TRANSrisk
TRANSITION PATHWAYS AND RISK ANALYSIS FOR CLIMATE CHANGE POLICIES

TRANSITIONS PATHWAYS AND RISK ANALYSIS FOR CLIMATE CHANGE MITIGATION AND ADAPTATION STRATEGIES

D3.2 Context of 15 case studies:

Global and Regional Contexts on Climate Change

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1 INTRODUCTION AND SUMMARY

TRANSrisk aims to create a novel assessment framework for analysing the costs and benefits of transition pathways related to climate change. A pre-requisite for the development of TRANSrisk framework is a better understanding of the current dynamics governing the establishment of these pathways. Originated by the co-influence of social, economic, technological and scientific factors, these dynamics are defined in their basic structure within the Paris Agreement 2015 and corresponding regional and national policies.

This report introduces the overarching areas of climate change policies based on the Paris Agreement 2015. It also identifies the main drivers of climate change to set up the background for the 14 sector specific country case studies that are the core part of this deliverable D.3.2.

This report has four parts: 1. the Global context with regional highlights; 2. the European Union context; 3. the Latin American and the Caribbean context; and 4. The Intended National Determined Contribution, INDCs, and a brief for the case studies. This report identifies some of the contextual risk and uncertainties affecting climate change within a regional and global context, which are summarised below.

Risks:

1. The increasingly (and possibly unavoidable) growth of the GHG, pollution and associated social problems (e.g., poverty, inequality, health and decreasing welfare). The limited preparedness of countries/Parties to face the unintended consequences led by climate change.

2. The trend in population growth and the demanded economic growth leads to a high risk of not even achieving 2.7°C by 2030.

3. The majority of the high and very high Human Development Index (HDI) countries falling far above the sustainable development threshold. This is linked to the existence of a vicious correlation between HDI and climate change. Strategies against climate change should aim to de-couple the relationship between climate change and HDI.

4. There are no clear strategies based on the (I)NDCs and national circumstances (e.g., resources and capabilities). Moreover, there is a lack of method, information and transparency (lack of trust) for the implementation processes on how to monitor the achievements regarding the Agreement.

5. The tensions between global institutions, the Paris Agreement attempting to set up collective ways to mitigate climate change and the increasingly multipolar world. This opens new opportunities for many countries to design/implement novel strategies for sustainable growth. For example, strategies differentiated for Small Island Developing

States and Latin American. However, it might restrain the political power of some others, for example the risks for the proper development of the EU climate-related policies (e.g., institutional, political, economic and financial risks).

Some uncertainties associated to the above risks at the regional and global level:

1. The uncertainty in achieving the technological and innovation pace required to support sustainable strategies (e.g., fast development of cleaner technologies, renewables, carbon storage, etc.). These innovative strategies must focus not only in the energy and electricity sectors, but must also open the analysis to focus on bottom up solutions for sectors. These strategies, nevertheless, must address the long term mitigation (and possibly adaptation) aims. The limited capabilities and capacities of the Parties to face the challenges imposed by climate change and the need for sustainable growth.

2. The main uncertainty of not achieving 2.7°C by 2030 is the extent of unintended consequences foreseen because of limited shared information systems, knowledge and capabilities. For example, what would be the extent of the damage for regions such as Latin American and Africa?

3. There is not a clear global/regional strategic effort aiming to mitigate climate change which considers decoupling it from HDI growth.

4. The lack of understanding of the local/national and regional resources and societies demands to couple them with sustainable strategies to mitigate climate change.

5. The increasingly multipolar world with associated turnarounds (e.g., Brexit and US election results) might threaten the current achievements of the UNFCCC and limit resources for collective innovative and inclusive strategies to mitigate climate change.

6. The uncertainty to match the technological and innovation pace to support sustainable strategies (e.g., fast development of cleaner technologies, renewables, carbon storage, etc.). These innovative strategies must focus not only on the energy and electricity sectors: they must also open the analysis to focus on bottom up solutions for sectors. These strategies, nevertheless, must address the long term mitigation (and possibly adaptation) aims.

2 GLOBAL CONTEXT

2.1 Introduction

This section focuses on the dynamics of the international debate of climate change policies, i.e. the Paris Agreement (reached on 12th December 2015) as it is the governing institution for climate change debate, as well as the prominent framework for its future at global, regional and national level.

Yet, in order to adequately frame the Paris Agreement within the global climate change issue, and to provide a more complete overview of the subject, this report will first address the social, economic and environmental megatrends determining the current state of the world and its most likely future dynamics. In doing so, this report will concentrate on those trends that have been identified as drivers for the climate change.

An analysis of the macro-sectors responsible for the emission of greenhouse gases, and of their interrelation with the above mentioned trends and drivers, will provide the necessary elements to understand the present reality of the climate change issue and its possible future pathways. Combing these findings with the results of the Paris Agreement will finally offer the opportunity for a first framing of the challenges, opportunities, limits and main risks related to strategies for climate change at global level.

Concluding remarks will be focused on reporting the risks and uncertainty related to the elements analysed in the report, harmonising them towards the objectives of TRANSrisk. A glossary is included in this report.

2.2 Global megatrends

The European Environmental Agency, EEA (2015) identified 11 global megatrends, which directly and indirectly influence the global ecosystem and human beings. These trends are: a) diverging global population trends; b) the urbanisation trend; c) the accelerating technological change; d) the need for continued economic growth; e) the development of an increasingly multipolar world; f) the intensified global competition for resources; g) the diversifying approaches to governance; h) the growing pressures on ecosystems; i) the increasingly severe consequences of climate change; j) increasing environmental pollution; and k) the changing disease burdens and risks of pandemics.

It is worth to notice that there are important overlapping and interactions between the megatrends. While one megatrend explicitly refers to climate change, others can be considered as direct and indirect trends determining the main drivers of the current climate change dynamics. Therefore, it is a fundamental step to determine effective strategies to both reduce the effects of climate change (mitigation) and to cope with its consequences (adaptation). More specifically, bearing in mind overlapping and interactions it is possible to identify h) to k) as environmental trends, while a) to g) can be defined as socio-economic trends.

TRANSrisk's research aims to include social, economic and environmental factors potentially influencing climate change mitigation and its interactions with natural resources availability and use as determinants for future scenarios and strategies. Each of the megatrends, as well as each of their interactions, shall and will be taken in due consideration and special attention has been given to the socio-economic megatrends within the scope of this global report. Socio-economic factors indeed play a key role to effectively framing a global perspective on the current trends and drivers, as well as on the future scenarios, pathways and strategies to address climate change.

Appendix A at the end of this report provides an overview of the interrelationships between the first seven different socio-economic megatrends and specifies their significance in determining drivers increasing and/or reducing the risk and uncertainties for climate change at global level. Appendix A is a reference for TRANSrisk researchers in the process of identifying those key drivers with higher significance for the project at regional and national level, which will be discussed below.

The uneven population increase and the strictly interrelated urbanisation trend, together with the need for a continued economic growth and its linked global competition for resources, are widely considered as key drivers in accelerating emissions of greenhouse gases. They therefore represent the most significant trends in terms of increasing the risk presented by climate change.

Population increase and economic growth were highlighted by the International Energy Agency (IEA) (2015) as the two key forces acting on carbon dioxide (CO_2) production, as reported in Figure 1. Other drivers, like carbon intensity of energy and the energy intensity of economic activities, were seen to have less of an impact.

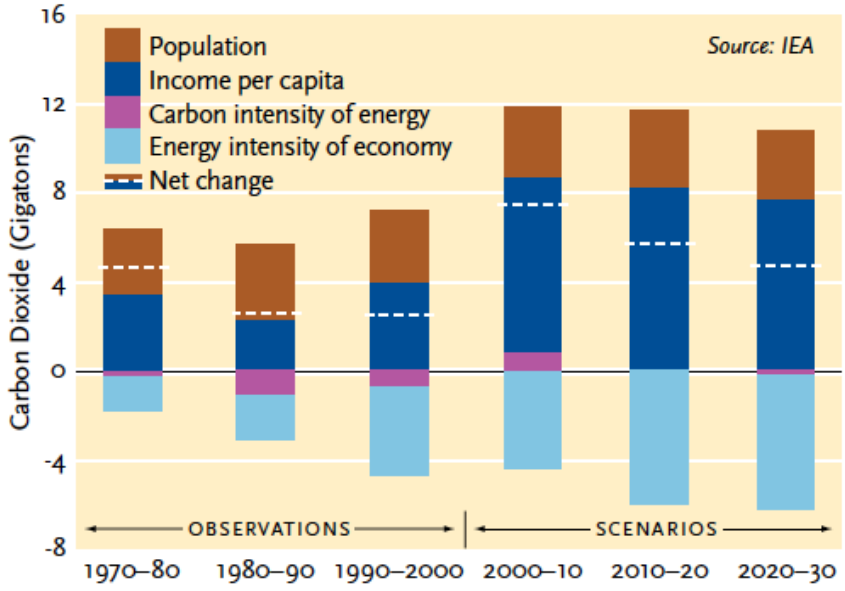


Figure 1: Drivers impacting on CO2 emissions growth

Source: (International Energy Agency, 2015).

Figure 1 uses the zero thresholds to separate forces driving an increase in CO_2 emissions (above the zero thresholds) from those pushing for their reduction (below the zero thresholds). With energy intensity of the economy falling below and therefore becoming a reductive driver for CO_2 emissions, and carbon intensity of energy playing a marginal role, population and economic growth (here represented in form of per capita Gross Domestic Product) are confirmed as the key drivers in increasing CO_2 emissions. The projected population increase to 8.2 billion by 2030 (OECD, 2008) and the need for continuous growth in global and local economies are perceived as inevitable aspects for human development, thus represent the main challenges for mitigating climate change and represent the highest risks in terms of increasing GHG emissions.

Box 1: Diverging global population trends

Africa. While population growth slows in the rest of the world, it continues to rise in Africa. The continent grew by 30 million last year, leading a total of 1.2 billion people. These population dynamics will have an influence on global demography in the 21st century. By 2100, Africa will contribute 82% of total growth: 3.2 billion of the forecasted overall increase of 3.8 billion people. Looking at the dynamics pushing for these rates, the total fertility rate of Africa is 88% higher than the world standard, while improvements in public health have led to a decrease in child mortality rates. Overall life expectancy has also risen. In absence of effective family planning programmes, rapid population growth helps overstrain educational systems and local economies. Infrastructures and social actions able to balance similar trends shall be put in place. Failure to do so results in per capita declines in living standards. In already economically strained nations, such as most African countries, these issues may lead to unsustainable social and economic dynamics, thus increasing tensions within the continent and beyond.

Europe. The European continent is facing challenges opposite to those affecting Africa in terms of population. Concerns focus on several related issues: low fertility rates, growing life expectancy and immigrant flow. In most recent years the economic crisis affecting the southern countries of Europe has discouraged young people from having children, thus impacting the already low fertility rates of the continent. With growing life expectancy, the continent registers a dramatically ageing population that is challenging national welfare systems, possibly pushing for further economic decline. Immigrant flow may represent an opportunity for reversing these trends in the medium- to long-term. Yet in shorter-term perspectives tensions related to the current flows of refugees and asylum seekers are adding new instability to the region. The lack of adequate strategies aimed at hosting and integrating the new arrivals, together with a general perception of these flows as a 'present danger' within the European society, may further exacerbate the tension dynamics related to the continental population's trends.

With special reference to economic growth, Figures 2 and 3 clearly show the strict correlation currently existing between the per capita GDP of the main macro-regions and countries of the world on one side and their ecological and carbon footprint on the other. Moreover, by including the Human Development Index (HDI) as one of the parameters for the footprint evaluation, the figures go further than the macro-trends analysis. For example, for the majority of the high and very high HDI countries falling far above the sustainable development quadrant the figures go far beyond the mere 'economic' interpretation of the climate change drivers. They also demonstrate the existence of a vicious correlation between HDI and climate change. Efforts aiming to mitigate climate change should be carefully considered under the light of this correlation. To be really effective, the new strategies against climate change should aim to de-couple this correlation, while any assessment of the risks related to these strategies should take into account their impact on the HDI of the affected areas.

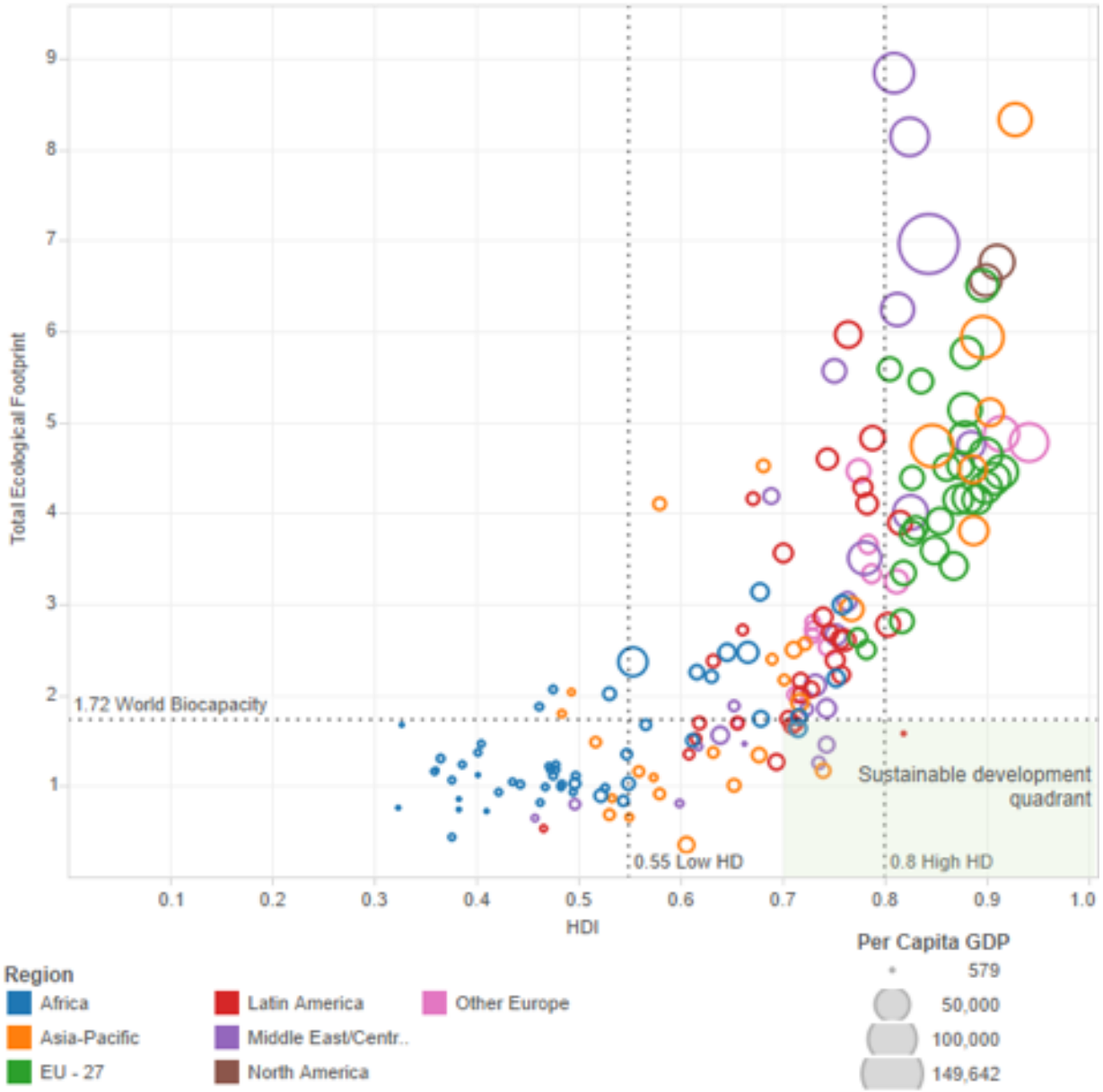


Figure 2: Interrelations between the ecological footprint, the HDI and the per capita GDP worldwide

Source: TRANSrisk elaboration of data from Global Footprint Network (2016)

Box 2: The need for a continued economic growth

Europe. The economic instability still affecting the EU after the 2009 debt crisis is currently threatening not just for a further integration of the region, but its own survival. Radically diverging economic approaches and behaviours are exacerbating the tensions between member states as well as those between the EU and its neighbours. The instability that still governs the economy of various European countries represents an unpredictable challenge for the Union. Economic uncertainty, or at least its perception by citizens, is registered as extending within several EU countries not directly touched by the debt crisis. As a consequence, anti-European movements, parties and actions (i.e. the Brexit referendum) are increasing in number and social, politic and economic relevance. A radical economic shift and a new, steady growth represent the most reliable, if not the only, solutions to these challenges.

Africa. African economic growth is entirely dependent on external investments. Endogenous financial structures still lack the necessary tools to be effectively supportive to African economic growth needs. The USA represents the largest investor, both for public and private funds, in the region. While traditional investors from Europe struggle to establish adequate amounts of investment for extending their influence on the continent, new investors have emerged in recent years. Fast developing countries public and private companies are substantially increasing their economic presence in the region. China leads this 'new wave'. Traditionally present in the region through aid programmes China has shifted its interests towards proper investments and trade. The continent has benefitted of this new investment relations in different ways. African countries are registering an increasing recognition in the current international economy structure, while part of the most recent investments has been focused on key infrastructures programmes. A steady increase in the gross domestic product has been registered for several years in different Sub-Saharan countries.

