UNIVERSITÀ POLITECNICA DELLE MARCHE
FACOLTÀ DI ECONOMIA "GIORGIO FUÀ"

Corso di Laurea Magistrale o Specialistica in International Economics

Development of the green economy in Italy: exploring the drivers of eco-innovations and green jobs at regional level.

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Anno Accademico 2018 – 2019

Abstract

Spiegare il fenomeno della *green economy* non è cosa semplice, in quanto si tratta di un tema molto ampio che abbraccia numerosi aspetti dell'economia e della società. L'oggetto del seguente elaborato è proprio quello di approfondire il concetto della green economy, a partire dal significato per poi arrivare a ripercorrere gli eventi storici più significativi, che hanno contribuito al suo sviluppo. In particolare, si approfondiscono i trattati e le conferenze internazionali che progressivamente hanno dimostrato una sempre maggiore consapevolezza sulla insostenibilità del modello economico tradizionale, soprattutto dal punto di vista ambientale. Nonostante tali accordi abbiano per lo più approvato e/o confermato ideali e principi invece che produrre concreti piani di attualizzazione (della green economy), passi avanti sono stati fatti sia a livello internazionale, sia a livello locale. L'elaborato procede quindi con l'analisi dei successi conseguiti e degli ostacoli incontrati nel percorso verso un'economia sostenibile, soffermandosi in particolare sul quadro italiano e nel contesto dell'Unione Europea. Un'approfondita analisi settoriale mostra che in Italia il fenomeno della green economy sta rapidamente crescendo e ne evidenzia i punti forti confrontando il paese con le grandi economie dell'Unione Europea.

Dato il quadro generale della green economy in Italia, la tesi prosegue con un'ultima parte di analisi e di ricerca statistica a livello regionale. L'obiettivo è quello di

studiare separatamente due fenomeni che sono il prodotto della green economy: gli investimenti green delle imprese e i *green jobs* (lavori verdi).

Considerata la variazione nella distribuzione geografica dei suddetti fenomeni nelle regioni d'Italia, si analizza la relazione di vari fattori socio-economici con i fenomeni oggetto di studio, al fine di verificare se esiste una correlazione. I risultati ottenuti mostrano che la presenza di imprese innovative, la spesa per la ricerca e lo sviluppo e per l'innovazione, la presenza di accordi di cooperazione per l'innovazione e il capitale sociale sono tutti fattori significativi e positivamente correlati con gli investimenti green delle imprese. Inoltre un alto livello di istruzione (laurea e post laurea) e il tasso di occupazione sono positivamente associati alla presenza di green jobs.

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INTRODUCTION

> Man is both creature and moulder of his environment, which gives him physical sustenance and affords him the opportunity for intellectual, moral, social and spiritual growth. […] Both aspects of man's environment, the natural and the man-made, are essential to his well-being and to the enjoyment of basic human rights – even the right to life itself.[1]

It was 1972, when the United Nations convened the UN Conference on the Human Environment and, for the first time, the relationship between human beings and natural environment became theme of international discussion. Those years witnessed the beginning of a new era characterized by an increasing attention on the impact of man's behaviour on the environment. The man-made development has come about through an undue exploitation of natural resources causing a continual and increasing deterioration of the Earth and during the last decades it has led to destructive dynamics that can no longer be ignored. Natural resources are not endless but they are essential to man's sustenance. Therefore, it is easy to understand that a respectful behaviour towards the environment is the key for a sustainable life and development. However, negligence, impassivity and deliberate disregard still dominate the general mind-set of individuals and societies and if the

[1] UN General Assembly, *Declaration of the United Nations Conference on the Human Environment*, Stockholm, 15 December 1972

attitude does not change first, the transition to a responsible and conscious behaviour will remain just a faint hope.

The disasters occurred during the last years confirm the need of an urgent change because the world can survive without the humankind but the humankind cannot survive without the world. My thesis, thus, aims at exploring in both macroeconomic and microeconomic dimensions the evolution of the *green economy*, an economic approach intended to guarantee a sustainable development. In addition, I deepen the concept by investigating the developments in eco-investing firms and green jobs throughout the regions of Italy. I decided to discuss the topic of the green economy because I believe that in this fast-changing ecosystem its role has yet to be properly recognised. Moreover, the lack of dissemination of clear and comprehensive information makes it harder to see the issue and the potential solutions; I believe that the more we get informed the more we are able to understand the problem and take personal actions.

The thesis consists in three chapters structured as follows: the first chapter opens with the explanation of the concept of green economy, trying to gather the most significant definitions that the literature and the international organizations provide. Then, it proceeds tracing the history of the green economy and its development around the world, focusing on the main events and motivations that pushed governments and international organizations to take steps toward a *greener* economy.

I decided to dedicate a whole chapter to the history of the green economy because I believe that by deepening the knowledge of historical facts it is easier to grasp their relationship with the development of the new economic paradigm.

The second chapter displays the current scenario of the green economy in the world and in the European Union, dwelling on the main improvements and obstacles that the countries are facing. In this chapter, I focus especially on the Italian development in comparison to the EU countries, especially Germany, France, United Kingdom and Spain, that together with Italy compose the "EU's 5 Big Economies". The analysis continues exploring the economic sectors, focusing on the areas of agriculture, industry and services that present the positive attitude towards the greening path. Once again, the focus is on the Italian case compared to the EU countries.

In the third chapter, I leave the macroeconomic perspective in order to examine if and in which extent the Italian enterprises are moving towards a more sustainable economy. In particular, I tried to identify the factors that drive eco-innovations and are correlated with the green jobs in the regions of Italy. Based on the available data on the geographical distribution of enterprises that invest in eco-innovations and the distribution of green jobs, I collected several factors and analysed their correlation with the variables subject of study.

The results and limits of my study will be explained in detail in the conclusion of this thesis.

1 HISTORY OF THE GREEN ECONOMY

1.1 Definitions of green economy

According to United Nations Environment Program (UNEP),

> A green economy is one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive.[2]

There is not a universally accepted definition of green economy and this has led to a multiplicity of definitions that emphasize one or the other aspect of the green economy. By looking at the varying institutes of governance of the sustainable development, it is possible to collect several information on the green economy and related frameworks such as the concept of *green growth.*[3]

The literature provides as well many source of definitions of the green economy.

L. Brown considers the green economy as an environmentally sustainable economy, a system of production and consumption within environmental balance.[4]

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[2] UNEP, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication - A Synthesis for Policy Makers,* 2011, p. 2

[3] Merino-Saum, A. *et al*., *Articulating natural resources and sustainable development goals through green economy indicators: A systematic analysis*, in "Resources, Conservation and Recycling", vol. 139, 2018, pp. 90-103

[4] Brown, L.R., *Eco-Economy. Building an Economy for the Earth*, New York, Norton, 3rd ed., 2012, pp. 44-45

In the interview to Tariq Banuri, he expressed that "the green economy [is placed] squarely within the context of sustainable development as a means of reconciling economic policies and economic behaviour with social and environmental needs."[5]

A definition of remarkable importance is the one given by the scientist Karl Burkart, who defines the green economy in six categories: renewable energy, green buildings, sustainable transport, water, waste and land management.[6]

What the above-mentioned definitions have in common is that they emphasize the relationship of green economy and sustainable development. The green economy is a means to achieve a sustainable development in all its dimensions: social, economic and environmental.

The concept of green economy has gained international relevance gradually but became central issue of global attention only when the governments of the world acknowledged that an urgent response to the double economic-environmental crisis, started in 2008, was needed. The major aim of the green economy, indeed, is to support the economic growth while protecting the Earth's ecosystems and eradicate

[5] Zarro, A., *Rio Summit 2012: What to expect? Interview with Tariq Banuri*, in "Development", vol. 55 (1), 2012, pp. 10-12

[6] Burkart, K., *How do you Define the 'Green' Economy?*, 2012 Available at: www.mnn.com/green-tech/research-innovations/blogs/how-do-you-define-the-green-economy

poverty in all its forms and dimensions.[7] "In this sense, the transition to a green economy will entail moving away from the system that allowed, and at times generated, these crises to a system that proactively addresses and prevents them."[8] Here we can tell the difference between the green economy and the traditional linear economy: the latter is based on the model *take-make-dispose* with little to no attention to the impacts on environment. Today, this system has definitely become unsustainable for the planet and the green economy provides a tool to address the ecological challenges and to promote a sustainable development.

However, what does *sustainable development* mean? The most widely used definition of sustainable development is that used by the World Commission on Environment and Development (WCED), the Brundtland Commission: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[9] This statement is enclosed in the report *Our Common Future* (1987), which highlights the three fundamental components of the sustainable development: social equity, economic growth and

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[7] UN, *The Future We Want: - Outcome document of the United Nations Conference on Sustainable Development*, Rio de Janeiro, 20–22 June 2012. Available at: https://sustainabledevelopment.un.org/content/documents/733FutureWeWant.pdf

[8] UNDESA DSD, UNEP, UNCATD, *The Transition to a Green Economy: Benefits, Challenges and Risks from a Sustainable Development Perspective,* 2012.

[9] World Commission on Environment and Development (WCED), *Our Common Future (The Brundtland Report),* Oxford University Press, Oxford,1987

environmental protection. The innovation of this report is that all the dimensions of sustainable development are put on the same level, so the objective is to formulate strategies to push economic and social growth that avoid environmental degradation, over-exploitation and pollution, and thus eliminate the trade-offs among these goals.

To understand better the concept of the green economy in relation with the sustainable development, as well as the challenges and the potential benefits, it is necessary to take some steps backwards in the history. In particular, we need to explore the events that led to the acceptance that the traditional economy is no longer adapt to the present world and has to be replaced with an innovative one to ensure the achievement of the global goals of sustainable development.

1.2 The origin and the historical development of green economy in the world

1.2.1 The United Nations Conference on the Human Environment

The first important event that brought the environmental issue on global stage is the United Nations Conference on the Human Environment, held in Stockholm in 1972. Before that, the topic had been already discussed internationally; for instance, some International Organizations had addressed issues of pollution, excessive use of natural resources and climate change already with the League of Nations. In the post World War II, economy raised consciousness about the

environmental costs of economic progress and the environmental issue became therefore subject of interest of the United Nations and its Economic Commission for Europe, the Council of Europe and the early OECD. Their mission was to gather scientific expertise, collect comparative data, propagate and found international scientific programs and induce greater media attention to the cross-border dimension of environmental protection.[10]

During the 1960s, the world experienced a financial and economic crisis. The economic growth slew down drastically in developed countries; the unemployment rate, the income and wealth gap increased remarkably, producing a knock-on effect on the emerging countries.[11] As expressed by Dudley Seers, the first Director of the Institute of Development Studies (IDS) at Sussex, the main challenge for development in the late 1960s was "understanding the causes of poverty, and the mechanisms by which unemployment emerges and inequalities grow, as a basis for genuine development plans."[12] However, in the same years the environmental movement, born in the first decades of the XX century, increased substantially to actively respond to the present ecological crisis by focusing the attention on air and

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[10] Kollegforschergruppe (KFG), *Environmental Protection in the Global Twentieth Century: International Organizations, Networks and Diffusion of Ideas and Policies*, Research College "The Transformative Power of Europe", Free University of Berlin, Berlin, 2012

[11] OECD, *Divided We Stand: Why Inequality Keeps Rising*, 2011a

[12] Seers, D., *The Meaning of Development*, Institute of Development Studies (IDS) at the University of Sussex, Communication 44, Brighton, 1970, p. 16

water pollution. The need to react to the socio-economic crisis as well as to the ecological crisis was urgent, therefore, the idea of giving a green response to the economic crisis in order to achieve a green growth emerged.

In 1970 the first Earth Day was organized to shift the attention to the environmental threat and the Environmental Protection Agency (EPA) was created in order to regulate and strengthen federal programs on air and water pollution, environmental radiation, pesticides, and solid waste.[13]In 1972, under the commission of the Club of Rome, founded in 1968 by Antonio Peccei, the Massachusetts Institute of Technology (MIT) published the scientific document *The limits to growth.* The document, not only contained the requests and complaints of the environmental movement, but also featured the dramatic scenario of the future humankind's environment due to the population pressure, resource depletion, and pollution.

In this context, The United Nation Conference in Stockholm, in 1972, represented a turning point. It was the first international conference that grouped the governments of the world around environmental issues and sustainable development policies. The Stockholm declaration resulted in a list of 26 principle of human rights and responsibilities in order to inspire the people of the world in the preservation and enhancement of the human environment, for the benefit of all

[13] Information about the development of the environmental movement is available at https://www.encyclopedia.com/earth-and-environment/ecology-and-environmentalism/environmental-studies/environmental-movement

the people and for their prosperity. One of the most important effect of the Conference in Stockholm was the foundation of United Nations Environment Programme (UNEP).

> UNEP is the leading environmental authority in the United Nations system. UNEP uses its expertise to strengthen environmental standards and practices while helping implement environmental obligations at the country, regional and global levels. Its mission is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations.[14]

In conclusion, the 1970s saw policy makers start paying more attention on the environmental protection, both at national and international level, extending the discussions and decisions beyond bilateral treaties. The Stockholm Conference and the events of the 1970s set the starting point for the development of a greener approach toward the social and economic growth. However, it is only in 1992 with the Rio Conference, and even more, in 2012 with Rio+20 Conference, that the concern about the planet protection became central and real action plans were approved to achieve the sustainability goals.

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[14] Sundholm, M., *UNEP: United Nations Environment Program*, available at: https://www.un.org/youthenvoy/2013/08/unep-united-nations-environment-programme/

1.2.2 The United Nations Conference on Environment and Development

Twenty years after the Stockholm event, in 1992, the United Nations met in Rio de Janeiro to talk again about the ecological crisis started in the 1960s because they realized that a list of principles and values was not enough to address the problem, which had worsened over the years and was expected to become even more threatening. The UN Conference on Environment and Development (UNCED), known also as Rio Conference or Earth Summit, in 1992, was the first global conference on the environment and definitely the biggest conference for the number of participants. It was the result of a huge international debate, as well as of the preparatory work of the World Commission on Environment and Development (WCED) and the report *Our Common Future* published by the WCED in 1987.

The Earth Summit remained a reference point for the sustainability development since it focused entirely on the relationship among the three pillars that compose it: social development, economic development and the environmental protection.

The UNCED approved with other 178 representatives of the other countries the Rio Declaration on Environment and Development and the Agenda 21, so called to indicate the action plan for the XXI century.

Moreover, it founded three global conventions: the United Nations Framework Convention on Climate Change (UN FCCC), the United Nations Convention to

Combat Desertification (UN CCD) and the United Nations Convention on Biological Diversity (UN CBD).

Last, it established the United Nations Commission on Sustainable Development (UN CSD) to ensure effective follow-up of the Earth Summit.

The Declaration on Environment and Development reconfirms the Conference in Stockholm and uses it as basis for a further expansion. It contains 27 principles that aim at providing a new and equitable cooperation on global scale through the establishment of new levels of collaboration between States to achieve international agreements to protect the ecosystem and ensure a sustainable global development.[15]

The Declaration introduces the principle of *Common But Differentiated Responsibilities* (CDBR) of the States, also included in the UN FCCC. The logic under the principle is that developed and developing countries have different capabilities (social, economic, environmental), and applying a *one-fits-all* policy to actualize environmental measures would not certainly benefit the developing countries. Therefore, differentiated efforts based on the individual capabilities, is the optimal solution to carry out effective and adequate actions. The same principle

[15] UN, *The Rio Declaration on Environment and Development*, 1992, pp. 1-12

will be clearly recalled in the Kyoto Protocol, that assigned distinct goals to developed and developing countries.

Also with regard to the Agenda 21, the *governance* plan for nations and regions, the Preamble states that "[it] will be carried out by the various actors according to the different situations, capacities and priorities of countries and regions in full respect of all the principles contained in the Rio Declaration on Environment and Development."[16]

Agenda 21 is organized in four sections:

- Social and economic dimensions
- Conservation and management of resources for development
- Strengthening the role of major groups
- Means of implementation

The first section deals with socio-economic topics, such as the sustainable development in developing countries, fight against poverty, change in consumption patterns, health promotion, sustainable demography and decisional production processes.

[16] United Nations Conference on Environment and Development (UNCED), *Agenda 21*, New York, 1992, paragraphs 1.1-1.6

The second section raises issues regarding the protection of the atmosphere, the management of fragile ecosystems (desertification, draughts, and mountainous areas), the fight against deforestation, water and waste management.

The third part is a call for global action in order to enhance the role and ensure a sustainable and equitable development to the most significant groups: women and children, NGOs, local authorities, business industry and workers, indigenous peoples and their communities, farmers, scientific and technological community.

