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Climate Change Impacts on Finance: managing one of the biggest threats to the global economy

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Abstract

Nowadays, the world is facing one of the most critical issue for the world economic stability and trying to procrastinate climate change impacts is no longer acceptable. However, governments have understood that the financial system needs to become sustainable in the long run and that the transition to a low-carbon and green economy may facilitate this change. Therefore, in order to reach this pathway, it is necessary a realignment of the financial system with the Sustainable Development Goals (SDGs).

The purpose of this thesis is to analyze which are climate change impacts on finance and which the potential pathways for climate change resilience. It has been underlined the critical role play by financial system and international cooperation to achieve the world economy sustainability. The analysis has started from the historical evolution of international climate policies and the development of the concept of climate finance. The Paris Agreement, signed in Paris in December 2015, has been one of the best results achieved in the international agenda.

This thesis has investigated the development of innovative financial instruments that in recent decades have been introduced in financial markets in order to combine sustainable growth with profitable financial results. It has been explored how companies have perceived climate change risks and how they can manage them. Moreover, it has been analyzed innovation in climate finance and the development of organizations for tracking and studying this phenomenon. Finally, the study concludes giving some insights of the Italian landscape of climate finance (with respect to the USD 100 billion goal) and of the sustainable initiatives implemented in the country.

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INTRODUCTION

Climate change has been defined by Mark Carney, the actual governor of Bank of England, as the tragedy of the horizon. It means that clearly the catastrophic impacts of climate change will be felt beyond the traditional horizons of most actors, imposing costs on future generation. However, current societies have no direct incentive to fix this problem[1]. The language of market failure and externalities has been largely applied to climate change. Indeed, it might be considered also the concept of the "tragedy of the commons" with respect to atmospheric sinks[2]. It is based on the fact that users have interests to use sink service units before other might use them (making them unavailable) and on the fact that it is also hard to exclude unauthorized users of doing so. This is also known as the problem of free-rider, when everyone acts in self-interest rather than exercising restraint to conserve global GHG sinks.

The development of the climate change issue started in the scientific arena where the awareness of the greenhouse problem has increased. The first scientific evidence of the rising in GHG emissions and global warming date back before the mid to late 1980s. However, only in 1990, it has been published in the first IPCC assessment report the man-made component of the greenhouse effect[3]. Starting from that moment, climate change has started to be considered as something highly connected to global reality.

Several years later, the 2008 financial crisis has highlighted the importance of creating financial markets more connected to real economy and more sustainable in the long run. It has also fostered the financial actors to think about their responsibilities and reflect on financial culture in a more profound way.

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[1] Speech by Mr. Mark Carney, Governor of the Bank of England and Chairman of the Financial Stability Board, at Lloyd's of London, London, 29 September 2015. See: https://www.bis.org/review/r151009a.pdf

[2] Hardin. (1968). The Tragedy of the Commons. Science. 13 Dec 1968: Vol. 162, Issue 3859, pp. 1243-1248. DOI: 10.1126/science.162.3859.1243

[3] Houghton, J. T., G. T. Jenkins, and J. J. Ephraums. 1990. Climate Change-The IPCC Assessment, Cambridge University Press, Cambridge.

Furthermore, in that occasion, it has emerged the key role played by the financial sector in providing the financial flows necessary to finance the global agenda for the transition to a low-carbon economy.

Indeed, in the Economics of Climate Change[4], the author Nicholas Stern has encouraged immediate action to fight climate change. In his publication he has declared that ignoring climate change impacts would be many times more expensive than fixing them. In order to reverse the global trend to higher temperatures, it is determinant to foster the global shift towards low-carbon economies. According to Stern, delay in taking actions would make the problem much more expensive and difficult to solve.

Managing this transition effectively and efficiently implies dealing with climate-related risks, together with exploiting numerous business opportunities. The purpose of this thesis is to analyze which are climate change impacts on finance and to investigate what are the financial mechanisms that have been implemented in order to tackle climate change effects. Climate change would represent a significant change agent in the financial services sector since it would influence all aspects of the industry.

Moreover, this study aims to underline the critical role played by financial innovation and international cooperation as key players for achieving the world economic sustainability. From the moment that climate change presents both major risks to the global financial system and opportunities for investors, it is extremely important to increase the knowledge concerning these issues. This study aims to move governments from inaction to action, and a society from apathy to engagement.

This research would contribute to the debate on the necessity to further enhance investors, corporates and governments responsibility in the implementation of climate change practices. Finance researches concerning

[4] See:
http://mudancasclimaticas.cptec.inpe.br/~rmclima/pdfs/destaques/sternreview_report_complete.pdf

insurance, risk management and financial institutions can help answer the question: *what are climate change impacts on finance?*

This thesis would lay-out the theoretical foundations of this topic by reviewing relevant literature. The reminder of this dissertation is structured as follows.

Chapter 1 start with the analysis of the historical evolution of international climate policies. The adoption of the Paris Climate Agreement would be presented as a crucial turning point in the international agenda. Starting from that moment, it has been clear that the great potential given to financial system need to be prudentially driven by international cooperation. In particular, the chapter continues showing that in order to achieve the goals of the Paris Agreement, there is the urgent need to accelerate and strengthen financial innovation.

Chapter 2 begins with the analysis of the existing literature related to the concept of financial innovation, presenting it as a leading factor for the alignment of the financial system with sustainable development. Then the research relies on the discussion of two of the most discussed reasons present in literature behind the necessity of financial innovation: government regulation and risk management. Financial markets, thanks to their mechanism to transfer and share risks, would be presented as part of the toolkit for reducing the economic damage caused by climate change. Then the chapter presents several financial innovations. They can, on one side, diminish the adverse consequences of weather shocks by transferring costs and risks of such shocks to those most willing and able to bear them, such as in the case of Catastrophe (Cat) Bonds. On the other side, they can reveal several business opportunities, such as in the case of Green Bonds.

Concerning the objective of increasing emerging markets healthiness, Chapter 3 analyzes the innovation implemented in climate finance and the numerous institutions that have been created in recent years in order to improve

their access to finance. The creation of new instruments would be determinant for helping communities to have the resources necessary for their development.

Successively, Chapter 4 focuses the analysis on risk management. It presents three risks that might challenge the financial stability: physical risks, transition risks and liability risks. The research examines in particular the condition of those companies engaged in fossil fuel sector, because they risk seeing their assets discounted (also known as "stranded assets"). Then the study continues with the concept of investment planning analyzed through the description of the divestment process and of reallocation of capital (such as investment in renewables). Furthermore, the chapter enhances the importance given in recent years to reporting practices. It would be suggested that companies (insurance in particular), communicate with investors in a transparent manner and create robust management processes, would reduce their liability risks. Finally, the chapter underlines the crucial role played by insurance companies.

After this global research, in Chapter 5 the focus moves to Italy, emphasizing the key factors related to climate change resilience. The study would present the Italian status quo concerning climate finance and sustainable development and offer some suggestions on future pathways.

CHAPTER 1

INTERNATIONAL CONTEST AND THE DEVELOPMENT OF CLIMATE FINANCE

Nowadays, the world is facing some of the most critical issues between global rates of greenhouse gases emissions and the growing of climate change impacts. Throughout history, it has happened different times that countries have tried to collaborate with each other to pursue international cooperation, mainly through voluntary international agreements. However, a real cooperation has always been extremely difficult to achieve from the moment that many countries have little interest in fixing the problem.

Mark Carney, the actual Governor of the Bank of England and Chairman of the G20's Financial Stability Board, in a speech highlighted two paradoxes: the first is that "the future will be the past", meaning that climate change inflicts a cost on upcoming generations and that the present one has no interest to fix this problem now. The second paradox is that "success is failure" because a too fast movement toward a low-carbon economy could materially damage financial stability[5].

This chapter describes the historical evolution of international policies, in particular due to the influence of climate change and give some insights of climate finance key terminology. First of all, it must be said that understand international climate policy and finance is essential to comprehend the political framework in which climate finance was born.

In past years the financial industry has showed several times its ability to impose its values and practices into the real economy. Now we assist to the

[5] Bank of England, 2016. Mark Carney, Speech: Resolving the climate paradox. Arthur Burns Memorial Lecture, Berlin. 22 September 2016.

opposite phenomenon in which something bigger that the global economy, such as the environment and in particular climate change, is leading financial markets to move forward the traditional idea of finance. To think about climate policy is something crucial, from the moment that current climate policies, even if their implementation might represent substantial costs, are meant to avoid even more huge damages.

1.1 International climate policy

The first scientific evidence of the rising in GHG emissions and global warming date back before the mid to late 1980s. Although the issue is not new at all, indeed, it has been observed by the Swedish scientist Arrhenius in 1896. He noted that an increased quantity of certain gasses in the atmosphere may have led to a global warming of the planet[6]. However, the concept has reached popular attention only during recent years and no one has referred to these changes in the atmosphere on the international agenda before the scientific conference planned by the World Meteorogical Organization (WMO) and the United Nations Environmental Programme (UNEP) in 1985 in Villach. They come out with the conclusion that global warming is highly probable and that it would be better if governments start to consider establishing an international convention on climate change[7]. A previous wave of international environmental activity has been seen in the 1972 Stockholm Conference.

1.1.1 Scientific awareness

In addition to the awareness that CO_2 levels were constantly increasing, in the mid-1980s, scientists stated that anthropogenic emissions of other trace gases

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[6] "Svante Arrhenius: Feature Articles". 2016. Earth observatory. Nasa.Gov. http://earthobservatory.nasa.gov/Features/ Arrhenius/.

[7] Bodansky, D., 2001. The History of the Global Climate Change Regime. *International relations and global climate change*, U. Luterbacher and D. F. Sprinz (eds.). MIT Press, Cambridge, Mass. 23-40.

(for example methane and nitrous oxides) have huge negative impacts on greenhouse effect, making the problem even more grave than what has been thought until that moment. Finally, the analysis of the historical temperature record in the 1980s showed that global average temperature has been increasing since the middle of this century. In particular, atmospheric CO_2 concentrations will increase to levels at least twice and possibly four times the highest amounts measured in the last 800,000 years spanned by ice-core records. An enormous range of evidence now supports the view that Earth's climate has warmed in the last 125 years mainly because of humans. Scientists regularly continue to register the many effects of global warming. Even though natural variability in the climate system makes year-to-year trends very noisy, the decade 2000-2010 was warmer than the decade of the 1990s, which was warmer than the decade of the 1980s, which was warmer than the 1970s[8]. The more recent attention to these themes has not focused only on environmental protection per se, but it has tried to improve more generally economic and social policies in order to achieve sustainable development.

This is forced by recent irreversible global threats, such as depletion of the stratospheric ozone layer, the diminishing of biological diversity in ocean but also on land and the greenhouse warming[9]. It can be said that climate change regime was born with the conclusion of the Kyoto Protocol in 1997, before that time there was the evolution of five different periods. The foundation period was the time when first concepts about global warming where developed to which followed the agenda-setting phase, from 1985 and 1988. In that period the issue change from a scientific into a political problem. "The consolidation of political

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[8] William F. Ruddiman, 2014. Earth' s climate: past and future. Third Edition, W.H. Freeman and Company, 41 Madison Avenue, New York, NY 10010.

[9] Liverman, D. M. 1989. Vulnerability to global environmental change. In Understanding Global Environmental Change: The contributions of risk analysis and management (R.E: Kasperson. K. Dow, D. Golding, and J. X. Kasperson, ends.), Clark University, Worcester, Massachusetts, 11-13 October 1989. Clark University, Worrcester Massachusetts, 27-44.

will at national and international levels depends to a large extent on the domestic and interstate forces that shape the evolution of global politics"[10].

Originally, the development of the climate change issue started in the scientific arena where the awareness of the greenhouse problem has increased. Starting from 1988 indeed, governments began to play a greater role and become heavily interested to this issue. In that year, the IPCC was founded by WMO and UNEP in 1988 and its goal was to summarize the scientific evidence on climate change and to partially reassess governmental control over the climate chance issue[11]. In the 1990, the first assessment report have highlighted that the human-induced greenhouse gas emissions aggravate the greenhouse effect[12]. At the Second World Climate Conference (SWCC), in the late 1990, the main task was to review the WCP set up by the first conference.

1.1.2 Rio de Janeiro 1992

In May 1992 there was the adoption of the Framework Convention on Climate Change (FCCC), the Convention represented not an end point, but rather a punctuation mark in an ongoing process of negotiation. The Parties to this Convention, signed at the UN Conference on Environment and Development in Rio de Janeiro 1992, have determined the main objective in Article 2: "stabilize greenhouse gas emissions in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system[13]". In that conference specific commitments for Annex-1 countries (industrialized countries and the former Eastern Bloc) have been defined: they had to "taking the lead" in the GHG emission reduction mission and advanced reporting[14]. It was the first

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[10] Bodansky, D., 2001. Ibid.

[11] Chasek, P.S., Downie, D.L., Brown, J.W. and Porter, G., 2005. *Global environmental politics.* 4th edition. Dilemmas in world politics. Westview Press, Boulder, Colo.

[12] Houghton, J. T., G. T. Jenkins, and J. J. Ephraums, 1990 Climate Change-The IPCC Assessment, Cambridge University Press, Cambridge.

[13] UNFCCC. 1992. Article 2. Rio de Janeiro 3-14 June 1992.

[14] UNFCCC. 1992. Article 4.2. Rio de Janeiro 3-14 June 1992.

time that there was an early separation between developed and developing countries. Moreover, Annex-2 countries (industrialized countries excluding the former Eastern Bloc) had to provide "new and additional" financial resources needed to cover costs of reporting obligations as well as mitigation and adaptation activities costs supported by developing countries[15]. The treated represented mainly the convergence of opinions and ideas, indeed, at its signing, the treated didn't express any particular limitations on emission by single countries or any enforcing mechanism[16].

In 1994 more than 50 states approve the UNFCCC and it finally entered into force. One year later, there was in Berlin the first Conference of the Parties (COP) and, in that occasion, it was created the Ad Hoc Group on the Berlin Mandate to discuss on a binding agreement on actions that should be taken after the year 2000. The IPCC's second assessment report in 1996 underlined the fact that climate change mitigation was a necessity[17].

1.1.3 Kyoto Protocol

With the adoption of the Kyoto Protocol in December 1997[18], certain obligations have been identified for industrialized countries in order to contain and maybe decrease their greenhouse gas emissions. The Protocol has recognized that developed countries were mostly responsible for the current level of greenhouse gases in the atmosphere and, as a consequence, they had such a duty to contribute more toward GHG emissions reduction. Annex-1 countries had binding targets on the emissions of six greenhouse gases in the period 2008-2012, they must be on average 5.2% below the 1990 level. The Protocol has also presented three flexibility mechanisms to reduce costs of meeting these targets,

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[15] UNFCCC. 1992. Article 4.3. Rio de Janeiro 3-14 June 1992.

[16] "Two Degrees: The History of Climate's Speed limit I Carbon Brief. 2014. Carbon Brief. https://www.carbonbrief.org

[17] Bodansky, D., 2001. Ibid.

[18] UNFCCC. 1998. Kyoto Protocol to the United Nations Framework on Climate Change. See: https://unfccc.int/resource/docs/convkp/kpeng.pdf

two of them were between industrialized countries, such as the Emissions Trading and the Joint Implementation among industrialized countries. There was also one mechanism called "Clean Development Mechanism" (CDM) meant to reduce emissions projects in developing countries. On one hand the EU and developing countries said that domestic actions were the main instruments for achieving emissions targets, on the other hand US-led position was less ambitious and flexible.

Developing countries initially tended to resist any mechanism that would allow developed countries to receive credit for emissions reductions occurring in developing countries. Countries such as Brazil, China and India were concerned about their right for economic development and wanted to avoid restrictions on their sovereignty. Several Annex-1 countries threatened not to ratify the Protocol. The US Senate, for instance, said that it would not agree to any protocol if it didn't express same commitments for developing countries and this was stated before Kyoto. Nevertheless, the discussions seemed to be solved with the Marrakesh Accords at the 7th COP, where important aspects were explained, included the CDM. At that time 55 nations ratified Kyoto because it was seen more ratifiable, however they had to wait 2005 before it entered into force. In particular until Russia and thereby countries, representing more than 55 percent, decided to ratify the Protocol[19].

The following years have been characterized by the conviction that a more climate change awareness might be developed. Many economists and politicians in particular, remained impressed after the publication, in 2007, of the Stern review for the British Government[20]. The Stern report claimed that costs of climate change would be higher than the costs of reducing GHG emissions and, as a consequence, strong political initiatives were unavoidable and were needed as soon as possible. Before the Stern report, the more diffused economic opinion

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[19] Henry, L.A. and Sundstrom, L.M. 2007. *Russia and the Kyoto Protocol: Seeking an alignment of interests and image*. Global Environmental Politics, 7(4). 47-69.

[20] Stern, N. 2007. *The economics of climate change. The Stern review*. Cambridge University Press, Cambridge.

was underestimating the costs of climate change and the high costs of mitigating actions, and it they both were considered to demand very limited action.

In the same year, the fourth assessment report of the IPCC has showed that the scientific community has been always more convinced that temperatures were rising mainly because of human-caused GHG emissions[21]. That report showed how the presence of greenhouse gases such as Methane, Carbon Dioxide and Nitrous Oxide in the atmosphere soared from 1800 until today.

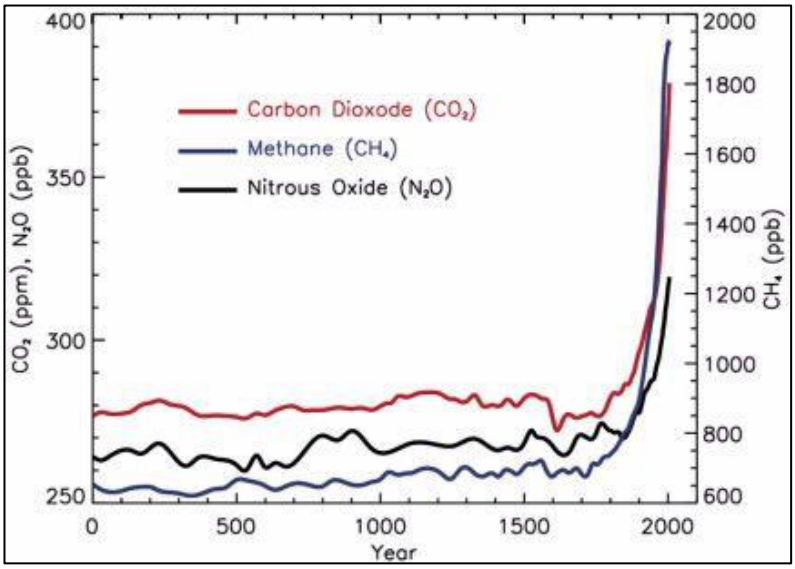

Figure 1: Atmospheric concentrations of important long-lived greenhouse gases over the last 2,000 years. Source: Climate Change 2007: Synthesis Report. IPCC Fourth Assessment Report 2005 https://www.ipcc.ch

Moreover, it advised that climate change would imply changing precipitation patterns, sea-level rise, melting of artic ice, changes in ecosystem and substantial decrease of agricultural yields in some developing countries[22].

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[21] Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M. and Miller, H.L., 2007. *Climate change 2007. The Physical Science Basis. Contribution of Working Group I to the Fourth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge; New York.*

[22] Parry, M.L., Canziani, O.F., Palutikof, J.P., Van der Linden, P.J. and Hanson, C.E., 2007. *Climate Change 2007. Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge; New York.

Another important event that increase sensibility with respect to climate change was the decision to assign the Peace Nobel prize in 2007 to the IPCC together with Al Gore. It was furthermore a media event that allows to increased public attention. Some positive events facilitate the climate awareness: at the 13th COP in 2007, Australia decided to ratify Kyoto and the Bali Action Plan[23] was adopted, moreover, the climate-sensitive Democratic Party won the US elections.

1.1.4 The Copenhagen Accord and following events

The 15th COP in Copenhagen 2009 was the largest climate summit ever, but the US and other big emerging countries didn't want to commit international agreement on GHG targets. It ended with the stipulation of the "Copenhagen Accord"[24] and with the opposition to agree by few developing countries such as Tuvalu and Venezuela. However, concerning the Conference, Bodansky argued that it had the positive consequence of starting to break down the "fire wall" between Annex-1 and non-Annex-1 countries, from the moment that major developing countries for the first time had pledged emission reduction actions under an international instrument and had accepted to report more often on their emissions and mitigations actions[25]. Moreover, in the accord it has been written that: "developed countries commit to a goal of mobilizing jointly USD 100 billion dollars a year by 2020 to address the needs of developing countries[26]". This obligation will be deeply analyzed in Chapter 5 dealing with the Italian context. The COP in Copenhagen can also be seen as the cornerstone for the negotiations

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[23] UNFCCC. 2008. Report of the Conference of the Parties on its thirteenth session, held in Bali from 3 to 15 December 2007. See:
https://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf

[24] UNFCCC. 2009. Report of the Conference of the Parties on its fifteenth session, held in Copenhagen from 7 to 19 December 2009. See:
https://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf

[25] Bodansky. 2010. The International Climate Change Regime: The Road from Copenhagen. Viewpoints series, Harvard Project on International Climate Agreements. Arizona State University Sandra Day O' Connor College of Law. 18 October 2010.

[26] See: https://unfccc.int/files/meetings/cop_15/application/pdf/cop15_cph_auv.pdf

that follows the next two years: all elements of the Copenhagen Accord were included in the Cancun Agreements in 2010 and in 2011, the 17th COP in Durban had seen the development of the new Green Climate Fund and the establishment of a new market-based mechanism. At the 18th COP in Doha, the majority of European countries and Australia (both responsible for only 15% of global GHG emissions) decided to decrease their emissions by 18% below 1990 levels according to a second commitment period under the Kyoto Protocol (2013-2020). In November 2013, in Warsaw at the 19th COP has been created the Warsaw Outcomes, it contained a manual for decreasing emissions from deforestation and forest ruin and a method to address loss and damage produced by long term climate change effects[27]. One year later, on December 2014, there was the 20th COP in Lima, it was just the occasion to push toward a new significant universal agreement.

Until 2015, the climate regime consisted of a set of inefficient regulations focused on a small group of countries while others where left free to operate as they preferred. In 2015 during the COP21, the 21st meeting of the UNFCCC, a new environmental agreement was signed. The Paris Agreement will be analyzed in depth in the next paragraph.

Conference	Date	Organizer	Conclusions and principal recommendations
Villach Conference	1985	WMO & UNEP	•Significant climate change highly probable •States should initiate consideration of developing a global climate convention
Toronto Conference	1988	Canada	•Global CO2 emissions should be cut by 20% by 2005

[27] UNFCCC. 2013. Report of the Conference of the Parties on its nineteenth session, held in Warsaw from 11 to 23 November 2013. See: https://unfccc.int/sites/default/files/resource/docs/2013/cop19/eng/10.pdf

			•States should develop comprehensive framework convention on the law of the atmosphere
UN General Assembly	1988	UN	•Climate change a "common concern of mankind"
Hague Summit	1989	Netherlands	•Signatories will promote new institutional authority to com- bat global warming, involving non-unanimous decision making
Noordwijk Conference	1989	Netherlands	•Industrialized countries should stabilize greenhouse gas emissions as soon as possible •"Many" countries support stabilization of emissions by 2000
IPCC First Assessment Report	1990	WMO & UNEP	•Global mean temperature likely to increase by about 0.3°C per decade, under business-as-usual emissions scenario
Second World Climate Conference	1990	WMO & UNEP	•Countries need to stabilize greenhouse gas emissions •Developed states should establish emissions targets and/or national programs or strategies
UN General Assembly	1990	UN	•Establishment of INC
UNCED Conference	**1992, Rio de Janeiro**	UNCED	•FCCC opened for signature •Coun- tries agree to reduce emissions with "common but differentiated responsibilities."

First Conference of the Parties	**1995, Berlin**	FCCC	•Berlin Mandate authorizing negotiations to strengthen FCCC commitments
Second Conference of the Parties	1996	FCCC	•Geneva Ministerial Declaration
Third Conference of the Parties	**1997, Kyoto**	FCCC	•Kyoto Protocol
Fourth Conference of the Parties	1998	FCCC	•Buenos Aires Plan of Action
Seventh Conference of the Parties	2001, Bonn	FCCC	•Marrakesh Accords
Thirteen Conference of the Parties	2007	FCCC	•Adoption of the Bali Road Map
Fifteenth Conference of the Parties	**2009, Copenhagen**	FCCC	•The Copenhagen Accord
Sixteenth Conference of the Parties	2010	FCCC	•Ended with the Cancun Agreements and the Green Climate Fund was established
Seventeenth Conference of the Parties	**2011, Durban**	FCCC	•Governments push toward the launch of the Ad Hoc Working Group on Durban Platform for enhance action
Eighteenth Conference of the Parties	2012	FCCC	•Governments adopted the Doha Amendment and launched a second commitment period of the Kyoto Protocol

Nineteenth Conference of the Parties	2013	FCCC	•Produced the Warsaw Outcomes
Twentieth Conference of the Parties	2014	FCCC	•Governments had the opportunity to make a last collective push towards a new and meaningful universal agreement in 2015.
Twenty-first Conference of the Parties	**2015, Paris**	FCCC	•195 nations sign the Paris Agreement

Table 1: Landmarks of the climate change regime. *Source:* Adapted from Bodansky 1995.

1.2 The Paris Agreement (COP 21)

During the conference, a new agreement within the UNFCCC was implemented, known as the Paris Agreement. The treaty was officially adopted on 12 December 2015, charted a new course in the global efforts to fight climate change. Indeed 195 countries adopted the first-ever universal, legally binding global climate deal. World leaders realized that climate governance up to that moment had not been sufficient, and they have felt the need of a universal legal treat on climate change capable to bind all member states. It represented the first occasion in which all nations participants agreed for the common purpose to undertake ambitious efforts to combat climate change and adapt to its effects, with particular attention reserved to developing countries. It was decided that consistent funds are needed to support their growth and developed countries signed this commitment. The agreement set out a global action plan to protect the world from dangerous climate change consequences[28]. It aimed to strengthen global response to the threat of climate change by keeping a global temperature

[28] https://ec.europa.eu/clima/policies/international/negotiations/paris_en

rise well below 2°Celsius above pre-industrial levels and to pursue efforts to contain the temperature increase even further to 1.5 degrees Celsius. The Agreement was also designed to support the ability of countries to react to the consequences of climate change and to deal with its impacts. In order to be compliance with these hard goals, the treaty has been divided in several thematic areas, namely adaptation, loss and damage, mitigation, finance, technology, capacity building and reporting and accounting. Moreover, the Conference facilitated the development of a more robust transparency framework.

The Paris Agreement foster for continuing financial and technical help to developing countries to assist them adapting to the disruptive consequences of climate change. Moreover, it aimed to create the favorable conditions for a transition away from fossil fuels toward cleaner renewable energy sources. The agreement contained also a loss-and-damage clause that recognize the importance of addressing the negative effects of climate change in developing countries. While the agreement didn't accept liability or the provision of compensation, it offered several conditions where support may be given. It has identified a concrete roadmap to scale up the developed Parties level of financial support for mitigation and adaptation actions in developing countries by jointly providing USD 100 billion annually by 2020[29]. According to these actions, the Italian amount of private finance mobilized will be analyzed in the last chapter.

On the 4th November 2016, thirty days after the date on which 55 Parties of the Convention, representing at least approximately the 55 % of the total global greenhouse gas emissions, have put their tools of ratification, acceptance, authorization or agreement with the Depositary, the Paris Agreement has started to be effective.[30]

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[29] "Adoption of the Paris Agreement"
http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf

[30] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

1.3 Sustainable Development Goals (SDGs)

In New York, from 25-27 September 2015, Heads of State and Government and High Representatives, have met at the United Nations Headquarters for the celebration of its seventieth anniversary. The Goals and targets were the results of over two years of intensive public consultations and engagements with civil society and other stakeholders around the world, paying specific attention to the opinions of the poorest and defenseless[31]. In that occasion they have established the new 2030 Agenda for Sustainable Development. It represented an ambitious plan for diminishing poverty and fostering economic development, social wealthiest and environmental safeguard worldwide[32]. The 17 Sustainable Development Goals adopted by countries in the 2030 Agenda for Sustainable Development officially came into force on 1 January 2016.

The Agenda called for action by all countries and it is founded on the five "P"s: People, Planet, Prosperity, Peace and Partnership. Countries had to mobilize efforts to end all forms of poverty, combat disparities and slow down climate change, the main value was that no one should be left behind[33]. During the creation of those goals, governments realized that, in order to diminish poverty across the planet, they should prepare the environment for building economic growth and improving several social needs such as instruction, health, social security and job chances. Moreover, it was said that governments had the primary responsibility for follow-up and review the progress made through the implementation of those 17 Goals **(see figure 2).** According to this view, it was important that government paid attention to the SDG financing gap, and in particular the focus on finance sector is determinant. This was a good strategy to

[31] https://sustainabledevelopment.un.org/post2015/transformingourworld

[32] International Development Cooperation, Three-Year Programming and Policy Planning Document 2016-2018
https://www.esteri.it/mae/resource/doc/2018/03/doc_triennale_2016-2018_eng.pdf

[33] https://www.un.org/sustainabledevelopment/development-agenda/

monitor the money and to see how much progress has already been made and to realize the dauting gap that remained.

Figure 2: The Global Goals for Sustainable Development. Source: The World Bank

Current trends are optimistic according to these needs, however existing financing tools have been adapted to sustainable ends. It is expected to see further innovation in these fields, with the dual focus on maximizing the potential of the financial instruments that exist nowadays and on increasing the opportunities for building an innovative sustainable growth.

Concerning these international purposes, Valerie Smith has written: *"With the combination of motivated clients, demanding investors, and a robust set of financing options, we may be able to close the gap and help create the future we want"*[34].

1.4 Policy responses to climate change: Mitigation

The International Energy Agency (IEA), it has stated the need to readdress the energy supply system and to scale up financial investments toward low-

[34] Valerie Smith. 2017. Sustainable Development Impact Summit. World Economic Forum. 18-19 September 2017. New York, USA. See: https://www.weforum.org/agenda/2017/09/the-money-is-there-to-fight-climate-change/

carbon economy. It has estimated that around USD 3.5 trillion yearly in energy sector investments would be necessary between 2016 and 2050 (compared to USD 1.8 trillion valued in 2015) in order to maintain rising of temperature below 2°C[35]. Indeed, if states would continue on the current path, without additional mitigation efforts, it is really likelihood that global mean surface temperatures over the 21st century would be between 1.2 and 3.4°C higher than the 2°C limit that has been universally fixed. To be compliant with this target, mitigation and adaptation strategies have been identified[36].

People's efforts, innovations, investments and policy responses to climate change can be mostly summarized into two categories: mitigation (also called preventive measures) intended to lower the size or timing of climate change and adaptive measures to deal with the consequences of climate change[37]. Together, adaptation and mitigation efforts facilitate the objective expressed in the United Nations Framework Convention on Climate Change (UNFCCC), Article 2: "To achieve [...] stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner[38]". All efforts to diminish or avoid emission of greenhouse gases can be: investments in and use of new technologies, renewable energy or

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[35] OECD/IEA and IRENA. 2017. Perspective for the energy transition. Investment needs for a low-carbon energy system. See: https://www.iea.org/publications/insights/insightpublications/PerspectivesfortheEnergyTransition.pdf

[36] Sloan Fellows, Stanford MSx Program Mark Allen Korin Crawford Je ´ ro^me The ´ ot Luca Toscani. *Climate Change and Capital Markets*. Stanford Business School.

[37] Jonathan M. Harris, Brian Roach and Anne-Marie Codur. 2017. *The Economics of Global Climate Change*. Global Development and Environment Institute Tufts University

[38] UNFCCC, 2015. Article 2. Report of the Conference of the Parties on its twenty-first session. Paris from 30 November to 13 December 2015.

the renovation of older equipment trying to make them more energy efficient, and finally the changing in consumer or business behavior.

Concerning the causes of GHG emissions, the primary sources of year-on-year emissions are the "burning of fossil fuels (coal, oil, and gas), with important contributions from the clearing of forests, agricultural practices, and other activities"[39]. Precisely, burning fossil fuel for electricity and heat generation produces about 25% of total GHG emissions; industry 21%; transportation 14%; other energy 10%; and buildings 6%; while agriculture, forestry, and other land uses (AFOLU) provide the residual 24% of total GHG emissions **(see figure 3)**[40].

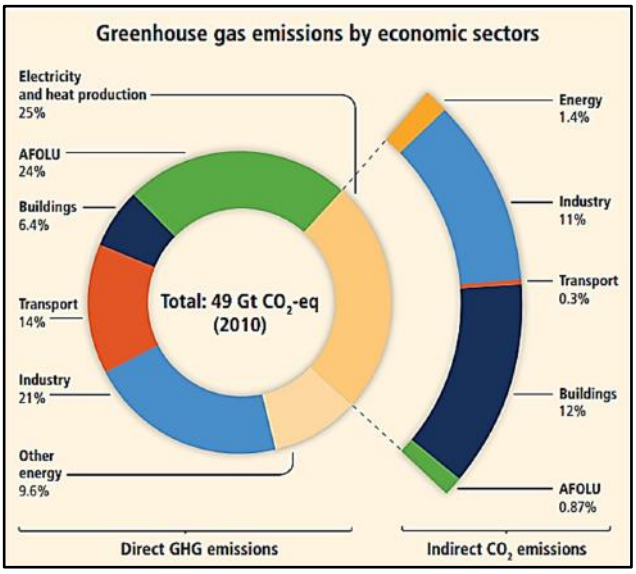

Figure 3: Greenhouse gas emissions by economic sector. Source: "Climate Change 2014: Synthesis Report," Intergovernmental Panel on Climate Change, 2014, pp. 47.

[39] U.S. Global Climate Change Research Program, "*Climate Change Impacts in the United States*", Thomas R.Karl, Jerry M.Melillo, and Thomas C.Peterson (eds.), 2014, p. 9.
[40] P. Smith, M.Bustamante, H.Ahammad, H.Clark, H.Dong, E.A.Elsiddig, H.Haberl, R.Harper, J.House, M.Jafari, O.Masera, C. Mbow, N. H. Ravindranath, C.W. Rice, C. R. Abad, A. Romanovskaya, F. Sperling, F. N. Tubiello, "*2014: Agriculture, Forestry and Other Land Use (AFOLU),*" *in Climate Change 2014: Mitigation of Climate Change*. New York, Cambridge University Press, 2014.

The concept of mitigation is as fundamental in the Paris Agreement as it was in the previous climate agreements. All measures and policies introduced to reduce the current status of greenhouse emissions and to mitigate the current situation are considered "mitigation actions". The mitigation efforts proposed by the Paris Agreement were to both cut the emissions caused by humans (called anthropogenic emissions in the treat) and to use more carbon sinks like trees, in order to delete a portion of the greenhouse gases present in the atmosphere. An additional way to mitigate the actual world climatic state is to nationally determined contributions as written in the treaty in Article 4. The accord declared that countries have the duty to "prepare, communicate and maintain" successive nationally determined contributions.

Furthermore, it has been always more evident that mitigation policies need to be supported with adaptation ones. Since climate change is already happening, and even though mitigation policies are applied in the immediate future, seeing sea-level increased and the warming of planet are two phenomena that will continue in the future, and probably for centuries[41].

1.4.1 Measures for mitigation strategy

Without further efforts to reduce GHG emissions beyond those in place today, emissions growth is expected to continue, driven by growth in global population and economic activities. It would be expensive to modify the current infrastructure developments and long-lived products that lock societies into GHG-intensive emissions. For this reason, it must be underlined the importance of early action for ambitious mitigation. In the Global Landscape of climate

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[41] IPCC. (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment. Cambridge University Press,Cambridge,UK.
IPCC. (2014). Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

finance 2017 it has been said that energy efficiency is now the first goal of public investment in mitigation. Considering public finance directed to the mitigation sector, it can be said that renewable energy has become the major focus of the investing policies. The following list are non-exhaustive measures that need to be undertaken in order to accomplish the objective of reducing GHG emissions divided by sectors:

- **Energy supply**
  - Decarbonization of electricity generation
  - Renewable energy technologies and other energy technology
  - Replacement of current coal-fired power plants with modern, efficient natural gas combined cycle power plants or combined heat and power plants
  - Carbon dioxide capture and storage (CCS) technologies
  - Transport
  - Technical and behavioral mitigation measures for all transport modes
  - New infrastructure and urban redevelopment investments and design

Decarbonizing means "reducing the carbon intensity" of electricity generation and it is a key component of cost-effective mitigation strategies in order to reach low-stabilization levels. The reduction of carbon intensity of fuel is constrained by energy storage and the relatively low energy density of low-carbon transport fuels.

- **Buildings**
  - For new buildings, the adoption of very low energy building codes
  - Retrofits where established building stocks exist
  - Behavioral technology
- **Industry**
  - Upgrading, replacement and deployment of best available technologies

- Innovation

The industry sector accounted for just over 30 % of global GHG emissions in 2010 and they are now greater than emissions from either the buildings or transport end-use sectors[42].

- **Agriculture, Forestry and Other Land Use**
  - Afforestation, sustainable forest management and reduction of deforestation
  - Cropland management, grazing land management and restoration of organic soils
- **Public policies**
  - Cap-and-trade systems for GHGs (effect has been limited thus far)
  - Tax-based policies specifically aimed at reducing GHG emissions
  - Reduction of subsidies, such as those within fossil fuel industries, for GHG-related activities

Move to low-carbon electricity, start new industrial processes and facilitate radical product innovations are some actions that could contribute to substantial GHG emission reductions. Some of the greatest worries in this direction is the lack of policy for investment incentives and experiences in material and product service. Behavior, lifestyle and culture have a significant impact on energy use and related emissions, with high mitigation potential in some sectors, in particular if it is complementary to technological and structural change. Emissions can decrease through changes in consumption habits and nutritional modification and diminution of food ruins. Also, information measures or monetary and non-monetary incentives might improve behavioral changes.

[42] METREX Futures Group. (2014). IPCC Fifth Assessment Report Mitigation. The Network of European Metropolitan Regions and Areas 125 West Regent Street.

1.5 Policy responses to climate change: Adaptation

In the Paris Agreement for the first time in international context, the concept of adaptation had been putted on par with the concept of mitigation. During years before that agreement it seemed to be cleared that certain consequences of climate change can no more be avoided. In this sense countries need to build resilience in order to adapt to the new panorama created as a consequence of climate change. According to Article 7 of the Paris Agreement: "*Parties hereby establish the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change...*[43]".

Contrarily of mitigation, adaptation didn't have the description of precise measures that should be taken. Adaptation was described using soft language and it was stated more as a global goal rather than a problem with a precise solution. However, in Article 7 it was included a sort of prescription, that said that each party to the treaty must submit adaptation communications including its plans and actions, and that parties should constantly be at pace with adaptation efforts. Adaptation has been defined by the Intergovernmental Panel on Climate Change (IPCC) as the "*adjustments in practices, processes or structures which can moderate or offset the potential damage or take advantage for opportunities created by a given change in climate*[44]". Another definition see adaptation as all adjustments and investments that the society make in order to limit the negative impacts of climate change. During past years there were many definitions of this concept that differ from one another in several ways.

"*Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory*

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[43] UNFCCC. (2015). Article 7. Report of the Conference of the Parties on its twenty-first session. Paris from 30 November to 13 December 2015.
https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf

[44] Yamin, F., J. Depledge. (2004). *The international climate change regime: a guide of rules, institutions and procedure.* Cambridge: Cambridge University Press. doi:10.1017/CBO9780511494659

and reactive adaptation, private and public adaptation, and autonomous and planned adaptation[45]". Another one defined adaptation as "the process or outcome of a process that leads to a reduction in harm or risk of harm, or realization of benefits associated with climate variability and climate change"[46].

On one hand, the first key words in the definition that express adaptation as "adjustment", "practical steps", "process" and "outcome" can be understood differently by various stakeholders. The word "process" is a very broad and open-ended term that does not include any particular time or subject references and can easily incorporate "steps" and "adjustments". On the other hand, the UKCIP has defined adaptation more like a result than an ongoing activity[47]. These apparently little differences might generate different beliefs from different stakeholders, depending on the meaning of the term that they have decided to adopt. The different definitions highlighted that climate change adaptation in any case would prevent change, it just deals with consequences. It can respond to impacts of climate change in both precautionary and reactive ways[48]. Well implemented adaptation strategies may reduce the sensitivity to climate change vulnerability[49], and probably also create the conditions for having competitive advantage[50].

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[45] IPCC. (2001). Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881pp.

[46] West, C.C. and Gawith, M.J. (Eds.). (2005). *Measuring progress: Preparing for climate change through the UK Climate Impacts Programme*. UKCIP, Oxford.

[47] See: https://www.ukcip.org.uk/about-adaptation/

[48] Schipper, E. L. F. (2007). *Climate Change Adaptation and Development: Exploring the Linkages.* Tyndall Centre for Climate Change Research, Working paper 107

[49] IPCC. (2007). *Climate change 2007: Synthesis Report.* An Assessment of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Core Writing Team, Pachauri, R.K. and A. Reisinger (Eds.) IPCC, Geneva

[50] Lash, J., and F. Wellington. (2007). *Competitive Advantage on a Warming Planet.* Harvard Business Review. Page 95-102.WBCSD 2008. Adaptation – An Issue Brief for

From the moment that often climate change mitigation efforts have several times been derailed in a number of ways, it is extremely important to help population, economies and eco-systems to adapt to the changing of the environment. "Adaptive capacity" is the capacity of a system, region, or community to adapt to the consequences of climate change. Being able to deal with changes, uncertainties and extreme events in climate are examples of adaptive capacity. In this sense, trying to foster adaptive capacity may decrease vulnerabilities and supports sustainable development[51].

According to adaptation strategies, another difference must be underlined: it is the one between private and public adaptation. The first is also known as "autonomous adaptation" and it is widely interpreted as initiatives by private actors rather than by governments, usually triggered by market or welfare changes induced by actual or anticipated climate change[52]. The latter is known as "planned adaptation" and it is often the decision of a public agency to deliberate a policy after the observation of a diffused awareness that conditions

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Business. World Business Council for Sustainable Development. See: http://www.wbcsd.org/DocRoot/iMn5EtG4bkjxQNLfU9UZ/Adaptation.pdf, 2010-06-09

[51] Goklany, I.M. (1995). Strategies to enhance adaptability: technological change, sustainable growth and free trade. *Climatic Change*, 30, 427-449.

Burton, I., J.B. Smith, and S. Lenhart. (1998). Adaptation to climate change: theory and assessment. In: *Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies* [Feenstra, J.F., I. Burton, J.B. Smith, and R.S.J. Tol (eds.)]. United Nations Environment Programme and Institute for Environmental Studies, Free University of Amsterdam, Amsterdam, pp. 5.1-5.20.

Klein, R.J.T., M.J. Smit, H. Goosen, and C.H. Hulsbergen. (1998). Resilience and vulnerability: coastal dynamics or Dutch dikes? *The Geographical Journal*, 164(3), 259-268.

Rayner, S. and E.L. Malone (eds.). (1998). *Human Choice and Climate Change Volume 3: The Tools for Policy Analysis*. Battelle Press, Columbus, OH, USA, 429 pp.

Munasinghe, M. and R. Swart (eds.). (2000). Climate Change and Its Linkages with Development, Equity, and Sustainability. Proceedings of the IPCC Expert Meeting held in Columbo, Sri Lanka, April 1999. LIFE, Colombo, Sri Lanka; RIVM, Bilthoven, The Netherlands; and World Bank, Washington, DC, USA, 319 pp.