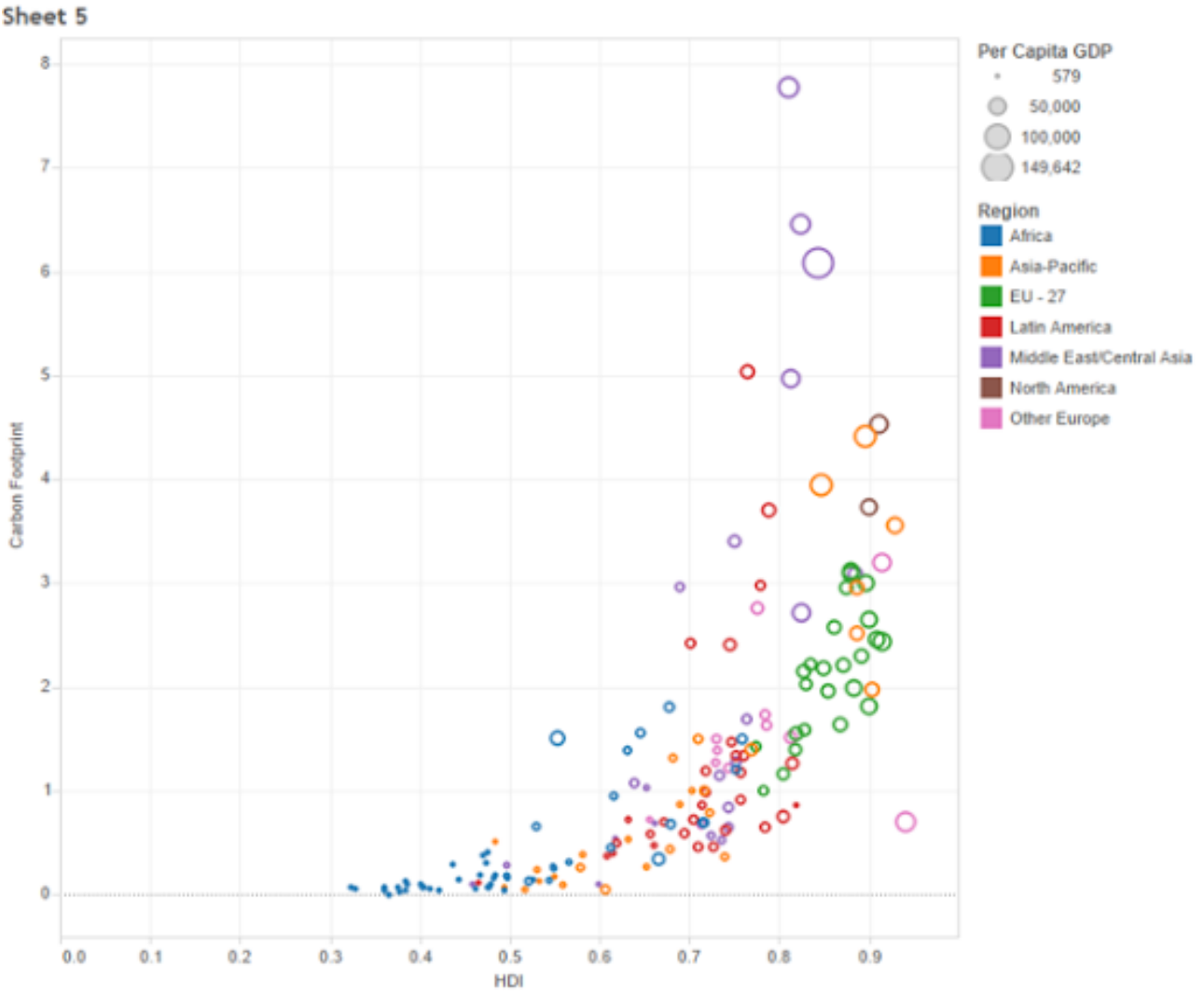


Figure 3: Interrelations between the carbon footprint, the HDI and the per capita GDP worldwide

Source: TRANSrisk elaboration of data from Global Footprint Network (2016)

The peculiar positioning of some Middle East countries in figures 2 and 3 highlights the global competition for resources megatrend. Several countries from this area register the highest rates in terms of both ecological and carbon footprint, due to their status as producers of fossil fuel resource in general and oil in particular. Together with water, metals and land, fossil fuels represent the primary objectives in the present race for resources. With the fossil fuels sectors experiencing an unprecedented crisis, and therefore destabilising in different ways the entire landscape correlated to climate change (see below, 2.5), competition for other resources is producing a huge variety of effects, most of them further deteriorating the environment and accelerating the climate change process.

The drivers for increasing demand of resources worldwide can once more be identified in the context of global population increase and continuous aggregate economic growth. The dominance of competition over collaboration approaches to resources has led to highly inefficient use of

them, at least on aggregate demand. Significant exceptions are present in many areas of the world, and are increasingly prevailing within those countries usually defined as 'developed'. Yet the demand for resources is still too high and unsustainable. Actions to contain the strongest adverse effects of global resources competition will be of primary importance in the adoption of effective strategies to cope with climate change and stimulate global sustainable development.

Box 3: The intensified global competition for resources

Africa. Historically, global competition for natural resources (included human beings) represented the most dramatic driver for the continent. From slavery to the civil wars of the second half of the twentieth century resources competition, led by actors external to the continent, has increased violence and intense suffering for many parts of the continent. While the regional resources keep on attracting foreign investors, new correlated trends have advanced since the beginning of this century. While North African countries faced, and are facing, increasing tensions often connected to their natural resources, Sub-Saharan Africa has enjoyed a reduction in open, resources related conflicts. As a consequence, a virtuous circle has slowly started to affect the region accelerating aggregate welfare growth and also influencing the adoption of more careful resources policies by the countries of the continent.

Asia. The geographical extension of Asia provides a varied and multi-faceted ways of the availability and use of natural resources. China, India, and Indonesia are the most productive mining economies, with China being world's largest producer of aluminium, gold, tin, and coal. South East Asia registers relevant mining resources too, including tin, silver, copper, gold and gemstones. Additionally, China currently represents a virtual global monopolist for rare earth metals. By extending Asian geography to Russia and the Arab Peninsula the continent becomes the largest producer for oil and natural gas as well. Nevertheless, the whole continent faces challenges in resources use and competition. Coal and fossil fuels, that provided the necessary support for the astonishing economic growth pace of the entire region, are now producing unsustainable environmental effects for all the highly industrialised countries in Asia, while the push of a sustained population growth and the increased welfare are pushing towards an overconsumption of available resources. Moreover, the presence of strategic resources like rare earth minerals provides additional pressure from international actors, revamping resources competition all over the continent. While, strategies aimed at phasing out the dependence of Asian economies from fossil fuels and non-renewable resources have been recently set up in several countries of the continent, their effects will be possibly verified only in a long-term perspective.

North America. The development and use of new technologies such as fracking and shale oil, and gas techniques provided the USA and North America in general with a completely new scenario in terms of their use compared to past decades. The USA represented the biggest net importer of oil worldwide for the most of the second half of the twentieth century and only with the beginning of this century, as a consequence of the fast pace of growth of several key large countries, i.e. China, India and Brazil, the USA slowly saw its imports contained in a

relationship with these countries' new thirst for energy and resources. Yet the real revolution appears more recent and linked to fracking and shale oil, and gas techniques. These technologies could transform some of these countries into exporters. The biggest challenge is now related to the wide and relatively easy access to these technologies that are strongly reducing the final price of oil and gas. These falls in price are reducing the economic sustainability of any project aimed at adopting the new technologies, thus making their adoption virtually unsustainable under an economic perspective. Moreover, they might also affect environmental risk, because of the uncertainty of their consequences in the long term.

The increasing urbanisation dynamics are mainly related to global population increase. Urbanisation dynamics represents an additional key driver for the growth in GHG emissions as it is shown in Figure 4.

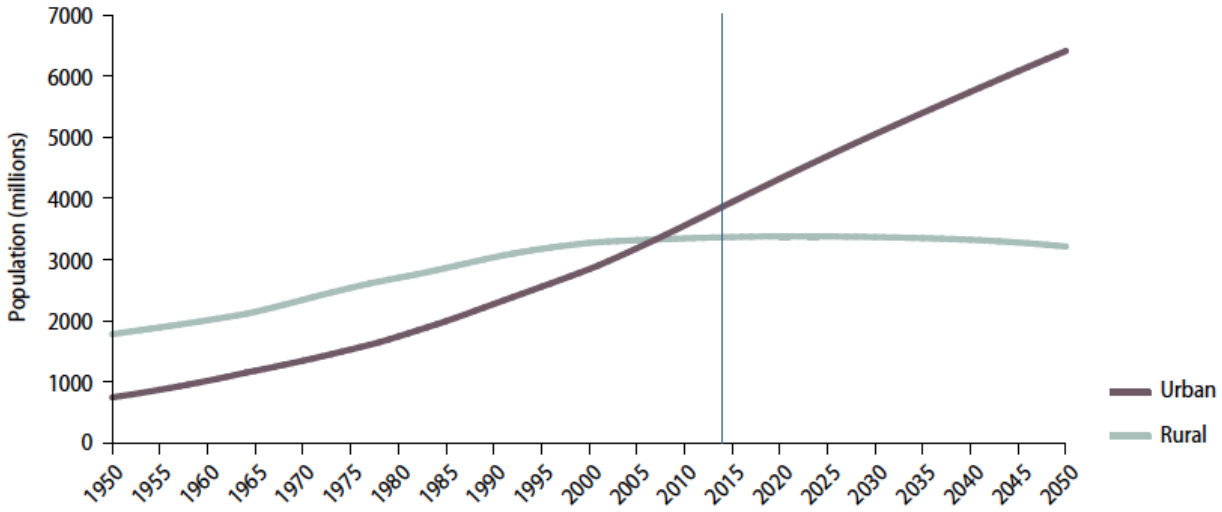


Figure 4: Urban and rural population of the world, 1950-2050

Source: World Urbanisation Prospects (United Nations Department of Economic and Social Affairs Population Division, 2014).

With urban areas consuming 78% of the world's energy, producing more than 60% of all CO_2 and significant amounts of other GHG emissions (UNHABITAT, 2016), the drastic increase in urban population worldwide has now become one of the keys to correctly interpret, and possibly contrast, the climate change issue. For example, if the urbanisation trend is usually perceived as a driver for GHG increase, by contrast an efficient management of urban development in future years will become a significant determinant for effective control and contrast of this increase. Urbanisation, with its double-sided interpretation, therefore represents a hugely delicate subject

for analysing the risks related both to climate change and its mitigation. The topic will require special attention in the development of the regional and national case-studies.

Box 4: The urbanisation trend

Asia. Taking into account multi-faceted of Asia, it is possible to identify recurring characteristics for some countries of the region. On one side, poverty, weak urban planning programmes and lack of resources and capabilities force millions of urban citizens to struggle for access to basic services and resources. These conditions affect mostly the least developed areas of the continent. By contrast Asia represents the highest concentration of mega-cities (13 out of 22) developed under the driver of sustained economic growth worldwide. For most of their citizens, access to basic services and resources is relatively easier than for the urban households in poorer countries. For these mega-cities, as with the majority of the other large cities of the continent, the biggest threat is currently represented by the lack of environmental sustainability in the adopted urbanisation models.

Latin America. After 60 years of chaotic but rapid urban development, four-fifths of Latin America population now live in towns or cities. That proportion is expected to grow to 87% by 2050. Threats similar to those affecting Asian cities are exacerbated by specific regional drivers (i.e. violence and corruption). The majority of the population of Latin American cities struggle to access resources such as water, sanitation, infrastructure, and energy. Developing adequate strategies for an accountable urban planning in the continent requires more radical transformations than those required in other areas of the world.

Technological change is widely considered as a key driver for mitigating GHG emissions. Global development and diffusion of adequate clean technologies appears, to many, as the only sustainable pathway to combat climate change, and as the tool able to decouple the link between economic growth and high HDI on one side and GHG increase on the other. Adopting innovative climate-friendly technologies on a large and very-large scale may indeed represent a system of economic activities able to eventually compensate the economic losses originated by the transition from the current socio-economic system to more sustainable, low-carbon pathways (e.g., Jacobs and Mazzucato, 2016, Perez, 2016, Zenghelis, 2016).

Box 5: The accelerating technological change

Asia. Technological change currently represents the most striking driver of change across the Asian continent. IT and connectivity represent the key unpredictable factors within the driver. With an estimated 80% of Asian adults accessing the internet by 2020, the consequences of such an extended connectivity are still unpredictable. But Asian technological change includes also sectors others than IT. New regional institutions promoting technological development have intensified their presence and relevance. For example, the Asian Infrastructure Investment Bank (AIIB), led by China and strongly supported by Chinese investors, offers new visions for continuing economic growth.

North America. The region still represents the highest concentration of highly innovative and technological firms worldwide, in any possible sector. This well-established leadership has lasted more than 60 years, and is mainly supported by a strategically diffused system effectively promoting both public and private investments in innovation. These comparative advantages are further supported by the North America higher education systems where, despite the existence of controversial aspects related to disparities in accessing to it, universities and study centres still represent the most advanced academic and research realities worldwide. They therefore add value to the existing strategies concerning technological advance and innovation.

Europe. Similarly to the US, Europe and the EU have enjoyed high degrees of competitive advantages on technological innovation over the years. Registering the presence of cutting-edge high technology firms, as well as counting on recognised public and private innovation centres all over the continent, Europe founded a relevant share of its economic and political relevance on technological evolution. Yet disparities between the different countries and EU member states led to an uneven distribution of these resources over the region. The attempts put in place by the EU to overcome the threats of this inequality, based on highly funded common research and innovation programmes (i.e. the recent Horizon 2020) and systems aimed at facilitating the exchange of students and scholars, register significant, positive impacts in terms of harmonisation in the EU access to advanced technologies. Yet the current uncertainty dominating the European economy and the different tensions shaking the entire EU, including Brexit, are negatively impacting efforts for an accelerated and uniformed technological change in the area.

Yet two main risks can drastically reduce the positive effects of clean technological innovation. On the one side the costs related to the adoption of the new technologies can overcome their economic benefits, while on the other an uneven spread of the technologies may lead to an increase in social, economic and environmental disparities, thus exacerbating frictions between different geographic areas or countries. Moreover, technological change does not always imply sustainable innovation and it may lead also to an increase in GHG emissions. More specifically the

technologies' diffusion process may increase the demand for new products whose production and use imply substantial increases in GHG emissions.

The development of an increasingly multipolar world is the key factor determining current and likely future, global geopolitical changes. Its overall impact is therefore extremely significant and its influence moves from general geopolitics up to influencing more specific sectors such as global strategies on climate change. Specifically, the development of a multipolar world, with new emerging forces and new balances of power, facilitates the shift of attention from old and established topics to new and more contemporary issues. Most of the countries that have enjoyed a fast pace of growth in both their economics and their global political status are facing severe consequences from climate change, and are therefore pushing for it to become a key subject in the international agenda. In this perspective, the positive outcomes for Paris can be seen also as a practical consequence of the increasing multipolarity of the world.

Conversely, other aspects of multipolarity can, in the long run, hamper international efforts against climate change. For example, countries seeing a contraction in their geopolitical role may adopt increasingly protectionist strategies in an attempt to preserve their relevance and interests. As a consequence, international negotiations on climate change, that represent the core driver for a global transition towards low-carbon pathways, may be drastically limited by an increase in geopolitical contrasts between emerging and mature areas of the world.

Box 6: The development of an increasingly multipolar world

Asia. The impressive pace in growth of most of Asian countries during the last two to three decades, their technological development and their increasing economic, social and (sometimes) political integration have made the continent a key nodal point for the current multipolarity trends worldwide. The increasing economic importance of Asia, in terms of production firstly and then in consumption, have been shifting the attention of big economic and financial stakeholders 'towards the East'. Economic surpluses originated by the boom in industrial production and corresponding exports, allowed most Asian countries to accumulate reserves that allowed them to act with increasing power on markets all over the world. This new economic significance has not yet corresponded to an equal political impact. The soft-power strategies traditionally characterising Asian diplomacy did not lead to radical transformations in terms of global governance of a multipolar world. Yet the first signals of change in international policy clearly appeared in most recent times, showing the effect of the power shift towards East. The Paris Agreement is an example of this new wave.

North America. North America, and the USA in particular, is currently suffering a 'loss of power' syndrome. US military and defence dominance and widespread geo-strategic presence, its apparently steady economic recovery from the 2007/08 crises and other megatrends like the technological innovation degree of its firms and the level of its higher education system keeps on granting a dominating role within the global governing system. Yet the fast economic growth of vast, previously lower income areas of the world (i.e. Asia) are now re-shaping and containing this dominance. The new dynamics for international balances of power are often perceived as direct challenges by the USA population and politicians, thus possibly becoming a huge risk factor for the next future, if not handed within the current international policy frameworks.

Together with the development of a multipolar world, diversification of the governance models and approaches possibly represent the key megatrend of the beginning of the current century. Originated by the diverging dynamics related on the one side to globalisation and on the other side to the pushes for a more localised and direct administration, thus often defined as a 'glocal' dynamic, this increasing diversification holds a significant role in strategies adopted against climate change. Diversifying governance approaches mainly mean the development of multi-level governance systems, shifting from dominance of national governments to a much more complex system. On the one side globalisation increased the role of big private actors (i.e. multinationals and investment funds) and international institutions, while facilitating the merging of national interests into bigger regional structures. On the other side the same globalisation process has stimulated the raising of bottom-up and more democratic approaches to governance to contrast to more perverse effects of globalisation. As a consequence, it is possible to register an increasing

relevance of actors such as local communities and authorities, as well as social and economic movements, in global governance.

Box 7: The diversifying approaches to governance

Latin America. Despite the problems affecting the current governance dynamics of different countries of the continent, Latin America has been representing a significant environment for experiencing and experimenting with new governance models. Supported by the presence of indigenous communities all over the continent and by the development of politically significant non-governmental movements, the continent registered a huge variety of different approaches to governance models able to integrate the classic political needs of institutionally organised states with requirements originated by informal but well-established, alternative organisations.

Europe. The European Union probably represents the most advanced formal approach to diversifying governance currently in place worldwide. Founded upon a balance of powers between its member states and its common institutions, the EU has always tried to promote an efficient multi-governance model since always. Moreover, the EU governance system has constantly tried to develop inclusion processes aimed at institutions other than its member states, thus facilitating the direct participation of regions and local authorities. Well interpreted by the strategy adopted by EU within the climate negotiations, the ambitious overall programme aims at integrating a variety of socio-economic and political realities, characterised by different and sometimes diverging perspectives and approaches. The governance model adopted by the EU, characterised by a mix of regulations and flexibility, is currently challenged by the tensions shaking the region including the uncertainties coming from Brexit. In addition, the economic uncertainty, the refugees' crisis, and the increasing fear for terrorism are directly threatening the foundations of European multi-governance and destabilising the region.

These dynamics are strongly influencing attempts to govern the climate change issue, leading to two opposing effects. On the one side increasingly multi-level governance on climate change can promote (and is promoting) more efficient, just and equitable strategies to fight it, by allowing a better understanding of the different needs, risks, opportunities and challenges related to it. On the other side the involvement of an increasing number of stakeholders, with different aims and views, may destabilise the debate on climate change, thus hindering its global effectiveness.

Now the analysis of the key socio-economic megatrends influencing the dynamics of climate change is completed, a focus on the sources of the same is required. An analysis of the macro-sectors responsible for GHG emissions is therefore proposed, with the double aim to further facilitate the process of linking the megatrends with the anthropogenic causes of climate change and to frame these latter within more specific socio-economic determinants.