The last section describes the means necessary to implement the sustainable development program, such as science, transfer of technology, education and training, international institutional agreements, financial mechanisms.

Agenda 21 remained the action plan until the 2015, when a new plan will be approved to pursue new or adapted goals: Agenda 2030.

1.2.3 The Kyoto Protocol

Almost at the door of the new millennium and after five years from the first Earth Summit, in 1997 the Parties to the UN FCCC concluded the Kyoto Protocol designed as the initial step to implement the Convention. The objective of the Kyoto Protocol was to reduce the concentration of greenhouse gases (GHGs) in the atmosphere, especially CO_2, by setting different targets on emissions to the Parties.

The agreement imposed a heavier burden on developed countries because it acknowledged that they are the main responsible of the GHG emissions in the atmosphere and it was in line with the CBDR principle, affirmed in the UNCED declaration.

Indeed, forcing developing countries to decrease the emissions in the same amount of developed countries would have been much more demanding because it would have impeded their economic development. Under the Protocol, only the determined Parties are committed to reduce, individually or jointly, "their overall emissions by at least 5% below 1990 levels in the commitment period 2008 to 2012."[17]

The Protocol required that the Parties meet their targets primarily through national measures; however, it allows also other possible *flexibility mechanisms* to achieve their targets (Emission Trading, Clean Development Mechanism and Joint Implementation). The purpose was to reduce the greenhouse gases emissions at the lowest possible cost, that is minimize the total cost of emission cutting. Nevertheless, the agreement effectively entered into force only in 2005, when the "55%" clause was satisfied with the ratification of Russia (November 2004).

[17] UN, *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, 1998, p.3

1.2.4 The transition to the new Millennium: UN Millennium Declaration and Johannesburg WSSD

The new millennium opens with an unprecedented event for the global development: in September 2000, the world's heads of state met in New York and adopted the United Nations Millennium Declaration. The Declaration reaffirmed the "support for the principles of sustainable development, including those set out in Agenda 21, agreed upon at the United Nations Conference on Environment and Development."[18] The General Assembly also set out series of eight time-bound targets, with a deadline of 2015, known as Millennium Development Goals (MDGs).

The news was that the MDGs moved away from the idea that economic growth is the principal objective of development and shifted the attention to the human development (poverty, people and their lives as main themes) as primary goal for the new millennium's global development. They explicitly recalled the objectives of Agenda 21 but leave almost at the end the environmental goal, focusing completely on the human conditions, especially on poverty and health. Moreover, they aimed at forming a global partnership that would hold both developed and

[18] UN, *United Nations Millennium Declaration*, General Assembly resolution 55/2 of 8 September 2000

developing countries, by promoting governments' accountability, mutual aids, debt relief and transfer of technology.[19]

The international consensus on the poverty ending accepted as the key for global development represents a disruptive event, since for the first time the issue of combating poverty prevailed over the economic objectives.

Ten years after the first Earth Summit, in 2002 The United Nations called the World Summit on Sustainable Development (WSSD) in Johannesburg. The main objective was to verify whether the conditions set in Rio in 1992 were carried out, with specific concern to Agenda 21. The summit was expected to provide the instruments to implement Agenda 21 and therefore achieve the goals of fighting global poverty and protecting the ecosystem.[20] However, the facts showed that the ecological problem had worsened as well as the poverty condition around the world, due to the trade liberalization and globalization of the 90s, which affected negatively the environment. Indeed, the North and South gap had increased: on one side, the developed countries led a consumer lifestyle and on the other side, the developing

[19] Fukuda-Parr, S., *Millennium development Goals: why they matter*, in " Global Governance", vol. 10, 2004, p. 395

[20] Von Frantzius, I., *World Summit on Sustainable Development Johannesburg 2002: A critical analysis and assessment of the outcomes*, in "Environmental Politics", vol. 13 (2), 2004, 467-473

countries did not respect the environmental norms and policies because of the declining economic growth and the augmentation of the cost of natural resources.

The result of the Summit was the approval of the Declaration on Sustainable Development and of the Plan of Implementation of the WSSD. However, the initial hopes had been abandoned. Since the preparatory work, the negotiations were difficult and at the end, the Parties were not be able to reach agreements in order to achieve the established goals.

The Declaration renewed the support for the principles of Rio declaration and Agenda 21. In other words, it came with a range of ideals and values aiming at the preservation of natural resources, the access to safe drinking water and sanitary facilities in developing countries, poverty ending and the promotion of renewable resources.

As regards the Plan of Implementation, the result was disappointing because all it did was encourage voluntary and hypothetical actions through the promotion of bilateral agreements and did not set out any concrete goal or specific timeframes nor incentive global commitments. In fact, the document, that should have outlined commitments and obligations, became instead "one filled out with voluntary options and choices, and may actually have watered down principles affirmed in

the Rio declaration."[21] In conclusion, the divisions between the governments and the civil societies rendered the summits outcomes too weak and represented an obstacle for the progress in dealing with environmental concerns.

1.2.5 Transition to green economy and Rio+20

The years that followed the WSSD were intense of events. The 2008 was a turning point in the economic history since it saw multiple disastrous crises at global scale that led the United Nations respond with a Keynesian approach, launching in 2009 the so-called Global Green New Deal (GGND).[22] The GGND was part of the Green Economy Initiative (GEI), launched by UNEP in 2008 to respond to the development challenges and imbalances in growth strategies that had caused the financial and economic crises.

The GEI pushed policymakers to address significant part of the investments in the green sector in order to reduce the threat of further food, water, energy, ecosystem and climate crises, which have heavier impact on the poor people. The objective was indeed to demonstrate that such investments would benefit the countries in

[21] La Viña, A. G. M., Hoff, G. and DeRose, A. M., *The outcomes of Johannesburg: assessing the World Summit on Sustainable Development*, in "SAIS Review", vol. 23 (1), The Johns Hopkins University, 2003, p. 64

[22] Barbier, E., *Global Green New Deal,* Report prepared for the Green Economy Initiative of UNEP., 2009

terms of growth, competitiveness, creation of jobs and improvement of job conditions, poverty reduction and, at the same time, protect the environment.[23]

To realize the Global Green New Deal, UNEP commissioned the work to the authors of *Blueprint for a Green Economy* (1989), considered the pioneering report that first coined the term "green economy".[24]

The GGND consisted in a series of *green stimulus packages* and UNEP identified specific areas where large-scale public investment could kick-start a *green economy*. The overall objective was to provide a policy strategy able to recover the world economy and at the same time ensure environmental sustainability. Inspired by this new thought, several governments started implementing significant green stimulus packages to recover from the economic recession.

The GGND set out three objectives:

- Economic recovery
- Poverty eradication
- Reduced carbon emissions and ecosystem degradation

It proposed also a framework for the green stimulus programs as well as supportive domestic and international policies.

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[23] Information about the Green Economy Initiative is available at: https://www.unsystem.org/content/green-economy-initiative-gei

[24] *Blueprint for a Green Economy* (1989), written by Pearce D., Markandya A. and Barbier E. B., presented for the first time a set of practical policy measures for greening modern economies towards a path to sustainable development.

At this point, the relationship between green economy and sustainable development was indisputable; as UNEP pointed out in its widely quoted *Green Economy Report*,[25] moving towards a green economy was the necessary strategic economic policy agenda to achieve a sustainable development. However, the international organizations protagonist in the development of the green economy, not only recognized it as the vehicle for the sustainable development, but also emphasized its relationship with natural resources as thematic priority for it. Indeed natural resources play a central role in the economic activities; therefore, a sustainable and efficient management of them is necessary to support both human and Earth needs. Consequently, resource efficiency is a "necessary criterion" for green economy.[26] The Economics of Ecosystems and Biodiversity (TEEB) included the "measures for eco-efficiency and wider resource efficiency" and the "decoupling [of] the economy from resource use and its negative impacts" two of the six fundamental building blocks in the transition to a green economy.[27] The resource efficiency appears as a key objective also in the OECD's Green Growth Strategy. In fact, green growth means "fostering economic growth and development, while ensuring that

[25] The *Green Economy Report* (UNEP, 2011) charges the "brown economy" with the global crises associated with climate change, food, energy and finance and fosters the necessity to invest in green sectors.

[26] OECD, *Towards Green Growth. A Summary for Policy Makers*, Paris, May 2011

[27] Ten Brink, P. *et al*., *Nature and its role in the transition to a green economy*, in "The Economics of Ecosystems and Biodiversity", 2012, p. 34

natural assets continue to provide the resources and environmental services on which our well-being relies"[28]. In a similar way, for the World Bank, green growth is "one that is efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts and resilient in that it accounts for natural hazards"[29].

Finally, in 2012, twenty years after the Rio Summit of 1992, the United Nations gathered again in Rio de Janeiro to hold the third Earth Summit, the so-called Rio+20 or United Nations Conference on Sustainable Development (UNCSD).
The intention was to review the UNCED, verifying which sustainable development objectives had been met, identifying the implementation gaps and thus propose measures for the way forward. During the run-up to Rio+20, several countries-led initiatives and reports were brought to the preparatory meetings, producing data and scholarly assessments that displayed "the state of the planet, its resources, and its inhabitants, human and nonhuman."[30]The results illustrated that the ecological crisis had worsened, despite the sectoral improvements. Therefore, the message for the upcoming Rio+20 was clear: it was the time for a "great transformation" that

[28] OECD, *Towards Green Growth. A Summary for Policy Makers*, Paris, May 2011, p.4

[29] World Bank, *Inclusive Green Growth. The Pathway to Sustainable Development*, Washington, DC, 2012, p.2

[30] Bina, O., *The green economy and sustainable development: an uneasy balance?*, in "Environment and Planning C: Government and Policy", Lisbon, vol. 31, 2013, p. 1025

had to lead the new "approaches to all three dimensions of sustainable development." [31]

Consequently, the two main themes addressed in Rio+20 were "the green economy in the context of sustainable development and poverty eradication, and the institutional framework for sustainable development".[32]The choice of these two themes resulted from the belief that the former could contribute to reinforce the three pillars of the sustainable development – social development, economic development and environmental protection – and the latter could contribute to the governance for each of them.

In this context, within the European Union an approach to a green economy was evolving. In 2010, the approved economic strategy, Europe 2020, was to build a *smart, sustainable and inclusive growth*, where sustainable is characterised as low-carbon and resource-efficient. When the time for the build-up to Rio+20 came, the European Union proposed the adoption of a *Green Economy Roadmap*, a menu of actions, plans of implementation, targets and indicators for the transition to a green economy. However, developed, emerging and developing countries had divergent

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[31] International Institute for Sustainable Development (IISD), *Summary of the United Nations Conference on Sustainable Development: 13–22 June 2012,* in "Earth Negotiations Bulletin", 27(51), 2012a, p. 22

[32] The main theme were discussed during First Preparatory Committee Meeting (Prep-Com 1) of the UN Conference on Sustainable Development (UNCSD), New York ,17-19 May 2010

priorities and different perceptions about the practical meaning of green economy and the steps to be taken to achieve it.

This entailed, especially in the second Preparatory Committee Meeting, the raising of oppositions from developing countries and China, that pointed out the challenges and the risks associated with the transition to a green economy. One of the risks feared by them was that the Green Economy Roadmap could be an attempt to impose a "one-size-fits-all" solution in favour only of developed countries. According to the CBDR principle, the treatment of countries shall be different depending on their level and stages of development. Consequently, adequate and flexible measures should have been provided for developing countries, such as exemption, lenient obligations and provision of finance, technology and capacity building.

Another issue was the suspect that green economy could have been used as a paradigm to legitimize protectionism thorough the introduction of environmental standards, regulations and restriction (e.g. carbon tariffs applied if the production process causes emissions higher than certain level or adequate controls on standards are absent). This would have certainly caused an undue advantage to domestic producers to the detriment of the developing country exporters, that did not have the financial resource or access to low-emissions technologies. Other risks were: the fear of exploitation of the green economy from developed countries just for

commercial interests; the strict environmental standard unsustainable for developing countries; and the "one-dimensional" approach.

The latter refers to the risk of taking the green economy out of the sustainable development framework, in which it is embedded, and considering only the environmental dimension, to the detriment of the fully development and equity dimension (UNDESA, UNEP, UNCTAD, 2011), penalizing again the developing countries.

The result of the conference was the approval of a nonbinding document, *The Future We Want*, which witnessed the double failure of the European Roadmap and of the conclusion of a strong international agreement. The document tried to call attention on the world's most pressing issues, while respecting the common but differentiated responsibilities and supporting the necessity to provide opportunities and benefits for all citizens and all countries.[33]

Nevertheless, this objective turned into the production of vague goals and few concrete commitments. The text was full of terms like "reaffirm", "support", "recognize" with regard to the UNCED's principles and Agenda 21, insisting on the urgency of accelerating an inclusive and people-centred sustainable development. However, it did not define any path to a green economy and no specific commitments or steps appeared in the document.

[33] UN, *op. cit.,* 2012

In conclusion, the most important outcome of Rio+20 was not the document itself but the fact that it inspired concrete action on the ground. Rio+20 called the world's governments "to make sustainable development priorities central to global thinking and action"[34]. Moreover, it led the UN to pursue an *open* process of consultation over the next two years in order "to establish an inclusive and transparent intergovernmental process on sustainable development goals that is open to all stakeholders, with a view to developing global sustainable development goals to be agreed by the General Assembly."[35]

For the first time, it was emphasized the importance of the negotiating role of the private and public stakeholders as well as of the civil society in order to pursue a sustainable development, since the governments alone cannot achieve this goal.

Finally, Rio+20 recognized that the pathway for the transition to a green economy lies at national and local level. "The focus shifted from the vision of an international framework to solve global environmental problems, through a global governance, to the promotion of domestic and local action"[36]; shift that was needed in order to keep up with the fast-changing environment based on all national peculiarities.

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[34] Ong, S. E., *et al*., *Examining Rio+ 20's Outcome*, Council on Foreign Relations, New York, 2012

[35] UN, *op. cit.*, 2012, p. 65

[36] Ong, S. E., *et al*., *Examining Rio+ 20's Outcome*, Council on Foreign Relations, New York, 2012

1.2.6 Agenda 2030 and Paris Agreement

As mentioned above, one of the most significant outcome of Rio+20 was the input for the development of the Sustainable Development Goals (SDGs), to be approved by the General Assembly by 2015. The main objective was to review, integrate or substitute the Millennium Development Goals (MDGs) to adapt them to the present world. To define them, Rio+20 created an Open Working Group on Sustainable Development Goals, charged with proposing a set of SDGs "limited in number, aspirational and easy to communicate, addressing all three dimensions of sustainable development"[37].

In August 2014, the UN General Assembly received the *Report of the Open Working Group of the General Assembly on Sustainable Development.*

One year later, in September 2015, it approved the document *Transforming our World: The 2030 Agenda for Sustainable Development*, a blueprint in 17 parts that set the final version of the SDGs and 169 target, "intended to stimulate action over the 2015–2030 time period in areas of critical importance for humanity and the planet"[38]. Compared to the Millennium Development Goals, the new goals present a shift in focus and in general more ambition, that does not merely reflect in the increased number of goals but in much more aspects. Several goals expanded in

[37] UN, *op. cit.*, 2012, p. 63

[38] Merino-Saum, A. *et al.*, *op. cit.*, p. 90

scope, for instance as regards the poverty eradication; the role of the Global Partnership for Sustainable Development is enhanced, involving "multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources"[39].

The greatest change is about the goal of environmental sustainability that now covers various dimensions of sustainability: sustainability in energy, in consumption and production, in agriculture, water and sanitation, urbanization and habitation patterns, industrialization and economic growth. Moreover, specific goals address the challenges of climate change and the preservation of the marine and terrestrial ecosystems.

[39] UN, *Transforming Our World: The 2030 Agenda for Sustainable Development*, 2015

Figure 1: Sustainable Development Goals

Source: www.sustainabledevelopment.org

Agenda 2030 wanted also to overcome the limits highly criticized to Agenda 21, that is the lack of concrete and quantified goals for the sustainable development. However, it remained a sort of *moral suasion* that never imposed real pressure or deadlines and could only count on the accountability of each country. The SDGs framework was plethoric, lacking of practical priorities and sometimes, even

contradictory. For instance, the goal 8(1) proposed a "per capita economic growth of at least 7% gross domestic product per annum in the least developed countries"[40]. An enormous growth, in such short time, would have definitely conflicted with the objective of containing the climate change set in the goal 13. However, this issue gave way to the Paris Agreement (12 December 2015) that prioritized the problem of climate change over the other aspects of sustainable development.

