration and refining sectors, respectively, for the wind and biorefineries segments; (ii) providing venture capital funding in innovative technologies and business model (start-ups with high technological intensity in renewables); (iii) establishing integrated businesses with the renewables sector, mainly in exploration and production operations.

Not only do investments show the low representativeness of renewables and low carbon in the oil majors' projects, but also the size of its production facilities in this segment. The installed capacity of companies in renewable energy has a very small share considering the total installed capacity in the countries in which they operate.

For example, in 2019, Equinor had wind farms installed in Great Britain, Norway, and Germany, and solar plants in Brazil and Argentina. Adding all the installed capacity of these two energy sources, Equinor had 0.3% of all solar and wind generation in these markets. A lower installed capacity was expected from the Norwegian major when compared to other oil companies, once they have a much more robust capital structure and a much larger volume of projects. Yet, even considering these other companies, none of them have more than 1% installed capacity of power generation share in the markets in which they operate (see Chart 3.2).

In addition to the low percentage of investments in renewables and the adoption of more conservative strategies, a report by Oil Change International (OCI) catches sight that, in the next ten years, oil companies will be even more intensive in oil and natural gas. According to Nunes (2020), oil production and also the emission of carbon in the atmosphere of the main majors (bp, Shell, Equinor, Chevron, Exxon, Eni, Total, and Repsol) tend to grow until 2030. The extraction of natural gas, considered by experts as the fuel of the transition, tends to fall. "What the OCI has demonstrated (...) is that, contrary to what oil companies claim, the presence of fossils in their portfolios is rising, with the exception of the Italian Eni" (NUNES, 2020).

CHART 3.2
Share of installed capacity of the companies in renewables in comparison to the total installed capacity of the countries in which operate (2019). In %



Source: Companies' Annual Reports and bp (2020) as presented by Ineep.

According to the OCI (2020a), oil production is projected to grow by at least 10% by 2030 in all companies, except for bp. In the case of ExxonMobil, the projection is that this expansion will exceed 50%, and Shell, Repsol, and Equinor should increase more than 20%. Furthermore, estimates point to a drop in natural gas production in several oil companies, such as Equinor (-6%), Total (-2%) and Chevron (-11%), by 2030. If that scenario is confirmed, the proportion of oil production would be higher than that of natural gas.

The OCI's main concern is that the climate goals defined in the Paris Agreement are unlikely to be achieved. The report highlights an alleged contradiction of companies that, on the one hand, advocate in favour of renewables, and, on the other, seek to ensure the conditions to preserve their investments in oil and natural gas.

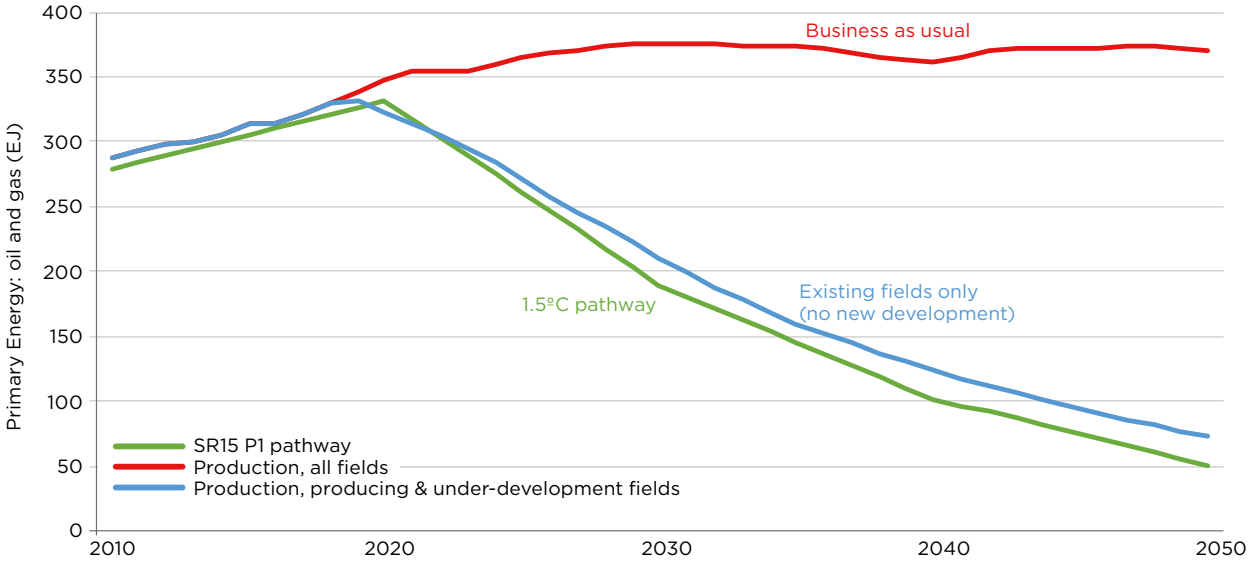
> **No major oil and gas company has released a climate pledge or sustainability plan that meets the bare minimum criteria for alignment with the Paris Agreement. In order to ensure a phase out that reflects the urgency and ambition of the Paris temperature limits across the entire oil and gas sector, governments must step in to manage the decline of production and facilitate a Just Transition. (...) In the five years after the Paris Agreement, many of the oil majors have released successive climate strategies, plans, and pledges. Increasingly, they claim to be part of the solution to the climate crisis—but the reality is very different. These companies continue to pursue aggressive lobbying strategies and demand bailouts and loopholes to preserve, and in most cases increase, fossil fuel production. Current events, however, provide no guarantee that fossil fuel production will stay in long-term decline. They also provide no indication that the current decline will be at the pace needed to limit global warming to 1.5°C, or that this decline will be a just (OCI, 2020a, p. 3-4).**

Chart 3.3 shows that, maintaining the current forecasted rate of investment in exploration and production, the volume of oil produced will halt any possibility of reducing the temperature. By 2050, the Paris Agreement believed that production should be at a level of approximately 30% compared to 2020. However, the outlook is that production will be relatively stable until that period.