2.3 GHGs and corresponding sectors

Any mitigation strategy (and action taken at any level, from the local to global) implicitly affects macro-economic sectors responsible for the GHG emissions. Mitigation strategies have implications for both the consumption of resources and the emission of GHG, and high emitting sectors are being strongly targeted by both the new rules on climate change (see below Section 2.4) and the current dynamics of the global resources management. A clear identification of the size and impact of each sector in terms of emissions is therefore a key element to evaluate their possible evolutions under the constraints of the new climate regime and the challenges of the current megatrends influencing it. Table 1 shows the evolving distribution of GHG emissions within macro-sectors worldwide, in between 1990 and 2010.

Table 1: GHG emissions per sector (Mega tonnes CO_2 equivalents, $MtCO_2$ eq), 1990-2010

Year	Energy	Industrial process	Agriculture	Waste	Land-use change and forestry	Bunker fuels
1990	22,715	1,114	4,010	1,146	3,335	591
1995	23,456	1,283	4,544	1,224	2,741	669
2000	25,252	1,469	4,620	1,297	2,778	789
2005	29,099	1,970	4,870	1,376	3,203	921
2010	32,183	2,493	5,213	1,469	2,759	1,023

Source: (World Resource Institute, 2016a)

From this data, it is possible to identify two sectors having registered relatively limited variation over time. 'Waste' appears to be the most 'static' compared to any other sector, while 'land-use change and forestry' (LUCF) shows a relatively inelastic trend, yet registering some relevant variations with reference to 1990 and 2005 in particular. For the latter it is likely that the uneven data is affected by the current technical limits on recording and registering the LUCF-related emissions impact. All the other macro-sectors have registered sharp increases over the time, with agriculture emissions registering a 30% increase in 2010 compared to 1990, energy about 40%, bunker fuels almost 75%, and industrial process registering an increase of more than 120%.

A second key consideration is represented by the overwhelming role of energy as the macro-sector impacting GHG emissions, with a share constantly maintained close to the three quarters of total overall emissions. An extensive variety of key sub-sectors is embedded within energy, including electricity and heat, transportation, manufacturing and construction, other fuels combustions and general fugitive emissions. Table 2 shows an energy-related GHG distribution sub-sector analysis in the period 1990-2010.

Table 2: Energy-related GHG emissions per sub-sector (Mega tonnes CO_2 equivalents, $MtCO_2$ eq), 1990-2010

Year	Electricity/heat	Manufacturing and construction	Transportation	Other fuel combustion	Fugitive emissions
1990	8,421	4,519	3,925	3,910	1,939
1995	9,044	4,471	4,239	3,770	1,936
2000	10,232	4,537	4,833	3,642	2,018
2005	12,217	5,317	5,403	3,893	2,292
2010	13,863	6,091	5,804	3,952	2,497

Source: (World Resource Institute, 2016a)

Table 2 registers trends in line with those referring to the macro-sectors analysed in Table 1, with a general increase in emissions over time for all the energy-related related sub-sectors. In more detail, the electricity/heat sub-sector registers a 64% global aggregate emissions increase in 2010 compared to 1990, transportation almost 48%, manufacturing/construction 35%, fugitive emissions almost 30%, while other fuel combustion levels remained stable over the time.

Most of the energy-related sub-sectors registered GHG emissions higher than the (non-energy) macro-sectors reported in Table 1, therefore playing key roles in a complete analysis and assessment of the current and future sectoral emissions' distributions. For example, by representing roughly one third of energy emissions, the electricity/heat sub-sector encompasses a range between 20% and 25% of the global GHG emissions.

As a consequence of this multi-faceted sector structure, most of the strategies and policies currently in place to stimulate mitigation actions at global level are focused on both the macro-sectors included in the figures and the sub-sectors embedded within the energy component. The entire set of sectors thus requires analysis within the scope of the TRANSrisk project to offer the integrated assessment of the available mitigation pathways.

Sector interactions, both within the framework of the general GHGs and within the energy domain, are a key element in the TRANSrisk project, therefore requiring detailed analyses throughout the project's development. Understanding the interaction dynamics across and within the sectors, as well as their interrelationships with the consumption of natural resources, must be considered a priority for TRANSrisk case study countries.

The importance of the energy sector requires special attention on primary energy resources and their management. Fossil fuels (oil, natural gas and coal), representing about three fourths of the global energy supply, are identified as the current key resources for the sector. At the same time, they can be considered as the resources most challenged by the current and future dynamics related to energy and climate change.

With a past trend that, aside from sporadic crises, maintained a steady and dominating relevance in the energy markets, fossil fuels are currently facing increasing threats in their use and further development. On the one side, due to their high GHGs emissions, they represent the primary target for mitigation strategies and are likely to be challenged by stricter and stricter policies aimed at reducing their use. On the other side the current dynamics of their exploitation are shaking the entire fossil fuels regime from its pillars. A variety of different elements is putting the entire regime under increasingly high pressure. While technological innovation (e.g. the adoption of fracking extraction methods) is dramatically increasing production potential, and therefore the supply, of these resources, the global economic trends and the increasing efforts to contain and reduce GHGs are pushing for a substantial reduction in global demand for fossil fuels.

These opposing trends currently collide, leaving high uncertainty concerning the future of fossil fuels and the entire energy domain. An oversupply should, in principle, push for drastic reductions in the costs of the resources, therefore stimulating a 'rebound' effect that should stimulate the demand side. Yet this process has not been effective, with markets providing no elasticity to the new production trends. As a consequence, processes of de-investment from fossil fuels have been constantly growing in most recent years, stimulating a shift of funds towards alternative energy resources (supported in this also by the new regimes regulating GHGs emissions). The energy markets' volatility and the opposite dynamics currently governing them exponentially increase the uncertainty characterising the whole global energy sector and its future. Further analysis of the future trends in terms of GHGs emissions and their mitigation thus requires significant consideration of developments of the elements currently undermining the fossil fuels regime.

A similar approach must be maintained towards implementation of adaptation strategies. In contrast to mitigation, adaptation sectors are characterised by unclear subdivisions, including domains like risk awareness, urban resilience, food and water security, biodiversity protection, land degradation combat, disasters management, coastal zones management, environmental pollution containment. All these domains are strongly affected by the megatrends introduced in Section 2.2. Yet the fragmented and heterogeneous list of sectors related to adaptation reduces the feasibility of a proper assessment framework like the one proposed by TRANSrisk. Addressing research efforts of TRANSrisk mainly towards mitigation strategies in some embedded sectors is

therefore more likely to provide useful insights and outcomes from specific sectors in each of the case study country analysed in TRANSrisk project.

Now we have introduced the megatrends affecting climate change, and made a brief analysis of the macro-sectors responsible for the GHG emissions, Section 2.4 provides an overview of the current stage of the climate change debate at global level. This refers to the definition of a global strategy to combat climate change, known as the Paris Agreement.

2.4 Overview of the accord of the Paris Agreement (COP21) on Climate Change and update on Marrakech (COP 22)

The climate change general debate has been dramatically shaken by the final result of the 21st Conference of Parties (i.e. States, which signed the Agreement) (COP21), held in Paris in December 2015 under the United Nations Framework Convention on Climate Change (UNFCCC). The unprecedented efforts put in place for the Conference led to an unexpected outcome: the signing of a high-profile, ambitious international agreement on climate change. The result of more than twenty years of diplomatic efforts, signed by almost 200 countries, with decades-long scope and highly ambitious objectives, the agreement signed in Paris on 12th December 2015, the Paris Agreement, represents a cornerstone for the international debate on climate change. It sets out the legal framework defining the pathways for a global low-carbon and resilient development, and defines the current status and balance of forces in the international climate change arena.

The final document approved in Paris (UNFCCC, 2015b) is composed of several different parts. Appendix B shows a summary of the main elements of the Paris Agreement. The first sections are mainly focused on the actions and strategies to be followed before the enforcement of the Agreement, established by the end of 2020. For a general understanding of its relevance and meaning the whole document needs to be analysed in a reverse order, starting from the Annex of the Paris Agreement referring to the proper Agreement. While this section offers a general overview aimed at focusing those aspects that most are related to the TRANSrisk project, more detailed analyses of the different parts of the accord are provided in the Appendix B of this report.

The Paris Agreement has a binding nature[1], smoothed by the absence of sanctions and the non-punitive, non-adversarial nature of the Agreement.[2] About one third of the document (12 pages

[1] As confirmed by paragraph 2 of Article 20 of the Agreement: "Any regional economic integration organization that becomes a Party to this Agreement without any of its member States being a Party shall be bound by all the obligations under this Agreement".
[2] Article 15.

out of 32) directly refers to the proper 'Agreement', organised in a preface and 29 articles that will enter into force from the 1st January 2021.[3] It is relevant to note that, since its preface, the Agreement recognises the risks related to the adoption of actions against climate change when affirming that: "Parties may be affected not only by climate change, but also by the impacts of the measures taken in response to it".[4]

Together with the pursuit of more sustainable economic models[5] and the need to increase the ability to adapt to the adverse impacts of climate change, the key target of the Agreement is affirmed by the identification of a range of containment objectives, where the 2°C above pre-industrial emissions limit represents its minimum ambition and containment within the 1.5°C increase represents its ideal goal. The text of the Agreement is focused on establishing the legal framework and provisions for the development of any strategy, policy, action concerning its general objectives. The structure of the Agreement, in principle, links any specific topic to a corresponding article. Despite the balance between the different themes, mitigation plays a key role among them (see Appendix B). The key and most recurring elements of the Agreement can be summarised in the following points: a) organisation of the contributions between the countries; b) relationship between developed, developing and least developed countries; c) carbon finance.

The definition of the Parties' contributions to the different objectives of the Agreement is based upon the adoption of a new tool, defined as Nationally Determined Contributions (NDC). Ideally representing each Party's highest possible ambitions, the NDC shall be prepared, communicated and maintained autonomously by each Party that, in doing so, shall take full responsibility for their implementation under the principles of environmental integrity, transparency, accuracy, completeness, comparability and consistency. No reference concerning the procedures and methodologies for the Parties to estimate their NDCs is provided within the Agreement. In addition to this, the text lacks of any reference to monitoring and evaluating instruments. The current provisions for the NDCs cannot be considered as sufficient in respect to effective alignment with the global objectives of the Agreement. A clearer definition of their institutional settings is part of the work-plan defined by the Agreement for the next five years.

Compared to the Kyoto Protocol the Paris Agreement presents a smoother but still certain differentiation between developing and developed countries. While a clear separation between countries with or without mitigation responsibilities does not exist anymore, the Agreement recognises "the principle of equity and common but differentiated responsibilities and respective capabilities, in the light of different national circumstances" among its guiding principles.[6] This principle was strongly supported by all the developing countries, and represents the key formal

[3] Assuming for that at least 55% of the Parties, representing at least 55% of the global GHG emissions, will have ratified the Agreement by that time.
[4] Paragraph 7 (not numbered), page 21 of the Paris Agreement.
[5] The Agreement clearly refers to the adoption of United Nations General Assembly Resolution A/RES/70/1, "Transforming our world: the 2030 Agenda for Sustainable Development" since its very first sections.
[6] Preface to the Paris Agreement.

discrimination between them and the developed countries, leading to several differentiations within the same text of the Agreement. Similar differentiations are often extended to a third series of Parties, defined as least developed countries and small island developing states. A clear listing of the Parties belonging to these various categories is not provided within the Agreement.

While relevant aspects, such as technology and capacity building are only marginally touched by the general provisions, leaving therefore huge normative gaps that will require to be filled in the next five years. The theme of finance is more widely included within the text of the Agreement. The topic is included in the overall objectives of the Agreement, stating the need to "making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development".[7] As a consequence emphasis to finance is given both directly, where the need for developed countries' Parties to financially support mitigation and adaptation efforts of developing ones, and indirectly, where a new mechanism to promote mitigation and to support sustainable development is introduced. The relevance given to finance confirms that it represents the greatest challenge for the implementation of the Agreement, therefore requiring special attention in assessing risks and opportunities linked to it.

Recently, the Marrakech Conference (COP22), formed of the Conference of the Parties (COP 22), the twelfth session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP 12), and the first session of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA 1), was an opportunity full of hope and goodwill for stakeholders and countries to identify concrete actions for implementation to provide a targeted and appropriate response to global warming. However, the detailed blueprint for action might be completed in the following 2-3 year period, pre-2020 Agenda (IFDD, 2016). Therefore, much remains to be done (UNFCCC, 2016a). And it is expected that "countries will work diligently and expeditiously to complete workload as soon as possible" (CarbonBrief, 2016).

The Marrakech action proclamation calls to moving forward purposefully to reduce GHG emissions and to foster adaptation efforts, thereby benefiting and supporting the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDG) (UNFCCC, 2016c). The main imperative now is to put the conservation and management of natural resources and human rights to the top of the agenda, ensuring that food and energy security could be achieved in sustainable basis, and especially for indigenous populations.

However, there are specific actions that are still problematic for several reasons. Finance continues to be a controversial issue. Countries were urged to continue scaling up their financial contributions towards the pre-agreed "$100bn a year by 2020" goal, and to achieve a greater balance between adaptation and mitigation. Some countries had hoped for stronger wording on

[7] Article 2, paragraph 1.C of the Paris Agreement.

this, since adaptation has long trailed mitigation, to the detriment of the most vulnerable countries (The Hindu, 2016).

It was also clear that having financial resources ("big pockets") is not enough to achieve the aims of the Paris Agreement; capacity building in the vulnerable and poorest countries is one of the most important challenges to cope with. Two extremes of building capacities include: a) the so called North-South technology transfer, which have uncertainties regarding the identification and diffusion of specific technologies because of the unsuitability of these technologies, which might not address the needs of the country-recipient, and b) the development and implementation (including diffusion) of more suitable technologies, which take into account the indigenous needs, aspirations and knowledge. However, there are multiple variations of them (including the South-South technology and knowledge transfer and sharing strategies), which require more participation of stakeholders (e.g. indigenous populations, communities, firms, etc.) in the design and implementation of sustainable policies and strategies to avoid "the regrets" in the long term.

The organisation of the "2018 facilitative dialogue" also proved to be controversial. Countries agreed in Paris that they would convene in 2018 to take stock of how climate action was going so far — a discussion that is intended to inform the next round of national pledges or NDCs[14]. Moreover, article 4 of the Paris Agreement deals with both the long-term "net-zero emissions in the second half of the century" goal, as well as the need for NDCs to provide "clarity and transparency". A key theme of COP22 was debating how best to create a fair "rulebook" that all countries could share and have confidence in when assessing each other's climate pledges. The technicalities of the rulebook, including baselines, methodologies, etc., will likely be a continuing discussion into 2018.[14]

Additionally, there are uncertainties and concerns regarding Donald Trump's victory in the US as he has proposed that America should pull out of the Agreement, which may weaken efforts to meet global targets. Experts say that pre 2020 action is vital. The UNEP Emissions Gap 2016 (UNEP, 2016) report addresses that Paris commitments are not enough to stop global warming. Moreover, the Doha Amendment to the Kyoto Protocol is a critical target for containing global warming. Given that US is not a Kyoto Protocol party, the implementation process depends of the agreement and efforts of other developed countries. So far, 73 countries have ratified the Doha Amendment, though 144 countries are required for it to be enforced. Therefore, dialogue and negotiations for ratifying the Amendment are needed (The Hindu, 2016, EcoFin Agency, 2016).

The success of the COP22 will not be seen in the short term. It has shown a step forward to implementation related to some of its objectives (IFDD, 2016): a) certain progress in the pre-2020 agenda; b) it highlighted the need for an adaptation-mitigation agenda (Paris Agreement-Sustainable Development Goals, Marrakech proclamation); 3) highlighting the discussion of the interactions and interlinkages of finance and capacity building and technology transfer; and d) enhancing the Parties' ambitions to achieve significant GHG reduction (i.e. NDCs).

Now the Paris Agreement and the Marrakech discussion have been introduced and the main elements for TRANSrisk have been analysed, Section 2.5 analyses other key elements contained in

the Agreement referring to the period prior to its entry into force (2016-2020). Three key elements have been identified: a) the new assessment mandated to the Intergovernmental Panel on Climate Change (IPCC) (2014b) and aimed at a 1.5°C target scenario and corresponding pathways; b) the work-plan to define the norms and regulations to implement the general provision of the Agreement and to enhance early voluntary actions prior to 2020; c) the role of stakeholders.

2.5 The 1.5°C Target and its implications

One of the most surprising outcomes contained in the Paris Agreement has been the introduction of a new, highly ambitious 1.5°C target as an ideal objective. The new target solely represents the 'ideal' objective of the Agreement, keeping the 2°C target as the maximum. Yet, as a main consequence, the challenging target requires a radical redefinition of the low-carbon pathways as discussed, analysed and assessed up to date.

With the IPCC handed the role of defining a new assessment (by 2018) in line with the 1.5°C target, there is an increasing concern around the opportunity and feasibility of identifying reliable pathways. More specifically, there are concerns that pathways can combine the current social, economic and technological capacities on one side with a sound environmental integrity on the other side. Despite the absence of a complete assessment concerning the target it is generally understood that it would imply a dramatic acceleration in mitigation processes worldwide. The new carbon budget, calculated in 1,000-1,200 billion tons of CO_2 by the Fifth IPCC assessment when referring to a 2°C scenario, would be probably reduced up to a half when re-calculated to meet the 1.5°C target. Similar considerations can be seen concerning its exhausting deadline that, in absence of radical cuts in the global emissions, may correspond to about a decade from now.

The core theme from now until the definition of the possible 1.5°C pathways then lies upon the assessment of the real feasibility of any of them. In doing so, answering some specific questions becomes of highest importance: Is it possible to identify at least one pathway compatible with the global right and need for development? What are the technologies that shall be implemented to reach the targets? What would be the economic and financial costs? Who should be charged with these costs? Would it be possible to transform these costs with associated opportunities? If the answer is yes, how and for whom? What implications, in terms of societal changes, would these new pathways lead to?

These questions cannot be currently answered. Yet each of them represents a multitude of risks and a high degree of uncertainty, therefore becoming of high importance for the research carried out in the TRANSrisk project with evidence from 14 sector country case studies. Following future developments, participating (directly and indirectly) in the efforts required to answer the questions and assessing the processes that will lead to exploring new pathways.