Built upon the 21st Conference Of Parties (COP21) of the UNFCCC, the Paris Agreement was a landmark agreement that brought all nations into a common cause to undertake accelerated and intensified actions and investments to combat climate change. Its central aim was to strengthen the global response to the threat of climate change by "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels"[41] . During the COP21, the UN FCCC commissioned the IPCC (Intergovernmental Panel on Climate Change) to work on the *Global Warming of 1.5°C*, *a Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emissions*

[40] ibidem

[41] Art. 2(a) of the *Paris Agreement* (UN, 2015), p. 3

pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.

Published in October 2018, it set out the objective of transition to zero carbon emissions by mid-century: an ambitious goal that requires great change.

At this point, the future economy was unlikely to refrain from undertaking the new models of the green economy, which seems to be the only pathway for a sustainable development and may offer great opportunities.

2 THE PRESENT FRAMEWORK OF THE GREEN ECONOMY

As we stated at the beginning, a widely accepted definition of the green economy is missing as it can refer to a sector (e.g. energy or agriculture), specific topics (e.g. pollution), principles (e.g. sustainability or well-being) or policies (e.g. environmentally related taxation). This reflects to the absence of a comprehensive assessment on the EU progress in the transition to the green economy. Indeed, numerous assessments use a bottom-up approach and focus on one or more of the above-mentioned topics, but very few have a more integrated approach.[42]

However, various institutions, national, regional and international, public and private, give their active contribution to monitor and assess the changes in the path of a green development. On the regional level, public institutions, such as the OECD, the EU and other European institutions, work for this purpose.

Eurostat report on the Sustainable Development Goals

Recalling the Sustainable Development Goals, the EU publishes yearly a report on the implementation of its sustainable development strategy and offers important insights on the areas related to the green economy and resource efficiency. The *Sustainable Development in the European Union: monitoring report on progress*

[42] European Environmental Agency (EEA), *Europe's environment – An Assessment of Assessments*, EEA, Copenhagen, 2011, p.94

towards the SDGs in an EU context (Eurostat, 2019) highlights that many countries have come a long way towards a sustainable growth, however, in many areas they are still far behind from meeting the goals and targets by 2030. The report affirms that the highest improvements reached over a five-year span are visible in the promotion of good health and well-being (SDG 3) and in the realization of sustainable cities and communities (SDG 11).

Common parameter to both sustainable development goals is the exposure to air and noise pollution, which directly affect the quality of life. In the period between 2007 and 2017, the share of population who suffered from noise pollution (due to traffic, constructions, industry, etc.) has fallen from 23% to 17.5%, while the exposure to air pollution, measured by the concentration of particulate matter in the air decreased by 16%, only considering the period between 2012 and 2017.

The trend of recycling rates contribute to assess the sustainability of cities and communities, as well as to evaluate the production and consumption patterns (SDG 12). The data reveal that the EU's recycling rate of municipal waste has reached almost half of total waste generated (46.4%), showing a slow but positive trend in the long period. Considering the recycling rate of total waste, excluding major mineral wastes, the share is more than half of waste generated (57% in 2016) and the difference is explained by the fact that most of municipal waste still undergoes to landfill or incineration. However, the EU is witnessing a relevant shift from landfill to incineration as waste treatment operations.

Over the period 2004-2017, the EU circular material use (CMU) rate, which measures the portion of materials used coming from collected waste, increased from 8.3% to 11.7%. Finally, while the amount of waste generated per capita has declined over the same period (-7.1%), in the short term it has grown (+3.3% since 2012): this fact is explained by the secondary waste generated during the treatment of waste. The goal of achieving responsible consumption and production takes into account not only the waste generation and treatment but also the decoupling environmental impacts from economic growth and the energy consumption.

Positive results concern the decreasing consumption of toxic chemicals, the increasing resource and energy productivity and the declining greenhouse gas emissions from new passenger cars.

As regards the energy consumption, the primary energy consumption has continuously decreased since 2002, while the final energy consumption has decreased in the long term but increased in the short term (+1.1% since 2012). The SDGs 7, dealing with the provision of affordable and clean energy, is connected to this topic. In addition to the showed trends, it is important to consider also the declining trend of energy dependence on imports from outside the EU.

Nevertheless, huge efforts are still needed to improve the energy efficiency.

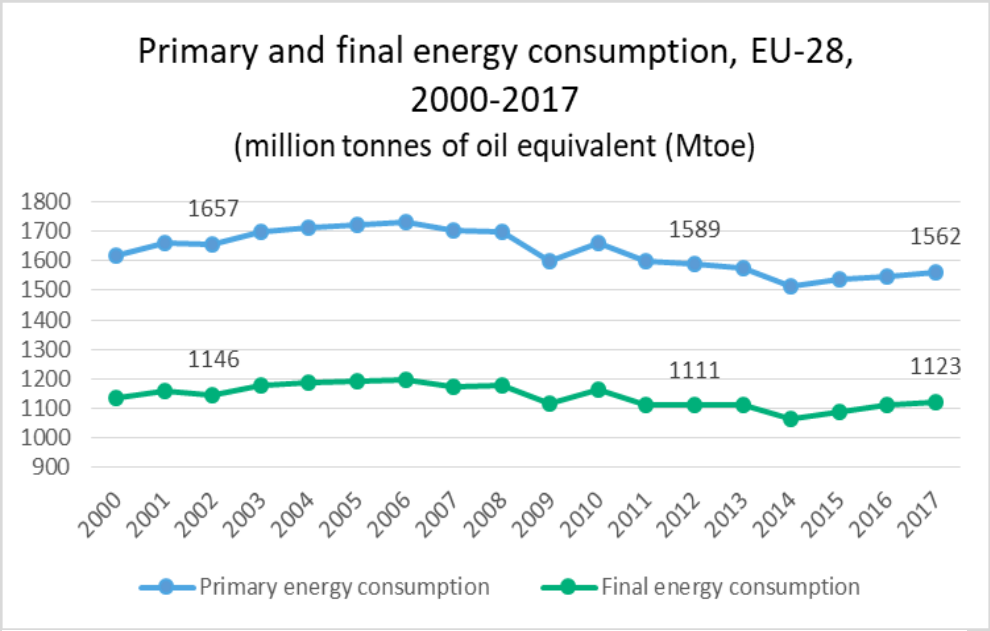

Figure 2: Primary and final energy consumption, EU-28, 2000-2017 (Data elaborated in Eurostat)

The report assesses also the sustainability in transports and illustrates a slight increase in the use of collective passenger transport between 2011 and 2016, whereas the use of rail and waterways freight have declined. The environmental regulation policies and the technological progress largely contributed to make the new cars cleaner, with emissions declining continuously (-10.4% since 2012). Nevertheless, the dominant use of passenger cars over public transport does not help reducing the pollution from the transport sector. Including the international aviation, the emissions from the transport sector accounted 24.6% of total EU emissions in 2017, being the largest contributor only after the energy industry (26.3%).

Looking at the trends in action to climate change (SDG 13), protection of life below water (SDG 14) and life on land (SDG 15), the EU has registered some positive trends: greenhouse gas emissions have decreased and the oceans register lower levels of acidity. Phosphate and nitrate concentration in rivers are finally declining and their demand of biochemical oxygen continue to decrease. However, from an overall perspective, these goals continue to raise high concern.

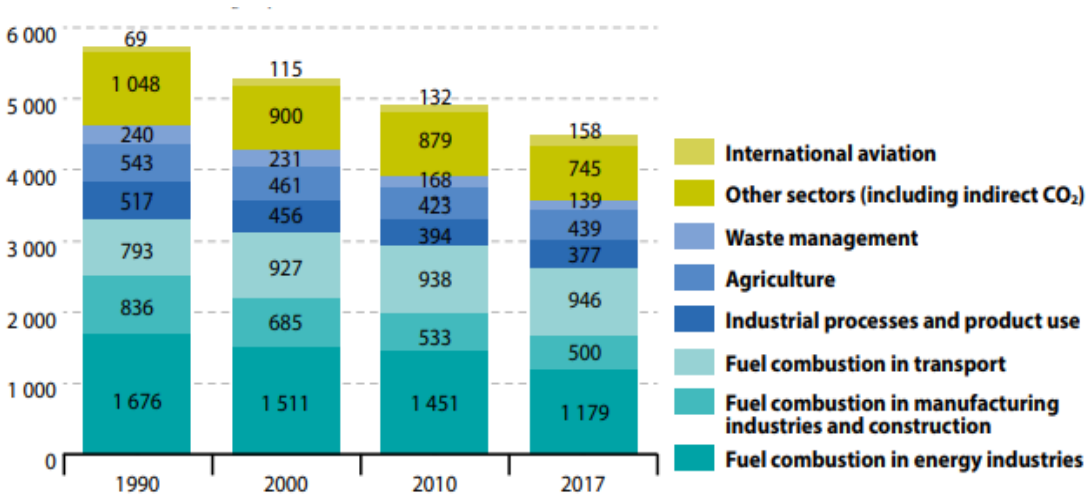

Figure 3: Greenhouse gas emissions by sector, EU-28, 1990, 2000, 2010 and 2017 (million tonnes of CO2 equivalent). Source: EEA

Finally, ensuring a sustainable agricultural production and containing its adverse environmental impacts are among the main concerns of the European Union (SDG 2 “Food Security”). While the production records positive trends in terms of labour

productivity, organic farming and public investments in agricultural R&D, the negative impacts on the environment and biodiversity require urgent action.

OECD's Green Growth Indicators

The OECD focuses on the theme of green growth, which stresses the importance of integrating economic and environmental policies in a way that highlights the opportunities for new sources of economic growth while avoiding unsustainable pressure on the quality and quantity of natural assets.[43]

The OECD provides a framework (last edition published in 2017), which presents four inter-related *Green Growth Indicators*: the environmental and resource productivity of the economy, the natural asset base, the environmental dimension of quality of life and the economic opportunities and policy responses. More general indicators of the socio-economic contexts and characteristics of growth complement the framework. According to the report of 2017, Luxembourg, Iceland, Denmark, Norway and the Netherlands were the best performing countries across most of the mentioned green growth areas. Looking at the trend over the period 2000 and 2015, Denmark, Estonia, the United Kingdom, Italy and the Slovak Republic recorded the highest improvements.

These results confirm the overall good performance of EU countries, even though none of them leads in all dimensions, and usually the least (and insufficient)

[43] OECD, *Towards Green Growth. A Summary for Policy Makers*, Paris, May 2011, pp. 4-20

progress concerns the protection of the natural asset base. Considering the countries that improved the most since 2000, Italy and the United Kingdom improved the most on material productivity, Denmark and Estonia on environmentally related innovation, Slovakia and Denmark on carbon productivity and Italy and Estonia on environmentally related taxation.[44]

2.1 The Italian scenario of the green economy: a comparative data analysis within the EU context

The annual report GreenItaly, published by Fondazione Symbola and Unioncamere, promoted in collaboration with Conai and Novamont, under the patronage of the Ministry of the Environment and Land and Sea Conservation, tracks and weights the strength of the Italian green economy. The ninth edition, in 2018, marks important achievements of the Italian performance in comparison with the other EU Member States. Especially, the report compares our country with the other four Big EU economies: Germany, United Kingdom, France and Spain.

According to the GreenItaly, the strength of the domestic green economy is visible in all the operations of the production process of non-agricultural businesses: from the consumption of raw materials and degree of energy efficiency, to the amount of produced waste and greenhouse gas emissions.

[44] OECD, *Green Growth Indicators 2017*, OECD Green Growth Studies, OECD Publishing, Paris, 2017

Consumption of raw material

According to Eurostat data, Italy reduced the use of raw materials by 40% between 2008 and 2016. In 2016, it consumed 306.6 tonnes of raw material per million euros produced in non-agricultural businesses. It means higher efficiency than the EU average (455 tonnes), following only the United Kingdom (236 tonnes, thanks to a finance-driven economy) and Luxemburg (283 tonnes). Compared to the large EU economies, Italy outperforms France (326.5 tonnes), Spain (360.1 tonnes) and Germany (407.9 tonnes).

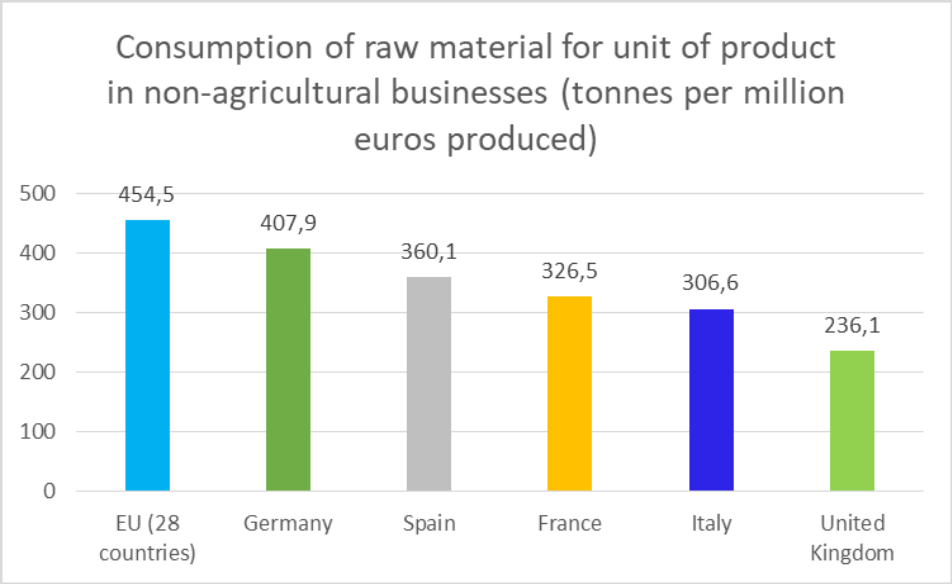

Figure 4: Consumption of raw material for unit of product in non-agricultural business (tonnes per million euros produced). Source: Unioncamere, *GreenItaly 2018*

Energy efficiency

As regards the inland energy consumption, Italy is second only to the United Kingdom, which is the best player, thanks again to an economy mainly characterized by the tertiary sector. Italy reduced the consumption of oil equivalent almost by 18% between 2008 and 2016, reaching 14.2 tonnes of oil equivalent per million euros produced. France follows with 14.9 tonnes, then Spain with 15.7 tonnes and last Germany with 17 tonnes per million euro produced.

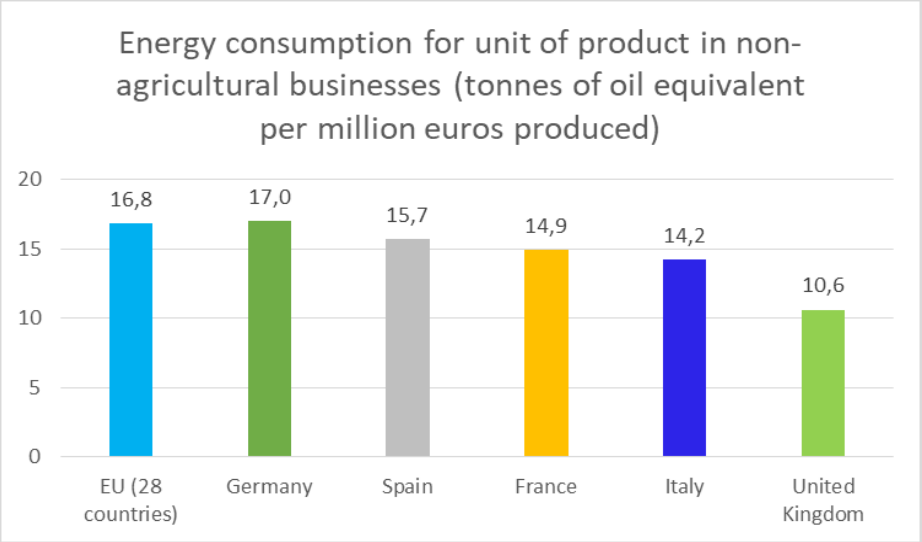

Figure 5: Energy consumption for unit of product in non-agricultural business (tonnes of oil equivalent per million euros produced). Source: Unioncamere, *GreenItaly 2018*

Waste production

In 2016, Italy held again the record in waste efficiency: it produced 43.2 tonnes per million euros produced (1.7 tonnes less than in 2008), far above the EU average, that was 89.3 tonnes per million euros produces. The other large EU economies decreased significantly the waste production, lowering the average from 67.8 in 2008 to 63.3 in 2016.