Given the context of deep uncertainty brought by Covid-19, oil companies tend to be even more cautious about entering new industries, including renewables. The structural change in energy demand, the search for self-sufficiency and the oil price crisis explain, in part, why the large oil companies, although maintaining their projects in renewables, tend to be less aggressive in making investments in the short term. The financing capacity of companies will decrease; however, lower prices make the investments necessary for oil exploration and production cheaper. In addition, national states have lost their appetite for energy projects due to the change in priorities set by the pandemic.

According to a study by Standard & Poor's Global (S&P Global), Covid-19 has different impacts on the energy transition. On the one hand, the American elections, Europe's "green" recovery package, and the Chinese government's will to invest more in this industry may redirect energy investments in the long run, with renewables playing a central role. On the other hand, the expansion of subsidies for the dirty industry and the lower returns in the medium-term may rule out these potential investments.

CHART 3.3
Global oil and gas extraction with and without new Development, compared to demand aligned with 1,5º (2010-2050) in exajoules



Source: OCI (2020a).

Besides that, S&P Global states that the pandemic is expected to negatively affect energy demand (see Chart 3.4). However, this does not mean that the share of renewables will increase.

- **COVID-19's impact on the global economy and consumer behaviours has reduced long-term world oil demand by 2.5 million barrels per day, according to S&P Global Platts Analytics. However, some adjustments to the demand outlook were positive as weaker oil prices make electric vehicles less competitive, reduce the drive for efficiency, and stimulate underlying oil consumption. The weaker oil demand therefore is not meaningful enough to substantively bring forward the timing of the peak in oil demand that S&P Global Platts Analytics projects for the late 2030s. For oil demand to peak by 2025, drastic changes would need to occur to business and consumer behaviour, including near full adoption of working from home, reshoring of supply chains, and widespread electrification of road transportation (S&P GLOBAL, 2020).**

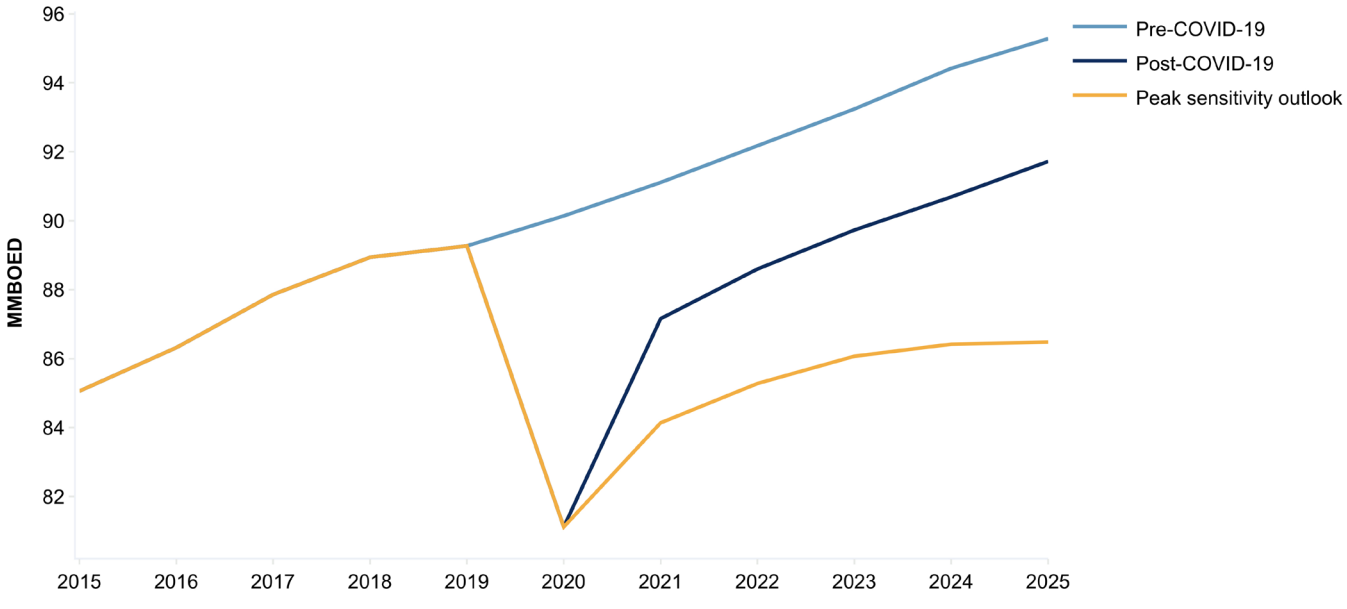
Up to now, the Covid-19 pandemic allows us to conclude that there will be a structural drop in energy demand and that prices are expected to be considerably lower, affecting the industry's profitability. Nevertheless, this does not automatically mean an abandonment of the use of fossil energies in favour of the use of clean energies.

The oil companies themselves preserve their position in the oil industry and still have very timid participation in renewable sectors in financial terms, and passive participation in operational terms. A more straightforward action, especially in this scenario of enormous uncertainty, will only occur along with an eventual more incisive action by the national states.

These observations suggest that, regardless of the oil company's profile, the path to energy transition is still quite uncertain in the long-term. That is, the incorporation of renewables occurs gradually and is restricted to investments in technology or small operations associated with other companies, especially start-ups. The percentage of investment assigned to the clean energy segment is still very low compared to the total invested by companies.

This "distance" from the energy transition is even greater when one considers Just Transition. The oil companies are still focused on oil and gas and gradually deciding their business models on renewables. Even in those more aggressive companies on the subject, the major capital projects in renewables started recently and are still being implemented. As a result, the discussion on Just Transition is still a practically non-existent topic in the strategies for the oil companies' renewables segment.