[52] Leary, N.A. (1999). A framework for benefit-cost analysis of adaptation to climate change and climate variability. Mitigation and Adaptation Strategies for Global Change, 4(3-4), 307-318.

are about to change or have changed and that an intervention is necessary to minimize losses or benefit from opportunities[53]. Another perspective is the one of Smith et al. (1996) that describe autonomous adaptations as those that occur "naturally," without interventions by public agencies, whereas planned adaptations are called "intervention strategies"[54].

The authors of the sixteenth chapter of the IPCC report said that adaptation projects receive, especially on the part of the private sector, less funding with respect to mitigation programs. Moreover, concerning the synergies and tradeoffs between adaptation and mitigation activities it is well known that an optimal mix between the two is not easy to determine. The same attention and economic funds are needed for both adaptation and mitigation strategies to climate change. In particular, lot of questions of equity and fairness emerge according to adaptation finance from the moment that developed countries have historically been the largest GHG emitters and should be financially responsible by helping the most exposed countries to build resilience to global warming[55].

An effective summary table of the different methods and investment opportunities which could be the outcome from adaptation to climate change has been showed in the *"Fifth Assessment Reports of the Intergovernmental Panel on Climate Change, Working Group II* ". It is presented below in **table 2**:

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[53] Pittock, B. and R.N. Jones. (2000). Adaptation to what and why? Environmental Monitoring and Assessment, 61(1), 9–35.

[54] Smith, J.B., N. Bhatti, G. Menzhulin, R. Benioff, M.I. Budyko, M. Campos, B. Jallow, and F. Rijsberman (eds.). (1996). Adapting to Climate Change: An International Perspective. Springer – Verlag, New York, NY, USA, 475 pp.

[55] Sabina Potestio. (2014). Climate finance issues in the IPCC report and possible future pathways ICCG Reflection No. 26/September 2014.

Overlapping Approaches	Category	Examples
Vulnerability & Exposure Reduction through development, planning & practices including many low-regrets measures	Human development	Improved access to education, nutrition, health facilities, energy, safe housing & settlement structures, & social support structures; Reduced gender inequality & marginalization in other forms.
	Poverty alleviation	Improved access to & control of local resources; Land tenure; Disaster risk reduction; Social safety nets & social protection; Insurance schemes.
	Livelihood security	Income, asset & livelihood diversification; Improved infrastructure; Access to technology & decision-making fora; Increased decision-making power; Changed cropping, livestock & aquaculture practices; Reliance on social networks.
	Disaster risk management	Early warning systems; Hazard & vulnerability mapping; Diversifying water resources; Improved drainage; Flood & cyclone shelters; Building codes & practices; Storm & wastewater management; Transport & road infrastructure improvements.
	Ecosystem management	Maintaining wetlands & urban green spaces; Coastal afforestation; Watershed & reservoir management; Reduction of other stressors on ecosystems & of habitat fragmentation; Maintenance of genetic diversity; Manipulation of disturbance regimes; Community-based natural resource management.
	Spatial or land-use planning	Provisioning of adequate housing, infrastructure & services; Managing development in flood prone & other high risk areas; Urban planning & upgrading programs; Land zoning laws; Easements; Protected areas.
Adaptation including incremental & transformational adjustments	Structural/physical	***Engineered & built-environment options***: Sea walls & coastal protection structures; Flood levees; Water storage; Improved drainage; Flood & cyclone shelters; Building codes & practices; Storm & wastewater management; Transport & road infrastructure improvements; Floating houses; Power plant & electricity grid adjustments.
		Technological options: New crop & animal varieties; Indigenous, traditional & local knowledge, technologies & methods; Efficient irrigation; Water-saving technologies; Desalinisation; Conservation agriculture; Food storage & preservation facilities; Hazard & vulnerability mapping & monitoring; Early warning systems; Building insulation; Mechanical & passive cooling; Technology development, transfer & diffusion.
		Ecosystem-based options: Ecological restoration; Soil conservation; Afforestation & reforestation; Mangrove conservation & replanting; Green infrastructure (e.g., shade trees, green roofs); Controlling overfishing; Fisheries co-management; Assisted species migration & dispersal; Ecological corridors; Seed banks, gene banks & other *ex situ* conservation; Community-based natural resource management.
		Services: Social safety nets & social protection; Food banks & distribution of food surplus; Municipal services including water & sanitation; Vaccination programs; Essential public health services; Enhanced emergency medical services.
	Institutional	***Economic options***: Financial incentives; Insurance; Catastrophe bonds; Payments for ecosystem services; Pricing water to encourage universal provision and careful use; Microfinance; Disaster contingency funds; Cash transfers; Public-private partnerships.
		Laws & regulations: Land zoning laws; Building standards & practices; Easements; Water regulations & agreements; Laws to support disaster risk reduction; Laws to encourage insurance purchasing; Defined property rights & land tenure security; Protected areas; Fishing quotas; Patent pools & technology transfer.
		National & government policies & programs: National & regional adaptation plans including mainstreaming; Sub-national & local adaptation plans; Economic diversification; Urban upgrading programs; Municipal water management programs; Disaster planning & preparedness; Integrated water resource management; Integrated coastal zone management; Ecosystem-based management; Community-based adaptation.
	Social	***Educational options***: Awareness raising & integrating into education; Gender equity in education; Extension services; Sharing indigenous, traditional & local knowledge; Participatory action research & social learning; Knowledge-sharing & learning platforms.
		Informational options: Hazard & vulnerability mapping; Early warning & response systems; Systematic monitoring & remote sensing; Climate services; Use of indigenous climate observations; Participatory scenario development; Integrated assessments.
		Behavioural options: Household preparation & evacuation planning; Migration; Soil & water conservation; Storm drain clearance; Livelihood diversification; Changed cropping, livestock & aquaculture practices; Reliance on social networks.
Transformation	Spheres of change	***Practical***: Social & technical innovations, behavioural shifts, or institutional & managerial changes that produce substantial shifts in outcomes.
		Political: Political, social, cultural & ecological decisions & actions consistent with reducing vulnerability & risk & supporting adaptation, mitigation & sustainable development.
		Personal: Individual & collective assumptions, beliefs, values & worldviews influencing climate-change responses.

Table 2: Approaches for managing the risks of climate change through adaptation. These approaches should be considered overlapping rather than discrete, and they are often pursued simultaneously. Source: IPCC 2014 Summary for Policy Makers

1.6 International Climate Finance

In many of the climate negotiation summits cited above (e.g. Rio 1992, Kyoto 1997, Marrakesh 2001, Bali 2007, Copenhagen 2009, Durban 2011 and Paris 2015), climate finance – the financial resources for mitigation and adaptation strategies – had a determinant role. Indeed, a crucial landmark that was agreed upon in the Paris Agreement is that of climate finance. In the absence of an internationally-agreed definition of what is recognized as "climate finance", it can be identified in low-carbon and climate-resilient development interventions with direct or indirect greenhouse gas mitigation or adaptation benefits[56].

Climate finance constitutes a very broad topic that refers to both mitigation and adaptation policies. Moreover, it implicates the participation of many stakeholders varying from States to financial institutions and civil society. It is hard to have the same common ideas of which are the key climate finance terms, concepts, policy makers, investors, financial intermediaries, analysts but there is a constant research study that aim to define them. In order to build a common understanding of key climate finance terminology it is necessary an ongoing discussion on how to track climate finance, identify efforts to measure its effectiveness, and help recognize where public sector actions may have the best results in fostering climate finance. Moreover, explaining project-level climate finance terminology will enable policymakers to comprehend the different options offered for public actors to both reduce the costs and boost the revenues of low-carbon and climate-resilient projects. This mechanism will facilitate private sector to make investments since they may become more attractive. **Figure 4** shows the history of international climate finance, both for public finance and market-based mechanisms.

[56] UNFCCC. (2014). Second forum of the Standing Committee on Finance. Montego Bay, Jamaica, 21 – 22 June 2014

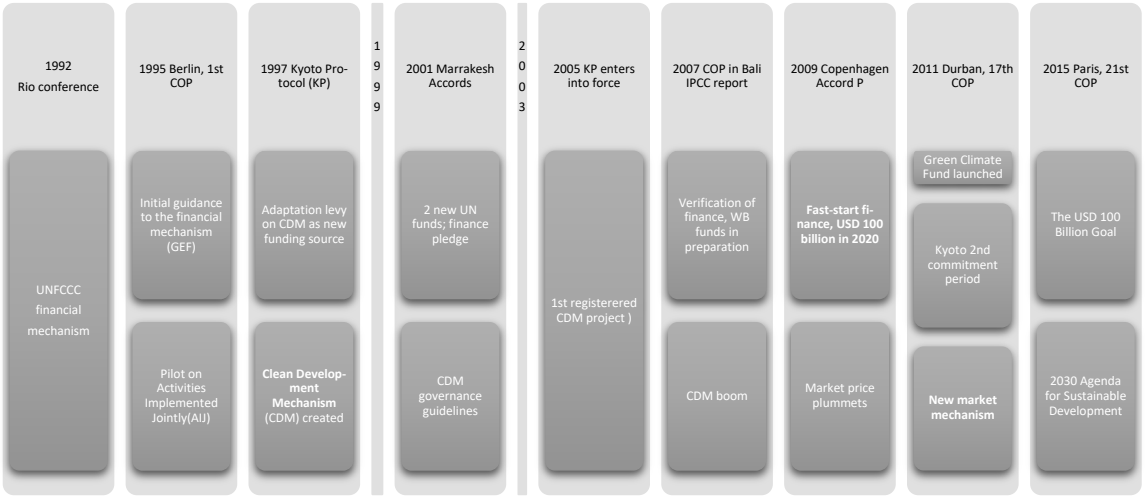

Figure 4: History of international climate finance. Source: own compilation; World Bank

In the final UNFCCC (1992) text the Northern and Southern countries bargained on finance and found an agreement[57]. Industrialized countries decided to provide financial resources in order to cover full incremental costs of developing countries mitigation and adaptation programs (including national GHG inventories, technology cooperation, research and information exchange)[58]. However, the costs covered where only those agreed between developing countries and operational entities of the financial mechanism[59].

How to gather sufficient amounts of money has always been among the most discussed topic in environmental treaties. Money is determinant for action, and without it, any policy designed in order to mitigate climate change and to create resilience and adaptation is unsuccessful. The UNFCCC and the Kyoto Protocol both failed as climate treaties in procuring enough flows of money because countries have been reluctant to provide adequate quantity of funds.

Today, new strategies still have to be found in order to raise the correct quantity of money. However, thanks to the fund established by the UNFCCC in the 2010 in Cancun called the "Green Climate Fund", developing countries were reassured to have the availability of a predetermined source of financial flows to

[57] Bodansky. (2001). Ibid.
[58] UNFCCC. (1992). Article 4.1. Rio de Janeiro 3-14 June 1992.
[59] UNFCCC. (1992). Article 4.3. Rio de Janeiro 3-14 June 1992.

fight climate change. Moreover, in the Paris Agreement, Article 9[60] established the functioning of financial resources in detail, underling that developed countries have greater financial obligations and that they should provide developing countries with enough financial resources and assistance to meet the mitigation and adaptation goals. It is also said that industrialized countries should mobilized climate finance through different sources, such as public and private funds. Moreover, in the Paris Declaration, published after the conference, it was said that countries must create new financial scheme that allows to unlock the $100bn/year that are needed to be invested in projects to combat climate change. At the conference it was largely comprehended that new financial inputs are essential in achieving long-term goals in climate change adaptation and mitigation. On one hand, this meant that it was essential to make the biggest change in investment sector. On the other hand, it was suddenly clear to investors and businesses that the world must shift its economic pattern and its energy pattern to clean energy, starting to leave behind fossils fuels.

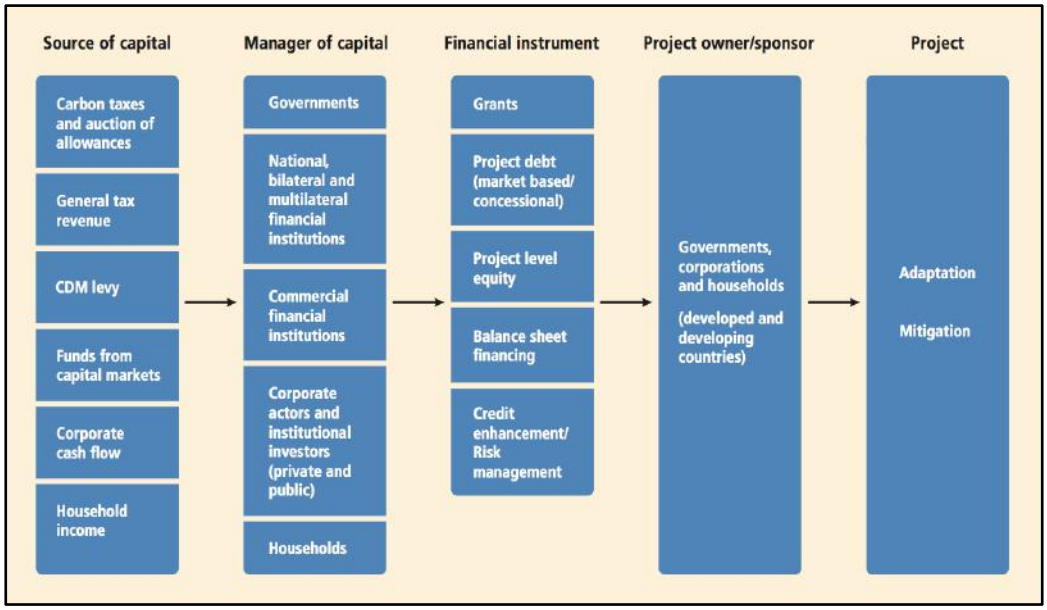

Figure 5: Overview of climate finance flows. Note: Capital should be understood to include all relevant financial flows. Source: IPCC "Climate Change 2014 Synthesis Report"

[60] UNFCCC. (2015). Article 9. Report of the Conference of the Parties on its twenty-first session. Paris from 30 November to 13 December 2015. See: https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf

There is no widely agreed definition of what constitutes climate finance, but there are some estimations of the financial flows associated with climate change mitigation and adaptation strategies. In order to reduce international emissions (in addition to financial needs), it is required a deep change in consumptions patterns, the transformation of some key economic sectors such as the energy one, the transportation and the industrial sector[61]. Moreover, it is necessary that this shift would take place as soon as possible. Since greenhouse gases stay in the atmosphere for many years, it is required 100 years actions starting from now to clean the air[62].

All experts have agreed that the inclusion of the private sector is needed and probably is the most feasible solution that allows the whole world to reach the goal. In particular, public money have been considered essential to unlock private investments in green sector. Furthermore, after the Paris Agreement, it has been established that, in order to foster greater efforts over time, countries have to update their already arranged nationally contributions every five years, by underwriting systematic updating and evaluation of strategies. This underline the fact that countries are ready to undertake new strategies to attract investments, new strategies to make green investments more attractive to the private sector[63].

Since countries can determine their way of meeting their obligations, the Paris Agreement can be seen as a good trade-off between regulations and autonomy. Within a proper enabling environment, the private sector, together with the public sector, can play a determinant role in financing mitigation and adaptation. For this reason, it is critical to understand how public finance can attract private investment. In this sense, quantifying and analyzing the effects of

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[61] Bodansky. (2010). The Art and Craft of International Environmental Law. Harvard University Press. Cambridge, Massachusetts. London, England.

[62] Giacomo and Marco casari. 2016 "Carbon is forever: a climate change experiment on cooperation". Working Paper DSE N° 1065. The University of Bologna.

[63] Bianca Mularoni. (2016). *Chasing an effective climate deal: are we on the right Path?.* LUISS, Department of Political science.

climate-related public interventions on private investment may help to understand broader processes, such as measuring the extent to which financial flows are in line with climate goals[64]. According to this, the analysis of Italian climate finance progresses would be analyzed in chapter 5.

By keeping in mind this goal, in 2013, the Research Collaborative on Tracking Private Climate Finance, an OECD-led network of research organizations, international finance institutions, and governments, has been established. The group provides data and methodological developments for estimating publicly-mobilized private finance for climate action in developing countries.

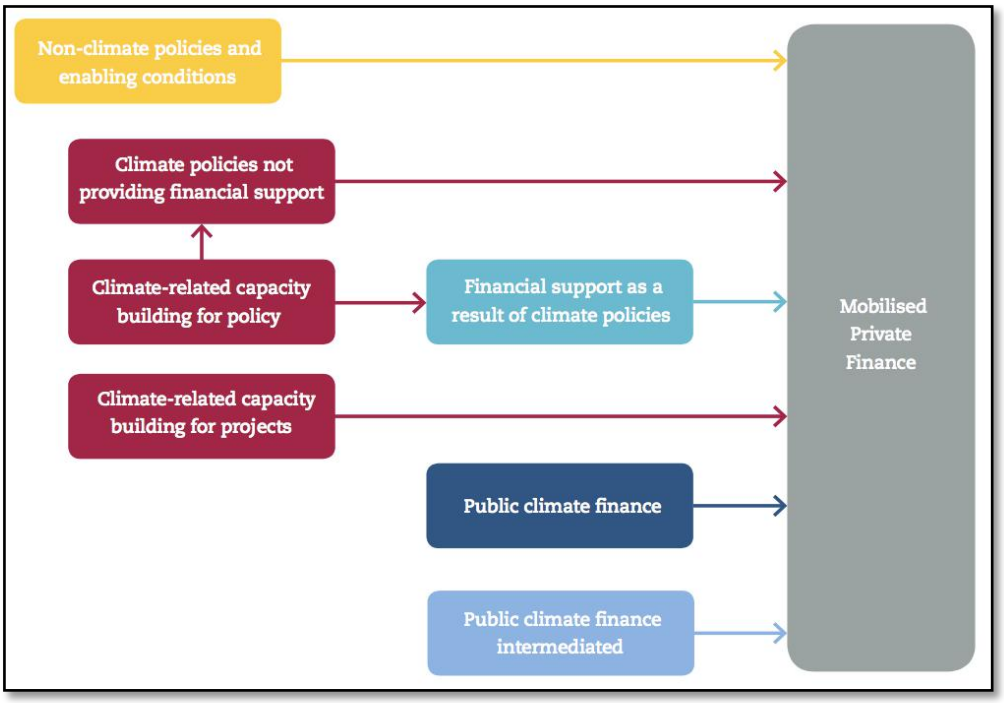

Figure 6: Illustration of the potential effects of different factors on private finance for low-emissions and climate-resilient projects. Source: OECD Private finance for climate action. November 2017

Many mitigation funds have tried to measure how much private finance has been directly leveraged through their interventions. The implementation and finance interventions that should lead to mitigation benefits have seen the

[64] OECD. (2017). *Private finance for climate action. Estimating the effects of public interventions.*

increasing importance of private companies and investors, in particularly in the renewable energy sector. **Figure 6** might provide an overview of these different effects and of the corresponding potential nature of the causal links between each factor and private investment.

1.7 Climate finance actors

A lot of debate has increased due to the uncertainty surrounding the climate finance definition. In particular, there is a lot of controversy on which are the sources of climate finance – public and/or private – what are its objectives and beneficiaries, how to determine the amount of funds and finally, how to guarantee that States are providing "their fair share" of climate finance[65]. Climate finance can be channeled through both public and private actors. However, there are some institutions with mixed public and private shareholdings (e.g. utilities), or whose funding contains both public and private sector contributions (e.g. investment funds) and/or a mix of private and public money borrowed from the capital markets (e.g. MDBs) that stay in the middle[66]. However, inside the UNFCCC and of the Kyoto Protocol is not determined if climate finance should comprise private apart from public finance. So far, the critical role played by the private sector with respect to climate resilience had determined the inclusion of both international and private finance in the definition of climate finance[67].

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[65] Kuramochi et al. (2015). *Mobilizing International Climate Finance: Lessons from the Fast-Start Finance Period*, Smita Nakhooda, Taryn Fransen, Takeshi Kuramochi, Alice Caravani, Annalisa Prizzon, Noriko Shimizu, Helen Tilley, Aidy Halimanjaya, Bryn Welham, Revised version, February 2015.

[66] Raphael Jachnik, Randy Caruso, Aman Srivastava. (2015). OECD *Estimating mobilized private climate finance: methodological approaches, options and trade-offs*. OECD Environment Working Papers, No. 83, OECD Publishing.

[67] Barbara Buchner, Jessica Brown, and Jan Corfee-Morlot. (2011). *Monitoring and Tracking Long-Term Finance to Support Climate Action*. OECD.

Global climate finance has nowadays a dynamic structure that is "constantly evolving"[68]. From the moment that there is no consolidated finance system, money comes from different channels through both multilateral and bilateral funds. The Climate Policy Initiative has identified public actors as "government ministries, bilateral aid agencies, export credit agencies, and multilateral, bilateral and national development financial institutions (DFIs)"[69].

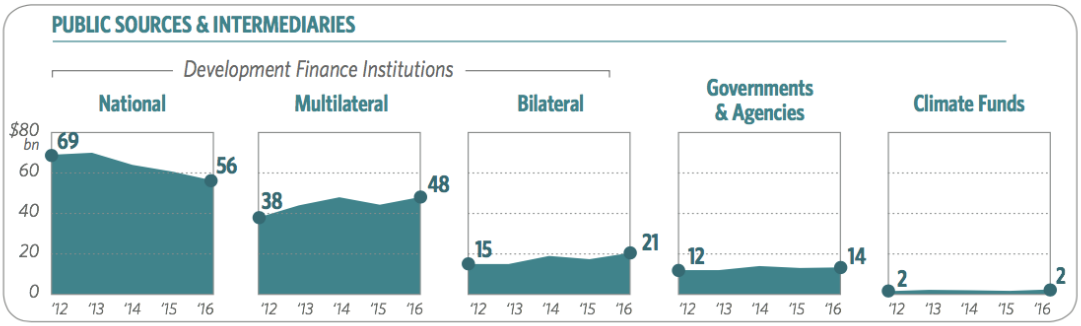

Figure 7: Sources and intermediaries of public climate finance. Source: OECD 2017; ODI 2017; CPI analysis

CPI has also recognized as sources of private finance "project developers, corporate actors and manufacturers, households, commercial financial institutions, institutional investors (like pension funds, insurance companies or sovereign wealth funds) and private equity venture capital and infrastructure funds"[70].

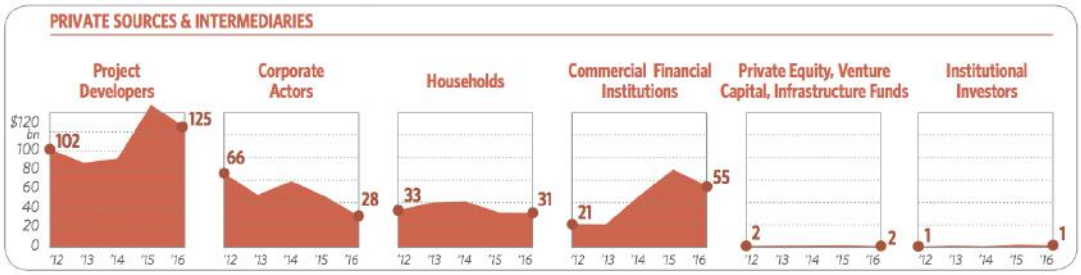

Figure 8: Sources and intermediaries of private climate finance. Source: BNEF 2017a; CPI analysis

[68] Nakhooda S., Watson C. and Liane Schalatek. (2015). The Global Climate Finance Architecture. Climate Funds Update. December 2015. p. 1.
[69] Climate Policy Initiative. (2014). *The Global Landscape of Climate Finance 2014*. Climate Policy Initiative, November 2014.
[70] Climate Policy Initiative (2014). Ibid.

It is extremely difficult to understand the link between public interventions and private climate finance. It has been shown in different studies that the main source in order to mitigate and to adapt to climate change impact comes from private investments. In particular private sector engagement is crucial because private businesses dominate many key decisions that can facilitate adaptation such as the location and design of roads and buildings and provide financing.

1.8 Defining Public Interventions and Instruments

The sources of public climate finance are mainly donor governments and their agencies, multilateral climate funds, and development finance institutions (DFIs). The role of climate-related public interventions is to encourage investments in private sector through two channels, in particular public actors can operate through:

- **Public finance:** providing directly financial support to projects, programs, funds or enterprises. It might comprehend finance coming from firms owned by the government and commercial banks, public pension funds and sovereign wealth funds, and finally official export credit agencies[71]. Nonetheless, it should be considered a possible negative consequence of the direct engagement of public finance. Indeed, it may crowd out private finance that would have been spent in the absence of public interventions.
- **Public policy:** offering a wide range of interventions that can indirectly facilitate climate-relevant projects and activities. These policies should create incentives that are attractive to private investors and that help decreasing perceived investment risks.

[71] Jachnik, R. et al. (2017). *Tracking climate-related export credits: existing official reporting practices, illustration of methodological options and implications through project examples*; Working document prepared for the Research Collaborative on Tracking Private Climate Finance.

Examples of public finance and policy and the respective instruments are showed in **Table 3.**

	Intervention Types	**Instruments**
Public Finance	Grants	Project or program level grants
	Debt	Loans
		Credit Lines
		Bonds
		Debt Funds
		Subordinate debt
	Equity	Direct Equity Investments
		Shares in Equity Funds
		Preferred Equity
	De-risking	Insurance
		Guarantees
		Derivatives
Public Policy	Regulatory Policy	Laws and Policy
		Plans and Targets
		Standards
		Quotas
	Fiscal Policy	Taxes
		Subsidies and Tax
		Reliefs and credits
		Market Support
	Information and Innovation Policy	Research and Development
		Licenses and Patents
		Technology Transfer
		Education and Awareness
		Data and Statistics

Table 3: It summarizes specific options within these intervention types. Source: Jachnik, Raphael, Et al. (2015).

According to the Report "Global Landscape on Climate Finance 2017[72]", the public contribution in the total climate finance has decreased in 2015/2016 to 34% with respect to the 40% that has characterized the 2013/2014 year. This might be due to the augment of private actors' investments as it will be analyzed in the following paragraph. The largest financial instrument used to channel climate finance is market rate debt. It has been accounted that the 54% of the total of the investment during 2015/2016 were made through this instrument with an average of $219 billion per year.

1.9 Defining private finance actions

Providing private finance in a given country in order to facilitate the transition to low-emissions and climate-resilient projects is likelihood the result of climate-related public finance actions and policy interventions, considering broader policy environments and the enabling conditions[73]. This theory has been spread through public institutions, development agencies and even some NGOs[74]. Private finance has two sectors in which it can operates: on one hand it can play the role of an independent provider/lender of climate finance to developing countries (MFIs and BFIs). On the other hand, it can also receive climate finance from MFIs and BFIs respectively. Clearly, when the private sector provides climate finance to developing countries, it does it for profits. The private sector has the power to give a significant help to facilitate the countries' adaptation pathway. Private owners and operators of climate-sensitive assets or business practices have the power to give their contribute in sectors with social

[72] CPI. (2017). Global Landscape of Climate Finance. See: https://climatepolicyinitiative.org/wp-content/uploads/2017/10/2017-Global-Landscape-of-Climate-Finance.pdf

[73] Hascic, I., et al. (2015). Public Interventions and Private Climate Finance Flows: Empirical Evidence from Renewable Energy Financing", OECD Environment Working Papers, No. 80, OECD Publishing, Paris.

[74] Brown, J. and Jacobs, M. (2011). Leveraging private investment: the role of public sector climate finance. London: Overseas Development Institute.

and economic relevance (for example, water and energy infrastructure, and agriculture), and to become climate-resilient in order to decrease risks and react to new market conditions[75]. Nonetheless, fighting climate change by private sector can develop that business sense that help safeguarding business continuity, profits, or to make them take advantage of new market opportunities[76]. Governments can offer an allowing environment that incentivizes and permits businesses to incorporate climate change considerations in investment decision making and facilitate businesses to take actions[77].

According to the concept reported on CPI "Global Landscape of Climate Finance 2017", private finance flows are those coming from corporations and project makers in the renewable energy sector, commercial bank project loaning, institutional investors' investing in infrastructure and families investing savings[78]. Funds are considered coming from the private sector if they are provided by family-controlled enterprises, quoted companies, joint ventures, consortia, partnerships, pre-institutional funding, special purpose vehicles, individuals/business angels' networks, subsidiaries, private equity or venture capital firms, as well as private charities, non-for-profit and associations[79].

It may happen that private actors would only invest in projects that reduce GHG emissions if their costs are lower than the carbon price (the investment planning theory would be analyzed more deeply in chapter 4). The main goal of private investors (maximizing profits) is not always close to the one of public actors. The political goal of reducing GHG emissions for instance is different

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[75] Chiara Trabacchi, Federico Mazza. (2015). Emerging solutions to drive private investment in climate resilience. Climate Policy Initiative. June 2015

[76] Agrawala S. et al. (2011). S. et al. *Private Sector Engagement in Adaptation to Climate Change: Approaches to Managing Climate Risks*. OECD Environment Working Papers, No. 39, OECD Publishing

[77] Agrawala and Fankhauser. (2008). Economic Aspects of Adaptation to Climate Change: Costs, Benefits and Policy Instruments. OECD Environment Working Papers.

[78] CPI 2017. *Ibid.*

[79] Hasčič, I. et al. (2015). Public Interventions and Private Climate Finance Flows: Empirical Evidence from Renewable Energy Financing. OECD Environment Working Papers, No. 80, OECD Publishing. http://dx.doi.org/10.1787/5js6b1r9lfd4-en

from the investors' one to consider non-carbon returns such as electricity payments when they have to decide in which GHG-reducing project types to invest[80]. Furthermore, during the biennial 2015-2016 it has been calculated that private climate finance amounted on averaged $270 billion/year. This amount was 23% higher than the annual average in 2013/2014[81].

1.10 Past investments

As it has been seen, starting from Rio de Janeiro 1992 Conference, it has been a continuous evolution in the front of international climate finance. At the 13th COP in Bali 2007, governments understood that finance played a determinant role under the Bali Action Plan. Gradually, developed countries have realized that a future result would consider "nationally appropriate mitigation actions" (NAMAs) by developing countries. Moreover, those actions should be "measurable, reportable and verifiable" (MRV). According to developing countries, NAMAs must be supported by finance, technology and capacity building, while MRV should act to support them.

In the years between 2007 and 2009, bilateral and multilateral agencies created a series of funds and started different initiatives for mitigation and adaptation actions in developing countries, e.g. the German International Climate Initiative or the Australia's International Forest Carbon Initiative[82]. The biggest intervention was the implementation of the USD-6 billion Climate Investment Funds (CIFs), managed by the World Bank. Many professionals thought that it was a good strategy for supporting national climate policy framework and that it facilitated the application of the Paris Declaration Principles on Aid Effectiveness. In few years the CIFs had received more than USD 4 billion and had ratified more than USD 2 billion of funding. Thanks to the

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[80] Greiner, Sandra, Michaelowa, Axel. 2003. Defining Investment Additionality for CDM projects - practical approaches, in: Energy Policy, 31, p. 1007-1015b

[81] CPI. 2017. *Ibid.*

[82] Brown, J. and Jacobs, M. (2011). Ibid.

Copenhagen Accord in 2009, industrialized countries decided to commit USD 30 billions of "new and additional" resources for the period 2010-2012. Moreover, it established that USD 100 billions of financial resources should be mobilized by 2020. It was also said that funding could come from a variety of sources, including private ones. Finally, in 2010 the Green Climate Fund (GCF) was set up and in its first full year of activity the GCF obligations had reached the 54% of the total flows from climate funds[83].

The two COP (20 and 21) Presidencies have asked the OECD to provide an updated estimate of climate finance flows as an input to the ministerial meeting on climate finance in Lima in October 2015. The OECD in collaboration with the Climate Policy Initiative (CPI) have published the results in the OECD report "Climate Finance in 2013-2014 and the USD 100 billion goal" (OECD, 2015). It was a pilot aggregate estimate of public and mobilized private climate finance flows with respect to the years considered. In that report has emerged that public and private finance mobilized by developed countries for climate action in developing countries has reached USD 64 billion in 2014, compared to USD 52 billion in 2013[84]. The data for those estimates were coming from developed countries and from the related financial institutions, considering major multilateral development banks and key climate funds. In addition, the Standing Committee on Finance's forthcoming 2016 Biennial Assessment[85] (BA) has published similar values of aggregate climate finance from developed to developing countries. The BA has counted a slightly higher value of US$53 billion in 2013, and a slightly lower one of US$61 billion in 2014. The OECD has been asked to furnish analytical support to developed countries to develop a real roadmap for meeting the goal of mobilizing USD 100 billion per year by 2020.

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[83] Barbara K. Buchner et all. 2017. Ibid.

[84] OECD, 2016. 2020 projections of Climate Finance towards the USD 100 billion goal: Technical Note, OECD Publishing.

[85] See:
http://unfccc.int/files/cooperation_and_support/financial_mechanism/standing_committee/application/pdf/2016_ba_summary_and_recommendations.pdf

Furthermore, the Climate Policy Initiative's 2017 edition, called "Global Landscape of Climate Finance" published in October 2017, updated the most comprehensive assessment of annual climate finance flows with data that started from 2015 and 2016. It provided for the first time a five-year trend analysis on the how, where, and from whom finance is improving toward low-carbon and climate-resilient actions globally. The aim is to provide trends, gaps and opportunities to scale up investments. Their findings indicated that climate finance flows have reached the highest point with $437 billion dollars in 2015, however that flow has dropped in 2016 to $383 billion. Overall considered, the average flows across 2015/2016 were 12% higher than during 2013/2014. In the following graph it can be seen the breakdown of global climate finance by public and private actors in years 2012-2016 ($billion):

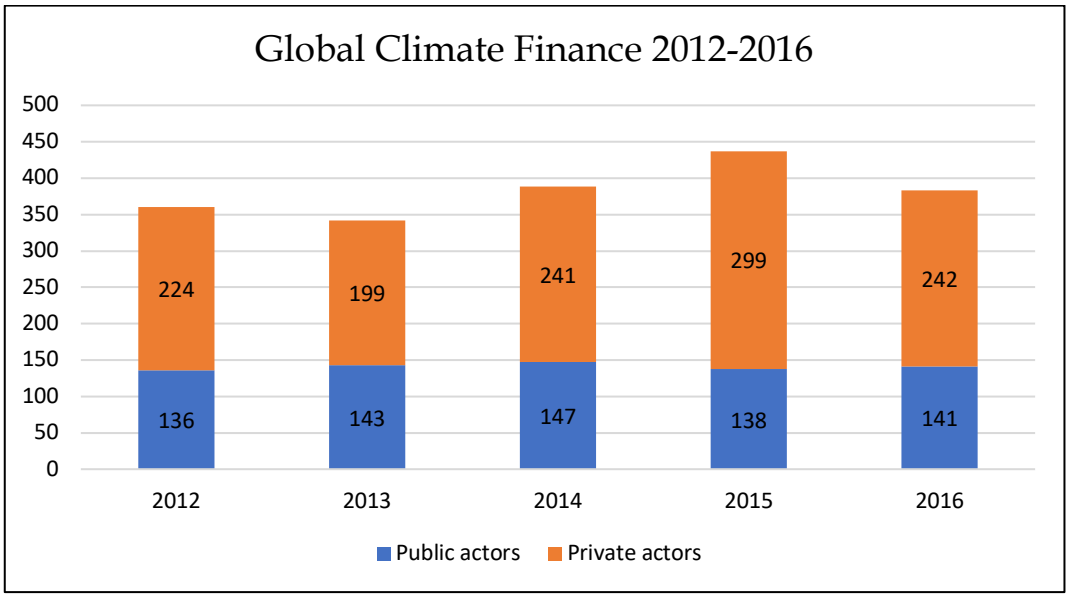

Figure 9: Global Climate Finance 2012-2016. Source: CPI Report: Global Landscape of Climate Finance 2017

The increase in overall finance in 2015 was not only for the scaling up of public finance, but it was mainly due to an intensification of private finance investments. This was also facilitated from the falling of renewable costs and the investments made for strong environmental policies. The pick in 2015 was reached mostly thanks to the surge in private renewable investment in China and in investments made for rooftop solar power in the U.S. and Japan. Furthermore,

the drop in 2016 was due to double factors: the fall of technology costs and the decreased capacity additions in some countries. With respect to the latter, it can be said than in China there was a scheduled phase-down in revenue support for wind projects for instance.

According to CPI Report on Global Climate Finance in 2017, total upstream and downstream fossil fuel investment in 2016 of $826 billion denoted that substantial potentially stranded investments could be refocused to meet low-carbon investment needs[86]. The stranded assets discussion would be examine in chapter 4.

1.11 Future investments

Finance had a fundamental role to play in fostering developing countries' efforts to diminish emissions, decarbonize their economies, and take actions against the impacts of climate change. According to the World Bank 2010, an estimated USD 75 to 100 billion is needed per year over the next 40 years in order to fight these changes. Moreover, mitigation costs had been considered separately and it has been estimated that they can range from 140 to 175 billion dollars per year by 2030[87]. As it has been seen, in December 2015, countries met in Paris had the objective to determine sufficient financial resources to support low-carbon development activities.

Climate finance can be identified as all actions made and all financial resources paid to cover the costs for moving from the actual world business model to a low-carbon global economy. All money spent must be used for mitigation or adaptation projects in order to fight current and future climate

[86] International Energy Agency (IEA). 2017. *World Energy Investment 2017*. Paris, France.

[87] The World Bank, 2010. *Development and Climate Change*. World Development Report 2010.

change impacts[88]. Overall considered, climate change represented for the private sector in particular a number of opportunities in mitigation and adaptation. If we looked on data from Bloomberg New Energy Finance, in 2015 there was a total investment in clean energy of $286 billion (more than six times the 2004 total)[89]. Moreover, in industry and manufacturing sectors, mitigation and adaptation opportunities can facilitate firms to save costs and realize competitive advantages. In construction, new buildings are gradually planned with better energy efficiency system. Climate change is an unavoidable issue that has long-run consequences for human health, safety, and economic growth.

A useful guidebook was published by the German Society for International Cooperation (GIZ) for designing public finance instruments to enhance private investment in low-carbon development. The guide is based on seven developing countries: Brazil, Costa Rica, India, Thailand, Vietnam, Morocco and Namibia[90]. From that study has emerged that different financing instruments combined together were more effective than a single mechanism. Moreover, researches noted that policies have worked better if they were tailored to single country and that engaging local stakeholders in the policy design increased the possibilities to success of that project. Finally, they have realized that policies should allow for flexibility to adapt to technology innovation.

It is clear that even if all currently planned mitigation and adaptation policies would be fully implemented, the goal of stabilize greenhouse gas emissions at 450 parts per million (ppm) probably will not be achieved by 2050. Responding to all challenges mentioned in this chapter requires large-scale investments. According to that, the development of innovative financing tools

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[88] Sifan Liu, B.A. 2016. *An econometric analysis of the influence of public interventions on private investment in climate finance*. Faculty of the Graduate School of Arts and Sciences of Georgetown University. Washington, DC.

[89] Frankfurt School of Finance & Management GmbH. 2016.*Global Trends in Renewable Energy Investment 2016*. United Nations Environment Programme and Bloomberg New Energy Finance.

[90] Sifan Liu, B.A. 2016. *Ibid.*

would be the major contribution to developing countries in the mobilization of additional resources.

For what is concerning the analysis of climate finance in general, it must be underlined that public finance commitments always take several years to translate into investments because of slowness budget approval processes, board deliberations and project proposal cycles that complicate the disbursement. Moreover, it must be remembered that many of the political commitments made before and during conferences had the 2020 targets and for this reason, there is a high probability that there might be significant growth from donors and public finance institutions in the next years[91]. A crucial challenge for the future of climate finance is linked to ethical and normative issues and to how to allocate the existing resources between vulnerable countries in the fairest and most equitable way possible.

Overall, it has been showed how much hard is to directly estimate a "Paris effect" on financial flows. In the next chapter climate impacts will be analyzed in different terms, through the length of financial innovation.

[91] CPI. (2017). *Ibid.*

CHAPTER 2

THE FINANCIAL PERSPECTIVE HAS CHANGED

Most of the times growth and development are supported by the financial system. In 2008 we have observed one of the worst global financial crisis. The world has assisted to the collapse of some markets in developed states and, as a consequence, some other developed and developing countries' economies have inexorably fallen down. However, the dramatic event of the global financial crisis had also a positive effect: the recognition that the financial system needs to become sustainable in the long run and that a possible solution to facilitate this change, is the transition to low-carbon and green economy. Therefore, in order to reach the pathway, it is necessary a realignment of the financial system with the sustainable development goals[92].

Policy makers and financial regulators have understood that it is indispensable to create a robust and sustainable financial system. Even if the effects of the 2008 financial crisis have continued to hit the global economy, from that dramatic event has emerged a new awareness of the importance of creating financial markets more connected to real economy. Ideas like the circular or green economy have slowly become the center of the economic strategies and policies for businesses and nations. The innovations in policies applied from developing to developed countries have demonstrated how the financial system can be more suitable with sustainable development goals. Nowadays, a new generation of policy innovators is trying to guarantee that the financial system is able to satisfy the needs of inclusive, environmentally-sustainable, economic development.

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[92] UNEP. (2015). The financial system we need. Aligning the financial system with sustainable development. The UNEP Inquiry Report. October 2015.

The main ways for financing the implementation of sustainable development is through financial markets or real economy. However, the great potential given to financial system need to be prudentially guided and all these actions must be complemented by international cooperation. Rick Samans has said at the World Economic Forum that in order to reach those ambitious goals, a new and more multidimensional period of international cooperation is necessary so that companies, civil society organizations and national and subnational governments are able to create networks of partnerships with the objective to accelerate progress where it is most needed and practicable[93]. According to this, the international agreement on the Sustainable Development Goals and the 2030 Agenda has underlined the urgent need to act on the biggest challenge issues of the time.

After the adoption of the Paris Climate Agreement, the financial sector has seen its role changed. Slowly moving from profit interests, it has started to play a crucial role in shifting capital allocation towards investments consistent with the Sustainable Development Goals. The transition towards sustainability would force profound structural changes to reinforce the links between economic growth and human development as well as the links between economic growth and the environment. The direction that has been taken during past years is positive, but it is necessary for the world as a whole, for both developed economies and emerging markets. The implementation of the Paris Climate Agreement and the Sustainable Development Goals probably would require tens of trillions of dollars of investments over the next two decades in developed and developing countries. Although some of the money will be provided by governments, the financial sector will have to play a central role because it would be the lonely able to provide the financial flows necessary to finance the global agenda.

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[93] Rick Samans, Head of Global Agenda and Member of the Managing Board, World Economic Forum. Sustainable Development Impact Summit Report 2017. New York, USA 18-19 September 2017.

The World Economic Forum Green Investment report published in 2013 said that the "additional investment needed to meet the climate challenge–for clean energy infrastructure, sustainable transport, energy efficiency and forestry – is about USD 0.7 trillion per year." At the Sustainable Development Impact Summit in New York, last 18-19 September, has emerged that: "between $5-7 trillion a year are needed to achieve the SDGs"[94]. The common factor that has transpired from all estimate reports is the fact that huge investments are needed. Furthermore, it is evident that the scale of finance required cannot be supported by the public sector exclusively. Luckily, the successful conclusion of COP21 has facilitate the introduction of topics like climate change or the potential of green finance on the top of the political agenda[95]. The private sector has to play a primary role in order to achieve the SDG goals. The world has never had an innovative agenda that suggested a new deal for people, prosperity and the planet for public-private-civil action on sustainable development and climate resilience.