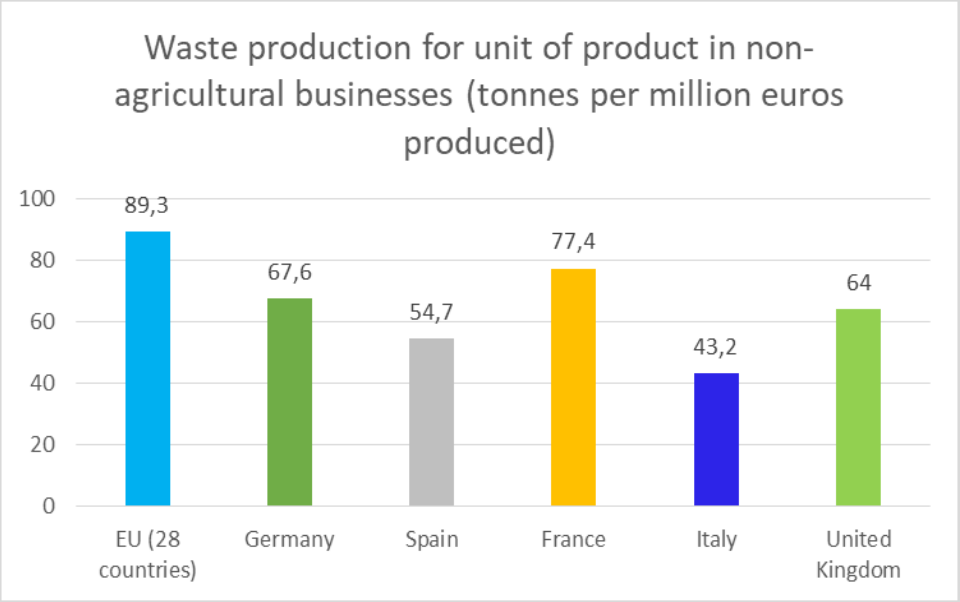

Figure 6: Waste production for unit of product in non-agricultural business (tonnes per million euros produced). Source: Unioncamere, *GreenItaly 2018*

Greenhouse gas emissions

The last factor we need to take into account is the amount of greenhouse gas emissions produced by the non-agricultural businesses. Considering the relation between the main gases released in the atmosphere (carbon dioxide, nitrogen oxides and methane) and the production value, France generates the least amount of emissions among the large EU economies (85.5 tonnes of CO_2 equivalent per million euros produced), due to a nuclear energy production system. United Kingdom (93.4 tonnes) is second place followed by Italy, with 104.2 tonnes per million euros produced. Both Spain and Germany are far from these results, with respectively 127.4 and 136.7 tonnes of CO_2 equivalent per million euros produced.

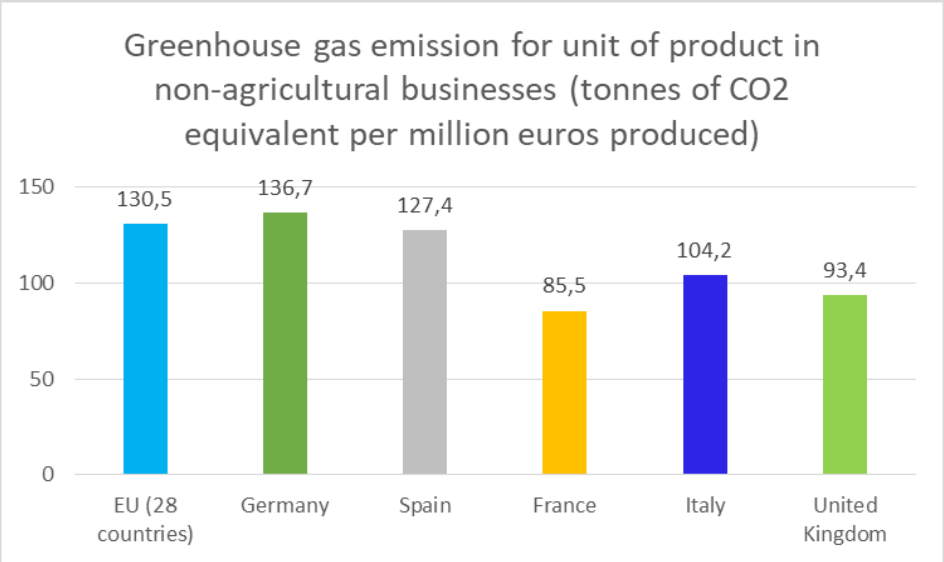

Figure 7: Greenhouse gas emissions for unit of product in non-agricultural businesses (tonnes of CO2 equivalent per million euros produced). Source: Unioncamere, *GreenItaly 2018*

The GreenItaly report combines the above indicators (raw material, energy, waste and emissions) to obtain an overall measure for environmental efficiency for each country. This results in an annual classification of the EU countries in terms of *eco-efficiency* along with the same classification in terms of *eco-tendency* (with base year 2008). In 2016, Luxemburg and Ireland dominated both the rankings and Italy was at the fourth place in the eco-efficiency ranking, just below the United Kingdom. As regards the eco-tendency, Italy lost few positions but it was still above the average of the large EU economies. From an overall perspective, Luxemburg, Ireland and the large EU economies showed great performance in eco-efficiency over the period 2008-2016. Malta improved remarkably its performance since 2015, by cutting the emissions of 17%, and 2016 it almost caught up with the large EU economies.

Circular economy

Finally, Italy is the leader in practice of the circular economy compared to the EU countries. When talking about green economy and circular economy, the two concept are usually confused. Green and circular economy imply economic growth-based development but with different means to pursue sustainability. While the circular economy topics focus on decoupling driven by technological innovation,

especially recycling and eco-efficiency, the green economic topics, in addition to these concepts, proposes nature-based solutions, such as green investments, green employment and conservation, thus being explicitly oriented to green growth.[45]

In this sense, the green economy acts as an "umbrella" for the circular economy.

Other studies reveal that the circular economy revolves around the 3R activities (reduce, reuse and recycle), but it is rarely mentioned that it needs a systemic shift. It is generally associated with a relative decoupling and thus the linkage to sustainability is not as direct as for the green economy. Moreover, the goal of social and intergenerational equity is barely indicated. [46]

Having clarified the differences between green economy and circular economy, we can get back to the current Italian context. The GreenItaly report highlights that Italy is European leader in the dematerialisation of the economy: it generates €4 of GDP for every kg of resource used, far above the EU average (€2.2) and the large EU economies (between €2.3 and €3.6). This means that it is the country with the highest percentage of recycling on the total of waste (including mineral waste): 79%, more than double the EU average (38%). The distance is large even when compared to the Big EU economies: France's recycling rate is 55%, UK's 49%,

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[45] D'Amato, D. *et al*., *Green, circular, bio economy: A comparative analysis of sustainability avenues*, in "Journal of Cleaner Production", vol. 168, 2017, pp. 716-734

[46] Kirchherr, J. *et al*., *Conceptualizing the circular economy: An analysis of 114 definitions*, in "Resource, Conservation and Recycling", vo. 127, 2017, pp. 221-232

Germany's 43% and Spain's 37%. Italy consumes 18.5% of secondary materials on the total consumption of materials: this replacement leads the country be the leader in circularity rate of the economy among the major EU countries. Furthermore, this brings to a saving of 21 million tonnes of oil equivalent and 58 million tonnes of CO_2.

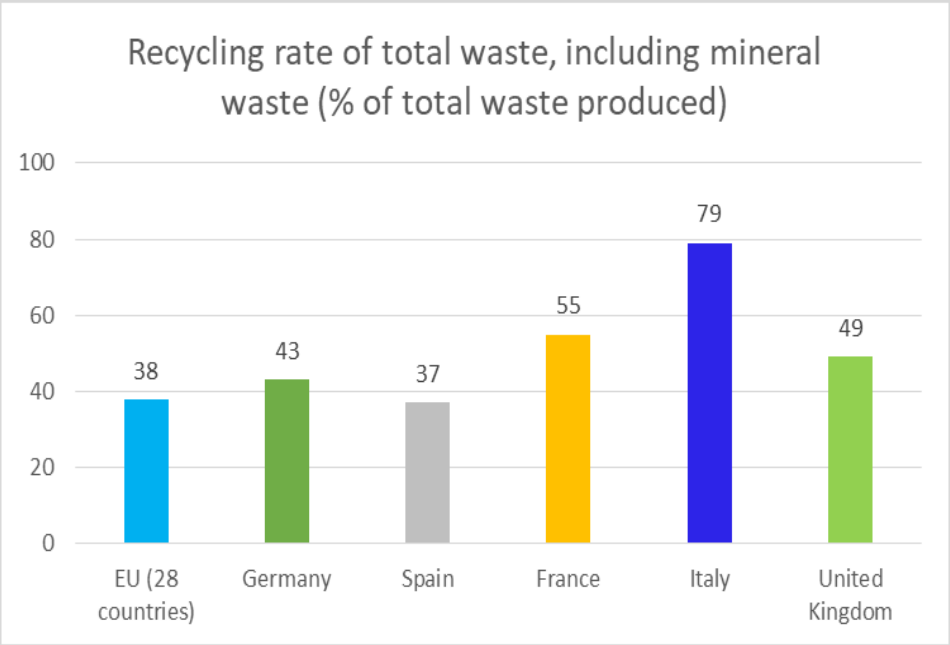

Figure 8: Recycling rate of total waste, including mineral waste (% of total waste produced). Source: Unioncamere, *GreenItaly 2018*

2.1.1 Sustainability by sector

We are witnessing a structural change of the Italian economy that is constantly moving into one direction: the green growth. The European countries are designing and implementing innovative policies to strengthen their processes of sustainable growth and Italy is keeping pace with the rest of the European Union. In some areas, Italy has still a long way to do (e.g. energy sector), however, in many areas it holds indisputable records. The pathway to success is favoured by the widely recognized Italian production value (Made in Italy), which reflects on the material and production quality, innovation, design and product image.

The Italian manufacturing industry produces 15% of value added of GDP, out of 21.7% of value added from the total industry (including construction). Compared to the large EU economies, Italy is second only to Germany, with 20.8% of value added of manufacturing industry and 27.9 % of value added of industry, including constructions. The branch of agriculture, forestry and fishing generates 1.9% of value added to the inland GDP, following only Spain (2.6%) and above France (1.6%), Germany (0.7%) and UK (0.6%). Considering the pure agriculture, without forestry and fishing the value added is € 30.7 billion, dominating the European ranking.[47] The manufacturing industry and the agro-food industry not only produce

[47] World Bank https://data.worldbank.org/country/italy

a significant economic value, but also reflect the image of a country built on long traditions and on a deeply rooted culture.

It is interesting to analyse the branches' degree of sustainability and explore the opportunities that they could offer by welcoming and fostering eco-innovations.

Agriculture

One main global issue about agriculture is to overcome the trade-off of raising the productivity while containing the negative effects on the environment. Estimates from FAO (Food and Agriculture Organization) affirm that by 2050 the world will need to feed more than 9 billion people, requiring nearly 70% more food than in 2009.[48] "Moreover, an expanding global middle class will demand more meat and other protein-rich foods, while extreme weather could slash yields in important agricultural regions."[49]

The undue use of pesticides and the intensive farming threaten both food security and environmental resilience. Therefore, we need to take into account many factors

[48] UN Food and Agriculture Organization (FAO), *Global agriculture towards 2050*, 2009, available at: http://www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/HLEF2050_Global_Agriculture.pdf

[49] Oppenheim, J. *et al.*, *McKinsey on Sustainability and Resource Productivity*, McKinsey & Company, Cait Murphy, 2015, p. 31

at the same time to evaluate the agricultural state: the greenhouse gas emissions, the share of organic farm and other factors that contribute to raise productivity.

The Italian agriculture is the least producer of GHG emissions within the European Union. It generates 569 tonnes per million euros produced, that corresponds to 46% less than the EU average. It is also ahead the Big EU economies: Spain produces 25% more than Italy, France 91% more, Germany is 118% above, and the United Kingdom 161% above. As regards the food production, Italy has the lowest number of crops with pesticide residues (0.4%)[50], three times less than the EU average (1.2%). France, Spain and Germany are far behind this level too.

Italy is the sixth largest organic farm in the world, with 1.8 million hectares and the second exporter of organic food worldwide, only behind the US. The Italian organic producers are almost double than in Spain and in France and young people play and important role in this area: in the EU, Italy counts the highest number of farms ran by under 35 years people, characterized by higher turnover and more employees. In conclusion, not only Italy is at the top of Europe for value added (excluding forestry and fishing), which accounts for 18% of the overall value added in the EU, it also boasts of the most sustainable agriculture. The path for developing innovative green

[50] Ministero della Salute, *Controllo ufficiale dei residui di prodotti fitosanitari negli alimenti - risultati in Italia per l'anno 2016*, 2018, p. 35

technologies for agriculture is still long but the progressive cost reduction and the fast technological development present great opportunities to the Italian farmers.

Manufacturing industry

The manufacturing industry is the cradle of the Made in Italy. The essence of the traditional values, quality, refinement and tendency to innovation find a room in the light manufacturing industry, which is now undertaking the path for a green transition. This transition is favoured by the prevalence of the light industry over the heavy industry, being structurally less incline to cause pollution and thus less environmentally impactful. Statistics elaborated by Ecocerved, which operates in the field of informatics systems for the environment for the Italian Chamber of Commerce, tracks the profiles of the manufacturing sectors in Italy. A way to measure the sustainability of each sector is again the eco-efficiency and eco-tendency rankings, as proposed by GreenItaly.

It results that electronics, electric devices, mechanical and means of transport have the overall highest score in eco-efficiency. However, none of them excels in all the dimensions: the electronics sector, for instance, should improve the waste management, while the electric devices sector should reduce the waste production. Food industry, furniture and other manufacturing activities, essence of Made in Italy, are just below the mentioned sectors. Chemical and petroleum industries are the least eco-efficient, confirming the major impact of the heavy industry on the

environment. However, looking at the trend over the period 2008-2016 (2015 for the indicator of energy consumption), the scenario is partially different.

At the top of the ranking, we find the industries of means of transport and industries of plastic, rubber and non-metallic minerals, followed by the chemical and petroleum industries. These sectors have been substantially improving their impact on the environment since 2008, especially by reducing the energy consumption and the pollution. From an overall perspective, considering at the same time eco-efficiency and eco-tendency, the mechanical, means of transport, food and furniture industries present the best scores within the Italian manufacturing industry.

The role of the Industry 4.0 in the mechanical engineering

The development of the *industry 4.0* is leading the manufacturing industry into the direction of a production more and more automated and interconnected. The industry 4.0 represents the new industrial revolution, which fosters the use of innovative materials, ICT technologies and robotics as the basis of the new production processes. In Italy, this sector has been increasing since 2014 and the year 2018 marked the record of its performance. The production increased up to € 6.9 million (+13.4% since 2017) thanks to the great manufacturer delivery

performance in both the internal and external market. [51] However, after 5 years of continual growth, the year 2019 presented a slowdown in both markets. After the positive shock caused by the government incentives (super-amortization and iper-amortization) that stimulated a quick and wide renewal of the Italian manufacturing companies, the investments have declined.[52]

The issue now is to reinforce the industry 4.0 because it plays a central role in making the mechanical industry highly competitive. The adoption of cutting-edge technologies, indeed, allows manufacturers to reduce the material consumption, make production cycles more efficient and personalize the product improving the relationship with the final user. Consequently, the manufacturers would be more incline to undertake sustainable initiatives in order to save energy, significantly reduce waste, constantly improve efficiency and offer high-quality products.

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[51] Balsamo, C., *UCIMU: 2018 anno record per l'industria italiana della macchina utensile. Attesa stabilità per il 2019*, UCIMU - Sistemi per produrre, 2018. Available at: http://www.ucimu.it/press/comunicati-stampa/v/2018/12/ucimu-2018-anno-record-per-lindustria-italiana-della-macchina-utensile-attesa-stabilita-per-il/

[52] Balsamo, C., *Secondo trimestre 2019: arretrano gli ordini di macchine utensili (-31,4%) ordini interni (-43%); ordini esteri (-28,5%)*, UCIMU - Sistemi per produrre, 2019. Available at: http://www.ucimu.it/press/comunicati-stampa/v/2019/07/secondo-trimestre-2019-arretrano-gli-ordini-di-macchine-utensili-314-ordini-interni-43-or/

Sustainable transport

During the 20th century the consumption of fossil fuels for transportation, machine and electricity generation raised enormously. The transportation industry accounts 24% of global energy-related GHG emissions, being among the main responsible for pollution, global warming and climate change.[53] The green economy calls for a low-carbon and resource-efficient system, essential to contain the effect of the climate change and to protect the Earth's eco-system. Therefore, mostly developed countries, but also some developing countries, are adopting new technologies to make the transport industry sustainable for the environment.