CHART 3.4
S&P Global Platts Analytics Refined Product Oil Demand Outlooks. In million barrels per day



Source: S&P GLOBAL (2020).

4. Oil Companies and the Just Transition agenda

As previously noted, the strategy of the American majors for the energy transition is restricted to some measures to mitigate climate effects. It also has a very small volume of investments in terms of operation and financing of the sector. Considering the actions towards the inclusion of clean energy are already very incipient, when it comes to the Just Transition, they practically do not exist. In general, the American oil companies present general training and professional qualification programs, but those are not directly related to the possible impacts for workers in the energy transition process. In other words, there are professional training centres that may or may not deal with clean energy, although traditionally in these companies, qualification courses are related to the oil and natural gas chain.

ExxonMobil has been conducting professional training courses to train workers in the United States in the face of technical needs demanded by the rapid evolution of the energy sector and the global market. Through the American Petroleum Institute, the oil company has assisted in the dissemination and application of certification in training centres and programs in the United States, which can help meet the short and long-term workforce needs. These training centres have a wide reach and potential impact, being equivalent to the American "third largest public university", since they operate together around 1,500 training centres.

In addition to the training centres, ExxonMobil has announced a $500,000 grant to finance a vocational technology training program in the Houston metropolitan area. This initiative aims to support community colleges in the development of skilled workers to compose the region's petrochemical industry.

Following the example of Exxon, the American giant Chevron has conducted professional training courses around the United States with the aim of training professional staff for future energy change. In addition, Chevron recently invested in increasing the diversity of workers. In 2020, Chevron announced a $5 million grant to Catalyst, a global non-profit advancing workplace gender equality. The aid will allow the organization to continue its research, programming, products and innovative events aimed at accelerating gender inclusion across the industry workforces.

Aside from the issue of professional qualification, the only concrete measure that relates workers and climate change at Chevron is related to the form of remuneration. The company sought to create variable remuneration incentives for employees according to the achievement of a reduction in greenhouse gas emissions, defining upstream reduction metrics of 25-30% for flaring and 20-25% for methane emissions intensity in the period from 2016 to 2023. These performance measures can be used to determine the annual variable pay program that affects approximately 45,000 employees. Even so, this measure does not dialogue with possible future impacts of the energy transition for the workforce.

In European IOCs, as noted, which adopt more aggressive measures in terms of energy transition, the Just Transition debate is as well in a more advanced situation. The French company Total, for example, in addition to the qualification programs, adopted partnerships with unions to promote greater use of clean energy.

In 2012, by an agreement with workers 'unions, Total committed to provide concrete support for employees' personal efforts to improve their home's energy efficiency and reduce their carbon emissions. Despite the importance of the Total's sustainable development strategy, it can be perceived as an attempt by the company to involve workers in the energy transition process. However, in a structural way, this does not mean that they are being effectively engaged in the discussion about the transition.

The launch of an offer of photovoltaic solar panels for workers was the first stage of this innovative campaign. It is aimed at all Total employees in France, more than 40,000 people at the time, who wished to equip their main or secondary home with a photovoltaic array. The advantages were as follows:

(i) A reduced system cost of up to 15 percent compared to market prices;

(ii) An exceptional Group discount of €1,50;

(iii) A bank loan at an attractive rate; and

(iv) A sponsorship offer giving the possibility for each employee to allow their relatives and friends to benefit from the same preferential rate.

In addition to this partnership, Total has also carried out professional qualification actions to prepare its workforce for the future. In 2019, the company launched L'Industreet, a forthcoming campus that will provide free tuition to young people aged 18 to 25 in the industry future professions. The courses range from 12 to 18 months in five sectors and ten professions of the future with strong hiring potential: automated production lines, non-destructive testing and inspection, power distribution terminals, digitalization of industrial facilities and attended robot multi-service maintenance. Its innovative teaching approach will mix classroom and technical courses with immersive work experience, and the programs offered will be customized to allow young people to enrol at l'Industreet at any time of the year. The goal is that, after completing the training, each graduate should be in a

position to find a job in the industry, continue their studies or start their own business.

Unlike Total, which adopted specific measures for Just Transition mainly to encourage the use of clean energy and to qualify its workers, Shell has a better-defined strategy of Just Transition, at least in terms of discourse.

> **The transition to a low-carbon energy future is necessary to manage climate change and it also needs to extend the economic and social benefits of sustainable energy to everyone on the planet. Shell endeavours to work with society in its move towards a low-carbon world while supporting workers and communities in a manner that is just, fair and inclusive (SHELL, 2020b).**

In the description of its energy transition principles, however, the company still does not make it very clear how it intends to work on the transition. There are two mentions on the subject. The first is a generic reference about the impacts on workers of including green projects in its investment portfolio. The second refers to the fact that management is attentive to the effects of the transition on employability:

> **{Shell will] assess the impacts of business activities in transition to manage and reduce the effects they may have on the lives of our workers, local communities and the environment, seeking to foster prosperity in the communities around our operations and contribute to local economic growth. [As well], involve and support employee representative bodies at the local level in each country with respect to the energy transition. The objective is to support the employability of employees and the technical development of their skills (SHELL, 2020b).**

Since the late 1990s, Shell has played a leading role in the National Oil Bargaining (NOB), which involves the refineries represented by the North American unions. In this way, the company had been dealing with issues such as the definition of wages and safety standards with the United Steelworkers Union (USW), while issues specific to each company were negotiated locally[36] (REUTERS, 2020).

However, recently, USW pointed out that it is rethinking this partnership, given the closure of some Shell refinery units. In view of the Paris Agreement commitments, Shell has been adopting measures in an opposite direction of that expected by the union (REUTERS, 2020).

Unlike its peers, bp has no action for Just Transition. Even so, the measures of Total and Shell, with the exception of qualification programs and support for the use of clean energy, consist more of signals about the importance of a Just Transition than something concrete aiming at its implementation.