2.1 Align the financial system with sustainable development

Sustainable development need finance coming in huge quantity from traditional capital flows, it indeed must be redirect towards different priorities and away from assets that deplete natural resources. Recent decades have seen improvement in the incorporation of sustainability factors into financial decision-making together with shifts in capital deployment, for example towards clean energy. For the development of a sustainable financial system it is essential to go beyond both business-as-usual approaches to financial market development, and to adopt ad hoc innovations. It is extremely important to use fintech innovation

[94] See: https://www.weforum.org/agenda/2017/09/the-money-is-there-to-fight-climate-change

[95] See: https://www.gbm.hsbc.com/solutions/sustainable-financing

if institutions want to accelerate green finance and investments. Moreover, both private and public stakeholders should collaborate in order to find innovative sustainable finance solutions. The relative roles of the public and private sector have seen changes in technologies moving through the stages of innovation as well as changes in the form of policies. A huge amount of policy innovations is growing in these years in developing and developed countries, together with international collaborations that are supporting national action to reach that objective. To reach this goal it is essential to work closely with international financial institutions so that they can promote, realize and scale up these innovations.

However, the more the spread in new technologies and the abatement of costs, the more the impact of innovation policies on climate change dumped its effects far beyond the policymaking country. For this reason, it makes sense to look at climate change-related innovation policy on a global basis. Technologies at different stages of innovation increase different policy issues and require different policy approaches. A successful innovation system should at first, use the right tools for each of the various stages and the distinct issues they pose; and, second, distribute resources and interventions to the stages where they are most helpful.[96] There is broad consensus that in order to solve the climate challenge in the limited time we have, a massive R&D effort is needed, involving both public- and private-sector actors around the globe. Numerous observers have concluded that current worldwide R&D expenditures in clean energy are far from adequate—one-tenth to one-half of what is required to prevent dangerous climate impacts[97]. At the Sustainable Development Impact Summit 2017 it has been forecasted that an additional $1 trillion annually in clean energy investments to limit global warming to below 2 degrees[98]. A successful

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[96] CPI. (2013).The Policy Climate. See: www.ClimatePolicyInitiative.org

[97] Nemet, G. and D. Kammen. (2007). *U.S. energy research and development: Declining investment, increasing need, and the feasibility of expansion*. Energy Policy. 35(1).

[98] See: https://www.weforum.org/agenda/2017/09/the-money-is-there-to-fight-climate-change

innovation policy may not create quantifiable results for years and may only produce outcomes based on the small effects of the projects. As a result, there is the lack of empirical evidence on the impact of policy on low-carbon energy technology innovation, and even on innovation in general, which is something really hard to measure. Given the enormous promise of low-carbon innovation, however, these issues are too important for the world development to set aside. Aligning investment with the SDGs, considering the objectives of fostering sustainable and resilient infrastructures, need policies and regulatory frameworks that incentivize changes in investment patterns. Muliaman D. Hadad, the Chairman of Indonesia Financial Services Authority has said that the sustainable finance program should not be implemented just for rising financial resources but also to improve resilience and competitiveness of financial institutions. Sustainable finance is a new challenge as well as the occasion for financial institutions to take benefits by growing and developing more stably[99].

2.1.1 The financial background

Financial experts have always suggested to take a long-term view to their customers when they were investing their money. This is because markets have always been subject to fluctuations and other variables.[100] Although this suggestion, some investors believe that there are some factors that would significantly impacts on the value of their investments. Those factors might be so huge to compromise the way businesses succeed. Climate change is one such risk. Globalization has maybe seen the most advancement in finance, where the liberalization of capital markets and short-term capital flows has been fostered since the 1980s, mainly by the International Monetary Fund (IMF) and the World

[99] UNEP. (2015). *The financial system we need. Aligning the financial system with sustainable development.* The UNEP Inquiry Report. October 2015.

[100] See: https://www.telegraph.co.uk/sponsored/finance/investments/climate-environment/11799182/how-climate-change-affects-investments.html

Bank. Most innovations have been originated in developed countries, and when financial markets have become more integrated globally, their spread incurred.

Concerning innovation, the first thing that comes into mind is "change", most of the times being positive concept, however in some circumstances, leading to negative consequences[101]. According to this, even if globalization has carried many benefits, it has also significantly augmented the exposure of domestic economies to shocks from external causes. Overall considered, things have changed and the instability of capital flows, global macroeconomic disparities and several financial crisis have underlined both large risks and very unsure earnings of financial globalization for development. IMF in particular has adopted a new recognized system of capital control that underline the risks linked to rapid capital inflows and outflows and has started to consider capital flow management measures under specific situation[102]. The international economic system must take the primary role in safeguarding global financial stability. By improving international financial regulation, it has aimed to reduce capital flow volatility and to foster the provision of urgent financing in response to external shocks.

2.1.2 The concept of financialization

The term financialization has identified the increasing role of financial effects, actors, markets and institutions in the economy. This idea has been confirmed with the increase in profits of financial institutions relative to non-financial companies[103]. In the 1970s, the concept of financialization has spread

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[101] Armagan Onder Henguner. (2015). Financial innovations in developing countries: the case of Turkey.

[102] International Monetary Fund. (2012). The liberalization and management of capital flows: an institutional view. Staff paper. Washington, D.C. 14 November.

[103] Epstein, Gerald. (2005). Introduction: financialization and the world economy. In Financialization and the World Economy, Gerald Epstein, ed. Cheltenham, United Kingdom: Edward Elgar.

thanks to financial interests that have led profitable investments in the context of slowing economies.

The authors Franklin Allen and Douglas Gale in their book wrote that "macroeconomic and sector-specific shock typically cannot be hedge"[104]. With the growth of the financial community itself, a revolution has taken place. Financial markets have seen a revolution through the introduction of sophisticated financial instruments which lead to the generation of benefits that can be shared with the rest of the economy. However, it must be remembered that, even if after this revolution potential risks are better shared in the system, every economy deals with risk in a different way. According to this, two definitions must be kept in mind: the first one is that activities are considered financial if they provide chances to individuals and firms. The second one is that risk sharing has always been considered as playing the central role in the allocation of economic issues.

The theory of financial innovation deals with the provision of opportunities for risk sharing or intertemporal smoothing, and, for the economist, it is normal not only to demand how innovation can emerge but also if the market is undertaking the right procedures for offering the institutions and instruments necessary[105].

2.1.3 Defining financial innovation

The definition of financial innovation has been derived from real sector innovation. On one hand, product innovation can be expressed as the introduction of a new product, or a significant qualitative change in an existing product. On the other hand, process innovation is defined as the introduction of a new process for making or delivering goods and services. Both types of

[104] Franklin Allen and Douglas Gale. (1994). *Financial innovation and risk sharing.*
[105] Franklin Allen and Douglas Gale. (1994). Ibid.

innovative mechanism should give higher returns values to the economy[106]. In defining financial innovations, Boot and Thakor (1997) have emphasized that financial innovation should be thought as a way for improving risk sharing providing tax advantages, in addition to information sensitivity[107]. Tufano (2003), has defined financial innovation as the act of creating and then popularizing new financial instruments as well as new financial technologies, institutions and markets[108]. Frame and White (2004), have explained one of the most used definition of financial innovation present in literature, they have defined it such as something that decreases costs, reduces risks, or offers a higher level product/service/instrument that might satisfy participants' demand in a better way[109]. Lerner and Tufano (2011) have expressed the idea that when financial innovation has been predominant in the system, there were much newer alternative for investments and consumption as well as other benefits deriving from cost reductions in collecting funds[110]. Finally, one of the most recent definition of financial innovations, according to the World Bank, is that of "having great potential for building social and climate resilience"[111].

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[106] Greenhalgh, C. and Rogers, M. (2012). Trade Marks and Performance in Services and Manufacturing Firms: Evidence of Schumpeterian Competition through Innovation. The Australian Economic Review

[107] Arnold W. A. Boot; Anjan V. Thakor. *Financial System Architecture.* The Review of Financial Studies, Vol. 10, No. 3. (Autumn, 1997), pp. 693-733.

[108] Tufano, P. (2003) Financial Innovation, Handbook of the Economics of Finance, 1, 307-335

[109] Frame, W.S., White, L.J. (2004) Empirical Studies of Financial Innovation: Lots of Talk, Little Action?. Journal of Economic Literature, Vol.42, No.1, pp. 116-144

[110] Lerner, J., Tufano, P. (2011) The Consequences of Financial Innovation: A Counterfactual Research Agenda, NBER Working Paper Series No: 16780

[111] World Bank (2012), 'Financial innovations for social and climate resilience: Establishing an evidence base' Social Resilience & Climate Change study, World Bank Publication

2.1.4 Financial Innovation in the 1970s and 1980s

The purpose of this excursus is not to understand why there were so many innovations in the last two decades, but to try to comprehend which is the factor that has determined this change considering that, for thousands of years, markets have advanced at a slower pace. It's not important to focus on a single episode of innovation in one specific segment of the economy, whereas it is useful to understand the innovative progress in general. Another consideration that must be made is the fact that researchers often concentrate their efforts in the analysis determining whether the innovation process is efficient or inefficient with respect to the innovation itself.

Flood (1992) has affirmed that the basic economic behavior of profit seeking is the main reason behind financial innovations. The probability of new profits generates the right motivation for innovating and it can be reached, for example, reducing costs through technological improvements. Miller in the 1980s has said that the existence of limited profitable transactions and interest rate cap has fostered financial firms to innovate. One of the most discussed reasons behind the need of financial innovation in the literature is government regulation. Another well recognized reason for innovating finance is to try to avoid risks. Indeed, it is probable that people would look for flexible chances for managing their risk. As Levich (1988) has affirmed, financial innovations (such as currency and interest rate swaps and options) have been created to manage risks (e.g., currency, maturity, credit, interest rate, default, etc.) more precisely[112].

Overall considered, the reasons behind the existence of financial innovations can be summarized in:

(1) more profitable opportunities,

(2) regulatory and firm-based constraints,

(3) hedging and diversifying risks

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[112] Levich, R. M., Corrigan, E. G., Sanford Jr, C. S., Vojta, G. J. (1988). *Financial innovations in international financial markets*. The United States in the World Economy (pp. 215-277). University of Chicago Press.

(4) and more generally, technological advancement[113].

Furthermore, the model proposed by Laeven et al. in 2015 have underlined the idea that financial innovation is determinant for sustainable economic growth and if financial actors would decide to stop to innovate, the growth cycle would be more inclined to stop[114].

2.2 Innovation types and actors

Innovation is inevitable, and it is an essential condition to expand the production of goods and services both in the industry and the financial markets in the 21st century. One evidence that has emerged is the fact that there are different types of innovations, different types of innovators and different reasons for innovation. Governments, corporations, banks and other intermediaries and exchanges are only some examples of innovators. Dealing with the reasons, they can be stimulated by the desire to make markets more efficient and complete and to hedge some risks that in the past were out of control. Index funds, financial futures and swaps are examples of innovations that have cut the transaction costs of doing what could previously be done in the market at higher costs. Other instruments have divided up streams of existing securities such as bond strips or different classes of shares. Recent innovation relates to the securitization of loans for residential energy efficiency projects. This is particularly useful especially for those people that don't have access to capital markets. Banks have indeed started to look into green loans for their clients.

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[113] Van Horne, J. (1985). *Of Financial Innovations and Excesses.* The Journal of Finance, Vol. XL, No.3, pp. 621-63

White, L.J. (2000). *Technological change, financial innovation, and financial regulation in the US: The challenges for public policy*. Performance of Financial Institutions: Efficiency, Innovation, Regulation, pp. 388-415

Tufano, P. (2003). Ibid.

[114] Laeven, L., Levine, R., Michalapoulos, S. (2015). *Financial Innovation and Endogenous Growth*. Journal of Financial Intermediation, 24, pp. 1-24

In 2015, Citi (the American multinational investment bank and financial services corporation) initiated the use of term asset-backed securities for energy efficiency. They created a new class of securities backed by unsecured installment loans to finance energy efficiency and water saving developments; the same approach has been used for distributed solar panel projects. According to Valerie Smith, the director and global head of corporate sustainability of Citi, the bank through his intervention as an intermediary for supporting funds in renewable energy projects and provide savings for energy customers, in 2016 has invested approximately $288 billion in clean energy[115].

Although financial innovations concept should be linked to a broad list of new product or process, most of the time these new instruments have emerged after the 1980s (such as the securitized assets). These financial products are still belonging exclusively to finance professionals, avoiding the interaction with other economic agents. This might be because of the successive technological development and the financial liberalization. Innovations are often led by different types of innovators according to their needs and their incentive to innovate. Moreover, it must be remembered that not always innovations are efficient since costs are not always embraced and benefits not acquired. Another problem is linked to the concept of free-rider from the moment that there are difficulties of "patenting" and the ease of "reverse engineering". Finally, it should be highlighted that since information is costly, information is often critical to the success of innovations. It indeed may happen that without information the product would not have been used or it would be used sub optimally.

However, thanks to progress made in communication and computer technologies, these new financial instruments have facilitated the extension of access to credit, reduces or transferred risks, increased efficiency, enhanced profitability and stimulated financial development and growth, especially in developing countries. The recent objective of financial innovation is to permit

[115] Valerie Smith. (2017). The money is there to fight climate change. World Economic Forum.

global savings to be allocated to their most remunerative use, and maybe to furnish developing countries the possibility to access to those markets and to adapt innovations in their economies.

2.3 Financial innovation in developing countries

The growing influence of emerging economies in international financial affairs has been the initial link between financial market development and national development priorities. The lack of access to finance for individuals and businesses in many countries can foster improvements in financial systems to meet long-term investment needs[116]. There are several reasons behind the necessity to foster innovation in finance in developing countries.

First, it can be said that policy changes (e.g. deregulation in line with liberalization) may augment profitable possibilities in the domestic economy. Second, the spread of foreign financial institutions (e.g. establishment of foreign banks in developing countries and foreign equity holders in domestic markets) has increased the possibility of meeting new innovative products or processes[117]. The existence of foreign banks in this integrated market structure had a critical role. Krozsner (1998) has written that the increasement in foreign bank diffusion in emergent markets can generate a good mechanism in those foreign banks that used to be less politically connected and less propense to corrupt the regulatory authorities[118]. Beginning from 1990s, deregulation, privatization and technological advances have attracted investors in developed countries to invest in emerging markets through portfolio flows, and in an integrated financial

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[116] World Bank. (2014). Global Financial Development Report 2014: Financial Inclusion. Washington, D.C.

[117] Armagan Onder Herguner. (2015). Financial innovation in developing countries: The case of Turkey. The Graduate school of social sciences of Middle East Technical University. Department of economics.

[118] Kroszner R. (1998). On the political economy of banking and financial regulatory reform in emerging markets. Booth School of Business. University of Chicago. (NBER).

structure, this was only possible through financial innovations[119]. Emerging markets are those that need the majority of funds and should use innovative products or apply innovative processes in order to attract additional investment flows. Therefore, the direction of diffusion of financial innovations has typically been from developed to developing countries.

In relation to the change in these circumstances, developing countries have also attracted most of new financial intermediation techniques from developed countries by direct diffusion of products and processes, and also by learning by doing from them. In this sense, financial innovation can be considered as a series of possible answers to problems and opportunities presented in diverse circumstances[120]. Its application might have been implemented in different ways with respect to other counterparts[121].

There are many reasons that stand behind the necessity of financial innovations in developing countries. One possible reason is the fact that in emerging countries, the banking sector and security exchanges are not as mature and well-built as in industrialized ones. Moreover, financial markets in developed countries are more subjected to market domination, while in developing countries markets are more government-oriented. Regulation has always had more influence on the decision-making process in emerging countries and this has created more difficulties in the implementation of financial innovation[122]. The need of financial innovations has resulted in different ways also depending on the speed of financial liberalization (the degree of integration into the global financial markets) and this has happened in particular because of different preexisting institutions. Furthermore, emerging markets have imported financial innovations from advanced economies because they are the most tackle by climate change.

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[119] Schmukler, S. L. (2004). Financial globalization: gain and pain for developing countries. Federal Reserve Bank of Atlanta Economic Review, 89(2), 39-66

[120] Armagan Onder Herguner. (2015). Ibid.

[121] Armagan Onder Herguner. (2015). Ibid.

[122] Armagan Onder Herguner. (2015). Ibid.

2.3.1 Developing countries suffer the most for climate change

The International Monetary Fund has called on developed nations to take serious measures to help climate-vulnerable developing countries better handle the impacts of climate change. These measures include start to finance infrastructure projects and other instruments to share risk through financial markets. The IMF's latest World Economic Outlook report has advised that the economies of developing countries are facing accelerating climate threats. Increasing temperatures have uneven macroeconomic effects, causing grave consequences especially in those countries with relatively hot climates, such as most low-income countries. The Burke, Hsiang, and Miguel (2015) findings have suggested that a rise in temperature would be particularly harmful for economies located in those regions of the planet[123].

It has also been demonstrated through new statistical analysis, that projected climate change would increase weather-related disaster with consequently creation of great damages. This is particularly true especially for low-income developing states which were historically more likely to be subjected to natural disasters with respect to developed countries. Low-income developing countries have contributed in a negligible way to atmospheric greenhouse gas concentrations, both in absolute terms and on a per capita basis[124]. They would suffer disproportionately from further temperature increases even if they have contributed little to this global threat. And within low-income countries, the poor would be those most heavily tackled by climate change[125].

Moreover, growth in developing economies is constrained more than in hot regions of advanced economies, and this corroborates the importance of

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[123] Burke, Marshall, Solomon M. Hsiang, and Edward Miguel. (2015). *Global Non-Linear Effect of Temperature on Economic Production*. Nature 527: 235–39.

[124] IMF. 2017. Chapter 3: *The effect of weather shocks on economic activity: how can low-income countries cope?.*

[125] Hallegatte, Stephane, and Julie Rozenberg. (2017). *Climate Change through a Poverty Lens*. Nature Climate Change 4: 250–56.

development in order to diminish their vulnerability. In those countries, economy is often based on agriculture and for this reason the augment in the average temperature may decrease output per capita in both short and medium term. It may also dramatically reduce the productivity of workers exposed to heat (in particular in sectors more exposed to the weather), cut investments for country development (because they become less attractive) and poorer human health. In an influential study, Dell, Jones, and Olken (2012) have discovered that higher temperatures considerably decrease economic growth in low-income countries[126].

2.3.2 International cooperation and domestic policies

Developing countries alone are not able to deal with climate change causes and consequences on their own. According to this, some domestic policies that would facilitate development, together with investment in specific adaptation strategies, could help reduce the adverse consequences of weather shocks. Nevertheless, climate change can be seen as a threat but also an opportunity for investment in developing countries[127]. The WEO report 2017[128] has also predicted that climate change would generate economic winners and losers at both individual and sectoral level but developing countries (in particular the poorer) would likelihood suffer more than developed countries from the rising in temperatures from the moment that they are situated in relatively hot climates. For this reason, international cooperation and all efforts that might stop the rise in temperatures and to limit the long-term risks of climate change would be vital to help vulnerable countries tackle climate change. The report has asked to the

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[126] Dell M., Benjamin F. Jones, and B. A. Olken. (2012). *Temperature Shocks and Economic Growth: Evidence from the Last Half Century*. American Economic Journal: Macroeconomics 4 (3): 66–95.

[127] International Monetary Fund. 2017. Seeking Sustainable Growth: Short-Term Recovery, Long-Term Challenges. Washington, DC, October.

[128] International Monetary Fund. 2017. *Ibid.*

international community to start climate action and to decrease greenhouse gas emissions before that they can cause more damage[129].

In order to achieve the transformation to a low-carbon and climate-resilient global economy the world's economy need that all countries pay attention and put efforts towards climate-friendly activities. Both public and private actors are informed about the risks and opportunities linked to climate action by discovering new ways of financing climate-resilient projects, trying to align their policy and business interests and the urgent need to scale up climate finance[130]. An evaluation of 'alternative' sources of finance have seen that often government actions have been required, together with the implementation of multilateral agreement, in order to fund climate finance[131].

Developing countries must overtake some constraints such as: high costs, limited access to credit for financing adaptive strategies, lack of sufficient information that may facilitate adaptation, limited rationality in planning for future risks and inadequate access to technology[132]. The implementation of the right policies might not be sufficient and might become particularly difficult in low-income countries, from the moment that they have huge spending needs and limited ability to mobilize the resources necessary for adaptation in a challenging economic environment[133]. Considering all these constraints, only the international community may play a key role in fostering and coordinating financial and other types of support for affected low-income countries.

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[129] https://unfccc.int/news/developing-countries-need-urgent-support-to-adapt-to-climate-change

[130] CPI. Barbara Buchner and Jane Wilkinson. Pros and cons of alternative sources of climate change financing and prospects for 'unconventional finance' (33). See: https://voxeu.org/sites/default/files/file/buchner%20and%20wilkinson.pdf

[131] CPI. Barbara Buchner and Jane Wilkinson. Ibid.

[132] Carleton and Solomon M. Hsiang. 2016. "Social and Economic Impacts of Climate." Science 353 (6304).

[133] International Monetary Fund. 2017. Chapter 3. Ibid.

International cooperation might help to suppress the man-made causes of global and limit its long-term risks consequences[134]. It is essential to understand the macroeconomic effects of weather shocks and the space for policy actions to manage them to reach stable growth in the long term. All these precautions help the implementation of the United Nations Sustainable Development Goals. The international community would support emerging markets through concessional climate finance that should mobilize the resources necessary to be resilient with climate change impacts.

In addition to financial assistance, numerous initiatives under the United Nations Framework Convention on Climate Change have encouraged the international exchange of knowledge concerning good practices in adaptation that may be incorporated into national and local plans. Countries negatively affected by climate change must enhanced their ability to smooth out shocks (that may become more frequent), invest in adaptation strategies (such as activity diversification) and in new infrastructure. In this way low-income countries might enhance their efforts and their resilience to rising temperatures and extreme weather events, trying to improve their knowledge, their skills and the implementation of clean technology. Some empirical evidences have highlighted that countries with better-regulated capital markets, higher availability of infrastructure, flexible exchange rates, and more democratic institutions would better face the impacts of temperature shocks. Moreover, adaptation strategies might diminish specific climate change effects and risks through the implementation of infrastructure projects, the adoption of the right technologies.

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[134] IPCC. (2014). Ibid.

International Monetary Fund (IMF). 2015. "Macroeconomic Developments and Prospects in Low-Income Developing Countries." Policy Paper, Washington, DC.

Stern 2015. Why Are We Waiting? e Logic, Urgency, and Promise of Tackling Climate Change. Cambridge, MA: MIT Press.

2.4 Coping with Weather Shocks: The Role of Financial Markets

Financial markets thanks to their mechanism to transfer and share risks, could also be part of the toolkit for reducing the economic damage caused by climate change. They can diminish the adverse consequences of weather shocks by transferring costs and risks of such shocks to those most willing and able to bear them[135]. Furthermore, they have different possibilities for mitigating the impacts of weather shocks, indeed they should consider the level of insurance penetration and on the ability to exactly price weather-related risks.

There are some empirical findings that show that when domestic and international financial markets are well regulated, strong democratic institutions are present, there are flexible exchange rates and several infrastructures are available, the medium-term negative consequences of increasing temperatures seem to fade. Households and firms more vulnerable to short-term fluctuations in temperature and precipitation may manage their specific weather exposure through an innovative use of insurance products, such as weather derivatives. Another financial innovation that have taken place for redirecting weather risk are catastrophe (Cat) bonds. Finally, the creation of green bonds has been seen as a good way to cope with the vast capital needs required to address climate change and for addressing longer-term macro-risk themes that consequently affect investors. The following paragraph would briefly described the main innovative financial products.

2.4.1 Insurance

Recent studies have highlighted the critical role that could play the insurance markets in facilitating economic recovery for the repercussion of weather-related natural catastrophes. The degree of penetration of insurance

[135] IMF. (2017). Chapter 3. *Ibid.*

activities may reduce the fiscal burden of natural disasters[136] and diminish their negative macroeconomic effects[137].

In the early 2000s, have been developed the first parametric insurance products. They have promised to guarantee protection from different weather-related risks to households and firms in low-income countries. Differently from traditional indemnity insurance for natural hazards, these products have offered outlays that were subject to a publicly observable index, such as rainfall or temperature. Even if their scheme has offered several advantages with respect to traditional product, they have left a significative amount of residual risk uncovered. Overcoming significant obstacles to the provision of traditional insurance to small farmers, these products have tried to abate transaction costs, they were easy to implement, and have limited potential adverse selection and moral hazard issues.

Nevertheless, insurance penetration has still remained low, especially in developing economies. Despite their advantages, the use of parametric insurance has been under expectation. It might be due to insufficient understanding of the product, high cost, and residual basis risk. Many factors have been expected to have contribute to the slow implementation of the novel financial instruments, including limited financial literacy or experience with similar financial products[138]. The analysis of climate risk linked to insurance sector will be better analyzed in chapter 4.

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[136] Lloyd's. (2012). Global Underinsurance Report. London: October 2012.

[137] Von Peter, Goetz, Sebastian V. Dahlen, and Sweta Saxena. (2012). *Unmitigated Disasters? New Evidence on the Macroeconomic Cost of Natural Catastrophes.* BIS Working Paper 394, Bank for International Settlements, Basel.

[138] Cole, Shawn, Gautam Bastian, Sangita Vyas, Carina Wendel, and Daniel Stein. (2012). *The Effectiveness of Index-Based Micro-Insurance in Helping Smallholders Manage Weather-Related Risks*. London: Evidence for Policy and Practice Information and Co-ordinating (EPPI) Centre, Social Science Research Unit, Institute of Education, University of London.

2.4.2 Catastrophe Bonds

Catastrophe (Cat) bonds can help transfer catastrophic weather risk to capital markets. Catastrophe bonds could have been defined as a high-yield bond that comprehend a provision that might cause the principal or interest payments to be delayed or lost to investors in case of a definite loss, such as a cyclone or earthquake[139]. They were first introduced by Hurricane Andrew in the mid-1990s. These bonds have paid interest or principal or both in normal times. The peculiarity was that they absorb losses if a forecasted catastrophe would happen. Catastrophe bonds have been issued by direct insurers and reinsurers to cope with a broad range of risks, comprising wind storms and earthquakes across various geographical regions (the United States, Europe, Caribbean, Japan). In recent years this mechanism has grown rapidly, achieving an exceptional volume of nearly $30 billion at the end of 2016 **(see figure 10).**

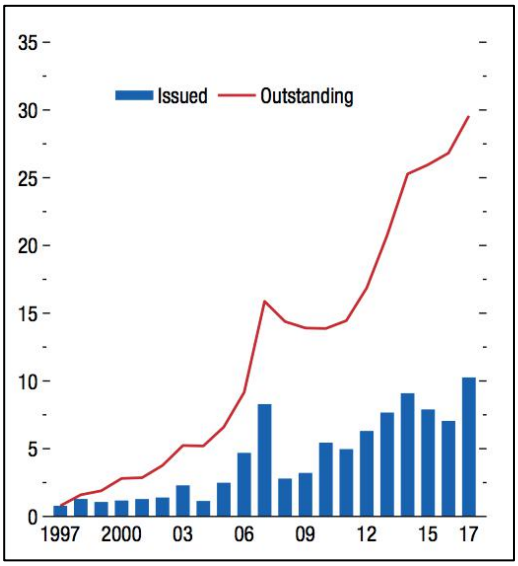

Figure 10: Catastrophe Bond Market *(Billions of US Dollars)*. Source: Artemis Insurance: Linked Securities and Catastrophe Bond Market Report (www.artemis. Bm). Note: Years ending June 30.

Investors are attracted by cat bonds since they have offered relatively high yields and low correlation with respect to the returns of most other financial

[139] OECD. Michel-Kerjan, E. et al. (2011). *Catastrophe Financing for Governments: Learning from the 2009-2012 MultiCat Program in Mexico*. OECD Working Papers on Finance, Insurance and Private Pensions, No. 9, OECD Publishing.

assets. Two main factors have probably determined the rapid growth of the Cat bond market: low-interest-rate environment (started after the global financial crisis) and new regulations that have identified in the Cat bond issuance the help of capital. In markets like Europe, Japan and United States they have been seen as a valid alternative tool to transfer risk exposures from natural disasters.

From the moment that low-income emerging countries are those most exposed to catastrophic risk, financial institutions have started to issue these types of bonds at first in order to assist them. The World Bank, for instance, in 2014 issued its first-ever Cat bond to furnish reinsurance to the Caribbean Catastrophe Risk Insurance Facility. A similar arrangement—the Extreme Climate Facility—has been implemented by the African Risk Capacity to permit the issuance of Cat bonds to reduce the impact of extreme weather conditions on member African countries.

2.4.3 Green Bonds

Green bonds are a recent market innovation designed to facilitate the collection of capital for projects and companies whose actions have a positive environmental impact. The final goal is to help to mitigate the long-term negative impact of climate change[140]. Green bonds are simple bonds with returns that are earmarked for projects with climate or other environmental benefits. Investors consider bonds as common instruments: they are mainly refinancing instruments, used for planned or finalized projects. They permit to equity investors and banks to take capital from current assets and reinvest them into new (green) projects[141]. Nevertheless, they can now be seen as an effective investment tool to finance the transition to a low-carbon economy.

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[140] Julia Kochetygova, Anadi Jauhari, CAIA. (2014). Climate change, green bonds and index investing: the new frontier. S&P Dow Jones Indices. August 2014.

[141] See: http://www.climatebonds.net/les/les/CBI%20State%20of%20the%20Market%202016%20A4.pdf.

According to the Climate Bond Initiative (CBI), a non-profit organization, "*the green bonds era has begun and its goal to mobilize bond markets as a low-cost financing tool would be essential for the realization of a low-carbon and climate-resilient economy*[142]." The first recognized as "green bond" has been issued by the European Investment Bank in 2007 to finance its climate-related projects which was listed on the Luxembourg Stock Exchange (LuxSE). A major turning point was in 2013 when the first sizeable corporate green bonds were issued by Électricité De France and Bank of America. Since its inception, the green bond market has grown rapidly at a 50%+ compound annual growth rate (CAGR), and it has continued to expand significantly in terms of scope, average issue size and issuer diversity **(see figure 11).**

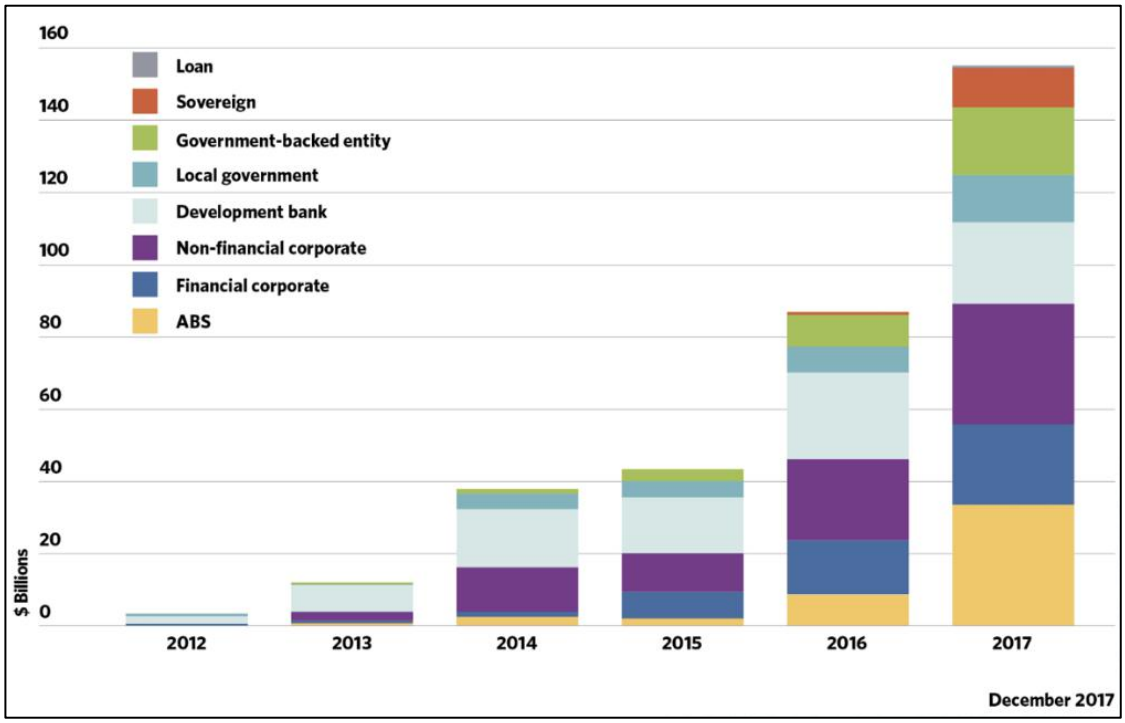

Figure 11: Green-bonds issued in $billions. Source: CBI/SEB

In 2015, labelled green bonds issuance amounted in total nearly to US$42 billion, up from US$37 billion in the 2014. In 2017, new green-bond issuance grew by 78 percent with respect to 2016, and has reached a total of more than $155

[142] Julia Kochetygova, Anadi Jauhari, CAIA. (2014). Ibid.

billion worldwide. According to the Climate Bonds Initiative, that number is projected to get close to $250 billion in 2018.

Since its origins, the green bonds market has seen the prevalence of Development Banks (or DFIs including but not limited to MDBs), however the variety of the issuer base is constantly increasing. Indeed, the development banks have been the first innovators of the concept of the labelled green bond.

Largest issuers to date	Amount	Issuer type	Country
EIB	$22.6bn	Development Bank	Supranational
KfW	$12.8bn	Development Bank	Supranational
World Bank	$10.6bn	Development Bank	Supranational
SPD Bank	$7.6bn	Commercial Bank	China
Republic of France	$7.6bn	Sovereign	France
Iberdrola	$5.6bn	Corporate	Spain
TenneT Holdings	$5.5bn	Corporate	Netherlands
EDF	$5.3bn	Corporate	France
IFC	$5.3bn	Development Bank	Supranational
Engie	$5.1bn	Corporate	France

Figure 12: Source: Bonds and climate change, the state of the market 2017

The strong credit-worthiness of development banks has supported the market in order to satisfy the request for AAA-rated green bonds, even if their share issuance was decreasing. The types of issuers every year has become more diversified, but the corporate green bond system has remained with the majority of the issuers belonging to the financial, energy and real estate sectors[143].

2.4.3.1 Green Bonds definition and structure

Even if the first green bond has been issued more than ten years ago, there is still no globally accepted definition on which are the characteristics that allow a bond to be defined "green" or which shades of green meet the threshold. There are no public rules about green bond issuance and the market is not standardized. However, in 2014 a consortium of investment banks developed the voluntary Green Bond Principles to foster disclosure, transparency and integrity

[143] Buhr,B. (2016). *Green Bonds 2015 Review*. Societe Generale Credit Asset Research.

in the development of the green bond market. According to current GBP guidelines, if the issuer uses the proceeds uniquely for capital expenditures associated with green or climate-related environmental benefits, a bond issue is green, moreover considering certain disclosures and transparent "policing" standards[144].

Green bonds market growth has determined the necessity of more transparency, they need to be highly monitored and record of performances must be tracked. In order to increase transparency and credibility, the International Capital Markets Association has started supervising the Green Bond Principles (GBP) that represent a guidance for issuers, investors and underwriters. In June 2016, Green Bond Principles have been updated, including new definitions and guidance on external reviews, references to a wider universe of environmental and climate-themed bonds and suggesting the adoption of GBP best practices. They give huge help by giving information about evaluation of environmental impacts, the methodology for standardized disclosure and simplifying transactions. A group of working technicians inside the Climate Bonds Initiative, has developed the Climate Bonds Standard trying to identify technical criteria to delineate projects and assets that can be seen as "green" and in this way qualifying them for green bond financing. Standard definitions are still not well explained so, in order to reassure investors over the coherence of the green bond evaluation procedure, almost 60% of issuers to date have used an autonomous analysis or listened a second opinion on the "greenness" of the bond.

Green bond market is growing its presence inside financial markets and this increases the necessity of clear rules coming from rating agencies and institutional investors. China and India have indeed already published green bond guidelines in order to furnish some certainties and boost their green bond markets. China's green bonds market is expected to grow to US$230 billion

[144] Julia Kochetygova, Anadi Jauhari, CAIA. (2014). Ibid.

within the next five years[145], but green financing in general will need to expand even faster to support China's ambitions.

Furthermore, dealing with the transparency that investors could expect from Chinese green bond issuers, it must be considered how Chinese companies poorly make disclosures on Environmental, Social and Governance (ESG) issues with respect to Western companies[146]. Running in the opposite direction, the Oslo Securities Exchange has created the first separate green bond listing in 2015, and one year before, a number of green bond indices have been created by typical providers. These actions together might help to increase investor's confidence, however it is clear that governments should agree on common standards.

2.4.3.2 Green Bonds function

Green bonds must be seen as an instrument to boost liquidity in financial markets and facilitate the procurement of capital for low-carbon transition. In many cases green bonds can give a smarter solution with respect to shorter-term bank loans when there is the intention to finance low-carbon and climate resilient projects, in particular especially in high-interest rate contexts. Different typologies of thematic bonds are growing in the financial panorama. Green bonds, sustainability bonds and social bonds are whose use toward environmental and social initiatives. In France and Poland governments have started to use sovereign green bonds in order to foster funding climate mitigation and adaptation projects and to be compliant with the targets that they have determined for themselves in the Paris Agreement[147].

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[145] Bloomberg News. (2016). China's $230 billion green bond thirst to super charge market.

[146] See: https://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/perspectives/perspectives-i1c2

[147] See: https://www.weforum.org/agenda/2017/09/the-money-is-there-to-fight-climate-change/

Initially the green bonds market was a supranational- and sovereign-dominated issuer market including issuers such as the World Bank, the European Investment Bank (EIB) and the International Finance Corporation (IFC). However, it has slowly become a broad global market that now includes corporate bonds, asset-backed securities (ABS), project and infrastructure assets, as well as subnational and municipal issuers (regional and city governments).

Figure 12 describes the 2014 segmentation of the market by issuer type, green attribute (labeled or unlabeled) and credit quality.

Type	Green Attributes	Credit Quality	Definition
Sovereigns, quasi-sovereigns	Labeled	High investment-grade	Bonds issued by country governments or entities that are fully owned by governments, e.g., KEXIM, EDC, KfW
Supranationals	Labeled	High investment-grade	Bonds issued by multilateral development banks and other international organizations, e.g., IFC, EIB, IBRD, Africa Development Bank
Subnationals including regional, state, municipalities and city governments	Labeled	Investment-grade	Bonds issued by regional, local or cities, e.g., Johannesburg, Massachusetts, Gothenburg
Corporates	Labeled	Investment-grade/ Subinvestment-grade	Bonds issued by corporates, including banks, e.g., Bank of America, GdF Suez, Arise, Unibail Radamco, EdF
Asset-backed securities (ABS)	Labeled	Low investment-grade	Asset-backed securities whose cashflows come from a portfolio of loans, receivables leases or PPAs, which are indirectly associated with renewable energy and energy efficiency projects e.g., Toyota ABS
Asset-backed securities (ABS)	Unlabeled	Low investment-grade	Asset-backed securities whose cashflows come from a portfolio of loans, receivables leases or PPAs, which are associated with renewable energy and energy efficiency projects, e.g., Hannon Armstrong, SolarCity
Project bonds/loans	Unlabeled	Low investment-grade/ Subinvestment-grade	Cashflows to repay come from specific assets created by the green bond proceeds, e.g., Topaz Solar Farms, Breeze, CSolar
Corporate – pure play green or renewable	Unlabeled	Low investment-grade/ Subinvestment-grade	Corporates with portfolio of renewable energy and energy efficiency, assets issuing debt at the corporate level, e.g., Terraform

Figure 13: Current green bonds market segmentation. Source: InfraCredit and S&P Dow Jones Indices LLC. Data as of July 31, 2014. Charts and tables are provided for illustrative purposes.

The Climate Bonds Initiative has estimated that the green bond market could raise $1 trillion per year by 2020. On one hand, in order to be able to satisfy this growth there is the necessity to ask for a more diverse array of issuers coming from both the public and the private sector. On the other hand, the diversity of issuers with varying funding needs and the stable growth of the green bond market, has the potential to attract both traditional and ESG mandate-driven

fixed income investors. For this reason, it is extremely important to increase the incentives that can stimulate investments coming from private funds.

At its core, the green bond concept is a market innovation in the sense that it allows efficient capital intermediation between investors and green or climate-related projects. On one side the majority of green bonds have been linked to climate change mitigation projects. **Figure 13** shows that the most common reasons for issuing green bonds were for Alternative Energy projects or for Energy Efficiency implementation. On the other side, those targeted to Climate Adaptation projects were issued almost exclusively by governments.

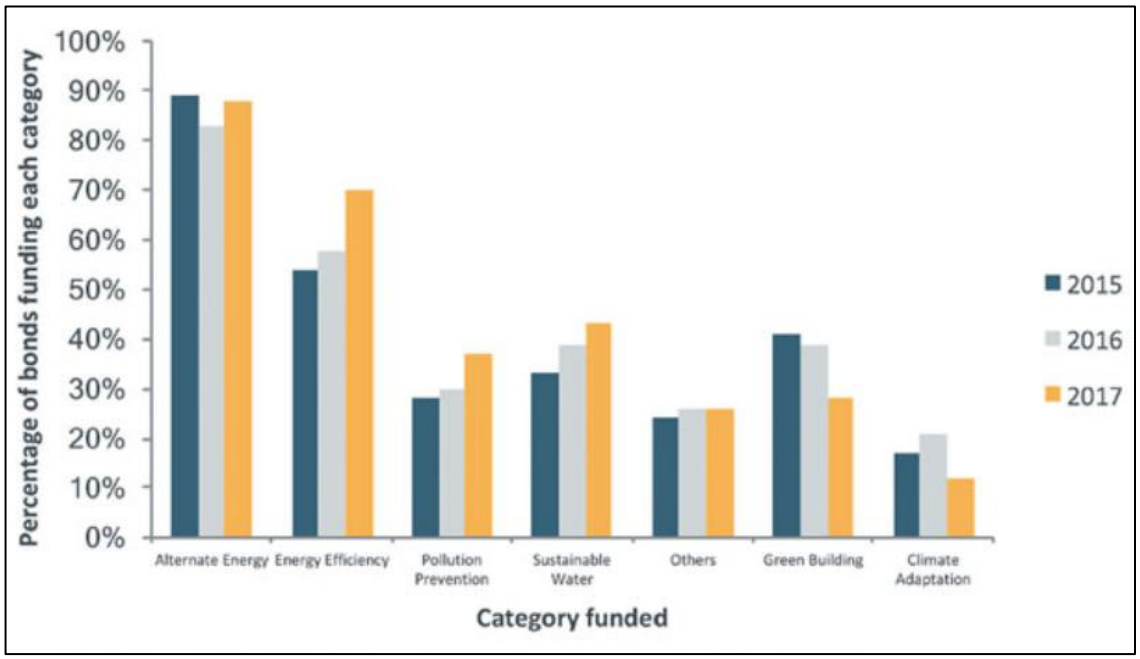

Figure 14: Estimated allocation of green bond proceeds. Source: Bloomberg Barclays MSCI Global Green Bond Index, MSCI ESG Research, as of 12/31/2015, 12/30/2016, 11/30/2017. Percentages exceed 100% as certain bonds may finance multiple categories.

2.5 Motivation behind financial innovation

The need for large amounts of capital to address climate change corresponds to the rising in investor awareness of, and sensitivity to, climate change issues and their potential impact on institutional portfolios. Investors consider the following key appeal for investing for instance in green bonds: they

want to make investments with an environmental impact, to be at forefront of climate finance, to send signal to stakeholders of their commitment to responsible investment, to align their investing activities with their own principles. The increasing awareness of climate change by investors and the public can be the precondition of the exceptional green bond market growth. Moreover, it is the signal of a number of converging trends: the perception that capital markets can offer solutions to meet the vast capital needs for climate-sensitive infrastructure and the idea that investors can meet environmental and sustainability mandates without compromising returns through the use of fixed income instruments[148]. Finally, there are several empirical evidences that demonstrate that shifting businesses toward low emission and climate resilient growth might provide the next phase of market innovation.

