

INNOVATION AS A MEAN TO ACCELERATE THE MINISTRY OF ECOLOGICAL TRANSITION'S POLICIES

Ministry of Ecological Transition,
Greentech Innovation Office



GRADUATING PROJECT

MSc. in Sustainable Management and Eco-Innovation

Audrey Boisroux

ETU20192372

2 November 2020

Supervised by Dany Hulot

ACKNOWLEDGMENTS

I would like to thank my internship supervisor Benoit Spittler who has been very helpful and very supportive regarding my graduating project. He has spent much time helping me, giving me tips on how I should do this project. He taught me a lot and it was very interesting to have the perspective of someone who has been on this service since the very beginning. Besides, his knowledge due to his past job helped me to increase arguments on some parts and he gave me very interesting contacts who helped me having a broader perspective on the subject.

I would also like to thank my colleagues, Pascal Pintado and Léa Straumann, who taught me so much during this internship and helped me understand how the structure was working. I thank them for their advice, which I think helped me progress a lot doing my work.

I would also like to thank all my colleagues, from chiefs to interns, with whom conversations on the potential of this structure inspired me to write this project. Thank you to Alain Griot, who gave me bibliographical tips, Thomas Cottinet for his knowledge on open innovation, Simon Faure and Adèle Francelet for their perspective.

I would also like to thank Materr'Up, Greenshield and all these companies that made me understand the Greentech world better.

Finally, I would like to thank the EME school and my graduating project tutor Dany Hulot who supported me, and gave me the way on how to do this project, through an unexpected method but very helpful. It also allowed me to do this exciting internship.

ABSTRACT

In 2016, the Ministry of Ecological Transition implemented the Greentech Innovation label. It is labelling companies which intend to develop solutions that have the potential to accelerate the Ministry's policies, from sustainable buildings to sustainable digital transformation. In order to help this acceleration, the Greentech Innovation service has developed a range of offers that are enabling companies, at early-stage development especially, to grow. From training them, to offering them a place to work, this service is trusting projects that seem to have a high potential on both economic and environmental perspectives. Even though it is difficult to say if companies that are succeeding have grown thanks to this label rapidly, some of them have benefited from support to gain aids and better visibility from the public and investors. However, the main question is to know if this label enables companies to accelerate the Ministry's policies. In order to answer this problematic, this project will describe the goals and benefits of a label, the Ministry's policies for which labelled companies could have an impact, the range of offer and their benefits to companies to grow and the actual activities of these companies. The answer is not simple; the youth of this program and the lack of follow-up regarding the assistance given to companies cannot give a precise conclusion. According to the policy in question, some innovations are relevant and could have a significant impact, while some topics do not have an innovation to solve their issues.

Table of contents

| | |
|--|----|
| ACKNOWLEDGMENTS | 1 |
| ABSTRACT | 2 |
| List of tables | 5 |
| List of illustrations | 5 |
| List of abbreviations used | 6 |
| List of symbols used | 7 |
| Glossary | 8 |
| General Introduction | 10 |
| Part 1: Literature review: Implementing a label to sustain public policies | 12 |
| Section 1.1 Labelling systems, a public, private and innovation issue..... | 12 |
| 1.1.1/ Typology of labels: origins and goals..... | 12 |
| 1.1.2/ Integrating principles of open innovation within labelling systems typology | 15 |
| 1.1.3/ Labelling systems criteria: a mean to achieve a label’s goals | 18 |
| 1.1.4/ Benefits of labelling systems for consumers..... | 20 |
| 1.1.5/ Benefits of labelling systems for companies..... | 21 |
| 1.1.6/ Benefits of labelling systems from a ministerial point of view | 23 |
| Section 1.2: Stakes around public policies | 25 |
| 1.2.1/ Sustainable buildings and cities policies | 25 |
| 1.2.2/ Water, biodiversity and mimicry policies..... | 28 |
| 1.2.3/ Circular economy policies..... | 33 |
| 1.2.4/ Renewable energy and energy efficiency policies | 37 |
| 1.2.5/ Sustainable digital transformation policies..... | 40 |
| 1.2.6/ Risk prevention policies..... | 45 |
| 1.2.7/ Health and Environmental Policies | 49 |
| 1.2.8/ Sustainable Transport policies | 52 |
| Part 2: Contribution of missions to the implementation of ministerial policies | 57 |
| Section 2.1. Service offers as a mean of developing innovation..... | 57 |
| 2.1.1/ Data work: a tool for companies to develop their processes | 57 |
| 2.1.2/ Implementing an innovation ecosystem: a mean to increase resources and network..... | 59 |

| | |
|--|----|
| 2.1.3/ Providing training offers: giving the keys to developing the activity..... | 62 |
| 2.1.4/ Providing assistance on various fields: showing support and increase chances of success | 65 |
| 2.1.5/ Making companies visible: an essential tool to attract consumers and investors | 67 |
| Section 2.2: Solutions brought by innovation | 70 |
| 2.2.1/ Labelled companies' contribution to the stakes of public policies | 70 |
| 2.2.2/ Analysis of environmental gains..... | 75 |
| Results and analysis..... | 84 |
| 1) Limits, strengths and levers of the missions according to the bibliographical contributions | 84 |
| 2) Analysis of the relationship between the bibliographical work and the missions | 86 |
| Conclusion and perspectives..... | 87 |
| REFERENCES: | 89 |

List of tables

Table 2.2.2.1.A: Amount of emissions according to the amount of active ingredient within fungicides, Source for the first column: ADEME. – p77

Table 2.2.2.1.B: Estimated total amount of emissions in kg due to the impact of active ingredients. -p77

Table 2.2.2.1.C: Estimated emissions that could be decreased, in kg, if 87% of surfaces were using the technology developed by Greenshield, with different margins of error. -p78

Table 2.2.2.2 A: Calculation of cement impact for 17 million tonnes of cement (Godoy Hilario, 2019) using figures from Sjunnesson (2005). -p81

Table 2.2.2.2 B: Consequences of using Materr'Up's processes to cover 5%, 20%, 50% of current uses of hydraulic concrete (in grams) -p82

List of illustrations

Fig 1.2.2: State of conservation of sites designated of Community Importance from 2013 to 2018. Source: Coulmin et al., 2020. -p30

Fig 1.2.2.B: State evolution of site designated of Community Importance, from 2013 to 2018. Source: Coulmin et al., 2020. -p31

Figure 1.2.3: Circular Economy, 3 fields, 7 pillars. Source: ADEME, 2020. -p34

Fig 1.2.4.A: Primary energy consumption by type of energy in 2019. Source: Department of Data and Statistical Studies of the Ministry of Ecological Transition. Source: Phan et al., 2020. -p38

Fig 1.2.4.B: Primary production of renewable energy by sector in 2019. Source: Department of Data and Statistical Studies of the Ministry of Ecological Transition. Source: Phan et al., 2020. -p39

Fig 1.2.6: State of progress of natural risk prevention plans. Source: Ministry of Ecological Transition, 2016 -p48

Fig 2.2.2.2 : Materr'Up concrete construction solutions. Source : Materr'Up -p80

List of abbreviations used

ADEME: Agence de l'environnement et de la maîtrise de l'énergie

B2B: business to business

CEI: Call for expression of interest, known in French as AMI: Appel à Manifestation d'Intérêt

CEREMA : Centre d'Etude et d'expertise sur les Risques, l'Environnement, la Mobilité et l'Aménagement

CIRAD : Centre de coopération internationale en recherche agronomique pour le développement

DRIEE: Direction Régionale et Interdépartementale de l'Environnement et de l'Energie

GHG: Greenhouse gas emission

IGN: Institut National de l'information Géographique et Forestière

INRA: Institut national de la recherche agronomique

IRSTEA: Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture

OFB: Office Français pour la Biodiversité

SME: small and medium-sized enterprise

SNBPE: Syndicat National du Béton Prêt à l'Emploi

WEEE: Waste Electronic and Electrical Equipment

List of symbols used

As: Arsenic

Cd: Cadmium

CO: Carbon monoxide

CO₂: Carbon dioxide

Cr: Chromium

Cu: Chromium

kWh PE./m².year: Unit of measurement of primary energy consumption per area unit per year. It is specifically used to measure the energy efficiency of a building.

Mtoe: Megatonne of oil equivalent

NM VOC: Non-methane volatile organic compound

NO_x: Nitrogen oxide

PAHs: Polycyclic aromatic hydrocarbon

PCDD-F: Polychlorinated dibenzodioxins

Twh: Terawatt hours

Glossary

B2B: trade from one company to another, which is different from B2C which refers to trade from a company to a consumer and B2A which is about trade from a company to an administration.

Call for expression of Interest: The European definition states that it is about “economic operators invited to put themselves forwards as candidates in advance of a public procurement operation by a contracting authority. It can be seen as a way of generating shortlists which may be used many times for many different procurement procedures”.

Call for Proposals: the European definition states that it is about “grants to support a specific action or project that helps further an authority’s policies”.

Cercosporiosis: a disease affecting beetroots

Design thinking: a method for innovation management

EIC Accelerator: European funding for innovation part of the Europe2020 program.

Greentech: a market that is intertwining digital technologies and ecological transition.

Fungicides: pesticides used to limit the development of fungus

Hackathon: event that gathers specialists of a field to develop new a project towards a specific subject during several days, it is often related to digital development.

Incubator: an incubator is a place where small companies can come to develop their activity, it is a workplace where they can sometimes do experiments, they also have access to training, or pieces of advice on funding, legal issues.

Living lab: a living lab is similar to an incubator; however, an incubator has an offer of services within the structure. Living labs are more referring to a coworking space. This space is dedicated to small companies to give them a workspace to develop their activity.

Market failure: when there is not an optimal allocation of resources or production.

Phytosanitary product: a product from chemical or natural origin used for plants in order to help them grow, heal or prevent diseases. It will sometimes be used a synonym for pesticides, as this project is mostly describing the preventing from disease and healing aspect.

SME: this describes a company that have less than 250 employees and a turnover inferior to 50 million euros per year

Start-up: sometimes, the term start-up will be used, the Greentech Innovation service uses this term for companies that are less than four years old or that have less than ten employees. Several writings exist, but the service has decided to use this version of the writing and only use the singular form, even to talk about several.

General Introduction

In 2018, Innovafeed has raised 40 million euros of fundings. This company has been labelled in 2016, the year when, the Ministry of Ecological Transition, implemented what was called at the time the Greentech verte label. It has since then, changed its name for Greentech Innovation. This change of name was announced during the Meet'Up Greentech 2020, an annual event organised by the service that is gathering the whole Greentech ecosystem. This decision was taken because the name was a little redundant, and the purpose was to give more credibility, visibility, and highlight the willingness to attract innovation.

Indeed, this label has been implemented in order to accelerate the governmental policies regarding the ecological transition. This initiative can find its roots in the new public management thinking. This thinking is about integrating private practices within the public sector. The private sector has started to integrate external resources to stimulate innovation in their structures. Indeed, integrating more people from different backgrounds into the thinking process helps to multiply ideas and to obtain a more demand-driven delivery. Hence, integrating these kinds of practice within the public sector had the potential to propose new ideas that would fit the public's demand and then would have more chance to make people change their behaviour towards sustainability.

Nevertheless, governments have long used similar practices through innovation competitions, which have had many different names over time. Thus, from this history, the Greentech Innovation label was born. Indeed, Greentech Innovation is a structure that means to attract innovation in order to accelerate the Ministry's policies. Different policies on different subjects have been implemented over the years; however, Climate Change is more than ever before, a significant stake for which significant changes have to be implemented. Hence, with the biodiversity declining, biochemical flows being degraded, strong measures have to be taken in order to not exceed other planet boundaries that would compromise very seriously the whole planet's ecosystem, implying unsafe and unpredictable risks affecting every species, including humans.

Thus, the Greentech Innovation has labelled companies from different backgrounds, working on different subjects that can help to decrease or at least, to slow down the effects of climate change. Companies with engineering or business background are applying to propose

solutions on the circular economy, energy efficiency, or sustainable transportation. Many topics exist for which companies can apply and try to make a difference to accelerate the Ministry's policies. It is evolving with time, and the criteria are as well but the aim and the remains the same, it comes from the belief, that innovation can help to find new solutions to replace malpractices that have been done over the years. It is the belief that disruptive innovation could have a substantial impact on people's behaviour and would impact many practices on both private and public sector. These innovations could have the potential to be spread at a larger scale and sometimes be adapted to other fields than the one for which they have been developed. Innovation is, therefore a mean for sustainable development. In order to make sure that this aim can be achieved, the label has set up a service offer so that labelled companies can reach their full potential. Some companies are entirely successful, as Innovafeed, mentioned above, but others encounter more difficulties and some, therefore, end up shutting down. Indeed, it is estimated that nearly 90% of start-ups go bankrupt in France, the innovation environment is a complicated world, where it is hard to make a business live. In this context, the Ministry can support them, but what about this offer?

Moreover, the question of the impact of these innovations can also arise and if they really are contributing to accelerating the Ministry's policies. Hence, this project means to study the efficiency of implementing such a label to accelerate these policies. This study will intend to answer to this question: **How does the Greentech Innovation label may contribute to the implementation of governmental policies regarding ecological transition?**

In order to answer to this question, several aspects will be studied, starting from studying what the literature is saying about labelling systems and the policies that have been implemented. In order to answer, governmental studies, among others, will be used. These documents have the perk to be describing precisely the goals the government is aiming at. Moreover, several ministerial services are dedicated to research in order to have the most precise vision possible on the situation. Hence, the first part will be dedicated to understanding labels, their aim, and benefits and then to see what are the policies that the Ministry has implemented to achieve different sustainable development goals. Once these elements are known it will be possible to study precisely how the Greentech Innovation label is assisting companies to help them develop and achieve their full potential so that they can contribute to the Ministry's policies. Finally, the actual contribution of these companies for the policies will be studied.

Part 1: Literature review: Implementing a label to sustain public policies

Section 1.1 Labelling systems, a public, private and innovation issue.

Hence, this first section is meant to describe the purpose of labels in general, what the dynamics they can generate. This section will explain the stakes around labelling systems, their benefits, to people, company and most of all, the government. Overall, this part will be describing the interest that can be found in labelling systems. It will show the difference between mainstream labels and the Greentech Innovation one.

1.1.1/ Typology of labels: origins and goals

Labelling systems have existed in different forms for a very long time. They were adopted on different aspects (food, clothes, for example) for various reasons such as security or quality. However, most economical researches have been done during the last century, focusing on quality features. Indeed, labelling systems appear to address issues caused by market failures. This has been theorized by many different authors over time such as George Akerlof or Philip Nelson. This principle of market failure mainly finds its origins in the 1970s. This part is meant to explain the appearance of such systems but also to describe the typology of labelling systems that have been created to respond to existing issues. Indeed, there is not only one kind of labelling system but many different that are meant to respond to different aspects. The “Greentech Innovation” label has appeared to address recent issues and is therefore quite different from the usual definition of a labelling system.

However, in order to adequately describe the purpose of this specific label, it is essential to explain the objective of mainstream labels and why they appeared in the first place. As mentioned above, labelling systems appeared to address market failures. Market failures refer to different aspects, but, in this case, it is mostly about the lack of information a consumer

may encounter while purchasing a good or service (Nelson, 1970). The consumer will face an asymmetry of information as the seller may have more information about the price or quality of the good in question. However, this aspect of decreasing market asymmetry can be described more thoroughly within the part dealing with the benefits of labelling systems for consumers.

Addressing market failures is made easier through the implementation of a labelling systems which will improve market functioning (Arjaliès, 2013).

Moreover, the implementation of labelling system also comes from increasing demand from consumers for transparency (Streletskaya, 2019). Hence, in order to respond to this demand, companies tend to label their product voluntarily in order to get consumers to buy as they realized that the willingness to pay was increasing when a product was labelled (Streletskaya, 2019).

Therefore, mainstream labels have been mostly implemented on goods and services. They are meant to give transparency about a specific criterion of a product during its whole life cycle (Houe et al., 2009). For instance, an eco-label will ensure the environmental quality of a product during its whole life cycle, meaning that the product should have the lowest impact possible from its production to its end of life (Houe et al., 2009). In order to check these criteria, IT tools are often involved to calculate the eco-efficiency of the product in question (Houe et al., 2009), ensuring as much as possible the quality of the label. This transparency shall give a sense of quality from the product, hence decreasing the asymmetry of information that a consumer may encounter and fixing the market failure.

Labels can be given through different processes, namely through an independent third party, or it can be self-appointed. However, those given through a third party tend to be more reliable and therefore to have the most significant impact on reducing market failures (Houe et al., 2009).

As the mainstream definition of labelling systems has been explained and that the purpose is clear, it is now possible to go further to understand how the “Greentech Innovation” label is working. Regarding this specific case, the process is quite different from the usual labelling system. The Greentech Innovation label used two different kinds of processes in order to create its network of start-up and SME: Call for Expression of Interest (CEI) and Call for

Proposals (Greentech Innovation 2016 and 2019). These processes are necessarily including public institutions. These processes are meant to raise proposals that are following policies the institution is aiming at. Indeed, these calls are implemented because a political need is expressed (Ministry of Ecological Transition, 2020). There is a whole process that is implemented before the launch of these calls. Once the institution is aware of the political need, they should describe the context within which the need arises (Ministry of Ecological Transition, 2020). Then, they should word more precisely what the institution is aiming at by identifying possible objectives and prioritize some of them. Once the objectives are set, processes of Call for expression of interest and Call for Proposals can start (Ministry of Ecological Transition, 2020). Hence, calls are the result of a process of political reflection.

However, both calls are different as one involves money (Call for Proposals) and the other is merely is granting a label within which some advantages are given (Call for expression of interest) (Greentech Innovation, 2016 and Greentech Innovation, 2020). However, they both are considered as policy leverage (Breton, 2014). These processes are usually a part of Future-Oriented Investment Programs that is an initiative of the general secretariat for investment (Secrétariat Général pour l'Investissement, SGPI), especially Call for Proposals as it involves money (ADEME, 2017). Indeed, this program is meant to develop innovation and investment in order to ensure green growth and employment (ADEME, 2017). One of the calls for proposals that was organised by Greentech Innovation had been done through a special envelope for ecological transition (Greentech Innovation, 2016). However, they realized that the process was fitting better the Future-Oriented Investment Programs and made the next ones' part of this program.

The principle is quite simple. When an institution is using these processes, they wish to create a network with civil society. They have an objective, and in order to implement it, they request a private intervention which could bring various opportunities. Therefore, they are explaining the issue they encounter and giving criteria of appliance (Breton, 2014). People that are interested in participating should submit an application file within the set deadlines, respecting the mentioned criteria (Breton, 2014). Then the process of selection begins in order to choose the projects that suit best the objectives that have to be reached. Several projects can be selected (Ministry of Ecological Transition, 2020). As the process is coming from an institution, they are more likely to choose different solutions that have the potential to solve

the issue they are encountering. Indeed, their purpose is not necessarily to strengthen a specific company but to implement a solution that can be applied, with time, to a grander scale. Therefore, the institution supports a company through the solution they are implementing. The benefits of the calls are allowing the company to develop its solution that is related to the political need (Ministry of Ecological Transition, 2020). Moreover, the goal that was set has to be achieved in the best possible way. Therefore, an institution is more likely to select very different solutions that can be tested so that in the end, positive outputs may emerge from it (Moisan, 2011).

However, unlike mainstream labels, no specific IT tools are being developed for the selection process. Only the “Demarches simplifiées” tool is used to gather application forms (Greentech Innovation, 2020). However, some other tools are used once the companies are labelled to have a better overview of each company's activity. Nonetheless, most of the process of selection is done through the participation of qualified people in specific fields (Greentech Innovation, 2020). Someone working in the general direction of risk management (Direction Générale de la Prévention des Risques) might be the judge of the risk management category for the Greentech Innovation call for interest, for instance.

This labelling system thus enables an institution to achieve its objectives by involving a wide range of actors. This kind of process is found in open innovation systems. A process that has so far been mainly found in the private sector but which is tending to open up to the public sector as well. However, in order to understand the links between this labelling system and open innovation, it is essential to study the very definition of this type of innovation.