Generally speaking, NOCs do not recognise the impacts on the workforce and do not demonstrate any effective involvement in favour of the Just Transition, except for Norwegian Equinor.

In the case of PetroChina, plans to expand the renewable industries were exposed and nothing was mentioned about the Just Transition process. For the Russian companies Rosneft and Gazprom - the ones that have as their main strategy for energy transition the expansion of investments in natural gas - the renewable projects as well as the strategies for Just Transition are not significant.

In the case of Equinor, the Norwegian company has also invested in training programs that contemplate the different areas in which it operates, including incentives for changes in the workers' area and segments. This measure allows the company to use its human resources more efficiently and take advantage of the experience of its professionals in new business areas.

In 2019, this was one of the main focal points of the company. Learning activities on digital topics, including the introduction of 'Digital Leadership' training, have more than tripled. There has also been a considerable increase in e-learning and distance learning activities due to ease of access and participation. At Equinor University, formal learning in activities related to security and digitization has been intensified.

In addition to investments in training and digitalization, Equinor has dedicated efforts to increase the diversity and cultural inclusion of its work team at all levels and locations. In 2019, the company established a series of guidelines for this agenda, listing Women in Equinor, Differently Abled, and LGBTQ+ groups. In 2019, Equinor included in the KPIs the diversity and inclusion index (D&I), focused on different dimensions of diversity, in order to attribute greater representativeness and value to the team. The company's goal for 2025 is for all of its teams to be diverse and inclusive.

Another point of great relevance was the inclusion of the Industri Energi Equinor Youth Committee in the discussion of climate change. Young people expressed concern about the impacts of rapid changes on workers and their families, as well as in regions dependent on the activities of polluting sectors, such as oil.

European companies are in general more concerned with the issue of Just Transition than the American, Chinese and Russian companies. Except for some actions by Equinor and Total that seek to involve workers in the discussion of the energy transition rather than adopting policies that mitigate its potential effects, one does not observe concrete practices towards the Just Transition. What can be seen are documents and rhetoric of the European majors on the topic. If the inclusion of the energy transition path in the activities of the oil majors still seems a long way off, the Just Transition is a topic that is hardly mentioned by them[37].

Finally, it must be emphasized the importance of the role of the State in the energy transition process. Not only to regulate and supervise this process, but mainly to capture the interests of the different actors involved, distributing social benefits fairly among them.

36 Available at: https://www.reuters.com/article/us-steel-labor-negotiations-idUSKBN20R31O

37 Although some companies, such as Exxon and Chevron, announce training courses in order to qualify their workers in face of new challenges in the energy market, it is unclear to what extent these qualifications in fact aim to requalify their employees for the new energies scenario. From our point of view, this proves the thesis that the energy transition has been more a rhetoric perspective than a strategic priority for these companies.

5. Just Transition and International Oil Companies' workers

Taking into account the perspectives of governments and companies on the Just Transition, one could learn about the different strategies and world views of the major global players in the oil and gas sector on the energy transition, as well as its possible impacts on the workforce. Some questions, however, remain open: how have oil workers perceived the process of energy transformation? How have the decarbonisation strategies of major oil companies reached their employees? How do they understand that this transition affects their jobs? Has the concept of Just Transition become part of the agenda of the union organizations in this segment?

To answer these questions, this Report includes qualitative interviews conducted, between September and October 2020, with union representatives from four major IOCs: ExxonMobil, Chevron, Royal Dutch Shell, and Equinor[38]. Distributed between the Exploration and Production (E&P) and Petrochemicals sectors, the choice for these representatives seemed significant to elucidate how the big oil companies have communicated to their employees the effects of the energy transition on their businesses, thus revealing how these companies have envisioned both future energy scenarios and the participation of its workforce in these new segments.

It also implies observing how an eventual low-carbon economy is seen in the perspective of workers who operate in an industry essentially reliant on the use of fossil fuels, whose jobs and professional expertise tend to disappear as the use of new energy sources increases progressively.

Evidently, as it is a qualitative research in which the study is based on an in-depth investigation of the views and perceptions of a small number of respondents, a survey of this type does not aim to extrapolate these perceptions to the group of workers in this segment (something that would only be possible through a quantitative research based on a valid statistical sample). However, its purpose is to highlight some points of view that shed light on the perception of oil workers regarding the energy transition, which may even be useful as a reference for later quantitative studies.

In order to understand how these perspectives are mobilized by workers' representatives, we conducted a semi-structured questionnaire with 24 questions separated by three thematic sections:

(i) The energy transition;

(ii) The energy transition and the companies;

(iii) The impacts of the energy transition process on the work environment[39].

Respecting the confidentiality of the respondents, once they chose not to reveal their personal information, the identities, positions, and organizations were preserved, as well as their citations in reference to the topics. Despite the different discourses and strategies adopted by the oil companies, an interesting fact to note in all the interviews is that many of the speeches of the union members seem to suggest similar perceptions and world views regarding the energy transition. It seems revealing for at least two reasons:

(i) On the one hand, it confirms the hypothesis raised at the beginning of this report that major oil companies have not involved the workforce and /or work representatives into the topic of energy transition and Just Transition, even those companies most enthusiastic about the entry into the renewables segment;

(ii) On the other hand, it suggests that regardless of the rhetoric carried out by these different companies in favour of the transformation of energy sources, their internal performance is still quite incipient for most workers. This raises hypotheses about whether this energy transformation is being considered by these companies based on the existing workforce (planning a Just Transition with upskilling, re-skilling, etc) or the incorporation of new groups of workers (trained in new technologies, green jobs, etc, before joining the company).