2.6 A work-plan to give effect to the Paris Agreement and to enhance actions prior to 2020

The first half the Agreement establishes a work-plan to give effect to the general legal provisions defined by its 29 Articles. The corresponding roadmap, as envisaged by the Agreement, concerns each of its main themes and is mandated to be complete before its official entry into force (at the end of 2020). As for the 1.5°C issue, the ability to establish and correctly implement the roadmap represents an enormous challenge for the entire international community, leading to several risks of failure and extremely high degrees of uncertainty. For example, implementing the work-plan means some crucial questions must be answered, as summarised below:

- Which low-carbon pathways are compatible with the new global temperature targets?
- How can economic, social and environmental sustainability be granted during the implementation of the Agreement?
- How can justice and equity be granted between the Parties and all the involved actors?
- Which instruments can be set up to provide the required degree of transparency for the new system?

A similar implementation is currently and officially 'bound' within the regime described in the Paris Agreement. This regime includes definition of the different organs leading the work-plan implementation, addressing their responsibilities. In doing so new ad hoc Working Groups (WG)[8] within the UNFCCC have been established,[9] while new responsibilities have been given to existing ones. Specific actions to be carried out by the Parties have been also defined as part of the work-plan implementation (e.g. a radical review of their already submitted NDCs).

The section of the Agreement concerning the pre-2020 enhanced action aims at stimulating and accelerating virtuous mitigation and adaptation activities prior to the entry into force of the Agreement, while at the same time attempting to harmonise these activities and guarantee their conformity to the principles and provisions of the Agreement. In broad terms this section can be seen as the set of measures to facilitate the implementation of a 'piloting period', when innovative strategies and policies will be voluntarily developed by the Parties in collaboration with key stakeholders. Similarly to the part focused on the work-plan, the section includes the definition of technical instruments, to be developed under the framework of the UNFCCC, aimed at promoting the entire enhancement process. The two sections can therefore be considered as complementary sides of the process towards the proper implementation of the Agreement.

[8] In the UNFCCC context the Working Groups are ad-hoc technical committees in charge to design measures and regulations concerning the different themes.

[9] The ad hoc Working Group on the Paris Agreement (APA) representing the most relevant among them.

The 'enhancing actions' subject is likely to become of primary importance for those attempting to assess the future developments in climate change mitigation and adaptation. Their direct impact must be added to their value as 'case-studies' for the correct and efficient implementation of the legal framework that will govern the climate change framework in future decades. It is therefore of significant importance to provide high-profile monitoring and evaluation activities in order to provide real support to policy-makers and other stakeholders directly engaged in the detailed definition of the Paris Agreement and beyond.

Box 8 : Representative Concentration Pathways (RCP) and implications of 1.5°C

The IPCC Fifth Assessment Report referred to four 'representative concentration pathways' RCP2.6, RCP4.5, RCP4.5, RCP6, and RCP8.5 developed by Moss et al. (2010) (see (IPCC, 2014a:439)

Table 3 below and Figure 5). Under all four RCPs, the global mean temperature increases during the first half of the 21st century, relative to pre-industrial reference years 1986-2005; but the pathways become more differentiated around the mid-century.

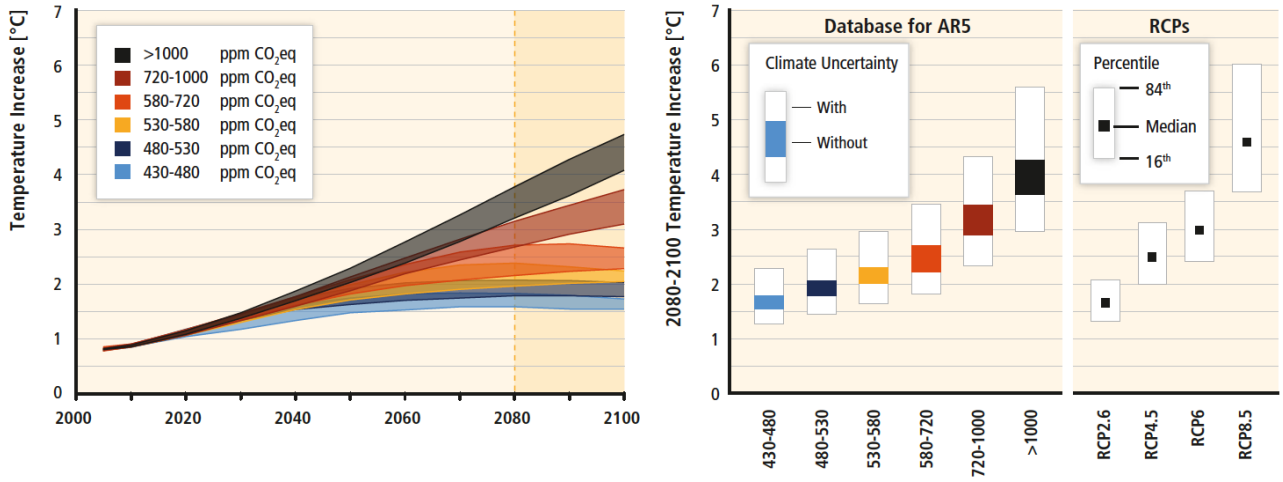


Figure 5: Projected temperature change and cumulative emission (GtCO2) for RCP 2.6, 1.4, 6.0 and 8.5.

Source: (IPCC, 2014a:439)

Table 3: RCPs and corresponding global mean surface temperature change (°C), concentration (ppm) and pathways

	2046-2065		2081-2100			
Scenarios	Mean (°C)	Likely range (°C)	Mean (°C)	Likely range (°C)	CO2-equivalent concentration in 2100 (ppm)	Pathway
RCP 2.6	1.0	0.4 to 1.6	1.0	0.3 to 1.7	Peak at ~490 CO2-eq. before 2100 then declines	Peak and decline
RCP 4.5	1.4	0.9 to 2.0	1.8	1.1 to 2.6	~650 CO2-eq. (at stabilization after 2100)	Stabilization without overshoot
RCP 6.0	1.3	0.8 to 1.8	2.2	1.4 to 3.1	~850 CO2-eq. (at stabilization after 2100)	Stabilization without overshoot
RCP8.5	2.0	1.4 to 2.6	3.7	2.6 to 4.8	>1,370 CO2-eq. in 2100	Rising

Source: (IPCC, 2013:90, IPCC, 2014a:430, Moss et al., 2010)

Of the four pathways RCP2.6 presents the most plausible scenarios for reaching the 1.5°C target stipulated in the Paris Agreement. Under RCP2.6 scenarios, the global mean temperatures will likely increase by 0.3°C -1.7°C (within the 5-95% range) and GHGs will likely peak at ~490 ppm before declining at the end of the century. In RCP 4.5, 6 and 8 scenarios, global mean temperatures will likely increase

by ~2°C to ~4.8°C (within the 5-95% range) and the global CO_2-equivilent would range from ~650 to >1,370 in the last two decades of the 21st century.

Considering that the global CO2-equivalent in February 2015 was approximately 401.62 ppm (NOAA, 2016), the 2°C target - implying a CO_2-equivalent concentration of ~490ppm in 2100- will be challenging to meet. The likelihood of limiting global warming to 1.5°C by the end of the century is therefore uncertain and raises questions on the risks that are inherent in the actions necessary to meet the target. Currently there are very few studies that explore the implications of meeting a 1.5°C target. Rogelj et al. (2015) study on "Energy system transformations for limiting the end-of-century warming to below 1.5°C" are among the few studies that have compared 1.5°C scenarios with 2°C scenarios. Their analysis indicate that 1.5°C scenario reach net zero CO_2 emissions by mid 21st-century, which is between 10-12 years earlier the 2°C scenarios. Net negative emission are also required in the second half of the century for 1.5°C scenarios while negative emissions are not necessarily required for 2°C scenarios. Additionally, long term mitigation costs of 1.5 °C may be up to two times higher than 2°C scenario. The 'window of opportunity' that exists in 2030 to limit temperature increase to 1.5 by the end of the century is "much lower and substantially smaller the corresponding window for 2°C consistent scenarios" (2015:525).

Rogelj et al. (2015) highlight the urgency of shorter term action but further studies are needed to identify the socio-economic and environmental impacts (costs and benefits) and risks associated with a 1.5°C target, particularly with technologies required for negative emissions including geoengineering (e.g. carbon capture and storage, solar radiation management, etc.).

2.7 Stakeholders other than Parties

Finally, a key element of the Paris Agreement is the increasing relevance given to the participation of stakeholders other than Parties. They are more often cited in those parts of the Agreement that do not belong to the proper accord and with a dedicated Section V. This represents one of the most relevant innovations compared to the past agreements. It is now clear that the non-Party stakeholders are not only required to play an increasing relevant role in the future implementation of the Agreement, but have already been key actors in facilitating the reaching of the same.

Following the pre-2020 enhanced action part, Section V of the Agreement concerns the role and relevance of the non-Party stakeholders. While providing a provisional list of the main categories composing them,[10] the section recognises their factual contribution to the reach of the Agreement and their key role for its future implementation. In doing so the Agreement encourages stakeholder

[10] Paragraph 134 of Section V includes among them: civil society, the private sector, financial institutions, cities and other subnational authorities.

action at any possible level and in any possible area related to the aspects discussed within the Agreement.

The increasing engagement of similar stakeholders in the future of climate change work represents a cornerstone in the dynamics that characterised the global climate framework up to date. Recognition of their relevance and contribution implies a radical change in the dynamics ruling the relationships between them and the Parties, opening up huge windows of opportunities for the establishment of new multi-level regimes to govern the low-carbon transition of the entire world. The qualitative and quantitative changes related to the new perspectives in integrating an increasing number of stakeholders in the climate mitigation and adaptation management strategies implies a corresponding increase in the related elements of uncertainty and risk. Including an attentive analysis of future evolutions in the stakeholders' engagement process therefore becomes a priority for those aiming to assess the risk components of new evolutions in the field of climate change management and/or strategies.

2.8 Conclusions

This global context report offers an overview of the key factors determining the current and future pathways related to climate change and the use of natural resources. By taking into account the socio-economic megatrends currently influencing global dynamics, discussing the macro-sectors responsible for the anthropogenic emissions of GHG and reviewing the political actions taken at international level to contrast climate change, this report attempted to illustrate those elements representing real or potential drivers of risk and uncertainty within the overall strategies addressing the climate issue.

The key elements and factors identified in this report should thus serve as a reference for the further implementation of the regional and national case studies and, more in general, it should become a useful tool to be adopted for the whole implementation of the TRANSrisk project. The findings registered in the different sections of this report represent the elements that frame the scope for the TRANSrisk project and framework.

The megatrends and their interactions represent the driving forces governing both climate change and its mitigation strategies, therefore representing the primary subjects for the implementation of effective assessment on the risks related to the topic. The macro-sectors responsible for anthropogenic emissions of GHG represent the targets for implementation of strategies aimed at mitigating climate change, understanding their future evolutions therefore becomes of high relevance to implement models able to critically assess the effectiveness of any mitigation strategy. Finally, the implementation of global policies on climate change represents the most important tool to govern both the megatrends dynamics and the GHG-related macro-sectors evolutions, and is therefore of primary importance for TRANSrisk analyses.

Fortuitously the 2016-2020 five-year period in many ways represents the ideal time period for the project. With most of the enhancement and implementation work on the Paris Agreement and Marrakech Conference still due to be completed in this period high degrees of uncertainty and risk will be registered. The megatrends will play a key role in the definition of the pathways for the enhancement/implementation process and the strategies and actions targeting the macro-sectors aligned with the SDG will be more and more defined and tested. Falling at the core of the five-year period, the TRANSrisk project has potential to become a reference study in the field of risk and uncertainty on the climate change.

3 EUROPE AND THE EUROPEAN UNION CONTEXT

3.1 Introduction

Focused on the European area, this section is mainly dedicated to the current status and future perspectives of the European Union (EU) in relation to climate change. Based on primary resources (official EU documents and reports) the report analyses the current strategies, policies and actions set up to facilitate a harmonious low-carbon pathway within the 28 member states of the Union. The analysis is framed by an overview of the role and relevance of the EU within the international climate change framework, aimed at offering a picture of the region's current status and main perspectives.

By drawing information from existing documents, the report provides a detailed analysis of the present reality of climate change in the EU, while at the same time offering an overview of its relationship with the broader theme of the socio-economic development of the area. This overview is further analysed in section 3.6 of the report, expressly focused on the main threats to, and limits of, the European climate framework.

This section is complemented by a brief introduction of the elements characterising the current climate strategies of those countries that do not belong to the Union and completed by a summary of the main conclusions.

3.2 The EU and the international debate on climate change

The EU represents the only regional[11] reality acting as single Party within the international climate change negotiations framework. Currently composed of 28 member states the EU comprise on aggregate more than 7% of the global population, 10% of the global greenhouse gases (GHG) emissions and about one fourth of the global nominal gross domestic product (GDP). Acting as a single Party is both a strategic choice and a legal obligation for the Union.

On one side the Treaty on the Functioning of the European Union confirms that: "The Union has exclusive competence to make directives and conclude international agreements when provided

[11] In this context the concept of 'region' must be technically conceived as group of Parties rather than limited geographic space, following by this the definition given and used within the framework of the United Nations Convention on Climate Change (UNFCCC).

for in a Union legislative act" (European Union, 2012, Article 3). On the other side the EU strategy plays a key role at international level. This unique legal framework potentially provides the member states with a much greater strategic relevance in international frameworks. Yet it shows limits, to be in-depth analysed later in this report, that brought to partial backlashes even during the Paris negotiations.

As presented in 2.4 to 2.6, the Paris Agreement represents a cornerstone for the international debate on climate change. The Agreement sets out the legal framework defining the pathways for a global low-carbon and resilient development, and at the same time defines the current status and balance of forces in the international climate change arena. Welcomed by almost the totality of the involved Parties and the commentators as a milestone for human actions on climate change, the accord provided contrasting outcomes concerning the role and achievements of the EU within it.

Concerning EU strategies and actions during the COP21 negotiations it is possible to identify them as double-sided. With France having proved to be hugely effective facilitator, the EU's leadership in co-creating a 'High Ambition Coalition' established a bridge between developed and developing states that increased the effectiveness of the negotiating process, while its efforts for a 1.5°C, rather than 2°C, maximum temperature increase were of high relevance for the final agreement.

However, at times, the EU also prioritised its own domestic priorities over global climate objectives, primarily due to economic concerns, thus weakening its leadership status. The apparent efforts of the EU to block the encouragement of technology transfers to developing states revealed the EU's desire to protect its own corporations, while its support of Poland's veto over the use of the word 'decarbonisation' within the agreement demonstrates that the need to keep internal harmonisation can compromise the international status of the Union.

Analysing the text of the final agreement, officially welcomed by the EU and its members as a great achievement, these contrasts appear in all their relevance. While the absence of an explicit differentiation between Parties with and without mitigation responsibilities can be seen as a positive outcome for the EU and all those countries, that were included in the Kyoto Protocol's 'Annex I Parties' group, other key passages of the text appear under a different light from the EU perspective. The presence of the long debated concept of 'common but differentiated responsibilities and respective capabilities' since the very first and relevant parts of the Agreement[12], strongly advocated by developing countries and opposed by the EU, is just the most evident element confirming that the Agreement represents a radical shift in terms of international relations. The presence of three articles (Articles 9 to 11) almost entirely focused on the financial, technological and educational support to be guaranteed by developed to developing countries and the recurring distinction between developed and developing countries' responsibilities to act

[12] The concept is included in paragraph 2 of Article 2, the key article determining the overall objectives of the accord.

further rectify the new reality concerning the power-sharing at international level, confirming a resizing of the EU role.

3.3 The EU framework for climate change: structure, functioning and general strategies

Unlike the international negotiations, the EU mandate on climate change and those related to the main correlated sectors (energy, environment, agriculture, transport, research and technological development) is based upon a shared structure, with the corresponding competences divided between the common entity and the single member states. To some extent such a horizontal arrangement of competences represents one of the limits in the EU approach to climate change, as explained more in detail later in the report.

The EU competences involve the participation of three entities: the European Commission (independent from national governments), the European Parliament (elected by EU citizens), and the Council of the European Union (representing member states). Most often, the Commission proposes new legislation, but it is the Council and Parliament together that pass the laws.

The Directorate-General for Climate Action (DG-CLIMA), organ of the European Commission, leads the efforts to fight climate change at EU and international level. Its mission can be summarised into five main elements: a) formulating and implement climate policies and strategies; b) taking a leading role in international negotiations on climate; c) implementing the EU's Emissions Trading System (EU ETS); d) monitoring national emissions by EU member countries; e) promoting low-carbon technologies and adaptation measures.

Based upon specific objectives endorsed by the European Council, and implemented under the guidance of the DG-CLIMA, three main strategies, characterised by differing time-horizons and degrees of ambition, are currently in place. These are: a) the 2020 climate and energy package; b) the 2030 climate and energy framework; c) the 2050 low-carbon economy roadmap.

Strongly linked and integrated with the broader 'strategy for smart, sustainable and inclusive growth' set up by the European Commission in 2010 (European Commission, 2010), the 2020 package is a set of binding legislation to ensure the EU meets its climate and energy targets for the year 2020. These objectives, known as the 20-20-20 targets, comprise a 20% cut in greenhouse gas emissions (from 1990 levels), a 20% share of EU energy from renewables and a 20% improvement in energy efficiency, all of them to be reached by 2020. With renewables and energy efficiency targets strongly influenced by the overlap between EU and member states competences a review of their development is not yet possible. As for the emissions cut target, almost entirely under mandate of the EU structure (see above the list of the DG-CLIMA competences), the most recent data (European Commission, 2015d) demonstrate that on aggregate the Union is in line

with its objective. EU emissions are projected to be 24% lower than 1990 by 2020, therefore falling below the given target.

Similarly to the 2020 package, the 2030 climate and energy framework sets three key targets (for the year 2030): a 40% cut in greenhouse gas emissions (from 1990 levels), a 27% share of EU energy from renewables and a 27% improvement in energy efficiency. At the present the targets are not characterised by a binding component and, based on the current policies put in place by the EU and its own member states, the same are not expected to be reached (idem). A set of new and more stringent actions will be therefore required to achieve with the 2030 targets. With the renewables and energy efficiency ones not explicitly mentioned, the emissions cut target is the only element of the package included in the Intended Nationally Determined Contribution (INDC) submitted by the EU (European Commission, 2015d) to the UNFCCC.