1.1.2/ Integrating principles of open innovation within labelling systems typology

Henry Chesbrough introduced the concept of open innovation (Remon, 2012) in 2003 in his book *Open Innovation: The New Imperative for Creating and Profiting from Technology* (Chesbrough, 2018). This concept suggests that companies should integrate both internal and external resources when innovating so they can create real value (Chesbrough, 2018).

This concept became a core interest in research (Chesbrough, 2018). Many authors studied the principle but also broadened the definition, considering to what extent this concept could be applied (Chesbrough, 2018). Therefore, as the definition started to be broadened, Remon (2012) summarized some of them. The concept is based on the fact that companies are using external resources in order to develop innovation. They will increase their performance through the potential knowledge of external resources; it can be done on different parts of the process from the development of the idea to marketing (Remon, 2012). When summarizing this principle, Remon uses different definitions given by West and Gallagher in 2006, Henkel in 2006 and Leadbeater in 2007. The one by West and Gallagher explains that when a firm is using open innovation, they are exploiting internal capabilities and resources to grab innovation opportunities and capitalize on them on diverse aspects. According to Henkel (2006), open innovation makes technology something more than just a tradable good and involves the public to develop the product, increasing their interest. Finally, Leadbeater (2007) defines different sources of open innovation, explaining that a company may choose more or less wide external contributions, depending on the process they wish to follow: having some pieces of information given by many different people ("Open Innovation OUT") or a full collaboration on the development process from fewer people ("Open Innovation IN").

It comes from the fact that innovative solutions might be inhibited if ideas are limited to an internal point of view (Hilgers, 2010). This concept can be defined as an organisation collaborating in order to get the knowledge they need to implement their project. It is a system that is interacting with its environment. The idea that is behind this process is that more creativity can come from an external point of view, that new ideas will not necessarily come from an internal perspective. Not only ideas but also processes can emerge from these practices (Remon, 2012). Hilgers (2010) goes even further by explaining that the more knowledge and ideas, the more a company's performance might increase regarding its process and its integration on the market. Indeed, the product might fit more the market's expectations. In order to achieve this objective, consumers and innovative users will be involved (Hilgers, 2010).

Hilgers (2010) showed that the process has worked very well for different companies that had implemented idea platforms and that the quality of the product was often higher than when it was done using only internal resources. This can be due to a knowledge that the company

does not have in the first place or also because the motivation might be higher, which has the other benefit to accelerate the development process and therefore decrease the innovation process cost.

The concept has mostly been researched regarding companies; however, it is a subject that is more researched and for which different ways of implementing it are being explored. Chesbrough (2018) defines the notion of open government briefly, taking the example of Barack Obama's administration. He explains that governments are looking for a way to change their practices and be open to new collaboration in order to "increase the innovativeness of public service delivery". He cites Hilgers, who has done preliminary research on this adaptation of this concept by the public sector. In his research, Hilgers (2010), develops the concept of "citizensourcing" as a way of implementing open innovation in the public sector. He explains that it is a new configuration that is creating a relationship between the government and citizens. Hence, practices of the private sector are applied to the public. Moreover, he describes three principles of crowdsourcing, but there is one in particular that fits best what the government intends to do with the Greentech Innovation label. This principle is called "citizen ideation and innovation". Within this principle, a government will engage its citizen to find innovative solutions and processes to solve a public issue. In order to do so, they might use an idea or innovation competition, where the purpose is to find a qualitative solution for "the common good". The process is simple; they will explain the problem that has to be solved and offer platforms to people so that they can give their ideas. Moreover, they might incentivize citizens through monetary reward or structures offers.

In France, these processes within governmental institutions are more and more used. Indeed, innovation opportunities, to implement public policies, are found through labelling different companies working on ministerial policies. This is the principle that is followed by the Greentech Innovation label, which is finding innovative solutions to accelerate their policies. ADEME (2017) is also following this process as they mentioned it in their report regarding the outcome of investment for the future program. Indeed, even though it is not the central aspect of this program, they are supporting open innovation projects as well.

Nonetheless, in order to be able to integrate solutions that can be positive for governmental policies, projects have to be selected according to specific criteria.

1.1.3/ Labelling systems criteria: a mean to achieve a label's goals

Labels are implemented to fit different expectations. Taking the example of food labels, they can be implemented to respect criteria of “health, taste, environmental concerns, food safety, animal welfare, local economic impacts, perceptions of wholesomeness, past traditions, and trendiness” (Streletskaia, 2019). These criteria apply to many different kinds of products and services. Therefore, the companies that are labelling these products and services implement a process to check if the criteria are well respected.

In the specific case of the Greentech Innovation Call for expression of Interest (CEI), the regulation gives some conditions that are mandatory in order to be selected. The companies are not labelled as such; they benefit from the label through the project they present. Therefore, the project presented should be innovative. It should be part of one of the sectors of public policies led by the Ministry of ecological transition: Sustainable buildings and cities, Water, biodiversity and mimicry, Circular economy, Energy efficiency, Renewable energy, Sustainable digital transformation, Risk prevention and Health and environment (Greentech Innovation, 2019).

However, this is not sufficient to be selected. Indeed, the project has to be developed by a SME, according to the definition of the European Union. This means that the number of staff members cannot exceed 250 people. Besides, there is a limitation regarding the turnover which cannot exceed 50 million per year nor can the balance sheet exceed 43 million (European Union, 2015). Moreover, the solution presented by the company should prove that it can be developed to a bigger scale. Besides, companies should not be in difficulty according to the European definition. Being in difficulty has been defined by the European Commission in 2004 as to be “unable, whether through its own resources or with the funds it is able to obtain from its owner/shareholders or creditors, to stem losses which, without outside intervention by the public authorities, will almost certainly condemn it to going out of business in the short or medium term” (European Commission, 2004).

Other criteria also need to be respected in order to be selected. As mentioned above, being innovative is the first criteria of selection (Greentech Innovation, 2019). It is the most critical aspect as the purpose of implementing this label is to ensure new solutions to a sector which

has sustainability issues. Therefore, when being innovative, the product or service labelled should ensure a change of practice. Being disruptive is considered as the best way to achieve sustainability. This disruptive criterion shall, therefore imply a change in people's life (Greentech Innovation, 2019). Moreover, it must be possible to implement the project (Greentech Innovation, 2019). Consequently, it is important that the project leader can prove that its solution is feasible, can be developed on a large scale and can reach its target markets, whether these are in France or abroad (Greentech Innovation, 2019). A solid business plan proving this must therefore be provided, since the spread of this technology will enable the implementation of sustainable practices and the creation of jobs in the territory. This aspect implies that the project is economically beneficial (Greentech Innovation, 2019). Moreover, proving that the project has an impact regarding environmental issues according to the different sectors (Sustainable building, circular economy etc.) is extremely important (Greentech Innovation, 2019). The project should make a difference regarding the impacts of its sector and avoid any impact transfer. Life Cycle Assessment is often appreciated.

However, as the label settled, the conditions evolved to include other parameters (Greentech Innovation, 2019 and 2016). Indeed, SMEs that are selected have an obligation to respond to the surveys carried out by the labelling service (Greentech Innovation, 2020). At some point, a hearing after three years was implemented (Greentech Innovation, 2019). It was meant to make sure that the project was reaching out its objective and to check if the project was still in line with the Ministry policies and/or contributing to their implementation (Greentech Innovation, 2019). Moreover, within the first CEIs and calls for proposals, the definition of SMEs was more restrictive. A criterion of years of activity was taken into account. During the first year, namely, when companies were labelled through the Call for Proposals, they had to be less than 36 months old (Greentech Innovation, 2016). During the first CEIs, they had to be less than 4 years old (Greentech Innovation, 2018). Moreover, the first Call for Proposals was more restrictive and more focused on digital technologies (Greentech Innovation, 2016).

Moreover, the condition of not being a company in difficulty will no longer be applied for the next CEI (Greentech Innovation 2020), as it is difficult to find out whether they are in difficulty or not, and as SME that are selected are often recent ones, therefore their financial situation has reasons to be unstable.

In the end, respecting these criteria is the best way to implement a solution that will be beneficial for the different actors involved: consumers, companies and government.

1.1.4/ Benefits of labelling systems for consumers

As mentioned previously, labelling systems appeared to address market failures. Therefore, it is necessary to understand how consumers can benefit from labels, as these were created so that consumers could gain back some power within market bargaining. Indeed, as they gain knowledge through labels, they may make better choices when purchasing a good or service. Labels give consumers a sense of quality (Streletskaia et al., 2019); they are aware of what is behind what they are paying for.

The author Nelson (1970) is the one that explained the most clearly this process. Indeed, his work was mostly about the lack of information caused by market failure. He was detailing the process through price of goods but also through quality and how information was applying to both of these aspects. Indeed, consumers are not necessarily aware of the actual price of a good and may pay a higher price than they should because they cannot access the information that they would need to pay the appropriate amount. This process also applies to quality; the information made available to consumers may not be enough to make the best choice regarding quality (Nelson, 1970). In order to counteract this asymmetry of information (the seller has much more information than the consumer), the consumer may use two different processes: experience and search (Nelson, 1970). They will have to search for the information that they need to make the most appropriate choice. However, this search mostly applies to expensive goods, otherwise, the cost of time can outreach the cost in terms of price. Indeed, choosing among a selection of cheap products is easier as people may try different products in order to find the best quality. Nelson (1970) was using the example of canned tuna fish. Buying several cans in order to make the best choice in the future as a lower cost than search. However, for more expensive goods, consumers do not necessarily have the time to investigate nor the competence. Therefore, in order to make the best choice, consumers may choose to trust an external entity, a label (Houe et al., 2009).

Moreover, more than just giving an advantage regarding information, labelling systems also have the benefit to fit new consumers' expectations. Indeed, eco-label is a good illustration of

these new expectations. As people are getting more aware of issues regarding sustainability (Houe et al., 2009) they tend to want to have a consumption that is fitting their convictions. Streletskaia (2019) explained how people tend to choose more easily products that were considered as eco-friendly more than cheaper products. Therefore, through labelling systems, consumers have the opportunity to make the best choice according to their expectations.

However, in the sense of the Greentech Innovation label, the consumers might be different as many companies are offering B2B solutions. Therefore, the consumers will be other companies or investors for which the label enables them to discover the company and have a sense of trust as they might trust the reasons why the Ministry would have labelled a company since they are labelled under the criteria mentioned above, i.e. having an impact on ecological transition and offering new tools for this purpose. Hence, companies and investors, which are in this case, consumers, that have these interests will have a sense of a company's capabilities through this label.

In the end, this last aspect is a benefice for both consumers and companies. Indeed, the fact that consumers have a perspective on the company's capability can increase the company's opportunities.

1.1.5/ Benefits of labelling systems for companies

Labels have the benefit to decrease information asymmetry and are therefore, beneficial to consumers. However, all the benefits do not only go to consumers; companies can find interest in getting a label for their products or services. Indeed, when getting a label for their products or service, the label will give a sense of quality, as Streletskaia (2019) explained in her research regarding the absence of labels. Therefore, this will have repercussions on the sales of the company because it can increase the trust of consumers that will be more likely to choose the product that is labelled over one that is not. Hence, labels can improve the image of a company (Houe et al., 2009). This improvement can be used for communication, to increase the visibility of the product or service to the public. If we take the specific example of the Greentech Innovation label, communication can be even more enhanced as the Ministry of ecological transition is a set institution that inspires trust, especially for investors. Therefore, companies will have more benefits when showing that they

got this label. Since they often are young companies, this makes it easier for them to enter the market as they have the confidence of the Ministry, visibility with investors and thus sometimes their funds. The label then enables the company to really be on the market. Moreover, the way the label works encourages collaboration with companies that become a part of the network, therefore they might develop even more their share of the market and discover new opportunities through these collaborations. Thus, this approach differs somewhat from traditional labels, which are most often aimed at companies already on the market and which seek rather to show certain qualities of their product and obtain a competitive advantage. However, the Greentech Innovation label seems to combine the advantages of both the traditional labels and those just mentioned. However, there are other advantages to labelling that have been described in the literature.

Regarding eco-label, several studies have shown that they were increasing the willingness to pay from consumers (Streleskaya, 2019). Indeed, as mentioned above, people tend to be more aware of sustainability issues and are more likely willing to pay for products that are fitting these criteria. Therefore, this willingness to pay, even for more expensive goods, came as an advantage for companies working in that field, these companies started to follow the demand of consumers that were more and more interested in the subject (Houe et al., 2009). Wen (2020) supported that argument of an increased willingness to pay for environmentally friendly products. Hence, being labelled becomes a competitive advantage against competitors. It is the increase of environmental concern from the population that is making it such a big advantage. Houe, et al (2009) showed that the phenomenon of competitive advantage was even more true when it regarded the competition with low-cost countries such as China, where a more expensive good that was environmentally friendly could be preferred to cheaper goods. When the product is labelled, the consumer believes the fact that the goods are actually environmentally friendly, trust is increased and so is the willingness to pay.

Moreover, the law is one of the most critical drivers of implementing eco-design processes (Houe et al., 2009). Indeed, implementing them might be a way to anticipate future governmental regulation and be competitive when the competition has to adjust. Indeed, if a company has implemented these processes while it was not a legal obligation, they have the time to develop their process and therefore to be well integrated in the market regarding these specific criteria. By being compliant to a regulation before it was one might lead to

economies of scale and having a product that is cheaper than their competition that needs to adjust. Wen (2020) explains that being labelled comes from different external pressure such as legal ones or stakeholders, or an anticipation of future business concerns.

However, according to the study led by Wen (2020), there is no consensus on literature regarding any economic or financial performance enhanced by environmental labels. Some studies seem to have shown a return to assets were found; some showed neutral or even negative effects on the financial performance.

Nonetheless, through the comparison of all these studies, Wen still tends to believe that a company's performance can still be enhanced due to an increase of legitimacy, a differentiation strategy and information asymmetry decrease.

Hence, companies might have many reasons to use labels for their business strategy, it is both interesting for them and their consumers.

However, according to the kind of label that is implemented, it can also be beneficial to authorities.

1.1.6/ Benefits of labelling systems from a ministerial point of view

In 2015, during COP21, the initiative "Mission Innovation" was launched by 23 countries, with the idea that innovation should be a significant tool for ecological transition (ADEME, 2017). The purpose of this mission is to accelerate policies in favour of technologies that are beneficial to the environment.

Using this kind of label is therefore, a way to achieve this objective. Call for expression of interest or Call for Proposals are used as an instrument of public policy to support sustainable development (Ministry of Ecological Transition, 2020). Indeed, these policies are pushing companies to develop new solutions, following indications given in the call's regulations. This way, innovation is not "spontaneous" but is promoted through public intervention. Therefore, more solutions can be offered (Moisan, 2011). Indeed, when using innovation as an objective of long-term public policy, innovators are encouraged to work on solutions according to a guideline. They have an objective to produce a solution regarding a subject, and if they do,

their innovation will be tested, supported so that it can be applied at last, to a grander scale. However, not all innovations will be implemented, and as Moisan (2011) explained, some public objectives change, they might face backlash. Nonetheless, having all of the innovations implemented is not a purpose itself, it is more about having innovation become an instrument of public policy, regulated and carried by the State so that more disruptive changes can be elaborated than when innovation comes from spontaneity. Moreover, the more innovation the State can carry, the more possibilities on the matter at stake can be explored (Moisan, 2011). This range of possibilities can then ensure that, in the end, sustainable solutions will come to replace malpractices.

Encouraging innovation as such is part of a reform of public policy to make it more efficient (Breton, 2014). Moreover, as governments realize that they need to act upon climate change, they also realize that a systematic change has to be operated. In order to do so, having disruptive technologies can ensure a new way of implementing new practices (Moisan, 2011). These new practices cannot be applied immediately as they, sometimes, demand significant changes regarding behaviour but also, the way things are produced, built and consumed. Moisan (2011) gave the example of the change of car fleet; this change cannot happen in a too short time-lapse. Hence, in order to achieve the goals, set for 2050, testing new solutions that could work by that year should be done right now and during this next decade. Labelling is a method chosen to accelerate this process.

Therefore, these many reasons make that this kind of labelling process is at the interest of the Ministry. It can enable an acceleration of its policies. When the Investment Program for the Future was initiated, the purpose that was set was to implement a green growth and a program that could lead to more employment as well (ADEME, 2017). Indeed, the more innovation initiated on the territory, the more employment can come out of it. It is at the interest of the Ministry as they can see it as a virtuous circle: more sustainable practices along with more jobs.

Moreover, as the Ministry is formulating the specifications of its labelling process, it enables them to prioritize some subjects according to their current policy. Besides, the call for interests that had been deployed over time, enabled the Ministry to identify some sectors within which innovation had potential.

Section 1.2: Stakes around public policies

The last part was defining the stakes for implementing labelling systems. Moreover, it was explaining how it could have an impact on public policies. However, in order to get into in-depth, within the demonstration of the efficiency of this label, the stakes around the policies that are aimed at, must be described. The stakes of public policies have been chosen according to the criteria of the Call for expression of interest led by the Greentech Innovation. Each public policy is a category within which a start-up or SME can apply. They develop an innovation that can help in achieving the goals of the policies. Hence, this part is meant to describe, the stakes around the different topics and the policies that have been implemented in order to tackle the issues that have been found. However, as there are many policies that have been implemented over time, this part is not meant to be summary of the law but rather an explanation of several aspects on which policies are focusing at the moment. It is about giving an idea of what is done and what needs to be done. This section will, therefore describe some of the policies that have been put in place and some of the major issues surrounding them. The topics that will be described will be the following: sustainable buildings and cities, water biodiversity and mimicry, circular economy, renewable energy and energy efficiency, sustainable digital transformation, risk prevention, health and environment and sustainable transport.

1.2.1/ Sustainable buildings and cities policies

Buildings and cities represent a significant stake regarding public policies as they are the place where most citizens of a country are living. Since our societies are dependent on these infrastructures, it is imperative to think about them most sustainably because they are not neutral. Indeed, buildings and cities have different impacts on diverse pollutants, some of them being significant. Indeed, the building sector accounts for 25% of the greenhouse gas emissions in France, two-thirds of these being linked to residential parts (Ministry of Economy and Ecological Transition, 2020). Therefore, building a place for citizens that has the smallest impact possible could have a significant effect on climate change in the future.

Buildings and cities' most significant impacts regard energy and construction, for which most policies are implemented. Working on these aspects could significantly decrease the number of diverse pollutants and act on climate change effects.

Construction of buildings has a very significant impact, especially concrete buildings. The most polluting aspect is the use of cement, even though it only represents 10 to 20% (Sjunnesson, 2005) of the components of concrete. This production accounts for 7% of the global CO₂ load in the atmosphere, as 1.6 billion tons are produced every year (Metha, 2001).

These emissions are linked, on the one hand, to the consumption of fuel to heat the cement kiln and, on the other hand, to the phenomenon of decarbonisation of limestone into lime ($\text{CaCO}_3 \Rightarrow \text{CaO} + \text{CO}_2$) (Spittler, 2020). For each molecule of lime produced (CaO = 36g of molar mass), there is an almost equivalent rejection of CO₂ (32g of molar mass) (Spittler, 2020). To this must be added the CO₂ emissions required to heat the kiln (coal consumption accounts for about 10% of the cement production, i.e. 1/3 of cement production in CO₂ emissions) (Spittler, 2020) Moreover, the production of cement has a significant impact on nitrogen oxide (NO_x) emissions (Sjunnesson, 2005).

The extraction of raw materials such as clay or limestone causes losses of topsoil but also deforestation. However, as clay and limestone are extracted in thick layers, these impacts are generally less significant than the extraction of river sand and gravel (Metha, 2001).

Besides, there are significant problems with water use (1 trillion L of water/year).

Also, the energy sources used in manufacturing are often fossil fuels (Sjunnesson, 2005). However, many cement plants have adapted their processes to inject high energy value industrial residues, such as used motor oil, shredded used tyres, etc. into the kiln, thus reducing the consumption of fossil resources and helping to eliminate waste (Spittler, 2020). Nevertheless, calcination remains the most expensive operation in terms of CO₂ emissions, accounting for 69% of cement works emissions (Sjunnesson, 2005). This production has an impact on global warming.

The transport of materials and concrete also accounts for a high share of emissions since most of them are transported by truck. Moreover, the mass of materials can lead to many trips that

multiply the rates even more. Proximity to production sites is therefore necessary to reduce emissions.