Concerning green bond market expansion, Yves Perrier, the Amundi CEO has said: *"Issuing a green bond is also a way for issuers to better communicate on their strategy with respect to climate change adaptation and mitigation. By combining these two aspects green bonds can be considered as one of the key instruments to mobilize capital markets to support sustainable development[149]."*

[148] Julia Kochetygova, Anadi Jauhari, CAIA. (2014). Ibid.

[149] See:
https://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/perspectives/perspectives-i1c2

CHAPTER 3

INNOVATION IN CLIMATE FINANCE

"*Climate change threatens development progresses made in water, agriculture, energy, and infrastructure around the world*", said Lord Bourne of Aberystwyth, Parliamentary Under Secretary of State, Department of Energy and Climate Change, UK, and Lab Principal[150]. The creation of new instruments is determinant for helping communities to have the resources necessary for today development needs and in the future. New instruments or organizations like The Lab provide the initial support for solutions that might move the system toward new sectors and opportunities. They offer real solutions to financing challenges and help in building new markets, attracting new investors, and unlocking billions of dollars in new climate-friendly investments in developing countries[151]. The main goal of these institutions is to find investment opportunities with a focus on improving energy efficiency, water consumption, land use, insurance and adaptation.

3.1 The Climate Policy Initiative

The Climate Policy Initiative is the major authority on tracking and studying climate finance movements. It works to improve the most important energy and land use practices around the world. It engages analysts trying to design and facilitate the implementation of policies that would drive growth while addressing climate risk. CPI's world-class team consist of analysts and

[150] See: https://www.publicfinanceinternational.org/news/2016/06/climate-finance-pilots-launched

[151] See: https://climate-adapt.eea.europa.eu/metadata/organisations/global-innovation-lab-for-climate-finance

advisors who work to develop energy and land use policies around the world, with a particular focus on finance. CPI gives the major part of its work to finance, financial institutions, and to comprehend what are the accessibility, costs, and risks associated with finance. It analyzes how public and private interests can fit with the goal of achieving low-emissions development. The CPI team try to understand different investor groups requests to suggest businesses how they should react to policy. It also supports international financial institutions and governments with their experience on expenditure through the analysis of international climate finance flows and specific investments[152]. It helps decision makers to answer ongoing questions through the in-depth analysis of analysts on what runs and what does not.

Another task is helping nations (especially low developed countries) to raise their economies by managing in a better way scarce resources and climate risk[153]. It has mainly four goals which are:

1- To reform energy markets for the low-carbon future
2- To employ finance as catalyst
3- To smooth energy transitions by addressing issues around assets whose value will be "stranded" in low-carbon world
4- To develop new models of growth for emerging markets.

The principal idea behind all these scopes is to generate a network that would build a system of climate finance that follows the suggestions written in the Paris Agreement.

The CPI's Global Landscape of Climate Finance can be seen as a benchmark for information about how financial resources are flowing from actors and sources to low-carbon and climate resilient activities. The CPI analysis helps governments identifying and tracking expenses deriving from climate

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[152] McNicoll, L. and R. Jachnik. (2017). *The "Investor Perspective" for estimating publicly-mobilised private finance for climate action: methodological proposal and case studies*. Working document prepared for the Research Collaborative on Tracking Private Climate Finance, Available at: https://www.oecd.org/env/researchcollaborative.

[153] See: http://www.thinktankmap.org/ThinkTankDetails.aspx?ID=149

change challenges. In this way they can enhance countries' ability to plan and better manage spending at the national and local levels and rearrange finance to regions where it may be more significant. The main reason for tracking climate finance is to support policies' design and implementation and to verify if financial instruments are achieving climate and growth goals successfully. CPI has developed assessment on the significance of projects and has determined if investment portfolios, financial instruments and support policies are effective. Moreover, its supports in developing new and innovative financial instruments would foster real investments in projects more inclined to resilient economy.
"*CPI is involved in implementing its approach to other countries around the world to support others to reach the climate and growth goals explained in the Sustainable Development Goals and the Paris Agreement*", said Barbara Buchner, Senior Director of Climate Policy Initiative[154].

3.2 The Lab: Driving sustainable investment

The Lab is an international initiative that help identify and address new climate finance instruments. The concept was born thanks to a public–private initiative that has started in the United Kingdom, the United States, and Germany. The founding visionaries of the lab have thought to find a solution for the lack of innovative instruments and attract more private capital. This is particularly true in the case of developing countries, from the moment that it is often hard for them to attract private investment at the scale needed to reach their sustainable development and energy access objective. The result was The Lab, which has been launched in September 2014. Moreover, it was thanks to other donor countries' help like Denmark, France, Japan, the Netherlands and Norway that it has been founded. "*The creation of The Lab has been based on a combination of*

[154] Barbara Buchner. (2016). *Innovative climate finance: a spotlight on India*. Climate Action Program. 28 November 2016.

factors[155]", said Barbara Buchner. The Rockefeller Foundation and Bloomberg Philanthropies indeed has also provided financial support. The Climate Policy Initiative operated as secretariat of the lab and it managed the application phase and the reporting and governance system.

The lab facilitates the process of completing concepts, demand funds from public and private sources and increasing the financial instruments to ensure they can deliver on commitments[156]. It is well recognized that collaborative efforts are needed in order to scale funding opportunities.

On one hand, bonds market is considered as the market that in most cases finances the "low hanging fruit" of climate finance such as energy efficiency programs and that in some way tried and tested technologies. On the other hand, implementing the National Determined Contributions (NDCs) is one goal at the heart of the Paris Agreement which requires funds that reach "higher hanging fruit". NDCs represent efforts that each country has to do in order to reduce national emissions and adapt to the impacts of climate change. In Article 4, paragraph 2 of the Paris Agreement it is written that each Party must prepare, communicate and maintain future nationally determined contributions that it wants to realize[157].

Therefore, one possible response to achieve this goal is the Global Innovation Lab for Climate Finance. Indeed, it is trying to accelerate innovation in order to solve these worldwide problems. In just two years in which it was fully operational, it has recognized, improved and strengthened climate finance instruments that have collected around USD 600 million for renewable energy, energy efficiency and land use plans in developing countries.

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[155] See: https://www.cleanenergyfinanceforum.com/2016/07/05/global-innovation-lab-for-climate-finance-incubates-programs

[156] Iliana Lazarova. 2016. *Ibid.*

[157] UNFCCC. (2015). *Article 4. Ibid.*

3.2.1 The Lab Goals

The Lab focuses on achieving three key outcomes:

- **Public-private dialogue:** in the sense that it aims to strength collaboration between the public and private sectors building aptitude and knowledge with the objective to identify and develop successful climate finance solutions;
- **Innovation & Transformative Solutions**: creating innovative, actionable, catalytic and financially sustainable solutions that might reduce risks and barriers to investment in sustainable development;
- **Mobilizing finance**: meaning that catalytic finance from Lab members, and the broader network, allows the design of pilot projects and the application of revolutionary solutions.

Nowadays, it aims to drive billions of dollars of private investment into climate change mitigation and adaptation projects in developing countries[158]. According to Barbara Buchner, at the Head of the Lab Secretariat ,the Lab goal is to reach a broad diversity of stakeholders. Indeed, the application is open to everyone: research organizations, academic institutions, financial intermediaries and private companies. There isn't the same number of projects in either mitigation and adaptation scope, although experts know where the barriers to green investment rely and thus, they work to find a balance between the two.

The Lab goal would like to foster private sector financing through well-designed financial instruments that layer in public funding so as to diminish risks and increase financial returns to levels where they become suitable for mainstream finance. Moreover, another objective is concerning acceleration in the sense that it aims to facilitate the path from talk to action by generating instruments that offer concrete solutions to financing problems faced in real projects in developing countries. These initiatives must also be replicable, so they can help establish new markets and attract new investors and build to the billions

[158] Padraig Oliver, Federico Mazza, and David Wang. (2016). *Water Financing Facility. Lab instrument analysis*. Global Innovation Lab for Climate Finance.

that are needed."[159]. The Lab crowdsources ideas on innovative solutions and offers its help to those projects that have passed the hard selection.

3.2.2 The Lab criteria

Concerning the screening phase, Buchner has said that there are four criteria that need to be met in order to pass the selection:

- Actionable: projects must be launch in a few years. An instrument is actionable when it recognizes (1) the type of the entity(ies) that could realize it, (2) the pathway towards the realization, considering the timeframe, activities and key steps, and (3) potential problems to set up and start the pilot and linked to management strategies.
- Innovative: new or heightened financial tools should be concrete and have direct implication. An instrument is innovative when it shows the faculty to address, directly or indirectly, difficulties to private climate finance that (1) have not already been solved or (2) that will be addressed in an improved manner compared to other instruments in the market.
- Catalytic: projects must facilitate private investment. An instrument is catalytic when it proved the ability to (1) mobilize private climate capital within a sizeable market, (2) be scaled up or applicable in different contexts and, (3) reach socioeconomic, development and environmental impacts.
- Financially sustainable: the idea must have certain influence and be simply imitable. An instrument is financially sustainable when it identifies a strategy to (1) withdraw public financial support, thereby realizing market feasibility, and (2) overcome potential problems to achieve the already planned goals.

The Lab has a 12 months cycle divided in three phases in which in the first part there is the selection of the projects according to those four criteria. The

[159] See: http://ndci.global/innovating-in-climate-finance/

second part represents the instrument design phase in which experts discussed about the development of the stages. Part three consists in the supporting phase of the pilot development, it focuses on the definition of target markets, the recruitment of human resources and the establishment of governance structure. At the end of the last phase, the project is expected to be ready for receiving strategic support, to have clear objectives, target markets and active sponsors.

3.2.3 The Lab projects for mitigating climate impacts

New engineering solutions have been implemented to increase the spread of new financial instruments that should unlock private investment for climate-resilient and low-carbon growth in developing countries. Improving efficiency in energy area is one factor that may have critical impact leverage. There are two financial vehicles in this area supported by the lab that have the goal to mitigate climate impacts[160].

The first comprehends the "**Energy savings insurance**", which is trying to protect main funds for improving efficiency by limiting investors' risk in the case of underperformance. It indeed guarantees the financial performance of the project even if the it doesn't make any energy efficiency savings. And again, concerning energy efficiency there is the "**Energy efficiency enabling initiative**", which is a recent supported project idea that would operate as a private equity fund. Considering the secretariat's analysis, a $100 million fund could generate up to 225GWh of annual savings, which may represent around 100 KT of CO2 emissions. Improvement in energy efficiency can save money for small- and medium-sized businesses (SMEs) in developing countries and at the same time they can decrease greenhouse gas emissions. The latter financial vehicle manages projects that deal with water, agriculture and infrastructure sectors. The objective is to have professionals that will try to explore innovative financial instruments not already available in climate finance structure with the purpose to unlock more private investments with respect the current situation.

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[160] Iliana Lazarova. (2016). *These forces are accelerating climate finance*. GreenBiz.

Barbara Buchner has underlined the fact that successful solution in scaling climate finance instruments are: increase awareness, furnish partnership between stakeholders and foster help from implementing organizations. According to her, the Lab's function is crucial to bring in external capital to enable that the risks and the rewards are attractive to the private sector. It aims to feed an ongoing innovation process and to renovate its approach for experts as well and in this sense, it is extremely important to be able of getting feedback from investors and other stakeholders. Even if it is too early to elaborate a system that is able to identify the impact of the endorsed projects, The Lab has the objective to continuously update and develop its impact measurement tools to create a solid and transparent reporting scheme.

3.2.4 Other Instruments

Water Financing Facility

In order to foster the disbursement of institutional capital for resilient water infrastructure, the "**Water Financing Facility**" concept has been developed. It has mobilized domestic investment into climate compatible water sector projects through the local bond market. The WFF loans are sponsored by the corporation but linked with specific water infrastructure investments that have been selected and planned to increase climate resilience and mitigation. It is well known that climate change is going to reduce water resources, especially in developing countries where poor populations are more exposed to extreme weather events. It has been estimated that in order to meet 2030 Sustainable Development Goals, annual funds corresponding to USD 114 billion need to be spent in order to guarantee minimum health levels and water supply[161].

The water sector has never been traditionally preferred by private investors because of its volatile revenues and the potential for political problems.

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[161] Hutton, G. & Varughese, M. (2016). *The Costs of Meeting the 2030 Sustainable Development Goal Targets on Drinking Water, Sanitation, and Hygiene*. Water and Sanitation Program, World Bank Group. Washington D.C.

In order to address these risks, the Facility issues investment-grade resilient water bonds to domestic institutional investors to support countries' national water and climate priorities, it prepares infrastructures that may rise the accessibility to safe and available water and at the same time it provides coherent gains for investors[162]. The sector has traditionally relied on the "three T's" of tariffs, taxes, and transfers (in the form of grants), underling political risks in the sector as wells as limiting long-term planning[163]. However, private finance is needed to fund an important portion of these investments. WFF aims to centralize knowledge, expertise and budgets, its scope is to mobilize large-scale domestic private investment from institutional investors such as pension funds and insurance companies to sustain countries' actions on adaptation and mitigation in the water sector.

In addition to the positive impacts on the costs of capital and resource mobilization for sustainable water infrastructure financing, this method simplifies numerous environmental and socially beneficial outcomes. It also augments the access to safe and affordable water, health, socio-economic development and resilience to ecosystem risks. Moreover, in order to manage the climate compatibility challenges of the water sector, the WFF have incorporated climate issues at all levels: country and project selection, project implementation, optimization, reporting and impact assessment.

Substantially, WFF will simplify the provision of long-term and low-cost loans in developing countries to public or private water utilities that have little or no access to commercial finance. The National Water Financing Facility would manage its mixed finance capital structure in order to issue local currency and investment-grade bonds to domestic institutional investors (for instance to pension funds and insurance companies). In particular, domestic pension funds

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[162] CPI. 2018. Bella Tonkonogy, Barbara Buchner and Ben Broche. *A recipe for $1 billion in sustainable investment.*

[163] OECD. (2010). *INNOVATIVE FINANCING MECHANISMS FOR THE WATER SECTOR*. Working Party on Global and Structural Policies. Organization for Economic Co-operation and Development (OECD). Paris.

and insurance companies are the primary investor class targeted in certain countries, but with the WFF also high net-worth individuals and international impact investors (that might have interest in investing in local bond markets) would also have the possibility to invest. It is important underling the fact that the target return for the bonds must be placed little bit higher than domestic long-term treasury bonds.

Agricultural Supply Chain Adaptation Facility

Another tool is the "**Agricultural Supply Chain Adaptation Facility**", it would direct private funds for agricultural supply-chain resilience, providing farmers with technical and financial support. The ASCAF works through Multilateral Development Banks that can become partner with agribusiness corporations in order to move along their supply chains and reach small and medium-sized farmers in developing countries. The Inter-American Development Bank, in partnership with Calvert Investments, has the objective to piloting The Facility in Latin America and the Caribbean through seed funding from the USD 5 million Climate-Smart Agriculture Fund for the Private Sector[164]. If the pilot project would be successful, the Facility may be scaled up and reproduced in order to reduce the agricultural shocks deriving from climate change. Moreover, they would be able to save and increase farmers' revenues.

Climate Investor One

An original approach has been applied to infrastructure advancement, it is called "**Climate Investor One**". It is an example of a mitigation facility endorsed by the Lab and covered by the NDCi.global. It is a hybrid concessionary/commercial platform that delivers funds for both project preparation and development. It aims to accelerate the deployment of renewable energy, in particular solar and hydro projects, in Africa, Asia and Latin America.

[164] See: https://www.climatefinancelab.org/project/agricultural-supply-chain-adaptation-facility/

Their approach to structuring ensures to accelerate the delivery of assets on the ground and at the same time to optimize their return on investments[165]. It works through the use of donor finance for development funds, then it combines donor finance as first loss equity with non-concessional public capital in order to de-risk a certain quantity of public-private construction fund. Finally, it offers to re-finance the facility privately in order to issue long-term senior debt to operational projects.[166]

The Oasis Platform for Catastrophe and Climate Change Risk Assessment and Adaptation

In order to provide access to well-defined and standardized analytics to increase the awareness and the management of risks in regions exposed to dangerous climate-related incidents, the Oasis Platform has been projected[167]. It is a set of tools that together aim to offer more robust and complete approach for analyzing risk from catastrophic events. Being aware of those risks is determinant for the management of natural disasters. Due to the lack of availability of high quality catastrophe risk models in developing countries, it allows the open access to data and open source to standardized analytics that permit risk assessment and reduction and promote investments in insurance. These analyses would be more deeply discussed in chapter 4 concerning climate risk. Moreover, it facilitates the fair evaluation of economic and financial losses.

3.2.5 The Lab Programs

The Lab runs on an annual cycle, which starts with a joint, international 'Call for Ideas' covering its four programs, each one with different priorities: The

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[165] See: https://www.climatefundmanagers.com/nl/

[166] See: https://www.climatefinancelab.org/wpcontent/uploads/2018/04/Lab-Impact-Report-2018.pdf

[167] See: https://climatepolicyinitiative.org/press-release/global-coalition-governments-investors-foundations-launch-four-new-financial-instruments-catalyze-billions-developing-country-climate-action/

Global Lab, two regional Labs – the India Innovation Lab for Green Finance and the Brazil Lab – and the Fire Awards.

The Global Lab looks for ideas to increase funds in mitigation and adaptation in developing countries, it indeed pays particular attention on climate resilient and sustainable urbanization projects. The India Innovation Lab focuses on green finance, together with the Global Lab. They foster ideas that leverage public or "blended" finance to facilitate huge private sector investments. In particular, the India Innovation Lab for Green Finance was launched in November 2015 and it put efforts on renewable energy, energy efficiency and sustainable transport. One of its products are the India Sustainable Energy Bonds, which are a class of bonds that should drive impact investment to sustainable energy in India by supplying debt exposure, sufficient returns and standardized impact measures. A similar initiative promoted by the India Innovation Lab is the platform "Finance for Resilience" pioneered by Bloomberg New Energy Finance and it tries to address the gap in clean energy investments. It aims to accelerate powerful, early-phase pilots and projects that can simplify the collection of funds for clean energy and green growth.

Finally, the Brazil Lab supports the implementation of changing climate finance instruments that may allow the realization of the NDCs to the Paris Agreement. All these labs are meant for incubating fresh ideas, mainly trying to fix the gap in clean energy investments.

3.2.6 The Lab Outputs

According to current data published on the Climate Finance Lab Website, two Global Lab instruments (Climate Investor One and the Oasis Platform) have recently proclaimed additional investment, making the total amount of investments that Lab have mobilized rising $ 1.15 billion since its launch in 2014. In March 2018, the Lab had reached the milestone of over $1 billion in sustainable investment.

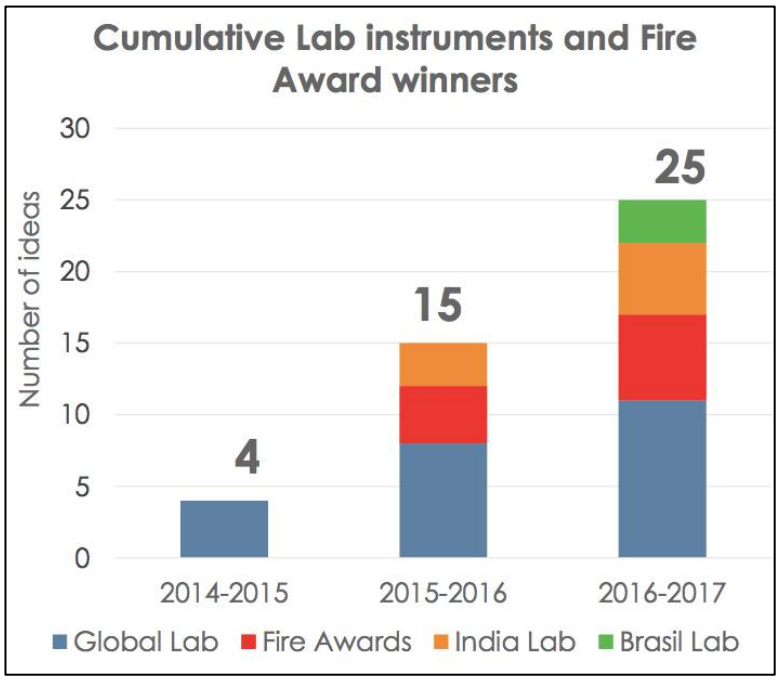

Figure 15: Cumulative Lab Instruments and Fire Award Winners. Source: https://www.climatefinancelab.org/wpcontent/uploads/2018/04/Lab-Impact-Report-2018.pdf

In 3 years, it has endorsed 25 ideas and grown to 4 programs targeting different regions and investments stages. It has been estimated that Lab members' investments of USD$228 million have mobilized another $750 million in investment[168]. It is important to underline that The Lab has attracted proponents from a wide array of sectors and that 30% of them came from the public sector. This means that the remaining 70% came from the private sector and this highlights its increasing interest for The Lab model. The Lab ideas have directly mobilized over $300 million of finance from private investors. However, almost 100% of private investments collected from Lab instruments has come from institutional investors and commercial banks and just in minimum quantity come from private equity investors.

[168] The Lab. 2018. *The Lab: Impacts and lessons learned, 2014-2017*. January 2018.

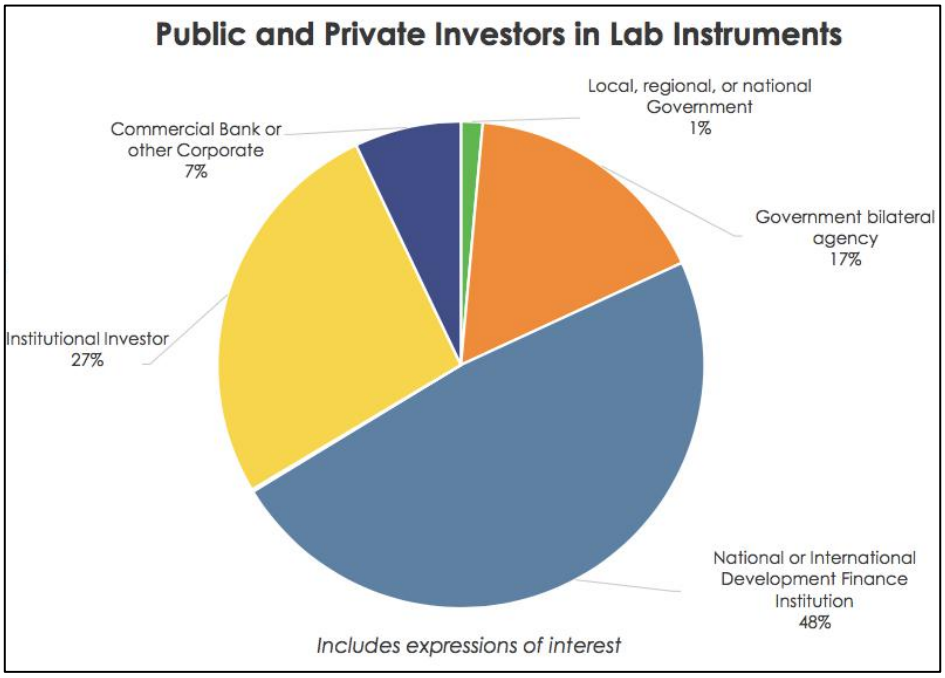

Figure 16: Public and Private Investors in Lab Instruments. Source: https://www.climatefinancelab.org/wpcontent/uploads/2018/04/Lab-Impact-Report-2018.pdf

3.2.7 The Lab Opportunities for the Future

The Lab has focused on the most challenging sectors and locations and it has seen an ongoing evolution of its objectives in order to be in line with the sustainable development needs. There is an extremely closed link between climate actions and innovation and it is positive to see how the urgency to fix climate change issues has result in the design of new financial tools. Moreover, it would continue to look for new sourcing solution to close the adaptation finance gap[169]. Investment is critical to achieve sustainable development global goals, but not enough finance is flowing. It has been calculated that finance is flowing with an average of USD $410 billion for climate change mitigation and adaptation actions in 2015 and 2016 (see Figure 17). On one hand, the IFC has valued that climate investments in developing markets may need $1.5 trillion annually through 2030. On the other hand, the UNEP has calculated that $140-300 billion

[169] The Lab. 2018. *The Lab: Impacts and lessons learned, 2014-2017*. Ibid

is needed annually for adaptation finance through the same time goal. Clearly much more is necessary in order to reach the global ambitions.

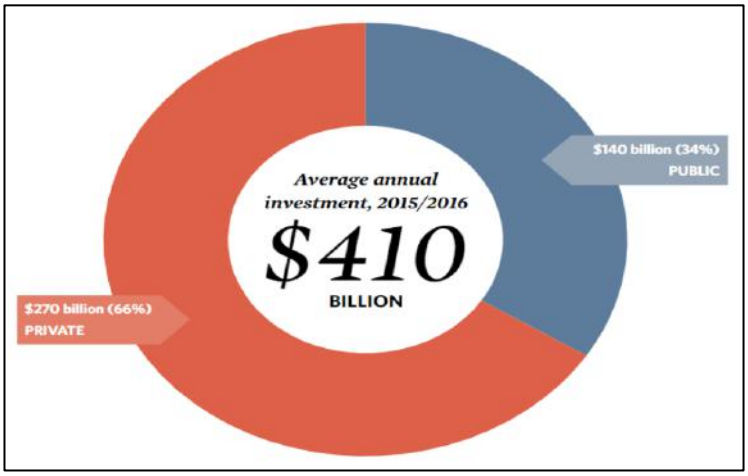

Figure 17: Average annual investment 2015/2016. Source: https://www.climatefinancelab.org/wpcontent/uploads/2018/04/Lab-Impact-Report-2018.pdf

However, it is stimulant the fact that the urgency of climate action foster innovation and it encourages the implementation of new financial tools. Through the identification, development and support of sustainable revolutionary finance ideas, the Lab aims to address billions of dollars coming from the private sector to a low-carbon, climate-resilient economy.

3.3 The EIT Innovations Communities

The EIT (European Institute of Innovation & Technology) Innovation Communities are dynamic and creative partnerships that spread European innovation and entrepreneurship to find answers to major societal problems. Their mission is to bring together, inspire and enable an active community to enhance a zero-carbon economy and climate resilient society.

Their experiences can:

- elaborate innovative products and services to be developed in every area imaginable, including climate change, healthy living and active ageing;
- start new companies and systems can be launched in the market and augment their impacts;

- develop a new generation of entrepreneurs who should become agents of change[170].

Moreover, the Innovation Communities promote activities that belongs to different parts of the innovation chain: training and education programs, supporting of the process from research to the market, innovative projects and incubator and accelerators processes that provides opportunities and practical tools to enable ideas becoming commercial success.

This model of innovation and knowledge exchange aims to:

- create a communication channel between expertise with resources and know-how;
- help sectors overcome information silos and gaps in knowledge and information;
- help decrease the risk connected to innovation by being the first to invest and support;
- nurture the most innovative ideas and apply scientific insight to commercial contexts.

Now there are six Innovation Communities that focus on different societal problems: EIT Climate-KIC addresses climate change mitigation and adaptation, EIT Digital focuses on information and communication technologies, EIT Food facilitates Europe at the center of a global revolution in food innovation and production, EIT Health addressed healthy living and active ageing, EIT InnoEnergy leads a sustainable energy pathway, EIT Raw Materials adopts sustainable practices in exploration, extraction, recycle and substitution of different materials.

3.3.1 EIT Climate – KIC

It is clear the urgent need of a systemic transformation, this means a revolutionary change in the entire system of practices and provisions and

[170] See: https://eit.europa.eu/activities/innovation-communities

Climate KIC represents the experimental framework. In the context of sustainability transitions, the role of experimenting has been recognized as crucial[171]. The EIT Climate – KIC has been launched in 2010 and it is one of the three original Knowledge and Innovation Communities (KICs) set up by the EIT. It is a European knowledge and innovation community, that works towards a prosperous, inclusive, climate-resilient society founded on a circular, zero-carbon economy. The main idea behind this network is to create a favorable environment for inspired thought processes and innovations to flourish. The main goal is to be able solve the problem of bringing climate-focused innovation to market[172] and to make in connection partners coming from different areas such as: business, academia, and the public and non-profit sectors in order to build networks of experts.

EIT Climate-KIC connects research, technology and business in order to find climate-resilient strategies and facilitate their introduction inside markets. The community addresses climate change mitigation and adaptation through four channels of activities:

- Urban transitions: it consists in promoting retrofit and decentralized energy, creating green and resilient cities and accelerating clean urban mobility;
- Sustainable production systems: it means reorganizing materials selection, reducing industry emissions and rebooting regional economies
- Decision metrics and finance: this area works on mainstreaming climate in financial markets, democratizing climate risk information, fostering bankable green assets in cities;

[171] Schot, J.W., Geels, F.W., 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda and policy. Technology Analysis and Strategic Management 20, 537–554.

[172] See: http://www.climate-kic.org/programmes/research-innovation/

- Sustainable land uses are projected as: enabling agriculture climate-smart, transforming food systems and encouraging forests in integrated landscapes.

Since 2010, more than $550 million of capital have been raised in external investment by its start-ups. Climate-KIC has also incubated more than 1 thousand of climate-positive companies has created more than 300 relations with partners[173].

3.3.2 EIT Climate KIC Hubs

Each of the current Innovation Communities has decided an Innovation Hub structure that best adapt to its strategy. However, in order to manage the hub, the community should follow some principles of good governance, in particular they must respect and reflect the diversity in the composition of the partners (ensuring a proper balance within the knowledge triangle), ensure an open and high-quality decision-making process, and divide the supervisory function from the operations.

There was a competitive selection process for the hubs and in June the winners went to Brussels to launch high-impact, low-carbon initiative that would be implemented in 2018. These projects focus on four strategic main concerns: adaptation to climate change, circular economy, energy efficiency and access to finance[174].

An example of Innovation Hubs is the EIT Climate-KIC Innovation Hub in Germany, headquartered at the EUREF-Campus in Berlin Schöneberg. It runs all the EIT Climate-KIC initiatives at local and regional levels. The center puts efforts into the creation of sustainable city systems, e-mobility, modelling, policy and technology road-mapping, solar energy, water and zero-carbon production. Moreover, the center becomes the incubator for local businesses, it is called Green

[173] See: https://www.climate-kic.org/news/solar-impulse-eit-climate-kic/

[174] See: http://www.climate-kic.org/news/ris-welcomes-three-new-countries/

Garage and it gives a suitable working place for six start-up companies maximum[175].

Since 2016, EIT Climate-KIC has been working to launch innovation hubs in Bulgaria, Cyprus, Estonia, Latvia, Malta, Portugal, Romania, Serbia and Slovenia. The EIT Regional Innovation Scheme fosters the climate innovation engagement by European regions. EIT Climate-KIC is expanding its network with the creation of three new innovation hubs across Croatia, Greece and Lithuania. It would be a crucial point for businesses from across the region and entrepreneurs. They would help organizations by furnishing knowledge, sharing and integrating new solutions from the lab directly to the market. With the introduction of Croatia, Greece and Lithuania in the scheme, are in total 12 countries that boosts climate innovation efforts across the continent.

Innovation investment can support businesses maximizing their knowledge and potentially becoming a market leader. Pathfinder is an innovative program that assists innovators to test, define and approve their assumptions about their innovative ideas. The Pathfinder has been thought to permit the collaboration of research and business stakeholders. In this way, different perspectives can emerge and putted together to guarantee that original ideas may reach real climate benefit and are considered viable innovation propositions. They typically last between three to six months and can obtain funds coming from Climate-KIC up to a maximum grant of €50,000[176].

3.4 Climate Finance Proposals

It is essential to foster these initiatives from the moment that climate finance is starved of investment and both SMEs and local banks (in particular in developing countries) often lack the expertise and confidence to invest in capital intensive energy efficiency measures or other forms of sustainable investments.

[175] See: https://eit.europa.eu/eit-innovation-hubs

[176] See: http://www.climate-kic.org/programmes/research-innovation/pathfinder/

The essential transitions or system innovations towards sustainability is probably the unique solution to tackle the dynamic, complex factors that feed the global crisis of our days. All climate finance initiative mentioned in this chapter are a valid research field to foster both technological and organizational changes toward sustainability systems. The experience of for instance Climate KIC in the adoption of transition thinking has been seen as an effective framework where to elaborate solutions and strategies that foster the sustainability goal.

Even if Climate-KIC or the Lab have been successful thus far, it is well known that lot of work still remain to do to turn this first billion into the trillions needed for being in line with the global goal established in the Paris Agreement. From the moment that certain sectors, such as renewable energy, have become more mainstream, the sustainable investment community should foster the attention on the development of ideas in the hardest sectors and regions to accelerate the introduction of funds in new markets[177]. A large number of instruments and studies have been emerged with the aim of addressing the various aspects of the challenges posed by sustainability transitions and sustainable development[178]. To that scope, for instance, the Lab's new 2018 class of instruments have paid more attention on sustainable transit to rural development and climate resilient land use. Transitions experiments are small-examples with the high potential to contribute to sustainability transitions[179].

However, all examples made are the proof of this successful model and as Barbara Buchner has said concerning The Lab initiative: "*the speed and volume of the investment that the Lab have attracted, signified not only the relevance of the instruments, but also the effectiveness of the Lab's public-private model*[180]".

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[177] CIP. 2018. Ibid.

[178] Elzen B., Geels F.W., Green K., (2004), System Innovation and the Transition to Sustainability: Theory, Evidence and Policy, Edward Elgar, Cheltenham.

[179] Raven, R.P.J.M., van den Bosch, S., Weterings, R., 2010. Transitions and strategic niche management: towards a competence kit for practitioners. Int. J. Technology Management. Vol 51 (1), 57-74

[180] See: https://www.climatefinancelab.org/news/1-billion-milestone/

CHAPTER 4

MANAGING CLIMATE CHANGE: INVESTMENT PLANNING, RISK MANAGEMENT AND REPORTING

According to the scientific research on this issue summarized in the Fifth Assessment Report (AR5) from the International Panel on Climate Change (IPCC), the scientific basis for climate change is widely accepted. However, it is extremely difficult to predict on a company level which can be the economic impact of climate change because the variables are complex and uncertain.

Companies have started to see the challenges and the opportunities associated with climate change since it has lead changes in the physical environment. Furthermore, it has impacts also in the regulatory context, forcing governments to put efforts in order to limit those changes[181] and to accelerate the transition to a low-carbon economy through technological innovations that would lead companies to new risks but also to new chances. If companies start planning for climate change they will probably not only protect financial institutions from climate-related shocks, but they would also help themselves to take advantages from potential opportunities that otherwise would most likely remain unexploited[182].

In particular, institutional investors are double tackled by climate change: on one side, they should deal with the risks concerning their investments; on the other side, they have the opportunity to powerful influence the way of leading

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[181] World Economic Forum. 2016. *The Global Risks Report 2016*. Geneva. See: http://www3.weforum.org/docs/GRR/WEF_GRR16.pdf

[182] See: http://www.acclimatise.uk.com/2017/06/01/financial-markets-are-ignoring-long-term-risks-like-climate-change/

business of companies in which they invest. Several studies have showed that pension funds and other institutional investors would probably be damaged by climate change effects and loose significantly the value of their investments. They should consider the physical risk of ruined assets or assets with reduced values as well as the regulatory risk due to stranded assets. It is extremely important that they start to act as prudent investors by analyzing their potential climate risks. Nevertheless, there are clear benefits originating from investments made in companies that give their priorities to energy efficiency improvements, GHG emissions reduction and sustainable business models support[183].

Managing these transitions (physical, technological and regulatory) is becoming challenging for companies and investors and there might be the possibility to run into liability risks if all procedure would not be well managed and evaluated correctly. For this reason, firms that early would try to understand and estimate possible connections of their business to climate change consequences can make the difference and probably can avoid failing in the long run.

It is evident that, depending on the companies' economic activities, climate change risk would be minor or major critical. Clearly, corporations with the higher risk profile are those engaged in activities such as coal mining, oil and gas production, electricity production from fossil fuels and other business activities with large greenhouse gas emissions. Companies should address climate change risk in a manner significant to their operations and banks or insurance companies should support their efforts to manage risks and pursue opportunities. Directors and officers should be first in line in managing physical and transitional risks related to climate change. They should foster developments in knowledge on how to reduce those risks impacts on their firms[184].

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[183] Dr. Janis Sarra. 2018. Ibid.

[184] Dr. Janis Sarra. 2018. *Fiduciary Obligations in Business and Investment: Implications of Climate Change.* Commonwealth Climate and Law Initiative. April 2018.

Moreover, it must be underlined that it is extremely important to encourage companies to be transparent, to act carefully and on a rationally informed basis. If they don't have the minimum knowledge and skill to deal with these analyses, they should look for experts in order to proceed with an informed decision process. Identifying how climate change may decrease companies' economic performance, understanding if management is taking relevant steps to prepare a long-term business strategy, developing the right scheme for the transition to a low-emission economy are only some of the actions that private companies, banks, and insurance institutes should begin.

4.1 Investors' engagement in climate issues

Climate change may affect company portfolio's returns over time, however it may represent the starting point for several business opportunities[185]. Incorporating climate concerns means that also investors would be able to take better investment decisions. They should be in the condition to analyze in the long run all risks and opportunities that companies might face. Once that the full range of considerations, concerning both risk and return, investors should encourage companies to implement higher standards and improve practices on these issues. In this way, they would give their active contribute to reach sustainable development and green economy. Shareholder action may help minimizing risk and guarantee that portfolio of companies would mainly be employed toward cost reduction and innovative climate products.

The early information is available for investors, the better would be for them when evaluating portfolio allocation and its alignment with climate targets. If firms would disclose more information concerning their climate-related risks and opportunities, this can help smooth price changes. It is clear that preventing

[185] See: https://www.nbim.no/en/responsibility/risk-management/climate-change2/

capital misallocation is a good way for decreasing financial stability risk[186]. Investors have specified that they want information that enable them to judge if directors are correctly focusing on risk management or not. Typically, the environmental policies implemented by the issuer and the board governance are the critical key sets considered by investors. They believe that several improvements are necessary and that companies should also disclose how they specifically estimate climate change-related risk and opportunities in their materiality assessment[187].

In order to help investors in their assessment, fifth-teen years ago has been created the Carbon Disclosure Project (CDP). It is an international non-profit organization that, through the power of measurement and information disclosure, has improved the management of environmental risks. The climate related information, the CO2 emissions, the environmental management systems are material issues that investors have started to consider crucial for better investments over a period of time. Climate change has become a significant factor for investment success and investors who ignore it, might be subject to bad consequences on their portfolio's value. Moreover, investors analyze business climate-related data for future duties, for company's future controversial issues (information such as the business carbon footprint). Information should enable portfolio managers to have a clear view on what companies are performing better and what companies need to be better in a long-term perspective related to the sector and related to their relatives and absolute performance.

Information must be comparable, standardized, harmonized, so that investors can look at those material risks across sectors and companies should develop a methodology for this type of comparison. Disclosure is a tool that has the scope to remove asymmetric information between the firm's management and investors. Concerning climate-related information, investors pay attention to

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[186] See: https://bankunderground.co.uk/2017/01/23/the-tip-of-the-iceberg-the-implications-of-climate-change-on-financial-markets/

[187] Cynthia A. Williams. 2018. *Disclosure of Information Concerning Climate Change: Liability Risks and Opportunities.* Commonwealth Climate and Law Initiative. April 2018.

different types of disclosures: some investors consider only the financial risks of their asset investments, while others might care also of the externalities produced in their portfolio (which might be the direct consequence of the firm's carbon emissions for instance). Well-designed climate-related disclosures would help investors in their investment decision process and encourage firms to undertake strategies that decrease their exposure to such risks.

Furthermore, it must be underlined that, the increased awareness of climate-related financial risks has led shareholders to increase their demand for strategic/reporting responses from the companies where they invest[188]. It is inevitably that climate change would have an impact on investment returns, however if those risks would be managed in the right way, the consequences would be less dangerous with respect to inaction. Trying to procrastinate climate change impacts is no longer acceptable from the moment that climate change risk is already material across the entire economy.

4.2 Climate change risks: focus on investments

Climate change can directly or indirectly have effects on markets, in particular the climate related risk can be categorized into three sectors: the environmental uncertainty, the economic climate risk and the climate policy risk. Greenpeace argued that there is another risk denoted as "business risk" and it should include all risks related to the augment of the cost of capital, the increasement of operating costs, the possibility for assets to lose value and become "stranded" and the reputational damage that can in turn cause the reduction in market valuation.

The impacts on environmental degradation are driven by the reliance on fossil fuels to power economic growth and by industrialized forms of agriculture that are needed to feed a gradual healthier global population. The final conclusion that threaten the environment is anthropogenic climate change.

[188] Cynthia A. Williams. 2018. *Ibid.*

Climate change is no longer something far from the global reality, it is already happening, and the world society is already paying for past mistakes. For this reason, it is important that businesses must avoid postponing the problem. This involves a drastic revolution of the world's economy and, therefore, investor thinking.

Some investments will be at risk, while others will take advantage of it. Investors face different perceptions and levels of climate change-related risk. It is essential for investors to consider a wide perspective of all possible risks in order to narrow down to the relevant parts of the analysis in a rational way. They should be aware of the potential risks that can have consequences on the economy through different channels, and how this in turn may affect values of all types of assets. Such risk can be approximately divided into asset level risk and direct investor risk.[189]

Asset level risk can be identified as all climate change consequences on the world economy. In particular the definition focused on physical risk for singular assets. Due to these news events, also the insurance industry has seen its markets changing and has started to deal in the context of insuring disaster. Another type of asset level risk is the carbon price risk for underlying assets. It has become a concern for investors every time that plants or production systems are subject to changes in carbon price policy, such as national or international taxes or cap & trade systems. Another problem can emerge after natural catastrophes linked to climate change because often companies with the highest climate impacts become liable for these types of damages.

Investor-level risk are those consequences that have directly impacts on markets. Investors can no longer ignore climate changes' effects. Moreover, portfolios are everyday riskier, especially those direct linked to energy companies. There are some regulatory risks that direct affects investors from the moment that financial market regulation pretend more transparency and ask

[189] Swiss Sustainable Finance. Maximilian Horster, CH.19 Climate Change and Associated Risk for Investors. Zurich, 2017.

companies to implement climate-related strategies. However, there are some negative economic aspects because of this focus on climate-change concerns. Indeed, some research has shown that climate issues may harm firms, from the financial perspective, they tend to become underperforming and this is a type of investment risk. Nevertheless, portfolio holdings can be possibly overvalued due to stranded assets. This term has recently gained substantial importance, in particular in environmental and climate change circumstances.

Last but not least, *the reputational risk* has recently become an important factor for investors and is becoming more and more determinant in financial markets. Institutional investors have started to consider sustainability aspects when making investments. They have started doing that for three main reasons:

- they want to obey to the national and international accepted standards/norms or specific values determined by their own society within their investment activity;
- they desire to improve the risk/return profile of investments;
- they want to foster sustainable thinking and business attitudes.

The idea behind the first reason is to reproduce certain values in the investment portfolio, independently from the financial effect and not trying to actively influence business practices. From recent analysis it has been shown that international guidelines such as the Global Compact or the OECD guidelines for multinational enterprises have certain relevance for investors' opinion. As a result, even minority shareholders need to review their investments to ensure they do not violate the relevant norms.[190] Another way to improve business attitudes is to dismiss investment in certain areas that are in conflict with the organization's values or simply avoid certain industries such as the tobacco or military one.

[190] Jaeggi, O., & Webber Ziero, G. (2016). What new OECD standards mean for investors. MIT Sloan Management Review -Blog. Available at: http://sloanreview.mit.edu/article/investors-required-by-oecd-to-broaden-due-diligence/.