Finally, the 2050 low-carbon economy represents the EU long-term roadmap towards a virtually zero emissions society. It sets an objective solely focused on cutting emissions, aiming at an aggregate reduction of 80% (from the 1990 levels) and an intermediate target of 60% by 2040. The 2050 low-carbon economy currently represents a mere 'statement' and most of its framework still requires to be established. Figure 6 shows the historical emissions in EU, as well as the most likely pathways based upon emissions projections in line with the objectives of the different EU strategies.

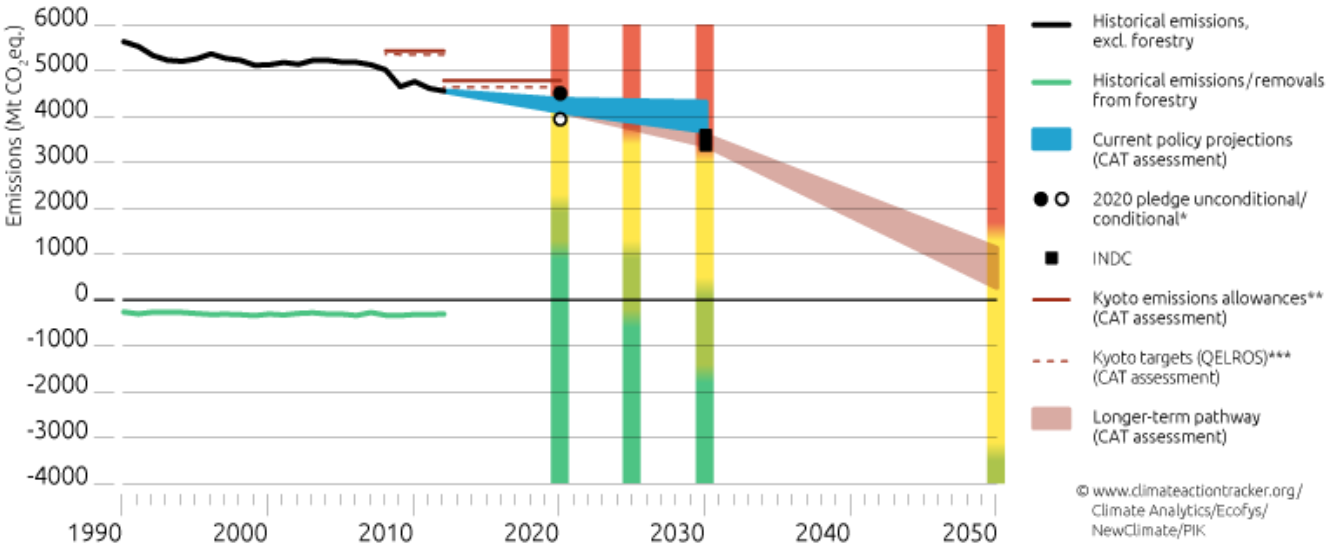


Figure 6: Historical and projected emissions in EU

Source: (Climate Action Tracker, 2016a)

3.4 The EU legislation and actions on climate regime

The main forms of EU legislation are directives, regulations and decisions. A regulation is a general measure that is binding in all its parts, directly applicable in the Member States and addressed to everyone. A directive is a binding measure as to the result to be achieved, but leaves member states to choose the form and method they adopt to achieve it. Decisions are EU laws relating to specific cases. They can be adopted by the Council (sometimes jointly with the European Parliament) or by the Commission.

Action plans, white papers, green papers, and communications can additionally be produced by the European Commission, serving to identify future legislative proposals. The Commission can also produce regulations, primarily serving as administrative acts on the functioning of the EU Institutions.

The EU, as well its member states, have set up different categories of instruments to accomplish established climate-related targets and objectives. These instruments comprise both cross-cutting and sectoral measures and are here-after analysed accordingly. A third sub-section will briefly introduce the EU policies in the field of climate change adaptation.

3.4.1 Cross-cutting tools to achieve the EU targets

Two instruments, whose functioning falls below the direct competence of the EU, are usually recognised as cross-cutting tools to support the efforts to mitigate GHG emissions of the union and its member states: the EU Emissions Trading System (EU-ETS) and the Effort Sharing Decision (ESD). An additional cross-cutting area within the climate framework of the Union can be identified in the development of climate technologies.

Launched 10 years ago, the EU-ETS represents one of the first and currently the largest GHG emissions trading scheme worldwide. It works on the 'cap and trade' principle. A 'cap', or limit, is set on the total amount of certain greenhouse gases that can be emitted by the factories, power plants and other installations in the system. The cap is reduced over time so that total emissions fall. Within the cap, companies receive or buy emission allowances which they can trade with one another as needed. They can also buy limited amounts of international credits from emission-saving projects around the world. The limit on the total number of allowances available ensures that they have a value.

The history of the EU-ETS is generally read in four different phases. Phase one (2005-2007) was a three-year pilot period of ‘learning by doing’ to prepare for phase two, when the EU ETS would need to function effectively to help the EU meeting the emissions targets established by the Kyoto Protocol. In phase one the EU-ETS covered only emissions from power generators and energy-intensive industrial sectors. In the absence of reliable emissions data, phase one caps were set on the basis of best guesses. As a consequence, the allocated allowances hugely exceeded demand making their price fall to zero by the end of 2007. The generation of verified annual emissions

data from the installations participating in the pilot phase filled the information gap and created a basis for setting national caps for phase two.

Phase two (2008-2012) coincided with the first commitment period of the Kyoto Protocol, which required the EU and Member States to meet their emission targets. Purchases of credits produced through the Kyoto mechanisms (the Clean Development Mechanism – CDM and the Joint Implementation – JI) were accepted to comply with the reductions duties. The new phase saw the inclusion of three states of the European Free Trade Association (EFTA)[13] in the system. Despite a cut in the total volume of emission allowances compared with the 2005 level, the economic crisis that began in late 2008 depressed emissions, leading to a large surplus of unused allowances and credits. This weighed heavily on the carbon price in the second trading period, leading to a de-facto 'market failure' of the system.

Phase three (2013-2020) represents a significant change compared to the previous two phases. In more detail the major changes envisaged in the new phase include: a) the institution of a single, EU-wide cap on emissions applies in place of the previous system of national caps; b) auctioning instead of free allocation adopted as the method for allocating allowances; c) new sectors and gases are included.

The European Commission presented in July 2015 a legislative proposal to revise the EU emissions trading system for the period after 2020. The proposal, known as phase four, is the first step in delivering on the EU's target to reduce greenhouse gas emissions by at least 40% domestically by 2030 in line with the 2030 climate and energy policy framework and as part of its INDC to the new global climate Agreement. To achieve the (at least) 40% EU target, the sectors covered by the ETS have to reduce their emissions by 43% compared to 2005. A detailed summary of the key elements characterising the phase four proposal can be found on the dedicated internet page of the EU portal.[14]

The ESD establishes binding annual greenhouse gas emission targets for member states for the period 2013–2020. These targets concern emissions from sectors not included in the EU-ETS, such as transport, buildings, agriculture and waste. In contrast to sectors in the EU-ETS, it is the responsibility of Member States to define and implement national policies and measures to limit emissions from the sectors covered by the ESD.

In the EU, as well as everywhere in the world, technological innovation is seen as an essential tool to reduce GHG emissions at the pace and intensity envisaged by the Paris agreement. The main

[13] Norway, Iceland and Liechtenstein, while Switzerland, fourth member of the EFTA, is currently negotiating on linking the Swiss ETS with the EU-ETS.
[14] Revision for Phase 4: http://ec.europa.eu/clima/policies/ets/revision/index_en.htm (Accessed 04 March 2016).

activities carried out by the EU in the field of climate change related research and technological innovation are represented by the Horizon 2020 Programme and the NER 300 and NER 400 Funding Programmes. The Horizon 2020 Programme represents the broad framework for research and innovation in the Union. It covers a variety of sectors with climate change being just one of them. Yet the centrality of the climate debate in the EU is pushing for a growing proportion of Horizon 2020 funds to be directed to it.[15]

The NER 300 Funding Programme[16] provides substantial funding for the large-scale demonstration of low carbon energy technologies in Europe and is the world's largest programme in this area. Funded from the sale of 300 million emission allowances related to the EU-ETS, the Programme awarded 39 demonstration projects with a total of €2.1 billion, and leveraged almost €3 billion additional funding from private resources. The NER 400 represents the recently introduced scale-up of the NER 300 Programme.[17] A complete listing of the additional actions developed by the EU to promote technological innovation in climate change can be found on the dedicated internet page of the EU portal[18].

3.4.2 Sector-based policies and measures

The framework of EU sectorial policies and measures concerning climate change encompasses a wide variety of areas that include: a) energy supply; b) energy demand; c) transport; d) industry and non CO_2 gases; e) agriculture; f) forests; g) waste. Some of the measures concerning these sectors are only marginally or indirectly related to climate change, yet play a relevant role for any climate action in the corresponding field. Whilst a complete review of the sectorial measures cannot be done within the limited space of the present report, Table 4 summarises the most relevant initiatives in the different sectors that may serve as reference for further research.

[15] See the climate-related section of the Horizon 2020: https://ec.europa.eu/programmes/horizon2020/en/area/environment-climate-action (Accessed 04 March 2016).
[16] For additional details see the NER 300 internet site: http://www.ner300.com/ (Accessed 04 March 2016).
[17] Idem.
[18] Low Carbon Technologies: http://ec.europa.eu/clima/policies/lowcarbon/index_en.htm (Accessed 04 March 2016).

Table 4: Summary of EU sectoral policies and measures related to climate change[19]

Sector	Sub-sector	Policies/measures
Energy Supply	Renewables	Renewable Energy Directive 2009/28/EC Energy Union Package COM(2014) 80 final
	Carbon Capture and Storage	Directive on the geological storage of CO2 2009/31/EC
Energy demand	Energy efficiency	Energy Efficiency Directive 2012/27/EU Energy Performance of Buildings Directive 2010/31/EU
	Eco-design energy labelling	Directive on eco-design 2009/125/EC Directive on energy labelling 2010/30/EU
	Green public procurement	http://ec.europa.eu/environment/gpp/index_en.htm
Transport	Regulation on CO_2 emissions from passenger cars and light commercial vehicles	CO2 and cars regulation 2009/443/EC CO2 and vans regulation 2011/510/EU
	Fuel quality	Directive on fuel quality 2009/30/EC Council Directive 2015/652/EU
	Environmental and safety requirements of tyres and gear shift indicators	Regulation 2009/661/EC Regulation 2009/1222/EC
	Clean vehicles	Clean vehicles directive 2009/33/EC
	Shipping	Strategy for maritime transport COM(2013) 479 final Monitoring, reporting and verifying regulation for large ships 2015/757/EU
Industry and non CO_2 gases	Fluorinated gases	Fluorinated gases regulation 2014/517/EU Mobile air conditioning directive 2006/40/EC
	Clean air	National emissions ceiling directive 2001/81/EC http://ec.europa.eu/environment/air/clean_air_policy.htm
	Industrial emissions	Industrial emissions directive 2010/75/EU
Agriculture	Common Agricultural Policy	Regulation on support of rural development 2013/1305/EU Horizontal regulation 2013/1306/EU
Forests	Land use, land use change and forestry (LULUCF)	Decision on LULUCF 529/2013/EU
Waste	Limitation of landfilling	Landfill directive 1999/31/EC
	Management of biodegradable waste	Waste framework directive 2008/98/EC
	GHG reduction from urban waste water treatment	Urban waste water treatment directive 1991/271/EEC

[19] Note: when not directly introduced with an internet site, each cited policy/measure has a hyperlink for the corresponding document online.

3.4.3 The Energy Union and corresponding strategies

In February 2015, the European Commission established the Energy Union, a regional cooperation mechanism that promotes the coordination of energy policy across member states. The Energy Union, established by the communication on a Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy (European Commission, 2015b), sets a 15 action plan to achieve the main aims within the EU Energy Policy.

The aim of the Energy Union is to make energy more secure, affordable and sustainable (2015b:2), whereas identified objectives are as follows:

- 'Pool resources, connect networks and unite the EU's power when negotiating with non EU countries;
- Diversify energy sources – so Europe can quickly switch to other supply channels if the financial or political cost of importing from the East becomes too high;
- Help EU countries become less dependent on energy imports;
- Reduce Europe's energy use by 27% or greater by 2030;
- Build on the EU's target of emitting at least 40% less greenhouse gases by 2030;
- Make the EU the world number one in renewable energy and lead the fight against global warming'(European Commission, 2016c).

The Framework Strategy does not establish any new legislation; rather it sets action plans that rely on the existing legislation and legal commitments of the Member States, including the Third Liberalisation Package[20] and the Renewable Energy and Climate Change Package.[21]

The Energy Union's Framework Strategy covers five thematic areas: including energy security, the fully integrated internal energy market, energy efficiency, decarbonisation and research and innovation. The action planned for Energy security is to: review existing legislation (including the Gas Supply of Security Regulation); to safeguard security of supply, progressing EU external energy

[20] Directive 2009/72/EC 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC; Directive 2009/73/EC of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC; Regulation (EC) No 713/2009 of 13 July 2009 establishing an Agency for the Cooperation of Energy Regulators; Regulation (EC) No 14/2009 of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003; Regulation (EC) No 715/2009 of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 1775/2005.

[21] Directive 2009/29/EC of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community; Decision No 406/2009/EC of 3 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 ("Effort Sharing Decision"); Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC ("Renewable Energy Directive"); Directive 2009/31/EC of 23 April 2009 on the geological storage of carbon dioxide.

policy to diversify sources of supply; to launch the strategy on LNG gas storage; and to improve the transparency on energy supply by enhancing information exchange mechanism and intergovernmental agreements between Member States and third countries.

A fully integrated internal Energy Market requires connecting the market's hardware by linking existing 'energy islands' to the main electricity and gas network by supporting infrastructure projects of common interests. A minimum interconnection target of 10% by 2020 for member states was set for installed electricity production capacity. Additional action on the software components includes adopting harmonised network codes and proposing legislation on the redesign of the electricity market.

The EU target for energy efficiency is 20% by 2020 and 27% by 2030. Actions planned to meet the targets includes a revision of the Energy Labelling Directive, Energy Efficiency Directive with a focus on buildings, and Energy Performance of Buildings Directive. A strategy will also be proposed for heating and cooling and to promote better access to financing instruments for energy efficiency.

Decarbonisation goals include reducing greenhouse emission by 20% below the 1990 level by 2020 and 27% by 2030. This requires preparing the renewable energy package and bioenergy sustainability policy for the post 2020 period as well as proposing on new market design for electricity.

The EU recognises that the Energy Union will need a new strategy for research and innovation. The aim is to pursue an integrated Energy Union research, innovation and competitiveness strategy for energy and climate (European Commission, 2015e). Some of the research focus includes: next generation renewable energy and storage technologies, smart grid and home technologies, clean transport and 'safe nuclear' and 'clean fossil fuels' (European Union, 2012).

Box 9: The Energy Union's Key Energy Strategies

The Framework Strategy sets 15 Action Plan within the five dimensions of the Energy Union. The Framework Strategy relies on the existing legislation and establishes the agenda for the further development of measures to achieve internal energy market and climate change objectives. The Commission has a leading role in taking action and promoting the Energy Union, furthermore, an increased role for EU regulatory bodies like Agency for the Cooperation of Energy Regulators, ACERs, and European Network of Transmission System Operators, ENTSOs, are planned. The planned actions within the Framework Strategy include:

(i) Full implementation and strict enforcement of existing energy and related legislation, especially the Third Liberalisation Packages and EU competition rules;

(ii) Diversification of supply gas (package for gas, strategy for liquid natural gas (LNG) and its storage, develop access to alternative suppliers);

(iii) Improving intergovernmental agreements compliance with EU legislation and their transparency (Commission involvement into negotiations).

(iv) Implementation of infrastructure projects to complete the energy market, integrating renewables and security of supply.

(v) New/revised legislation on security of supply for electricity and a new European electricity market design.

(vi) Developing the regulatory framework set-up by the Third Liberalisation, in particular the functioning of ACER and the ENTSOs.

(vii) Regional cooperation for market integration.

(viii) Improving transparency on energy costs and prices as well as protection of vulnerable consumers through social policies.

(ix) Reviewing energy efficiency legislation and use of European funds for renovation of housing for reaching at least 27% energy savings by 2030.

(x) Developing a 'Smart Financing for Smart Buildings'-initiative, facilitating access to existing funding instruments.

(xi) Speeding up energy efficiency and decarbonisation in the transport sector, its progressive switch to alternative fuels and the integration of the energy and transport systems.

(xii) Proposing legislation to achieve the greenhouse gas reduction target agreed at the October 2014 European Council both in the Emissions Trading System and in the sectors outside the Emissions Trading System.

(xiii) Proposing a new Renewable Energy Package for achieving the target of at least 27% at EU level.

In February 2016 the Commission announced its Energy Security Package. This is the action taken within the dimension of security of energy supply of the Energy Union. In general, the aims of the security of supply are to diversify Europe's sources of energy and make better, more efficient use

of energy produced within the EU. The Energy Security Package sets out how to equip the EU for global energy transition and prepare for possible energy supply interruptions. Furthermore, energy security is also the political priority of the Junker Commission and is in line with the climate change mitigation action.

The Energy Security package consists of (i) Security of Gas Supply Regulation (EUR-Lex, 2016b); (ii) A decision on Intergovernmental Agreements in energy (EUR-Lex, 2016a); (iii) Liquefied natural gas (LNG) and gas storage strategy (European Commission, 2016a); (iv) Heating and Cooling strategy(European Commission, 2016b). The main measures/aims established by the package require greater cooperation between member states such as creating rules that would require an EU country to help out its neighbour if it is experiencing a very severe gas crisis. The European Commission would also have greater authority to take action regarding the intergovernmental energy agreements between member states and non-EU countries. The measures also provide support for market access, such as outlining how better access to a rapidly developing global market in Liquefied Natural Gas (LNG) and better use of gas storage across the EU. The package will additionally launch the first ever strategy to tackle high-energy use, particularly for fossil fuels in the heating and cooling and improves access to information for consumers.

3.4.4 Adaptation in the EU

Initiated by a 2009 White Paper, the co-ordinated national adaptation policies within the EU are currently based upon a Strategy Paper on Adaptation to Climate Change adopted by the European Commission in April 2013. The strategy aims to "enhance the preparedness and capacity to respond to the impacts of climate change at local, regional, national and EU levels, develop a coherent approach and improve coordination". It is based on a plan of actions, including promoting action in member states, better informed decision-making, climate-proofing action at the EU level, and strengthening the institutional framework for co-ordination, financing, and monitoring. Stakeholders from the local, regional and national level are encouraged to participate in the development of the strategy[22].