In light of these common views, the interviews of union representatives highlighted other common perceptions, namely:

(i) **Just Transition is a little known/explored theme among the union representatives interviewed.** Although they work in one of the industrial sectors most sensitive to an eventual energy transition, especially in terms of working conditions and income, the union members interviewed showed little knowledge about either the risks that the current transition process can generate for the industrial employee, or about the union discussion that seeks to equate the concern with the decarbonisation of the economy with the notions of equity and social justice. In some cases, even the term "Just Transition" was not known to respondents;

38 We tried to interview other union representatives from the majors Total and bp, but unfortunately we did not get any response until the conclusion of this report.

39 The questionnaire carried out is present in the Annex of this Report.

(ii) **Respondents are sceptical of the vision of a short to medium-term energy transition.** Their lack of knowledge regarding the Just Transition can be justified by the fact that they do not believe that there will be any significant change in the energy mix of these companies. In this sense, a respondent of an American oil company even stated: "We see a pressure hitting the oil market as a whole. We heard that bp is making big changes in their company, that they are moving their businesses to a green economy, but what we see at Exxon, Chevron, or even Shell, is that there is nothing to point in that direction". Even if an energy transformation process is underway, one must consider it still happens through the prioritization of natural gas, which in part is seen as a guarantee that part of the current operating structure of these major companies will remain more or less unchanged in a near future. As another union representative of an American oil company concluded: "It is quite possible that not even my granddaughters will see a major change in the energy sector";

(iii) **The energy transition is a problem for workers of future generations.** The fact that workers minimize the effects of the energy transition in the short term does not mean that they are not aware of the potential risks that the current energy transition may affect the industrial worker. In other words, there is an understanding that, in the future, workers in the oil and gas industry may lose their jobs to "green" jobs, and that this can lead to unemployment for many of the workers who do not qualify for these new jobs. Even so, they believe that the issue will still be a cause for struggle for the next generations. It also suggests that other demands – such as the maintenance of post-pandemic jobs, for example – are more important for the union movement at the present moment. According to a union representative linked to an European oil company: "Energy transition is a topic for the next day";

(iv) **There is little information disseminated among workers about the performance of their companies in the transition process.** In general, the respondents showed little information about the company's plan for the coming years, either in the field of operational decarbonisation or in the search for new sources of energy. They have also shown that they are unaware of any initiatives that major oil companies have taken to reallocate workers negatively affected by these organizational changes. Besides, they suggest that this type of information is more concentrated at the managers' level and less widespread among the other sectors of these companies. As one of the workers' representatives of an European oil company stated: "They invest in the company, but not in the worker to join this transition process. Managers are included, but the bottom of the work chain is not";

(v) **Without a Just Transition policy, employees are required to take responsibility for their professional retraining.** In the absence of a clear internal policy to readjust the workforce of these major companies to a low-carbon economy, respondents report an atmosphere of uncertainty in production plants. This forces them to seek certificates and professional qualifications in these new segments on their own account. According to a representative of the European oil workers: "Some companies are threatening people, saying: 'we are going to invest in new energies and if you want to be part of it, you must invest in your inclusion in this process' (...) They deliver the responsibility to the worker";

(vi) **The lack of training for employees indicates that the energy transition in the majors could happen far from the current models of productive plants of these companies.** In this sense, some of the respondents highlighted their concern when observing that the lack of training for the requalification of the current workforce – added to the recent mergers and acquisitions that major oil companies have carried out in the green energy start-ups – could be an indication that the new recruitment of the oil companies may originate from these nascent companies. Thus, the current formal workers of these companies fear that their social protection can be threatened by these new market conditions, given that the hiring by these start-ups occurs, in many cases, in more unstable and with more precarious working and salary conditions. As one respondent representing European oil workers suggested: "In the end, everyone is looking for job security, good wages and healthy conditions. It doesn't matter so much if the job is in another area, as long as it is in good working conditions";

(vii) **There is an overall atmosphere of uncertainty, but it tends to be more sensitive among workers in segments exclusively reliant on oil products.** Although natural gas is pointed out by many as an important transitory energy source for major oil companies, respondents recall that not everything that is made by oil can be replaced by the use of natural gas. In this sense, there is a great concern from some respondents about how the energy transition may affect the petrochemical sector, since the use of oil in this segment is essential. For this reason, some union members expressed fear that these links in the oil productive layer may not be properly relocated to these other segments that the oil and gas chain produces. This indicates that the energy transition tends to affect in multiple ways different sectors of the same company. As one of the respondents underlined: "When talking about energy transition, the climate is of apprehension for these workers".

The findings presented above seem to confirm the trend of other researches on the same topic. In this sense, the research "Offshore: Oil and gas workers' views on industry conditions and the energy transition", carried out by the collective Platform London in partnership with the organizations Friends of the Earth Scotland and Greenpeace, released in October 2020, gathers some of the perceptions of U.K. offshore oil and gas workers regarding the energy transition. One of the most impressive data from the survey reveals that, of the 1,383 workers interviewed, about 91% of them said they did not know the term "Just Transition" (OCI, 2020b).

At the same time, that same survey points out that 82% of respondents said they would consider moving to a job outside the oil and gas industry, with more than half of them being interested in renewable energy and offshore wind energy, and with others expressing a preference for decommissioning work on oil platforms, as well as other low-carbon occupations[40].

In other words, the findings above suggests that, despite the lack of knowledge of these workers about the Just Transition, their interests are focused on jobs in a low-carbon economy, if it is guaranteed similar or better working conditions than the ones in the oil industry and recycling programs funded by governments or oil and gas companies. In this sense, the survey also points out that respondents would only change if they had job stability (58%), better salaries (21%) and similar working hours (11%).

Crossing the statements of our interviews with union representatives and the survey findings of the Platform London (2020), it is possible to observe certain important congruence between the two works. The first is that workers are concerned with the agendas that involve the Just Transition, even though they do not have specific knowledge on the topic. This shows how workers and union representatives are still distant from the claims of the international union movement, even though they experience in their daily lives a certain climate of apprehension and uncertainty about what a decarbonised future may bring to their jobs.