The second reason has largely been analyzed in the previous paragraph, while the third one is based on the hypothesis that implementing sustainability factors, when making investment decisions, might give more financial consciousness in the short, medium or long term. This reason is connected to the idea of the fiduciary duty, meaning that when investors are managing other savers' money, they should act to guarantee that also their interest is completely safeguarded. The most important of these duties, which pertain directly to the responsibilities of institutional investors, are loyalty and prudence. It must be considered that directors and officers may be aware about physical and transitional risk related to climate change issues, and how these risks can have consequences on their firm in order to act in the best interest of the company[191]. The prudent management assets mechanism is believed to be an extension of the integration of ESG factors.[192]

4.3 Reasons for sustainable investing

Several studies have explained that, in particular in the long run, more responsible and sustainable business practices, might generate much better investment occasions. Certain companies for instance are convinced that, thanks to ethical considerations, their investments can add value in the sustainable development path. It can be said that motivations of companies involved in these types of investments tend to advance through stages. At first organizations need to be compliant with regulation, then they start to integrate ESG factors in their evaluation and investment process. In this way they reduce risks and can take advantage of new investment opportunities. Finally, a certain sense of duty has spread throughout the whole company and managers feel the need to adopt investments in a way that push the economy as a whole more sustainable. It must

[191] Dr. Janis Sarra. 2018. *Ibid.*

[192] UN Global Compact, UNEP FI, PRI. 2015. Fiduciary duty in the 21st century. Available at: http://www.unep.org/fileadmin/documents/fiduciary_duty_21st_century.pdf.

also be remembered that drafting a sustainable investment policy is an ongoing process.

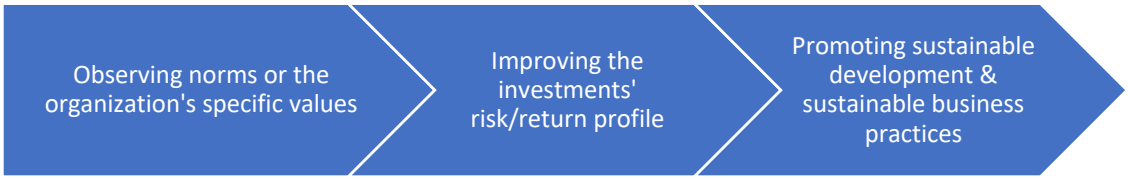

Figure 18: Evolutionary Development of Motivations for Sustainable Investing. Source: Swiss Sustainable Finance (2016)

Every day, investors who have the role to manage capital for third parties on a fiduciary basis, consider sustainability factors when they have to value investments and determine their investment policy for one or more of these reasons. The following information help top management determining which are the relevant motivations for becoming involved in sustainable investment.

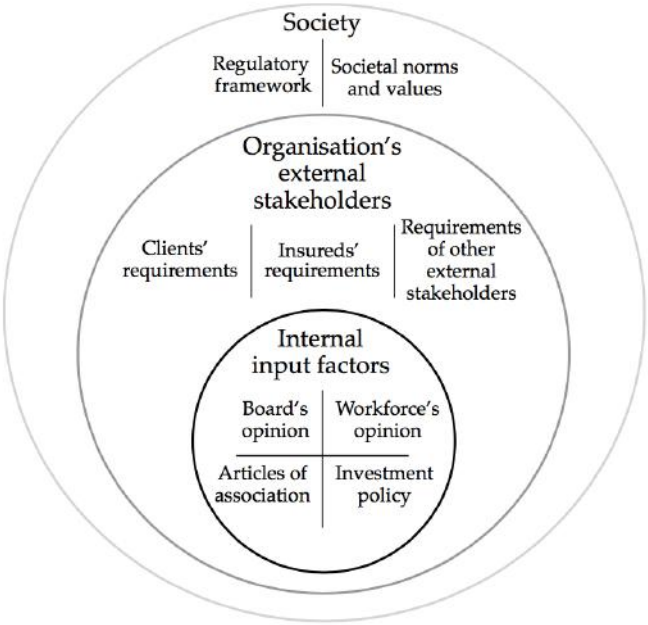

Figure 19: Input Factors for Determining the Main Motivations. Source: Swiss Sustainable Finance (2016).

The next information gives an idea for what kind of determinants are taken into consideration (see also **Figure 19**):

- Organization's investment policy,
- Organization's statutes,
- Initial analysis of the existing portfolio (asset classes, preliminary sustainability review),
- Opinions of internal stakeholders (e.g., supervisory board, employees),
- Opinions of external stakeholders (e.g., beneficiaries, customers, other external stakeholders—for example, in response to surveys or through inclusion of such representatives in discussions),
- Information on regulatory developments,
- Societal norms[193]

4.3.1 Pro and cons for sustainable investing

It is extremely urgent to learn how to transit the financial system and its intermediaries from the traditional idea of finance to sustainable infrastructure finance. Increasing right market signals can be a good way to augment private financing of infrastructure. Moreover, if regulators and policy-makers help reorienting investors underling the positive factors that characterized those type of investments, they can perceive risk in a different way and better understand their potential return.

Investments in sustainable development will require sufficient levels of supply of long-term financing, and they must be carried out both by public actors through increasing public incentives and by private sector, which really depend on those efforts. In the World Economic and Social Survey 2011 has emerged that the green economy approach is probably fully compatible with sustainable development. Moreover, it has underlined the urgency of a strong action that

[193] Swiss Sustainable Finance. Sabine Döbeli, CH.22 Implementing a Sustainable Investment Policy – A practical Guide. Zurich, 2017.

would extract the economy away from the inertia of business as usual and move it to a new idea of finance[194]. Policymakers have indeed tried to harmonize the economic and the environmental goals in a green policy agenda but there were three main obstacles.

The first one is the fact that there are low returns to green investments and as a consequence there are scarce investments, which is *the second* problem, *and third,* slow innovation doesn't facilitate advancement in this pathway. To overcome these obstacles, OECD has projected a diagnostic tool which classified the main obstacles to green growth into those causing low economic returns and those causing low capacity to adequate generated returns, or low appropriability of returns **(figure 20).**

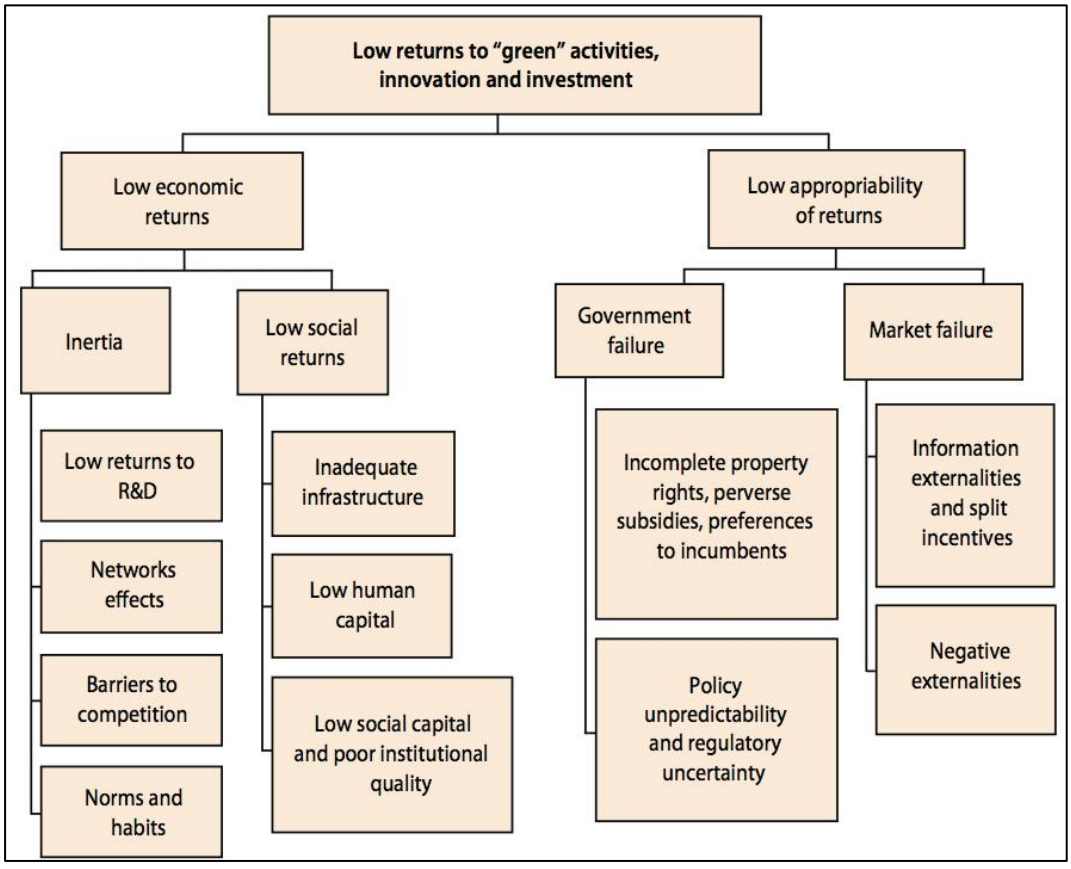

Figure 20: Green Growth Diagnostic. Source: OECD (2012b), p. 128, figure 5.1.

[194] UN. 2011. World Economic and Social Survey 2011. *The Great Green Technological Transformation.* New York, 2011.

When principal problems have been identified, OECD have suggested that effective institutional arrangements and policy packages must be built for the transition towards green growth. Financing investment in public infrastructure, including adaptation to and mitigation of climate change, is an ambitious goal that has often required large sums of upfront finance and the acceptance of the fact that returns will be seen mainly in the medium and long terms[195]. Moreover, the prolonged slowdown in global economic growth has seen, as a consequence, the fact that the generation of long-term investment has become particularly challenging. Reductions in productive investments (for example in crucial infrastructure projects) would damage productivity growth in the medium to long run, furthermore blocking the realization of the Sustainable Development Goals.

Investors have always been focused on short-term gains and, for this reason, they might have less incentive to invest in energy efficiency. These types of improvements indeed might take five years or more to recover first costs. Long-term finance might be insufficient in developing countries, from the moment that creditors prefer to supply short-term financing in order to limit risk. According to this, different Survey reports have declared that development banks should be the vehicle for addressing some of the unmet demand for long-term financing[196]. International and national development banks are able to reduce adaptation activities-related risk and leveraging large amounts of private sector financing. They have facilitated increased levels of participation of the private sector in financing their adaptation portfolios[197]. However, the divergence in monetary policy that have emerged between United Stated Federal

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[195] UN. (2013). World Economic and Social Survey 2013. *Sustainable Development Challenges*. New York, 2013.

[196] UN. (2005). World Economic and Social Survey 2005. *Financing for Development*. New York, 2005.

[197] Climate Policy Initiative. (2015). Global landscape of climate finance 2015. Authors: Barbara K. Buchner and others. November 2015. See: http://climatepolicyinitiative.org/wp-content/uploads/2015/11/Global-Landscape-of-Climate-Finance-2015.pdf.

Reserve and central banks of other major countries may have augment capital flow volatility. Central banks and Governments have indeed found difficulties in recent years in managing volatile capital flows.

The 2005 Survey have suggested that the institutional design should avoid excessive public sector risks and bad interest rate for subsidies and must consider the actions taken by development banks as complementary to those made by the private sector. Moreover, the herald is to start considering banks themselves as agents of innovation that may, at least in the long run, boost private sector financial development. Successively, the 2012 Survey has recognized that in order to improve international financing for development, it is necessary innovative thinking. In this sense, international finance can make the difference by adding domestic leverage financial mobilization[198].

4.4 Climate change risks: focus on the whole economy

All asset classes, industries and economies will soon be affected by climate risk which can be defined as a really pervasive systemic risk. There are evidences supported by daily scientific discoveries, in particular The Intergovernmental Panel on Climate Change (IPCC) tastes that climate can have a significative effect on the functioning of our economic society. "Climate change will amplify existing risks and create new risks for natural and human systems" (IPCC, 2014b). In 2015 Bank of England has identified three types of risk factors that depend on climate change and climate change policies and may undermine the stability of banks, insurers and the overall financial system: physical risks, transition risks and liability risks.

[198] UN. 2017. World Economic and Social Survey 2017. *Reflecting on seventy years of development policy analysis*. New York, 2017.

4.4.1 Physical Risks

Physical risks refer to those risks deriving from extreme events, such as heat waves, heavy precipitations, hurricanes and these are going to become even stronger with further warming. The risk of the physical consequences of climate change can damage the economic values of businesses in several sectors. Increased physical risks present major challenges to insurance and reinsurance business models because of the increased costs and frequency of natural catastrophic events. It may happen that those events would alter the equilibrium between premiums and claims, leading insurance companies to be exposed to uncovered losses[199]. In particular in the financial sector those risks may have two opposite forecasts. On one side, they can become even higher if financial institutions continue financing activities that are intensive in CO_2 emissions, this may increase climate-related physical risks. On the other side, financial sector may address the reductions of climate-relate physical risks by financing the development of technologies that help reduce CO_2 emissions.

This is mainly a problem of externalities from the moment that financial institutions aren't necessarily subjected to the losses and gains that derive from changes in climate-related physical risks. Banks and insurers have implemented capital requirements for containing prudential risks. However, adapting these regulations in order to consider externalities might impact on their primary objective and consequent unwanted effects.

The real happening of natural disasters due to climate change may product concrete financial losses, some of which are covered by insurers companies while others are uninsured. The following scheme illustrate how these events could affect individual financial institutions and consequently affect the equilibrium of the financial system.

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[199] IMF Staff Discussion Note. 2016. Mai Farid, Michael Keen, Michael Papaioannou, Ian Parry, Catherine Pattillo, Anna Ter- Martirosyan, and other IMF Staff. *After Paris: Fiscal, macroeconomic, and financial implications of climate change*. SDN/16/01

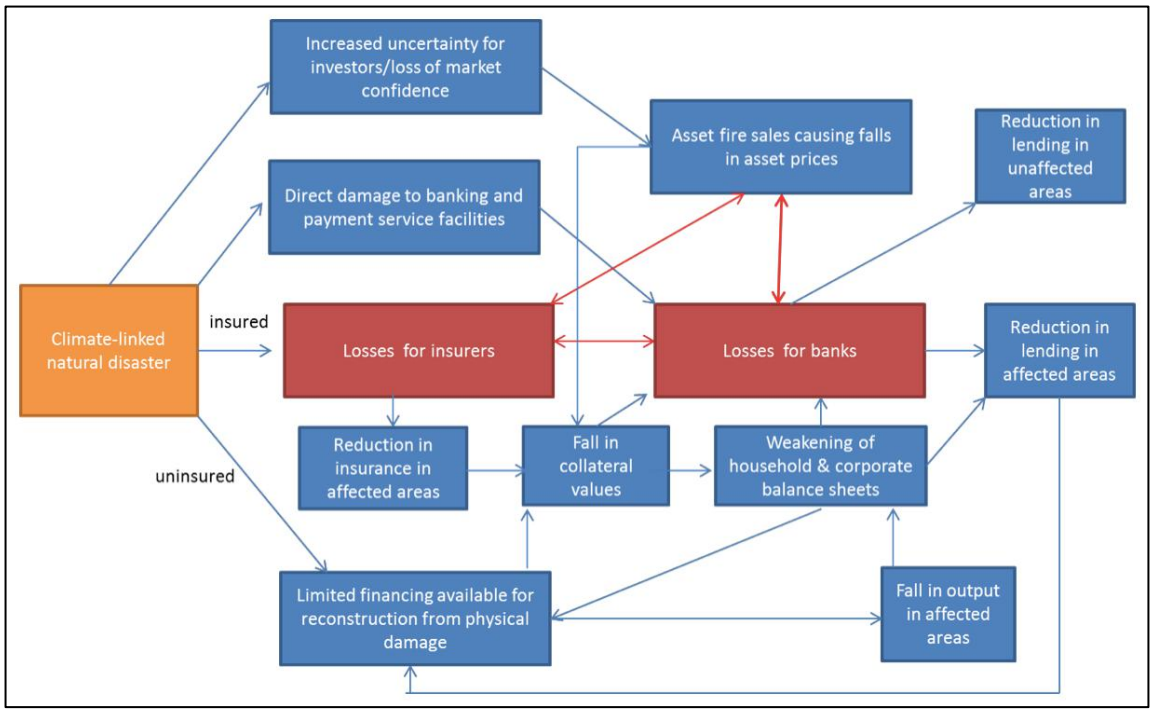

Figure 21: A transmission map from a natural disaster to financial sector losses and the macroeconomy. Source: Bank of England.

The main difference in the transmission mechanism reflect the presence of insurance institutions and reflect the extent to which losses were covered or not. It must be also considered the fact that if insured losses caused by an extreme weather event are consistently huge, they might cause the failure of the insurance companies. This can in turn interrupt the supply of relevant insurance products and services with heavy consequences on financial markets. Assets of distressed insurers would be rapidly sold, and this would decrease asset prices which can adversely reduce values in the balance sheets of other financial institutions, such as banks. Several researches have suggested that both insurers and reinsurers still tend to base their analysis heavily on historical data without implementing climate change trends. Luckily, there are some institutions that have begun to consider catastrophe models in their analysis that include the consequences of climate change[200].

[200] See: http://www.rms.com/blog/2014/06/24/rms-and-risky-business-modeling-climate-change-risk/

However, the risks of banks default might be mitigated through the implementation of rigorous financial regulation and supervision. Developed countries are those more advantage since banks tend to have well-diversified asset portfolios and borrowers used to be better insured[201] with respect to banks clients in developing countries. The existing literature points out that grave natural disasters may lead to different perception of risks, which in turn can lead to have longer term impact on financial market dynamics. In particular, it has been found that CEOs who have heavily suffered the consequences of extreme weather events would behave more conservatively, while those who don't, would continue to lead firms aggressively[202].

4.4.2 Transition Risks

Transition risks can be seen as those risks associated with the change of the world economy from high carbon intensity to a lower-carbon one that would cause initial economic inefficiencies and financial losses. It is though that a slow transition to a low-carbon economy is reasonable if the forecasts on international policies would be severe according to carbon emissions, thus inducing the shift of private investments towards low-carbon technologies. Nevertheless, the adoption of new tightening regulations might possibly lead to both positive and negative effects depending on the size of the sectors affected with respect to the whole world economy.

According to the FTSE 100 index, for instance, the oil and gas sectors alone account for the 12,5% of the world economy (as at March 2016). The world needs for oil and coal must reach the peak by as early as 2020. It has been estimated by

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[201] Bank of England. 2015. *The impact of climate change on the UK insurance sector. A Climate Change Adaptation Report by the Prudential Regulation Authority.* London. September 2015.

[202] Bernile, Bhagwat, Raghavendra. 2017. *What doesn't kill you will only make you more risk-loving: Early-life disasters and CEO behavior*. Journal of Finance. 72, (1), 167-206. Research Collection Lee Kong Chian School of Business.
Available at: http://ink.library.smu.edu.sg/lkcsb_research/4223

the International Energy Agency that in order to remain within the 2°C limit, investment in fossil fuel related assets must be around $16 trillion less with respect to business as usual by 2040. The swift changes in capital allocation must take the direction toward investment in renewables and efficient energy usage[203]. A significant reduction in CO2 emission can be reached without interrupting GDP growth by simply increasing the energy efficiency and reducing carbon intensity of energy. This solution can be showed through the Kaya identity below:

$$\text{Carbon emissions} = \text{Population} \times \frac{\text{GDP}}{\text{Population}} \times \frac{\text{Energy used}}{\text{GDP}} \times \frac{\text{Carbon}}{\text{Energy used}}$$

The reallocation of capital might facilitate the financial stability. Moreover, companies that have implemented alternative energy usage might benefit of this revolution, while those that are least in line with these changes may suffer for the consequences of this transaction[204]. It is evident that as soon as the transition begin, as less would be the impacts of this transition risks for companies.

Huge investments in low-carbon energy production are needed together with the introduction of tightened carbon emission policies. Furthermore, it is highly likelihood that sharp falls in assets prices would happen, for instance those of fossil fuel and firms that use them as the primary source[205]. The transition processes can be implemented through two channels: by divesting from highly fossil fuel companies or by making investments in energy efficiency and technology innovations.

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[203] See: https://bankunderground.co.uk/2017/01/23/the-tip-of-the-iceberg-the-implications-of-climate-change-on-financial-markets/

[204] See: https://bankunderground.co.uk/2017/01/23/the-tip-of-the-iceberg-the-implications-of-climate-change-on-financial-markets/

[205] Bank of England. 2015. Speech Mark Carney. *Breaking the Tragedy of the Horizon – climate change and financial stability*. Lloyd's of London. 29 September 2015.

4.4.2.1 The divestment process

There are several evidences that some institutions have started to divest from high-carbon assets, such as fossil fuel companies, and this has already generated some market consequences. First starters of this trend were US universities and religious institutions; indeed, they have started to sell their holdings in companies that they have considered had the potential to have negative impacts on the environment. It has been estimated that at the end of 2015, more than 500 companies across the world (overall amounted US$3.4 trillion in assets) have divested from fossil fuel companies[206].

Not only asset managers have started this trend of decreasing investments in high-carbon intensive firms; moreover, several banks and insurance companies have announced to reduce their financial exposure to coal sector (for example banks like Bank of America, Crédit Agricole, Citibank and Allianz). In 2015 and 2016, the Norway's sovereign wealth fund, one of the top 10 investors in the global coal industry, has decided to reduce investment made in companies belonging to the coal sector. Development finance institutions, including MDBs and other DFIs, are also trying to avoid new investments in coal-fired power plants[207].

The private sector has started decarbonizing its investment portfolios on a voluntary basis. The Portfolio Decarbonization Coalition is a good initiative promoted by a group of long-term institutional investors that has tried on voluntary commitments to switch institutional investments to low-carbon-exposure firms (commitments have exceeded $230 billion at end-2015). This shift would require information such as those published by the CDP on carbon footprints[208].

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[206] See: https://350.org/in-the-space-of-just-10-weeks/

[207] New Climate Economy. 2016. *The sustainable infrastructure imperative: Financing for better growth and development.* September 2016.

[208] IMF Staff Discussion Note. 2016. Mai Farid, Michael Keen, Michael Papaioannou, Ian Parry, Catherine Pattillo, Anna Ter- Martirosyan, and other IMF Staff. *Ibid.*

Changes in the regulatory framework are the biggest threat for numerous investors that have invested in companies belonging to the oil and gas industry[209]. These policy changes could have asked to these firms to cut their carbon emission making them under pressure and, as a consequence, block them to exploit the reserves that they already have. As said by John Ditchfiel, financial adviser at environmental investment experts Barchester Green: "*There is therefore the risk that these 'assets' become stranded as energy businesses are forced to leave oil and gas in the ground; this could wipe billions off the value of gas and oil companies. And this would have a very direct impact on the savings, pensions and investments of many individual investors*"[210].

4.4.2.2 Stranded assets

Numerous are the definitions of stranded assets in the energy context. In its origin, the term "stranded costs" or "stranded investments" has been linked to "the decline in the value of electricity-generating assets due to restructuring of the industry"[211]. The International Energy Agency has defined stranded assets as "those investments which have already been made but which, at some time prior to the end of their economic life (as assumed at the investment decision point), are no longer able to earn an economic return as a result of changes in the market and regulatory environment brought about by climate policy"[212].

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[209] See: https://www.telegraph.co.uk/sponsored/finance/investments/climate-environment/11799182/how-climate-change-affects-investments.html

[210] See: https://www.telegraph.co.uk/sponsored/finance/investments/climate-environment/11799182/how-climate-change-affects-investments.html

[211] Congressional Budget Office. 1998. "*Electric Utilities: Deregulation and Stranded Costs*". October 1998. Available at: https://www.cbo.gov/publica9on/11252

[212] WEO Special Report 2013. IEA. 2013. Redrawing the Energy Climate Map: World Energy Outlook Special Report, International Energy Agency, Paris, and Organization for Economic Co-operation and Development, Paris. http://www.worldenergyoutlook.org/media/weowebsite/2013/energyclimatemap/RedrawingEnergyClimateMap.pdf. Pag 98.

Due to some regulation changes for instance, assets can be converted to liability and recorded on the balance sheet as a loss of profit. For this reason, the Carbon Tracker Initiative has also defined these economic losses as "the result of changes in the market and regulatory environment associated with the transition to a low-carbon economy"[213]. Overall considered, the definition most accepted has emphasized that assets have become stranded because of the need of the reduction of fossil fuel usage in order to reach the decarbonization of the energy system, hopefully by mid-century[214].

Different factors can lead assets to lose their value and to be considered obsolete and to be dismissed before the time planned. Some variables can be: new government regulations, the evolution of social norms (such as fossil fuel divestment campaign) or changes in consumer needs (they may need more certification schemes) or simply litigation factors because of coal and hydrocarbon resource usage. Divestment campaigns have the objective to guide institutions to withdraw their investment from fossil fuel assets. It has been estimated that around 520 institutions with US $3.4 trillion in assets under management have decided to divest from fossil fuels, considering projects inside universities, cities, religious institutions, pension funds, foundations and others[215].

A special coalition called "The Portfolio Decarbonization Coalition" (PDC) is trying to mobilize a group of institutional investors with critical thinking in order to progressively decarbonize their portfolios[216]. It is really important to convince banks that they have to shift away from "brown" investments from the moment that they don't follow principles in line with low-carbon and climate

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[213] Carbon Tracker Initiative (n.d.), "Stranded Assets". See: http://www.carbontracker.org/resources/

[214] IRENA. 2017. "*Stranded assets and renewables: how the energy transition affects the value of energy reserves, buildings and capital stock*", International Renewable Energy Agency (IRENA), Abu Dhabi, www.irena.org/remap

[215] For a complete list see: http://gofossilfree.org/commitments/.

[216] See: http://unep.org/pdc/.

resilient development. The same reasoning must be done for oil and gas companies. Carbon Tracker, U.N. Principles for Responsible Investment, and leading public institutional investors have published a study of the value of "stranded assets". They have discovered that: "across the oil and gas industry $2.3 trillion of upstream projects – roughly a third of business as usual projects to 2025 – are inconsistent with global commitments to limit climate change to a maximum 2°C"[217]. Citigroup has projected that by 2050, considering a low-carbon scenario, the value of "unburnable" fossil fuel reserves could reach over US$100 trillion[218]. Companies belonging to the oil, gas or coal sector should seriously discount their assets in the ground because of the high probability to see a significant percentage of their value diminishing. Otherwise those companies can materially misstate their financial position and business risks.

Another problem connected to assets valuation is the technology risk/innovation disruption from the moment that climate-related campaigns give relevance to different and less carbon-intense technologies. This is a damage for climate-harming industries and probably the starting point for their decline.

4.4.3 Liability Risks

Bank of England research in 2015 has discovered that there are three primary lines of discussion for determining liability:

1- *Failure to mitigate*: the appellant could claim that the suspect (e.g. an oil company) has misrepresented its climate impacts causing damages for the claimant and more gravely causing the release of GHGs.

2- *Failure to adapt*: the claimant could declare that the defendant has condemned him to suffer for worst weather conditions and probable financial losses because they had supplied products or services

[217] Carbon Tracker Initiative. 2017. *2 degrees of separation: transition risk for oil & gas in a low carbon world*. June 2017.

[218] Channell, J., Jansen, H., Curmi, E., Rahbari, E., Nguyen, P., Morse, E., Prior, E., Kleinman, S., Syme, A. and Kruger, T. 2015. *Energy Darwinism II: Why a Low Carbon Future Doesn't have to Cost the Earth*. New York: Citigroup.

without considering quality standards and regulation on carbon emissions.

3- *Failure to disclose or comply*: the appellant could claim that the respondent has not adequately disclosed information concerning climate change. Maybe it has misled that information or been not compliant with climate change-related legislation or regulation[219].

However, the liability risk is most likely to damage determinant institutions within the system such as insurance companies, while the transition risk is the most dangerous for the financial system as a whole. The positive note is that transition risk can be mitigated through the implementation of effective policies that may foster private investment toward low-carbon technologies.

4.5 Three Main Actions

It is evident that companies that want to survive in this complex world economy should plan certain climate change expectations for their long-term financial objective. For instance, the Norges Bank Investment Management had suggested three main actions that companies, or investment funds can undertake in order to deal with relevant climate change challenges: incorporate possible climate risks in their strategic planning for new investments, manage risk and implement shared standards for their reports.

4.5.1 Investment Planning

Companies should define which are the direct or indirect implications of the generation of greenhouse gas emissions and properly find ways to achieve their reduction over time. Firms should address climate change in a manner significant to their processes and try to cope with the climate-related risks and exploit the possible opportunities.

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[219] Bank of England. 2015. *Ibid.*

The boards may consider the following suggestions in order to plan correctly feasible financial goals and implement the right business strategy:

- They can constitute a committee of relevant experts that can support strategic decision-making and forecast future scenarios due to climate change regulation, carbon prices, technological development and the world environmental conditions.
- They should forecast how their business should act in a 2°C scenario and try to be prepared for regulations changes, especially for those companies engaged in activities such as coal mining, oil, gas and production and all business activities that potentially have huge greenhouse gas emissions.
- When they recognize what are the business implications for their direct or indirect emission of greenhouse gasses, they should foster the transition to a low-carbon economic system.
- They should plan investments according to those potential physical or regulatory climate impacts and value if investment remunerations enable them to profitable returns and to business sustainability in the long-run.

All these plans should be implemented considering the sustainability of the business practices and last but not least the profitability of the business itself. Firms should consider that market conditions would change rapidly, and they should be able to be competitive. In order to do this, they should invest gross amount of money in research and development. They should foster for the spread of lower carbon infrastructures, such as those that offer alternative energy solutions and eco-efficiencies[220]. This trend can be confirmed by the fact that in the current financial environment are prevailing low returns from traditional investments. Infrastructure investments can be seen as a good way to diversify investors' portfolio and, at the same time, they can produce solid risk-adjusted returns.

[220] Cynthia Williams. 2018. *Ibid.*

4.5.1.1 Pricing climate risks

Both transition risks and physical risks can be incorporated into investment assessment procedures already in place. However, the uncertainty that characterized climate change issues and data availability are variables that often prevent experts from analyzing correctly those factors of risk. According to this, financial market stability it is most likely to be exposed to such risks since there are no standardized scenarios of future climate risk regulations and future expectations can be only based on current market prices. For instance, considering CO2 prices, it might happen that policy-makers, following a low-carbon scenario, would decide to increase the CO2 costs to the social costs.

The special advisor of CDP Paula DiPerna has suggested that a price on carbon emissions is the best way for society and the economy to consider the otherwise invisible cost of greenhouse gas emissions. It may also help companies become conscious of the risks linked to those emissions with respect to their businesses and the comparative costs of different potential choices[221]. For instance, changes on CO2 prices would have huge impacts on energy and heavy industry companies. In this case a "transition shock" might happen since investors haven't had the possibility to consider those price changes when they assess for investments and therefore, they would significantly lose their values. Few researches[222] have been published concerning the impact of climate change on the financial sector with the exception of the insurance industry that has already been affected by its damages.

It must be underlined the distinction between factoring physical risks and factoring transitional risks with respect to financial stability:

- Factoring in of physical risks is something that is essential worldwide, and according to the IPCC, especially for the following sectors that felt directly

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[221] CDP. 2017. *Putting a price on carbon. Integrating climate risk into business planning.* October 2017.

[222] Maddison, A. 2006. *The World Economy: a Millennial Perspective.* Development Centre of the OECD. doi:10.1787/9789264189980-en

the impacts of climate change: energy, water, transport, tourism, agriculture, infrastructure and healthcare[223]. The same would happen to the insurance sector which is directly affected by the augment number of claims as it has been analyzed for liability risks. However, physical risks are felt indirectly from the financial sector, because of the decreased assets value for instance. Therefore, financial markets are indirectly affected by climate change physical risks[224].

- Factoring transitional risks and the associated liability risks is something that might have higher impacts on financial stability. This is due to the fact that the currently transitional risks for financial system are estimated to be higher with respect to the impacts of climate change on physical risks (they affect financial market indirectly). The literature on the economic costs of global climate change[225] has estimated that for instance for German industry the 2-5% of the asset value are potentially at risk even in the short term, conversely physical risks have been estimated around 0.1-0.6% in the long-run[226].

This difference might be due to the fact that, despite the real consequences that several sectors face for unaddressed physical risks management, across all sectors transitional risks have been better analyzed. The level of disclosure of physical risks still remains low compare to the risk it potentially poses to all

[223] IPCC. 2014. Summary for Policymakers. In: Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. In O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, et al., Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

[224] V. Lutz, M. Stadelmann. 2016. *Final report: Potential Impact of Climate Change on Financial Market Stability*. Zurich. 21 October 2016.

[225] Dietz, Simon, Bowen, Alex, Dixon, Charlie and Gradwell, Philip. 2016. *Climate value at risk' of global financial assets.* Nature Climate Change. ISSN 1758-678X

[226] V. Lutz, M. Stadelmann. 2016. *Ibid.*

sectors[227]. Moreover, the shorter duration gives to the pricing of transition risks (including liability risks) greater importance in financial markets with respect to pricing of physical risks. So far, most studies have concentrated on the implications of transition risks, for instance by the Carbon Tracker Initiative in 2011 o by other researchers[228]. On the contrary, less attention has been paid to the exhaustive analysis of physical risks, which have only partially been studied in macro models by Dietz et al. in 2016, Dafermos et al. in 2017 and more recently by Bovari et al. in 2018[229]. Nevertheless, the two risks have become equally important in the long run thanks to the growth of global interdependence of financial markets.

Another difference between these two risks is concerning maturities and lifetime of the assets. The maturities of climate risks for physical risks is difference since they may happen in the medium-long term, while for transition risks they may occur soon but increase in the longer term. The lifetime of an asset should be considered for valuing the loss of value that can result from the occurrence of a climate risks at any given moment in time[230]. Furthermore, in the case of physical risks, happening in the form of extreme events, longer-term

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[227] EY. 2017. *Climate risk disclosure barometer*. See: https://www.ey.com/Publication/vwLUAssets/ey-climate-risk-disclosure-barometer-lr/$FILE/ey-climate-risk-disclosure-barometer-lr.pdf

[228] Johnson, V. 2012. *Unburnable Carbon: Rational Investment for Sustainability*. The New Economics Foundation, London.

Battiston, S., Mandel, A., Monasterolo, I., Schu¨tze, F., Visentin, G. 2017. *A climate stress-test of the financial system*. Nat. Clim. Chang. 7 (4), 283–288.

Stolbova, V., Monasterolo, I., Battiston, S. 2018. *A financial macro-network approach to climate policy evaluation.* Ecol. Econ. 149, 239–253.

Trinks, A., Scholtens, B., Mulder, M., Dam, L. 2018. *Fossil fuel divestment and portfolio performance.* Ecol. Econ. 146, 740–748.

[229] Dafermos, Y., Nikolaidi, M., Galanis, G. 2017. A stock-flow-fund ecological macro-economic *model.* Ecol. Econ. 131, 191–207.

Dietz, S., Bowen, A., Dixon, C., Gradwell, P. 2016. *'Climate value at risk' of global financial assets.* Nat. Clim. Chang. 6 (7), 676–679.

Bovari, E., Giraud, G., Mc Isaac, F. 2018. *Coping with collapse: a stock-flow consistent monetary macrodynamics of global warming*. Ecol. Econ. 147, 383–398.

[230] V. Lutz, M. Stadelmann. 2016. *Ibid.*

investments would be subjected to bad consequences since investors would not be able to divest those assets as quickly as they can do for equity and debt assets.

4.5.1.2 Factoring in Climate Risk

Climate risks can be factored in by incorporating them into different existing models for investment evaluations. In the finance industry, experts used to estimate directly the returns of certain assets in certain regions, as well as the co-variance between them[231]. Discounted cashflow method is the most common method for investment evaluations. The NPV of a project is useful in capital budgeting to measure the profitability of a projected investment. It consists in the difference between the present value of cash inflows and the present value of cash outflows, in particular:

$$NPV = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t}, \text{ where:}$$

N = total number of periods

T = time of the cash flow

i = the discount rate, i.e. the return that could be made per unit of time on an investment with analogous risk

R_t *= the net cash flow i.e. cash inflow – cash outflow, at time t*

There are different techniques to factor in climate risks in the net present value method. Potential climate risks can be factored into cash flows for instance due to earnings changes (e.g. lower electricity sales due to climate-induced lower availability of water) or because of alteration in operational costs (e.g. CO2-levies, costly maintenance), or linked to investments cost changes (e.g. higher dams due to higher floods). Moreover, they can be factored in by growing the discount rate. It has been predicted indeed that both physical risks (e.g. volatility of water

[231] Campbell, J. Y. & Viceira, L. M. 2002. *Strategic Asset Allocation: Portfolio Choice for Long-Term Investors.* Oxford University Press.

availability) and transitional risks (e.g. regulatory interventions to contain CO2 emissions) would potentially augment the discount rate.

One common solution for valuing the discount rate is given by the capital asset pricing model where:

$$\textit{Expected return} = \textit{Risk free rate} + \beta\ (\textit{Expected market return} - \textit{risk free rate})$$

According to this model, β (beta) is a measure for the risk of an investment. Therefore, if beta would be modified, this have consequences on climate risk assessment. The adjustment of beta, and thus the expected return, can be used for valuing individual projects but also entire corporate decisions of government financial plans. In that way, climate risk can be factored into the evaluation of the expected return on investment and the creditworthiness of businesses[232].

Other two methods can be used for valuing investment decisions: the first is the payback period, which aims to measure the number of years necessary to repay the initial investment. In that case climate risks can be involved only in that cash flows, but not in the discount rates. The second is the real options valuation (ROV), which is more complex and consider the assumption that investors have the possibility to invest but they can also submit this option until a certain time t (expiration time). This mechanism is based on the fact that the lower is the uncertainty of the investment (as longer has been deferred the investment), the more attractive is the investment when it is risky. For this reason, climate risks can be considered in the form of increased variance in the returns of affected investment (for instance in the case of investments in fossil fuel sector). The effect is that investors would opt for postponing investment in order to reduce

[232] Germanwatch, Deutsches Institut fu¨r Wirtschaftsforschung, Wuppertal Institut fu¨r Klima, U. E., Potsdam, U., & Klimafolgenforschung, P.-I. f. (2009). *Mainstreaming von Klimarisiken und - chancen im Finanzsektor. Klimabezogene Chancen und Risiken in Versicherungen, Vermo¨gensverwaltung und Kreditvergabe. Abchlussbericht fu¨r Bundesministerium fu¨r Bildung und Forschung*. Bonn: Germanwatch.

uncertainty (with regard to climate change and climate policy) and real options would become more valuable.

Finally, diversifying portfolios in different ways with respect to traditional market conditions, has remained a useful method for investors for factoring climate risks. It might be reminded that stock markets suffer from excess volatility, therefore increasing levels of climate risk could lead to frequent stock price movements with respect to what estimations have suggested[233]. The risk is even more difficult to hedge completely because of the global incidence of climate impacts and the potentially long holding periods that would be required[234].

It is not in the purpose of this thesis to analyze the different investing models, what is important in this field is to highlight the fact that international studies have showed signs that factoring in is already taking place. Active management of these risks has indeed mostly already taken place through reinsurers and major property and casualty insurers exclusively in the insurance industry. Clearly there are high costs of action, but several simulations have showed that the use of proper accounting methods would save significant amount of money[235]. In the CISL (2015) study for instance, it has been suggested that up to 50% of the financial losses can be avoided. The idea that yield reductions (due to the impacts of climate change on financial markets) can be mitigated through the introduction of adjustments into the investment allocation has been expressed in another study called "Investing in a Time of Climate Change" made by Mercer in 2015. In both analyses, it has been hard to determine the extent to which potential future developments are discounted and for this

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[233] Shiller, R. J. (1981). *Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?* Am. Econ. Rev. 71, 421–36.

[234] CISL. (2015). *Unhedgeable risk: how climate change sentiment impacts investment.*

[235] Kent D. Daniel, Robert B. Litterman, and Gernot Wagner. (2016). *Applying Asset Pricing Theory to Calibrate the Price of Climate Risk*. NBER Working Paper No. 22795. November 2016.

reason this topic should be discussed more often in the field of research and professional work.

4.5.1.3 Pricing in the insurance industry

Concrete pricing measures of climate risks have already been implemented by the reinsurance industry. This industry is directly affected by physical risks; therefore, it should continually incorporate adjusted weather damage into model measurement. For this reason, markets have developed high confidence in the insurance sector's capacity to underwrite its sustainability risks. The climate risk peculiarity makes the chances, amount, and timing of impacts on firms diffuse and hard to estimate. The probability of certain risks consequences for this industry cannot be forecasted only objectively on the basis of historical-statistical data. Due to pricing based on historical data, insurance companies are not able to fully factor in abrupt changes in weather risks that occur within one year since direct and indirect effects of climate change are progressively reducing their predictability of damages. In the late 1980s and early 1990s, traditional risk assessment approaches founded on loss finance data have started to be considered inadequate to handle exceptional, dangerous and emerging risks. Therefore, the industry has converted its approach and, through the use of science, have started to implement systems models and scenarios to better understand current risk distributions and boundaries. Risk management focused on these metrics aims to guarantee that insurers remain solvent and can fulfil their commitments even in the worst years[236].

Alterations of the expectations can frequently happen; however, they are not always reflected in premium adjustments for the fear of losing clients. The price of insurance policies can be evaluated in two different ways: based on risk proportionally or based on a defined average price that reallocates the risk

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[236] David King, Daniel Schrag, Zhou Dadi, Qi Ye and Arunabha Ghosh. 2015. *Climate change: a risk assessment.* See: http://www.csap.cam.ac.uk/media/uploads/files/1/climate-change--a-risk-assessment-v9-spreads.pdf

mutualistically among the most vulnerable population and the less exposed. There are still lot of information deficits that should be considered such as climate change evolution and decision on climate policies. Big reinsurance companies can take advantages by diversifying their risks on a global scale and have access to better information.

The experience of the insurance industry has been taken as an example by other institutions. For these reason, banks, pension funds and asset managers rely on the knowledge of the insurance industry and consider if the companies where they have invested have adequately been insured for climate change damages. Reinsurance companies for instance can communicate their climate risks data to other financial institutions through the publication of reports, or by sharing platform, or implicitly through premium price. Based on the benefits that derive from the right pricing of own operational activities, these companies might send out signals that facilitate the factoring in of climate risks for investors. Especially in recent years several hundred companies have started to report to CDP yearly, and other companies provide annual- and/or sustainability reports[237].

Furthermore, since the 1990s, insurances and reinsurances have also used so-called natural catastrophe bonds (nat cat bonds) to outsource risk (see chapter 2). These instruments have seen a particularly strong expansion after the hurricanes in 2004/2005 in the USA. On one side, insurers see catastrophe bonds quite attractive since they decrease the risks of loss in the event of disasters. As it has been explained in chapter 2, the insurer takes only a part of the risk. On the other side, investors find interestingly catastrophe bonds because catastrophe risks are scarcely correlated with other financial market risks such as currency risks[238].

As already mentioned in chapter 3, The Lab has projected a financial instrument, called OASIS Platform for Catastrophe and Climate Risk

[237] V. Lutz, M. Stadelmann. 2016. Ibid.

[238] IPCC. 2014. Summary for Policymakers. *Ibid.*

Assessment, which aims to offer a more clear, robust and complete approach for investigating and pricing risk from extreme events. The Platform could support climate resilience by helping developing countries improving their knowledge to narrow the gap between insured and uninsured losses. It is expected that this platform can directly save re/insurers 25-50% in modeling costs and foster USD 1-9 million in new risk model development[239]. Moreover, it can promote investment in property insurance coverage and help spreading the use of catastrophe risk modeling beyond the insurance industry for risk-informed decision-making.