3.5 EU climate strategies towards developing countries

Similarly to the reality within the Union, the climate strategies of EU towards developing countries are characterised by actions and policies implemented by the Union as a whole and by those implemented by the single member states. Until recent years, similar policies where hugely dominated by the single member states' actions. In 2013 for instance the EU-governed funds

[22] A complete introduction to the adaptation EU strategies, policies and actions can be found in the official site of the European Commission: http://ec.europa.eu/clima/policies/adaptation/what/index_en.htm (Accessed 02 March 2016).

addressed to climate actions in developing countries were limited to less than € 1 billion, against a total of more than € 8.5 billion from its member states, with some countries substantially overcoming the EU budget (see Table 5).

Table 5: Climate finance provided to developing countries (2013)

Country	Funds (in thousands of €)
EU	964,262
Germany	3,441,089
France	2,621,804
United Kingdom	985,543
Sweden	314,531
Netherlands	286,563
Spain	254,575
Denmark	249,000
Others (21 countries)	392,570
Total	**9,509,937**

Source: (European Commission, 2015a)

Nevertheless, elements such as the new Paris Agreement are pushing for a scale-up in EU climate efforts towards developing countries. The ambitious framework of programmes recently released by the Union (European Commission, 2015c) offers clear evidence concerning this scaling-up process. In more detail, the framework includes three key objectives: a) at least 20% of the EU budget will be spent on climate action by 2020; b) at least €14 billion, an average of €2 billion per year, of public grants will support activities in developing countries between 2014 and 2020; c) compared to the average level in 2012-2013, funding for international climate action will more than double.

While part of the new finance will be provided to international structures such as the Green Climate Fund, most of the agenda will be directly implemented by the EU and its member states. The African region has been clearly selected as a priority for EU intervention, yet it is likely for the Union to use some already established tools to cover actions in other regions. More specifically, the EU will provide more climate-oriented governance to five instruments aimed at supporting sustainable development processes: the IFCA (Investment Facility for Central Asia), the AIF (Asia

Investment Facility), the IFP (Investment Facility for the Pacific), the LAIF (Latin America Investment Facility), and the CIF (Caribbean Investment Facility).

3.6 Risks for EU climate strategies implementation

Several elements may threaten the implementation of the EU climate strategies in the short, medium and long-run. Risks for the proper development of the EU climate-related policies are originated by a variety of factors and can be grouped into five main categories: a) institutional and political risks; b) economic and financial risks; c) infrastructural and technological risks; d) educational and social risks; e) time and scale risks. All these risks shall be considered as touched by harmonisation as a cross-cutting risk.

The legislative structure characterising the nature and functioning of the Union may represent by itself a key institutional risk. The balance of powers established between European institutions and member states may, at some point, slow down the process of implementation of the general climate policies, may lead to differentiations in their implementation within the member states and may even lead to their failure for several reasons such as: a) The lack of unanimity concerning some decisions of the most 'politicised' organs of the union (e.g. the Council), b) The different timings that have always characterised the incorporation of the European regulations within the legislative bodies of the member states (especially relevant when concerning the directives), c) The possible contrast between legislative bodies of the single members and the one of the EU.

Political risks are mainly originated by political crises (e.g. the 2007-2011 Belgian political crisis that included one year and half of absence of a national government) or radical political changes (e.g. the recent elections in Poland that led to the establishment of a government with positions contrasting with the EU climate policies) within the member states. Political risks may also include consequences of political crises at EU level in sectors that share nothing with climate change but whose proportion may destabilise the Union in its own pillars (e.g. the recent refugees' crisis or the UK referendum to exit the EU).

As a general consideration both the institutional and the political risks can be framed under the concept of 'harmonisation'. This is a key element in supporting and implementing climate policies and strategies within the Union and, on a broader perspective, it represents a pillar for the EU. A sound management of the current climate policies, as well as the implementation of innovative strategies based upon the new Paris agreement, may facilitate the process of harmonisation within the Union. Encouraging outcomes from this stage of the climate policies implementation may increase the interest of the member states, therefore accelerating and scaling-up both their development and the harmonisation process. On the opposite front their failure may exacerbate the contrasts within the states and between them and the Union, further contributing to threaten the overall structure of the EU.

The economic and financial crisis affecting the EU since 2008 could heavily impact the overall package of the EU reforms and policies on climate change. These latter will need to attract relevant shares of capital investment, which may be hard in a financial uncertainty context such as the current one. Moreover, based on the recent experience concerning the EU-ETS (see above section 3.4.1), the economic crisis currently threatening sectors such as heavy industry and manufacturing may destabilise core elements of the overall climate framework of the Union. Finally, the deep economic crises of single member states (e.g. Greece) may spread to other areas of the region, which may affect the overall structure of the EU therefore influencing any policy or strategy developed within it.

When correctly implemented the reforms and measures previewed by the EU on climate change may counterbalance the effects of the economic/financial crisis of the region. Similar measures may stimulate economically virtuous circles, leading to the creation of new jobs and wealth all across Europe. However, an incorrect implementation of these measures may lead to an uneven distribution of their socio-economic benefits. Countries that already enjoy an advanced level of integration with policies concerning climate change may further increase their economic and social gains related to the policies' application, while states with a less advanced approach to the pillars of climate action may be marginalised. This situation reveals once more the importance of a proper harmonisation in the implementation process of the EU policies on climate change.

Involving radical transitions in a variety of sectors directly and indirectly touched by climate change, the reforms and policies currently developed by the EU see backlashes related to infrastructural risks. Sectors such as energy, transport and agriculture already enjoy important degrees of integration within the EU member states. Yet the overall integration process of similar infrastructures is still uneven and requires further substantial efforts to be safely completed. While the innovations related to the climate policies may accelerate the harmonisation of similar areas, a lack of attention in implementation may undermine these processes. Adopting common strategies for further development of the European energy, transport and agriculture infrastructures therefore becomes a key element for the future of the Union.

In this perspective a fair and harmonised process of technological innovation, integrated by effective choices in the field of technology transfer appears to be the core strategy for guaranteeing a sound infrastructural integration in the Union. However, a fragmented technological development may lead not only to an uneven distribution of the related benefits, but also to a more dangerous failure of the infrastructural harmonisation processes.

Education and public awareness play a key role for the social acceptance of the transformation implied by the new perspectives offered by the current evolutions in climate change mitigation and adaptation. A radical transition that implies important changes in social behaviours cannot be implemented without a process of education and communication able to raise the attention and consciousness of the European citizens. The ability to demonstrate the high degrees of integration between the climate measures and other policies addressing relevant social and economic issues will represent a key target for any action aiming to facilitate the climate awareness rise over

Europe. The technological innovations required to implement the low-carbon transition of the European society also imply the adoption of new educational systems to develop the necessary workforce skills.

Both the public awareness implementation process and the educational transformation will require relevant investments and efforts that are unlikely to guarantee immediate benefits, instead offering them on a longer timeline. A similar 'timing gap' may reduce the appeal for a proper development of educational and awareness strategies, as they can be seen as avoidable costs by the most conservative forces acting within the EU. Consolidating these strategies shall therefore become a priority in implementation of the EU climate actions.

A final obstacle to the correct implementation of the EU strategies on climate change is represented by the hugely fragmented timing and scale frameworks that characterise them. While the timing issues concerning the adoption of the EU policies by its own member states, which represents one of the highest risks of the entire system, have been already discussed, additional concern is originated by the different timings between the policy priorities, business strategies and the horizon of the climate change impact. Acting for a convergence between these timings therefore represents a priority to guarantee integrity in the implementation of the EU climate programmes.

The variety of sectors and areas touched by the EU climate policies implies integration between different scales and levels of actions. The low-carbon transition process will involve any size of firms, but also of public institutions, from the EU to the local level. At the same time, it will require the active participation of other stakeholders acting at different levels, such as social movements and communities, academic institutions, non-governmental organisations and individuals in general. Integrating the needs and priorities of such a varied set of actors will no doubt represent one of the biggest challenges for a proper implementation of the climate transition envisaged by the EU.

3.7 Europe beyond the EU

An overview of the current climate-related situation of countries not included in the EU is required to complete the analysis of the European case study. In doing so it is possible to organise these countries into three main groups: a) countries enjoying special relationship with the EU (the EFTA countries[23]), b) countries candidate or possible candidate to enter the EU; c) countries under the influence of Russia. The analysis includes a set of transcontinental countries (Azerbaijan, Georgia, Kazakhstan, Russia, and Turkey) that have territory both in Europe and Asia.

[23] Norway, Iceland and Liechtenstein, while Switzerland, fourth member of the EFTA, is currently negotiating on linking the Swiss ETS with the EU-ETS; and the EFTA site: http://www.efta.int/.

The EFTA comprises four countries: Iceland, Liechtenstein, Norway and Switzerland. Due to their special links with the EU the four countries enjoy climate policies that can be assimilated to those of the Union. The four of them have submitted INDCs with objectives in line with the EU ones (including a 40% reduction in their emissions compared to 1990) and three of them already participate to the EU-ETS (the fourth one, Switzerland, is currently negotiating for its ETS to be linked to the European one). It is possible to affirm that in most of their elements the ETFA-countries policies and measures on climate change are strictly in line with the EU model.

As for the countries candidate and potentially candidate to enter the EU, they currently include Bosnia, Serbia, Montenegro, Macedonia, Albania and Turkey. According to their INDCs these countries follow different climate strategies. While three of them (Serbia, Bosnia and Montenegro) adopted economy-wide reductions targets far below the EU ones and are generally considered as low ambition programmes[24], the remaining three (Albania, Macedonia and Turkey) adopted an even more conservative position introducing non economy-wide GHG reductions in their INDCs. Similar positions appear to recall the pre-Paris geopolitical localisation of the six countries, as all of them belonged to the non-Annex I group under the Kyoto Protocol.

As for the countries under the geopolitical influence of Russia, four of them (Russia, Ukraine, Moldova and Azerbaijan) adopted very conservative economy-wide reductions targets, while three of them (Kazakhstan, Armenia and Georgia) preferred the adoption of non-economy-wide ones. A plausible explanation for such a reluctant approach towards substantive climate actions and strategies lies on at least two factors: on one side all these countries had no binding emissions reductions under the Kyoto Protocol, on the other the economy of most of them heavily relies upon the income from their fossil fuels reserves.

3.8 Conclusions

With the Paris Agreement in place the most recent evolutions on climate change at international level open entirely new perspectives, characterised by the definition of new opportunities, challenges and threats in a variety of socio-economic areas worldwide. While part of the European continent seems to have adopted a conservative approach towards this 'revolution' the EU and its closest partners embraced the new situation by adopting measures that may lead to a radical acceleration of low-carbon transition of their economies and social realities.

The 'aggressive' strategy adopted by the EU, together with its traditional limits and weaknesses (see above section 3.6), may nevertheless destabilise the proper implementation of the Union's climate measures in the long-run, while at the same time contributing to exacerbate the existing contrasts within its member states and between them and the central EU structure. Hence the

[24] For further details, see the INDCs evaluation page of Climate Action Tracker: http://climateactiontracker.org/indcs.html.

new climate framework has all the elements characterising a period of uncertainty, whose future pathways currently appear unpredictable in their development.

Efforts to assess and clarify the process of evolution of the current and future climate strategies therefore become key elements to support their own implementation. With its strong link to the EU context, the TRANSrisk project may represent a leading example for the further development of similar efforts.

4 LATIN AMERICA AND THE CARIBBEAN (LAC) CONTEXT

4.1 Economic and Social Background

Latin America and the Caribbean (LAC) correspond to 32 countries[25] located in South and Central America, the Caribbean and North America (Mexico). According to the International Monetary Fund (2014), these economies have a total population of 525 million people in 2014, of which 78% reside in urban areas with corresponding social problems and increasing demand for services. The regional GDP at market prices was $4,775 trillion US and its GNI (Gross National Income) per capita (current market prices) was $8,990.

LAC GDP grew at rates similar to the rest of the world in the last 35 years. Between 1980 and 2013 world GDP grew at 3.3% while LAC increased by 2.9%. In the last decade (2003 to 2013) LAC and the world grew at 4% per year in 2003 to 2013. Despite LAC growth, inequality still persists in the region, with 82 million people living on less than $2.50 per day, while the middle class (US$10-US$50 per day) accounts for 34% of population (World Bank, 2012).

Within the TRANSrisk project, Chile will be analysed in greater detail as part of the 14 country case studies. This overview will focus more broadly on the LAC region and will analyse a group of countries that are geographically connected to Chile or that are main trade partners of Chile.

The LAC countries are classified in two groups. The first group corresponds to those countries that have shown a positive economic growth rate in recent ten years, as seen in Bolivia, Chile, Colombia and Peru. The second group is composed of countries with negative growth rates such as Argentina, Brazil and Venezuela. Both groups represent historically 65.5% of the GDP of LAC and almost 6.4% of the world´s GDP.

4.1.1 First group of countries with economic growth

According to the Focus Economics (2015), Chile has a population of 17.8 million and its capital, Santiago, is the largest city with 5.8 million people. Chile has a GDP of $265 billion US while its GDP per capita (market prices) was $15,187 (2011-2013). Its GDP growth was 5.2% from 2011 to 2013 and decreased to 2.2% in 2014-2016. Public debt and external debt are moderate at 12% and 43.5% respectively. Chile has a market oriented economy with sound and prudent fiscal policy and large free agreements with its major trade partners, including the United States and China, as

[25] Antigua and Barbuda, Argentina, The Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, and Venezuela.

well as regional agreements such as the Trans-Pacific Partnership. However, Chile is highly dependent on copper exports and has relatively small domestic markets.

Colombia has a population of 46.4 million, with a GDP of $362 billion US and its GDP per capita was $7,759 (2011-2013) (Focus Economics, 2015). The economy grew at 5.2% between 2011 and 2013, but decelerated to 3.4% between 2014 and 2016. The public debt-to-GDP ratio was at 33.3% while external debt was 23%. Colombia has a consolidated financial system and a constitutional status with the aim of controlling inflation and political consensus on economic policies. However, it faces on-going armed internal conflict, a large shadow economy and it is vulnerable to downwards shifts in commodity prices like oil and minerals.

Peru had a population of 30 to 31.9 million in the period 2011-2013, with a GDP of $189 billion US and a GDP per capita of $6,188. Its GDP growth was 6.1% between 2011 and 2013 and declined to 2.9% between 2014 and 2016. In 2011-2013, its public debt-to-GDP ratio was 20.7% of GDP while its external debt was 29.7%. It is a market-oriented economy that has successfully controlled inflation rate and also has a strong position of international reserves. It has an unequal income distribution and a large informal economy.

4.1.2 Second group of countries with an economic decline

As a part of the low growth group, Argentina had a population of 41 million, GDP of $597 billion US and a GDP per capita of $14,536 during the period 2011-2013. The country grew at 4% between 2011 and 2013 but it is expected to have a growth rate of 0.8% between 2014 and 2016. Until very recently, it had a very unorthodox economic policy with limited access to international financial markets and was very vulnerable to external shocks.

Brazil had a total population of 200 million in 2011, with a GDP of $2,471 billion US and a GDP per capita of $12.407. Its GDP growth rate was 2.8% between 2011 and 2013 but it is expected to shrink at 1.3% per year between 2014 and 2016 due to strong political problems and inadequate infrastructure which creates bottlenecks for economic growth. Additionally, privatisation and deregulations efforts are lagging.

Venezuela had a population of 29.5 million in 2011-2013 and GDP of $256 billion while the GDP per capita was $12.048 in the same period. Its GDP growth was 3.7% from 2011 to 2013 but it is expected to decrease to an average of -5% between 2014 and 2016 due to its deep political polarisation, runaway inflation (of approximately 700% in 2016), exchange rate misalignments and its dependence on domestic oil production as an economic driver.

4.2 Climate Change

Latin America is one of the most diverse regions of the world not only in its geographic characteristics but also in its social formation, which will be discussed in the next section. Considering a conservative scenario of increases in world temperature of around 2°C and a pessimistic scenario 4°C, in the next 84 years, the region might experience in each case a corresponding increase in temperature of around 1.5°C and 5.5°C respectively compared to 1951-1980 according to a World Bank scenario (World Bank, 2012).

Two main consequences of these climate change scenario are challenging for Latin-American. The expected climatic changes in the future include: 1) rains, drought and flooding and 2) sea level rise. In the case of rain, the Andean region comprised mainly of Bolivia, Chile, Peru and Colombia is exposed to a significant reduction in precipitation. The reduced rainfall affects fruit production in the central valleys of Chile and cereal production in Bolivia and Peru. In Colombia, coffee production is less significantly impacted but wine production in the west of Argentina (on the other side of the Andes Mountains) is already affectedly considerably. On the other hand, drought and flooding also affect the tropical regions of Colombia, Peru and Bolivia, which share some parts of the Amazon region. The north of Argentina and the Amazon region of Brazil are now experiencing the consequences of flooding and higher operational costs of hydroelectric generation (idem).

The second problem the region will face is how to deal with an increase of 0.55 to 1 meter sea level in important urban regions such as Rio de Janeiro, Recife, Buenos Aires, and the coast of Chile, Lima and other cities and islands. The pattern of increased rise in sea level in the following 34 years would imply significant costs in coastal infrastructure of at least 22 cities and it would require around US$1.5 billon per 40 cm of sea increase level (idem). Moreover, some important activities like tourism are exposed to climate changes that would alter their business model, losing competitiveness vis-a-vis inland tourism.

There are other specific events that represent risks for the region in this scenario. For example, glaciers and snow peak changes already affect many regions in central and south Andes. On average around 18% less volume is already visible in the region. Water security and fresh water are also at risk in the region. For example, flooding and mudslides in the borders shared by Brazil, Peru and Bolivia as well as the south of Brazil and Argentina are correlated with a high mortality rate, not just due to the specific event but also for health consequences. Furthermore, flooding would impact agriculture production as it would require changes to some land uses. Many other impacts, include biodiversity, fisheries coral reefs, amazon rain forest degradation, health and energy, would affect the region (idem).

4.3 Energy[26]

A relevant issue is the energy situation in the region. Consumption of primary energy has been growing at 3.0% per year in the last decade, which is significantly greater than the 2.3% rate in the 1970s to 1990s and the 1.9% growth rate in the 80s.