The major impacts of transport are acidification and eutrophication.

These figures show how concrete buildings contribute to the increase of CO₂ and NO_x, showing the necessity to develop new solutions to act upon these emissions.

However, as mentioned above, energy in buildings contributes extensively to climate change. Indeed, in 2020, most energy consumed in France is consumed in the building sector (43%), besides, in 2017, the Ministry of Ecological Transition (2017) argue that more than 123 million of CO₂ were emitted through this sector.

The impact of energy itself will be explained more thoroughly within the part related to energy policies. However, as most consumption relates to the building sector, some particular legislations have been implemented to tackle these impacts within this sector. Indeed, focusing on this sector can enable the country to decrease significantly diverse emissions and have an effect on practices. Therefore, energy retrofit is one of the major policies led by the Ministry of Ecological Transition. Some are very specific to buildings while it can simply be linked to laws implemented to use less energy or at least cleaner sources. Therefore, in order to achieve this objective of more efficiency regarding buildings, energy retrofit for cities and buildings can play a significant role.

European Union has set a directive in 2012 that is enhancing energy efficiency. This directive has been transposed into national law. Hence, several measures regard energy retrofit and have for purpose to enhance energy retrofit. Thus, the report of 2013, on the transposition of this directive, describes some of the measures such as the financing measures that have been taken in order to facilitate the financing of energy renovation works (Ministry of Ecological Transition, 2013). For instance, the « eco-prêt taux zéro » which exists since 2009 helps citizens to pay for their renovation works, as long as they prove that the amount of work that will be done can have an impact regarding energy efficiency. Besides, financial aids have been implemented in order to reduce the costs of these works. These financial aids are given more easily when the person has a passport that is retracing the works that will be done, evaluating

the actual consumption to the expected low consumption (Ministry of Ecological Transition, 2013).

More recently, the new report on the transposition of the European Union's directive (2020) describes the decrees which have been implemented to reinforce an obligation to decrease the final energy consumption of buildings from the services sector, by 40% in 2030, 50% by 2040 and 60% by 2050, compared to the rate of 2010 (Ministry of Ecological Transition, 2020).

These decrees also created a program held by the ADEME to assist and inform people who wish to initiate renovation works and give more financial aid.

Nonetheless, not only existing buildings have regulations to control their efficiency regarding energy. Indeed, in 2012, the parliament adopted a law for thermal regulation for new buildings. This law is usually known as RT2012 (Ministry of Ecological Transition, 2020). This law has the main objective to divide CO₂ emissions in the building sector by four by 2050. Hence, the norm is based on the "low consumption building" label for which the limit cannot outreach 50 kWh PE/(m².year) (Ministry of Ecological Transition, 2020). Moreover, when designing the building, constructors should take into account the characteristics of the field where the building is built in order to enhance them and limit the need for energy. Besides, for buildings without air conditioning, it should be built so that the temperature does not exceed a threshold that has been set, to limit even more energy consumption (Ministry of Ecological Transition, 2020).

When this law has been adopted, the purpose was that by 2020, buildings could be "positive energy buildings". Hence, decreasing the consumption before being able to produce some. Moreover, in 1974, another thermal regulation had enabled France to divide by two energy consumption of new buildings, the purpose is, therefore, to increase these effects.

1.2.2/ Water, biodiversity and mimicry policies

Biodiversity is also a significant issue in which various policies are implemented. However, it is necessary to define what biodiversity is and its current state in France in order to understand the framework in which these measures are implemented.

Biodiversity is defined as "the variability among living organisms from all sources" (Leveque et al., 2019). This variability thus applies to species, i.e. their diversity within their own populations but also the diversity of different species and ecosystems. We consider the richness of the genes of the same species, the richness of the number of existing species and the diversity of ecosystems. The interaction of all these aspects is also taken into account in this definition (Leveque et al., 2019).

French biodiversity is very rich, statistics led by Leveque in 2018 showed that 81% of European ecosystems were represented within metropolitan France and that two species were found every day by Science in the country, mostly insects and in overseas territories. The large territories France has, on different parts of the planets enables the country to have such diverse biodiversity. This biodiversity is essential for human beings as it is relying on natural resources to survive.

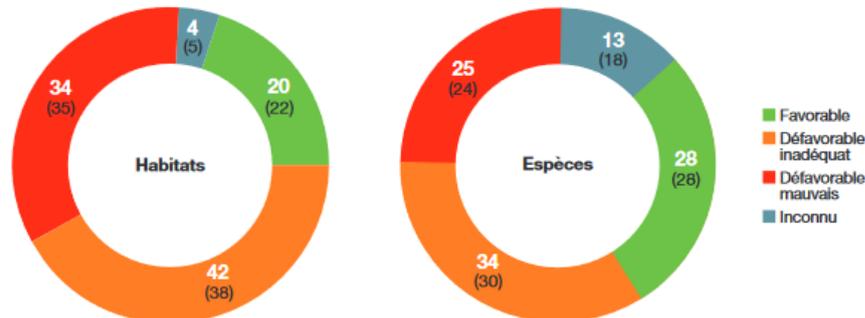
However, biodiversity is endangered at the moment. Indeed, figures show that many habitats are under threat in Europe, 68% of which are found in metropolitan France (Leveque et al., 2018). A similar observation applies to species since 18% of threatened species in Europe are represented on French territory (Leveque et al., 2018).

The Habitats European Directive defined some sites of Community Importance. These sites include some species and habitats which are considered as threatened or rare (Leveque et al., 2018). Therefore, these sites are under measures that are meant to protect them in the long term. Nonetheless, this subject will be a little bit more developed below. France has 132 sites that are fitting this criterion, but overseas territories are not included. Regarding this principle, the study led by Leveque in 2018 used figures of 2014 from the European Commission regarding the state of these sites. It showed that 22% of these sites were considered in a good state, 38% in an inadequate state, which does not mean it is seriously endangered but rather that measures should be taken and 35% in a bad state implying serious danger of extinction. The rest is unknown.

Regarding these sites in a more specific way, another study has been led by the Ministry of Ecological Transition on the period of 2013 to 2018 (Coulmin et al., 2020). Regarding habitats, 20% were in a good state, 42 % in an inadequate state, 24% in a bad state and 4% being

unknown (see fig 1.2.2.A). Regarding species, 28% were in a good state, 34% in an inadequate state and 25% in a bad one (see fig 1.2.2 A).

Graphique 1 : état de conservation des habitats et des espèces d'intérêt communautaire sur la période 2013-2018
En % d'évaluations



Note : (XX) = taux de l'exercice 2007-2012.

Source : UMS PatriNat, 3^e rapportage DHFF, 2019. Traitements : UMS PatriNat et SDES

¹ Les expressions « habitat d'intérêt communautaire » et « espèce d'intérêt communautaire » qualifient respectivement un habitat ou un taxon rare, retenu par l'UE comme patrimonial et méritant une protection spécifique et un suivi particulier, sous la responsabilité subsidiaire des États membres.

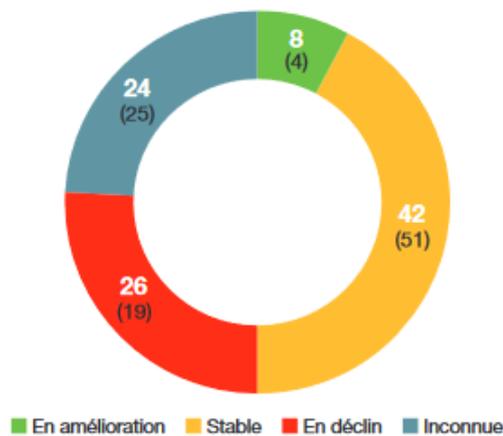
Fig 1.2.2.A: State of conservation of sites designated of Community Importance from 2013 to 2018. Source: Coulmin et al., 2020.

Regarding the state of water, figures are more encouraging as 44,2% are considered in a good state, 39,4% in an average condition, and 16% being in a bad or even mediocre condition, the rest being unknown. The encouraging fact about these figures is that there was an increase of good state watercourse due to preservation or restoration policies (Leveque et al., 2019).

Overall, the Ministry studied the evolution of conservation of sites designated of Community Importance from 2013 to 2018 (Coulmin et al., 2020) showing that 42% had remained stable, 8% had improved, and 26% had declined (see figure 1.2.2.B).

Graphique 2 : tendance d'évolution de l'état de conservation des habitats et des espèces d'intérêt communautaire au cours de la période 2013-2018

En % d'évaluations



Note : (XX) = taux de l'exercice 2007-2012.

Source : UMS PatriNat, 3^e rapportage DHFF, 2019. Traitements : UMS PatriNat et SDES

Fig 1.2.2.B: State evolution of site designated of Community Importance, from 2013 to 2018.

Source: Coulmin et al., 2020.

Overall, these figures show that some improvements have been made on the subject but the figures are not very encouraging, as the degradation keeps on progressing.

Several factors that can explain this loss of biodiversity, the first being the reduction or degradation of the natural environment (Leveque et al., 2019). These are due to the extension of urban areas and permanent cultures. These extensions are known to harm biodiversity as they reduce the number of species and are making the natural habitat of lesser quality. Other factors come into consideration, such as climate change or the increase of “invasive exotic species” (Leveque et al., 2019).

In order to solve these issues, several solutions can be carried out, such as the implementation of strong regulation to protect habitats. This leads to the creation of protected natural parks, for instance (Leveque et al., 2019). This has been done, but other policies have been implemented to act upon these issues, as well.

Policies that are implemented regard the protection, preservation and restoration of habitats. Indeed, most policies that France has implemented are related to the Convention of Rio of 1992. In 1992, the Rio Summit implemented an international convention about the protection

of biodiversity. It was signed by about 193 countries and was known as the first convention that was putting biodiversity as a “common concern of humankind” (Ministry of Ecological Transition, 2018). Therefore, it was implemented to ensure measures towards its protection. It had a very significant impact as a European strategy was set up following this event. This led to directives such as the Habitats Directive mentioned above. One of the measures that were taken is the National Strategy for biodiversity. The presentation of this measure made by the Ministry of Ecological Transition (2018) claims that it is this Summit that is at the origin of policies implemented at an international, European and French level. It also states the objectives to be reached with the convention, namely to ensure the conservation of biodiversity, the sustainable use of natural species and environment, and a fair and equitable sharing of the benefits arising from the use of natural resources (Ministry of Ecological Transition, 2018).

This specific policy of National Strategy for Biodiversity has been implemented within the past decade, after the COP10 (Ministry of Ecological Transition, 2018). The purpose was to ensure the efficient use of natural resources (Ministry of Ecological Transition, 2018). The ambition France had behind this strategy was to ensure that biodiversity could be a part of every single public policy that would be implemented. Several objectives had to be achieved; it was about making people want to act for biodiversity, but also to ensure the preservation of the living and their evolution (Ministry of Ecological Transition, 2019). Another objective was to invest in an “ecological capital”, ensure sustainable and fair use of biodiversity. As mentioned, it was also about ensuring that other public policies would be in line with actions implemented towards biodiversity so that it could be as efficient as possible (Ministry of Ecological Transition, 2019). Finally, this strategy was about increasing the knowledge about the subject and raising awareness towards it (Ministry of Ecological Transition, 2019). In order to implement this strategy, several parties have contributed, institutions, but also citizens (Ministry of Ecological Transition, 2019). It was implemented at different levels so that it could be adapted according to each regional specificity, for instance (Ministry of Ecological Transition, 2019). Several institutions are hired to check the evolution of biodiversity to see if the actions are achieving their goals (Ministry of Ecological Transition, 2019). However, as mentioned above, it has not been successful. The strategy’s timeframe was from 2011 to 2020 and even with the implementation of the “Biodiversity Plan” to support its action, figures

showed a situation going worse, even if some indicators had increased during the timeframe. The 2019 IPBES report showed that this decline and degradation was getting worse (Leveque et al., 2019). Therefore, as the figures are not going in the right directions, new solutions need to be implemented so that the ideals that were named in the Rio's convention can be achieved.

1.2.3/ Circular economy policies

The circular economy is another significant stake for which policies are implemented. The Department of Data and Statistical Studies of the Ministry of Ecological Transition (Magnier et al., 2017) explained in their research about key indicators on circular economy that one of the main political stakes was to go from a linear economy to a circular one. They used ADEME's definition to explain the concept. Hence, it is a concept that appeared in the 1970s and is an economic system within which production and exchange are meant to increase the resources use's efficiency, decrease the impact on the environment and increase citizen's welfare, at every step of the lifecycle of a product or service. When writing the roadmap for the circular economy, the Ministry of Ecological Transition (2019) defined it as an aggregate of better production, better consumption, waste management and people being gathered. Circular economy enhances a productivity gain on resources (Ministry of Ecological Transition, 2019).

Three fields (waste management, supply from economical actors, and demand and behaviours of consumers) and seven pillars are involved to define circular economy (recycling, extraction and sustainable purchasing, eco-design, industrial and territorial ecology, economy of function, increase of use time and sustainable consumption) (see figure 1.2.3).

L'économie circulaire

3 domaines, 7 piliers



Figure 1.2.3: Circular Economy, 3 fields, 7 pillars. Source: ADEME, 2020

Implementing measures to go towards a circular economy could have a significant impact on the amount of waste that is produced in France. Indeed, ADEME (2019) has published a report on the key figures of waste, arguing that in 2017, 326 million tons of waste were produced in France, thus about 4.9 tons per inhabitant. Out of these 326 million, 39 million tons were produced by households, 63 million by companies (which does not include construction and aspects that can be assimilated) and construction accounted for the most part, as it produced 224 million tons. ADEME went further and explained what happened to this waste. Hence, 66% are recycled or backfilled, which is 13% more than ten years before, 28% were eliminated, which is 15% less than ten years before and 6% were used for energy recovery, which is the most significant increase since it represents 59% more than ten years before.

ADEME also highlights the benefits of recycling as they mention that 67% of the paper industry's supply is based on recycled products, 49% for the steel industry and 56% for the glass industry. Another benefit are the 23 million tons of CO₂ avoided through recycling, 11 million oil barrels avoided for energy production and 111 650 direct jobs that are involved.

Within the introduction of the roadmap for the circular economy written by the Ministry of Ecological Transition (2019), some figures are also given. It says that waste recovery is lower than in the neighbouring countries, as the household waste recovery rate was 39% against 65% in Germany and 50% in Belgium. The figures given by the Ministry also show that household waste does not benefit this much from recovery as the figures from ADEME might

lead one to think. Indeed, the 61% remaining are being incinerated or put into landfills. Moreover, household waste is not the only flaw, as this introduction highlights the lack of recycling of plastic, only 20% against 30% in average in the European Union, regarding plastic bottles, Nordic countries are way better as 90% of their bottles are recycled against 55% in France (Ministry of Ecological Transition, 2019).

In this research regarding Greentech as a tool for green growth, Moisan (2011) was pointing out the aspects in which the circular economy had potential but not exploited enough. These aspects regarded selective sorting, recycling, waste recovery, soil decontamination and eco-design.

Hence, France has the potential to do better regarding the circular economy and, many different policies have been implemented to enhance this potential.

The law that can be considered as the most important regarding this matter is the law on the fight against waste and the circular economy that was promulgated on the 10th of February 2020. ADEME has explained the main measures of this law. The first measure is about making consumers aware of the characteristics of what they purchase. Hence, producers and importers are legally obliged to inform their consumers -if their product generates waste- about their environmental characteristics such as recycled materials, how to fix them, etc. and some specificities for some specific products (such as phones, electrical products or furniture). The second main measure is about tackling waste (e.g. recycling of non-food waste that was not sold, or incentives for reuse.) The third measure is to decrease the environmental impact of plastic (e.g. no disposable plastic products allowed). Finally, the fourth main measure is about making producers responsible through incentives to eco-design, having a certain amount of recycled material etc.

Nonetheless, this law is not the only policy that has been led for a circular economy. N. Hulot (former Ministry of Ecological Transition) and B. Poirson (former Secretary of State of the Ministry of Ecological Transition) had launched in 2017 the works on a roadmap in order to reach the goals set by the United Nation within its 2030 agenda for sustainable development (Ministry of Ecological Transition, 2019). This roadmap, that has been mentioned above is the result of four workshops which have been created to find solutions on circular economy, one on territories, the second on plastics, the third on sustainable consumption and production

and the fourth one on economical instruments. Moreover, an online platform has been set to collect the opinion of citizens on the matter (Ministry of Ecological Transition, 2019). This roadmap has been published in 2019 and is giving many tips on how to act for a circular economy. There are several purposes attached to this roadmap, a decrease of consumption, better recovery of waste, decrease greenhouse gases and create jobs. To be more specific, the objectives that have been set are:

- to decrease resources consumption, in relation to GDP by 30%, by 2030,
- to decrease by 50% the amount of waste put in landfills, by 2025,
- to have about 100% of the plastic recycled by 2025 which could lead to saving 8 million tons of CO₂ emissions every year and finally,
- to generate about 300 000 new jobs in the sector which would be local, could not be relocated and have a long-term vision.

This roadmap should enable the country to have a more sustainable production and consumption so that in the long term, its ecological footprint can decrease significantly. This roadmap is used as a tool for the National Climate Plan set by the government (Ministry of Ecological Transition, 2019).

The circular economy is also at stake in other laws for different aspects such as sustainable and efficient natural resources consumption in the law for energy transition for green growth. This law also encourages waste prevention or at least waste recovery, even though it had been the case since the 1975 law on waste. Finally, one of the stakes of the national strategy for the ecological transition towards sustainable development that was applied between 2015 and 2020, was to create an economic system that limits resources extraction and pollutants emissions.

Moreover, in order to follow this purpose, several labels have been implemented but will be described more thoroughly within the parts regarding the actions of the Greentech Innovation labelled companies.

1.2.4/ Renewable energy and energy efficiency policies

Energy is another major stake regarding the policies led for sustainable development. Indeed, energy transition includes, energy-saving and renewable energy, among other aspects that have been, or will be treated as the main policies led by the Ministry of Ecological Transition. These aspects are energy retrofit, circular economy, and sustainable transport. Hence, energy deals with many different matters, however, this part cannot cover all of them, so it will be mostly about the main aspects that come to mind when thinking about sustainable energy, namely energy savings and renewable energy. Nonetheless, it is crucial to understand the stakes around energy in order to apprehend the policies that are implemented.

Energy serves many needs and is an essential element for a society's development (Edenhofer et al., 2011). However, since the 1850s, the main source of energy is fossil fuels, which has increased carbon dioxide emissions significantly. The IPCC report on *Renewable Energy Sources and Climate Change Mitigation* (2011) argued that 56,6% of global anthropogenic greenhouse gas concentration was due to fossil fuels consumption. It also argues that this concentration is responsible for increasing average temperature. According to this report, the amount of CO₂ concentrations continues growing; it claims that by the end of 2010, the amount was 39% higher than before industrialization. Indeed, in 2011, fossil fuels combustion represented 85% of the global primary energy. Moreover, this report also shows that a significant increase in energy demand will occur and it is important to implement strong policies in order to limit any more damages on climate change. Hence, implementing energy conservation/saving and renewable energy policies are one way to act upon these issues. The potential of renewable energy is significantly high, IPCC report (2011) showed that it has more potential than any source of energy that is used at the moment and could sustain our current and future economies if they are fully developed, solar energy having the most potential of all kinds of renewable energy.

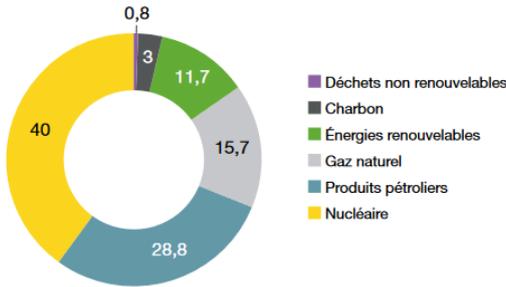
Renewable energies are very diverse; they may come from the wind, water, sun, heat of the ground, wood, waste, plants or biomass (Phan et al., 2020). They come from natural processes and are not exhaustible as they are perpetually renewed.