4.5.1.4 Investment Planning Data

Preqin is an alternative assets industry's source of data and intelligence and it provides information thanks to multilingual analysts that are strategically placed in key industry centers across the world. It has been showed in different market research that in 2015 the average capital allocation to infrastructure is 6.4%[240]. In 2016 the average allocation stands at 4.3% of total assets under management, showing a slight decrease with respect to the previous year[241]. This might be the reflection of the probable impact on revenues of rising valuations of assets together with the constrained attractive investment available in the market. Indeed in 2016, the increased availability of debt financing and the increase number of investors searching for investments in infrastructure have augmented the competition, that, as a consequence, has risen prices of

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[239] EIT. Climate-KIC. 2016. *Climate-KIC project OASIS one of four new financial instruments endorsed by The Global Innovation Lab for Climate Finance.* See: https://www.climate-kic.org/news/climate-kic-project-oasis-one-of-four-new-financial-instruments-endorsed-by-the-global-innovation-lab-for-climate-finance/

[240] Preqin. 2015. Infrastructure Spotlight. June 2015. Available at: https://www.preqin.com/docs/newsletters/inf/preqin- infrastructure-spotlight-june-2015.pdf.

[241] Preqin. 2016. The 2016 Preqin Global Infrastructure Report – Sample pages. Available at: http://docs.preqin.com/samples/2016-Preqin-Global-Infrastructure-Report-Sample-Pages.pdf

infrastructure assets. Even if in recent years investments in infrastructures have showed strong returns, high prices (due to the increased research for asset), they might have cancelled positive returns. Nevertheless, international policies could have a certain influence in fostering investments for improvements on existing infrastructure as well as it has been fostered at the Paris Agreement.

The 54% of fund managers thought that they have more difficulties for discovering attractive investment opportunities with respect to previous years[242]. The positive aspect, according to this, is that managers have started to look outside the traditional developed markets (such as those in Europe or in North America) and this can be a good chance for developing countries to foster their investments attractivity. Moreover, considering that several countries had significant budgets deficit, it is most likely that a huge part of projects would be capitalized by the private sector and governments should give incentives to facilitate this process.

However, according to Bradford T. Nordholm, the CEO & Managing Director of the Starwood Energy Group: "There are huge opportunities. It is estimated that over the next 10 years, there will be approximately $300bn of new investment opportunities in electric power generation infrastructure[243]." In 2015 research on infrastructure investments, has emerged that for the 76% of investors their expectations have been completely satisfied.

As showed in **figure 22**, the majority of investors (52%) have declared that they want to increase infrastructure allocation in the long-run. Thi percentage has even increased the following year when investors have declared to be 89% satisfied from their investment performances[244].

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[242] Preqin. 2017. The 2017 Preqin Global Infrastructure Report – Sample Pages. Available at: http://docs.preqin.com/reports/2017-Preqin-Global-Infrastructure-Report-Sample-Pages.pdf

[243] Preqin. 2016. Ibid.

[244] Preqin. 2017. Ibid.

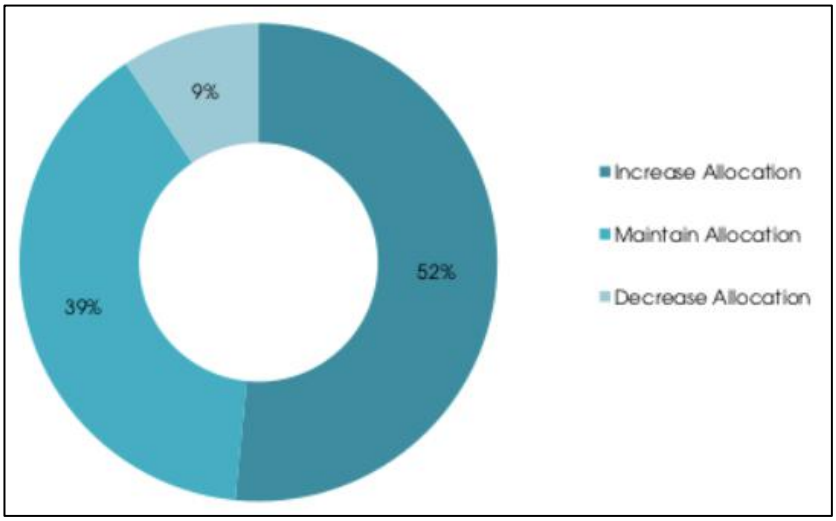

Figure 22: Investors' Intentions for Their Infrastructure Allocations in the Longer Term. Source: Preqin Investors Interview. December 2015.

4.5.1.5 Barrier to investments

The current level of investments in renewable energy and energy conservation is not enough to reduce emission as targeted in the Paris climate change agreement. This has created a clean energy investment gap that may have caused countries to miss chances of improving energy security, creating new working opportunities and fostering innovation[245]. As it is showed in **figure 23**, in order to reach the Paris climate goals, investment in new renewable power generation should rise 75% above the existing projected trajectory.

The reason why investment in infrastructure has not spread is because investors may find many barriers such as uncertainty in the policy environment, scarce policy support, absence of feasible financial vehicles that help proving liquidity, easy access to objective information and quality data and underlying risks.

[245] IIGCC, INCR, UNEP FI. 2011. *Investment-grade climate change policy: financing the transition to a low-carbon economy*. September 2011.

Figure 23: Forecast total investment in low carbon energy Vs investment needed to keep to 2°C. Source: Blooomberg New Energy Finance (BNEF) forecast of total investment in lower-carbon generation (US$ billion, real). From the report Mapping the Gap: The Road from Paris.

As it is showed in figure 23, current efforts made by capital markets towards a lower-carbon emission economy aren't enough[246]. There are certain financial markets imperfections and some economic policies deficits that don't allow that transition.

Investors interested in energy sector-related investments may face a series of risks that often reduce their incentive to finance the project. For example, some risks are outside the control of the investor (e.g. wholesale electricity prices, government policy, market conditions), whereas others concerning the technology considered can be managed (e.g. load factor, technology maturity, cost structure). Together, those risks may have impacts on both sides of the investment equation: costs (capital and operating) and sales (prices, volumes, timing of sales)[247].

Finally, there may be the problem that green investments often demand relatively extraordinary initial investment costs that only distribute yields from

[246] Dnb. 2017. "*Bottlenecks in funding of green investments*. *DNBulletin*. January 2017.
[247] IIGCC, INCR, UNEP FI. 2011. *Ibid*.

long to very long term, which exposes banks and investors to relatively high liquidity risks. Moreover, since current investment projects are often financed through debt, this makes the return on equity less attractive for private investors. To attract more private capital, it is necessary to value positive externalities of green investment for instance under the lens of social welfare and environmental improvements. According to this, public entities must play a key role in launching mechanisms that offer financial compensation for the positive impacts made by the green energy in particular and sustainable investment in general[248]. Climate change is more often seen as a business occasion for investors to help protecting the world while undertaking profitable actions. As it has been analyzed in chapter 2, one of the most favorable chances is green bonds. It has been seen as a key private sector solution that might help finance favoring the world's transition to a low-carbon economy[249].

4.5.2 Risk Management

The Global Risk Report from the World Economic Forum in 2016 has declared that a "failure of climate change mitigation and adaptation has risen to the top and is perceived in 2016 as the most impactful risk for the years to come[250]". Now, there is the increasing consciousness that traditional methods are no more enough for dealing with climate threats. On one side, the bank of England has identified three types of risks for financial institutions as it has been analyzed in paragraph 4.4. On the other side, companies have understood that they should implement a robust and integrated framework to monitor, report

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[248] S. Ben Hadj, J. De Mulder, M.-D. Zachary. 2017. Sustainable and green finance: exploring new markets. September 2017.

[249] See:
https://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/perspectives/perspectives-i1c2

[250] World Economic Forum. 2016. *Ibid.*

and regularly reassess climate change risk. The following actions help firms in risk management:

- They should consider material climate change risk that may affect their business.
- They should consider relevant risk adaptation and mitigation measures. According to this, the following actions may be undertaken: increasing the use of less carbon-intensive raw materials, optimizing the logistic and the distribution system and broadly speaking restructure business.
- In particular they should define and monitor material climate change risk in their supply chains. Particular attention should be paid to the procurement process for products and services and to the implementation of the best environmental practices in supply chain management systems.

4.5.3 Reporting

In recent years, companies have understood that in order to take better financial decisions, it is essential to start considering social and environmental factors. Becoming transparent firms has become a critical factor for business sustainability, in particular, they should outline their business strategy concerning climate-change-related policies. Companies should try to reach business transparency with respect to investors in order to defend their sustainability credentials and avoid claims. If they communicate with investors in a transparent manner; create robust management processes and controls; and improve methods to measure, track and report on environmental results, they can reach better performance[251].

The following actions have been suggested to firms in order to report material climate change risks:

[251] BMO. Global Asset Management. 2015. Green bonds: financing the transition to a new economy. November 2015. See: https://bmogamviewpoints.com/wp-content/uploads/2015/11/BMO-Responsible-Invest-Persp-Green-Bonds-V4.pdf

- They should publish on their website the strategy on how they want to address physical and transition climate change risks and opportunities. In particular, they must bring into line their criteria with recent standards set by the TCFD recommendations.
- Firms should consider international accepted reporting as a way to enable investors to take informed decisions and to give them the possibility to analyze their portfolio greenhouse gas emissions. As The Norges Bank Investment Management has said: "*companies should report greenhouse gas emissions to appropriate, internationally recognized reporting initiatives to better enable investors to analyze portfolio greenhouse gas emissions*"[252]. Moreover, reporting information can be useful for consumers to choose the right financial products and regulators to measure the threat for the financial system from sustainability-related constraints.

4.6 Brief History on Reporting

Reports on the social and environmental factors has started in the 1980s by several companies belonging to the chemical industry. Reports on non-financial figures have increased their spread over the last twenty years. Environmental, human rights and corporate accountability issues have started to be analyzed in the Global Reporting Initiative Standard, which has been pioneered of sustainability reporting since the late 1990s. More recently, has emerged between companies the idea that they should also explicitly report on their strategies on how they are going to deal with their climate risk mitigation responsibilities[253].

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[252] Norges Bank Investment Management. 2017. *Climate Change Strategy. Expectations to companies.* Available at: https://www.nbim.no/globalassets/documents/climate-change-strategy-document.pdf?id=5931

[253] Financial Stability Board Task Force on Climate-related Financial Disclosures. 2016. "*Phase I Report of the Task Force on Climate-related Financial Disclosures*". See: https://www.fsbtcfd.org/wp-content/uploads/2016/03/Phase_I_Report_v15.pdf.

Indeed, companies have started to consider how to monitor greenhouse gas emissions associated with their primary activities because this relation can have huge impacts on business costs. To facilitate this control, a serial of benchmarks and targets have been identified in order to help the board in its valuation. Companies should prepare the description of the criteria used for deciding appropriate metrics.

The Greenhouse Gas Protocol, for instance, has suggested that companies should disclose in annual reports or on the website the absolute and relative greenhouse gas emissions. GHG Protocol has been developed when in the late 1990s, the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), felt the necessity of international standard for corporate GHG accounting and reporting. In September 2014, the Principles for Responsible Investment (PRI) network have launched the Montreal Carbon Pledge. It is a commitment by investors (more than 120 investors worldwide have joined the pledge by the time of COP 21 in December 2015), with the object to disclose the carbon footprint of their equities portfolio and to publish relative amounts. Investors have the willingness to understand their portfolio's carbon footprint in order to find which are the key areas for reducing emissions according to their business. They want to be able to track progress in making these reductions, prove a public obligation to addressing climate change, and address stakeholder interests about climate change. Since an investment portfolio may be exposed to risks on one side and present opportunities related to climate change on the other side, understanding both the features could lead to better investment returns[254].

Moreover, the Paris Agreement in December 2015 committed to participants precise climate goals. In that occasion, the GHG Protocol, has been essential with its standards and tools for helping countries and cities to track their progresses towards those objectives[255]. The transition to a lower-carbon economy

[254] See: https://www.investopedia.com/terms/m/montreal-carbon-pledge.asp

[255] See: https://ghgprotocol.org/about-us

needs substantial changes across economic sectors and industries. For this reason, financial policymakers (such as the G20 Finance Ministers and Central Bank Governors), with the purpose to avoid losses in assets, have asked the Financial Stability Board to elaborate a method that can force financial sector to take into account of climate-related issues. In order to collect the information relevant for investors, lenders, and insurance underwriters to appropriately assess and price climate-related risks and opportunities, the Financial Stability Board, in December 2015, has established an industry-led task force: the Task Force on Climate-related Financial Disclosures (Task Force)[256].

At the beginning, the Task Force has made a deep analysis of the landscape of climate-related disclosures of the time, in order to be able to identify what aspect countries have in common, what are the differences with respect to parameters used and which are the areas for improvement. The main goal of the Task Force has been to design a coordinate mechanism that can evaluate relevant climate-related financial risks and opportunities for both non-financial and financial companies[257]. It has underlined the fundamental role assumed by reporting mechanisms and represented one of the most important steps towards a unified disclosure code across countries.

According to the UNEP Inquiry into the Design of a Sustainable System the critical themes concerning reporting are explained in **table 4**:

Action Area	**Current Reporting Dimension**	**Sustainability Agreement**
Reallocation	Corporate disclosure, listing	Enhancing reporting on stock exchanges on a broad range of sustainability factors, clear

[256] TCFD. 2017. Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures. June 2017. Available at: https://www.fsb-tcfd.org/wp-content/uploads/2017/06/FINAL-TCFD-Report-062817.pdf

[257] Financial Stability Board Task Force on Climate-related Financial Disclosures. 2016. *Ibid.*

	rules, exchanges, products, ratings, and research	disclosure for environmental assets (such as green bonds), transparency on sustainability in investment research.
Risk	Reporting on prudential risks through national and EU risk frameworks	Integrating sustainability factors into risk reporting at firm and system levels across asset classes. Transparency by credit rating agencies on ESG factors. Reporting by financial regulators on aggregate risks and performance.
Responsibility	Reporting by financial institutions to shareholders and beneficiaries	Reporting on sustainability policies, strategy and performance across portfolios and products as well as at the institutional level.

Table 4. The Role of Reporting in a Sustainable Financial System. Source: MATTM & United Nations Environment Programme, 2017. Financing the Future. Report on the Italian National Dialogue on Sustainable Finance.

The Task Force's report has suggested on how to disclose clear, comparable and coherent information on climate-change-related *risks* and opportunities. By adopting these suggestions, companies have been able to enhance their *responsibility* concerning climate issues. Furthermore, this has led corporations to be able to *reallocate* capital more efficiently.

- *Reallocation*: Several estimates have suggested that US$5-7 trillion a year is needed to realize the SDGs globally[258]. The EU's Capital Markets Union also has recognized the critical role that financial markets have assumed for mobilizing capital for sustainable development[259]. In order to

[258] UNCTAD. 2014. World Investment Report 2014: Investing in the SDGs. http://unctad.org/en/pages/ PublicationWeb yer.aspx?publicationid=937

[259] UNEP Inquiry/2 Degrees Investing Initiative (2016). *Building a Sustainable Financial System in the European Union: The Five 'R's of Market and Policy Innovation for the Green Transition.* UNEP Inquiry/2 Degrees Investing Initiative. http://unepinquiry.org/wp-content/uploads/2016/04/Building _a_Sustainable_Financial_System_in_the_European_ Union.pdf.

reallocate capital to develop a more sustainable world economy, reporting mechanisms are essential to promote and enhance the access to green finance. Especially in developing countries, where local financial institution presence in the country is weak, the strategic use of reports and resources coming from Multilateral Development Banks and Development Financial Institution is important. Another priority is to finance sustainable infrastructure projects (for instance has been estimated that in the following 15 years, the world will need to invest around US$90 trillion in sustainable infrastructure assets[260]) and foster clean tech innovation (innovation in finance must be improved in both quality and quantity terms as it has been seen in Chapter 2). In Paris, this need has been satisfied with the launch of Mission Innovation, a new platform sustained by 20 countries to accelerate global clean energy[261]. Innovation in financial technology (fintech) has the double benefits of bringing down costs and to facilitate the access to sustainable solutions.

- *Risk*: in recent times, systemic risk management has become necessary as it has been explained in previous paragraphs. The new framework in the financial system should incorporate macroprudential and systemic risk factors when it is subject to climate change issues. This revolution is something that had impacts on insurance companies and credit rating agencies too. The first are particularly tackled by climate change and other environmental challenges[262]. The latter have decided to integrate ESG factors into their evaluation of creditworthiness of bonds[263]. Moreover, national, regional and international financial institutions at the Paris

[260] Brookings, New Climate Economy and LSE. 2015. Driving Sustainable Development through Better Infrastructure. See: http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2015/07/Bhattacharya-et-al.-2015.pdf

[261] See: http://www.mission-innovation.net/

[262] See: http://www.unep.org/psi/commitments/

[263] See: http://www.unep.org/newscentre/Default.aspx?DocumentID=27074&ArticleID=36196

Agreement have been asked to report on how their financial plans incorporated climate-proofing factors[264] and to share experience and develop common approaches.

- *Responsibility*: aligning financial responsibility with sustainable development is something crucial for the stability of financial markets. Growing numbers of financial institutions have started to adopt shared principles that may help them integrating ESG factors. The UNEP Finance Initiative in 2005 has committed to the law firm Freshfields Bruckhaus Deringer a report in which it has been written that responsible investments are those that integrate ESG principles in the investment decision-process. Because of that report, several governments have announced that ESG issues must be considered when dealing with investment decision-making[265]. OECD have implemented for financial actors, a multi-stakeholder process with the right tips with respect to due diligence[266]. Policymakers have supported this process underling how core responsibilities are connected to sustainability factors (notably fiduciary duty for investors, corporate governance for enterprises). Considering sustainability is something that is always most likely part of the fiduciary duty and other obligations of institutional investors. From a 2015 report by Oxford University and Arabesque Asset Management, relying on more than 200 academic studies, industry reports, newspaper articles and books, has emerged that 88% of the research examined has showed "solid ESG practices" by companies and this has led to better operational performance. Moreover, the 80% of the studies analyzed has revealed that a company's stock performance is positively influenced by

[264] UNFCCC. 2016. Decision Adopting the Paris Agreement, paragraph 43. December 2015. Available at: https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf

[265] New Climate Economy. 2016. *Ibid.*

[266] See: http://mneguidelines.oecd.org/rbc- nancial-sector.htm

good sustainability practices[267]. A study performed by Deutsche Bank in 2012, based on more than 100 academic studies, have discovered that ESG factors are correlated with superior risk-adjusted returns[268]. Disclosure is necessary not only for corporations but also for financial institutions and for companies' clients in order to understand whether ESG factors are being properly managed and this can turn into positive financial returns. Significantly, the TCFD highlighted the importance of forward-looking disclosures as well as reporting on past performance[269]. Measuring progress is one of the basic preconditions towards sustainable development, according to national and international experts. Progress on this purpose, concerning financial innovation and the increased awareness related to climate change threats, may help closing the gap between financial investments done and the remaining part needed to exploit the transition to a prosperous, inclusive and sustainable economy.

Next chapter would analyze the Italian context concerning climate finance. The purpose is to reflect on results that have been already achieved and to identify initiatives that can be implemented in order to encourage all actors in the financial community to make the Italian financial market more active, pioneering and with appealing in sustainability terms.

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[267] Clark, Feiner, Viehs. 2015. *From the stockholder to the stakeholder. How sustainability can drive financial outperformance.* March 2015. Available at: https://arabesque.com/research/From_the_stockholder_to_the_stakeholder_web.pdf

[268] Deutsche Bank's 2012 report, "*Sustainable Investing: Establishing Long-Term Value and Performance*". 2012. Available at: https:// institutional.deutscheam.com/content/_media/Sustainable_ Investing_2012.pdf

[269] MATTM & United Nations Environment Programme. 2017. *Financing the Future. Report of the Italian National Dialogue on Sustainable Finance*. Available at: http://www.minambiente.it/sites/default/files/archivio/allegati/sviluppo_sostenibile/Financing_the_Future_EN.pdf

CHAPTER 5

CLIMATE FINANCE IN ITALY

In previous chapters it has been highly demonstrated that the world transition to a lower carbon economy is something crucial to fight climate change. For this reason, several global policies have promoted less carbon-intensive production and consumption of energy. Since climate change is determined by greenhouse gas emissions from human activities, one of the main global targets adopted has been to cut those emissions. In the second point in the Copenhagen Accord it has been declared by Member States that they: "*agree that deep cuts in global emissions are required according to science*". They would follow the indications documented in the IPCC Fourth Assessment Report in order to maintain the risen in global temperature below 2°C. The Member States' statement continues declaring that they would cooperate in order to develop a low-emission strategy since it is inevitable for sustainable development[270]".

The EU is an ambitious contributor to the global efforts to combat climate change and diminish GHG emissions. It has indeed declared, in 2015, that it has reduced its GHG emissions by 22% compared to 1990 levels and thus already achieved and surpassed its 2020 target of a 20% reduction[271]. As it can be seen in **figure 23b**, Europe was historically most responsible for climate change. The past intensity levels of industry and wealth in developed countries amounted to the 79% of the emissions from 1850 to 2011, overall considered.

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[270] UNFCCC. 2010. *Report of the Conference of the Parties on its fifteenth session, held in Copenhagen from 7 to 19 December 2009*. FCCC/CP/2009/11/Add.1 30 March 2010

[271] Eurostat Statistical Books. 2017. Sustainable development in the European Union. Monitoring report on progress towards the SDGs in an EU context. Luxembourg. Publications Office of the European Union. November 2017.

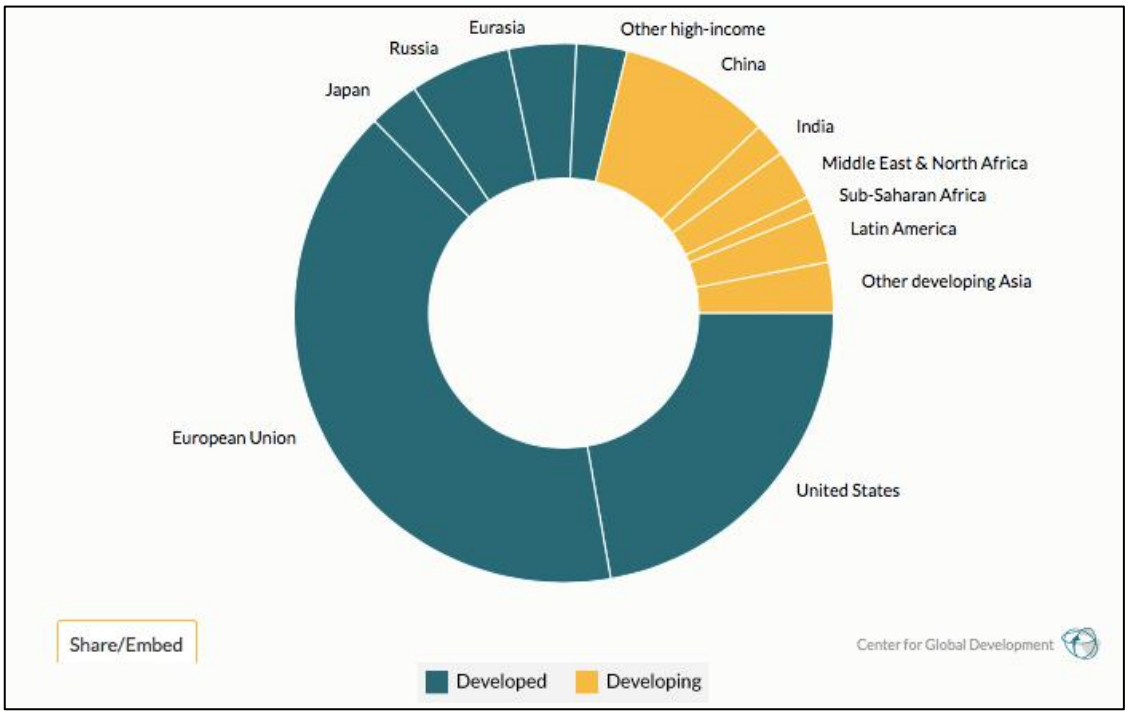

Figure 23b: Who caused climate change historically, CO2 emissions. Source: Center and Global Development, See: https://www.cgdev.org/blog/climate-change-and-development-three-charts

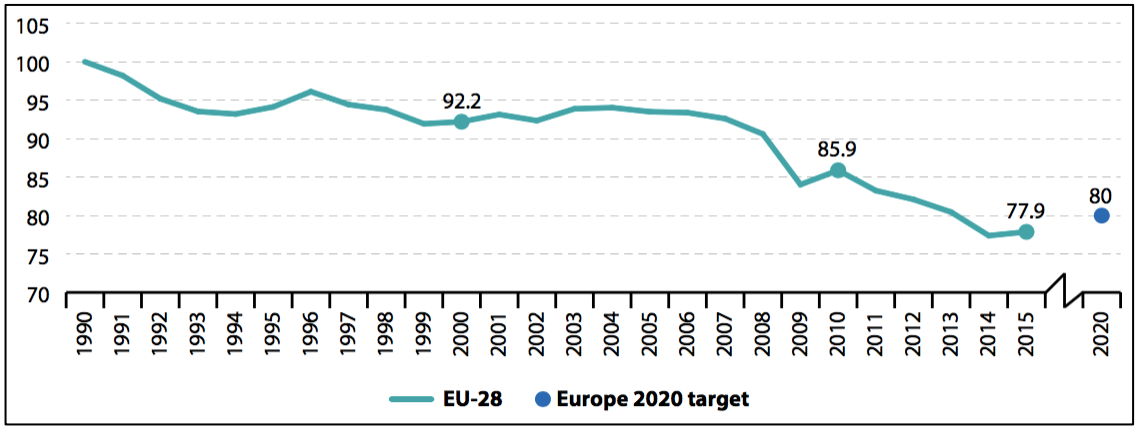

Figure 24: Greenhouse gas emissions, EU-28, 1990-2015 (index 1990=100). Note: Total emissions, including international aviation and indirect CO2, but excluding emissions from land use, land use change, and forestry (LULUCF). Source: European Environment Agency (EEA) (Eurostat online data code: sdg_13_10)

The fall in total GHG emissions can be addressed to improvements in energy efficiency and in energy mix. Besides those, other main driving forces can reflect their impacts on GHG emission levels: more efficient industries, technological changes and innovations (allowing the consumption of less energy for the production of more products and services), decreased carbon footprint of

the waste sector, reduction of livestock in agriculture and the use of nitrogenous fertilizers[272]. Furthermore, between 2008 and 2009 the economic crisis has reduced industrial production, transport volumes and energy demand sharply, causing the decline in GHG emissions. Finally, in marginal part, unprecedentedly high average annual temperature and winters in 2014 and 2015, characterized by particular warm temperatures, has decreased the fuel consumption for heating.

Linked to innovation, it can be said that the EU success in GHG emission policies is directly connected to the uptake of renewable energy. The Paris Climate Agreement of 2015 has indicated that the world might be able to fight climate change if it shifts from a fossil fuel-based economy toward a low-carbon one. Carbon risk has been proved in chapter 2 (see discussion on stranded assets) to be a tangible problem, and investors have decided to gradually diminish fossil fuels investments in favor of green technology. The accord has raised awareness about the opportunities that derive from renewables and the benefits that derive from energy efficiency. The EU has indeed highlighted the relevance of renewable energies for mitigating climate change impacts and for facilitating the decarbonization of the system.

5.1 Renewable sector in Europe

Since 2004, the EU has constantly increased the share of renewables in energy consumption. Renewable capacity in the EU has augmented by 71% between 2005 and 2015. It has caused the double positive effect to contribute to sustainable development and to create more local jobs. Meanwhile, the continent has seen increasing its economic growth, meaning that, the energy transformation, can trigger economic prosperity while limiting carbon emissions.

[272] Eurostat. 2017. Climate change – driving forces. See: https://ec.europa.eu/eurostat/statistics-explained/index.php/Climate_change_-_driving_forces

According to this, cooperation on European level (but also on global level) is essential to ensure the implementation of sufficient action to avoid catastrophic climate change impacts. Moreover, the shift towards renewable energy has the inner potential to slowly diminish the continent's dependence on external providers (Europe imports 54% of its energy) and reinforce its energy security.

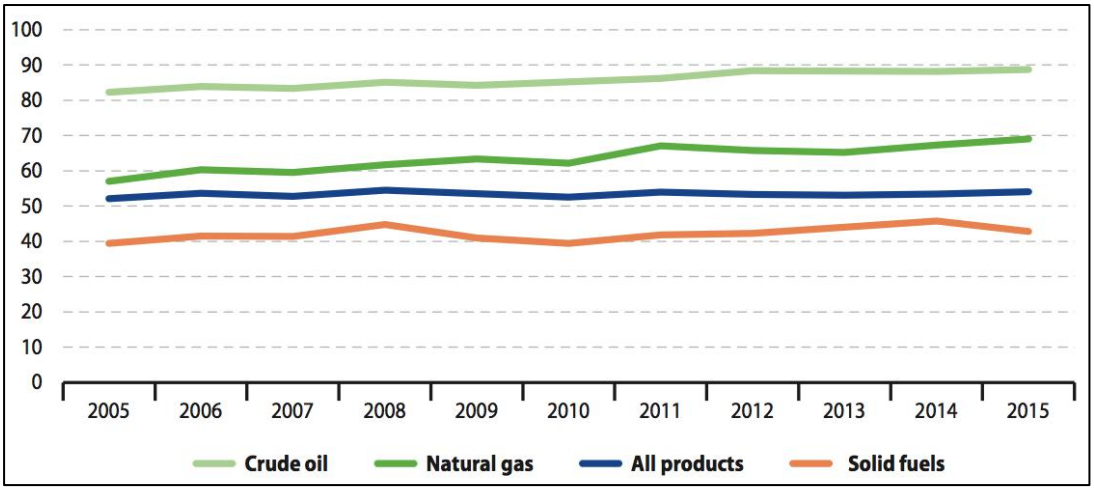

Figure 25: Energy dependency rate, EU-28, 2005-2015 (% of net imports in gross inland consumption and bunkers, based on tonnes of oil equivalent). Source: Eurostat (online data codes: nrg_100a, nrg_102a and nrg_103a)

In 2014, the EU has adopted its 2030 energy and climate framework called "The clean energy package". It has the goals of reducing GHG emissions of at least 40% (with respect to 1990 levels), reaching at least 27% the share for renewables in the energy sector and improving at least 27% in energy efficiency. However, those objectives have not been enough to fulfil the EU's targets under the Paris Agreement[273]. For this reason, another "Clean energy for all Europeans" package has been introduced in 2016. It has the objective to try to align EU internal energy legislation with its Paris commitment.

[273] EU commission. Energy, climate change, environment. Climate action. EU action. Climate strategies & targets. 2030 climate & energy framework. See: https://ec.europa.eu/clima/policies/strategies/2030_en

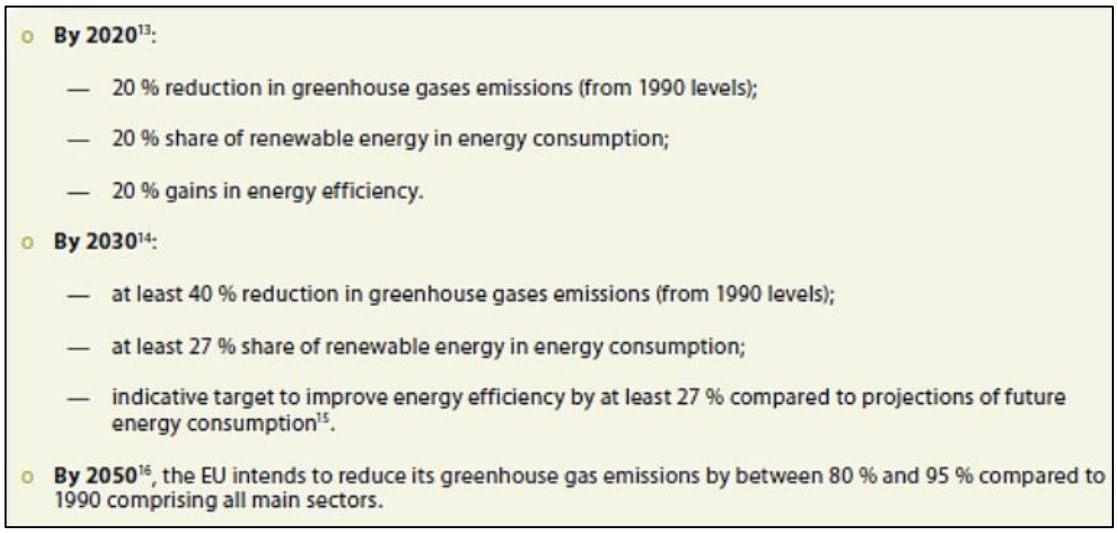

Figure 26: EU targets for reducing greenhouse gas emissions. Source: Court of Auditors' special report 31/2016 "Spending at least one euro in every five from the EU budget on climate action: ambitious work underway, but serious risk of falling short"

The EU, through its proposals, has established the basic conditions for implementing the low-emission mobility. It had also a longer-term perspective set out in the "Roadmap for moving to a competitive low carbon economy in 2050", in which it has decided to cut its GHG emissions by 80% by the middle of the century with respect to 1990 levels[274]. Renewables have assumed a notable role in making the EU a worldwide innovator in development. EU countries own 30% of the patents in renewable energy worldwide and they have demonstrated their real pioneer intentions to stay ahead by maintaining the priority on research and innovation in the expected future. Thus, the EU's biggest research program, called "Horizon 2020", has predicted to allocate 6 billion euros to renewable energy for the period 2014-2020[275]. Europe has a historic mission to represents a global model for energy transition and green innovation and to limit global

[274] EU commission. Energy, climate change, environment. Climate action. EU action. Climate strategies & targets. 2050 low-carbon economy. See: https://ec.europa.eu/clima/policies/strategies/2050_en

[275] See: https://ec.europa.eu/energy/en/funding-and-contracts

warming[276]. There is still lot of work to do, but the European continent is now in a position to become a global leader in green energy.

5.2 Renewable sector in Italy

Italy is the world's eighth largest economy, the third largest in the Eurozone and will soon be the third largest EU Member State after the UK decision to exit the European Union. However, in recent years, its economy has faced hard times characterized by youth unemployment and emigration of skilled workers[277]. The Italian economy is struggling to exit from a long recession caused by fiscal austerity, weak business and consumer confidence, deteriorating labor market conditions, slow wage growth and hard credit conditions[278]. Luckily, it has started to slowly recover from that recession and one of its leading sectors is the energy one. It has been showed that, contributing to increase competitiveness, making a more sustainable economy and improving energy system (through improvements in energy efficiency and renewable energies), had produced a positive effect in terms of country's levels of employment[279].

However, in the international context it has gone unnoticed that Italy has achieved the biggest results in terms of renewable energy and energy efficiency. Italian energy intensity is 18% less than the EU 28 average and it is the second largest producer in Europe in renewable energy[280] **(see Figure 27)**.

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[276] R. Bertram, R. Primova. 2018. *The Energy Atlas 2018*. Heinrich Bo ll Foundation, Germany. Friends of the Earth Europe, Belgium. European Renewable Energies Federation, Belgium. Green European Foundation, Luxembourg. April 2018.

[277] Coletto Diego. 2010. Effects of economic crisis on Italian economy. Eurofound, Wyattville Road, Loughlinstown, Co. Dublin, D18 KP65, Ireland. See: https://www.eurofound.europa.eu/publications/article/2010/effects-of-economic-crisis-on-italian-economy

[278] EIU. 2015. *Country Report Italy*. The Economist Intelligence Unit Limited, London.

[279] MEC e MATTM. Italy' s National Energy Strategy 2017. See: http://www.sviluppoeconomico.gov.it/images/stories/documenti/BROCHURE_ENG_SEN.PDF

[280] Eurostat (2017), Energy Data: Main tables〔nrg107a〕

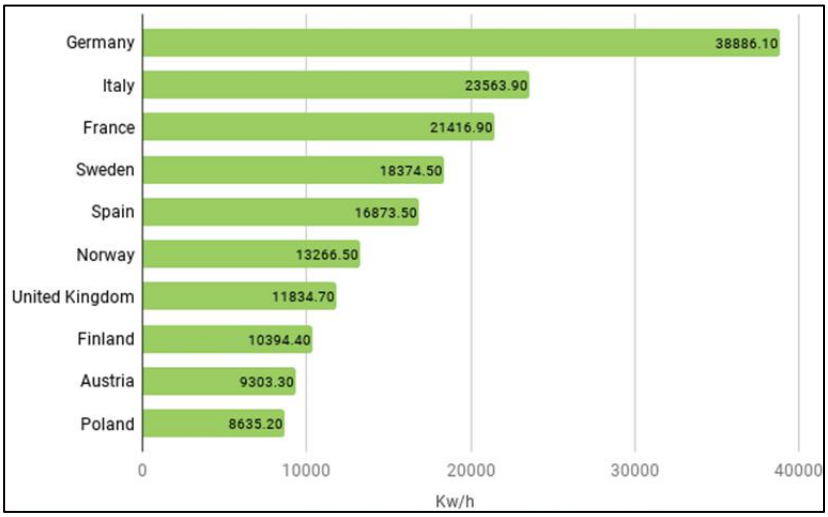

Figure 27: Top 10 European Countries by Produced Renewable Energy. Source: https://www.greenmatch.co.uk/blog/2017/07/top-eu-countries-in-clean-energy

Moreover, it is the fifth country in the world for largest solar photovoltaic capacity[281] **(see table 5).** Italy's National Energy Strategy 2017 indeed has presented actions that must be implemented for the 2030 target. Those objectives are in line with the long-term scenario planned in the EU Energy Roadmap 2050[282]. Italy has been an early adopter of the renewable energy system and this has helped the country to reach its 2020 EU energy targets in 2014.

Ranking by Total Capacity		
China	34.5	77.4
Japan	8.6	42.8
Germany	1.5	41.3
USA	14.8	40.9
Italy	**0.4**	**19.3**
Great Britain	2.0	11.7
India	4.1	9.1
France	0.6	7.1
Australia	0.9	5.8
World Total	75	303

Table 5: Solar PV Global Capacity (Top Countries in 2016). Source: REN21 2017

[281] REN21 (2017), 'Renewables 2017: Global status report'.

[282] MEC e MATTM. Italy's National Energy Strategy 2017. See: http://www.sviluppoeconomico.gov.it/images/stories/documenti/BROCHURE_ENG_SEN.PDF

It can be said that, among the 28 EU Member States, eleven have already reached the level required to meet their national 2020 targets: Bulgaria, the Czech Republic, Denmark, Estonia, Croatia, Italy (in 2015), Lithuania, Hungary, Romania, Finland and Sweden **(see figure 28).** Even if 2020 Energy targets have already been achieved (satisfying objectives concerning the transition of the energy sector), other efforts are still required from Italian government policies concerning climate risk.

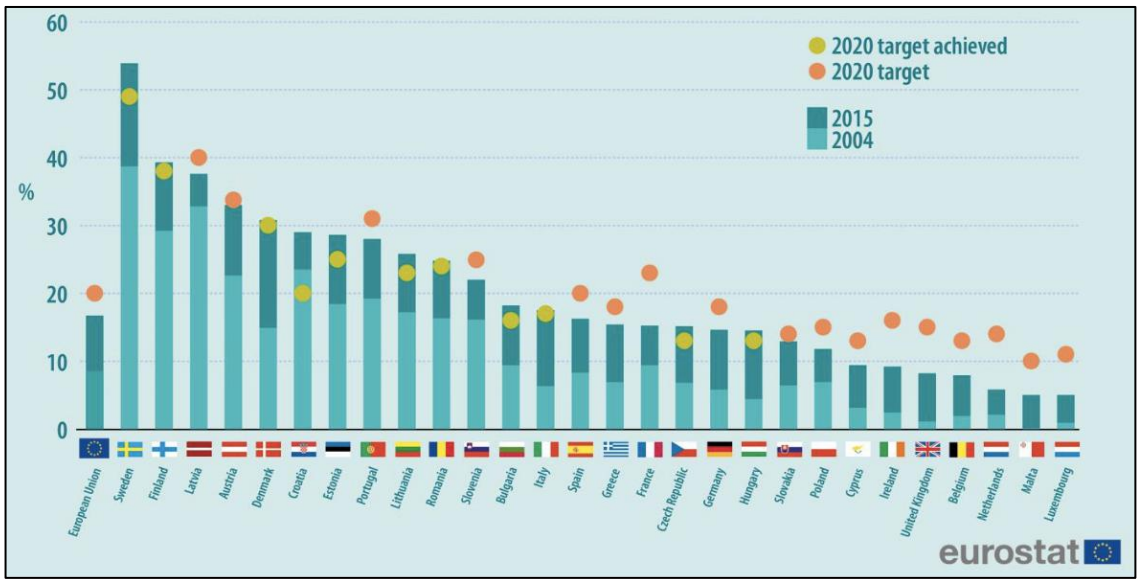

Figure 28: Share of energy from renewable sources in the EU Member States (in % of gross final energy consumption). Source: Eurostat 2017.

5.3 Italian vulnerability to climate change

Within Europe, Italy is one of the most vulnerable countries with respect to climate impacts. Its geographical configuration is one of the reasons why it is highly exposed to natural disasters (comprising floods, landslides, earthquakes and heatwaves). Climate change effects have aggravated those natural risks, in particular: extreme weather events, increased temperatures, more frequent severe droughts, coastal erosion and the rise in sea-level[283]. It must be underlined

[283] European Environment Agency. 2017. *Climate Change, Impacts and Vulnerability.*

the fact that geographical characteristics, especially of the North of the country, have determined its vulnerability to flooding from extreme weather.

Those events have caused huge economic losses since that area holds 40% of Italy's productive activities[284]. Total economic losses due to climate events amounted to €65 billion in the period 1980-2015. Water-related climate risk might have huge negative impacts on agriculture sector. During the summer 2017, the Italian agriculture sector has indeed experienced economic losses of 2€ billion[285]. Moreover, it can be said that climate changes can have huge negative consequences on the country's tourism sector, which corresponds to 11% of Italian GDP[286]. The coastal erosion (due to sea-level rise) and the loss of snow mass in the mountain, might have negative effects on the country attractivity for tourists. It has been forecasted that climate impacts on tourism might lead to decrease GDP levels up to 1% by 2050[287].

5.4 Climate-related economic losses

As it can be seen in **figure 29**, that between 1980 and 2015, the EU countries have experienced monetary losses that in major part (around the 86%) can be attributed to climate-related extreme events. It must be said that losses of human lives, cultural heritage or ecosystems services have not been considered in the graph. The figure has represented only economic losses deriving from monetized damages to certain assets. Governments have to reflect on the surprising fact that more than 70% of those losses have been caused by only 3% of disaster events. **Figure 30** is meaningful since it clearly reflects the fact that within Europe, Switzerland is the country that had the major economic losses due to climate-

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[284] Mosello. 2015. *How to deal with Climate Change? Institutional adaptive capacity as a means to promotes sustainable water governance*. Springer

[285] BBC. 2017. *Rome hit by water rationing as Italy struggles with drought.* BBC Europe. 24 July 2017,

[286] World Travel & Tourism Council. 2017. *Economic Impact 2017: Italy.*

[287] World Travel & Tourism Council. 2017. *Ibid.*

related extreme events. It can signal the fact that countries with the higher wealth standards would face the worst economic scenarios.