In the last two decades, 1.1 of the 2.7 percentile points of growth in primary energy consumption is explained by more intensive natural gas demand in transport and electric generation. Petroleum supplied 55.1% (1970-1991) and 44.8% (1992-2013) of the overall energy demand while natural gas represented 12.9% in 2013 but currently makes up 21.7% of the energy demand in 2016. There are three fuel types that dominate the energy matrix. First, nuclear experienced high rates of growth, accompanied by increases in nuclear energy in the first three decades (in the period 1970-2002 it grew on average by 15.1% per year). The second is coal, which for the first time experienced a decrease in the decade 1992-2002; and third, the promising growth of other renewable energies like solar and wind that from 2003 to 2013 showed growth of 10.3% per year.

After two decades of moderate growth (at 3.2% per year in the period 1990 to 2000), electricity generation in the region increased by 5.2% on average between 2003-2013, which resembled the large electricity demand growth of 9.3% from 1970 to 1980.

The electric generation matrix is historically composed by 53.2% of hydrocarbons, and natural gas varies between 17.2% (1970-1991) and 25.1% (1992-2013). Renewal energies have shown a remarkable growth rate (an average of 41.4% in the last decade).

4.4 Financial Institutions for Climate Change

In Latin America, the structure of financial institutions, which support climate change is formed of three different groups (Climate Financial Update, 2015): 1) Contributors, 2) Bilateral and multilateral institutions, and 3) Recipients countries.

Contributor countries[27] are organised around five initiatives:

(i) The Global Climate Change Alliance (GCCA+) focused in the most vulnerable areas to respond to climate change. GCCA+ in Latin America is concentrated with programs in the Caribbean region;

[26] This section uses data from OLADE. 2016. Energy Balances data 1970-2013. Available: http://www.olade.org/?lang=en [Accessed 04 November 2016].
[27] Australia, Canada, EU, UK, Germany, Japan, Norway, US and Denmark.

(ii) International climate fund (ICF) from the government of UK that has presence in Brazil, Chile, Peru and Colombia;

(iii) International Climate Initiative (ICI), a Germany initiative that has 98 projects in the region mainly focused Peru (30.6%), Brazil (25.5%), Chile (16.3%), Colombia (13.2%) and rest of Latin America;

(iv) The government of Norway developed the International Climate Forest Initiative (ICFI) that has projects in Brazil, Colombia, Peru, Guyana and Mexico.

(v) The US initiative named Global Climate Change Initiative (GCCI) is concentrated in Brazil, Peru, Ecuador and Colombia in South America.

Regarding bilateral and multilateral institutions, they can be classified into two groups: within and outside the UNFCCC. Within the UNFCCC the private initiative has two instruments: Joint implementation (JI) and the clean development mechanism (CDM) both under the Kyoto Protocol.

The multilateral instrument is hosted by the Conference of the Parties (COP) that developed three main instruments: Green Climate Fund (GCF), Adaptation Fund (AF) and Global Environment Facility (GEF). These three instruments constitute the communication with initiatives outside of the UNFCCC.

The Paris Agreement (UNFCCC, 2015b) stabilises new responsibilities and commitments of financing. First, the Agreement stipulates that developed countries shall provide financial resources to assist developing countries with respect to both mitigation and adaptation, in continuation of their existing obligation under the Convention. Secondly, developed countries should continue to take the lead in mobilising climate finance from a wide variety of sources, instruments and channels, noting the significant role of public funds, through a variety of actions, including supporting country-driven strategies and taking into account the needs and priorities of developing country Parties. Such mobilization of climate finance should represent a progression beyond previous efforts. Finally, At COP 21, it was also decided that developed countries intend to continue their existing collective mobilisation goal through 2025 in the context of meaningful mitigation actions and transparency on implementation. Also, prior to 2025 the Conference of the Parties serving as the meeting of the Parties (CMA) to the Paris Agreement shall set a new collective quantified goal from a floor of $100 billion US per year, taking into account the needs and priorities of developing countries.

Outside of the UNFCCC, the Inter-American Development Bank and the World Bank are the most active institutions in the region. Projects like Partnership for Market Readiness the carbon finance initiative, and scaling up renewable energy program work in Argentina, Brazil, Chile, Colombia and Peru, have been funded. In addition, there are three specialised funds to climate change and for the conservation of natural resources: Amazon Fund, Brazilian National Fund of Climate Change and Mexico Climate Change Fund.

The EU is expected to provide more climate-oriented governance to the region aimed at supporting sustainable development processes: the LAIF (Latin America Investment Facility), and the CIF (Caribbean Investment Facility).

4.5 Conclusions

Latin-American is one of the most diverse regions in the world regarding natural resources and population. It is also a region facing high indexes of poverty and inequality. The economic trend follows an open market strategy based mainly in the exploitation of natural resources (e.g. mining and fossil fuels) and manufacturing. This strategy has been accompanied by a large mobilisation of the population from rural to urban areas. Therefore, the region faces a great demand of services such as electricity (which is based on fossil fuels) and water supply, which put great pressure on natural resources use.

In addition to economic growth, the region is facing important challenges regarding climatic changes (e.g. rains, drought, flooding and sea level rise). These climatic changes have put at risk the current infrastructure in many cities, as well as threatening important economic sectors (e.g. tourism, energy and electricity production). Also, there is an important risk affecting biodiversity, fisheries coral reefs, amazon rain forest, which might also lead to unintended consequences such as increasing migration to urban areas, which are already polluted and lack basic services, therefore affecting the health of the most of the population.

Climate change calls for significant reductions of GHG emissions, which suggests a sustainable strategy. This might not be plausible in the short term because of the current social problems based on the high degree of poverty and inequity that prevails in the region, which demands high economic growth. However, it might be a long term sustainable strategy, which will not only require more economic resources, but also capacity building on sustainable bases to fulfil the growth expectations of the region.

5 INDCs AND PARIS AGREEMENT 2015

An updated synthesis report on the aggregate effect of Intended Nationally Determined Contributions (INDCs), published by UNFCCC on 2 May 2016 (UNFCCC, 2016b), confirms most of the doubts and uncertainties surrounding concerning them since the very first submissions (see Section 2). The new document analyses the effect of the 161 INDCs communicated by 4 April 2016, providing estimates of the aggregate greenhouse gas emission levels in 2025 and 2030 resulting from the implementation of those INDCs. Comparing the business as usual scenario, the trajectories resulting from the INDCs and the 2/1.5°C pathways, Figure 7 visually represents the report's findings.

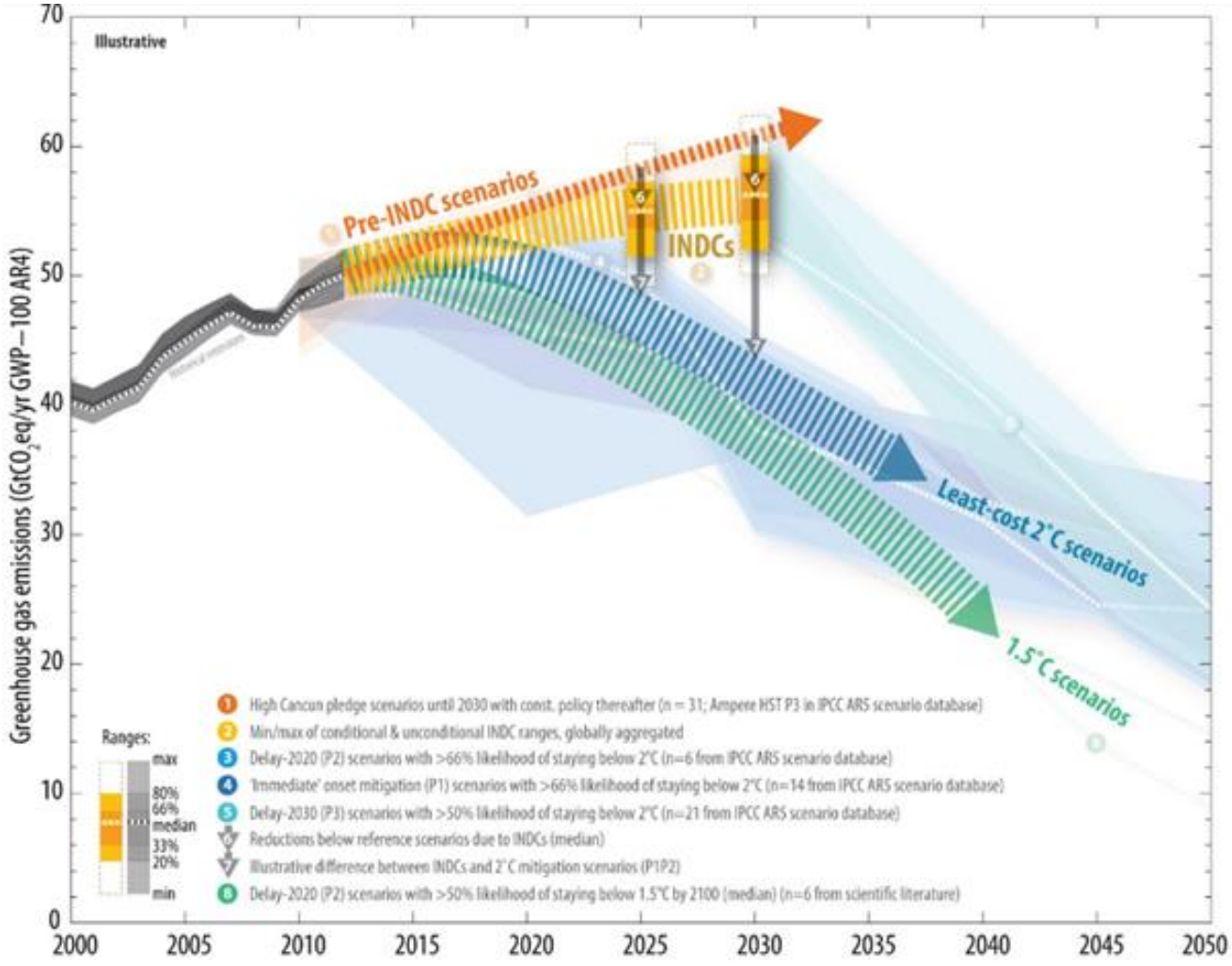


Figure 7: Comparison between forecasted INDCs and 2/1.5°C pathways

Source: (UNFCCC, 2016b)

The report underlines that, even in the best case scenario (assuming for all the INDCs pledges to be met), represented by the yellow curve in Figure 7, greenhouse gases (GHG) emissions fail to be reduced in line with the Paris Agreement's primary objectives. While showing some progress in comparison to the business-as-usual scenario (orange curve), they clearly appear insufficient to fulfil both the 2°C and the 1.5 °C pathways (blue and green curves), potentially leading instead to an increase in global aggregate GHG emissions. The INDCs system has now been identified by different institutes and commentators as the biggest limitation and source of uncertainty for a full implementation of the Paris Agreement (Hare, 2016, Hone, 2016, IISD, 2016).

By looking specifically at the INDCs of those countries in the scope of the TRANSrisk project it is possible to identify a huge differentiation, in terms of pledged efforts, between them. It is possible to rank the countries' efforts by using the methodology developed by Climate Action Tracker (CAT): an independent science-based assessment, which tracks the emission commitments and actions of the single countries (Climate Action Tracker, 2016b). The CAT system includes four different ratings: (a) inadequate (positions that may lead to a warming likely to exceed 3–4°C); (b) medium (not consistent with the 2°C target and requiring for other countries to make greater effort and much deeper reductions); (c) sufficient (fully consistent with below 2°C limit); (d) role model (more than consistent with below 2°C limit). No country has been rated 'role model'. Based on this classification, countries studied by the TRANSrisk project result as follows.

Canada: inadequate. The country's INDC land use, land use change and forestry (LULUCF) accounting in its GHG mitigation framework. The accounting originated by the LULUCF sector is likely to provide credits of 126 Mt CO_2e and therefore offering the opportunity to substantially increase the level of industrial GHG emissions allowed under Canada's target. According to the effort-sharing principles a similar INDC has to be rated as "inadequate", meaning it is not consistent with various interpretations of an equitable approach to reach a 2°C pathway.

Chile: inadequate. The country adopted a strategy focusing on containment of emissions compared to a future Business as Usual (BAU) scenario. Its pledges are substantially less ambitious than the draft the Chilean Ministry for the Environment released in December 2014. Chile's INDC does not contain any intermediate target (2025) which instead it appears, based on the Paris Agreement, a critical aspect to be considered.

China: medium. China submitted an INDC whose targets include a CO_2 emissions peak by 2030 at the latest and the reduction of its carbon intensity of GDP by 60% to 65% below 2005 levels by 2030. However, the emissions resulting from the 2030 carbon intensity targets, if taken in isolation, are significantly higher and would be rated as 'inadequate'. The weak INDC carbon intensity targets, if taken literally, would only be reached at the expense of important national policies and actions, including in relation to reduced air pollution. This appears unlikely. This means China's INDC (and its national actions) are not consistent with limiting warming to below 2°C unless other countries make much deeper reductions and comparably greater effort than China.

European Union (EU): medium. The EU proposed a single INDC for all its members, therefore the TRANSrisk analysis has to be limited to a general overview of the region's targets. A positive element of the EU's INDC is the specification that it includes economy-wide emission reduction goals. Nevertheless, the overall level of GHG emissions reductions proposed in the INDC is not yet sufficient to fall within the range of approaches for fair and equitable emission reductions for the EU. Currently implemented policies are projected to reduce domestic emissions by 23–35% below 1990 levels and hence do not—yet—put the EU on a trajectory towards meeting either its 2030 or 2050 targets, which is 40% below 1990 level by 2030 (Latvian Presidency of the Council of the European Union, 2015). A final concern is linked to the uncertainty for the distribution of duties within the 28 EU countries.

India: medium. Similarly to China, India submitted an INDC based upon targets to lower the emissions intensity of GDP by 33% to 35% by 2030 below 2005 levels. With the policies it already has in place, India will achieve an emissions intensity reduction of around 41.5% below 2005 levels by 2030. Media coverage ahead of the India's INDC submission predicted a more ambitious intensity target (a range of 35% to 45%), which would have been more in line with current policies. The "medium" rating indicates that India's climate plans are at the least ambitious end of what would be a fair contribution.

Indonesia: inadequate. Under different assumptions as to what fraction of effort is devoted to deforestation, the INDC could be rated either 'medium' or 'inadequate'. Indonesia is the only main deforestation emitter globally where a continuation of the trends of the last decades from independent estimates would result in a potentially very strong increase from deforestation emissions in the period to 2030. Indonesia's INDC targets include deforestation emissions due to deforestation and peatland destruction, which at present account for the largest source of the country's emissions. The effect of the INDC on future deforestation emissions is not made clear in Indonesia's submission.

Kenya: not rated. CAT has not yet offered a complete analysis of Kenya's INDC.

Switzerland: medium. Swiss INDC aims at reducing emissions by 50% by 2030, compared to 1990 levels. In addition, Switzerland communicated an emissions reduction target of 35% for 2025. Previously, Switzerland had made an unconditional commitment to decrease emissions by 20%-30% below 1990 levels by 2020. With currently implemented policies and measures Switzerland will neither be able to meet its pledge nor its INDC.

6 APPENDIX A: INTERRELATIONSHIPS BETWEEN SOCIO-ECONOMIC MEGATRENDS 2015

Table 6 aims to be an easy-to-use tool to understand and further explore the main interactions between the megatrends introduced in Section 2.2 of the Global Context report. Each of the seven socio-economic megatrends is represented both in the columns and in the rows of the table. Each cell represents the corresponding interaction. When the subject of the crossing row and column corresponds (i.e. urbanisation trends in column matches with urbanisation trends in row) the key aspects of the corresponding megatrend, discussed in narrative form in Section 2.2 of the Global Context report, are summarised. Table 6 shall also serve both as a tool to better frame, understand and analyse the global dynamics of the megatrends and as an instrument to be adopted in analysing the corresponding trends within the framework of the regional and national case studies.