In 2019, The Department of Data and Statistical Studies of the Ministry of Ecological Transition found that renewable energy represented 11,7% of primary energy consumption, and 17,2% of the gross final energy consumption. It has grown significantly since the beginning of this century. Indeed, in 2009, the primary energy consumption of renewable energy only represented 7,8%, and the gross final energy consumption has increased of 8 points since 2005. Therefore, in 2019, renewable energy was on the fourth position regarding energy consumption, the first one being nuclear energy (representing 40% of the consumption), the second being oil products (29%) and the third one natural gas (16%) (see figure 1.2.4.A).

CONSOMMATION D'ÉNERGIE PRIMAIRE PAR TYPE D'ÉNERGIE EN 2019

TOTAL : 2893 TWh, dont 339 TWh pour les énergies renouvelables

En % (données corrigées des variations climatiques)



Source : calculs SDES

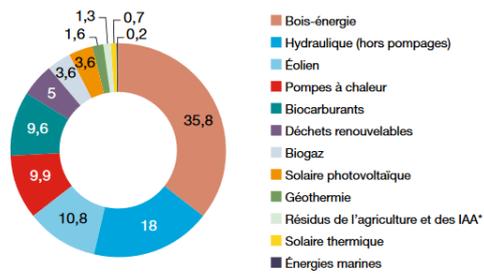
Fig 1.2.4.A: Primary energy consumption by type of energy in 2019. Source: Department of Data and Statistical Studies of the Ministry of Ecological Transition. Source: Phan et al., 2020

Production has also increased over the years, 72% more energy is produced through renewable energy than in 2005 (Phan et al., 2020). However, this increase is not as high as consumption. The importation of biofuel and wood-energy can explain this gap. However, this latter is the most produced energy (35,8%) with hydraulic power (18%) (see figure 1.2.4.B). This figure makes France, one of the main hydraulic power producers of the European Union (Phan et al., 2020). However, other kinds of renewable energy are being developed, which explains this significant increase, it is particularly the case for wind power (21% increase since 2018), heat pumps and biofuels, they all together represent 30% of the primary energy production (Phan et al., 2020).

PRODUCTION PRIMAIRE D'ÉNERGIES RENOUVELABLES PAR FILIÈRE EN 2019

TOTAL : 320 TWh

En %



* IAA : industries agroalimentaires.

Source : calculs SDES

Fig 1.2.4.B: Primary production of renewable energy by sector in 2019. Source: Department of Data and Statistical Studies of the Ministry of Ecological Transition. Source: Phan et al., 2020

In order to get better results, ensuring energy efficiency can enable the country to reduce its consumption of fossil fuel energy and use more easily renewable energy. Hence, the department of data and statistical studies of the Ministry of ecological transition showed that in 2018, primary energy production was increasing while primary energy consumption was slightly decreasing and was stable when climate-corrected.

Moreover, in the period 2014-2018, 322Twh of energy savings were made through the implementation of Certificate of Energy Savings (Certificat d'Economie d'Énergie, CEE, in French) (Ministry of Ecological Transition, 2020). These certificates take different forms such as subsidised loans, bonuses or free diagnosis for energy-saving measures; they are an incentive for taking measures regarding this matter. These savings represent 88% of the savings that have to be done until 2020, according to a major European Union's directive on energy's efficiency (Ministry of Ecological Transition, 2020). Indeed, the purpose is to get to consumption of 219,9 Mtoe of primary energy in 2020, in 2018, it was representing 235,1 Mtoe (Ministry of Ecological Transition, 2020).

The directive has led to many initiatives regarding energy efficiency. Hence, the figures mentioned above are, for the most part, the result of policies to enhance renewable energy production and consumption, and energy savings. Indeed, regarding renewable energy, the European Union has set a directive that promotes the use of these energies and sets a target of 32% of gross final energy consumption by 2030. In order to follow that directive, France has

set the objective to reach 23% by 2020 and 33% by 2030. This latter has been implemented as a set objective within the energy and climate law of 2019.

However, in order to achieve these objectives, several actions have been implemented, money set in research and development, tax cuts to promote its use and tax increases for the use of fossil fuel (Phan et al., 2020). Indeed, in 2018, France has given 126 million euros on R&D, mostly on solar energy (41% of the expense) and biomass (39%). Renewable energy represented 11% of the public investment made on R&D regarding energy.

Overall, the investment made by the state in 2017 on renewable energy represented 8 billion euros, for which 5 billion were used to implement them concretely. Most investments were targeted on onshore wind turbine strings (28%), heat pumps, photovoltaic and wood-energy (Phan et al., 2020). These investments have been progressing these past few years; they increased from 7,5 billion euros in 2016 to 8,6 billion in 2017 (+14%) and 8,8 billion in 2018 (+2%) (Ademe, 2020).

Moreover, the directive mentioned above has led to several laws, one of them has the purpose of decreasing by 40% the use of fossil fuels by 2030, compared to its rate in 2012 (Ministry of Ecological Transition). This will enhance the use of renewable energy and force decisions regarding energy savings. In order to achieve this purpose, several measures have been included within this law, such as reinforcing Certificate of Energy Savings (Ministry of Ecological Transition, 2020). However, most measures were implemented when the first law applying the directive was voted. Indeed, this law was about obligating energy sellers to do energy savings through having CEE, promoting energy savings to their clients, whomever they are (citizens, municipalities or companies). This law also ensured to finance energy retrofit or to make it easier.

Finally, more than having a positive impact on climate, renewable energy has enabled France to create jobs, as in 2018, this sector was employing 90 120 people on a full time, which is 14% more than in 2016. Besides, these jobs are located in France and cannot be delocalised.

1.2.5/ Sustainable digital transformation policies

This part will describe sustainable transformation policies. However, in order to understand what is at stake, it is essential to know that sustainable digital transformation applies to different aspects. First, this transformation should ensure sufficient use, namely that these technologies should be built under several constraints that are not harming the environment (Blandin-Obernesser, 2020). Indeed, the production of software and hardware have an impact on the environment that is extremely high. However, it is not only the production but the whole life cycle of digital technologies that are relevant within this subject. Authors tend to have difficulty in proving the exact impact of digital technologies; therefore, different figures are given regarding the impact on CO₂ emissions. Indeed, according to the European Commission, digital technologies are responsible for 2% of the global CO₂ emissions while the Shift Project gives even more alarmist figures as they argue that it is responsible for 3,7 to 4,3% of the global emissions (Blandin-Obernesser, 2020). According to a study based on LCA methodology, done in 2019 (Bordage), digital technology has a massive impact in the world, on primary energy consumption (4,2%), greenhouse gas emission (3,8%) water consumption (0,2%) and electricity consumption (5,5%). The European Commission claims that electricity consumption represents even more as they are arguing for higher figures, between 5 and 9% of the global electricity consumption. The study led by Bordage (2019) claims that electricity consumption does not usually fit as a relevant environmental indicator, however, the high supply it requires, makes it important to mention within the study of the digital world. This study specifies that digital technologies could represent a country due to the amount they represent. Besides, if they were actually a country, their footprint would be 2 to 3 times higher than France's one (Bordage, 2019). This study shows that the worst phase, regarding LCA's criteria is the use phase, except for what they call traditional equipment (which represents most of the digital world) for which manufacturing (Bordage, 2019) has the greatest impact regarding energy. Moreover, it is explained that the most impact comes from production (extraction of raw materials and transformation in digital components), especially when it comes to the user equipment production. This production has a more significant impact than network or data centres, especially if the electricity consumption is considered (Bordage, 2019).

However, ADEME studied more thoroughly the subject comparing different reports on the matter, and their findings showed that a lack of knowledge regarding the global impact of the

digital world and that the impact that was the most well-known was during the use phase (ADEME, 2016). Therefore, most results would find impacts regarding energy consumption and GHG emissions. However, they explained that the hypotheses made by the researchers could highly influence the results. Hence, they analysed other impacts on different stages of the digital world's life cycle. They still found that the use phase was having an impact on GHG emissions and energy consumption, but they also studied other aspects. Therefore, they found very high consumption of non-renewable natural resources during manufacture (ADEME, 2016). Regarding the end of life phase, ADEME also found that it was tough to have a proper end of life for these devices. Hence, less than 50% of French WEEE is recycled according to specific rules, and only 15,5% in the world. The roadmap written by Blandin-Obernesser (2020) estimates that in 2021, 52 billion tons of WEEE should be generated, while it was 45 million tons in 2016. Moreover, ADEME and Blandin-Obernesser agree regarding the fact that it is difficult to recycle in appropriately this waste. Most of them are not, only the plastic parts but the extraction of metals and minerals is difficult so they are either burnt, thrown to landfill or treated in an illegal manner which leads to the "emission of persistent organic pollutants and non-degradable and bio-accumulative heavy metals" (Ademe, 2016). Nonetheless, the impact of the end of life phase is not easy to find as ADEME claims that no study has used a proper and realist model to analyse this phase yet.

Therefore, measures should be taken in order to make production, use, transport and the end of life of this product more sustainable. The stake is high and is growing since the needs for these technologies are growing as well. However, the rate of production of these devices has slowed down compared to the rate it had between 2000 and 2015, stabilising to an estimated 50% increase for 2015 to 2025, which is still an important increase. Moreover, the number of devices makes it a very significant stake since the figures mentioned above are mostly due to their quantity (Bordage, 2019). Indeed, 34 billion digital technologies existed in 2019 (Bordage, 2019). It is a very important figure, showing the growing importance of these technologies within our daily lives. It is because there are many devices that we need to consider other ways of production, use and end of life. Stakes around the environment and technologies should be intertwined in order to meet both needs, a greater use of technologies that is not harming the environment.

However, digital transformation is not simply about decreasing the life cycle of these technologies. Digital transformation is also seen as a tool that could serve changes towards sustainable development goals. ADEME that have been mentioned above worked on a report to see how digital technologies could contribute to the reduction of environmental impacts (2016). Their findings are moderate. They found that it could have an impact on several sectors such as buildings and manufacturing, but transport and energy are the sectors where there is the most potential. The hypothesis was to say that by using smart systems, 15% of CO₂ emissions could decrease compared to 2002's practices.

ADEME (2016) explains that the impact these technologies can have depends on how they are used. They give the example of a development of new economic models which, depending on how these technologies are used, could lead to either efficiency logics or "hyper-consumption".

Moreover, when digital tools are used, the main issue that can be encountered is pollution transfers, even if it seems that emissions benefit more of digital technologies than when they are not used, according to different hypotheses (ADEME, 2016). Taking different examples such as e-commerce, working remotely or dematerialization, most indicators are decreasing regarding the impact, even though the conclusion remains moderate, especially regarding dematerialization (ADEME, 2016).

Rebound effects seem to be the most threatening aspect of the use of digital technologies. ADEME used the example of energy efficiency that could increase energy consumption in the long term, which would therefore increase GHG emissions.

However, despite the studies that have been reported above, there is still a lack of data regarding the digital world. Indeed, some methodologies mistakes have been highlighted by ADEME (2016) on reports regarding the subject. Its impact is still not very well known and, much work has to be done on the subject, which is increasing the difficulties regarding the implementation of truly sustainable measures on the matter. Therefore, some recommendations are made. The policies implemented cannot, in this context, fully respond to the issues behind the digital revolution, as there are so many uncertainties. However, the implementation of measures on the known aspects could, in the long term, lead to specific improvements in favour of the ecological transition. According to the logic that is followed,

implementing digital solutions could actually have positive repercussions on decreasing several environmental impacts.

The issues surrounding digital technology are becoming increasingly relevant since it is nowadays a question of digital transformation. This transformation is partly linked to the health crisis facing humanity. This is a recent argument but one that has taken an essential place in the reflection on changes in behaviour and the use of digital technology. On the other hand, because the development of these technologies makes it possible to respond to new needs and potential for change involving a simplification of practices has been found in the use of digital technology. Thus, since the digital transformation is a major challenge for public policies, it is clear that it is essential to develop more sustainable practices around this issue.

That is why a roadmap has been published in July 2020 (Blandin-Obernesser), and this initiative is aiming at advising on what should be done towards digitalisation in order to make it fit with sustainable development goals. This initiative has been led by the “Haut conseil pour le Climat” and the “Conseil national du numérique”. Implementing such a roadmap enables to respond to the European Commission’s objective which has signed a Green Pact for which digital transformation is a significant part (Blandin-Obernesser, 2020). Moreover, another reason why this roadmap has been written is that it could contribute to reaching the 17 sustainable development goals of the UN.

This roadmap has set 3 objectives: reducing the digital environmental footprint (0 emission without any compensation by 2030) through eco-design methodology, using digital technologies to serve ecological transition and creating an efficient toolbox that could help this ecological transition.

A great deal of work is underway at both national and European level. The digital world is integrated into many laws (such as those relating to the circular economy) and the subjects between the environment and the digital world are becoming increasingly similar in political terms.

A responsible digital charter has also been implemented so that different actors from different sectors (public actor, company or association) can engage in more sustainable use or conception of digital technologies through self-evaluation with objectives of improvement.

This charter can be applied to their stakeholders as well, increasing its impact (Institut du Numérique Responsable, 2020).

Another example is the fact that the Minister for Ecological Transition and the Secretary of State for Digital Affairs opened together the Meet'Up Greentech 2020, showing their desire to make digital technology a tool for ecological transition. Therefore, it could become a tool for the policies mentioned above and below.

1.2.6/ Risk prevention policies

France is, as any country, exposed to different kinds of risks. As it is something that could happen anytime, preventing the risks and managing the ways it happens, helps reduce the damages it can have. Managing risks is about both technological risks and natural risks. Both risks are different and come from different aspects. Technological risks are linked to human activities regarding the lifestyle (nuclear energy use), malpractices (soil acidification), accidents (hydrocarbon leaks) or wrongful uses (phytosanitary products) (Dagorgne, 2005). While natural risks can be linked to human activities as well, it is the intensity of these risks that is increasing due to the activities. Indeed, natural risks are very linked to climate change stakes. This is why, for pragmatic reasons, this part will be more focused on this aspect. Indeed, as climate change effects intensify, natural risks do as well. Indeed, the report written by the IPCC in 2014 (Kovats et al.), showed that more and more systematic failures would occur in Europe due to climate change. The natural risks France can encounter are diverse and unequal according to the geographical regions. More than 2 out of 3 cities in France are exposed to at least one risk (Ministry of Ecological Transition, 2016).

The main risk that can be found in France is flooding. Indeed, it is the risk that causes the most damage and applies to a large number of cities. (Georisques, 2020) Indeed, according to the report on the prevention of major risks by the Ministry of Ecological Transition, published in 2016, no less than one in four French people may be exposed to flooding, and one in three jobs, and this is a risk that involves high economic costs. Moreover, the IPCC report of 2014, showed that the increase of sea level will have a large impact on this risk even though adaptation measures can mitigate this risk. However, Georisques, a platform giving data on risks, does not exclude zones that are not coastal (rivers included), as it explains that the whole

territory is subject to this risk since floods come from multiple sources such as rainfall or even groundwater.

The second risk that France may encounter is an earthquake. This is the most feared risk because it represents the risk that can cause the most victims (Ministry of Ecological Transition, 2016). It is in the Antilles that this risk is most feared, even though earthquakes regularly occur in metropolitan France and the overseas territories. Indeed, their intensity is relatively low in these other territories, reducing the fear of damage. Recently, the most striking earthquake was the one that took place in 2019 in Teil, which showed the dangers of collapsing or damaging buildings (Georisques, 2020). Even though it is one of the most potentially dangerous risks, it is one of the few risks that is not connected to climate change issues (Ministry of Ecological Transition, 2016).

Then, there is a risk of volcanic eruption. It is considered a major risk since it can have very severe damages, it is not easy to predict and a lot of population and equipment can be nearby and be affected by the eruption. Moreover, the fact that a volcano can be resting for a more or less long time makes risk management harder even though some eruptions may have consequences in the long term (Georisques, 2020).

Ground movements are another risk that France faces every year. These are diverse: landslides, collapses, mudslides etc. and their intensity also varies. This intensity also affects the damage caused, both from an economic and social point of view. It is a complicated phenomenon to study due to its multiplicity of factors (Géorisques, 2020). The increasing frequency of landslides seems to be linked with climate change and will likely increase in the future. These ground movements are moreover linked to another risk France is facing, avalanches.

Then, forest fires are an increasing risk due to climate change. They have different origins such as air, water and soil pollution. Increase in heat waves phenomenon may have an impact on forest ecosystems (Géorisques, 2020). Moreover, hot and dry periods have had an impact on the severity of forest fires (Kovats et al., 2014).

Storms have increased in Europe as well, increasing the damages it can cause. However, there is no proof that it is due to anthropogenic climate change yet (Kovats et al., 2014). In Europe, another risk that France is facing, seems to not be linked to climate change is cyclones.

Risks are therefore numerous and most of them are linked to climate change, however their intensity and frequency is very diverse. Nonetheless, the same principles apply when it comes to managing these risks. Indeed, when implementing a risk management strategy, it should be done with a long-term vision, since climate change effects are the most common cause for these increasing risks, their intensity and frequency is more likely to increase overtime. Hence a long-term vision is necessary (Mortureux, 2017). Mortureux, Director General of the General Direction of Risk Prevention in the Ministry of Ecological Transition, wrote a report on the subject and explained that identifying precisely the risks can help controlling risks and their consequences. The report on the prevention of major risks by the Ministry of Ecological Transition (2016) is explaining clearly the meaning of risk management. It argues that citizens should be involved through information so that can be part of this risk management. Moreover, this report sets out seven principles to make risk prevention effective.

The first principle is that it is very important to develop a knowledge regarding the risk, namely to know what happened in the past, to search some mechanisms, to search how a phenomenon is behaving, its frequency and intensity so that in the end, it becomes possible to know when these risks may occur. The second principle is to monitor the phenomenon through meteorological, geophysical or hydrological methods. The third principle is to inform the population as much as possible by making documents available on risks and their consequences. A law has come into effect, following this principle, since from now on, any tenant or buyer of a property must be informed of the potential risks associated with that property. The fourth principle is to integrate risks within development planning and urbanism. This principle has been applied through the plans for the prevention of foreseeable major natural risks (PPRN in French) (see figure 1.2.6), that have been included within Local Urban Plan (PLU in French). The purpose is to ensure that zones that are considered as risky do not become riskier, or when possible to diminish the risk. The fifth principle is to decrease the damages of a risk, through training. Indeed, the more architects and municipalities are trained on taking risks into account, the less damages can be done. The sixth principle is to be prepared if a crisis occurs. This implies to prepare the means that could help the population.

Finally, the last principle is when a crisis has occurred, it is important to analyse what happened so that it can be even managed in a better way in the future.

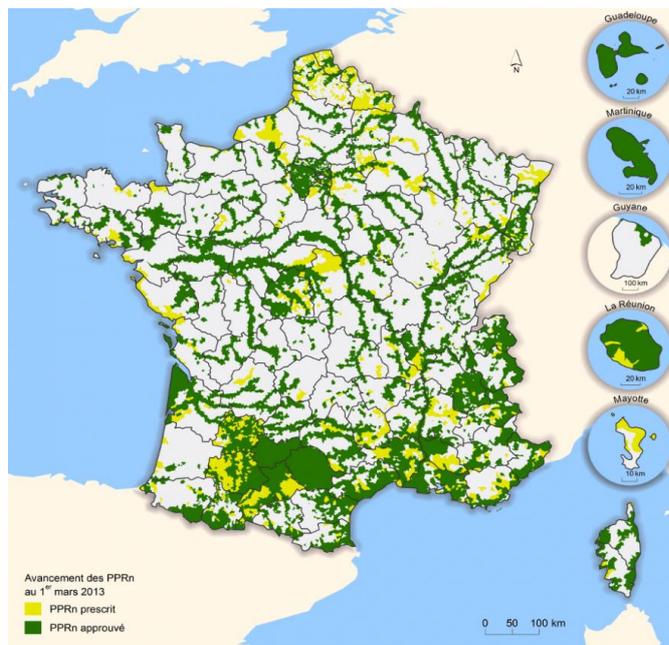


Fig 1.2.6: State of progress of natural risk prevention plans. Source: Ministry of Ecological Transition, 2016

Implementing these prevention policies has helped several countries in Europe regarding the flooding risks. Indeed, climate change effects will force people to adapt to the risks. It is an even more important stake within urban areas where there is a high concentration of people and buildings, which makes them more vulnerable to the risks (Kovats et al., 2014)

Several actions have been implemented on a political level to ensure a good risk management. Indeed, Dagorgne (2005), summarizes it through the implementation of regulatory measures, technical measures and research.