This atmosphere of uncertainty is enhanced by the lack of clarity with which these major oil companies have led their entry into the renewable energy business. It can be seen by the fact that there is a perception among workers that there is a major change taking place in the sector while these companies are not communicating to their employees how these changes will alter their business and, consequently, the composition of their workforce.

This may help to explain why union representatives of major companies are still quite unconcerned about the issue of Just Transition. Given that neither the major oil companies seem interested in transforming their energy sources in the short and medium-term, nor the governments seem committed to forcing these companies to invest in clean energy sources in the meantime, the union representatives of the oil sector seems to be more concerned with keeping post-pandemic jobs and wages than with the possible negative effects of an ongoing energy transition.

For this reason, the lack of clarity of these major companies makes workers feel dubious about the energy transition. On the one hand, there is a certain optimism that this change will not happen in their generation, or that it will not directly impact their jobs, allowing some union representatives not to treat the issue as a priority for their claims. On the other hand, there is a certain pessimism when noting that these companies are in a transition process without properly preparing their employees, placing thus the burden of qualification for these new green occupations on the backs of the workers.

The workers of these major oil companies and their representatives find themselves divided between the hope that this energy transition will happen simultaneously with the relocation of the workforce and the fear that this transformation will mean an unstable working future and precarious working conditions. This perception brought by the researches elaborated and analysed in this study brings along an important warning sign to the union movement. This warning sign is related to how workers are aware of the consequences of an energy transition carried out in the imperatives of the free market, but are still unaware of the potential of Just Transition as a claiming of their own rights.

Far from being just a statement of how disconnected workers are from environmental issues, these researches reveal a window of opportunity for union movements to act in a better communication strategy with their union members, drawing their attention to the climate issue and transforming their hopes for job stability and better working conditions into an ecologically sustainable political agenda.

40 The choice for these occupations does not seem to be by chance. According to another survey by Platform London, it is estimated that there is "some" or "good" overlap in at least 64% of the skills needed for workers in the oil and gas sector and workers in offshore renewable energies, which indicates that workers in the oil sector have similar and/or compatible knowledge and experience with renewable energies (OCI, 2019).

Conclusion and recommendations

The behaviour of the oil and gas industry in the face of the urgency for clean energy and the effects of the long-awaited energy transition on the labour market are still unknown, even for professionals and experts in this sector. So far, there is a large set of uncertainties about the pace and path of the transition, since they are influenced by various actors and aspects of each scenario. In the Covid-19 pandemic context, most countries prioritize supply security and protection of their industries in their energy policies. In some cases, this means giving incentives to fossil energies.

Therefore, oil and natural gas will still occupy a privileged space in the global energy mix in the medium term. While new producers are emerging, especially in the United States, the number of countries with exploratory potential still in search of the much-desired self-sufficiency is also relevant. The industry, therefore, remains in full swing and there are no signs of slowing down, at least in the medium term. At the same time, oil is expected to be important in the transition because it is the majors that concentrate much of the energy sector's capital. And so, their investments will be decisive for the transition to accelerate in the medium term.

Another possible assumption is that the transformations to come will have repercussions on the labour market, such as the generation of "green" jobs, the extinction of activities related to the most polluting energies and manufacturing. There may be other outcomes, like the redefinition of some occupations and even the destruction of some job positions. And countries must still adapt their technologies to effectively include renewables in their mixes.

These elements raise more doubts than certainties about the future of the transition, especially when coupled with the dispute in the geopolitics of energy, the control of the energy supply, and the technical obstacles to the expansion of renewable energy raise more doubts than certainties about the future of the transition. The transition will occur, but it seems wrong to specify the time or pace of this process.

Meanwhile, the importance of the national states and oil companies is certain. In fact, the strategies of the national states, as seen in this study, have an important influence on the policies of the oil companies. In general, energy self-sufficiency and the exploitation of local resources are often at the forefront of these policies. This explains the relief packages created by the United States government for shale gas and tight oil companies or the Russian investments in the natural gas industry. One of the factors that inspires Europe's most aggressive strategy for renewables is precisely the lack of abundant fossil resources.

In this sense, IOCs have adopted different positions. For most of them, the focus is on ensuring access to investors, as the demands of the financial market for the decarbonisation of energy sources are recurrent. Among the oil companies, there are also important geographical differences. The European ones have been more likely to adhere to the changes than the others. This does not mean, however, that their performance is way more aggressive than the others regarding this issue.

Regardless of long-term strategies, Covid-19 revealed the conjuncture influences its implementation in each period. Currently, in face of the crisis, the priority of the majors is to promote major cuts in investment and their work teams. At the same time, they concentrated their efforts on the oil and gas exploration and production segment, which are considered more profitable. Some renewable energy generation projects have been preserved, but there are uncertainties regarding the coming years. Regardless of changing circumstances, long-term strategies of the companies have important differences when compared to the energy policies of their countries of origin.

The United States wants to be a larger exporter of unconventional oil and gas and expand its influence on the geopolitics of energy. ExxonMobil and Chevron, for example, are focused on exploring oil and natural gas production in its different types (LNG, shale and tight, conventional, deep-water and heavy oil) and on petrochemical and downstream projects, mainly in the United States, Asia, and Australia.

Russia focuses its efforts on the exploitation of natural gas, through Gazprom, Rosneft, Transef, and Gazprom Export. Together, they work to increase, by 2030, unconventional offshore production of shale oil and gas in the Russian Arctic, and expand the extraction and trade of liquefied natural gas (LNG) for the Asian market.

Western Europe, in turn, focuses its agenda on renewable energies. Yet, in countries where the oil and gas industry plays a relevant economic role, governments do not give up on continuing to explore the fossil market. Norwegian Equinor and French Total are a little more advanced in the development of renewable projects. In contrast, the British bp and Shell continue to bet more on the oil and gas sector in comparison to their European peers.