Table 6: Interrelationships between socio-economic megatrends to determine factors for climate change risks

Megatrends	Uneven increase in global population	Urbanisation trends	Need for a continued economic growth	Global competition for resources	Technologic change	Increasingly multipolar world	Diversifying approaches to governance
Uneven increase in global population	- Population increase as driver for GHG increase - Diverging population increase rates as determinants for local and regional CC-related tensions	- Population increase accelerate the urbanisation process - The combination of population and urbanisation trends may accelerate GHG emissions growth	- Economic growth and population increase represent the main drivers in GHG emissions growth - Their combination may both reduce (ageing of population and related reduction of economic growth) or accelerate (high rates in population increase and related need for additional economic growth) the drivers for GHG production	- Population increase accelerates resource demands and competition, both of them being driver in GHG production - Population needs for resources lead to their inefficient use and may lead to an increase in GHG emissions related to their use	-Technologic change may reduce the impact of population in term of resource consumption and GHG production - Excess of technologies demand linked to population increase may lead to further request of resources and GHG production	- Uneven population increase accelerates the multi-polarisation process - Uneven population increase in an unstable geo-political context may facilitate migration dynamics and frictions between different geographic contexts and reduce the opportunities for common actions against climate change	- Governance approaches may influence the increase of global population and its impact on climate change - The variety of actors involved in strategies to govern population increase may further jeopardise population dynamics and may not correctly evaluate their relevance in GHG dynamics
Urbanisation trends	- Population increase accelerate the urbanisation process	- Needs related to the accelerated urbanisation trends	- Accelerated urbanisation requires more consistent	- Non-controlled urbanisation processes lead to	- Innovation in technologies may smooth the adverse	- Urban clusters tend to become individual actors within the	- Efficient governance for urbanisation may compensate the

	- The combination of population and urbanisation trends may accelerate GHG emissions growth	strongly impact the GHG emissions growth	economic growth, thus stimulating GHG emissions	significant increases in resources demand and inefficient use of them	effects of accelerated urbanisation dynamics	multipolar world further jeopardising a global governance in GHG emissions	pushes for related GHG emissions growth
Need for a continued economic growth	- Economic growth and population increase represent the main drivers in GHG emissions growth - Their combination may both reduce (ageing of population and related reduction of economic growth) or accelerate (high rates in population increase and related need for additional economic growth) the drivers for GHG production	- Accelerated urbanisation requires more consistent economic growth, thus stimulating GHG emissions	- Economic growth is widely recognised as primary driver in stimulating GHG emissions	- Sustained economic growth implies increasing demand for resources - Sustainable economic growth may require a more efficient use of resources	- Changes in technologies may facilitate a more efficient use of resources and reduce carbon intensity, facilitating more sustainable economic models - Technology may raise new market demands intensifying economic growth but also the demand of resources and the GHG emissions - Economic growth based on the ownership of technologies may reduce their diffusion decelerating the widespread of technologies for climate mitigation	- Diverging economic growth represents one of the key drivers for a multipolar world and leads to new dynamics in resources demand and competition and in GHG emissions	- New governance approaches are influenced by economic dynamics - New governance based on the emergence of economic forces may facilitate its adherence to issues affecting the economy, like climate change
Global competition for resources	- Population increase accelerates resource demand and competition, both of them being driver in GHG production - Population needs for resources lead to their inefficient use and may lead to an increase in GHG emissions related to their use	- Non-controlled urbanisation processes lead to significant increases in resources demand and inefficient use of them	- Sustained economic growth implies increasing demand for resources - Sustainable economic growth may require a more efficient use of resources	- The global competition for resources may accelerate the process of their inefficient consumption - On the opposite side the need to preserve resources against global competition may facilitate a more efficient use of the same	- An increasing demand for technologically innovative products and processes may push for an increase in resources consumption and corresponding GHG emissions - Technology may stimulate a more efficient use of resources reducing	- A multipolar world may increase the global competition for resources and their over-use - Global competition for resources in a multipolar world may increase frictions and reduce opportunities for global actions against climate change	- Different and diversifying approaches to governance influence the trends of competition for resources, stimulating a 'winner-loser' process - Similar trends reduce the efficacy of attempts to create global coalitions against climate

					demand and competition		change
Technologic change	-Technologic change may reduce the impact of population in terms of resources consumption and GHG production - Excess of technologies demand linked to population increase may lead to further request of resources and GHG production	- Innovation in technologies may smooth the adverse effects of accelerated urbanisation dynamics	- Changes in technologies may facilitate a more efficient use of resources and reduce carbon intensity facilitating more sustainable economic models - Technology may raise new market demands intensifying economic growth but also the demand of resources and the GHG emissions - Economic growth based on the ownership of technologies may reduce their diffusion decelerating the widespread of technologies for climate mitigation	- An increasing demand for technologically innovative products and processes may push for an increase in resources consumption and corresponding GHG emissions - Technology may stimulate a more efficient use of resources reducing demand and competition	- Technological innovations are required to meet the objectives related to mitigation in global GHG emissions	- The race for new technologies may become a key aspect of a multipolar world, accelerating its development - The race may increase frictions between different geo-political areas, reducing the chances for an effective global action against climate change	- Different approaches to governance may facilitate diverging trends in technological change depending on the relevance given to it in the different governance contexts - Diverging trends to govern technological change may influence the local and global efficacy of strategies aimed at mitigating GHG
Increasingly multipolar world	- Uneven population increase accelerates the multi-polarisation process - Uneven population increase in an unstable geo-political context may facilitate migration dynamics and frictions between different geographic contexts and reduce the opportunities for common actions against climate change	- Urban clusters tend to become individual actors within the multipolar world further jeopardising a global governance in GHG emissions	- Diverging economic growth represents one of the key drivers for a multipolar world and leads to new dynamics in resources demand and competition and in GHG emissions	- A multipolar world may increase the global competition for resources and their over-use - Global competition for resources in a multipolar world may increase frictions and reduce opportunities for global actions against climate change	- The race for new technologies may become a key aspect of a multipolar world, accelerating its development - The race may increase frictions between different geo-political areas, reducing the chances for an effective global action against climate change	- An increasingly multipolar world opens windows of opportunity for new priorities to become global subjects - Loss of power from former dominating regions may increase geo-political frictions and reduce opportunities for global actions	- A multipolar world with diversifying governance approaches increases the involvement of stakeholders thus facilitating the comprehension of the effects of climate change at any level - An excess of governance approaches in a multipolar world may jeopardise global efforts against climate change

Diversifying approaches to governance	- Governance approaches may influence the increase of global population and its impact on climate change - The variety of actors involved in strategies to govern population increase may further jeopardise population dynamics and may not correctly evaluate their relevance in GHG dynamics	- Efficient governance for urbanisation may compensate the pushes for related GHG emissions growth	- New governance approaches are influenced by economic dynamics - New governance based on the emergence of economic forces may facilitate its adherence to issues affecting the economy, like climate change	- Different and diversifying approaches to governance influence the trends of competition for resources, stimulating a 'winner-loser' process - Similar trends reduce the efficacy of attempts to create global coalitions against climate change	- Different approaches to governance may facilitate diverging trends in technological change depending on the relevance given to it in the different governance contexts - Diverging trends to govern technological change may influence the local and global efficacy of strategies aimed at mitigating GHG	- A multipolar world with diversifying governance approaches increases the involvement of stakeholders thus facilitating the comprehension of the effects of climate change at any level - An excess of governance approaches in a multipolar world may jeopardise global efforts against climate change	- Different approaches to governance may represent an opportunity for a more complete management of climate-related action, but may also stimulate a jeopardising process reducing its efficacy

7 APPENDIX B: SUMMARY OF THE MAIN ELEMENTS OF PARIS AGREEMENT

This Appendix aims at complementing the information and analysis introduced in sections 2.4 to 2.6 of the Global Context report. The document is organised into two parts. Section 7.1 details the single articles of the Paris Agreement, with their key significance and current limits. Section 7.2 focuses on a key element recurring over the entire Agreement: the distinction of (undefined) degrees of responsibilities between developed, developing and least developed countries. The Appendix B aims to serve as practical compendium for TRANSrisk researchers, who may use it as a reference for specific areas.

7.1 Mitigation, adaptation, transparency and other relevant topics in the Paris Agreement

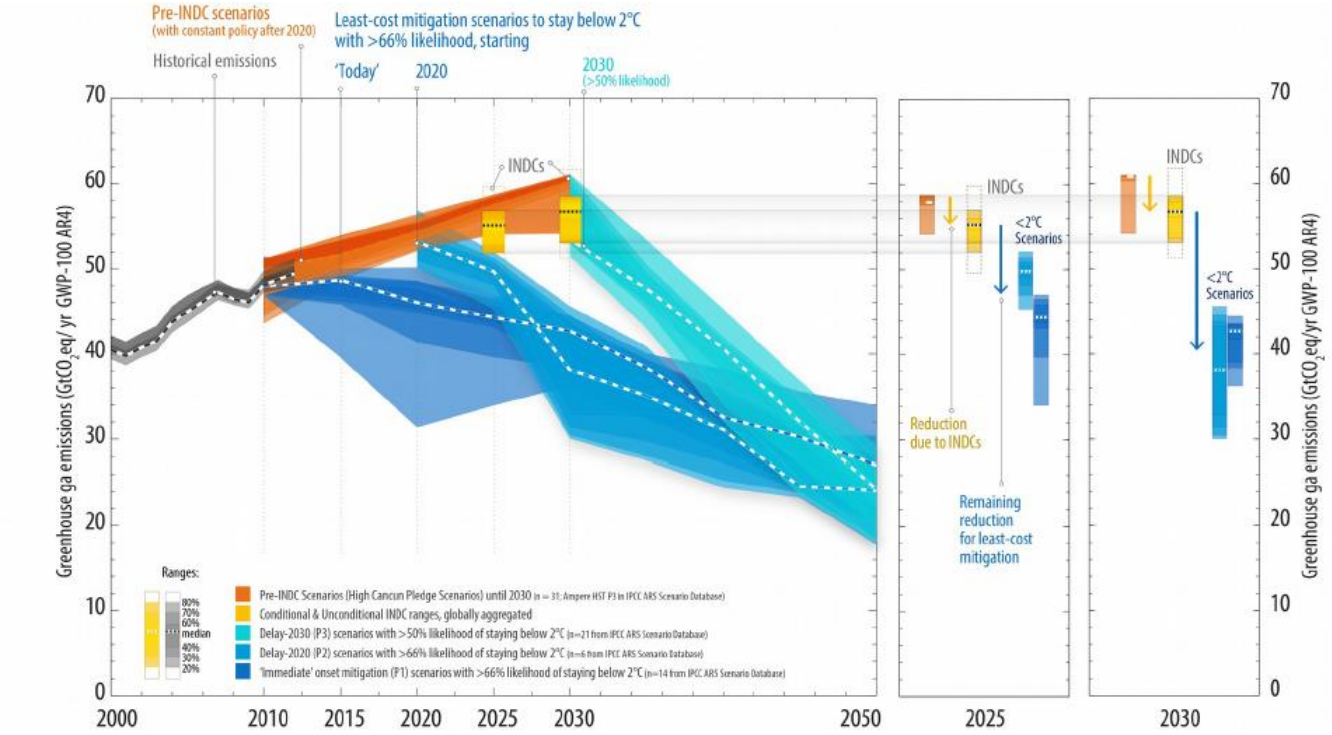
By establishing for the 2°C target to be accepted by all the participating countries as its minimum objective and the 1.5°C target as ideal scenario, the Paris Agreement (UNFCCC, 2015b) becomes aligned with the most recent scientific evidence provided by the Intergovernmental Panel on Climate Change (IPCC) in its Fifth Assessment (5A) (2014b), and even goes beyond. In doing so the climate agreement implicitly requires establishing a framework to design an accountable and effective emissions scenario in accordance with the target. The corresponding scenario keeps global anthropogenic carbon emissions within a 'Global Carbon Budget' (GCB) identified by the IPCC of 1 trillion tonnes of carbon dioxide (CO_2). With 52% of the GCB already used by 2011 (World Resource Institute, 2016b), this framework implies the adoption of sharp mitigation strategies.

The Agreement defines the mitigation pillars in three Articles (4 to 6) (UNFCCC, 2015b). The core element, to develop appropriate strategies to achieving the ambitious objectives of the Agreement, is defined in Article 4. The Article affirms urgency for the involved Parties to reach their own (and the global) peak of emissions as soon as possible, and start a rapid reductions process thereafter. In doing so the Parties are required to adopt an instrument defined as Nationally Determined Contributions (NDC) to be reviewed and further enhanced every five years.

Ideally representing each Party's highest possible ambitions, the NDC shall be prepared, communicated and maintained autonomously by each Party that, in doing so, shall take full responsibility for their implementation under the principles of environmental integrity, transparency, accuracy, completeness, comparability and consistency. Parties' joint implementation of the NDC is foreseen, while the Article reiterates that different capabilities may determine different levels of ambition, therefore reaffirming the discrimination between developed, developing and least developed countries (see section 7.2).

Prior to the Paris COP21 all Parties were required to submit a preliminary intended NDC (INDC), based on principles similar to those finally adopted in the Agreement. Referring to a time-frame of ten years (2020 to 2030), the aggregate result of the submitted INDCs resulted substantially below the needs and requirements related to the 2°C Target, as shown in Figure 8.

Figure 8: UNFCCC scenarios to reach the 2°C Target by 2050



Source: (UNFCCC, 2015a)

Based on its forecasts illustrated by the yellow part in Figure 8, the UNFCCC forecasts that the INDCs will possibly contain the rise of temperature below 2.7°C. Other influential sources are more pessimistic, identifying their impact to be within a range of 3.1 to 5.2°C (MIT, 2015). The gap between the aggregate INDCs and the target is openly recognised in the first part of the document, where the Conference of Parties "Notes with concern that the estimated aggregate greenhouse gas emission levels in 2025 and 2030 resulting from the intended nationally determined contributions do not fall within least-cost 2 °C scenarios" (UNFCCC, 2015b).[28] It is therefore generally understood that the NDC-based approach will require relevant revisions to enhance its effectiveness over the years, while the Agreement by itself simply reiterates the need for the Parties to reconsider their current submissions and contemplates additional mitigating measures to support the NDC approach (see paragraph below). Adjustments to the NDC-based might be

[28] Paragraph 17 of section II of the Agreement.

adopted during the 5-year window between the COP21 and the formal entry to force of the new Agreement by the end of 2020.

The mitigation framework of the Paris Agreement if further established by Article 5, that affirms the importance of sinks and reservoirs enhancement and conservation, and by Article 6 that recognises the opportunity for the Parties to engage in voluntary, cooperative actions to promote higher ambitions in their mitigating actions. Article 6 is likely to become a key element of the Agreement, potentially representing the legal framework for the establishment of multi-level emissions trading schemes (ETS) that may reach a global structure. Despite the absence of a clear reference to carbon markets, these considerations can be deducted by the description of the 'mechanism' to be set up in order to govern such voluntary, cooperative actions, as well by the introduction of 'non-market' options in the second half of the Article.

Article 7 establishes "the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change"[29] and identifies the main criteria to be adopted in pursuing the goal. The approach is generally similar to the one related to mitigation, to the extent it acknowledges the need for a country-driven approach yet framed and supported by an international cooperation framework. Despite its reiterated relevance the Agreement does not explicitly suggest measures similar to the NDCs for adaptation, therefore leaving huge spaces of uncertainty concerning the future development of adaptation strategies at any level. Even less structure is given to the 'loss and damage' issue discussed in Article 8, with a wording that appears lighter than any other section of the Agreement, merely summarising a vague list of principles concerning the topic.

With Articles 9 to 11 focused on the relationship between developed and developing countries (see below section 7.2) the following three articles respectively concern three key elements from the Agreement's agenda, therefore requiring a synthetic analysis. Made of a single paragraph Article 12 states that: "Parties shall cooperate in taking measures, as appropriate, to enhance climate change education, training, public awareness, public participation and public access to information".[30] The Article thus implies the need for a radical shift in the current education and information systems worldwide, with the aim to offer present and future generations the necessary knowledge tools to deal with any aspect related to climate change. The transformational education challenge will be a key element for the success of the entire framework designed by the Paris Agreement.

Article 13 focuses on an additional key aspect for the development of the Agreement: transparency. The transparency framework introduced by the Article and described as the instrument "to build mutual trust and confidence and to promote effective implementation"[31] aims at establishing an innovative system for information sharing and communication between the

[29] Paragraph 1 of Article 7.
[30] Article 12.
[31] Paragraph 1 of Article 13.

Parties, potentially concerning any strategy, policy or action set up for the climate change management at any level. The Article is extensively elaborated and includes clear definitions of the technical pillars for the establishment of the framework. In more detail, the Article includes two categories of information that Parties shall regularly provide in order to facilitate the transparency framework, these being:

- "(a) A national inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases, prepared using good practice methodologies accepted by the Intergovernmental Panel on Climate Change and agreed upon by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement;
- (b) Information necessary to track progress made in implementing and achieving its nationally determined contribution under Article 4".[32]

Article 14 establishes a system to take stock of the implementation of the Agreement, assessing the collective progress towards achieving its long-term goals and objectives. Referred to as the 'global stocktake' the system shall be managed and controlled directly by the "Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA)". The latter represents the new denomination for COP linked to the proper entry into force of the Agreement. The remaining articles of the Agreement are focused on definition of the organs regulating, ruling and managing it (Articles 15 to 19), and to the proper regulation of the Parties' participation to the same (Articles 20 to 29).

7.2 Developed, developing and least developed countries

The Paris Agreement establishes a completely new perspective concerning the Parties' responsibilities in tackling climate change. Under the Paris framework Parties shall be collectively responsible for the achievement of the stated objectives. The Paris approach therefore overcomes the Kyoto Protocol's discrimination between countries with and without mitigation duties. As already reported in section 1B, all Parties required to define 5-year-based NDCs containing clear indications concerning their pursued mitigation measures. Yet the absence of a radical discrimination concerning the different Parties' duties is counterbalanced by the introduction of the 'common but differentiated responsibilities and respective capabilities[33]', that leads to the establishment of different rules for developed, developing and least developed countries throughout the document.

[32] Paragraph 7 of Article 13.
[33] Paragraph 3 of the preface to the agreement.

This rules' differentiation is confirmed in Article 4, where is started that developed countries "should continue taking the lead by undertaking economy-wide absolute emission reduction targets",[34] while developing countries "should continue enhancing their mitigation efforts, and are encouraged to move over time towards economy-wide emission reduction or limitation targets".[35] The differentiation is further reaffirmed in most of the articles analysed in section 1B and, more than all to a greater extent, by Articles 9 to 11, which expressly address the establishment and development of measures aiming to facilitate a low-carbon economic pathway for developing and least developed countries, based on the direct support of developed countries.

Article 9 is focused on the provision of financial support, Article 10 concerns the provision of technological support and Article 11 addresses the need for the implementation of proper capacity-building mechanisms to facilitate the integration of the developing and least developed countries within the framework established by the Paris Agreement. The three articles are widely elaborated and detailed, yet they do not provide quantitative indications concerning the proper developments of the described initiatives and actions. These three articles were strongly pushed by the alliance of developing countries defined as 'Group of 77+China' [36], and may represent cause of clash between developed and developing countries in the future, thus representing one of the most challenging elements of the Agreement.

[34] Paragraph 4 of Article 4.
[35] Idem.
[36] Further details about the Group composition, strategies and actions see: http://www.g77.org/.

8 GLOSSARY (BASED ON IPCC AND UNFCCC GLOSSARIES, WHEN NOT OTHERWISE STATED).

Ad hoc Working Group on the Paris Agreement (APA): subsidiary body established at COP 21 in charge for the implementation of the Paris agreement.

Conference of Parties (COP): The supreme body of the Convention. It currently meets once a year to review the Convention's progress. The word "conference" is not used here in the sense of "meeting" but rather of "association".

Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA): new denomination of COP after the entry to force of the Paris agreement.

Emissions Trading System (ETS): A market-based instrument used to limit emissions.

Global carbon budget (GCB): The area under a greenhouse gas emissions trajectory that satisfies assumptions about limits on cumulative emissions estimated to avoid a certain level of global mean surface temperature rise.

Global stocktake: global registry of the action set up by the Parties in any mitigation, adaptation and any other action under their responsibility within the Paris agreement.

(Intended) Nationally Determined Contributions – (I)NDCs (Climate Policy Observer definition) (2015)**:** The actions a national government intends to take under the future UNFCCC climate deal, due to be agreed in Paris in December 2015. NDCs are, therefore, the basis of post-2020 global emissions reduction commitments that will be included in the future climate agreement.

Kyoto Protocol: An international agreement standing on its own, and requiring separate ratification by governments, but linked to the UNFCCC.

Land-use change and forestry (LUCF)

Party: A state (or regional economic integration organization such as the European Union) that agrees to be bound by a treaty and for which the treaty has entered into force.

Sinks: Any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere. Forests and other vegetation are considered sinks because they remove carbon dioxide through photosynthesis.

United Nations Framework Convention on Climate Change (UNFCCC): Convention adopted on 9 May 1992 in New York and signed at the 1992 Earth Summit in Rio de Janeiro, whose ultimate

objective is the ‘stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system’.

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