In order to increase the awareness towards risks, several platforms have been created. The most well-known one is G eorisques, which has been mentioned above. The purpose of this platform is to give the ability to citizens to be informed about the risks surrounding them, giving information to as many people as possible (Mortureux, 2017). Moreover, a Natural Risk Observatory has been created in 2012 through a convention that has been renewed every three years since then. The purpose of this observatory is to increase knowledge about risks to help risk management at a political level, increasing risk culture (Mortureux, 2017).

Hackathons and calls for proposals have been launched to encourage the taking into account of risks in development planning. It has been also done so that more data can be open to the public, increasing the strategies for this matter (Mortureux, 2017).

Risk management policies are diverse and their importance continues to increase with the climate issues linked to them. New solutions will need to be found so that damages can be as low as possible in the future.

1.2.7/ Health and Environmental Policies

The health and environment topic is a very vast subject, as most of the topics mentioned above, therefore as it is not possible to cover every aspect that goes within this part, it will be focused on the phytosanitary issue.

France is the leading consumer of phytosanitary products at the European level, and the third largest in the world behind the United States and China (Zhang et al., 2011). Limiting the use of these products represents a major challenge both for its effects on the environment and on health. However, limitation remains difficult because of the economic advantages of these substances, they make harvests safer and have thus made farmers who used them largely dependent on them. Therefore, a switch to organic farming requires that farmers be given the means to limit their losses. The recent example of the reintroduction of Neonicotinoids showed the difficulty this shows how difficult it is to reconcile health and environmental issues with economic issues.

However, in spite of these still very topical issues, objectives of decreasing the use of phytosanitary products remains a stake for which the Ministry of Ecological Transition needs to act upon.

Hence, in 2007, during the Grenelle Environment Forum, France set itself the objective of reducing its use of pesticides by 50% in 10 years (Urruty, 2015 and Ministry of Agriculture, 2015). In 2008, the national Ecophyto plan was set up to meet this objective. This plan complies with European directive 2009/128/EC. Despite the efforts made, the objective was not achieved and the plan was therefore updated in 2015 (Ecophyto II) and then reinforced in 2018 (Ecophyto II+). In fact, strengthening this initiative seemed essential, since

the "NOmbre de Doses d'Unité" (NODU) indicator, chosen to monitor progress in the use of phytosanitary products, has not yet shown any positive effect over the last ten years (Pingault et al., 2009).

This plan initiates to "reduce the use of phytopharmaceutical products" (commonly known as phytosanitary products) "by 50% by 2025 and to phase out glyphosate by 2020 for the main uses and by 2022 at the latest for all uses" (Ministry of Agriculture, 2020).

The data used in France to account for the use of plant protection products come from a database: the national bank of sales of phytosanitary products by approved distributors (Banque Nationale des Ventes de produits phytopharmaceutiques par les distributeurs agréés : BNV-d). This database records the sales of these products in France by department. These data are available for diffuse pollution charges (OFB, 2020).

This database was thus able to show a drop in sales in 2017, establishing the number of substances sold at 70,000 tonnes. However, a significant increase was noted in 2018. This was due to the implementation of an increase in the charge for diffuse pollution for substances deemed to be of "concern". Thus, in order to anticipate the rise in prices, some farmers have taken the decision to buy these products in advance, at the same time increasing the number of sales and purchases of these products (Ministry of Ecological Transition, et al., 2020).

Moreover, in order to avoid certain inconveniences, some border farmers tend to buy their substances abroad. Nevertheless, they are obliged to communicate these purchases in the same way as substances purchased in France because of diffuse pollution charges. Nevertheless, communications concerning these border purchases are not published in open data as is the case for French purchases and sales.

However, despite the difficulties identified in reducing the sales of phytosanitary products in general, a drop in the sale of products of concern has been observed (-15% for CMR 1 between 2009 and 2011 and -9% for CMR 2 between 2016 and 2018). This is due, on the one hand, to the increase in taxes on these products and, on the other hand, to their withdrawal from the European market. There were 38 substances of concern withdrawn from the market between 2018 and 2019 (Ministry of Ecological Transition et al., 2020). This reduction seems necessary since the fact sheet on pesticides in the State of the Environment reports established that 20% of the substances sold in 2017 were considered toxic (REE, 2019).

Thus, the legislation in place aims to achieve a less pesticide-dependent agriculture, which would meet sustainable development objectives.

Reducing the use of these pesticides responds to human health issues as well as environmental issues.

Concerning the effect on the environment, the use of pesticides affects different aspects. Indeed, there are four different mechanisms for the diffusion of these substances: adsorption, volatilisation, leaching and infiltration (REE, 2019). This diffusion will act particularly on water and soil, and soil degradation and water contamination can be observed. However, the effects on air are still very poorly known at the moment, but potential effects are not to be neglected.

Indeed, in the case of soil, pesticides tend to disperse beyond the plants that are treated because of phenolics.

Wind can also transport them, and rain also acts on soil contamination by allowing pesticides to infiltrate the soil (Vadillo, 2018). Some substances are very persistent, since one of them, lindane, is still found in metropolitan French soils. However, it was banned in 1988 because of its toxicity to humans and the environment. Soil degradation in areas of intensive agriculture can reinforce the phenomenon of persistence in soils of this type of substance.

On the other hand, rainfall leads to water contamination phenomena, pesticides are washed away by the rains and thus reach continental waters (Vadillo, 2018).

In some cases, there is infiltration of pesticides into groundwater. This infiltration into the water table is all the more of a problem since these waters renew themselves only very little and in the case of persistent substances their degradation is low, which can lead to contamination over several decades (REE, 2019). Thus, 80% of the groundwater monitoring networks have revealed the presence of pesticides at least once, and almost one out of two times this presence represented a concentration higher than the standard set by the decree of 11/01/07 relating to quality limits and references for raw water and water intended for human consumption (above 0.1µg/l) (REE, 2019).

Regarding watercourses, the movement of pesticides in water leads to making them non-potable (20% of French watercourses) since the concentration rate of pesticides is higher than the standard (Vadillo, 2018). Even when concentrations are not above the norm, their

presence remains problematic since they are very frequent. Indeed, analyses of 23 million samples were carried out between 2014 and 2016 in rivers and lakes in metropolitan France. These analyses revealed an almost systematic presence of pesticides (REE, 2019).

Regarding the effect on health, the dispersal capacity of pesticides affects human health, especially the crop workers who use them. The use of pesticides can have repercussions on the skin with an allergenic effect but also respiratory problems. Chronic illnesses have been diagnosed in exposed professionals. (Baldi et al., 2013). The pathologies studied are "neurological illnesses and disorders, impairment of the reproductive function, alterations in development as well as cancers" (Baldi et al., 2013).

The effects on the non-agricultural population are more difficult to highlight, as they are still poorly known.

These figures show how great of an issue phytosanitary product remain, and that there is still a need to find new solutions to act upon it. Many policies have been implemented but the results are not there yet, which is why the Ministry is also encouraging innovation on this specific topic.

1.2.8/ Sustainable Transport policies

In France, transport is responsible for 31% of greenhouse gas (GHG) emissions and 40% of carbon dioxide (CO₂) emissions (Commission des comptes des transports de la nation. 2019).

Transport is responsible for various negative externalities. Road transport, in particular, has an effect on the emission of various pollutants, road accidents, noise pollution and the natural environment.

The Aphekom project, from 2011, furthermore revealed that living near road traffic "significantly increases morbidity due to air pollution" (ADEME, 2016). Diesel engine exhaust effluents were classified as carcinogenic by the WHO in 2012 (ADEME, 2016).

In 2013, the WHO also characterised outdoor air pollution and particles in outdoor air as carcinogenic (ADEME, 2016) in a more general way.

94% of greenhouse gas emissions from transport are related to road transport. These emissions do not take into account vehicle manufacturing or even infrastructure. These are emissions linked to the transport of people and goods on French territory only (Commission des comptes des transports de la nation. 2019).

Among the greenhouse gas emissions linked to transport, 52% are linked to private cars (Commission des comptes des transports de la nation. 2019).

However, road transport is responsible for the emission of various pollutants, and it is estimated that it emits between 40 and 100% of the majority of transport emissions (Commission des comptes des transports de la nation. 2019).

Road transport is the main emitter of nitrogen oxide (NO_x), copper (Cu), zinc (Zn) and lead (Pb) in all sectors (Commission des comptes des transports de la nation. 2019).

On the other hand, the energy mode used for vehicles has a major impact on the type of pollutant emissions. In fact, petrol vehicles, which account for about 25% of vehicle-kilometre traffic, are responsible for 75% of carbon monoxide (CO) and non-methane volatile organic compound (NMVOC) emissions. Diesel contributes nearly 90% of the emissions of nitrogen oxide (NO_x), dioxins and furans (PCDD-F), polycyclic aromatic hydrocarbons (PAHs) and particles with a diameter of less than 10µm (Commission des comptes des transports de la nation. 2019).

Furthermore, when measured in vehicle-km, diesel is responsible for 83% of greenhouse gas emissions from road transport (Commission des comptes des transports de la nation. 2019). Thus, in 2018, passenger cars emitted 71.3Mt CO₂e (-3.1% compared to 2017), light commercial vehicles (transporting people and/or goods) emitted 25.6Mt CO₂e (i.e. 38% more GHGs than in 1990), while heavy goods vehicles emitted 30.4Mt CO₂e (+3.6% compared to 2017) (Commission des comptes des transports de la nation. 2019).

For the latter, since 1990, the level of GHGs linked to their traffic has increased by 6%, while at the same time the goods transported (measured in tonnes.km) have increased by 56% (Commission des comptes des transports de la nation. 2019). Moreover, their average loading rate in 2018 has increased by 2% compared to 2014. However, it should be noted that 39% of goods transported on French territory are transported by foreign vehicles (Commission des comptes des transports de la nation. 2019).

These figures may of course change as the consumption of non-oil products increases, but in 2017 it increased 1.7% less quickly than the consumption of oil fuel (2.1%). Gas consumption, for its part, has increased by 29.8%, reaching 0.2% of the energy consumed (Commission des comptes des transports de la nation. 2019).

However, some improvements can be found. In 2018, greenhouse gas emissions decreased by 1.6% compared to 2017(Commission des comptes des transports de la nation. 2019). This is due to:

- A decrease in the unit consumption of light vehicles and heavy goods vehicles;
- A stagnation of private car traffic;
- A slowdown in road freight transport.

In addition, concerning carbon monoxide (CO) and benzene, European regulations have been put in place and the levels set have been respected, as they have decreased and remain low. The decrease in benzene is explained in particular by the reduction of this product in petrol as well as by the renewal of the car fleet which contains fewer petrol vehicles (Commission des comptes des transports de la nation. 2019).

Despite an increase in traffic over the period 1990-2017 (about 44%), the energy performance of vehicles has however clearly improved (Commission des comptes des transports de la nation. 2019).

Over the same period, nitrogen oxide (NO_x) emissions have decreased by 60%, carbon monoxide (CO) and non-methane volatile organic compound (NMVOC) emissions have decreased by more than 90%. This 90% decrease is mainly due to the gradual introduction of catalytic converters and the renewal of the vehicle fleet and thus the increase in the share of vehicles (Commission des comptes des transports de la nation. 2019).

On the other hand, an improvement in air quality near road traffic was detected between 2000 and 2017. A decrease in particles with a diameter of less than 10µm was observed (Commission des comptes des transports de la nation. 2019).

Despite these improvements, air quality remains an externality with very important consequences in several aspects.

Firstly, the most important negative externality in terms of quantity is the emission of nitrogen dioxide (NO₂). The annual concentration of this is twice as high near traffic as at the urban background (Commission des comptes des transports de la nation. 2019).

Furthermore, although a decrease in the quantity of nitrogen dioxide emissions can be observed since 2000, in 30% of the measuring stations located close to traffic, the threshold set by the European standard for long-term health protection is exceeded (Commission des comptes des transports de la nation. 2019).

On the other hand, in 2017, the regulatory threshold for particulate matter was not met in 3.8% of measuring stations located close to road traffic (Commission des comptes des transports de la nation. 2019).

It should also be noted that the finer the particles, the greater the share of responsibility of road transport. Indeed, exhaust emissions, road wear and tear and certain vehicle parts are responsible for the emission of certain particles. Thus, road transport contributes 12.1% of emissions of suspended particles of all sizes, 13% of particles with a diameter of less than 1µm and 14% of particles with a diameter of less than 2.5µm (Commission des comptes des transports de la nation. 2019).

However, emissions are very diverse and cannot be reduced to particles. Transport is also responsible for between 12.1 and 25.8% of emissions of carbon monoxide (CO), polycyclic aromatic hydrocarbons (PAHs), cadmium (Cd), dioxins and furans (PCDD-F) and arsenic (As) (Commission des comptes des transports de la nation. 2019).

Between 1990 and 2018, transport-related greenhouse gases increased by 10%. Indeed, in 1990, 23% of greenhouse gas emissions were transport-related, compared to 31% in 2018. The increase in these emissions has been gradual, about 0.3% per year. Nevertheless, during this period, the overall French GHG emissions decreased by 19% (Commission des comptes des transports de la nation. 2019).

Moreover, over the period 1990-2017, emissions of copper (Cu), chromium (Cr), arsenic (As), zinc (Zn), polycyclic aromatic hydrocarbons (PAHs) and dioxins and furans (PCDD-F) increased. This increase is linked to the increase in traffic in the case of copper. However, PAH and PCDD-F emissions have decreased in recent years (Commission des comptes des transports de la nation. 2019).

All of these externalities have set a pattern for change. Indeed, Moisan (2011) in his research regarding the implementation of Greentech to serve green growth has explained that transport was one of the first sectors for which roadmaps and Calls for Expression of Interest have been implemented.

The purpose was to enhance research regarding low CO₂ for vehicles. Hence, these researches were mostly based on hybrid or electric technologies or even biofuel. However, at the time he wrote his research, Moisan (2011) was highlighting the technical and economical flaws of these concepts, which would eventually delay the placing on market.

However, since then, new programs have been implemented to enhance sustainable transportation. Indeed, at the end of 2019, a law for mobility has been implemented to ease daily transportation, through transports that are “easy, less expensive and cleaner” (Ministry of Ecological Transition, 2020). This law involves mostly local territories so that the solution implemented could be the most adapted to their population. The final objective of this law is that by 2040, vehicles using fossil fuels are no longer sold, the use of bicycles has tripled, the use of electric vehicles is widespread, as is the practice of car-pooling (Ministry of Ecological Transition, 2020).

In order to ease these changes, French Mobility has been implemented. This program is meant to create a community of actors of this sector that can develop together new solutions for these objectives. French Mobilities can also enhance experimentation on innovative solutions at different scales and if successful, implement them, especially in different territories that are not well served in the matter (French Mobility, 2020).

As a conclusion, labels have been implemented for different reasons but has showed a lot of potential regarding the acceleration of ministerial policies, in addition to being beneficial to both companies and consumers. Moreover, now that the policies led by the Ministry of Ecological Transition and the stakes surrounding them have been explained it will be possible to make a demonstration of the efficiency of this label regarding these specific topics.

Part 2: Contribution of missions to the implementation of ministerial policies

This part has the purpose of showing concretely what the Greentech Innovation label really is about, once companies have been labelled, namely the activities that it is leading in order to help companies develop so they can in the end, indeed contribute to the Ministry's policies. Hence, this part will be containing two sections, the first one will be describing the activities, and the second will present companies, showing the actual work that is done towards the Ministry's policies and overall sustainable development.

Section 2.1. Service offers as a mean of developing innovation

The first section intends to show an aspect that has not really been mentioned before but in order to make companies efficient regarding public policies, an offer of service has been implemented. This offer is large, going from data work to making companies visible, to training or even to offer them a working place. Indeed, by making some tools available to these companies, they have more chance to develop and have an impact regarding their sustainability and economic goals.

2.1.1/ Data work: a tool for companies to develop their processes

The work on data is relatively new and is an initiative that is growing. Indeed, since the reorganisation of the service, linking Greentech Innovation and the Data and Artificial Intelligence services into one same service, more initiatives of this kind are being explored. This is a first step, since certain work organisation habits tend not to change. As the reorganisation took place at the beginning of 2020, the work towards this reorganisation is progressive. However, it would seem that as the distinction between the poles diminishes, joint work in this direction should increase.

An in-depth collaboration of data and Greentech would enhance the move towards open data initiatives which are growing. This would be a major advantage since it would give access to needed data to a broader public and enable companies and citizens to make some calculations and decisions based on facts. Indeed, the hackathon that was organised in June by both poles

opened data regarding energy retrofit to a greater public. The fact that the Ministry, together with other institutions and data holders, made the data available allowed the emergence of proposals whose value could be increased due to a certain accuracy of the figures. Indeed, certain ideas could emerge from a better knowledge of the facts. Besides, SME's that are labelled Greentech Innovation were invited to participate and had the opportunity to collaborate with other actors from different sectors. The purpose of this hackathon was to encourage people to find solutions to enhance energy retrofit and thanks to the open data; some companies had the opportunity to develop their project more thoroughly.

Implementing more such initiatives could have a very positive impact on the assistance given to the labelled companies as it would give them opportunities to develop their project even more. Indeed, it is a way to have access to data which are not being treated or that are not entirely open because they are in the hands of more prominent companies who have the resources to treat them. Therefore, opening data is an opportunity for companies of the Greentech Innovation to work on these data despite their potential lack of resources, that is due to their recent structure.

However, data remains a delicate issue as some are considered as sensitive and are thus not open to the public, which is blocking start-up to get the information they would need. For instance, in July, a company called to get information regarding the money spent by farmers per hectare on phytosanitary products. This information was very important to them as they were developing a technology that was enabling farmers not to use these products through different processes. It was a company who is still in the development process, doing tests, and therefore they needed to know the money that was spent in order to get a perspective on their competitiveness. Indeed, by having this information, they could have been able to know if it was profitable to use their technology rather than pesticides. Knowing these figures was an opportunity to adapt either their technology or their range of price, but as I tried to get into the subject, I realised it was very sensitive data that was not accessible. I have had numerous phone calls in order to get this information and was sent from one institution to another, without getting any information. After some time, I was helped internally to get the information, but it had been very hard to find, and the data was only speculative. Therefore, the work that is done in this service should help companies have an idea of what is happening within the market, as the Ministry may have access to data that is "hidden". Moreover,

information is not always completely clear and companies do not have the social network to ask their questions. Indeed, the administrative way is complicated, and people might have issues understanding to whom they should ask their questions. That is when The Greentech Innovation can intervene and get the data required to their network or a part of the administration. Indeed, the Ministry produces a lot of data and statistics. The Greentech Innovation label is a part of the innovation and research service, but many other services are working on different themes related to sustainable development. Knowing the different specialities of the different services, Greentech Innovation can make this data accessible to the start-up and SME. Moreover, as it is a complex structure, and depending on the data, institutions might feel more comfortable giving information to a representative of an institution rather than to a small company. Hence, the Greentech Innovation service can have a significant role in this matter. However, it is a work in progress. As it is developing and having more interaction with different networks, the circulation of information might get easier and could help more thoroughly labelled companies.

This data work is very related to the implementation of an innovation ecosystem. Indeed, this research for data connects people who have data with people who need it to implement their solution.

2.1.2/ Implementing an innovation ecosystem: a mean to increase resources and network

The principle of an open innovation ecosystem has been explained within the first part, and it was explaining how it was more and more integrated within governmental institutions. However, this part is meant to treat how it is done concretely within the Greentech Innovation label. In order to create an open innovation environment, companies that get the Greentech Innovation label should be able to collaborate with a whole ecosystem. Open innovation, as mentioned before, is meant to outreach the limits of innovation through collaboration. Therefore, the Ministry has many interests in developing this practice. The more innovation, the more solutions can be found to reach sustainable development goals they have set.

Moreover, when collaborating, companies have more opportunities to thrive and therefore, to implement their solution in sustainably. Besides, in some cases, the solution might have the

potential to be extended to other fields than the one it was originally made for. Consequently, several initiatives have been launched to reach this objective.