In China, the priority is energy security. In this sense, natural gas is strategic because it is easily found in the region and its consumption supports the country on climate change issues. For instance, these have been the guidelines adopted by state-owned PetroChina and Sinopec.

Despite these differences, oil companies have adopted a very conservative strategy in renewable energy. None of them invest more than 5% of their Capital Expenditures (Chart 3.1 of this report) in renewables. Therefore, the vast majority of projects remain in oil and natural gas. Furthermore, the installed capacity to generate energy through renewables is still very low, less than 1% (Chart 3.2 of this report). Even when looking at the next ten years, this kind of performance seems to have few changes. Besides, the strategy of entry in the renewables market is still quite passive and restricted to the creation of venture capital funds, R&D expenses, investments, and acquisition of start-ups. In short, a very small part of its capital is invested in renewables, the installed capacity is still very low and the investment profile occurs associated with small companies in order to minimize risks.

Some companies have ambitious pledges for the next few years, such as Equinor and Total. Even so, there does not seem to be a generalized growth trend for renewables in the oil companies' portfolio. Regardless of the oil company's profile, the path to energy transition is still somewhat uncertain on the long-term basis.

This certainly reflects in the workforce. In general, neither workers nor their representatives do have a clear perception of the performance of their companies in renewables. When considering the issue of Just Transition, the debate is almost non-existent. Even in those companies that have more straightforward renewable projects, there is no clear concern about the impacts of the energy transition process on workers.

In other words, the Just Transition theme is hardly addressed by companies or their countries of origin. With very few exceptions, as in France and Norway, this debate is ignored by the majors and the governments of their headquarters. When consulted, the union representatives were not familiar with the topic.

As previously observed, the energy transition is still a very incipient issue in oil companies and its acceleration will depend on several factors. However, as the majors invest in the renewables industry, workers who are employed in oil companies and workers who will join the wind or solar segments will suffer major impacts.

This is because oil companies overall are not concerned so far with how the transition will impact workers. Moreover, the more diversified performance of the oil companies tends to increase the differences between the types of jobs generated, including for operational workers. This can create much dispersed demands and make it difficult for workers to act. Finally, in many cases, depending on the public policies adopted by each country, this transition process can also change in terms of direction and intensity, affecting the workers themselves.

Based on these considerations, Ineep makes some recommendations that may be important for the workforce while monitoring the energy transition process:

- Elaboration of permanent research to monitor the speed and direction of the energy transition. The framework described in this report may change in the short term;
- Creation of institutional channels for bringing oil workers closer to those in the renewable sector. This can help in creating common demands and acting together, strengthening the bargaining power of the workforce;
- National unions must demand direct dialogue with their governments. Workers' voices must be heard.
- Creation of union representatives – management commissions in oil companies based on the energy transition to monitor strategic changes, how they will affect existing jobs and design possible solutions;
- Participation of union representatives in the countries' public energy policy forums to be involved in the debate on Just Transition;
- Creation of union company networks to establish communication between workers in the same company operating in different countries. The performance in the renewables segment may vary according to the company and the country. It may be more advanced in such a nation than in another one. This would help to share obstacles and lessons learned from workers who experience the first effects of energy transition of that particular company;
- Creation of more precise and quantitative indicators, like the wage ratio between blue collars and green collars, the expenditure on training for adaptation of workers, on Just Transition to facilitate the comparison of different national and business experiences;
- Creation of a permanent forum on Just Transition so the concept becomes more disseminated among the workers.
- Design of union strategies to systematically organise workers of the renewables sector to avoid a deterioration of labour standards.

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Annex

Type of Just Transition	Description	Examples
Status quo	Corporations and free market advocates emphasise the business opportunities associated with a green economy. They do not call for changes to the rules of global capitalism, but rather a greening of capitalism through voluntary, bottom-up, corporate and market-driven changes. States or governments are expected to provide an enabling environment for action, through incentives to businesses and consumers, and objectives such as the Paris agreement. The need to compensate and/or provide new job opportunities to workers who will lose out as a result of the shift to a low-carbon economy is recognised; however, issues around job distribution or negative externalities produced by those jobs (such as degraded land and water in mining communities) do not enter in. Support may take the form of corporate-run job retraining programmes, pension schemes and other forms of compensation for affected workers	**The Ruhr, Germany:** Displaced workers receive decent compensation and help in acquiring new jobs. Miners who have worked for at least 20 years can retire at 49 and then receive a monthly stipend until they qualify for a pension. Young miners are given another energy or mining job, or else are retrained while still receiving decent pay.
Managerial reform	Greater equity and justice are sought within the existing economic system. While certain rules and standards are modified and new ones can be created – on access to employment, occupational safety and health – no changes are made to the economic model and balance of power. Advocates of this approach recognise that the existing fossil fuel regime generates rising inequalities within fossil-dependent communities, and that existing labour standards are ill-adapted when it comes to securing workers' health and wellbeing. Enterprise-wide planning, as well as social dialogue between unions and employers, are presented as key means to reduce emissions whilst increasing resource productivity.	The International Trade Union Confederation **(ITUC),** the **ILO's Just Transition Guidelines,** a number of national unions, large environmental organisations, and private sector initiatives, including the **Sierra Club,** support managerial reform rooted in public policies and investments, and call for measures such as skills development, OSH measures, the protection of rights in the workplace, social protection and social dialogue. Workers and their unions are considered both the beneficiaries and drivers of the shift towards a low-carbon world. The ITUC focuses on labour-related issues, but does not question the established economic model. Emphasis is placed on social dialogue and tripartite negotiations between governments, unions, and employers as the process through which rights/benefits can be secured.
Structural reform	A structural reform approach attempts to secure both distributive justice and procedural justice, implying institutional change. Solutions are not solely produced via market forces or traditional forms of science or technology, but emerge from modified governance structures, democratic participation and decision making, and ownership. The distribution of benefits or compensation is not granted via top-down mechanisms, but rather is the result of the agency of workers, communities and other affected groups. This type of transition highlights the fossil fuel energy system's embeddedness in society and the structural inequalities and injustices that it produces. This kind of reform might be found at local levels in small, worker/citizen-owned energy cooperatives. But it also entails implementation of new forms of governance that span political boundaries and reassessment of inequitable institutions and structures governing, for example, energy production and global supply chains	The **Trade Unions for Energy Democracy** initiative advocates for a Just Transition politics that addresses labour-focused transitions in ways that also foreground the need for socioeconomic transformation and transition of the entire economy. However, it calls for a shift away from the social dialogue approach used by the ITUC and mainstream unions towards a social power approach, guided by the belief that current power relations must be transformed and that this can only be achieved through public/social ownership and democratic control over key sectors (especially energy).