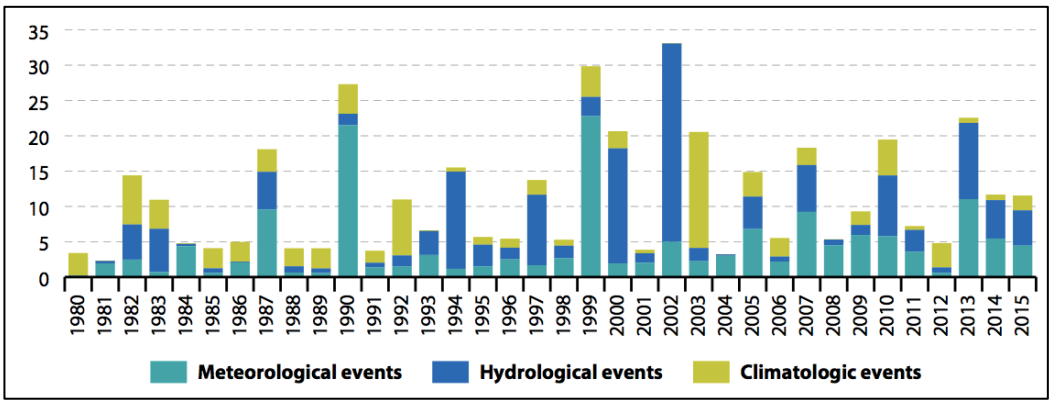

Figure 29: Climate-related economic losses, EU-28, 1980-2015 (billion EUR (2015 values). Source: European Environment Agency (EEA) (Eurostat online data code: sdg_13_40)

It is still not possible to determine with 100% of certainty the direct link between climate change and extreme events, however, several statistical attribution studies have demonstrated that those events have become more frequent and stronger as a consequence of global climate change[288].

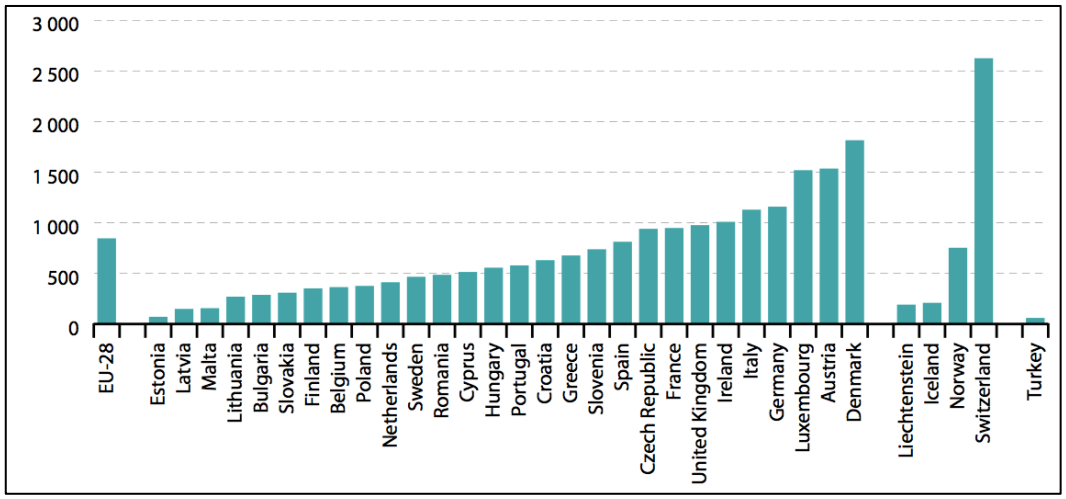

Figure 30: Climate-related economic losses, by country, 1980-2015 (cumulative losses since 1980 in EUR per capita (2015 values)). Source: European Environment Agency (EEA) (Eurostat online data code: sdg_13_40)

[288] EEA. 2017. *Economic losses from climate-related extremes*. February 2018. See: https://www.eea.europa.eu/data-and-maps/indicators/direct-losses-from-weather-disasters-3/assessment-1

5.5 Achieving low-carbon economy

In order to lead the transition toward a sustainable economic system, it is not sufficient to foster decarbonization of developed economies alone. Major efforts are needed in order to protect and revitalize the world ecosystem. The task of investing in the development of the world's poorest countries without increasing global emissions would require huge investments and financial support from developed countries.

To kick-start the transition, Heads of Government, Ministers and heads of other delegations, at the fifteenth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, held in Copenhagen in 2009, jointly have agreed to mobilize USD 100 billion dollars yearly by 2020 for climate finance (both adaptation and mitigation) actions in developing countries. The fulfilment of that target would be achieved from a wide variety of sources: private and public, bilateral and multilateral, including alternative financial sources. It was the first time in which that type of development assistance has not been seen in the conventional sense of the term, but it was meant as development assistance that would pay off globally. The scale, extent, and difficulty of the task has been unprecedented, but countries felt that they should face the challenge of climate change directly, since it would be the most difficult mission the world has ever encountered.

Since developed countries have contributed the most to greenhouse gas emissions (as it has been showed in **figure 23b**), the EU has decided to collaborate with developing countries to support their revolution towards a new and more sustainable energy system. Their efforts have been addressed toward the decarbonization of their energy mix, in order to decouple economic growth from increases in harmful emissions[289]. International cooperation has been discovered to play a key role and has been implemented in multiple areas simultaneously: for decreasing emissions, for developing R&D, and for financing investment and

[289] Eurostat Statistical Books. 2017. *Ibid.*

progress. Furthermore, the purposes of mitigation and adaptation have been followed with the objectives to contribute to resilience and to manage environmental risks in the weakest and most exposed regions of the world. In that way, it has been added an environmental component to the various actions taken by developed countries to strengthen social and economic cohesion, infrastructure and governance[290].

The sources and the quantity of flows for climate change mitigation and adaptation according to the objective to mobilize yearly $100 billion have been defined more specifically at the Conference of the Parties in Paris. Furthermore, in that occasion, it has been decided the way in which policy makers would try to recover losses and damages from climate change impacts. The reason why developed countries have decided to support developing countries relies on chapter 2, where it has been explained that less industrialized countries are those most tackled by climate change impacts. It is especially people in low- and middle- income countries that have been hit hardest and need help to become climate resilient **(see figure 31)**.

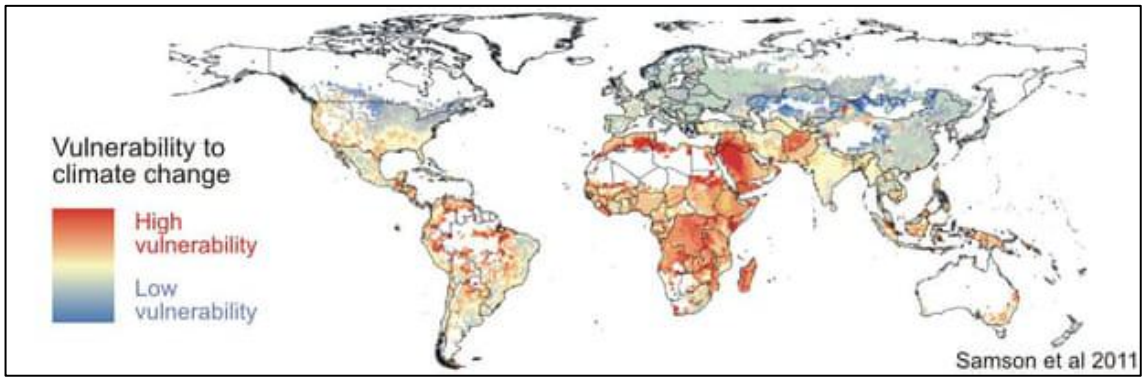

Figure 31: Vulnerability Index (bottom frame). Source: Samson et al 2011.

In Paris, developed countries strongly agreed to the implementation of a concrete roadmap to achieve the US$100 billion goal, by determining how they would increase financial flows and provide technology and capacity building support. In preparing the roadmap, countries have consulted expert from

[290] International Development Cooperation. Three-year Programming and policy planning document 2016-2018.

Organization for Economic Co-operation and Development (OECD) for their assistance.

The following actions represent the strategy that developed countries should implement in order to pursue the achievement of the US$100 billion goal and to help catalyze developing countries' efforts to a revolutionary transformation towards low emission, climate resilient societies. The US$100 billions roadmap is developed across four dimensions:

- Scaling-up public resources;
- Significantly increasing finance for adaptation:
- Using public finance and policy interventions to effectively mobilize private finance;
- Supporting enhanced access, capacity building, and investment readiness[291].

Table 6, collects the announcements declared by developed countries at the Conference of the Parties in Paris. Overall considered, in several analysis has emerged the fact that the public finance alone cannot bring about the transformation required. Private investment and international cooperation are two fundamental elements together with reporting framework implementation. Developed countries had indeed decided to work with all Parties to continue to improve the tracking of climate finance and to create a collectively agreed transparency framework under the Paris Agreement.

[291] See:
http://www4.unfccc.int/Submissions/Lists/OSPSubmissionUpload/261_295_131233554162587561-Roadmap%20to%20the%20US$100bn%20(UNFCCC).pdf

Country	Climate finance pledge - including information specific to adaptation, where available
Australia	Announced a AU$1 billion climate finance commitment over 5 years. We expect our pledge to be 100% grant-based finance. Australia will continue to prioritise adaptation, while being responsive to the needs and requests of developing country partners.
Austria	Austria will strive to provide at least half a billion euros in climate finance between 2015 and 2020 in addition to the current Austrian pledge to the GCF. We aspire to over-achieve the pledged amount in total climate finance. We are committed to achieving a balance between mitigation and adaptation in bilateral grant flows over time, while also taking into consideration priorities of individual partner countries.
Belgium	Belgium committed to provide €50 million a year until 2020.
Bulgaria	As a transition economy, Bulgaria can support the climate finance efforts on a voluntary basis. Bulgaria pledged US$100,000 to the Green Climate Fund in late 2015.
Canada	Canada has committed CAD$2.65 billion between 2015 and 2020 to support developing countries in their transition to clean and climate-resilient economies. Canada's contribution will scale up to CAD$800 million per year by 2020. As part of this pledge Canada already made announcements related to adaptation including CAD$300 million to the GCF, CAD$30 million to the LDCF, CAD$50 million for the G7 Climate Risk Insurance Initiative and CAD$10 million to the World Meteorological Organisations to support early warning systems.
Czech Republic	Annually, the Czech Republic will provide around US$5,000 thousands of climate financing through bilateral cooperation. Any further additional contribution to other multilateral funds such as the GCF or GEF beyond 2018 has not been decided yet.
Cyprus	The President of the Republic of Cyprus has made a pledge for €350.000 towards the Green Climate Fund (GCF) during the COP21 in Paris.
Denmark	Denmark announced it would commit DKK 270m (approximately US$38 million) in earmarked climate finance in 2016, including DKK 156 million to the Least Developed Countries Fund (approximately US$22 million). This will in 2017 be increased to DKK 300m (subject to parliamentary approval). Additional public climate finance will be provided through a range of bilateral and multilateral interventions.
EC	The EU and its Member States provided climate finance worth €14.5 billion in 2014 to developing countries, including grants from the budgets of the EU and its Member States, and loans by public development banks and blending. In addition, the European Investment Bank financed €2 billion of climate projects in developing countries. Pledges from EU Member States also make up about half of the pledges so far received by the UN's Green Climate Fund (US$4.7 billion). At least 20% of the EU budget will be spent on climate action by 2020. This means that at least €14 billion, an average of €2 billion per year, of public grants from the EU budget will support activities in developing countries between 2014 and 2020. Compared to the average level in 2012-2013, funding for international climate action will more than double.
Estonia	Estonia has pledged to contribute €1 million per annum for climate finance until the year 2020.
Finland	Finland intends to provide over half a billion euros in new investment funding for developing countries over the next four years, a substantial part of which will contribute to climate finance.
France	France announced that it would, by 2020, (i) increase annual climate finance from current €3 billion level to more than €5 billion, almost all but not exclusively via AFD (bilateral); and (ii) within this objective of €5 billion of climate finance in 2020, triple its annual adaptation finance to reach €1 billion by 2020.
Germany	Germany recalled that it aimed at doubling its international climate finance by 2020 compared to 2014.
Hungary	Hungary has pledged HUF 1 billion (approximately US$3.5 million) from 2016 to latest 2020 for international climate finance projects on a multilateral and bilateral basis, which is in addition to its July 2015 pledge to the GCF of HUF 1 billion.
Iceland	Iceland will strive to provide around US$10 million annually to climate related development efforts. Focus will be placed on geothermal development, sustainable land and ocean management, as well as gender equality in climate action.
Ireland	Ireland will continue public funding ensuring €175 million in climate finance over the period 2016 to 2020 mainly for adaptation and will increase our contribution to the Least Developed Countries Fund.
Italy	Italy announced that it will increase its support for international climate finance reaching at least US$4 billion between 2015-2020. In the provision of public financial resources we aim to strike a fair balance between mitigation and adaptation.
Japan	Prime Minister Abe announced at the Summit Meeting of COP21 that Japan will provide, in 2020, approximately 1.3 trillion yen of public and private climate finance, 1.3 times up from the current level, to developing countries.
Latvia	Latvia has provided €350,000 to the Green Climate Fund.
Liechtenstein	Liechtenstein has provided CHF 50,000 to the Green Climate Fund.
Lithuania	Lithuania has agreed to make available to the Green Climate Fund the sum of €100,000.
Luxembourg	Public climate finance from 2014-2020 amounts to €120 million, including €30 million in 2020 and including a total contribution of €35 million to the GCF (€5 million/year). Climate- related ODA funding is expected to be around €35 million per year which comes on top of the €120 million. Until further notice, the proportions will be as follows: adaptation- 40%, mitigation- 40%, REDD+ 20%.
Malta	Malta has agreed to make available to the Green Climate Fund the sum of €100,000.
Monaco	Monaco has a pledge amounting to €420,000 per year until 2018. We expect to increase our pledge thanks to the increase of our ODA.
Netherlands	Before COP21 (2015), the Netherlands announced that it would provide and mobilise €440 million in 2015 with an increase to €550 million in 2016. In 2016, the Netherlands provided a target of €660 million for 2017.

New Zealand	The Prime Minister announced at COP21 that New Zealand would contribute up to NZD$200 million in climate-related support over the next four years (including 2019). New Zealand's current projections suggest that it will now meet this $200 million target in three years rather than four, and New Zealand expects to once again exceed its budgeted commitment as other adaptation and mitigation projects come online. Due to New Zealand's significant contribution to renewable energy in the Pacific region, over three quarters of our climate-related support is likely to go towards mitigation activities. New Zealand is actively working to balance our climate mitigation support with more adaptation activities; while also helping recipient countries in the Pacific meet their targets for both access to electricity and renewable energy generation.
Norway	• Norway intend to continue REDD+ finance at least at current levels until 2020 (Budget for 2015 is 2,8 billion NOK) • Green Climate Fund: Committed NOK 400 million per year in 2016, 2017 and 2018. Regarding REDD+ finance: All is directed at mitigation, though recognizing that improved forest management and protection may make significant positive contributions to adaptation. Regarding GCF, the fund will "strive to maximize the impact of its funding for adaptation and mitigation, and seek a balance between the two".
Poland	Poland has announced its intention to provide US$8 million until 2020 for climate finance, including for the Green Climate Fund.
Portugal	In 2016, Portugal announced a pledge of €10 million of climate finance by 2020. In 2015 Portugal made available to the Green Climate Fund the sum of €2 million. Portugal also disbursed at the end of last year extra €500,000 to CPLP (Community of Portuguese Language Countries) for capacity building projects in the field of climate change.
Slovenia	Slovenia has pledged €3,500,000 /year over the period 2016-2020 including 3,500,000 in 2020.
Spain	Doubling its international climate finance by 2020 compared to 2014, by mobilising an amount of €900 million by 2020.
Sweden	Sweden provides support to both mitigation and adaption through a wide variety of channels. Before COP21, Sweden pledged to substantially increase, nearly double, its contributions to multilateral climate funds in 2016, compared to 2015. It is now clear that we will achieve this goal, including by additional voluntary contributions to the Adaptation Fund and the Least Developed Countries Fund. During the period 2015-2020 Sweden will disperse on average nearly 500 mSEK per year to the Green Climate Fund, currently making us the biggest donor per capita. Adaptation will remain important in our bilateral development cooperation.
Switzerland	In the past our (multi-)bilateral climate finance was distributed as follows (only grants): 2013: 61% adaptation and 39% mitigation; 2014: 57% adaptation and 43% mitigation; We have no indication that this proportion will change significantly in the future unless the demand from our partner countries will change accordingly. Switzerland has committed US$100 million to the Green Climate Fund, which will be disbursed in three tranches over three years (2015-2017)
UK	In September 2015, the Prime Minister announced that the UK will significantly increase our climate finance over the next five years, providing at least £5.8bn by 2020. In 2020, the UK's annual climate financing will be double that of 2014. The UK can also reaffirm our commitment to achieve a 50:50 balance between adaptation and mitigation spend over this period.
US	The U.S. pledged to double its grant-based public finance for adaptation by 2020, implying an increase of more than $400 million in annual adaptation finance.

Table 6: Climate finance pledges and announcement from developed countries. Source: http://www4.unfccc.int/Submissions/Lists/OSPSubmissionUpload/261_295_131233554162587561-Roadmap%20to%20the%20US$100bn%20(UNFCCC).pdf

5.6 Reporting Climate Finance

The International community has recognized the need to join efforts to increase climate finance flows and to avert dangerous climate change. It has become extremely important to be able to track and report those financial flows that support climate change mitigation and adaptation. Building trust and accountability concerning climate finance commitments is essential to monitor trends and progress in climate-related investments. Transparency is a criterion required in these measurements so that the fulfilment of commitments can be autonomously assessed, together with the effectiveness on how funds must be used. This concept has recently seen its importance increased and it has become

a critical tool in order to build trust between developed and developing countries. However, in order to achieve transparency, it has emerged the necessity to develop a framework for the measurement, reporting ad verification of international climate finance. In line with these needs, the EU has adopted and enhanced reporting framework on climate finance in 2013. As it has been explained by the European Commission, concerning international climate finance, it is important to ensure transparency both on climate finance flows and on the action financed by those flows[292].

The EU and its Member States are the world's largest contributor of climate finance to developing countries, and they have tried to increase integration into their broader development strategy. For this reason, they have started to report their climate finance to both the UNFCCC and OECD. The European Commission (EC) has also produced the reports for the European Development Fund (EDF) and the European Investment Bank (EIB).

The different reports are described below:

- *Biennial Reports (BR) to the UNFCCC* (every two years): Developed countries' reporting of climate finance to the UNFCCC following the reporting guidelines for National Communications and Biennial Reports (BR)[293]. In Article 9, point 5, of the Paris Agreement, it is indeed established that: "*Developed country Parties shall biennially communicate indicative quantitative and qualitative information related to paragraphs 1 and 3 of this Article*". According to the agreement, they should include estimated levels of public financial resources designated to developing countries Parties. Moreover, it encourages other Parties to furnish such information biennially on a voluntary basis[294]".
- *Reports to OECD_DAC database* (every year): this annual tracking system gathers statistics on ODA and other resource flows to

[292] See: https://ec.europa.eu/clima/policies/international/finance/transparency_en#tab-0-0

[293] UNFCCC. 2011. UNFCCC biennial reporting guidelines for developed country Parties - Annex 1 to Decision 2/CP.17.

[294] The Paris Agreement. 2015. Article 9, point 5.

developing countries from bilateral and multilateral development co-operation providers. Data are publicly available in the Creditor Reporting System (CRS) database via OECD-Stat. In these reports, the so-called "Rio markers" for estimating climate finance are applied.

- *Member States' Monitoring Mechanism Regulation (MMR)* reports to the EU (every year): requiring Member States to submit annual report on financial support, capacity building and technology transfer activities to developing countries based on the best data available[295]. The EU Member States present their annual reports under *Article 16 of Regulation No 525/2013* that defines a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change (called MMR)[296].

With the objective of increasing the international discussions and fostering transparency on climate finance, ahead of the UNFCCC 21st Conference of the Parties (COP21) in Paris in December 2015, the present and incoming COP Presidencies (Peru and France) on the time have asked the Organization for Economic Co-operation and Development (OECD) to account the estimated mobilized climate finance and to determine the progress towards the UNFCCC climate finance goal. In 2015 indeed, a report on climate finance mobilized towards the US$100 billion goal, has been prepared by the OECD together with the Climate Policy Initiative (CPI)[297]. The preliminary estimates provided in the report have already been analyzed in chapter 1, paragraph 1.10. Due to the challenges in forecasting future levels of climate finance and, in certain cases, in the availability of up-to-date information, the prediction should be prudent and

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[295] See: https://ec.europa.eu/clima/policies/international/finance/transparency_en#tab-0-0

[296] H. P. Dejgaard, J. Appelt. 2018. *Analysis of the climate finance reporting of the EU.* ActAlliance EU. April 2018.

[297] OECD. 2015. "*Climate finance in 2013-14 and the USD 100 billion goal*". See: http://www.oecd.org/environment/cc/OECD-CPI-Climate- Finance-Report.htm

follow conservative principles. One particular area where future research is needed is concerning the development of methodologies for quantifying the role of climate policy and the mechanisms behind the mobilization of private finance[298].

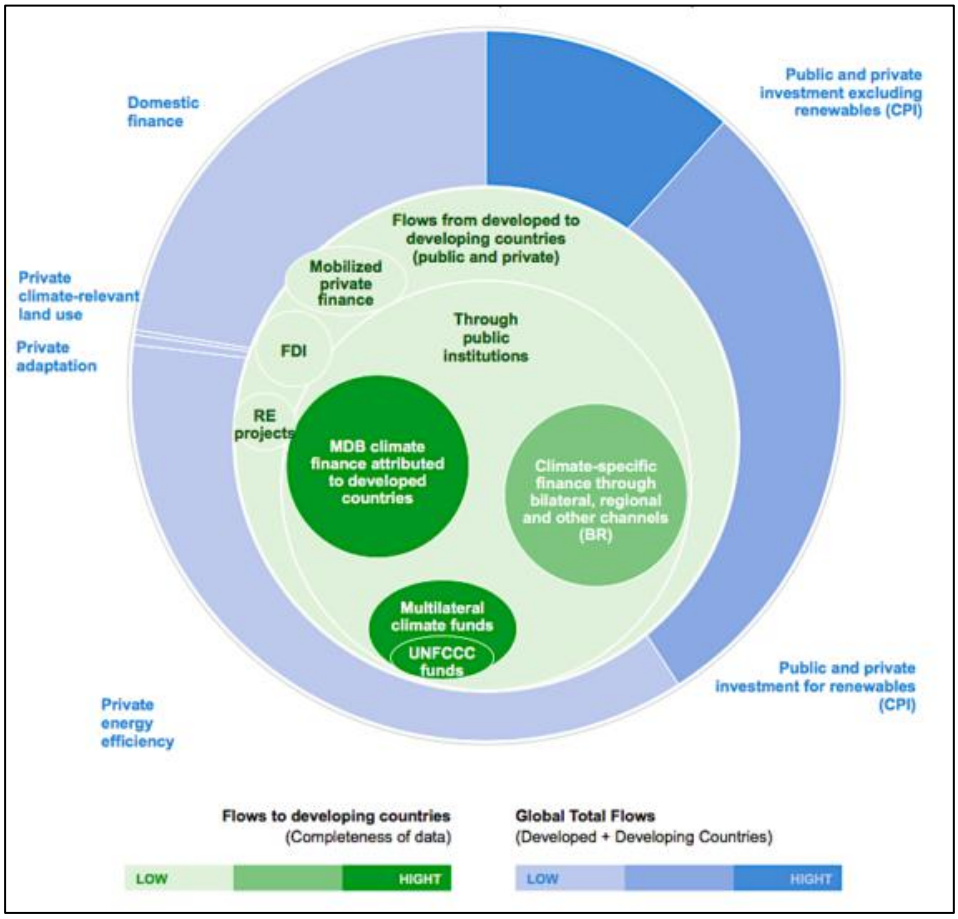

Figure 32: Climate finance flows in 2013-2014 (USD$ billion and annualized). Source: See: https://cleantechnica.com/2016/11/14/unfccc-tackles-finance-flows-cop22-week-1/

5.7 Italian contribution to climate finance

As it has emerged from chapter 1, paragraph 1.6, all experts have agreed the inclusion of private sector is necessary in order to achieve the Paris Agreement goals and the SDGs. In order to support the implementation of the 2030 Agenda and to foster private finance mobilization to achieve the US$100

[298] OECD. 2015. *Ibid.*

billions goal, and more broadly the SDGs, an ongoing process of research studies have been implemented.

The Italian Government, following its declaration to commit US$ 4 billion by 2020 **(see table 5)** for the US$100 billion goal, in the two-year period 2015-2016, has provided a total of US$ 729.75 million for climate specific support projects, representing an augment of 70% compared to the total allocated in 2013-14 (US$ 428.76 million)[299]. Although the gap to fulfil the 2020 target is still high. In the third biennial report, sent to the UNFCCC on December 2017 by the Sustainable Development DG of the Ministry of Environment, it is written that Italy has not yet begun to report private investments, but it has started to activate measures to mobilize private capital[300]. Involving the private sector in funding the transition to low-carbon climate resilient (LCR) economies can be seen as a determinant factor for the success of the mission. It has been demonstrated in several studies that public finance and policy interventions can mobilize substantial levels of private finance, however, the ability to evaluate the quantity of such mobilization is currently limited[301]. Public money is considered essential to unlock private investments; however, it has become extremely difficult to determine the amount of private finance mobilized thanks to public interventions.

For this reason, Italy has decided to carry out a pilot study to track mobilized private finance through public intervention. It would be led by the Italian Ministry for the Environment, Land and Sea together with CMCC. The latter, is a national research center, founded in 2005 within the framework of the National Research Plan, and specifically the National Research Plan on Climate.

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[299] Third Biennial Report (BR) of Italy. 2017. See: http://unfccc.int/files/national_reports/biennial_reports_and_iar/submitted_biennial_reports/application/pdf/132867045_italy-br3-1-br3_2017_italy.pdf

[300] Emanuele Bompan. *100 miliardi l'anno per il clima: ecco dove trovarli.* La Stampa. Tuttogreen. 19 Aprile 2018.

[301] Jachnik, R., Caruso, R., Srivastava, A. 2015. *Estimating mobilized private climate finance: methodological approaches, options and trade-offs*. OECD Environment Working Papers, No. 83, OECD Publishing. http://dx.doi.org/10.1787/5js4x001rqf8-en

The study would be conducted in collaboration with the OCSE Research Collaborative, a network that brings together governments, research institutions and international finance institutions. Considering RC guidelines, the study would cover Italian public climate finance interventions provided through Italian public institutions and bilateral flows without considering multilateral channels such as Italian contributions to MDBs, the EU budget or support to climate funds. This is mainly due to the fact that workable methodologies that will exclude double counting are not yet reliable on multilateral flows. In this way, it would be possible to have an efficient system to count the resources mobilized at national public or private level.

The scope of the study is to offer a first estimation of the private finance mobilized as a result of Italian public intervention in climate resilient and mitigation projects in developing countries during the period 2015-2017. The objective is to provide a reliable and robust estimation of the mobilized private finance from both qualitative and quantitative perspectives. The study has been commissioned not only to get better insight into the figures but also to better understand the methodological issues that are involved in those calculations. It aims to contribute to the work of the OECD-hosted Research Collaborative on Tracking Private Climate Finance, an organized platform for recognizing research priorities and gaps, as well as to communicate results achieved in order to increase awareness in this area. The final output of this reporting activity should be to represent a compass to address public policies and market action.

Through several analysis they want to test the extent to which currently available secondary data can address part of the information needed for measuring private finance mobilized by developed country public interventions. A discrete number of on-going pilot studies by individual developed countries have already been implemented. Next to Italy indeed, pilot measurements have already been undertaken by the UK, Denmark, the Netherlands, Switzerland, Norway, Germany, France and Belgium, although most of these are not published yet.

Italian path towards a sustainable financial system is most likely to be under way. However, measuring the level of country's progress and conduct a sort of gap analysis (with respect to the $100 billion goal) in order to recognize missing data and elaborate of a proper measuring progress methodology would be very useful in fostering Italian Sustainable Development.

5.8 Landscape of finance and sustainable development in Italy

Italy is one of the world's largest economies (8th by nominal GDP and exports) and it is the 3rd largest economy in the Eurozone. Overall considered, it can be said that Italy has an economy with significant and valuable assets. However, the fast-changing landscape affects the financial stability, making difficult delivering long-lasting performance. In recent times the country has faced even worst conditions due to the competitive challenge of sustainable development[302].

The Italian transition towards a "green economy " (a low-carbon, resource-efficient and physical resource preservation model) has already been undertaken. However, the lack of financial resources and of a clear guidance to support SMEs have complicated the integration of climate risk into development planning[303]. In 2015, according to the research conducted by the Sustainable Development Foundation, "Core-Green" companies (producing goods or services with high environmental value) and "Go-Green" companies (meaning that they have an environmental strategy and/or management system and they adopt high quality environmental standard in the production processes or in the

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[302] MATTM & United Nations Environment Programme. 2017. *Financing the Future. Report of the Italian National Dialogue on Sustainable Finance.* See: http://www.minambiente.it/sites/default/files/archivio/allegati/sviluppo_sostenibile/Financing_the_Future_EN.pdf

[303] L. Fischer, T. M. Marchand, S. Tomlinson. 2018. *Italy's role in the European low carbon transition. A political economy assessment*. January 2018.

product design) represent 42% of all Italian businesses[304]. In 2016, the "Green Economy Report 2016" have compared green economy performances of major European economies in eight critical areas (greenhouse gas emissions, renewable energy, energy efficiency, waste recycling, eco-innovation, eco-food production, protection of natural capital and sustainable mobility). From that analysis has emerged that the Italian industry performance index, based on 16 indicators, stands at 59.4 considering a scale from 0 to 100. In particular, as already showed in the previous paragraph, Italy has achieved best performances in renewables.

The new National Energy Strategy published in 2017, has been the proof of the country's priority given to energy and environmental issues in Italy. It has emerged the national intention to phase out coal power by 2025 and the wish to expand the share of renewable energy in final energy consumption to 28% by 2030[305]. The transition towards a sustainable energy system has indeed been principally supported by policies and investments committed for climate change mitigation initiatives. For instance, the Italian government in 2005 has introduced the first feed-in tariff (FIT) specifically for photovoltaics. This has strongly fostered the spread of that type of energy **(see table 4)**. Concerning the effect of public policy interventions, several researches from a worldwide sample have highlighted that feed-in tariff (FIT) policies play an important role (positive and significant coefficient) for both the investment decision and the volume of investment[306].

5.8.1 Spotlight on Italian Bank System

Political tensions and a weak financial system have created difficulties to Italian government to promote a clean economy transition and support more

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[304] http://www.statigenerali.org/cms/wp-content/uploads/2015/11/relazione_lo_stato_della_green_economy_in_Italia.pdf

[305] Ministry of Economic Development. 2017. Italian National Energy Strategy 2017

[306] Haščič, I. et al. 2015. *Public Interventions and Private Climate Finance Flows: Empirical Evidence from Renewable Energy Financing*. OECD Environment Working Papers, No. 80, OECD Publishing. http://dx.doi.org/10.1787/5js6b1r9lfd4-en

innovative business models[307]. The Italian financial system is bank-centric, indeed, as it has emerged in 2010 from a research, less than 16% of financial intermediaries were independent from banking groups. The Italian financial sector is quite traditional for two main reasons: first, because of the characteristics of the demand side (the private sector is characterized by vast prevalence of SMEs), and second, because of the small size of financial players with respect to other global peers. The biggest Italian bank ranks 29th in the world[308]; the biggest insurance ranks 7th[309]; and the largest asset manager ranks 34th[310]. These peculiarities have made the request of investment needed for innovation even more difficult to be satisfied.

However, the financial sector itself has started to move towards the implementation of sustainable development factors in its core activities. Italy has been one of the first developed countries that have introduced in 2007 transparency regulation for all Sustainable and Responsible Investment (SRI) products. This meant that it has been required to financial institutions that sell financial products labelled as "green" or "sustainable" or "responsible" to deliver further information on what conditions, procedures and controls have been applied to avoid any abuse of public trust. Furthermore, government has introduced in 2012 a disclosure obligation for pension funds on how ESG concerns are integrated into their investment policies[311].

In chapter 2 it has been analyzed how, in last years, investors have become more interested on disclosure on climate-related risks. In the retail market, it has emerged from a recent survey, based a sample group of the Italian population, that 45% of households are interested in SRI and would consider SRI products in their investment choices. Nonetheless, collective efforts are needed to raise the

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[307] L. Fischer, T. M. Marchand, S. Tomlinson. 2018.*Ibid*.

[308] See: http://www.relbanks.com/worlds-top-banks/assets

[309] See: http://www.internationalinvestment.net/products/insurance/upbeat-outlook-commercial-lines-insurers/

[310] See: https://hub.ipe.com/top-400/total-global-aum-table-2016/10007066.article

[311] MATTM & United Nations Environment Programme. 2017. *Ibid.*

level of awareness of financial professionals on social/environmental[312]. ShareAction, the responsible investment campaign group, has classed the UK and Italian banks as "bystanders" on the issue of climate change **(see table 6)**. They have been judged to have done minimum efforts for the challenges and opportunities that would emerge from the switch to a low-carbon economy[313].

Furthermore, the bad result of Unicredit can be confirmed by another report that has graded banks on their policy commitments regarding extreme fossil fuel financing and calculates the amount of their financial flows for those fuel. The ninth annual fossil fuel finance report has considered financial flows from 2015 to 2017 **(see table 7)**.

Group	Rank	Bank	Country	Score (out of 162)
Leader	1	BNP Paribas	France	107
Challengers	2	UBS	Switzerland	94
	3	HSBC Holdings	UK	92.5
	4	Crédit Agricole	France	92
	5	Societe Generale	France	89
	6	ING	Netherlands	82.5
Learners	7	Deutsche Bank	Germany	61.5
	8	Barclays	UK	58
	9	Santander	Spain	56.5
	10	Credit Suisse Group	Switzerland	55.5
	11	RBS	UK	54
	12	BBVA	Spain	52.5
	12	Standard Chartered	UK	52.5
Bystanders	14	UniCredit	Italy	43
	15	Lloyds Banking Group	UK	37

Table 7: Ranking of the 15 largest European banks. Source: ShareAction survey carried out by between July and November 2017. See: https://shareaction.org/wp-content/uploads/2017/12/BankingRanking2017.pdf

Table 8, has showed the Italian bank Unicredit ranked at 30th position on the global scale for financing tar sands oil, Arctic oil, ultra-deepwater oil, LNG, coal mining, and coal- red power.

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[312] MATTM & United Nations Environment Programme. 2017. *Ibid.*

[313] Martin Arnold. 2017. Lloyds, Unicredit get low rankings on climate-change response. Financial Times. 7 December 2017. See: https://www.ft.com/content/c0e3b756-9c6b-3eb9-abb4-bb7746081714

RANK	BANK	2015	2016	2017	TOTAL
1	CHINA CONSTRUCTION BANK	$10.311 B	$9.320 B	$6.985 B	$26.616 B
2	ROYAL BANK OF CANADA (RBC)	$9.300 B	$4.173 B	$13.011 B	$26.485 B
3	JPMORGAN CHASE	$6.875 B	$7.598 B	$11.645 B	$26.118 B
4	INDUSTRIAL AND COMMERCIAL BANK OF CHINA (ICBC)	$10.869 B	$8.067 B	$6.222 B	$25.158 B
5	BANK OF CHINA	$7.579 B	$6.957 B	$5.774 B	$20.310 B
6	TORONTO-DOMINION BANK (TD)	$4.025 B	$4.401 B	$9.097 B	$17.522 B
7	HSBC	$5.699 B	$2.990 B	$5.633 B	$14.322 B
8	AGRICULTURAL BANK OF CHINA	$6.582 B	$4.396 B	$3.206 B	$14.183 B
9	CITIGROUP	$4.202 B	$5.141 B	$4.666 B	$14.008 B
10	BANK OF AMERICA	$4.134 B	$6.363 B	$3.120 B	$13.617 B
11	MITSUBISHI UFJ FINANCIAL GROUP (MUFG)	$4.163 B	$3.482 B	$3.524 B	$11.170 B
12	BARCLAYS	$3.334 B	$3.951 B	$3.642 B	$10.927 B
13	MORGAN STANLEY	$4.248 B	$2.934 B	$2.898 B	$10.080 B
14	DEUTSCHE BANK	$5.564 B	$2.450 B	$1.959 B	$9.974 B
15	SCOTIABANK	$3.922 B	$2.217 B	$3.817 B	$9.957 B
16	GOLDMAN SACHS	$4.045 B	$1.874 B	$3.069 B	$8.987 B
17	MIZUHO FINANCIAL GROUP	$3.057 B	$3.333 B	$2.447 B	$8.837 B
18	CANADIAN AND IMPERIAL BANK OF COMMERCE (CIBC)	$3.116 B	$1.848 B	$3.807 B	$8.772 B
19	BANK OF MONTREAL	$1.736 B	$2.933 B	$3.711 B	$8.381 B
20	CREDIT SUISSE	$2.771 B	$1.997 B	$3.057 B	$7.825 B
21	SOCIÉTÉ GÉNÉRALE	$3.212 B	$2.001 B	$1.999 B	$7.211 B
22	BNP PARIBAS	$2.742 B	$2.351 B	$1.949 B	$7.043 B
23	SUMITOMO MITSUI FINANCIAL GROUP (SMFG)	$2.097 B	$1.645 B	$1.109 B	$4.851 B
24	WELLS FARGO	$1.375 B	$1.562 B	$1.715 B	$4.651 B
25	CRÉDIT AGRICOLE	$1.727 B	$1.419 B	$1.431 B	$4.577 B
26	UBS	$1.776 B	$1.624 B	$1.077 B	$4.477 B
27	SANTANDER	$859 M	$2.567 B	$816 M	$4.241 B
28	ING	$1.591 B	$1.337 B	$514 M	$3.442 B
29	STANDARD CHARTERED	$1.162 B	$660 M	$1.303 B	$3.125 B
30	UNICREDIT	$410 M	$788 M	$720 M	$1.917 B
31	COMMONWEALTH BANK OF AUSTRALIA	$1.111 B	$220 M	$182 M	$1.513 B
32	BPCE/NATIXIS	$498 M	$371 M	$315 M	$1.183 B
33	ROYAL BANK OF SCOTLAND (RBS)	$815 M	$307 M	-	$1.122 B
34	AUSTRALIA AND NEW ZEALAND BANKING GROUP (ANZ)	$219 M	$536 M	$289 M	$1.044 B
35	WESTPAC	$539 M	$64 M	$212 M	$815 M
36	NATIONAL AUSTRALIA BANK (NAB)	$633 M	$144 M	$34 M	$811 M
TOTAL		$126.297 B	$104.018 B	$114.956 B	$345.271 B

Table 8: Extreme fossil fuels – League Table. Source: https://www.banktrack.org/download/banking_on_climate_change/banking_on_climate_change_2018_web_final.pdf

Conversely, according to another research conducted by CDP, an Italian bank, Intesa Sanpaolo S.p.A, has obtained the A score concerning climate[314] **(see table 9).** The Climate A List has been established in 2011 and integrated for water and forests in 2015 and 2016 respectively. Due to the more established nature of CDP's climate program, in recent years, the organization has obtained proportionately more responding companies and therefore more companies have achieved an A score in climate. A significantly smaller pool of organizations has been asked to respond on forests and water. CDP researchers have requested information on climate risk and low carbon opportunities from the world's largest companies on behalf of over 650 institutional investor signatories, with total assets amounted to US$87 trillion[315].

[314] See: https://b8f65cb373b1b7b15feb-c70d8ead6ced550b4d987d7c03fcdd1d.ssl.cf3.rackcdn.com/comfy/cms/files/files/000/001/290/original/A_list.pdf

[315] See: https://www.cdp.net/en/climate

Company	Country	Climate	Water	Forests			
				Cattle Products	Palm Oil	Soy	Timber
Financials							
Allied Irish Banks plc	Ireland	A					
Bank of America	USA	A					
Bankia	Spain	A					
Basler Kantonalbank	Switzerland	A					
Berner Kantonalbank AG BEKB	Switzerland	A					
BNY Mellon	USA	A					
CaixaBank	Spain	A					
DNB ASA	Norway	A					
Goldman Sachs Group Inc.	USA	A					
ING Group	Netherlands	A					
Intesa Sanpaolo S.p.A	Italy	A					
Lloyds Banking Group	United Kingdom	A					
MAPFRE	Spain	A					
MS&AD Insurance Group Holdings, Inc.	Japan	A					
Nedbank Limited	South Africa	A					

Table 9: The CDP A List 2017. Source: https://b8f65cb373b1b7b15feb-c70d8ead6ced550b4d987d7c03fcdd1d.ssl.cf3.rackcdn.com/comfy/cms/files/files/000/001/290/original/A_list.pdf. Note: the grey cells mean that companies have not been requested to respond to this program as their business activities are not deemed material for that theme or the company did not meet the sample setting criteria.

Indeed, Intesa Sanpaolo has been for years fully aware of the importance to pursue a clear and effective strategy to contrast climate change and set precise qualitative and quantitative targets[316]. The Group has been included in the Dow Jones Indices for economic, social and environmental sustainability. Carlo Messina, Managing Director and CEO of Intesa Sanpaolo has said that, being part of this index for the eighth year (which is one of the major official and discriminatory at international level), has confirmed: "*the recognition of the Group's daily commitment to integrating economic, social and environmental*

[316] See: https://www.group.intesasanpaolo.com/scriptIsir0/si09/contentData/view/2018%20Dow%20Jones%20sustainbility%20index%20-ENG.pdf?id=CNT-05-00000005121E5&ct=application/pdf

sustainability into our corporate strategy, a commitment that we have also highlighted in the 2018-2021 Business Plan[317]".

Company	Country	Industry Group	Comment
Bayerische Motoren Werke AG	Germany	Automobiles & Components	
Peugeot SA	France	Automobiles & Components	Addition
Valeo SA	France	Automobiles & Components	
ABN AMRO Group NV	Netherlands	Banks	Addition
Banco Santander SA	Spain	Banks	
Bankia SA	Spain	Banks	
Bankinter SA	Spain	Banks	Addition
BNP Paribas SA	France	Banks	
CaixaBank SA	Spain	Banks	
ING Groep NV	Netherlands	Banks	
Intesa Sanpaolo SpA	Italy	Banks	
Skandinaviska Enskilda Banken AB	Sweden	Banks	
Societe Generale SA	France	Banks	

Table 10: Dow Jones Sustainability Europe Index. Dow Jones Sustainability Indices in Collaboration with RobecoSAM. 18 September 2017. Source: https://www.compromisoempresarial.com/wp-content/uploads/2017/09/DJSI2017_ComponentList_Europe.pdf

Since 1999, the Dow Jones Sustainability Indices (DJSI) have been monitoring the environmental, social, economic and governance performance of major companies on the world's stock exchanges. He has continued: "*As the leading bank in Italy and one of the leaders in Europe, we are proud to support responsible growth, focused on inclusion, the wellbeing of people, communities and the environment, by guaranteeing solidity and transparency, which are fundamental for a sustainable present and future and are increasingly important in assessing the value of a company*."

Intesa Sanpaolo has implemented numerous green finance initiatives, with the development of innovative products and services and the financing of environmental projects. In 2017, the disbursements for green economy projects amounted up to 1.3 billion euro, and more than 5 billion euro has been spent overall during the last four years (period 2014-2017). The bank's strategy has included the 500 million Green Bond issued to finance 77 projects dedicated to renewable energy and energy efficiency with over 213,000 tones of avoided CO2 emissions per year[318].

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[317] See: https://www.pbz.hr/en/priopcenja-novosti-novosti-gradani-novosti-poduzetnici/intesa-sanpaolo-again-dow-jones-indices

[318] Intesa Sanpaolo. 2018. PRESS RELIESE. *Intesa Sanpaolo again in the Dow Jones Indices for economic, social and environmental sustainability*. Milan – Turin. 13 September 2018.

5.8.2 Overview of Green Bonds in Italy

One of the principal objectives for the Italian sustainability policy development is to is move beyond the banking sector and to try to attract the resources of institutional investors. The OECD has prepared a set of policy suggestions on how to channel institutional capital for green infrastructure. European issuers have always allocated a substantial part of green bond proceeds to the energy sector (dominating Europe market with over 60%). However, it has recently seen its level dropped in favor to transport and building sectors **(see figure 33).** In Italy, the Ferrovie dello Stato group has given its contribute to this trend issuing its first green bond in December 2017 for EUR 600 million.