One of these initiatives is simple; it is to connect start-up and SME with people of the network with whom they might have an interest. One concrete example is a company that was developing a robot able to analyse and sort out waste in places with risks of radiation or contamination. In order to make their test, they needed to put in relation with the Commission for Atomic Energy and Alternative Energies. The Greentech Innovation label had the contact and could ask them directly if they could let them do their test. Nonetheless, these demands do not necessarily have a systematic positive answer, but they might get an information they do have otherwise, or have a quicker answer.

Until recently, these open-innovation approaches were mostly limited to these aspects of linking people with the Greentech Innovation label network, namely the Ministry and the companies. However, new actions have been launched to develop synergies with other actors.

Indeed, during the Meet'Up Greentech 2020, which will be mentioned below, the launch of a national incubator network has been announced.

This network is about uniting different incubators in France with which partnerships can be developed. Incubators are very various and all have different offer propositions, hence creating a network with sustained relationships, can help capitalise these offers. This creation seems to be the activity of Greentech Innovation's service with the most potential. Indeed, this creation would allow labelled companies to benefit from an even greater offer. Moreover, cooperation can be greater between companies and on many territories on a national scale. The project is still in the development phase and discussions with incubators are more or less advanced, so it is not possible to say too much about the real effect that this network could have in the future for labelled companies. Nevertheless, many ambitions are accompanying this creation, notably to facilitate the support of SME through a single platform. Innovation in the service of the ecological transition could be further enhanced through numerous partnerships. Moreover, even if nothing is planned on this subject, it could be interesting to see the France Transition Ecologique project join this network. Since this project ultimately proposes to facilitate the vision of entrepreneurs on their action in favour of ecological transition through the provision of tools but also a better understanding of the aid that can be

distributed for this purpose. If the whole network can benefit from this platform, and even participate in its elaboration, it seems that an acceleration of policies in favour of ecological transition will be possible. However, this is still only a supposition since the state of these projects is still at an early stage. Nonetheless, these projects keep showing how a move towards open innovation could be beneficial for sustainable development.

Besides, regarding this aspect of incubators, the Greentech Innovation service used to have an incubator per se, in Champs Sur Marne, however, for different administrative reasons and in order to get closer to Paris, the service decided to leave and to create a living lab within the Cresco building, in Saint-Mandé. This building is owned by the gathering of municipalities: Paris Est Marne et Bois. They, therefore, rent its third floor, where there is a coworking space, to Greentech Innovation. This space is made available by Greentech Innovation free of charge to labelled companies. Therefore, small companies who do not have enough resources to have their own space or those who just have been created can work there. Besides, the fact that they share this space is easing their interaction with other labelled companies. In addition to these interactions, this coworking space has been chosen strategically as it is located near several offices for which labelled companies can have interests, for example, the National Institute for Geographic and forest information (known in French as IGN), Meteo France, the Centre for studies and expertise on risks, the environment, mobility and planning (known as Cerema in French) and the Regional and Interdepartmental Directorate for the Environment and Energy (known in French as DRIEE), the French office for biodiversity (known in French as OFB). Therefore, many interactions and synergies can be created. Indeed, many start-up would need to collaborate with these structures, and the proximity is easing these partnerships. Besides, the fact that these companies are nearby would also highlight their potential to these structures which might also need their collaboration. Therefore, the benefit is mutual. Hence, the Greentech Innovation service is selecting companies whose activity could benefit from a collaboration with these structures but also with the public authorities who own the building. Therefore, by implementing this space at this location, companies can develop their activity through multiple collaboration but also create a market with the actors that are surrounding them. Indeed, if we take the case of local authorities, they have policies to implement, and in order to do so, they might need the help of companies working in their policies field. In the case of Paris Est Marne et Bois, their primary subject regards waste

management, therefore, they could benefit from having companies within this field working within this coworking space. They could have the ability to develop multiple approaches with them while companies benefit from a public market. Therefore, these synergies can create new forms of open innovation, as creation is enhanced through these multiple potential collaborations.

Overall, the fact that the Greentech Innovation service is developing this network could also enable them to have a broader range of choice regarding the speakers of their training.

2.1.3/ Providing training offers: giving the keys to developing the activity

During the past years, the Greentech Innovation office was organising training days addressed to labelled start-up and SMEs. The goal was to give them critical elements about a subject that might be useful to them. Therefore, twice a year, start-up and SMEs had the opportunity to follow training regarding design thinking. This training would help them understand the concept, and give them keys to implement it within their companies. Moreover, the trainer would coach them after the training day through meetings so that what they learnt could be truly implemented, so they could have advice on the way to do it and have a follow-up. Therefore, according to companies' needs, the trainer would organise one to several follow-up personal meetings on their progress. The Greentech Innovation was at the origin of the payment of the service so that they could have the opportunity to be more efficient within their thinking regarding innovation. It was both a personal and private training offered to companies that might not have the means to implement this on their own, otherwise.

However, the pandemic had an impact on this training offer. Even though the trainer would still be in contact with the first companies and other such training is planned, the Greentech Innovation office decided to reorganise their training offers.

Start-up are young companies, that need to work on many aspects of development in order to be sustainable and be a part of the market. Therefore, they need training on different aspects but have very little time to do so. Consequently, in order to respond to these constraints, the Greentech Innovation label decided to develop a different format. They decided to provide webinars, which fit better the spirit of the times. Therefore, the training is

shorter (1 hour to 2 hours and a half) and is built to fit the company's expectations. Indeed, several subjects have been previously selected by the Ministry and then proposed to the companies so that they could choose what subject they were more interested in. Once the program was done, it became possible to organise them properly. Moreover, the greatest perks of this format are the fact that it is easier to get people available to do the training because it requires less of their time and they do not have to move to attend the training. This also has an impact on the type of speaker who will intervene during the training. This kind of format is more flexible and enables Greentech Innovation to target many different kinds of people who have many skills in their field who might have been busy in another context. However, this perk also has its disadvantage as it also becomes easier to cancel the intervention at the very last minute.

This flexibility also allows offering a broader diversity of training. Indeed, the Greentech Innovation service realized that start-up needed other kinds of knowledge, some that might be more practical and would help them develop their activity more. Therefore, four kinds of training were planned:

- Institutions offers: this kind of training is meant to help companies understand how to navigate between the different offers that institutions are proposing. This will be about different kinds of fundings, what are the different services and how they work. The purpose is that, not only, they know what exists and how it can help them but also to give them a contact within these institutions so that when they are in need regarding some aspects, they can call them to get more information. Besides, these training can also explain to whom they can make their demands because some institutions have places in the whole of France to give assistance. They can explain the procedures to be followed so that their requests are better taken into account. Indeed, when applying for funding, a file has to be put together, and these webinars can be an opportunity to give guidance on how a file has to be put together so that it is received and has a better chance of being accepted.
- Organisational tips: this kind of training is mostly useful for start-up. Indeed, some start-up are young companies, with few employees, which makes the diversity of skills

smaller. Therefore, some weaknesses have been spotted, in particular in companies led by engineers. These people are people who have very specific skills and a very advanced technology, but they might not have business skills which can slow down the market introduction of their products. Therefore, webinars are implemented to give them tips on how to fill this gap. Hence, webinars on how to deal with the press, how to succeed in hiring, or how to raise funds are being implemented. Of course, these webinars are open to every single start-up and SMEs that are labelled but they might target more companies that lack these kinds of skills, or that are very young.

- Tools: there are few webinars of this kind, but they still represent aspects that companies might need to develop. Indeed, it is a presentation of tools they might need to use to increase their value proposition. Very different kinds of tools are presented but they might all be useful to people who have a small team. For example, a webinar was held on a tool to facilitate the creation of a website.
- Problem sessions: this kind of training is quite different from the other kinds, as they are meant to present issues that exist within a sector. The "problem sessions" take stock of the problems faced by different actors. It is a state of the art of technologies and market functioning. The aim is to identify what is not working, the subjects on which there are blocking points, no solution, in order to propose solutions to these problems in the long term, to see where solutions can be found. The solution should not be found right away during the webinar; the purpose is more about pitching the problem rather than the solution so that companies may identify opportunities. Indeed, they might find out that their technology could be adapted to another field.

In order to make these webinars the most relevant, and make sure they were subjects that were interesting for companies, a survey has been sent in which they could vote for their favourite subjects. According to their answers, the program has been adapted, and it has been a way to identify in priority the speakers for the favourite subjects.

Finally, to make these topics relatable, it has been decided to integrate a testimony of a labelled company at the end of each webinar (except for problem session, which is very

specific) so that they could express their experience about the topic, explain the difficulty they might have encountered, and how they overcame them.

Therefore, these webinars have been designed in such a way that companies can come out of them with all the keys in hand to develop optimally. The process is still at an early stage due to the other very time-consuming activities that were mentioned earlier, but they seem to have interesting potential for many companies, especially those that are still at an early stage of development.

2.1.4/ Providing assistance on various fields: showing support and increase chances of success

The Greentech Innovation service hires interns and trainees of different profiles regularly. Hiring people with different profiles makes it possible to bring in skills that are also different and thus to provide specific support at different periods. Therefore, some assistance has been provided regarding methodology in many aspects, such as legal advice or environmental analysis. However, as interns and trainees are not experts in their topic yet, the aim is to provide an approach and a vision rather than expertise as such. In addition, the network to which trainees and apprentices are entitled sometimes allows them to become more familiar with specific resources that companies can use.

Therefore, some companies may need some figures in their field to see how their company is doing compared to the average. Sometimes, they may ask for a full analysis from an intern or trainee. However, as a non-expert and without every single aspect of the company's context, the analysis might not be complete. However, it can still be interesting as these companies are very young; therefore, as mentioned before they often lack resources and the fact that they can have assistance provided on different subjects can be helpful. For instance, having someone making a summary of the most important laws within their field; could help them implement limits when developing their projects and understand where their market starts and where it stops. When a company wants to have a more concrete idea of their impact, as most of them cannot afford a life cycle analysis (which costs about 100,000 euros), something that can be done is to find and gather and summarize data about their sector so they can see how they fit within these numbers. It can also be about guiding them towards a methodology,

showing them some websites that can be useful to them as they might, in some cases, provide regular analysis on their sector. For instance, it can be about showing them some reports done by ADEME, tools they have such as “Base Impact” or “Base Carbone” or “Bilan GES”. It can also be about showing them statistics websites from various ministries or institutions from the Ministry such as “Georisques”. Overall, analysis can be done, but the most important is to provide assistance and not necessarily doing a complete work that would represent the time of a full-time job.

This assistance can be useful to companies as it gives them a vision, however, as there are not necessarily people in the service that have these specific skills to supervise the work, it might be incorrect or lack precision. Therefore, this approach should be made through full-time employees, or experts of the field should at least check it. It would give a more in-depth vision even though the work remains incomplete. This approach is mostly about giving tips on how to make some improvements, but it is not the work of an expert, companies should not rely too extensively on this kind of assistance. They should use the guidance and do the work extensively on their own. Moreover, the fact that it is based on trainees and interns’ skills makes this assistance temporary, therefore, the assistance required should not be something that requires a long-term backing.

This assistance is also about supporting companies within their procedures. Hence, it may happen that letters of recommendation are written so that companies can benefit from certain aids. In order for the letters to be signed at the highest level of the Ministry, a file can be put together, for which an analysis of their work can be mentioned. Moreover, this support is shown through the labelling process therefore, in some cases, the label can be used by companies to highlight their application for aid. For instance, one of the companies labelled Greentech Innovation mentioned its label when applying for support from the European fund EIC Accelerator. The label is then a way of proving the solidity of the project and gives it a certain credibility: The Ministry knows about the project and supports it. The project has already gone through a selection process and has been chosen as sufficiently solid, innovative and promising to be selected.

Assistance is, therefore, provided on different aspects but is not the key element of this service as it is mostly temporary. However, it has some very interesting features as it can give clues on the path companies should follow regarding some aspects. It can also be something that

will enable them to get help from others, so it is quite important, even though not central. The central and probably most efficient service of the Greentech Innovation is to make them visible to the public.

2.1.5/ Making companies visible: an essential tool to attract consumers and investors

All the offers mentioned above, are helping companies to develop, to have access to resources they would not have otherwise and use a network that can be part of their approach towards sustainable development. However, in order to develop, they also need to be visible. Therefore, the Greentech Innovation service is implementing several processes in order to increase the network these companies have and in order to make them able to present their work. Visibility work is very important, it is a way for companies to, on the one hand, develop collaboration, getting the money they need to develop but also to make people aware of the existence of their technology so it can at some point be the norm. Hence, one of the greatest parts of this service is the organisation of its annual Meet'Up. Indeed, it is the most time-consuming mission because it is a very important moment during the year. Usually, the Meet'Up last one day and takes place in a place symbolic to start-up and innovation. Last year, it was organised at Station F, the biggest European campus of start-up.

This Meet'Up is a major event which intends to bring together the whole Greentech ecosystem. It is a business event where companies may meet, but above all, where they can meet investors, local authorities, big companies, or groups and press. This event is meant to make them find business opportunities for collaboration, fundraisings, or public purchases.

Usually, the Meet'Up is a physical event, so that Greentech Innovation labelled companies can be highlighted. Indeed, the two last promotions of labelled companies, each have a free booth to exhibit and talk about their activity to the visitors of the event. Moreover, for those having a demonstrator, they also have the opportunity to exhibit it. In addition to these booths, space is dedicated to business meetings, within which all visitors and exhibitors can meet and discuss business. Nonetheless, mostly Greentech Innovation labelled companies benefit from these meetings since their visibility is increased as they are exhibiting. In order to manage the time and place of these meetings in the best possible way, a service provider is hired.

This event gathers a lot of people, as the edition of 2019, had about 1000 registrants, and more than 1000 meetings were organised. There is a hard work of communication to make the event known to the public, and a lot of networking is involved so that the registrants' profiles fit the best the expectations of the exhibitors.

However, this year's edition has been turned upside down due to the sanitary situation. Hence, the date has been pushed, and the format went from physical to digital in a relatively short period. Nonetheless, in order to maintain or even increase the scale of the event, several aspects have been added, despite the digital constraints. Indeed, the event took place over two days; the program changed completely, adding many aspects. Indeed, the purpose was to have the most attractive program so that a great number of people would be interested in participating and therefore to take part in the business meetings. Therefore, a lot of communication has been involved, because more than simply increasing direct business opportunities it was also a way to make the label known, not only to the ecosystem but to a greater public. Moreover, the more the label is known, the more people can apply to the Calls for Expression of Interest. As the number of applicants grows, the number of solutions to accelerate the Ministry policies can grow as well. Besides, it can also increase synergies as people become aware of the Ministry's service. As it gets well-known, the interest can grow and more business, consumers and local authorities might work with the labelled companies. Therefore, the whole event has been broadcasted on YouTube at the same time, so even those who did not register could still follow it.

Hence, the program had to be attractive, therefore several aspects have been added. Initially, when it was a physical event, only Ministers were supposed to talk, and four prize-giving ceremonies were planned, it was more focused on the business meetings and exhibitions. However, a digital solution implies a different approach, and gives somehow, more opportunities. Indeed, in the same way as for webinars, digital solutions give more flexibility. Hence, speakers from different places, with busy schedules can take an hour of their time to speak during a panel table, a prize-giving ceremony etc. It is a challenge to make a digital event as attractive as a physical one, as the face to face approach is sometimes preferred, and it is harder to keep people's attention. Therefore, guest speakers have been selected very carefully. Panel tables have been organised in such a way that they deal with topical subjects related to Greentech but which can still reach as many people as possible. Each of them was

composed of at least one member of a Greentech Innovation labelled SME, one public actor and one private. Hence, topics such as sustainable mobility in regards to the sanitary crisis have been discussed, the stakes around the circular economy or how to farm and integrate Greentech. Besides, a question-answer session about the recovery plan has been organised, which was giving concrete business answers to companies. Some big companies working within the Greentech sector, such as BackMarket did some testimonies, showing what Greentech could bring to the economy and the environment. The prize-giving ceremonies were kept, and more prizes were given. There were prizes from investors, competitiveness clusters, press, local authorities, and consultants. We had given them a book explaining the activity of several start-up they selected, making them aware of what the Greentech Innovation labelled companies were about, highlighting them to the voters but also the public watching the ceremony. Finally, four Ministers talked during this event, making exclusive announcements regarding diverse subjects.

The diversity of subjects, speakers and their quality enabled the event to gather more than 2000 registrants and the objective of attracting people to go on digital business meetings was reached as more than 13000 meetings were held. The main objective was therefore achieved since these opportunities are ultimately the main reason for holding this event.

Hence, the Meet'Up Greentech is the main event of the year to make companies visible however, other events are organised at a smaller scale to make them visible to different actors. Indeed, monthly breakfasts are organised between a small group of labelled companies working on the same topic and the general commissioner for sustainable development. It is an opportunity for companies to meet people working on the same topic as them and therefore a potential opportunity of collaboration and it is also a way to present their project to a high-ranking member of the Ministry. Besides, on a less regular basis, the Ministry of Ecological Transition can have a meeting with a small group of labelled companies to present their solutions acting towards the Ministry's policies.

These meetings are sometimes broadcasted so that more people can see these presentations and thus increasing their visibility.

All these offers are enabling to develop, to be known and therefore to increase their potential towards accelerating the Ministry's policies, however, in order to do so, it is important to have innovation that actually relate to these policies.

Section 2.2: Solutions brought by innovation

This section will show how companies contribute to accelerating public policies, and how they relate to them. Moreover, some analysis of the potential environmental gains they could bring will be described.

2.2.1/ Labelled companies' contribution to the stakes of public policies

In order to accelerate the Ministry's policies, different solutions have been developed by different companies. However, in order to understand the impact of the Greentech Innovation label, it is important to know what these companies' activities are really about. The label often highlights some companies that they call "pépites", which could be translated as a jewel. This word is meant to describe those who have the most potential, based on several criteria. Indeed, in order to be classified as those highlighted companies, the SME in question should have a solid project, often supported by a disruptive innovation, for which the spread could have a very important impact and that could potentially be adopted in other fields. Besides, these kinds of companies often have a solid business model which makes them rapidly grow in terms of fundraising or turnover, and the plus is when their activity generates employment. However, not every single criterion has to be met in order to fit into this category, sometimes a company with a lot of potential or one that is succeeding very well regarding one criterion can suffice to make it a "jewel".

Therefore, this part is meant to present those companies that the label is highlighting. However, there are several ones, so it is about presenting a few of them for each category. In order to understand how much the Greentech Innovation label can contribute, or not, to accelerate the Ministry's policies.

Regarding the sustainable building and cities policy that has been described previously, several companies are working on aspects that could decrease the impact of construction and the energy it requires.

One of these companies is called Materr'Up. This company will only be described shortly as a brief analysis of their environmental impact will be explained within the next part.

Matter'Up is a company that is working on both construction and energy impacts. Indeed, they have developed a concrete that is decreasing the carbon emissions, through a special cement, which is regulating the building's temperature. Besides, this cement has special properties as it is meant to replace the most used cement in France: Portland cement, which composition has many impacts, as well as its manufacture, in particular the fact that it has to be heated at a very high temperature. On the contrary, Materr'Up cement does not require any heating process and is using clay as a main component.

Therefore, as the temperature is regulated, and the components used are different, and are meant to be less impactful, both energy and construction impacts can be decreased. Moreover, this technology can be adapted to many different kinds of building construction, which increases its potential regarding new construction.

Regarding the biodiversity, water and mimicry policies, there are several companies that could help accelerate these policies. However, some of them have been classified on the health and environment category, even though their impact could fit this biodiversity category, as well. Indeed, both these impacts can be related. As protecting the environment and health can lead to protecting biodiversity as well. Hence, one company that is classified within this category is Ecofilae.

Ecofilae is recovering wastewater. Indeed, they are using wastewater for several purposes, according to the local situation. According to the situation, they will adopt the best possible practices. These practices are various, it can be washing roads, irrigating, improving the soil, or recharging rivers and even groundwater. They consider that wastewater can be “cost-effective, a sustainable source of energy and recoverable by-products”. Hence, there is an effect on humans, plants, soils and overall, the environment's health. Moreover, this encourages a sustainable use of water in many aspects, protecting the ecosystem surrounding water. Their solution is mostly based on assisting companies and people who wish to find solutions on how to reuse their waste water. They use their expertise, and labs to make tests and propose the solution that fits best their client's expectation.