Type of Just Transition	Description	Examples
Transformative	A transformative approach to Just Transition implies an overhaul of the existing economic and political system that is seen as responsible for environmental and social crises. In addition to changing the rules and modes of governance, proponents promote alternative development pathways that undermine the dominant economic system built on continuous growth. While workers are an important part of this approach, a transformative Just Transition also involves the dismantling of interlinked systems of oppression—such as racism, patriarchy and classism—that are deeply rooted in contemporary societies. Common to the different interpretations of transformation is the notion of aiming for positive and progressive change that overcomes systems and structures that reproduce and exacerbate environmental problems and social injustice. However, there is no coherent vision of the pathways needed to arrive at transformative just transition. The processes required to bring about change are context specific and dependent upon the societal baseline from which it emerges.	A range of groups, networks and organisations, such as the US-based **Labor Network for Sustainability, Cooperation Jackson,** the **Oregon Just Transition Alliance,** the **Just Transition Alliance,** the **Climate Justice Alliance, Grassroots Global Justice Alliance,** the **Women's Environment and Development Organisation,** the **Indigenous Environmental Network (IEN)** and **Movement Generation** argue that economic inequality can be addressed in concert with environmental and climate justice, and the transformation of prevailing power structures, but that the process must be diversified, decentralised, democratic and community-led.

Source: JRTC, 2018 apud PINKER, 2020

Interview guide

Questionnaire

SECTION 1: The Energy Transition

1.1. In your perception, what is the phenomenon of energy transition and how has it been manifesting? Is it more associated with a change in the energy mix or decarbonisation?

1.2. How do you see the advance of renewable energies in the energy transition scenario? And about the role of natural gas? In your perspective, which energy source will be the most relevant in this process?

1.3. Who are the main actors mobilized in the transition process?

1.4. How do you see the dynamics of global governance and the transition process?

1.5. In your perspective, what are the impacts of national decarbonisation agreements and targets?

1.6. Have you noticed any change in social behaviour regarding the transition agenda due to the Covid-19 pandemic?

1.7. What do you understand by Just Transition? Do you believe that the concept is familiar to the most workers?

1.8. Do you believe that the electoral debate is influencing the transition process?

SECTION 2: The energy transition and the companies

2.1. How is the energy transition process occurring in your company?

2.2. What strategies has your company been adopting for the transition process?

2.3. How is this process in other regions where your company operates? Do you believe that there are regional differences in the strategies adopted?

2.4. Have there already been any changes in the productive and technological process of your company?

2.5. Does your company have maintained a dialogue with the workers about the energy transition? What are the existing communication channels and what is their quality?

2.6. Do you think that your employers are directly communicating early, often, or openly about the transition impacts?

2.7. In your perspective, does your company's position regarding the transition is happening more at the level of discourse or actual practice?

2.8. Do you notice the entry of new actors in this transition process (for example, start-ups, NGOs, green funds, workers, among others)? What do you think about this new market dynamics?

SECTION 3: The impacts of energy transition process on the labour environment

3.1. Has the transition process been impacting your workday and remuneration? If yes, in what way?

3.2. What are the main changes for you? What is the main fear of workers?

3.3. Do you think it is possible for you to be relocated to a position in the renewable sector in the future? If so, how would you feel about it? What do you think would be the main differences in terms of salary, working hours and working conditions?

3.4. Have you noticed the occurrence of some process of work flexibility? What are the mechanisms?

3.5. Has your company been taking measures to mitigate the impacts of the transition on workers?

3.6. In collective bargaining agreements, are there any points that address this issue? If so, which ones?

3.7. Is the transition process already influencing union organizations? How?

3.8. In your perspective, what are the main challenges of the transition process in the coming years?

Head office

IndustriALL Global Union
54 bis, route des Acacias
1227 Geneva Switzerland
Tel: +41 22 308 5050
Email: info@industriall-union.org

Regional offices

Africa office
Physical address:
North City House
Office S0808 (8th Floor)
28 Melle Street, Braamfontein
Johannesburg 2001 South Africa
Tel: +27 11 242 8680
Email: africa@industriall-union.org

Postal address:
P O Box 31016
Braamfontein 2017 South Africa

South Asia office
16-D, 16th Floor
Atma Ram House
No.1, Tolstoy Marg
New Delhi - 110 001 India
Tel: +91 11 4156 2566
Email: sao@industriall-union.org

South East Asia office
809 Block B, Phileo Damansara II
No 15, Jalan 16/11
46350 Petaling Jaya Selangor Darul
Ehsan, Malaysia
Email: seao@industriall-union.org

CIS office
Str. 2, d.13, Grokholsky per., Room 203
12090 Moscow Russia
Tel: +7 495 974 6111
Email: cis@industriall-union.org

**Latin America &
the Caribbean office**
Avenida 18 de Julio No 1528
Piso 12 unidad 1202
Montevideo Uruguay
Tel: +59 82 408 0813
Email: alc@industriall-union.org

www.industriall-union.org

ineep Instituto de Estudos Estratégicos de Petróleo, Gás Natural e Biocombustíveis

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