Considering the EU28-EFTA, the market of alternatively powered vehicles records a positive trend: in 2018, it increased by 28% since the previous year. However, this trend is not enough to offset the CO_2 emissions produced by the new vehicles, since also the oil share has raised by 12%, achieving 56% of market share.[54] Thanks to the high sales of gas vehicles, Italy has the largest market share of alternatively fuelled vehicles both in the EU and in the EU-EFTA. Between January and March 2019, Italy held the 21% of the EU market share and the 18.9% of the EU-EFTA

[53] International Energy Agency, *CO2 Emissions Statistics. An essential tool for analysts and policy makers*, 2017. Available at: https://www.iea.org/statistics/co2emissions/

[54] Associazione Nazionale Filiera Automobilistica (ANFIA), *Focus UE/EFTA mercato autovetture ad alimentazione alternativa. Anno 2018*, 2019, p.3

market share. Germany was just below with 17.9% of EU-EFTA market share, followed by UK (10.9%), France (10.2%), Spain (8.7%) and Norway (7.2%).[55]

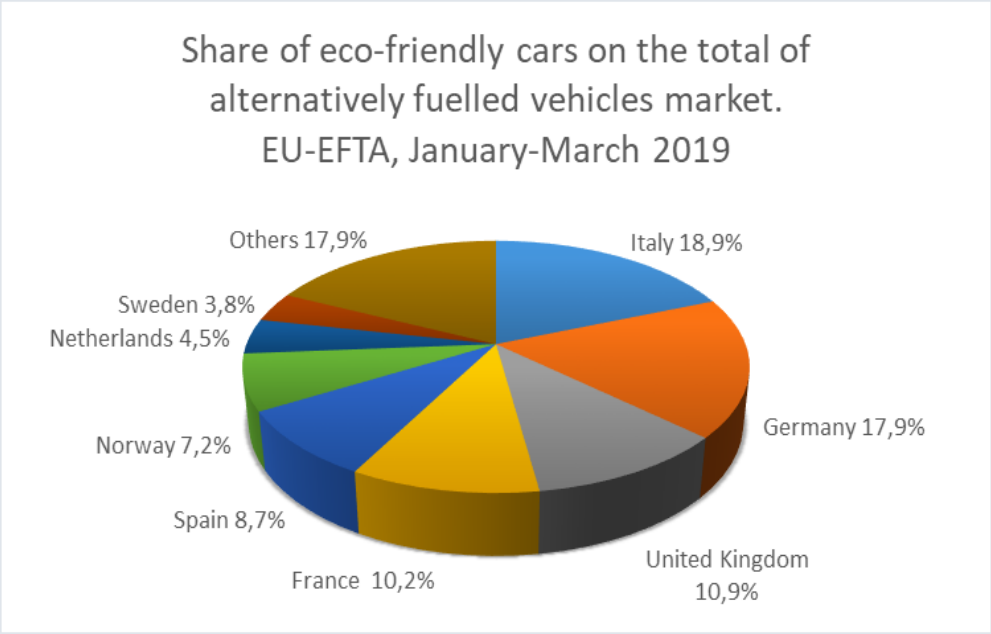

Figure 9: Share of eco-friendly cars on the total of alternatively fuelled vehicles market. EU-EFTA, January-March 2019. Source ANFIA, 2019

Negative notes concern diesel and petrol cars. In Italy, between March 2018 and March 2019, diesel cars declined by 25.6%, remaining though a significant share, and petrol cars increased by 21%, holding almost 44% of market share. The electric vehicles (EVs) still represent a small portion of the alternative fuels: the share was only 3% in March 2019 but it is expected to grow thanks to the introduction of the

[55] ANFIA, *Focus UE/EFTA mercato autovetture ad alimentazione alternativa. Gennaio-Marzo 2019*, 2019, p.3

eco-bonus. In the EU-EFTA the EVs share is 34% on the total alternatively fuelled vehicles market. The absolute record for electric vehicles is held by Norway, which achieved the highest market penetration in the world in 2017, with 39.9% of global market share. Indeed, while in the EU-EFTA one car for every 32 registered was electric in 2018, in Norway the ratio was one electric car for every 1.6 registered.[56] In Norway, EV's sales reach new heights almost every month: in June 2019, the authorities registered 7,428 new electric cars, +87% than in June 2018, with 48.4% of market share.[57] Especially the use of electric vehicles, among the alternatively fuelled vehicles, is addressed to reduce CO_2 emissions. In large cities, it would improve air quality and yield other benefits to urban residents. However, fossil fuel-generated electricity is still the main source to recharge the EVs', and maintaining this system, overall emission levels are likely to remain largely unchanged. Therefore, a fundamental shift to renewable energy sources is needed for EVs to deliver on their full potential to reduce emissions and generate environmental sustainability.[58]

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[56] ANFIA, *Focus UE/EFTA mercato autovetture ad alimentazione alternativa. Gennaio-Marzo 2019*, 2019, p.8

[57] Hampel, C., *Norway: EV sales continue to look up Jan-June 2019*, 2019. Available at: https://www.electrive.com/tag/ev-sales/

[58] UN, *World Economic and Social Survey 2018. Frontier technologies for sustainable development*, United Nations, New York, 2018, p. 41

Lastly, it is important to note that along with the green transformation of the personal cars, the role of sharing mobility is increasing. In Italy, the number of services of sharing mobility have raised on annual average by 12% between 2015 and 2018. The year 2018 witnessed an increase of carsharing and scootersharing, despite the bike is the preferred means. In the same year, 5.2 million Italians used the service of sharing mobility, 24% more than 2017. The sharing mobility sector improved also in quality: the share of electric vehicles out of the total of vehicles raised from 27% in 2017 to 43% in 2018, due to the boom of electric scootersharing, which increased from 6% in 2017 to 22% in 2018. However, the share of municipalities with service of mobility sharing are only 271, 3% of the total of Italian municipalities.[59] The issue is largely due to the large differences in the accessibility to mobility among territories and by the decreasing investments in transport, mainly addressed to road transport, large infrastructures and large cities. The challenge is thus promoting the growth and the efficient integration of the sharing mobility services throughout the national territory in order to reduce the impact on the environment and increase both the accessibility and the social and territorial inclusion.

[59] Onorato, L.*et al*., *Terzo Rapporto Nazionale sulla Sharing Mobility 2018,* pp. 4-57

Furniture and Construction

The Italian furniture industry is constantly on the lookout for innovative solutions that match the quality traditionally associated with the Made in Italy with technical requirements of the product that attest the comfort, safety, material quality and sustainability. In terms of sustainability, the Minimum Environmental Criteria (CAM) became mandatory for public purchases of furniture in public tenders in 2017, leading companies to deal with complex issues and technical specifications.

The Italian furniture industry and constructions is witnessing an increasing use of wood due to its environmental performance. This has led the Italian furniture industry to be at the forefront for the high circularity rate and the massive use of recycled materials globally. The chipboard panels continue to constitute the Italian furniture base and their realization deploys techniques that use a larger percentage of recycled wood than the European average.

Despite in many countries the post-consumption wood waste is burnt to produce energy and the recycling rate is about 30% of the wood released for consumption, in Italy the recycling rate is more than 63% and the wood panel industry absorbs more than 95% of it.[60] In 2018, the recycling rate of wood waste increased by 7.74% since 2017, leading to a reduction of CO_2 emissions by almost 1 million tonnes, about 2% of the total CO_2 produced in Italy. These and the future expected

[60] Rilegno. *Rapporto 2019,* p. 6. Available at: http://www.rilegno.org/rapporto-rilegno-2019/

improvements are possible thanks to *Rilegno* system, the National Consortium for the collection, recovery and recycling of wood packaging, which has been working in this field for more than 20 years.

In building sector, especially in the green buildings, wood plays an important role. Being a natural and renewable material, it contributes to the reduction of CO_2 in the atmosphere, and its insulating property allows high-energy performance and cost saving for heating and cooling. In Europe, Italy is in fourth place for wood building production, after Germany, UK and Sweden and with growth higher than the average. The green building sector is 7% of total building sector and has a value of 1.3 billion euro.[61]The overall building sector, however, is an issue in the EU, since it is the largest responsible for energy consumption (about 40%) and substantially contributes to the generation of CO_2 emissions.[62] Anyway, the European Commission recognizes its vast potential to contribute to a carbon-neutral and competitive economy. In this direction, the EU has established a legislative framework that includes the Energy performance of buildings directive (EPBD) (2010/31/EU) that requires that all new buildings must be *nearly zero-energy buildings* (NZEB) from 31 December 2020. (Since 31 December 2018, all new

[61] Fondazione Symbola – Unioncamere, *GreenItaly 2018, Una risposta alla crisi, una sfida per il futuro,* p. 212

[62] European Commission (EC), *Energy Performance Buildings*, 2019. Available at: https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-performance-of-buildings/overview

public buildings already need to be NZEB). The new challenge is therefore linking the renovation of buildings with sustainability.

Unfortunately, the Italian framework does not seem favourable, according to ANCE (Associazione Nazionale Costruttori Edili) statistics: out of 12.2 million residential buildings present in the national territory, 70% was built before the first anti-seismic and energy-efficiency regulations were issued. Their heating requirements are on average 4 times higher than the actual regulatory threshold. Moreover, 9.3 million residential buildings were built in the areas with the high seismic risk.

ANCE estimates the need of 105 billion euros structural intervention to achieve seismic improvement and 33.5 billion euros for upgrading the energy efficiency. It is a huge investment but the fiscal incentives encourage the building renovation and the energy efficiency upgrading. Between 1998 and 2017, 16 million Italian families (62% of total Italian families) invested for renewing their houses, thanks to the fiscal incentives.[63] These numbers give confidence to the development of the green building sector, considering also that the European market is expected to grow considerably, supported by national and European policies that promote the reduction of energy consumption in the building sector.

[63] Camera dei deputati – Documentazioni e ricerche, *Il recupero e la riqualificazione energetica del patrimonio edilizio: una stima dell'impatto delle misure di incentivazione*, 5th ed., n. 83/4, 2017, p. 1

Recycling system

Italy is leader in the EU for the highest waste recycling rate. In 2016, 79% of total generated waste (including municipal and industrial waste) was sent for recycling, more than double than the European average (38%) and far ahead France (55%), UK (49%), Germany (43%) and Spain (37%).Even considering the recycling rate excluding the major mineral waste, Italy confirms its great performance. Italy recycles 68% of non-mineral waste, after Slovenia (80%) and Belgium (78%). It is far above the EU average, which has a recycling rate of 57%. In 2017, the per capita production of municipal waste was 489 kg, in line with the EU average (486 kg). The recycling rate was 47.7% of total municipal waste, second to Germany (67.6%) among the major EU economies.

In the packaging sector, the recycling rate is 68%, mostly composed by paper (3.9 Mt), wood and glass (each about 1.8 Mt). The highest recycling rate (sent for recycling and released for consumption) is again paper (80%), followed by steel (75%) and glass (73%). Other important data are the balances between export and import of both recycled and recyclable materials in our country. From the overall handling, within the EU and outside the EU, it turned out that Italy imports 700000 tonnes of recycled materials more than it exports. In 2017, recycled and re-injected material into production cycles in Italy was 96.3 Mt, higher than national recycling. These data provide two signals. On one hand, the Italian production system is capable of enhancing the recycled materials and therefore there is demand for it; on

the other side, Italy is not able to fully satisfy this demand through a greater valorisation of waste on our territory. Lastly, Italy is, with Germany, the leading European country in the recycling industry, which comprehends the collection, preparation for recycling and production of new recycled items. Both the quantity of recycled secondary materials and the economic turnover attest this record: in economic and employment terms, this chain is worth over €55 billion and employs over 190,000 workers.[64]

2.2 The renewable energies technologies: protagonist of the green revolution for a sustainable future

As already said, the problem of energy consumption has become of primary importance on global scale. Achieving energy efficiency, together with low-carbon intensity, is the greatest quest for the green economy. The world, which has funded its development on the fossil fuel combustion, causing environmental, social and economic problems that we know well, is now exploring innovative technologies in order to prevent irrecoverable disasters for our planet. The green technological revolution is bringing disruptive technologies, more efficient in the use of energy and other resources and less responsible for the generation of harmful pollutants.

[64] Fondazione Symbola – Unioncamere, *op. cit.,* p. 228-236

The technological progress has already created several green technologies for carbon capture and more efficient energy use, techniques to replace non-biodegradable resources, and sustainable farming and forestry techniques, as well as technologies to render coastlines and infrastructure less prone to natural disasters.[65]

However, the development of these innovative technologies, based on the use of renewable energy sources, implies some challenges. In a world where the *brown* technologies still dominate the entire economic system, the first issue consists in facing the high cost of moving out from the traditional non-green technologies, incompatible with the target of sustainable development. In this context, the role of the Governments is fundamental to support and incentive the radical shift to green technologies that requires a profound transformation of the infrastructures and capital investments. Moreover, since the green technologies take place mostly in developed countries, the next issue is how to transfer and make them accessible in the other regions.

The question mainly concerns the developing low-income countries and South regions, which are not able to afford the green technologies. Further innovation and

[65] UN, *World Economic and Social Survey 2011. The great green technological transformation,* United Nations, New York, 2011, p. IX

scaling up are essential to achieve economies of scale that drive down unit costs and spur the diffusion and large-scale deployment of the green technologies.[66]

Governments, again, play a key role in promoting research and development of green technologies and their diffusion, as well as the benefits that would accrue to the societies. Nevertheless, Governments can reach little results without a strong international cooperation. The global dimension of the environmental challenges (climate change, food insecurity, deforestation) and of the green technological revolution requires international cooperation to facilitate the green technological transformation. Governments must ensure coherent policies among all countries to accelerate the green technological transformation while adapting to local conditions and sectoral needs.

Multilateral environmental agreements, trade and investment rules, financing facilities and intellectual property rights regimes need to be aligned and intensified for those countries that face more challenges in greening their economy.

2.2.1 Trend of the renewable energy technologies

On a global perspective, the share of renewable energy in total final energy consumption reached 17.5% in 2016, up to 16.6% in 2010.[67] It is interesting to note

[66] UN, *World Economic and Social Survey 2018,* p. 100

[67] Fondazione Symbola – Unioncamere, *op. cit*., p. 222

that the use of traditional biomass has decreased in comparison to the use of modern renewable energies, which exclude the former. While the share of traditional biomass passed from 7.9% in 2010 to 7.3% in 2016, the share of modern renewable energies passed from 8.6% to 10.2%.[68] The use renewable sources is divided in three components: electricity, transport, and heating and cooling.

The market of renewable energies is growing especially in the electricity sector, due to the rapid expansion of wind and solar PV. However, most of final energy use is concentrated in the heating and transport sectors (about 80%) and the share of renewable sources in these sectors is definitely lower than in the electricity sector. In 2016, the heating and cooling in industry and buildings sectors absorbed half of final energy consumption but only 9% of modern renewables penetrated the global market. Even worse, the modern renewable energies accounted for only 3.3% of total transport energy consumption in the same year.[69]

Looking at the European Union, the consumption of renewable energy sources more than doubled between 2004 and 2017, growing from 8.5% to 17.5% on the gross final energy consumption.

[68] UN, *The Sustainable Development Goals Report 2019*, United Nations, 2019, p. 37

[69] ibidem

The largest contributors to the renewable energy mix are still wood and other solid biofuels (42%) and among the modern renewable energies the wind power overtook the hydro power for the first time in 2017 (respectively 13.8% and 11.4%).[70]

The EU is the largest consumer of renewable energy in absolute terms, followed by China, United States, Brazil and India. The International Energy Agency, however, forecasts that in the period 2018-2023 China will surpass the EU due to the policies to decarbonise all sectors and reduce air pollution.[71]

Italy, with a share of renewables of 18.3%, is above the EU average and ahead Spain (17.5%), France (16.3%), Germany (15.5%) and UK (10.2%).[72] Moreover, Italy has already surpassed its target imposed by the Renewable energy directive (2009/28/EC) of 17% of energy consumption coming from renewable sources. However, in July 2018 the original directive was revised and the new one (2018/2001/EU) establishes the target of at least 32% by 2030. It is a challenging goal that needs great efforts to improve the energy efficiency in all sectors (transport, electricity, and heating and cooling), including stronger policies, cooperation mechanisms and efficient technologies.