Hence, the great potential of this project has been noticed, and several institutions are supporting this activity, such as the Centre for International Cooperation in Agronomic Research for Development (known in French as CIRAD), the National Research Institute of Science and Technology for the Environment and Agriculture (known in French as IRSTEA) and the National Institute for Agricultural Research (known in French as INRA).

Regarding circular economy, Poly to Poly is a company with a lot of potential that is specialised into plastics. They developed two activities, a label “Circular Plast” which is about promoting products containing recycled plastics. This label is linked to their first and main activity which is a digital platform to facilitate the supply of recycled polymer for plasturgists. Their platform relates information regarding recycled polymers, e.i. their chemical and physical characteristics, their stock and price so plasturgists have a better vision on what is available and can integrate them within their products. Their innovation enables producers to have a better use of plastic and enhance recycling. However, there are many other solutions that are being developed to enhance sorting out practices, to increase the efficiency of treatment sites, or to promote reuse and reducing waste.

When looking at solutions developed to increase energy efficiency or the development of renewable energy, Greentech innovation has labelled several projects which may have a lot of potential.

For instance, Entech is promoting a solution which enables stock and production optimization in electric networks. Indeed, in order to promote the use of renewable energy they are developing a system to stock energy which is working through algorithms and systems of optimized energy conversion. This solution is enhancing the use of renewable energy and optimizing energy efficiency solutions.

Other solutions such as the one developed by Sereema, enabled wind turbine operators to increase their turbines’ production through a box with connected sensors. This box is analysing data around the wind turbine to make adjustments that are related to the palms, or wind change. This box enables maintenance and enhances productivity 24/7. This solution is therefore increasing the efficiency of renewable energy, making them more productive and increasing their supply.

Not all solutions have the same potential despite the particular demands of the jury in this category. Some of the proposed solutions can be considered as niche solutions, and proof of their impact remains to be proven. Nevertheless, this requirement on the part of the juries makes the quality of the projects fairly good. Often few projects are selected, but overall, they have a strong potential for development.

Regarding sustainable digital technologies policies, this part is a lot more complicated. Indeed, it is probably the category for which there is the smallest number of applications each year. Besides, even though the projects might be interesting, none of them can be considered as really disruptive, nor bring any great change regarding the impact. Most projects will be using digital technologies to enable consumers to make better choices regarding their environmental impact, some are also linked to making software less energy dependent. However, as mentioned, there is a lack of information, and mostly of reports that follow a solid methodology regarding the impact of digital technologies. Therefore, it is not easy to quantify the benefit any technology could have in this perspective.

Hence, there are very few projects that have been labelled. Indeed, among the 173 companies that are labelled, only 10 projects have been classified within this category.

Greentrader is the company that could be considered as the project with the most potential, since they are encouraging second hand trade of computer equipment, on a B2B perspective. This project has the perk to make specific equipment available to other companies which would need it. It could have an impact, but a lot of questions remain regarding the scale of this impact. However, this project could easily be classified in the circular economy category as it is more about managing unused equipment rather than making it sustainable to the core, or using it as a means for sustainable development.

Regarding risk prevention policies, solutions proposed by start-up are more related to managing the risks than preventing them per se. Hence, this management is done through data collection and increasing knowledge on a subject. Through this knowledge, it can prevent having too many consequences as people are aware of the risk coming, and are therefore more likely to be prepared. The fact that most innovations are based on increasing awareness, making the degree of disruption quite low in this category, even though it is necessary. Nonetheless, solutions are found for both industrial and natural risks.

Regarding risks in general, Infolash, develops a digital system based on algorithms that gathers official and local information on one single platform. The purpose is to make citizens aware of the different information and alerts that their authority is giving, in real-time through a modern solution.

If we take the specific example of industrial risks, Skipper NDT, developed a technology for pipeline maintenance. Indeed, this tool is used in buried pipelines and allows the identification of corrosion effects on these pipes. This identification allows action to be taken before a crack appears. Measures can be put in place to repair or replace the affected area. This then limits the leakage of any potentially hazardous liquids that the pipeline may contain. This technology makes it possible to prevent many incidents with sometimes dramatic consequences for the environment.

The health and environment topic is quite related to the biodiversity topic, as they both intend to protect the environment and health, which is having an impact on biodiversity. Indeed, the policy on decreasing the number of phytosanitary products has an impact on biodiversity. When these products are not used, ecosystems are more protected, even though, as mentioned above, extended mono-crop does not promote species diversity. However, the ecosystems that may be present there are protected. Greenshield, a company for which the impact will be presented a little bit more thoroughly below, is developing a solution to decrease the use of pesticides by farmers. Indeed, their technology is about detecting bio-aggressors as soon as possible, and getting rid of them through a laser. This technology is preventing the increase of these bio-aggressors within the field, by detecting through sensors the places of the fields where they might grow.

Twenty-nine projects related to mobility have been labelled by Greentech Innovation. These projects relate to very different aspects, such as increasing soft mobility solutions, or make them easier to use, besides there are projects towards cleaner mobility. Electric 55 charging is one of the most viable projects, on an economical point of view. This solution is meant to give access to a network of interoperable electrical terminals for electric vehicles. These terminals are connected to a computer network to ensure their efficiency and their level of battery. The aim is to move towards a generalisation of these networks so that electric mobility can no longer represent a constraint.

However, even though some solutions could be very interesting for a more sustainable kind of transportation, they are not necessarily all viable, and might not all work in the long term.

This part has shown that the companies that have the potential and that are the most highlighted are not necessarily contributing directly to the Ministry's policies. They are, nonetheless, having an impact on sustainable development, but it seems that a focus should be done between the actual policies from the Ministry and the innovation that are being labelled. It seems that during the selection process, some sectors should be targeted in order to get more innovation to sustain some policies, in the sustainable digital transformation for example. However, all policies have not been presented, nor all the companies that have been labelled, hence it seems that many innovations have the potential to accelerate the Ministry's policies. Nonetheless, improvements have to be done regarding the targets for the labelling selection process, but the potential is there.

2.2.2/ Analysis of environmental gains

Now that companies have been presented, and the potential of it has been highlighted, this section will discuss the potential of two companies, through an analysis of the gains they could make if their technology were developed on a large scale. The first company is GreenShield, a company that is working on the health and environment topic, which intends to decrease the amount of pesticides and the second one is Materr'Up which is about decreasing the emissions of construction and about making buildings more energy efficient.

2.2.2.1/ GreenShield case

The start-up Green Shield, offers a system for preventing diseases that can be found in crops. It uses a disease detection system, and then implements a laser system to limit the use of pesticides before the disease has had time to spread.

The uses of this innovation are currently limited to specific crops but could eventually be applied to other types of crops.

For example, they currently act on sugar beet crops and prevent the use of fungicides against cercosporiosis disease and insecticides and aphicides to control aphids that are vectors of beet yellows disease.

As far as sugar beet is concerned, it is considered that cercosporiose disease can be responsible for up to 30% of crop losses. Thus, the use of pesticides makes it possible to avoid major yield losses, with a significant economic impact. Nevertheless, considering the damage of pesticide use presented in context, laser use would make it possible to limit losses as well as damage.

They are also used on vines and reduce fungicides against mildew and powdery mildew diseases (GreenShield, 2020).

It should be noted that the type of pesticides used depends on the type of crop, so France consumes mainly fungicides, particularly in vineyards, followed by herbicides and finally insecticides (Baldi et al., 2013). We also note that despite the small proportion of vines on agricultural land, this is a crop that is a high consumer of pesticides, since it alone consumes 20% of them (Baldi et al., 2013), 80% of which are fungicides (Mézière et al., 2009).

Thus, the impact of GreenShield on pesticide use would have a potentially very significant impact since it would make it possible to reduce the use of pesticides on a very consuming crop: vines. Hence the most potential of their technology would probably be regarding these particular kinds of crops. In order to understand their potential this part will treat specifically the wine crops.

Nonetheless, in order to get an idea of the potential, it is important to have a vision of the figures on emissions due to the use of pesticides.

Based on the figures given by the “costs of fungicides, insecticides and herbicides registered for use in vineyards in 2011 report” (Réseau d’avertissement phytosanitaires, 2011), it was possible to calculate the average weight of active ingredient used in fungicides, which are used within vineyards. However, these calculi are based on fungicides sold in Canada, consequently, it is giving an estimation rather than a completely precise amount that would be found in France. Thus, the average dose of active ingredient mixed with 100 L of water (considering the highest dose of each product) is 7,35kg.

These doses have an influence on the emissions of different pollutants. Hence, the table below shows, on the first column, how much impact one kilogram of active ingredient generates (regarding carbon dioxide, methane and nitrogen oxide).

Table 2.2.2.1.A: Amount of emissions according to the amount of active ingredient within fungicides, Source for the first column: ADEME

| Impact | KG impact /KG of active ingredient | Amount of the impact for 7,35 kilos of active ingredient |
|------------------|------------------------------------|--|
| CO ₂ | 5,5537 | 40,819695 |
| CH ₄ | 0,01855 | 0,1363425 |
| N ₂ O | 0,00015 | 0,0011025 |

Source: first column is based on ADEME, carbon base documentation, then calculus.

Reading: In France, on average, 40.82kg of CO₂ is emitted over an area of one hectare.

The French wine and vineyard guide states that 835,805 hectares are dedicated to the vine, in France. Based on this figure, it is possible to calculate an estimated quantity of active ingredient used on this surface, which would be 6 143 166,75 kg.

Moreover, knowing this surface enables us to calculate how much carbon dioxide, methane and nitrogen oxide are emitted in France.

Table 2.2.2.1.B: Estimated total amount of emissions in kg due to the impact of active ingredients

| Impact | Amount of impact per category of impact |
|------------------|---|
| CO ₂ | 34 117 305,18 |
| CH ₄ | 113 955,74 |
| N ₂ O | 921,48 |

Reading: in 2016, an estimated 34,117,305.18 kg of CO₂ were emitted from the total surface area of French vineyards, i.e. 34,117.31 tonnes.

The potential favourable consequences linked to the development of the use of GreenShield's innovative processes according to the development scenarios of its processes

In 87% of areas, farmers trigger the use of pesticides linked to disease outbreaks. Which represents: 727,150.35 hectares.

Hence, as GreenShield enables farmers to detect earlier, these diseases, they could avoid up to 87% the emissions of carbon dioxide, methane and nitrogen oxide by using their laser technology instead.

However, there is a margin of error that should be taken into account. The potential amount of emissions that could be decrease are presented on the table below:

Table 2.2.2.1.C: Estimated emissions that could be decreased, in kg, if 87% of surfaces where using the technology developed by Greenshield, with different margins of error

| Impact | Amount of impact per category of impact, on 87% of surfaces | Amount of impact per category of impact, on 87% of surfaces with a 75% success | Amount of impact per category of impact, on 87% of surfaces with a 50% success | Amount of impact per category of impact, on 87% of surfaces with a 30% success |
|------------------|---|--|--|--|
| CO ₂ | 29 682 055,51 | 22 261 541,63 | 14 841 027,75 | 8 904 616,65 |
| CH ₄ | 99 141,50 | 74 356,12 | 49 570,75 | 29 742,45 |
| N ₂ O | 801,68 | 601,26 | 400,84 | 240,50 |

Reading: If 87% of the vineyards decided to use Greenshield's technology rather than using pesticides, in the event of a disease outbreak, 29 682 055,51 kg of CO₂ could be avoided. If the operation is successful on 75% of these plots of land, this would mean a reduction of 22 261 541,63 kg of CO₂.

Moreover, pesticides have different impacts on several aspects, such as air, soil and water pollution. The consequences on pollution could also be decreased significantly.

Since the watercourses located near the vines and the groundwater in these areas still carry residues, it would become possible to limit them. Furthermore, in terms of air pollution, this would make it possible to limit the presence of pesticides in the atmospheric phases in which they are found. Moreover, a non-negligible impact on the copper content of soils could be found, thus lowering their toxicity for organisms. Finally, the soil would be less eroded, and its quality could be restored overall.

2.2.2.2/ Materr'Up case (2 pages)

When manufacturing conventional hydraulic concrete, the production process that has the most impact is cement.

Materr'Up is offering an alternative clay binder to conventional cements. Indeed, these are emitting high amounts of greenhouse gases (CO₂) during their production. Their technology does not require heating and avoids the decarbonation of calcareous materials, which limits the strong impact of this stage, in terms of greenhouse gas (CO₂) emissions but also atmospheric pollutants (NO_x in particular). Moreover, the choice of clay as a component helps to limit the damage that can be caused by the extraction of certain resources (river sand and gravel), the transport of which can also have many repercussions. Indeed, clay is a resource that can be found locally in abundance.

Materr'Up process of manufacturing is linked to several important aspects of ecological transition namely a low carbon technology, with a circular economy vision, implying local stakes. The circular economy stake is highlighted with the production of their site concrete. This concrete allows the recovery of materials (such as excavated material from construction sites) for reuse. This aspect largely limits the impact in terms of waste.

The figure below shows the uses in which Materr'Up's innovations offer alternatives to conventional concretes:



Fig 2.2.2.2 : Materr'Up concrete construction solutions. Source : Materr'Up

The main format of concrete manufactured is C25/30, which is an alternative for 80% of the concrete volumes in France. The use of clay concretes could therefore be extended to many construction elements.

Their concrete can nevertheless be applied to many other uses as presented above. The DTU 21 and S1 to S5 formats further extend their range of ready-mixed concrete.

In order to understand how their innovation could impact this sector, it is important to give some figures on pollutant emissions, in the sector.

Life Cycle Analyses for their binder, carried out at Materr'Up's request, show a result of 80 to 250 kg of CO₂ per tonne, compared with 800 to 1000kg per tonne for conventional cement.

The Environmental and Health Declaration Sheets (FDES in french) drawn up show a result of 100 to 160 kg of CO₂ per m³ for site concrete, compared with the 277kg of CO₂ of the competition.

Cement production in France represented 17 million tonnes in 2017 (Godoy Hilario, 2019).

Knowing that for 1kg of cement, 0.71kg of CO₂ (carbon dioxide) are emitted, 2.7mg of CO (carbon monoxide), 0.7g of NO_x (nitrogen oxide), 0.09g of SO_x (sulphur oxide), 2.6g of CH₄ (methane) and 1.3mg of HC (hydrocarbon) are emitted (Sjunnesson, 2005).

Considering these figures in relation to the French annual production, the following figures can be found:

| Impacts | Impact of conventional cement | Share of impacts affected by Materr'Up (80%) | Share of impacts affected by Materr'Up (50%) | Share of impacts affected by Materr'Up (20%) | Share of impacts affected by Materr'Up (10%) |
|-----------------|-------------------------------|--|--|--|--|
| CO ₂ | 12 070 000 t | 9 656 000 t | 6 035 000t | 2 414 000t | 1 207 000t |
| CO | 4,59*10 ¹⁶ mg | 3,672*10 ¹⁶ mg | 2,295 x 10 ¹⁶ mg | 9,18 x 10 ¹⁵ mg | 4,59 x 10 ¹⁵ mg |
| NO _x | 11 900 000 t | 9 520 000t | 5 950 000 t | 2 380 000 t | 1 190 000t |
| SO _x | 1 530 000t | 1 224 000t | 765 000t | 306 000t | 153 000t |
| CH ₄ | 44 200 000t | 35 360 000t | 22 100 000t | 8 840 000t | 4 420 000t |
| HC | 2,21 x 10 ¹⁶ mg | 1,768 x 10 ¹⁶ mg | 1,105 x 10 ¹⁶ mg | 4,42 x 10 ¹⁵ mg | 2,21 x 10 ¹⁵ mg |

Table 2.2.2.2 A: Calculation of cement impact for 17 million tonnes of cement (Godoy Hilario, 2019) using figures from Sjunnesson (2005).

Conventional concrete production requires the consumption of natural resources such as sand and gravel from alluvial deposits in riverbeds.

Materr'Up's clay concrete manufacturing process reduces the constraints on the use of these materials, which have a high impact on the environment.

Clay is a resource that can be found in abundance in France, which limits certain impacts. Moreover, the reuse of materials from excavated building sites limits the production of waste as well as the impacts of extraction.

Therefore, developing the use of Materr'Up's innovative processes could be beneficial, and different scenarios have been thought in order to see the potential favourable consequences of implementing it.

Considering that for 1 m³ of concrete produced, 1.5kg of CO₂ (carbon dioxide) are emitted, 0.86g of CO (carbon monoxide), 2.3g of NO_x (nitrogen oxide), 3.3g of SO_x (sulphur oxide), 1.7g of CH₄ (methane) and 0.32g of HC (hydrocarbon) are emitted (Sjunnesson, 2005).

According to the SNBPE, in 2018, 40 056m³ of ready-mix concrete were produced during the year in France (SNBPE, 2020).

Consequently, taking into account the monthly production of concrete multiplied by the different impacts, the following figures can be found:

| Impact | Impact of conventional concrete | Share of impact affected by Materr'Up (50%) | Share of impact affected by Materr'Up (20%) | Share of impact affected by Materr'Up (5%) |
|-----------------|---------------------------------|---|---|--|
| CO ₂ | 60 084 000,00 | 30 042 000,00 | 12 016 800,00 | 3 004 200,00 |
| CO | 34 448,16 | 17 224,08 | 6 889,63 | 1 722,41 |
| No _x | 92 128,80 | 46 064,40 | 18 425,76 | 4 606,44 |
| So _x | 132 184,80 | 66 092,40 | 26 436,96 | 6 609,24 |
| CH ₄ | 68 095,20 | 34 047,60 | 13 619,04 | 3 404,76 |
| HC | 12 817,92 | 6 408,96 | 2 563,58 | 640,90 |

Table 2.2.2.2 B: Consequences of using Materr'Up's processes to cover 5%, 20%, 50% of current uses of hydraulic concrete (in grams)

Overall, using this process could have a lot of beneficial impacts and it could have a positive impact on global warming.

Results and analysis

1) Limits, strengths and levers of the missions according to the bibliographical contributions

The literature review showed how the Greentech Innovation labels and how calling upon Greentech solutions, in general, can raise solutions for sustainable development. This is why the Ministry chose to do so. However, some limits can be raised. Indeed, it happens that doubts are raised upstream about projects and their viability or their capacity for dissemination but are nevertheless labelled. This is a strength as well as a weakness because it gives a chance to projects that will be able to develop through the support given by the Greentech Innovation service. However, it may sometimes seem counter-productive and, contrary to the regulation and the very intention of the CEI, it may seem like a waste of time and overall resources. This may, in some ways, reduce the credibility of the labelled companies because they are of very unequal levels, and therefore some are side-lined in the support they receive.

However, the literature review was not highlighting too much the support that an authority can give to companies, indeed, few researches on the subject have been done. The studies on labels are more related to mainstream labels and show some advantages such as an image benefit for companies, or decreasing information asymmetry for consumers. Literature does not really show that when an authority is implementing this kind of process, they do not simply grant a label, they also are implementing a whole system that is meant to help them develop. It is not an easy task, since start-up are fragile structures that can be easily impacted and the fact that the Ministry is helping them could help to decrease the number of start-up failing, which is at the moment, 90% of them. Hence, explaining the mission was a way to show how it could be beneficial to start-up to be labelled in other ways than just the image, even though it is very impactful, especially when it is an authority such as a Ministry.

Moreover, the literature review does not really show the difference of level that can be found within these kinds of label. This difference of levels has an impact on the support that labelled companies may get. Hence, some companies may be favoured which is actually a frequent reproach from other labelled SMEs and start-up. The fact that the biggest ones are favoured,

and might be more highlighted is not something that is showed, however, it can be explained by the fact that the number of labelled companies is large and sometimes a selection has to be made. For instance, during the Meet'Up, when the Greentech Innovation was asking investors to vote for their favourite companies for the prize-giving ceremony, it was not possible to give them the entire book highlighting all their activities, a selection had to be made so that these people be willing to vote. Hence the so-called "jewels" are more highlighted and sometimes have more advantages. This fact may call into question the first selection. Consequently, if some are less highlighted, are they really helped? And therefore, do they really stand a chance to contribute to the Ministry's policies?