European issuers have been the first starters in the green bond market, global green bond issuance has started with multi-lateral development banks, raising funding for climate-related projects in 2007/2008. Climate Bonds Initiative in its 2016 research has estimated that there are $694bn of climate-aligned bonds to the transition to a low- carbon economy (an increase of $96bn with respect to the 2015 report)[319]. The Italian green bond market has been launched in 2014 with deals from multiutility company Hera (it has issued the first Italian green bond of €500 million) and energy companies Enna Energia and Innovatec. More recently, Enel issued a €1.25 billion green bond[320], registering a demand from institutional investors (many of whom SRI) higher than double.

[319] CBI & HSBC. Bonds and climate change. The state of the market in 2016. See: https://www.climatebonds.net/files/files/CBI%20State%20of%20the%20Market%202016%20A4.pdf

[320] See: https://www.enel.com/media/press/d/2018/1/green-bond-enel-eng

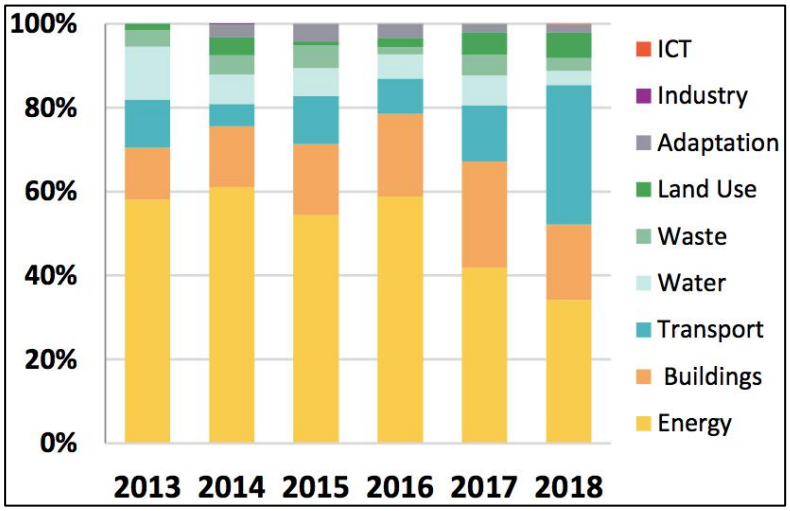

Figure 33: European Bond allocation 2013-2018. Source: CBI. The Green Bond Market 2018.

In Italy, the stock of these climate-aligned bonds is estimated at €738 million (banks have provided loans to renewable energy projects up to €27 billion between 2007 and 2014[321]). The country cumulative green bond issuance from 2014 to the first quarter of 2018 amount to EUR 5.1 billion, with more than 50% issued in 2017 (EUR 2.9 billion last year)[322] **(see figure 34).** However, the green bonds share with respect to overall debt is 0.07% with an average of 0.16% in G20 countries. In 2017, Intesa Sanpaolo has been the first Italian bank to debut as "green" issuer. The € 500 million Senior Unsecured 2022 deal has amplified the Bank's commitment to sustainability and it has been meant to support projects that have a positive environmental impact and promote energy efficiency. It is forecasted that in 2018, Italian green bonds market would continue to grow and reach more than doubled volumes with respect to 2017[323]. Energy and transport companies are expected to drive growth together with sovereign green bond.

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[321] UN and MATTM (2016), "Financing the future: Report of the Italian National Dialogue on Sustainable Finance".

[322] CBI. The Green Bond Market 2018. See: https://www.climatebonds.net/files/reports/the_green_bond_market_in_europe.pdf

[323] See: https://www.moodys.com/research/Moodys-Italian-corporate-bond-issuance-to-slow-in-2018-19--PR_384416

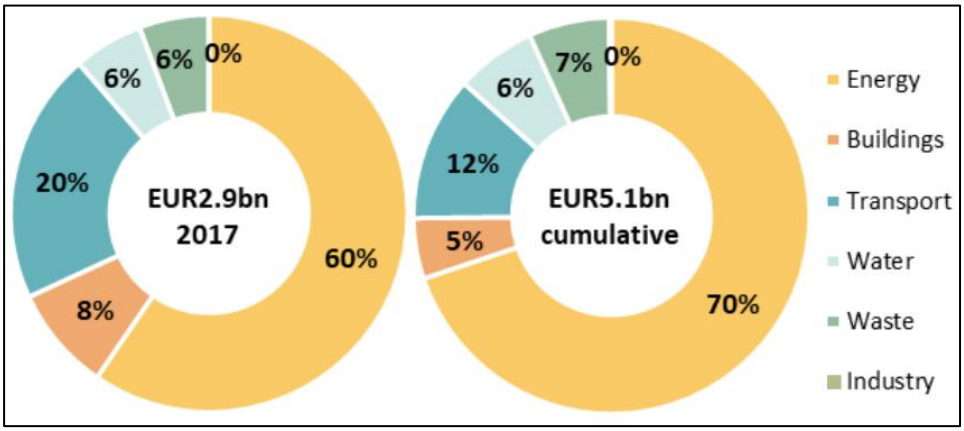

Figure 34: Share of Sector Green Bonds allocation. Source: CBI. The Green Bond Market in Europe 2018.

Beside some large energy companies, such as Eni or ENEL, which could exploit institutional market through large size green bonds appealing to institutional investors, for smaller entities it could be difficult to gather enough green projects to be financed. As it has been seen, in Italy, capital markets are relatively small compared with the overall size of the economy. For this reason, a number of innovative instruments have been launched to encourage SMEs to access capital markets. The most effective measure introduced in the last decade with that objective is the so-called "mini-bond", i.e. corporate bonds of small size, with simplified administrative procedures, that can be easily issued also by SMEs. The instrument has been promoted during the Sovereign Debt crisis, when the Government led by President Monti has issued four different decrees in order to improve the utilization of the credit channels alternative to the bank financing for the non-listed companies, especially the SMEs (before that moment they hadn't had the opportunity to access to this kind of resources). They have been introduced with the Growth Decree (i.e. Decrees No. 83/2012 and 179/2012 collectively). Thus, from 2012 to 2015, there were 179 issues in Italy, totaling more than €5.5 billion, of which over 100 issues totaled less than €50 million – with significant future potential for green SMEs[324].

[324] MATTM & United Nations Environment Programme. 2017. *Ibid.*

Even if the green bond market has not yet developed, there is significant potential in the green mini-bond market, along with strategic issuance from public entities. A green bond development committee could help design a roadmap for expansion. Moreover, the role of institutional investors in creating a demand for green bonds in Italy is critical, as it would be analyzed in the following paragraph concerning insurance key role.

5.8.3 Italian Insurance Industry

Institutional investors can be defined as financial players that manage assets on behalf of third parties, notably: pension plans (including both pension funds and professional pension schemes), banking foundations, insurance companies and asset managers. The financial sector most exposed to climate change risks is without any doubts the insurance one. The insurance sector has seen its strategic role increased in terms of underwriting, claims management and asset management after the climate change advent. It has become a very crucial issue for the insurance industry since it would foster the development of new products with the scope of both safeguard the economy from extreme weather events and making earnings. At the same time, it has presented enormous market-based opportunities for advancing innovative and proactive solutions in terms of mitigation and adaptation actions.

Italy is one of the most European areas vulnerable to climate change impacts. The environmental group Legambiente has recently published a report that has revealed that 7 million people in Italy live in area exposed to risks on landslide or flood. These results are in line with the high level of citizens' and entrepreneurs' awareness of those risks linked to extreme weather events **(as showed in figure 35)** but they are in contrast with the low rate of insured companies and households for this type of damage and of the tools available to manage those risks. This means that extreme weather events would cause high social impacts, economic losses and environmental consequences. The responses collected have showed a high level of awareness of climate impacts linked to both the industrial sector (i.e. safety of production activities and assets) and to society

and environment[325]. The results of survey like this, should foster public administration and insurance companies to develop an innovative public-private scheme to prevent, manage and limit those types of risks.

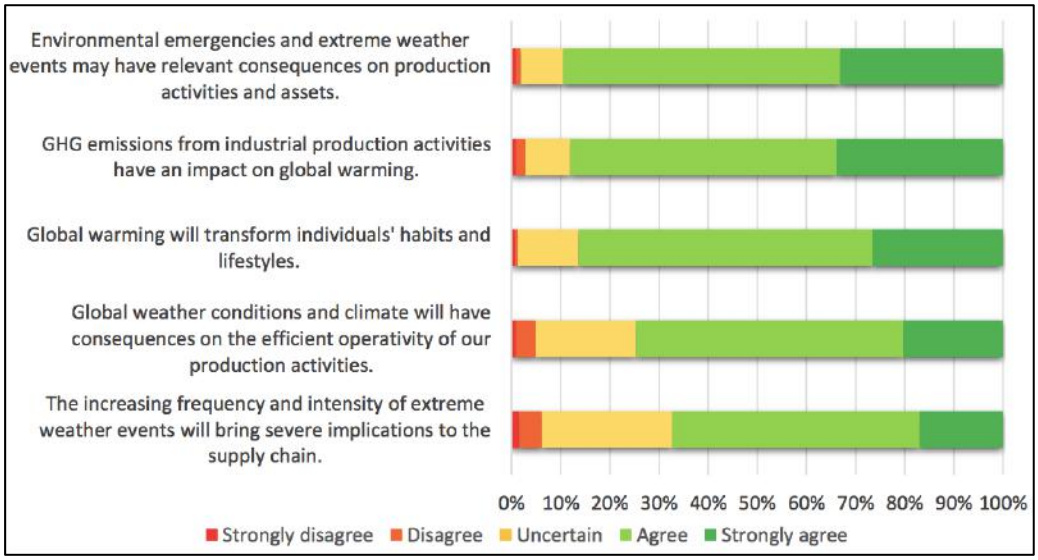

Figure 35: Awareness of Climate Impacts: 487 respondents. Source: See: http://www.minambiente.it/pagina/marrakech- partnership-global-climate-action

Insurance companies are high responsible for the sustainable transformation of the global economy since they are among the most important asset owners in the global economy. They manage one third of the world's investment capital. In spite of this, AXA (one of the world's biggest insurer) has been the only major insurance company that in April 2017 has ended underwriting some coal companies[326]. The majority of them are still the major investors in the fossil fuel sector, including in coal companies **(see table 11).** In that European ranking, at the 8th position, it appears also the Italian insurance company Generali.

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[325] F. Testa, Niccolò, M. Todaro, F. Iraldo, F. Gasbarro, R. Ianna. (2017). *Assessing climate change mitigation and adaptation efforts in the Italian industry: the results of an explorative study*. Retrieved from the Italian Ministry of Environment and Protection of Land and Sea website: http://www.minambiente.it/pagina/marrakech- partnership-global-climate-action

[326] UnfriendCoal. 2017. *Insuring Coal No More. An insurance scorecard on coal and climate change*. November 2017.

INSURANCE GROUP	TOTAL FOSSIL FUEL INVESTMENTS	% OF ANALYZED INVESTMENTS	% OF REPORTED TOTAL ASSETS UNDER MANAGEMENT
Allianz	59.03	6.56%	3.08%
AXA	34.34	8.79%	2.32%
Aviva	13.99	11.85%	3.25%
Chubb	5.25	11.53%	N.A.
DZ Bank	4.30	5.62%	1.01%
Swiss Re	3.97	11.21%	N.A.
Zurich	3.69	9.09%	1.45%
Generali	2.53	9.98%	0.46%
Munich Re	2.17	7.99%	0.87%
Talanx	0.65	9.71%	0.41%
Mapfre	0.35	9.95%	0.44%
Covéa	0.29	5.51%	0.30%
SCOR	0.17	4.74%	0.85%
Lloyd's of London	0.01	2.19%	N.A.
Unipol	-	-	N.A.
Total	**130.74**	**7.79%**	**2.15%**

Table 11: Ranking European insurance groups on total fossil fuel investments (in $ billion). Source: Profundo report, April 2017.

As reported by the insurance group, the total bond-holdings in these sectors amount to US$ 1.8 billion (see **table 12)**. It represents the 9.6% of the total bond-holding found and the 0.3% of the total assets under management. It seems that the involvement of Generali in the fossil fuel underwriting sector can be considered as quite high (compared also with the European peers)[327].

Both citizens and enterprises think about insurance companies as an institute that can protect them from the impacts of natural disasters, accidents, disease and other catastrophes. However, **figure 36**, shows how insurance plays a critical role in enabling further coal project. The insurance industry has indeed also a self-interest in helping to avoid runaway climate change.

[327] Margreet Simons, Joeri de Wilde. 2017. *The involvement of European insurance groups in the fossil fuels sector.* Profundo. 25 April 2017.

Indicator	Total bondholdings	Total shareholdings	Total investments
Fossil fuel investments	**1,813.63**	**719.23**	**2,532.86**
Total investments found	18,863.92	6.522,52	25,386.44
% of total investments found	**9.61%**	**11.03%**	**9.98%**
Reported total AUM	N.A.	N.A.	546,270.00
% of reported total AUM	**0.33%**	**0.13%**	**0.46%**

Table 12: Total fossil fuel investments (in US$ million). Source: Profundo report, April 2017

Generali is the world's fourth-largest multi-line insurer with an active involvement in fossil fuels as an investor and underwriter. The company likes to compare itself to peers such as Allianz, AXA and Zurich and, differently from them, it has so far only taken baby steps on coal. However, it has said that it would not underwrite underground mining projects. In its 2016 Sustainability report has emerged that the insurer has divested from a number of companies with high coal intensity. Generali has also answered to a survey conducted by the California Department of Insurance saying that it would no longer invest in companies depending on coal for more than 30% of their business. The company has indeed taken a first step towards a cleaner investment policy, but it is far from the target of fully divest from the harmful coal industry[328]. In February 2018, Generali has approved its climate change strategy that include the following decisions:

- Divest € 2 billion from coal
- € 3.5 billion in new green investments by 2020 (through green bonds and green infrastructures)
- Increase the offer of products with environmental value
- Dialogue with stakeholders to facilitate the transition to a society with low environmental impact

As said by Mary Robinson, former Irish President, in October 2013 there is a controversial to continue to make investments in fossil fuel companies that

[328] See: https://www.greenpeace.org/international/story/16696/climate-chaos-change-coal-insurance-fossil-fuels-investment/

are the inner cause of the problem of climate change. She said: "*We can no longer invest in companies that are part of the problem of the climate shocks that we're suffering from*". By March 2017, 705 institutions and 58,000 individuals representing $5.46 trillion in assets have agreed to divest from the fossil fuel industry[329].

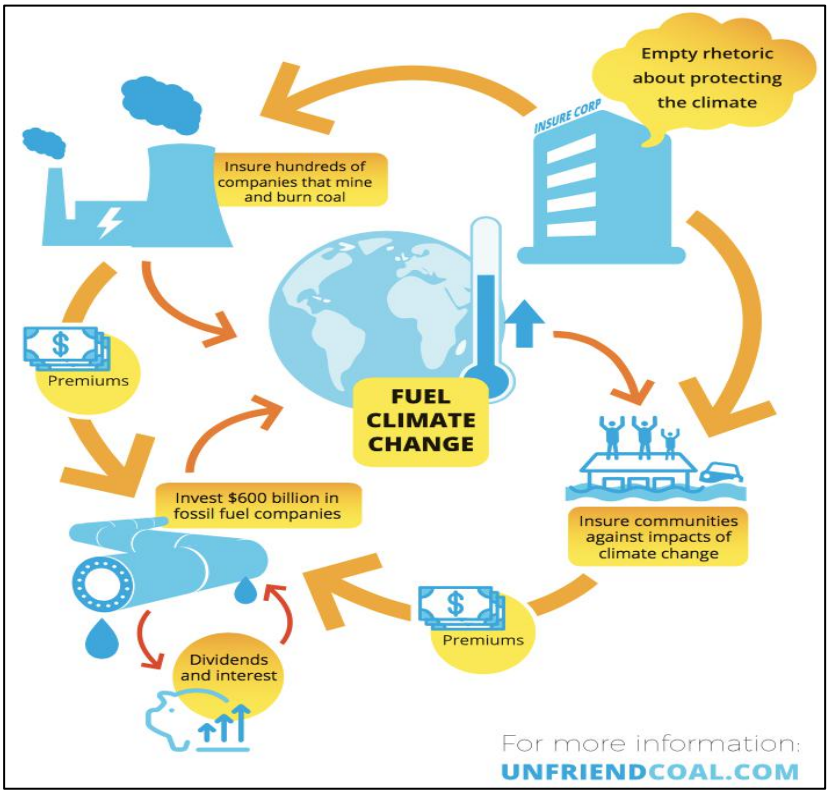

Figure 36: The climate change-insurance profit cycle: how the insurance industry fuels climate change. Source: UnfriendCoal.com

After the COP23 climate conference in November 2017, it has been decided that insurance companies must adopt new policies or not underwrite any new projects with companies that: derive almost 30% of their profits or power generation from coal, make, exchange or use at least 20 million tons of coal annually, project investments in new coal mines, power plants or infrastructure[330]. Since 2015, global insurance groups like AXA, Zurich, SCOR,

[329] See: https://gofossilfree.org/commitments/, viewed on March 23, 2017

[330] Peter Bosshard. 2017. *Underwriting Climate Chaos: Insurance Companies, the Coal Industry and Climate Change*. April 2017.

and now Allianz have decided in 2017 to avoid ensuring some or all new coal projects, Swiss Re has declared that it would follow those companies soon. Overall considered, 15 insurers with just over 4 trillion USD in assets, have acted and have collectively divest about $20 billion in equities and bonds from coal companies or have ceased to underwrite coal projects, thus making coal uninsurable[331].

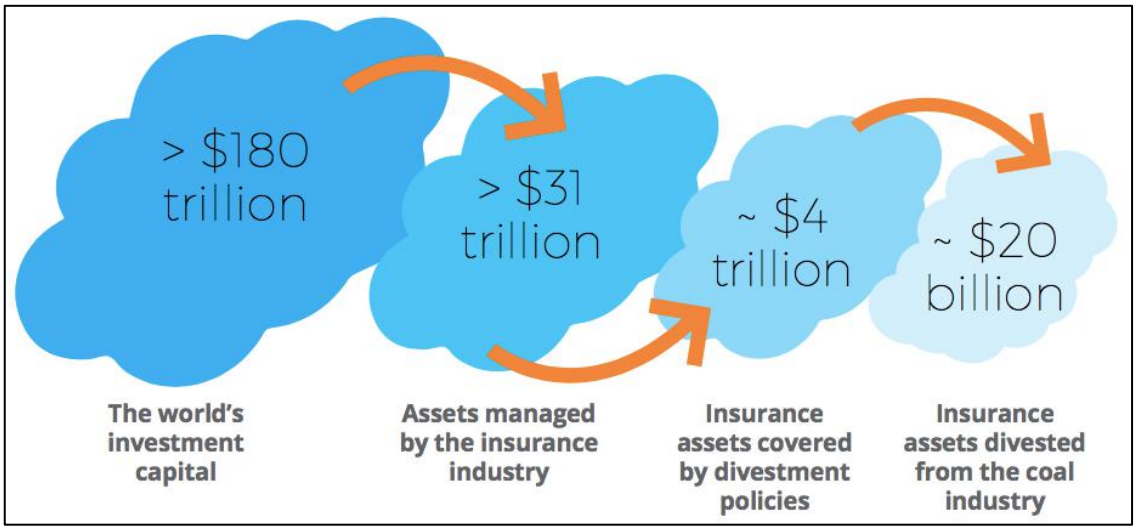

Figure 37: Insurance assets divest from the coal industry. Source: C. Harrell and P. Bosshard. Insuring Coal No More. Kanchan Mishra, Profundo. November 2017.

The last IVASS report[332] has underlined the fact that the Italian insurance market is driven by a few big players. In the last years, those few Italian insurance companies have started to implement SRI policies or products such as Cattolica Assicurazioni Group, Generali Group, UnipolSai Group and Reale Group. UnipolSai for instance has presented its Sustainability Plan in 2010 and has uncharged the Senior Executives and the Board of Directors' Sustainability Committee to monitor its development. To reinforce its Responsible Asset Management activities, since 2016 the Group has followed the Principles for Responsible Investment (UNPRI) and consolidated its investment in Alternative

[331] UnfriendCoal. 2017. *Ibid.*

[332] See: http://www.ivass.it/ivass_cms/docs/F23273/Relazione%20IVASS%202015.pdf

Investments. As one of the major Italian institutional investors, it has been on the front line in the promotion of responsible investment. The Group has understood that a key challenge for institutional investors might be transparency and has decided to give importance in the creation of a fair dialogue with clients and beneficiaries as well as stakeholders and wider society. In the field of the green economy, investments have been implemented in the sectors of renewable energies (photovoltaics, wind, hydroelectric, biogas, renewable biomasses), energy efficiency, environmental innovation (particularly the reduction of energy and materials by input unit), sustainable mobility and reforestation.

Unipol Group has also decided to launch the DERRIS (Disaster Risk Reduction Insurance) project, which has been co-funded by the European Commission under the Financial Instrument for the Environment (LIFE). This project has promoted an innovative model of multi-stakeholder cooperation that has involved public administrations, insurance companies, academic institutions and SMEs. The scope has been to create an innovative public–private insurance scheme that produces virtuous behaviors regarding protection, prevention and adaptation to the effects of climate change, and increases local resilience. This should decrease the costs of extreme weather events that are covered by public spending[333].

Insurance companies have recently decided to implement an environmental management system to assure a continuous improvement of their performance. Reale Mutua and Italiana Assicurazioni, for example, have implemented their ISO 14001 certification in 2012 and 2015. This meant that all the firms of Reale Group Italy have started to adopt a corporate strategy that allows the integration of the evaluation of environmental aspects and impacts. Insurance companies that have started to include socio-environmental concerns into their investment policies can contribute to drive economic development towards a more sustainable model.

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[333] Marisa Parmigiani. 2016. *Insurance to manage climate risk*. Climate 2020 Rising to the challenge. UNA-UK.

Recently, other Italian institutional investors have decided to join the PRI, including Eurizon Capital SGR and Pioneer Investments. Etica SGR is at the moment the unique company that offers SRI funds and it was the first Italian institution that joined the Montreal Carbon Pledge (obligating investors to publish the carbon footprint of their portfolios).

Institutional investors, through the use of commercial levers, such as the price of the policies in the case of insurance companies, or by promoting good practices behavior in terms of risk prevention, may create environmental and social value in addition to financial one. They have a central role in contributing to sustainable development and managing climate change impacts.

5.9 Greening Italian System

In this chapter has emerged Italian vulnerability to climate change impacts. Nonetheless, it seems that the Italian financial system is not supporting the transition toward a low-carbon economy. Opposite to the global finance community, that it emerging as a partner in the challenge of responding to climate change, Italian economy is still dominated by fossil fuels.

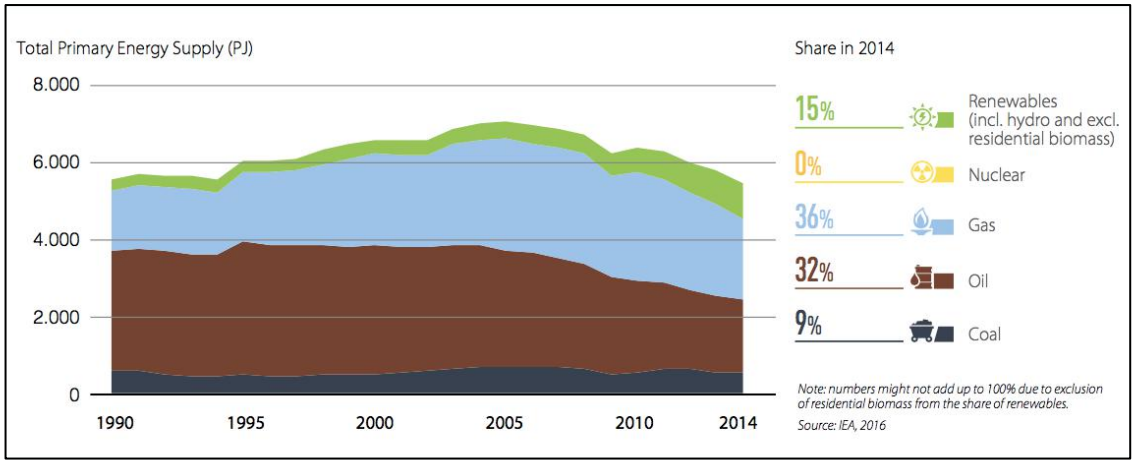

Figure 38: Italian Energy Mix. Source: IEA. 2016.

Luckily, since 2004, oil and gas consumption have started to decrease thanks to the reduced energy demand (due to the 2008 financial crisis), and thanks to an increased used of renewables. Relying on the survey conducted by

the Italian Banking Association's Observatory on Banks and Green Economy, biggest banks in Italy have sponsored over 27 billion euros (31.3 billion U.S. dollars) of renewable energy capacity between 2007 and 2014. Currently, renewables represent around 37% of installed generating capacity. The development of renewable energy and the improvement in energy efficiency have presented an opportunity for businesses to increase their revenues by exploiting new markets, to reduce import costs (in 2016 Italy has spent €30 billion on oil and gas imports) and to move to a sustainable economy.

Moreover, at least 42 percent of Italian businesses are "green-oriented", according to a November 2017 report by Italy's Foundation for Sustainable Development. "*Banks, which are a chief source of SME financing... have already been expanding their green financing activities, specifically in renewable energy*", has said Corinne Bendersky, credit analyst at S&P Global Ratings[334].

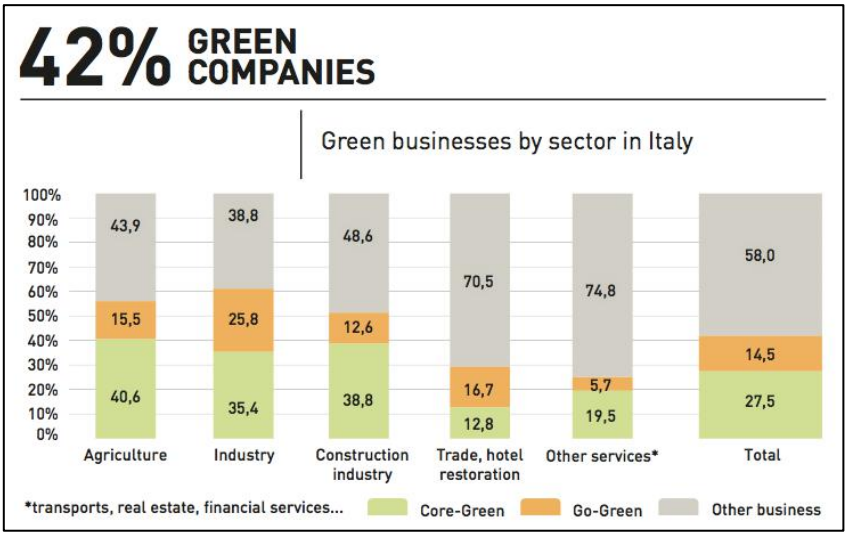

Figure 39: companies' orientation. Source: Sustainable Development Foundation (Using Pragma data, 2015)

Green banks are indeed the engine to rise as the country's small and midsize enterprises (SMEs) research of financing for their green projects and greater lending for green buildings. Intesa Sanpaolo for instance has started its process development towards sustainability, with a specific focus on climate

[334] See: http://www.xinhuanet.com/english/2018-08/04/c_137366868.htm

change issues and with the awareness that innovation (the development of new products and services) and corporate responsibility may contribute to tackle environmental changes and the related social impacts[335].

In addition, some progresses have started to be seen in asset management, in particular, thanks to the launch of SRI products within the last two years. The rising importance of sustainability in the financial sector has marked the 2016 edition of Salone del Risparmio. Moreover, in June 2018, Borsa Italiana has joined Climate Bonds Partners Programme. "*This decision was meant to develop more and more conscious investments as well as international standards and good practices in green finance. The introduction of green bonds on Borsa Italiana's Fixed Income markets confirms our commitment towards the growth of sustainable finance in Italy*", has said Pietro Poletto, Global Head of Fixed Income Products and Co-Head of Equity, Funds & Fixed Income in Secondary Markets, London Stock Exchange Group[336].

The country is currently seeing a growing share of institutional investor assets incorporating environmental, social and governance factors. However, there are still a range of barriers that prevent these and other promising developments from having a systematic impact[337]. The inherent tensions within the Italian political system have made complex the relationship between privates and government and the State and the EU. Europe has always been a strong driver for Italy, indeed, the Italian policy innovation has been led by the EU climate, energy and mobility legislation and the same should happen for the financial sector. Italy was a frontrunner when it has introduced the Sustainable and Responsible Investment regulation in 2007. Recently, it has adopted legislation on the public disclosure of nonfinancial information, including social

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[335] Intesa Sanpaolo. 2018. *Green Bond Report.* June 2018. See: https://www.group.intesasanpaolo.com/scriptIsir0/si09/contentData/view/GREEN%20BOND_2018.pdf?id=CNT-05-00000005089F1&ct=application/pdf

[336] CBI. 2018. *Borsa Italiana joins Climate Bonds Partners Programme*. London. 22 June 2018. See: https://www.climatebonds.net/files/releases/media_release-borsaitaliana-joinsclimatebondspartnerprogram_220618_.pdf

[337] See: https://www.unenvironment.org/news-and-stories/press-release/italy-lays-out-roadmap-increasing-flows-sustainable-finance

and environmental performance[338]. Introducing a transparent decision-making process and accountability mechanism has been critical for facilitating the entrance of new capital providers for the transition to a low-carbon economy.

Government has understood that its lonely intervention would not be sufficient. More recently indeed, Italy has demonstrated its willingness to make climate action more central to its broader economic and foreign policy. It is indeed clear that all "climate change stakeholders" such as private citizens, political citizens and/or entrepreneurs/investors can contribute, with their behaviors and their business and financial strategies, to the transformation of the financial system into a more sustainable one. This awareness has significantly developed in Italy, where, according to a survey carried out by Schroders in 2017, the majority of respondents assume conducts that aim to shift towards a more sustainable society: 79% is careful about waste reduction and separate collection, 63% buys local products, 60% takes account of his/her ecological footprint in making decisions on mobility and home energy consumption[339]. Moreover, government has tried to increase private commitment by offering a better understanding of the benefits deriving from climate action.

The introduction of EU funding and financial regulation should represent a lever to direct more Italian funds to investments into a climate resilient future. The Paris Agreement and the launch of the UN SDGs have offered great opportunities for institutional investors for greening the Italian financial market. In particular they have facilitated the introduction of the mechanisms for measuring achievements at national level through the implementation of the pilot study. Italy has two ongoing initiatives: to scale up sustainable capital and to explore solutions for getting capital to where it is most needed for successful delivery of the Sustainable Agenda.

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[338] Jones day. 2017. *New Disclosure Requirements on Nonfinancial Information for Italian Public Interest Entities*.

[339] Schroders. 2017. *Global investor study. Global perspectives on sustainable investing 2017*. http://www.schroders.com/en/sysglobalassets/digital/insights/2017/pdf/global-investor-study- 2017/schroders_report_sustainable-investing_final.pdf

CONCLUSION

The nature of climate risk makes the possibility, extent, and timing of impacts on finance dispersed and difficult to assess. Several are the factors that connect climate change to finance, including climate change policy, innovation in climate finance, technological change, asset stranding, divestment process, green investment, weather events and long-term physical damages, liability risks and reporting practices. However, the current scarce knowledge concerning the relationship between all these variables has fostered the development of this thesis. This study is based on the belief that recognizing the impacts of climate change on finance would foster the incentive to act.

Climate change has been called a problem of extreme, permanent, highly unsure and dangerous global risk[340]. The narrative on climate science and its impacts is steadily gaining momentum[341]. However, the awareness concerning climate change and its impacts on financial systems is still low and must be increased. This study has analyzed the climate-risks faced by different stakeholders and its effects on the financial perspective.

From this research has emerged that there are several ways in which climate-related risks can be managed. Moreover, this study has provided evidence that financial innovation has fostered the development of new financial instruments able to exploit new business opportunities. Climate change has indeed become a significant factor for investment success, and investors who ignore it might be subject to bad consequences on their portfolio's value.

By reviewing the position of several authors in literature, this thesis contributes to the ongoing debate on climate change and the role of finance. This study aims to increase the awareness concerning climate change and its impacts on finance.

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[340] Stern. (2006). *Ibid.*

[341] Matthews H. D. et all.(2017). Estimating carbon budgets for ambitious mitigation targets. Current Climate Change Reports.

Regarding this management problem the following main research question seems relevant:

What are climate change impacts on finance?

In order to answer to this question, the following research questions have been considered:

- *Which have been the climate-related risks for the financial stability?*
- *How did climate change affect financial sectors and what are the business opportunities?*
- *What is the status quo concerning these issues in Italy?*

Concerning the first demand, three are the climate-related risks that have been analyzed: physical risks, transition risks and liability risks.
Physical risks have been defined as acute and chronic phenomena due to climate change that can cause significant damage to economic activities (and, consequently, to investors). Indeed, it has been seen how the unwanted real occurrence of natural disasters due to climate change may lead to material financial losses (some of which are covered by insurers companies while others are uninsured). Considering losses covered by insurance it has emerged that huge damages from extreme weather events might cause the failure of the insurance companies. In that case, assets of distressed insurers would be rapidly sold, and this would decrease assets prices, causing the reduction of values in balance sheet of other financial institutions, such as banks.

Moreover, the research has highlighted the fact that insurance sector is the most exposed to climate change risks. Nevertheless, it has been examined its strategic role played in terms of underwriting mechanisms, claims management and asset allocation. Conversely, the banking sector has faced indirectly climate-change-related effects. It has been seen how, in many cases, the banking sector has transferred its risk back to the insurers who often have acquired debt products. Clearly, in this case, banks could be indirectly affected by insurers risk

of bankruptcy or by customers' operations, consumption, and financial circumstances.

Transition risks have been described as the financial risks that may emerge from the process of modification towards a lower-carbon economy. The transition processes can be implemented through two channels: by divesting from highly fossil fuel companies or by making investments in energy efficiency and technology innovations. Overall, if on one hand, dealing with climate change impacts on finance means including climate risk variables into investment decisions, on the other hand, it means also shifting from the consumption of fossil fuels (divestment process) towards clean energies (reallocation). Divestment process has been defined as the mechanisms through which the investor sells some of his shares with the highest carbon intensity. Concerning this issue, it has been seen how, in recent years, a special coalition called "The Portfolio Decarbonization Coalition" (PDC) has tried to mobilize a group of institutional investors in order to decarbonize their portfolios.

Concerning climate change impacts on financial values, it has been analyzed the problem of stranded assets. The definition most accepted has emphasized that assets have become stranded, because of the need to reduce fossil fuel usage. It has been explained that different factors might lead assets to lose their value, some of them are: new government regulations, the evolution of social norms (such as fossil fuel divestment campaign) or simply changes in consumer needs (they may need more certification schemes).

Moreover, the increasing public debate over climate risks, in particular on stranded assets, has revealed that financial institutions have augmented their attention on the potentially vast scale of climate risks.

For what is concerning the allocation of resources for the transition to low-carbon economies, green bonds have seemed to be the main financial instrument used. Green Bonds have been issued because they have been able to satisfy the vast need of capital required to address the low-carbon transition and to boost liquidity in financial markets. This research has showed how, since its inception, the green bond market has grown rapidly at a 50%+ compound annual growth

rate (CAGR), and it has continued to expand significantly in terms of scope, average issue size and issuer diversity. This might be reconducted to the political impulse given by the Paris Agreement or to the increased level of climate change awareness among investors.

According to this, this study has underlined the new investor perspectives concerning investment planning. For decades, investors have been focused on short-term gains and, in recent year, this has become the huge barrier for investment in clean energy. For this reason, they have started to change their focus and to slowly move towards long-term goals. This concept is particularly important concerning investment planning, since the majority of green investments have long-term process of remuneration of capital. However, problems concerning the current perception of risk, could be directly addressed by public intervention.

Moreover, it has become always more evident that well-designed climate-related disclosure processes, would help investors in their investment decision process and encourage firms to undertake strategies that decrease their exposure to such risks. Climate change has indeed affected their evaluation of portfolio allocation, aligning it with climate targets and, as a consequence, focusing on long-term perspective.

Concerning green investment, this thesis has examined how the majority of bonds have been issued in the energy sector. It has emerged that the unique difference between green bonds and "traditional" bonds is that investors are conscious about the "greenness" of the assets considered, with a framework intended to furnish assurance on this[342]. Moreover, the development of green bond markets has been presented as the signal of the increasing request for new standards. This trend has reflected the bigger demand of investors for the integration, not only of climate-related issues in capital allocation, but also, more

[342] OECD. (2016). J Boissinot. *Finance and climate: the transition to a low-carbon and climate-resilient economy from a financial sector.*

broadly, of those related to environmental, social and corporate governance (ESG).

Green bonds market growth has determined the necessity of more transparency. They need to become highly monitored and records of performances must be tracked. It has been seen how the development of green financing instruments have been supported with the introduction of market standards in 2014 such as "Green Bond Principle"[343]. In particular, these issues have started the standardization of the rules on project eligibility and the monitoring of the use of proceeds.

With respect to transparency, the research has underlined that, the increased awareness of climate-related financial risks has led shareholders to increase their demand for strategic/reporting responses from the companies where they invest. Several researches have demonstrated that if they communicate with investors in a transparent manner; creating robust management processes and controls; and improving methods to measure, track and report on environmental results, they can reach better performance[344].

The FSB task force main goal has been implemented to design a coordinate mechanism that can evaluate relevant climate-related financial risks and opportunities for both non-financial and financial companies[345]. Furthermore, the study has underlined the fundamental role assumed by reporting mechanisms for representing one of the most important steps towards a unified disclosure code across countries. Companies have progressively tried to reach business transparency with respect to investors in order to defend their sustainability credentials and avoid claims.

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[343] ICMA. (2015). *Green Bond Principles – International Capital Market Allocation.* See: https://www.icmagroup.org/green-social-and-sustainability-bonds/green-bond-principles-gbp/

[344] BMO Global Asset Management. (2015). *Green bonds: financing the transition to a new economy*. November 2015. See: https://bmogamviewpoints.com/wp-content/uploads/2015/11/BMO-Responsible-Invest-Persp-Green-Bonds-V4.pdf

[345] Financial Stability Board Task Force on Climate-related Financial Disclosures. (2016). *Ibid.*

Linked to the definition of claim, it has been introduced, and explained, the concept of *liability risks*. They have been intended as the omission action of doing something such as: failure to mitigate, failure to adapt or failure to disclose or comply.

Considering all these impacts, this thesis would finally suggest that the financial services sector as a whole would be capable of handling impacts of future climate change, even if low-probability, high-impact events or multiple closely spaced events might critically affect parts of the sector. It has been seen that in order to increase this possibility, it must be fostered financial innovation and international cooperation. Moreover, the financial system should move toward rising firm size, augment diversification, improve integration of insurance with other financial services, and enriched tools to transfer risk.

Given all these impacts, what is the Italian situation concerning the financial sector?

The current Italian policy agenda for financing resilience to climate change impacts is inadequate. This study has demonstrated that investment in green bonds in Italy are still low (green bond share with respect to overall debt is 0.07% with an average of 0.16% in G20 countries). This might be possibly reconducted to the fact that Italian market is characterized mainly by small entities (also known as SMEs). Thus, it may be hard for them to gather enough green projects to be financed. For these reasons such as the lack of financial resources and of a clear guidance to support SMEs, Italian government have introduced in the last decade the so-called "mini-bond". They have been presented as corporate bonds of small size, with simplified administrative procedures, that can be easily issued also by SMEs. Even if the green bond market has not yet developed, it has been demonstrated the significant potential in the green mini-bond market, along with strategic issuance from public entities.

Overall considered, it has seemed that, on one side, the Italian financial system is not supporting the transition toward a low-carbon economy. Acting in

opposite direction with respect to the global finance community, the Italian economy is still dominated by fossil fuels.

However, on the other side, it can be said that the Italian transition towards a "green economy“ (low-carbon, resource-efficient and physical resource preservation model) has already been undertaken.

Concerning investment in renewable energy the research has showed that Italy is among the best producers of renewables in Europe. It has been seen that it reached satisfying results (fifth in the world for capacity) in the solar photovoltaic sector. Renewable energy diffusion has increased radically in Italy in recent years, probably thanks to government adoption of several policy instruments in past years to support the deployment of RES. Moreover, technology costs have diminished for all renewables, and both wind and solar PV have almost become cost competitive with traditional fossil-based generation options.

In light of the limited public financial budgets, another key requirement for modernizing the Italian energy system has emerged from this study. It has been related to fostering the mobilization of private capital and ensuring access to credit for firms and households. According to this, it has emerged that financial policymakers would not determine the transition to a low-carbon economy alone. They would establish the frameworks, and the private sector will make the investments.

Moreover, the new National Energy Strategy published in 2017, has been the proof of the country’s priority given to energy and environmental issues in Italy. It has emerged the national intention to phase out coal power by 2025 and the wish to expand the share of renewable energy in final energy consumption to 28% by 2030. The transition towards a sustainable energy system has indeed been principally supported by policies and investments committed for climate change mitigation initiatives. In particular, the research has highlighted that also the financial sector has started the implementation of sustainable development factors in its core activities. Indeed, Italy has been one of the first developed

countries that have introduced in 2007 transparency regulation for all Sustainable and Responsible Investment (SRI) products.

All these research findings have confirmed Italian inclination to make climate action more central to its broader economic and foreign policy.

Furthermore, concerning future research, it has been clear that all "climate change stakeholders" such as private citizens, political citizens and/or entrepreneurs/investors can help, with their behaviors and their business and financial strategies, the transformation of the financial system into a more sustainable one.

Hence, it can be summarized that this study has offered and interesting lens for analyzing climate change impacts on finance. It has highlighted the fact that climate change would affect the full range of financial activities, not just insurance, even if it remains the sector most affected. There is a lot that financial institutions can do to address climate-related risks and opportunities.

According to several researches, businesses that consider climate change issues as a valuable opportunity would probably increase their corporate profitability and build a strong sustainable competitive advantage. Indeed, those that have tried to understand and estimate possible connections of their business to climate change consequences, would make the difference and probably avoid failing in the long run.

Moreover, collective actions have been seen as a powerful tool for facing climate change challenges. This study has suggested that, active civil society and private sector engagement with these institutions, may help to bring new issues and perspectives to bear climate change impacts. Indeed, increasing the awareness among citizens of climate change impacts has been one of the scopes of this research. Future research projects should consequently investigate the potential impact of citizen-led solutions to managing the mitigation and adaptation behaviors with regard to climate change. However, clearly, in the absence of right underlying policy, regulatory frameworks and favorable environments, that strategic engagement would never be achieved.

This thesis has focused on how all financial institutions have a unique opportunity to shape the global transition to a low carbon economy. Institutions such as insurers and pension funds have also waked up to the opportunities that has risen from the transition to a low carbon economy. Financial sector would play an invaluable role in reshaping the global economy. It will reduce the risks of a systemic financial crisis.

While existing studies have for sure provided valuable and interesting insights, the overall attention that this research has attracted is still low. The goal of this thesis is to provide a stimulus to encourage leading finance researchers to engage with climate change and the many financial risks and opportunities it creates. Moreover, I hope that this review of the literature and my suggestions for future research would provide some help in overcoming the challenges that climate change issues still face.

"We are the first generation to be able to end poverty, and the last generation that can take steps to avoid the worst impacts of climate change. Future generations will judge us harshly if we fail to uphold our moral and historical responsibilities"
Ban Ki-moon, Secretary-General United Nations.

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