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[70] EC, *Renewable energy statistics*, in Eurostat statistics explained, 2019. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php/Renewable_energy_statistics

[71] IEA, *Renewables 2018 -Market analysis and forecast from 2018 to 2023*, 2019. Available at: https://www.iea.org/renewables2018/

[72] Fondazione Symbola – Unioncamere, *op. cit*., 222

Focusing on the sectoral detail, Italy is not well on track to meet the 2020 target of 10% of renewables (including liquid biofuel, hydrogen and biomethane) in the transport sector, since the share was only 6.5% in 2017. Actually, only Sweden and Finland reached and went beyond the target with 32.1% and 18.8% respectively. Better performance is visible in the electricity sector, where the share of renewable energy was 34.1% of the gross electricity consumption, being above the EU average (30.7%). As regards the heating and cooling, the share of renewables was 20.1%, above the EU average (19.5%). [73]

[73] EC, *Renewable energy statistics*, in Eurostat statistics explained, 2019

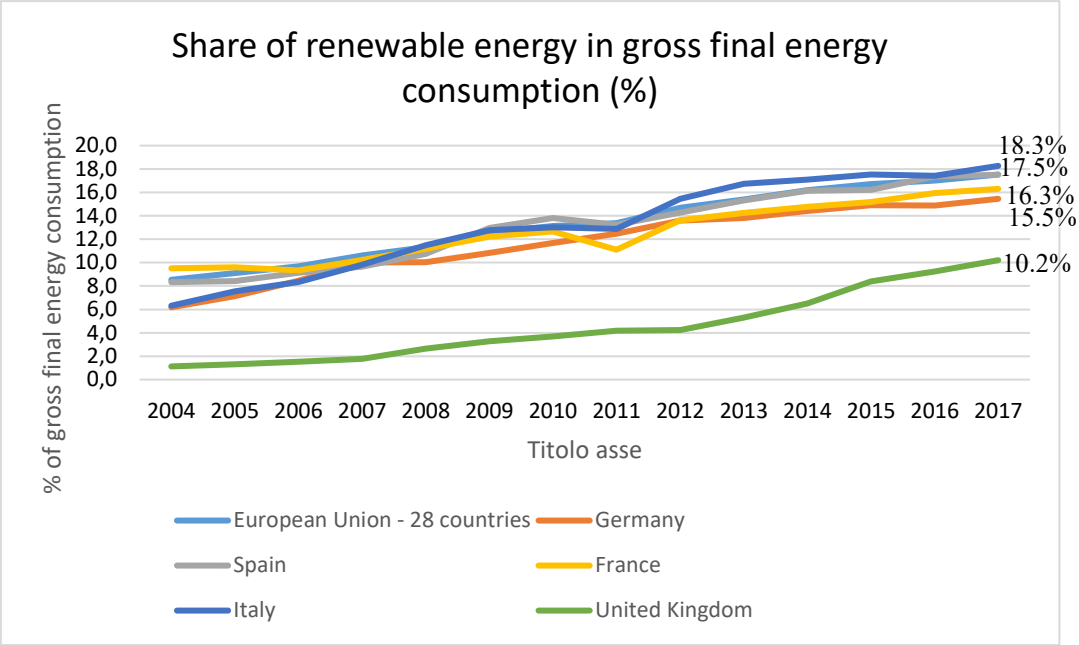

Figure 10: Share of renewable energy in gross final energy consumption. Data elaborated in Eurostat

As regards the sources of renewable energy, the modern bioenergy represents the largest contribution both on global level (50%) and on EU level (65%). According to the IEA, however, the period between 2018 and 2023 will see a reduction of its share because of the expansion of the solar PV and the wind in the electricity sector. In the European Union, the wind energy may become the future leader technology for sustainable energy production. Indeed, in 2017, its share was 15% of the total

of renewables, three times the energy provided by the solar PV, that was only 8.7%.[74]

Nevertheless, the solar power has been growing at the fastest pace among all the other sources and, according to IEA, in the best-case scenario, it could generate 27% of global electricity demand by 2050, even though right now it accounts for less than 1%. This estimate may seem too optimistic, however, the innovations in the regulatory supports, including feed-in tariffs, tax credits subsidies, the industrialization, with the resulting technological innovations, low interest rates, leaner supply chains, and improved economies of scale, and finally, the new financing models aimed at addressing the high up-front cost of installation, are all clear signal of its feasibility. The market of renewable energy is thus becoming more and more resilient and thinking about a future where the energy is powered by clean energies is getting real.

The threat of oil as obstacle for the development of the renewables appears weakening. First, they operate in different markets: while oil is predominantly used for transport, in the electricity sector, it accounts for about 5% of power generation worldwide and about 1% in Europe. Renewables, on the contrary, are mostly used for electricity.

[74] IEA, *Renewables 2018 -Market analysis and forecast from 2018 to 2023*, 2019

In Europe, gas is a major player in power production (18.6%) and because in many countries renewables are still expensive, it could slow the growth of renewables. However, changes in the spot price of gas are unlikely divert long-term investments in renewable energy and actually cheap gas can complement renewables. Indeed, wind and solar are intermittent, therefore, a backup non-intermittent source of power is essential for the industry. Another element on favour of renewables is that their cost continue to decline: regulatory supports, economies of scale and the technological innovations reduce production costs and allow cheap energy storage. In the long term, while the cost of conventional fuels are volatile and may go either up and down, renewables will go in one direction only: down.[75]

In conclusion, the transition to a world powered by renewable sources will not come in short time. However, not even the oil and gas prices, much lower than the renewables' price, have restrained the development of green technologies.

In fact, the great strides that this sector is making can only foster growth expectations.

[75] Oppenheim, J. *et al*., *op. cit.*, p. 21

3 DETERMINANTS OF ECO-INNOVATIONS AND GREEN JOBS IN ITALY

In the previous chapter, I addressed the issue of the current environmental sustainability within the Italian economic sectors, focusing on their development over time in comparison with the other EU countries. The goal was to provide a framework of the Italian situation, essential to have a preliminary knowledge about the state of the green economy in Italy and thus to study in what way this phenomenon is developing among the Italian firms. What emerged is that the economic sectors (agriculture, industry and services) have undertaken a "greening" path that make them favourable to foster eco-innovations and the growth of green jobs.

In the following paragraphs, I will deepen the concepts of eco-innovations and green jobs in order to understand what factors drive their development and to see if these or other factors can explain the uneven geographical distribution of eco-innovations and green jobs in the regions of Italy.

3.1 Eco-innovations and green jobs in Italy

The term *eco-innovation* lacks of a specific definition and many researches gave their contribution to define it. The concept refers to products, processes, organizational and/or marketing methods that reflect the two common

consequences of diminished adverse effects on the environment and more efficient use of resources.[76] The terms eco-innovations, green innovations and environmental innovations are often used interchangeably, thus this should not create ambiguity.

Contrary to other innovations, environmental innovations can lead to a "win-win" situation with both economic and environmental benefits.[77] The eco-innovations are addressed to realize profits for the company, while internalizing the negative environmental effects. It is thus in line with the objective of the green economy that pursues profitability without hurting the goal of environmental protection.

According to Kemp *et al*. (2001), "environmental innovation consists of new or modified processes, techniques, systems and products to avoid or reduce environmental damage"[78] and, similarly, Horbach *et al*. (2012, p. 119) define eco-innovations as "product, process, marketing, and organizational innovations, leading to a noticeable reduction in environmental burdens.

Positive environmental effects can be explicit goals or side effects of innovations. They can occur within the respective companies or through customer use of

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[76] Hojnik, J. and Ruzzier, M., *What drives eco-innovations? A review from an emerging literature*, in "Environmental Innovation and Societal Transition", Elsevier, vol. 19, 2015, p. 32

[77] Frondel, M. *et al*., *What triggers environmental management and innovation? Empirical evidence for Germany*, in "Ecological Economics", vol. 66 (1), 2008, pp. 153-160

[78] Kemp, R. *et al., Survey indicators for environmental innovation*, paper for International Conference Towards Environmental Innovation Systems, 27-29 September, 2001, Garmisch Partenkirchen, Germany.

products or services."[79] In 2011, the European Commission made a survey, *Attitudes of European Entrepreneurs Towards Eco-innovation*, giving a definition of eco-innovation. The term refers to "the introduction of any new or significantly improved product (good or service), process, organizational change or marketing solution that reduces the use of natural resources (including materials, energy, water and land) and decreases the release of harmful substances across the whole life-cycle of the product"[80].

Considering the Italian context, GreenItaly 2018 gives us relevant information on the trends of eco-innovations among national firms. It illustrates that 345390 firms operating in the industry or services sector with employees have made eco-investments in the period between 2014 and 2017 and/or projected to invest by 2018 in green products or technologies. This number corresponds to 24.9% of the entire non-agricultural sector with employees, which has decided to invest in products or technologies with higher energy efficiency and/or reduced environmental footprint. Considering the annual trend, the number of firm that planned to eco-invest in 2018 slightly decreased since 2017; however, from an overall perspective, the proportion of eco-investing firms out of the total firms was higher than the level in 2011.

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[79] Horbach, J. *et al*., *Determinants of eco-innovations by type of environmental impact – the role of regulatory push/pull, technology push and market pull*, in "Ecological Economics", vol. 78, 2012 112-122

[80] EC, *Attitudes of European Entrepreneurs Towards Eco-innovation,* Flash Eurobarometer 315, The Gallup Organization, 2011, p.4

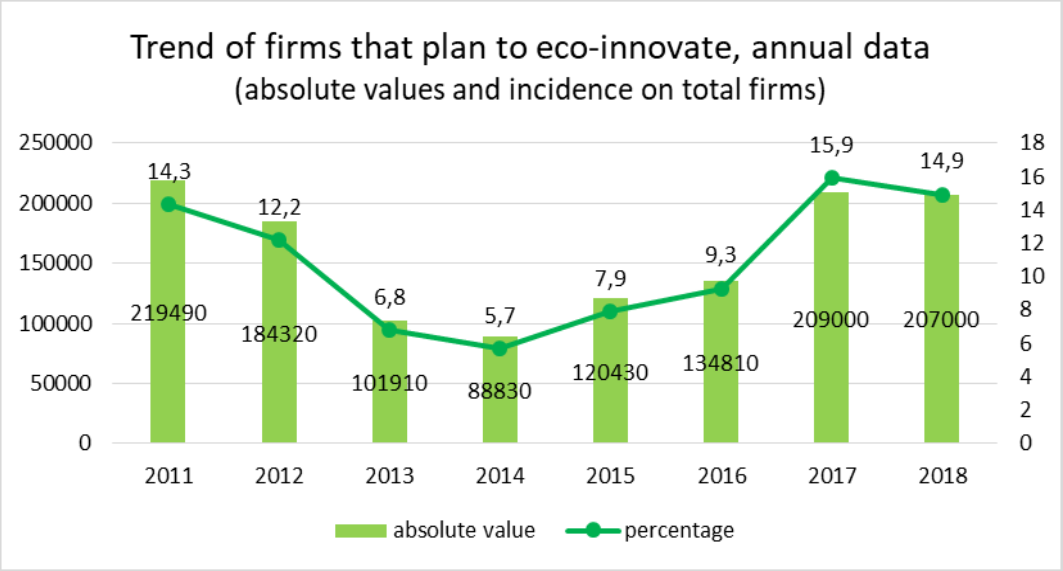

Figure 11: Trend of firm that plan to eco-innovate, annual data. Source Unioncamere, *GreenItaly 2018*

The phenomenon of green investments, despite being mainly concentrated in the services sector, has the highest incidence in the industry sector. In particular, the water and energy public utilities present the largest share of investing companies (44.6%) out of the total firms in the water and energy sector, followed by the manufacturing industry (30.7%) and constructions (20.8%). On the contrary, the tertiary sector accounts for 23.9% of firms investing in environmental sustainability. Analysing the manufacturing sector, GreenItaly 2018 shows that the sector more incline to make green investments is the petrochemical, followed by the rubber and plastic industry, paper and printing, electronics and metallurgy. The smallest share of investing companies is in the textile, clothing, leather, hide and

shoes industry. In the tertiary sector, the financial and insurance services have the largest share of investing firms, immediately followed by the transport and logistics sector. However, it must be remembered its higher environmental footprint. Other services that invest in green economy are car and scooter commerce, health and education services, accommodation and catering.

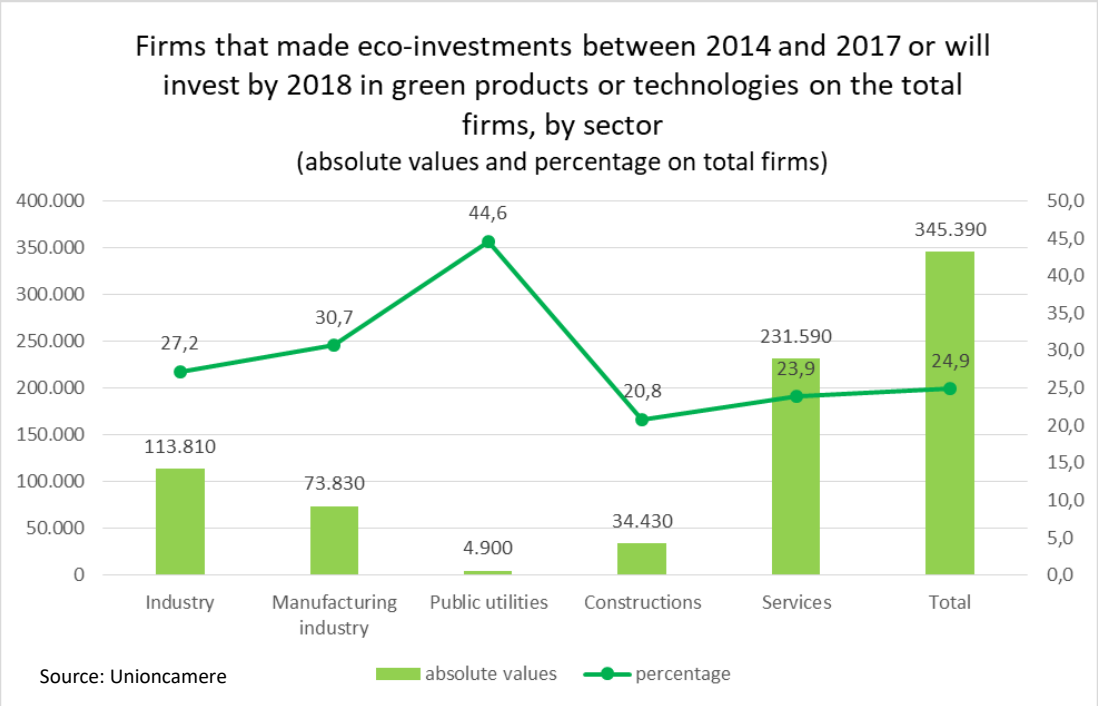

Figure 12: Firms that made eco-investments between 2014 and 2017 or will invest by 2018 in green products or technologies on the total firms, by sector. Source Unioncamere, *GreenItaly 2018*

The studies relative to the green innovations usually distinguish the type of innovation (eco-product, eco-process, eco-organizational innovations) in order to

study the phenomenon in all its complexity. Given this distinction, it appears that the incidence of eco-products, eco-processes or eco-organizational innovations across the sectors in which the European small-medium enterprises operate does not present marked differences.[81] Going into detail, the study conducted by Triguero *et al*. shows that any sector is particularly overrepresented or underrepresented in eco-organizational innovations. "Medium-high technology manufacturing firms are more overrepresented in eco-product innovators, while medium-low technology firms are overrepresented in those performing eco-process innovations"[82]. Only the construction sector has a significantly lower presence in eco-process innovations compared to the other sectors.

GreenItaly also shows that almost two-thirds of companies that make green investments are large-size (more than 500 employees) and only one-third are small-medium enterprises. This is due to the increasing economies of scale but also that large companies have higher environmental impact.

[81] Triguero *et al*., *Drivers of different types of eco-innovation in European SMEs*, in "Ecological Economics", vol. 92, 2013, pp. 25-33

[82] ibidem.