Regarding the actual activities of the company, a presentation of their activities showed that many of them were working on different projects could accelerate the Ministry's policies presented in the bibliography. However, it is complicated to really determine the effectiveness of these projects because the project assessments have not been carried out. Knowing how they are going and studying their development, in a deeper manner could be useful because even if the Greentech Innovation service is often checking their economic health through surveys, it could be interesting to have kept the hearing criteria within the regulation of the CEI. Hence, the explanation of the missions showed that some of them had some potential. However, the analysis was too brief and not very detailed, due to the lack of data on the part of the companies (they do not necessarily want to communicate too much on their process, to avoid competition issues) and the lack of equipment to do a precise analysis. Therefore, we only have an estimation of what could happen if their activities were developed at a larger scale and the estimation shows the positive potential of companies.

However, placing the label under the supervision of the Ministry makes it possible to maintain credibility, which may nevertheless be called into question by the aspects mentioned above. Nevertheless, labelling start-ups always represents a risk, it is a way of showing a certain confidence a support from the Ministry on companies and this can in some cases propel start-ups: help to benefit from certain aids etc.

2) Analysis of the relationship between the bibliographical work and the missions

Few pieces of research have been done on this particular kind of labelling systems. This lack of literature makes it difficult to have a complete perspective on the effectiveness of the label.

The labelling process of Greentech Innovation is different from mainstream labels. While mainstream labels such as eco-labels have shown an increase of environmental and economic performance, it is not sure that it is the case for the Greentech Innovation label. As long as there are no in-depth studies done on the matter, it will be difficult to say for sure. Besides, labelling a company through a solution does not have the same impact than having a product that is. However, the Greentech Innovation label is not a quality label, it is a label that is meant to highlight solutions and to help them develop so that the policies implemented can be accelerated.

In this case, the labelling system does not have the impact of fixing information asymmetry, it is a way to assist companies to develop. The process is different, the result of labelling is as well.

Moreover, at the contrary of mainstream labels, this very specific kind of label, and the Greentech Innovation especially, is not well known. However, it is starting to be recognized within its ecosystem. Not many people know about it, it does not have the strength that it could have otherwise. Besides, the offers that the label is offering are not clear enough or not communicated enough so that companies can benefit from it completely. A better communication, and a precise assignment of tasks between the member of the team could enable it to have a larger public, and to have more in-depth assistance.

Conclusion and perspectives

The Greentech Innovation label is giving opportunities to companies. Indeed, they have access to a valuable network, they are highlighted and getting support for actions they might want to implement. Therefore, regarding the rate of young companies that are failing due to their lack of customers or investment, this label is giving these companies an opportunity to thrive. Of course, during the labelling process, the Greentech Innovation service is checking the ability of companies very carefully to find a market. Hence their chance to fail is lower. Moreover, even though the label is not very known, the fact that it is part of the Ministry of Ecological Transition gives credibility to these companies which can help them get grants and funding.

However, the fact that the service is highlighting companies with the most potential or those which are already succeeding does not give a clear view on if it is really the label that is enabling them to succeed. However, it is sure that being labelled gives credibility to companies and as their network can grow through this label, they might get more opportunities.

Nevertheless, the fact that this label is only four years old does not give the opportunity to have a clear perspective on the effectiveness of these companies contributing to the governmental policies, due to the label.

Regarding the acceleration policies that have been described, many companies seem to be promising on this matter. Indeed, the technologies that are being developed have the potential to replace malpractices and are making some practices towards sustainable development easier for both companies and households. Therefore, the opportunity that they get from being labelled to develop their activity makes them likely to act upon sustainable development policies. However, some innovations that are labelled do not fit the Ministry's policies questioning the coherence of labelling them. However, it would seem that labelling targets need to be reconsidered. Indeed, some labelled companies do not participate in ministerial policies while some policies have no or very little innovation dedicated to them. However, this might be due to an evolution of activity from the company. Hence, hearing them after some time, could have been a solution to avoid having this evolution which does not match the Ministry's policies. Nevertheless, in order to get a broader range of candidates,

further work on the search for candidates and above all, a greater visibility of the label beyond the ecosystem could lead to this kind of result.

Nevertheless, it would seem that a new approach is being put in place since the change of name. Indeed, it is on this occasion that the incubator network was announced, moreover the partnerships are multiplying and the potential behind this label could be revealed in the long term.

However, we could say that most Greentech Innovation's activities meant to help companies being developed are very promising, nevertheless, there is no guarantee that it really helps them. Besides, the offer does not always seem clear to companies, and their attendance to events, excepting for the visibility ones, is not very high, questioning the importance and/or relevance of these offers.

Moreover, this research has been based on SME's impact on accelerating the Ministry's policies, however, it could have been interesting to also focus on their impact on the environment, on a more global aspect, as well. Indeed, the current trend for Ministry's policies tend to focus on the CO₂ impact (carbon neutrality), data treatment and artificial intelligence while impacts on the environment are far wider than this focus. Therefore, the conclusion of this work might have been different if it had been focused on a broader perspective. Some questions could have been raised about the ability of labelled companies to have an impact on more aspects related to sustainable development. However, other companies could have been highlighted. Besides, the policies that have been presented are those related to the Greentech Innovation's criteria of selection, if other kinds of policies have been presented, regarding sustainable finance for example, the results would have been different as well, as there are, currently, no companies working on this subject at the moment. Therefore, this study has shown a bias regarding the range of policies for which the companies are contributing.

REFERENCES:

ADEME, 2019. Déchets Chiffres-clés L'ESSENTIEL 2019. Available at : https://www.ademe.fr/sites/default/files/assets/documents/dechets_chiffrecles_lessentiel_2019_010695.pdf

ADEME, 2020. *Documentation Base Carbone*. Bilans-ges.ademe.fr. Available at: https://www.bilans-ges.ademe.fr/documentation/UPLOAD_DOC_FR/index.htm?pesticides_et_autres_produits.htm.

ADEME, IN NUMERI. 2020. Marchés et emplois concourant à la transition énergétique dans le secteur des énergies renouvelables et de récupération, Situation 2016-2018, Perspective 2019, Objectifs 2023. 174 pages. Available at : <https://www.ademe.fr/marches-emplois-concourant-a-transition-energetique>

ADEME. 2016. Impacts des transports sur l'environnement. Available at: <https://www.ademe.fr/expertises/mobilite-transports/elements-contexte/impacts-transports-lenvironnement>.

ADEME. 2017. Bilan 2010 - 2017 du Programme d'investissements d'avenir (PIA) – ADEME. Available at: <https://www.ademe.fr/bilan-2010-2017-programme-dinvestissements-davenir-pia>.

Arjaliès, D., et al., 2013. Le rôle de la labellisation dans la construction d'un marché: Le cas de l'ISR en France. *Revue française de gestion*, 236(7), 93-107. doi:10.3166/RFG.236.93-107.

BALDI I., et al.. 2013 Pesticides Effets sur la santé, Paris : Les éditions Inserm. Available at : <https://www.inserm.fr/information-en-sante/expertises-collectives/pesticides-effets-sur-sante>

Blandin-Obernesser A. et al., 2020. Feuille de Route sur l'environnement et le numérique. 50 mesures pour un agenda national et européen sur un numérique responsable c'est-à-dire sobre et au service de la transition écologique et solidaire et des objectifs de développement durable. Conseil National du Numérique. Available at : <https://www.vie-publique.fr/rapport/275352-feuille-de-route-sur-lenvironnement-et-le-numerique>

Bogers et al., 2014. "Surfing the New Wave of Open Innovation Research," in *New Frontiers in Open Innovation*, (Oxford: Oxford University Press, 2014), pp. 281-294; J. West, A. Salter, W. Vanhaverbeke, and H. Chesbrough, "Open Innovation: The Next Decade," *Research Policy*

Bordage F., 2019. Environmental footprint of the digital world. GreenIT. Available at : <https://www.greenit.fr/environmental-footprint-of-the-digital-world/>

Breton, É., 2014. Répondre à l'appel (à projets): Récits d'un apprentissage silencieux des normes de l'action publique patrimoniale. *Politix*, 105(1), 213-232. <https://doi.org/10.3917/pox.105.0213>

Commission des comptes des transports de la nation. 2019. Les comptes des transports en 2018 - 56e rapport de la Commission des comptes des transports de la Nation. Available at : <https://www.statistiques.developpement-durable.gouv.fr/les-comptes-des-transports-en-2018-56e-rapport-de-la-commission-des-comptes-des-transports-de-la>

Coulmin, A., et al., 2020. *Biodiversité Rare Ou Menacée : Peu D'améliorations Depuis 2007*. Statistiques.developpement-durable.gouv.fr. Available at: https://www.statistiques.developpement-durable.gouv.fr/sites/default/files/2020-03/datalab-essentiel-207-biodiversite-rare-menacee-mars2020_0.pdf

Dagorne, A. et al., 2005. Catastrophes, risques naturels, anthropiques et technologiques : la cindynique. Dans : Andrée Dagorne éd., *Les risques naturels: La cindynique* (pp. 3-8). Paris cedex 14, France: Presses Universitaires de France. Available at : <https://www.cairn-int.info/les-risques-naturels--9782130551775-page-3.htm>

Deloitte DD, 2016. Potentiel de Contribution du Numérique à la Reduction des Impacts Environnementaux. Etat des Lieux et Enjeux pour la Prospective. ADEME Available at : <https://www.ademe.fr/potentiel-contribution-numerique-a-reduction-impacts-environnementaux>

Edenhofer et al., 2011. Renewable Energy Sources and Climate Change Mitigation Report. IPCC. Available at. https://www.ipcc.ch/site/assets/uploads/2018/03/SRREN_Full_Report-1.pdf

European Commission, 2004. Community guidelines on state aid for rescuing and restructuring firms in difficulty, Official Journal of the European Union, p.2.

European Commission, 2015. User guide to the SME definition, Luxembourg: Publications Office of the European Union, ISBN 978-92-79-45301-4 Available at: <https://ec.europa.eu/docsroom/documents/15582/attachments/1/translations>

French Mobility, 2020. Plan d'action. La démarche France Mobilité. Available at: <https://www.francemobilites.fr/demarche/plan-action>

Géorisque, 2020. Inondations, Présentation. Available at : <https://www.georisques.gouv.fr/risques/inondations>

Géorisque, 2020. Mouvements de terrain, Présentation. Available at : <https://www.georisques.gouv.fr/risques/mouvements-de-terrain>

Géorisque, 2020. Séismes, Présentation. Available at : <https://www.georisques.gouv.fr/risques/seismes>

Géorisque, 2020. Volcanisme, Présentation. Available at : <https://www.georisques.gouv.fr/risques/volcanisme>

Greenshield. 2020. Home - Greenshield. Available at: <https://greenshield.fr/#Projets>.

Hilgers D. and Ihl C., 2010. "Citizensourcing: Applying the Concept of Open Innovation to the Public Sector," International Journal of Public Participation, 4/1 p 67-88.

Houe R., et al., 2009. Assessing the compliance of a product with an eco-label: from standards to constraints International Journal of Production Economics, Volume 121, pp. 21-38, Available at: doi.org/10.1016/j.ijpe.2008.03.014

Institut du Numérique Responsable, 2020. Charte Numérique Responsable. Available at: <https://charte.institutnr.org/>

J. Sjunnesson, 2005, Life Cycle Assessment of Concrete. Available at: <http://lup.lub.lu.se/luur/download?func=downloadFile&recordId=4468239&fileId=4469176>

KOVATS S. et al., 2014. AR5 Climate Change 2014: Impacts, Adaptation, and Vulnerability. Chapter 23. IPCC. Available at: <https://www.ipcc.ch/report/ar5/wg2/>

Le portail technique de l'OFB. 2020. Dataviz - Les produits phytosanitaires en France | Le portail technique de l'OFB. [ONLINE] Available at: <https://professionnels.ofb.fr/fr/doc-dataviz/dataviz-produits-phytosanitaires-en-france>.

Leveque A., 2019. Les enjeux de biodiversité en France métropolitaine : analyses croisées. Service de la Donnée et des Études Statistiques. Commissariat Général au Développement Durable. Ministère de la Transition Écologique. Available at : <https://www.statistiques.developpement-durable.gouv.fr/les-enjeux-de-biodiversite-en-france-metropolitaine-analyses-croisees>

Leveque et al., 2018. Biodiversité - Les chiffres clés – Édition 2018. Service de la Donnée et des Études Statistiques et Observatoire National pour la Biodiversité. Commissariat Général au développement durable, Ministère de la Transition Écologique. Available at : <https://www.statistiques.developpement-durable.gouv.fr/biodiversite-les-chiffres-cles-edition-2018>

Magnier C., et al., 2017, 10 indicateurs clés pour le suivi de l'économie circulaire, Données et études statistiques, Ministry of Ecological Transition. Available at :

<https://www.statistiques.developpement-durable.gouv.fr/sites/default/files/2018-10/datalab-18-economie-circulaire-edition-2017-c.pdf>

Ministry of Agriculture. 2015. Plan EcoPhyto 2. Available at: https://agriculture.gouv.fr/sites/minagri/files/151022_ecophyto.pdf

Ministry of Agriculture. 2018. Le Gouvernement donne une nouvelle impulsion au plan Écophyto. Available at: <https://agriculture.gouv.fr/le-gouvernement-donne-une-nouvelle-impulsion-au-plan-ecophyto>

Ministry of Agriculture. 2020. Le plan EcoPhyto qu'est-ce que c'est? Available at: <https://agriculture.gouv.fr/le-plan-ecophyto-quest-ce-que-cest>

Ministry of ecological Transition, 2013, Rapport de la France sur la transposition de l'article 7 de la directive 2012/27/UE relative à l'efficacité énergétique. Available at : <https://ecologie.gouv.fr/sites/default/files/Rapport%20article%207%20-%20Commission.pdf>

Ministry of Ecological Transition, 2016. Prévention des risques majeurs. Synthèse. La démarche française Available at : <https://www.ecologie.gouv.fr/sites/default/files/pr%C3%A9vention%20des%20risques%20majeurs%20d%C3%A9marche%20fran%C3%A7aise%20ed%202016.pdf>

Ministry of Ecological Transition, 2017. Energie dans les bâtiments. Politiques publiques, bâtiments et règles de construction. Available at : <https://www.ecologie.gouv.fr/energie-dans-batiments>

Ministry of Ecological Transition, 2018. Stratégie nationale pour la biodiversité. Available at: <https://www.ecologie.gouv.fr/strategie-nationale-biodiversite>

Ministry of Ecological Transition, 2020. Rapport de la France. En application des articles 24.1 et 24.2 de la directive 2012/27/UE du Parlement européen et du Conseil du 25 octobre 2012 relative à l'efficacité énergétique Actualisation 2020. Available at: <https://ecologie.gouv.fr/sites/default/files/Rapport%20annuel%202020.pdf>

Ministry of Ecological Transition, 2020. Exigences réglementaires pour la construction des bâtiments. Politiques publiques, bâtiments et règles de construction. Available at : <https://www.ecologie.gouv.fr/exigences-reglementaires-construction-des-batiments>

Ministry of Ecological Transition. 2016, Règlement AAP Greentech Innovation

Ministry of Ecological Transition. 2018, Règlement AMI Greentech Innovation

Ministry of Ecological Transition. 2019, Règlement AMI Greentech Innovation

Ministry of Ecological Transition. 2019. La feuille de route économie circulaire (FREC) | Ministère de la Transition écologique. Available at: <https://www.ecologie.gouv.fr/feuille-route-economie-circulaire-frec>.

Ministry of Ecological Transition. 2020, Guide méthodologique à l'attention des lanceurs d'appels à projets visant à accompagner le développement durable des territoires

Ministry of Ecological Transition. 2020, Règlement AMI Greentech Innovation

Ministry of Ecological Transition et al.. 2020. Communiqué de presse : Plan de réduction des produits phytosanitaires et de sortie du glyphosate : le Gouvernement renforce la transparence des données et la mobilisation de l'expertise scientifique

Moisan, F., 2011. Du fonds démonstrateur aux investissements d'avenir : promouvoir une offre française dans le domaine des technologies vertes. *Annales des Mines - Responsabilité et environnement*, 61(1), 109-115. Available at : <https://doi.org/10.3917/re.061.0109>

Mortureux M., 2017. Rapport du délégué aux Risques majeurs 2015-2017 - Délégué aux risques majeurs, Direction général de la prévention des risques. Ministère de la Transition Ecologique et solidaire. Available at : <https://ree.developpement-durable.gouv.fr/donnees-et-ressources/ressources/publications/article/rapport-2015-2017-du-delegue-aux-risques-majeurs>

Nelson, P., 1970. Information and Consumer Behavior. *Journal of Political Economy*, 78(2), 311-329. Available at: <http://www.jstor.org/stable/1830691>

P. KUMAR MEHTA, 2001, Reducing the environmental impact of concrete. Available at: <http://ecosmartconcrete.com/docs/trmehta01.pdf>

P.M. Godoy Hilario, 2019, Production totale de ciment France 2011-2017. Statista. Available at: <https://fr.statista.com/statistiques/544737/production-ciment-france/>

Phan et al., 2020. Chiffres clés des énergies renouvelables - Édition 2020. Service des données statistiques et étude. Le service des données et études statistiques. Ministère de la Transition Ecologique. Available at : https://www.statistiques.developpement-durable.gouv.fr/sites/default/files/2020-07/datalab_69_chiffres_cles_enr_edition2020_juillet2020_0.pdf

Pingault N. et al., 2009, « Produits phytosanitaires et protection intégrée des cultures : l'indicateur de fréquence de traitement », Notes et études socio-économiques, 32, 61-94.

Remon, D., 2012. Innovation ouverte et capacités dynamiques : préparation à la collaboration internationale des PME. *Innovations*, 39(3), 71-98. Available at : doi:10.3917/inno.039.0071.

Renaud, C. et al., 2011. Evaluation globale des impacts environnementaux des itinéraires techniques viticoles : l'Analyse du Cycle de Vie (ACV). *Revue Suisse d'arboriculture Viticulture, Arboriculture, Horticulture*, 43(3), pp.184-189.

Réseau d'avertissements phytosanitaires, 2011. Coûts de fongicides, d'insecticides et d'herbicides homologués dans la vigne en 2011. Bulletin d'Information Agrireseau.net. Available at: <https://www.agrireseau.net/Rap/documents/b03vig11.pdf>.

Spittler S. 2020. Interview with Benoit Spittler, ex inspector for installations classified for the protection of the environment (ICPE)

Streletskaia, N. et al.. 2019. 'Absence labels: How does information about production practices impact consumer demand?', *PLoS one*, 14(6), p. e0217934. Available at : doi: 10.1371/journal.pone.0217934.

Syndicat National du Béton Prêt à l'Emploi. 2020. *Les Chiffres De La Production 2018*. Available at: https://www.snbpe.org/le_bpe/la_production/les_chiffres_de_la_production_2016

Urruty et al.. 2015. Usage des pesticides en agriculture : effets des changements d'usage des sols sur les variations de l'indicateur NODU. Available at: <https://agriculture.gouv.fr/usage-des-pesticides-en-agriculture-effets-des-changements-dusage-des-sols-sur-les-variations-de>

Vadillo S. 2018. Les innovations accélérant la transition écologique. Available at: <http://Greentechverte.fr/wp-content/uploads/2018/11/Memoire-Sarah-Vadillo.pdf>

Vicard F. et al., 2018. Modélisation macroéconomique appliquée à l'économie circulaire. Etat de l'art et préconisations de développement. Rapport d'expertise de l'ADEME.

Vin-vigne.com. 2020. *Vignoble De France - Liste Des Vignobles Français - Vin-Vigne.Com*. Available at: <http://www.vin-vigne.com/vignoble/> .

Wen H. et al.. 2020. Impact of environmental labeling certification on firm performance: Empirical evidence from China. *Journal of Cleaner Production*, Volume 255

Zahm F., 2011, « Grenelle Environnement, plan Ecophyto 2018 et indicateurs agro-environnementaux : outils de pilotage versus instruments d'une transformation de l'action publique agro-environnementale », 10es journées françaises de l'évaluation, Juin 2011, Nantes, France. Available at: https://www.researchgate.net/publication/280857825_Grenelle_Environnement_plan_Ecophyto_2018_et_indicateurs_agro-environnementaux_Outils_de_pilotage_versus_instruments_d'une_transformation_de_l'action_publice_agro-environnementale