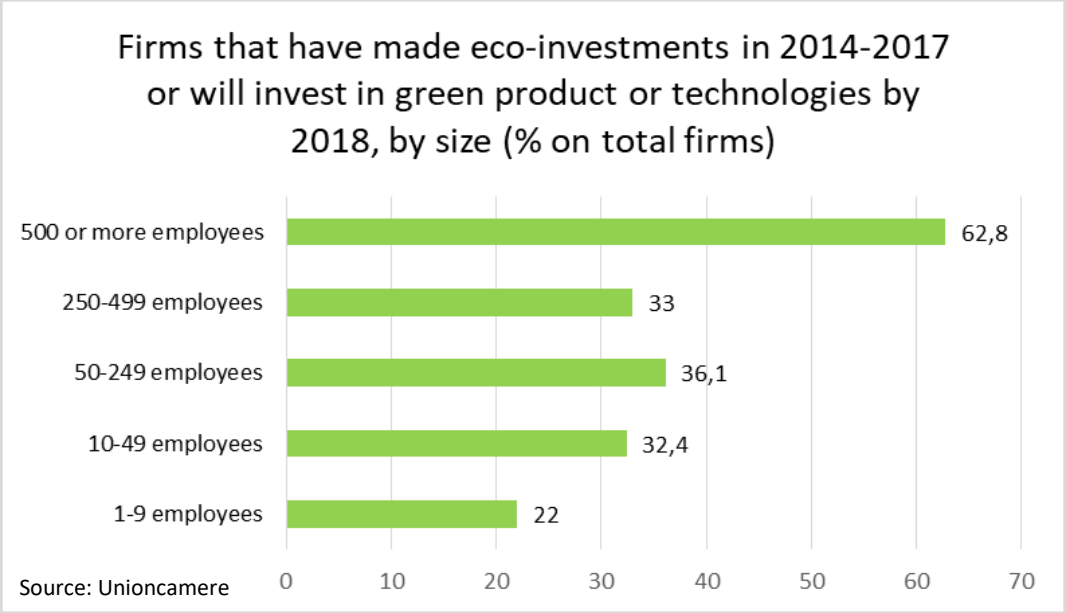

Figure 13: Firms that have made eco-investments in 2014-2017 or will invest in green products or technologies by 2018, by size. Source Unioncamere, *GreenItaly 2018*

The growth trend of the green economy shows that investing in environmental sustainability is also great way to create new jobs and reconvert the existing professions. The concept of green economy is thus directly linked to that of the so-called "green jobs". It is important to underline that "green jobs" do not only refer to professions related to the environment or the renewable energy sector but potentially (almost) all works.

> Green jobs are work in agricultural, manufacturing, research and development (R&D), administrative, and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this

> includes jobs that help to protect ecosystems and biodiversity; reduce energy, materials, and water consumption through high efficiency strategies; de-carbonize the economy; and minimize or altogether avoid generation of all forms of waste and pollution.[83]

The Istat workforce survey shows that in 2017 the stock of workers employed to green jobs in Italy reached almost 3 million units (2998.6 thousand), corresponding to 13% of the total national employment.[84] The green employment has been recording a continued growth for the last four years, and in 2017 it contributed 10.1% to the overall employment and 12.8% to the overall value added in Italy.[85] Moreover, it is interesting to see that the highest incidence of green jobs among the business areas is in the design and R&D departments, where the share of new contracts for workers employed in green professions was 63.5% of total contracts projected for 2018. This data confirms the strong connection between green economy and business innovation.

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[83] UNEP/ILO/IOE/ITUC, *Green Jobs: Towards Decent Work in a Sustainable, Low Carbon World,* Worldwatch Institute, Washington, DC, 2018, p. 3

[84] The survey considers the entire economy, including agriculture, industry and services activities, and considers both the private and public sectors.

[85] The quantitative data on the green jobs presented and the relative incidences of the phenomena are related to the activation contracts envisaged (with a duration of more than 20 days). In addition to the recruitment of employees, the inflows comprise also the flows of collaborators, temporary workers and not employed workers; thus, it is possible that more contracts are assigned to the same person.

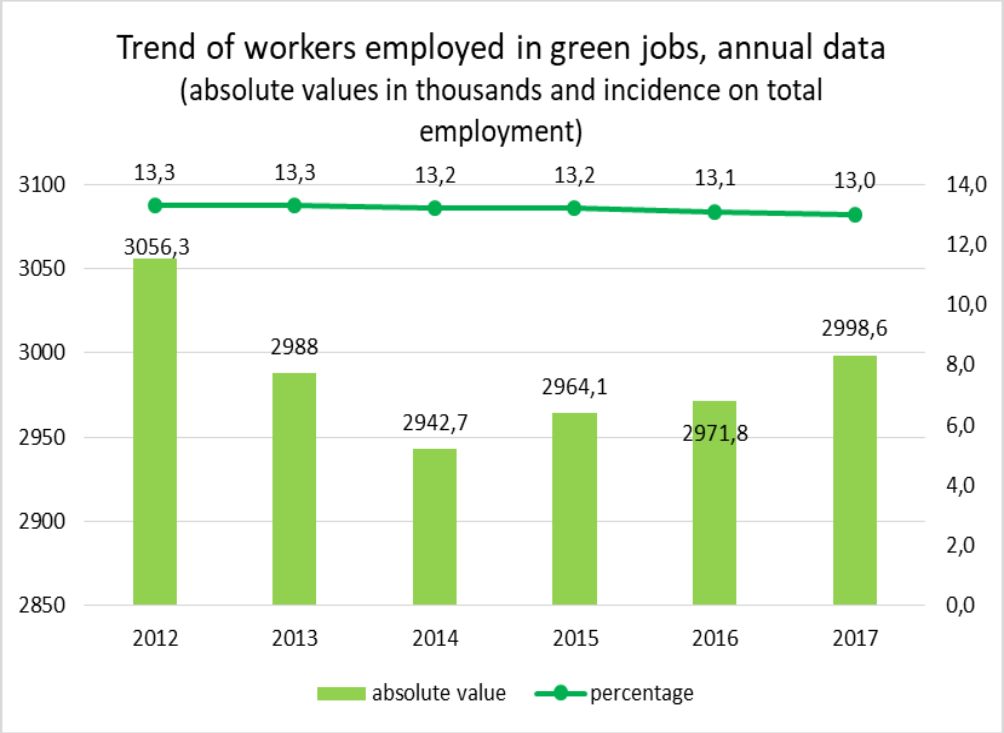

Figure 14: Trend of workers employed in green jobs, annual data. Source: Unioncamere, *GreenItaly 2018*

3.2 Drivers of eco-innovations

3.2.1 Firm-specific factors

From the data presented by GreenItaly 2018, it seems that the sector in which a company operates and the size of the company influence the propensity to make green investments. There is a wide and increasing literature on the study of the factors that drive environmental innovations and most of analysts agree on the results achieved by the report.

Sector

As regards the industry, the literature confirms the tendency of companies with higher polluting potential to develop more eco-innovations in order to reduce their environmental impact and the associated economic costs. Firms adopt these innovations usually to save costs and/or in response to external pressure (e.g. environmental regulations).[86] Horbach highlights sectoral differences in the inclination of adopting innovations with environmental effects. The chemical industry, for example, being an environmentally intensive industry, is one of the most involved industries in green innovations.[87] Similarly, Belin *et al*. emphasize the positive correlation between the energy intensive firms and the determination to reduce this consumption.[88]

The firms characterized by highly polluting production processes tend to introduce environmental measures more than less polluting firms, for Frondel *et al*..[89]

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[86] Pereira, A. and Vence, X., *Factores empresariales clave para la eco-innovación: una revisión de estudios empíricos recientes a nivel de empresa* (*Key business factors for eco-innovation: an overview of recent firm-level empirical studies)*, in "Cuadernos de Gestión", vol. 12, 2012, p. 82

[87] Horbach, J., *Determinants of environmental innovation— New evidence from German panel data sources*, in "Research Policy", vol. 37, 2008, p. 170

[88] Belin, J. *et al., Determinants and specificities of eco-innovations – an econometric analysis for the French and German industry based on the Community Innovation Survey*, in "Cahiers du GREThA", 2011, p.15

[89] Frondel, M. *et al., op. cit*, p. 14

In the same vein, from the study conducted by Kesidou and Demirel in the field of environmental R&D, it appears that the most committed sectors are the producers of energy and water, fuel or coal, oil and nuclear and chemical products.[90]
Mazzanti and Zoboli add that sector is the main structural factor – more than size – affecting the possibility to invest in environmental R&D and the adoption of innovative output.[91]

Size

Concerning the company size as determinant of eco-innovations, the positive relationship is widely confirmed by the existing literature. Larger companies are more likely to eco-innovate and in a greater extent because they have more financial, technical and human resources, systemized R&D department and probably a better defined internal organization that support the firm's capacity to implement environmental innovations. The lack of these resources, typical of small firms, may represent a barrier to innovate.[92]

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[90] Kesidou, E. and Demirel, P., *On the drivers of eco-innovations: empirical evidence from the UK*, in "Research Policy", vol. 41, 2012, pp. 862-870

[91] Mazzanti, M. and Zoboboli, R., *Examining the factors influencing environmental innovations*, FEEM working paper series 20, Milano, 2006

[92] Del Río, P., *The empirical analysis of the determinants for environmental technological change: a research agenda*, in "Ecological Economics", vol. 68 (3), 2009, pp. 861-878

The positive correlation between company size and eco-innovation propensity appears in numerous studies.[93] Rave *et al*. emphasize also that large firms are more capable of creating continuous eco-innovations[94] and Hojnik and Ruzzier (2015) acknowledge the positive influence that size has on eco-innovation in both development/innovation and adoption/diffusion stage.

Other authors illustrate a positive correlation between the company size and the decision to eco-innovate in all level (product, process, organizational innovations). Concerning the process, Rennings *et al.* (2006) also prove a positive influence of size on environmental process innovations.[95] Focusing only on product eco-innovation, Kammerer emphasizes that large size determines the expansion of green products and with a greater degree of novelty.[96] Horbach (2008), comparing eco-product and eco-process innovations versus other innovation, does not obtain any

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[93] See for example De Marchi, V., *Environmental innovation and R&D cooperation: empirical evidence from Spanish manufacturing firms*, in "Research Policy", vol. 41, 2012, pp. 614-623;
Hofer, C. *et al., The competitive determinants of a firm's environmental management activities: evidence from US manufacturing industries*, in "Journal of Operation Management", vol. 30, 2012, pp. 69-84

[94] Rave, T. *et al., The determinants of environmental innovations and patenting: Germany reconsidered*, Ifo Working Paper, 97, 2011, pp. 7-19

[95] Rennings, K. *et al*., *The influence of different characteristics of the EU environmental management and audit scheme on technical environmental innovations and economic performance*, in "Ecological Economics", vol. 57, 2006, pp. 45-59

[96] Kammerer, D., *The effects of customer benefit and regulations on environmental product innovation. Empirical evidence from appliance manufacturers in Germany*, in "Ecological Economics", vol. 68, 2009, pp. 2285-2295

significant correlation with size. However, he finds a positive correlation with size, when he compares environmental innovations and non-environmental innovations with the no-innovation alternative.

Kesidou and Demirel (2012) find a significant association between investment in end of pipe technologies and company size but the relationship becomes insignificant when investments concern integrated technologies or environmental R&D. [97] On the other hand, Frondel *et al.* identify size as a very important driver of both cleaner production and end of pipe technologies.[98]

Age

Another structural factor that seems affecting eco-innovations is the age of the firm. Even though not considered in GreenItaly report, it is interesting that some researchers have found a U-shaped relationship between company age and the likelihood of the realization of eco-product and/or eco-process innovations.[99]

"The younger the company, the more likely it is to be environmentally innovative; while this (environmental) innovativeness decreases with company age, more mature companies might have developed a broader internal knowledge base,

[97] Kesidou, E. and Demirel, P., *op. cit.*, pp. 862-870

[98] Frondel, M. *et al.*, *op. cit.*, pp. 153-160

[99] See for example Rehfeld, K-M. *et al.*, *Integrated product policy and environmental product innovations: An empirical analysis*, in "Ecological Economics", vol. 61, 2007, pp. 91-100

consequently leading to the realization of further environmental product innovations"[100]. According to Hojnik and Ruzzier (2015), while most of drivers appears in the adoption/diffusion stage of eco-innovation, company age affects eco-innovation only in the stage of development/innovation. For Rave *et al*. (2011) there effects are mixed. When comparing eco-innovators and non eco-innovators, age seems to be not significant; however, in primary sectors younger firms drive the self-reported eco-innovation activities but older firms are more capable of giving continuity to eco-innovation.

In this vein, GreenItaly adds that young farms, held by young people are characterized by a greater attention to the issues of sustainability, innovation and differentiation. Young farms include innovative activities ranging from the product transformation to direct sales, from educational farms to agriasilo, but also social farming, welfare, care of the landscape or the production of renewable energy.

As we can expect, the firm's characteristics, although related with the propensity to eco-innovate, are insufficient to explain comprehensively the dynamics of the phenomenon. A well-known and widely accepted classification of the determinants of green innovations includes supply-side factors[101], demand-side factors and environmental regulations and policies.

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[100] ibidem

[101] The firm size is conventionally included in the supply-side factors but I adopted another method to group together the structural characteristics and keep them separated by the other determinants.

3.2.2 Supply-side factors

Technology push, R&D and networks

From the supply side, the role of technological capabilities (technology push) is recognized as a very important driver of eco-innovations. The researchers stress the weight of R&D investments in order to build a significant technological capital and to develop innovations. "Consequently, R&D is one of the inputs driving the adoption of innovative output".[102]

In addition, the literature argues that the availability of technological capabilities, obtained through R&D, triggers further innovations. This concept of path dependence defined by Baumol with the expressions "innovation breeds innovation", works also for environmental innovations.[103]

Some researchers have highlighted the possible causal relationship existing between the company's involvement in networks and R&D investments. It seems that the collaboration with research institutes, agencies and universities influence the R&D or environmental investments.[104] Moreover, while the technological and

[102] Mazzanti, M. and Zoboboli, R., *op. cit.*

[103] Baumol, W. J., *The free-market innovation machine – Analyzing the growth miracle of capitalism,* Princeton University Press, New Jersey, 2002

[104] See for example Mazzanti and Zoboli (2006); Triguiero *et al.* (2013); Horbach (2008)

managerial capabilities enhance more process and organizational innovations, the firms that "invest" in networks are more active in all types of eco-innovations.[105]

Cost saving

It is important to bear in mind that implementing environmental innovations implies significant investment costs (in R&D, acquisition of technological capital, change in a specific process, training of employees, etc.) and this is the reason why, for long time, the conventional thought was that the costs for environmental innovations imposed a burden on firms and threatened their competitiveness. However, since the 1990s, many analysts revaluated the causal relationship between environmental preservation and the economic performance. They argued that owning better environmental practices could actually improve economic or financial performance, and not necessarily raise costs.[106] In other words, environmental innovations can facilitate firms to achieve environmental goals and/or comply with environmental regulations in a cost effective way.

Porter largely studied the issue of pollution emphasizing the link with the waste of resources, the inefficient use of raw material and the lost energy. On the contrary,

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[105] Cainelli, G. *et al*., *Environmental innovations, local networks and internationalization,* Working paper 8, 2011 OPENLOC, University of Trento, Italy

[106] Porter, M.E. and van der Linde, C., *Toward a new conception of the environment-competitiveness relationship*, in "Journal of Economic Perspectives", vol. 9 (4), 1995, pp. 97-118

a productive use of resources is often positively associated with a reduction in pollution.[107] Therefore, reducing the level of pollution through better environmental practices can lead to a reduction in the expenses for raw material, energy and services (wastewater treatment, garbage collection or use of recycling facilities). Consequently, cost-saving is one of the main motivations for undertaking environmental innovations and it is interesting to note that eco-innovators give higher importance to cost reduction compared to other innovators.[108] Although for Hojnik and Ruzzier (2015) cost-saving is a common driver for all types of eco-innovations, most researchers believe that it is effective especially in driving eco-process innovations, through a more efficient use of energy and materials. Improving the resource productivity, the cost of material and energy declines and level of eco-efficiency increases.[109]

3.2.3 Demand-side factors

Before deciding whether investing in environmental innovations and at what level, firms have to consider the demand pull factors. According to Horbach (2008),

[107] ibidem

[108] Rave et al., *op. cit*

[109] See for example Rennings (2000); Triguiero *et al*. (2013); Horbach *et al*. (2011)

the expected market demand for green products and the expected market share impact (turnover) are the most relevant variables.

It is widely acknowledged that these factors are decisive to eco-product innovations and eco-organizational innovations. The development of green products can be a form of differentiation, generating a competitive advantage.[110] Enterprises should exploit niches in environmentally-conscious market segments. Given the consumers' willingness to pay for extra environmental features, the additional costs incurred for the production can be transferred to the final price.

Rehfeld *et al*., (2007) support the hypothesis that if the companies are able to satisfy consumers' requirements, they are likely to maintain the competitive advantage. With regard to the expected turnover, Horbach considers the exporting activities of the companies and argues that firms oriented to the international market are exposed to a greater competitive pressure and therefore, are more prone to eco-innovate.

3.2.4 The role of environmental regulations and policies

Besides supply-side and demand-side factors, environmental regulations play a decisive role in driving eco-innovations at all levels. It is worth recalling that the relationship between environmental practices and generation of costs have been

[110] Ambec, S. and Lanoie, P., *Does it pay off to be green? A systematic overview,* Academy of Management Perspective, vol. 22 (4), 2008, pp. 45-62

challenged by a number of analysts and, since the 1990s, the disruptive idea of the positive impact of environmental innovations on the economic or financial performance took hold. In this context, the most highly discussed theory was the so-called Porter Hypothesis (PH), which not only supported the above mentioned idea but also claimed that "properly designed environmental standards can trigger innovation that may partially or more than fully offset the cost of complying with them".[111]

The authors believed that strict and adequately designed environmental policies may spur innovations, which in turn would offset the costs of complying with them. In addition, the "innovation offsets" originated by the environmental standards, can also lead a firm to obtain an absolute advantage over foreign ones not subject to similar policies. The PH has been largely discussed and tested by many analysts and what the studies have in common is that the win-win situation of less pollution and cost reduction is more likely to occur when some conditions are in place.

Firms characterized by flexible production process, which play in industries with intense competition where cost reductions are highly desirable and where market-based instruments (like pollution taxes or tradable permits) are implemented, can achieve both the goals. Hojnik and Ruzzier (2015) emphasize the primary role of regulations over the other factors in driving all types eco-innovations (product,

[111] Porter, M.E. and van der Linde, C., *op. cit.*

process and organizational eco-innovation, environmental technology and, environmental R&D). Moreover, they highlight the impact of stringent regulations on both stages of eco-innovation (development/innovation and adoption/diffusion) and their prevalence over economic incentive instruments.

In a similar way, Frondel *et al*. (2007) found that policy stringency is more significant than individual policy instruments. While Triguero *et al*. (2013) found that access to subsidies and fiscal incentives do not have any significant effect on the decision to eco-innovate in Europe at the firm level, other authors argued that environmental innovations depend on public subsidies.[112] The presence of divergent findings raise the question of what environmental policy instruments (tax/subsidies, voluntary schemes, environmental and technical training programme, etc.) are more effective in supporting eco-innovation.

Clearly, factors like market dynamics, technological trajectories, coordination and consistency of different policy instruments should be taken into account. (Triguero *et al*., 2013).

In this regard, Eyraud *et al*. found that specific public intervention, such as feed-in tariffs and carbon pricing mechanisms, foster green private investments.[113] Feed-in tariffs are a form of price support especially effective in supporting the expansion

[112] See Belin *et al*., 2011; Horbach, 2008

[113] Eyraud, L. *et al*., *Who's Going Green and Why? Trends and Determinants of Green Investment,* IMF Working Paper, 2011

of renewable energy, with green investments being two to three times larger when countries adopt such a scheme (other factors being equal). Carbon pricing mechanisms mean higher taxation of fossil fuel. Higher oil prices increases the cost of traditional fossil fuel technologies and consequently the cost of green investments are relatively reduced. This implies that higher taxation of fossil fuels to address negative externalities associated with their use, or a reduction in subsidies, would help foster green investment.[114] Other policies, like biofuel support, do not appear to be associated with higher investment rates (Eyraud *et al*., 2011). Finally, some authors specify that existing environmental regulations drive eco-innovations but expected future regulations do not have significant influence such as Horbach (2008) and Triguero *et al*. (2013).

3.2.5 Socio-economic factors

So far, I presented and explained the most common classification of the determinant of eco-innovations that includes supply-side factors, demand-side factors and environmental policies. However, this classification does not consider the role of socio-economic conditions, which could favour or impede the development of green innovations. A research conducted by Yi and Liu on the green

[114] Coady, D. *et al., Petroleum Product Subsidies: Costly, Inequitable, and Rising*, IMF Staff Position Note 10/05 Washington, 2010

economy in China reveals an asymmetric distribution of green firms and green jobs in the country's regions and the authors argue that local clean energy policies, along with socio-economic factors, explain the variation in green economy across cities.[115]

The socio-economic factors analysed are per capita GDP, unemployment rate, industrial electricity consumption, volume of emissions of sulfur dioxide, labour supply, measured by population size, population trend and educational attainment, labour mobility, marketization of the regional economy and energy-related government staff.

From their study, it emerges that larger population size and higher per capita GDP are positively correlated with a higher number of green jobs and green businesses. However, the natural population growth rate is positively correlated with the number of green jobs but not correlated with the number of green firms. Both the educational attainment and marketization index have significant and positive coefficients: cities with a large number of general institutes of higher education and with a higher level of marketization are associated with more green jobs and green

[115] Yi, H. and Liu, Y., *Green economy in China: regional variations and policy drivers*, in "Global Environmental Change", vol. 31, 2015, pp. 11-19

businesses. In contrast, cities with a larger volume of sulfur dioxide emissions are associated with fewer green jobs and green businesses.

The industrial electricity consumption and the number of energy related government staff are positively correlated with the number of green firms, but are insignificant in predicting the number of green jobs. The same goes for labour mobility, significant in green business growth, but not so in the number of green jobs. The coefficients for the unemployment rate are insignificant in both models.

3.3 Empirical analysis of the drivers of eco-innovations and green jobs in the regions of Italy

3.3.1 Distribution of green jobs and green firms

In Italy, green jobs and eco-innovating firms are distributed unevenly across the regions.

Lombardia holds the leadership in both cases: the firms of industry and services sectors with employees that have planned to invest in green products or technologies by 2018 were almost 62000, that is 17.8% of the total eco-investing firms in Italy. Follows at distance Veneto, with almost 35000 green firms and then Lazio, Emilia Romagna and Campania, all with more than 25000 green firms.

In the same vein, the contracts for green jobs to be activated by 2018 were 123380 in Lombardia, corresponding to 26.1% of the national total. The gap with the next

regions is even more evident, having Emilia Romagna and Lazio less than half of Lombardia's new green contracts, about 45500, and Veneto almost 43000 contracts. The figures on green jobs and green firms only partially explain the phenomena in the region. Just to give an example, a region with many firms or with a high employment rate is more likely to present higher level of green investments and green jobs. Therefore, we need to look at the incidence on the total firms and total new contracts in each region to have an overall picture of the regions' green propensity.

Looking at the incidence of green jobs, we find again Lombardia at the top of the ranking (13.3%), followed by Piemonte (12.7%) and Basilicata, which jumps from the third place from the end of the absolute ranking to the third place of the relative ranking (12.6%).

As regard the incidence of the eco-investing firm in the regions, I calculated the share of the green firms on the total active firms of the industry and services sectors with employees in each region. It emerges that Trentino Alto Adige has the highest incidence (26.6%), immediately followed by Veneto and Friuli Venezia Giulia, and then Piemonte. From this perspective, also some southern regions, Basilicata, Sardegna, Molise and Calabria, present high great proportion of green firms on the total firms in the territory.

Table 1: Firms that planned to eco-invest in 2014-2018, by region (absolute values and incidence in the regions)

Region	Absolute value	Incidence in the region (%)
Piemonte	25272	25,6
Valle d'Aosta	743	18,9
Liguria	8998	22,2
Lombardia	61650	24,1
Trentino Alto Adige	8543	26,6
Veneto	34797	26,4
Friuli Venezia Giulia	7300	26,3
Emilia Romagna	28270	24,4
Toscana	23163	21,2
Marche	5157	22,7
Umbria	8998	20,9
Lazio	32545	22,9
Abruzzo	7754	22,1
Molise	1731	23,7
Campania	26176	20,6
Basilicata	20355	21,2
Puglia	3112	25,4
Calabria	9818	23,7
Sicilia	21954	21,5
Sardegna	9352	24,6

Table 2: Planned new contracts for green jobs in 2018, by region (absolute values and incidence in the regions)

Region	Absolute value	Incidence in the region (%)
Piemonte	38869	12,7
Valle d'Aosta	990	7,0
Liguria	11498	10,2
Lombardia	123380	13,3
Trentino Alto Adige	10965	8,2
Veneto	42654	9,5
Friuli Venezia Giulia	11546	11,2
Emilia Romagna	45562	10,4
Toscana	23637	8,3
Marche	5300	10,0
Umbria	10303	8,9
Lazio	45480	10,7
Abruzzo	10093	9,8
Molise	1619	9,6
Campania	29467	9,0
Basilicata	20912	8,4
Puglia	4608	12,6
Calabria	8017	8,7
Sicilia	19994	8,9
Sardegna	8688	6,8

3.3.2 Regression model

Given the distribution of green jobs and green firms across the regions of Italy, my objective was to explore and identify the determinants of these phenomena. In line with this goal, I collected several variables that I assumed to be correlated with the presence and development of eco-innovating firms and green jobs. The data,

extracted from Istat database on regional level, partly differ between the two variables object of study. With regard to the eco-innovating firms, I considered the following factors as independent variables:

- **Pollution**: share of resident population that believe that the area where they live has pollution issues.
- **Per capita GDP**
- **Graduated and post-graduated people**: share of population with a degree or post degree, out of 10000 inhabitants of the region.
- **Export**: share of regional exports on the national total exports
- **Trust between individuals**: percentage of resident population who believes that most of people are trustworthy
- **Volunteering**: percentage of people that have carried out volunteering activities
- **Expenditure in R&D**: share of expenditure for research and development activities incurred by the region on total national expenditure.
- **Innovative firms**: companies with at least 10 employees in the industrial and service sectors that have carried out activities aimed at introducing product, process, organizational or marketing innovations. The proportion is calculated on the total active firms with at least 10 employees operating in the industrial and services sectors in the region.

- **Expenditure for innovation**: expenses incurred for the introduction of product or process innovations: design and R&D activities, acquisition of machinery, equipment, software and buildings aimed at innovation; acquisition of know-how; other activities such as the training of personnel targeted for innovation, new product marketing.
- **Firms with partnerships for innovation**: share of regional innovative firms that have actively participated to R&D or innovative projects with partner organizations, either public or private.

The choice of the abovementioned variables is the result of some considerations. My assumption was that favourable economic condition, high educational level, great social capital and strong innovation boost might be positively correlated with higher level of eco-innovating firms. Similarly, I expected that a higher pollution rate might spur investments in more ecological solutions.

Following the same reasoning, I included for the variable of green jobs the following factors:

- **Per capita GDP**
- **Graduated people**
- **Employment rate**
- **Expenditure in R&D**
- **Volunteering**

- **Trust between individuals**

To explore the relationship between the selected independent variables and the variables object of study (green firms and green jobs), I employ a linear regression models (OLS) setting the latter as dependent variables.

Available date for eco-innovating firms and green jobs are in a cross-sectional form for the period 2014-2018. However, as for eco-innovating firms I also have information on the period 2008-2013, I also decided to include this period in my analysis as a robustness check.

Results

The table 3 shows the results of the regression that considers the eco-innovative firms as dependent variable. The column 1 and 2 presents the results of the regression when it is run for 2014-2018, while the column 3 presents the results of the regression when I include also the observations for 2008-2013.

Specifically, the model in column 1 considers the relation of socio-economic variables and innovation variables with the eco-investing firms, and the model in column 2 adds two independent variables that contribute to build social capital (volunteering and trust between individuals).

Table 3: Results of the regression on eco-innovating firms

	2014-2018	2014-2018	2008-2013 & 2014-2018
VARIABLES	Eco-innov. firms	Eco-innov. firms	Eco-innov. firms
Pollution	-0.248**	-0.226**	-0.272***
	(0.089)	(0.073)	(0.075)
Per capita GDP	-0.486*	-0.540***	-0.190
	(0.241)	(0.144)	(0.190)
Degree and post degree	-0.004	-0.001	-0.001
	(0.003)	(0.003)	(0.001)
Export	-0.124	-0.242	-0.273*
	(0.191)	(0.167)	(0.119)
Expenditure for innovation	0.001*	0.001*	0.001*
	(0.000)	(0.000)	(0.000)
Partnership for innovation	-0.039	-0.064	-0.149
	(0.165)	(0.146)	(0.143)
Innovative firms	0.295***	0.317***	0.075
	(0.080)	(0.079)	(0.108)
Expenditure R&D	0.145*	0.383*	0.337**
	(0.126)	(0.190)	(0.161)
Volunteering		0.630***	0.465**
		(0.173)	(0.218)
Trust between individuals		0.115	0.086
		(0.251)	(0.258)
Observations	20	20	40
R-squared	0.723	0.842	0.484

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In all cases, the pollution variable is significant and negatively correlated with the presence of eco-investing firms. Per capita GDP is significant and negatively correlated with the dependent variable and exports are significant when considering only the two periods and negatively related to the number eco-investing firms. The expenditure for innovations and for R&D are significant and positively correlated to the green firms. Similarly, the variable relative to innovative firms has a strong and positive correlation with the dependent variable. Volunteering is also positively associated with the green firms, while trust between individuals and share of graduated people are not significant.

There results partly confirm the initial assumption; indeed, variables related to innovation and social capital have a positive relationship with the share of eco-investing firms. However, contrary to my hypothesis, regions with higher volume of pollution are associated with fewer green firms. Similarly, export rate and per capita GDP appear to be negatively related to the expansion of the eco-investments phenomenon.

Anyway, many other factors probably are correlated with the green investments in the regions and the regions themselves present different internal characteristics depending on the area or province. Therefore, it is likely that an analysis made at provincial level, relying on a considerable number of observations, may provide results that explain the variable more accurately.

The table 4 shows the results of the analysis of the relationship between the green jobs variable and the independent variables described above.

Table 4: Results if the regression on green jobs

VARIABLES	Green jobs
Degree and post degree	0.009***
	(0.003)
Employment	0.280*
	(0.170)
Trust between individuals	-0.129
	(0.217)
Volunteering	0.347
	(0.302)
Expenditure R&D	0.040
	(0.101)
Per capita GDP	-0.464
	(0.322)
Observations	20
R-squared	0.646

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Focusing on the independent variables, the model tells us that the amount of graduated people and the employment rate are significant and positively associated with the number of green jobs. In other words, regions characterized by a high level of education and high employment rate are more prone to create green jobs.

CONCLUSION

In this research work I treated thoroughly the theme of green economy in order to provide the reader with a comprehensive overview of how this topic is developing over time. I touched various aspects of the green economy, especially the ones related to the changes in the industrial and services sectors, before eventually moving to an analysis of the eco-innovations and green jobs in the regions of Italy. My research was aimed at exploring the drivers of these two phenomena and the results of the analysis have partly confirmed my hypothesis.

From the regression model, it emerges that innovative firms, significant expenditure in R&D and for innovation, firms with partnerships for innovation and great social capital are factors correlated with the number of eco-investing firms. Moreover, a high level of education and high employment rate are positively associated with the number of green jobs in the regions. However, some assumption have not found empirical confirmation in the data obtained from the linear regression. Both per capita GDP and export rate are significant and negatively associated with the eco-investing firms in the regions. I expected the opposite effect, especially regarding the GDP, because the studies analysed revealed a positive correlation.

In the same vein, some factors that I assumed influencing the creation of green jobs actually are not significant, according to the regression. This led me to consider some limitations of my study. First, my research relies on cross-sectional data. This

method poses a threat to the validity of the study because it does not take into account the changes of eco-investing firms or green jobs in a time period. Moreover, the number of observation is limited to the number of the regions in Italy or, in the best case, the double when the dependent variable of eco-investments considers both the periods 2008-2013 and 2014-2018. A small sample size is likely to affect the whole significance of the model.

These limitations may open up opportunities to deepen the research by investing the effect on the distribution of green jobs and green firms at provincial level. With a larger sample size, the statistical method would obtain greater validity. In addition, a panel data analysis may be a more effective tool to capture the dynamic character of the dependent variables, since it examines changes in variables over time.

Last, it would be interesting to include other independent variables in the model, for which I did not have access. For instance, future studies may verify if some regions or provinces receive specific public funding for eco-investments and quantify this information in order to include it in the statistical analysis. Considering that the firms investing in green economy the number of the green jobs are increasing, and because large part of my thesis has compared the Italian greening path with the EU's countries' ones, it would be interesting to compare also this aspect of the green economy to see if common factors drive the eco-innovating firms and the green jobs.

ACKNOWLEDGEMENTS

I would like to give my heartfelt thanks to people who played a role in my academic accomplishments.

Foremost, I would like to express my sincere gratitude to my supervisor prof. Valentina Peruzzi for the continuous support of my master degree thesis. Her expertise and consistent advice helped me bring my study and research into success.

I would like to extend my gratitude also to all the staff of the university library and of the computer lab who allowed me to carry on my research providing books, online and offline material.

Last but not the least I would like to thank my friends and all the people who, directly and indirectly, encouraged me to complete this project. Especially my family and my boyfriend for their constant source of inspiration and motivation: to them goes my all work.

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