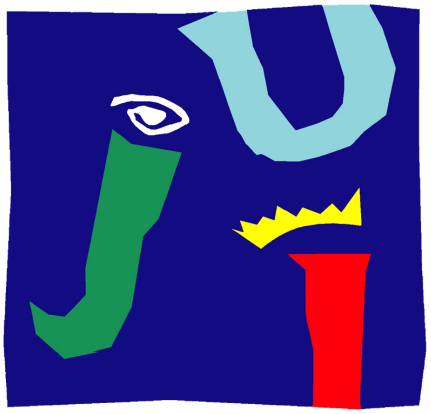

UNIVERSITAT JAUME·I

DIGITALISATION AND GREEN ECONOMY

Autor: Ivan Miralles Soler

Tutor: Luis Martínez Cháfer

GRADO EN ADMINISTRACIÓN Y DIRECCIÓN DE EMPRESAS

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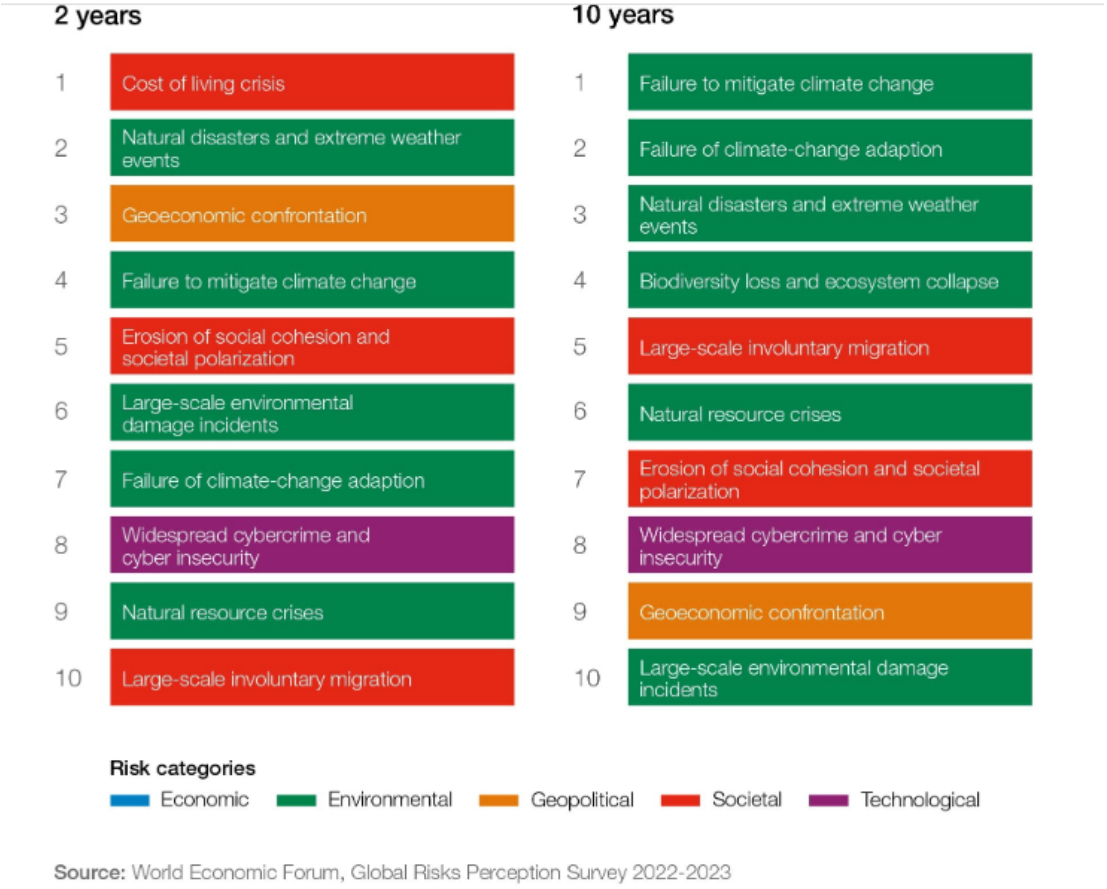
1. INTRODUCTION

Nowadays, as described in *Business intelligence: business evolution after industry 4.0. Sustainability* (Romero et al., 2021), Any company is subject to a highly competitive and constantly changing business environment. Therefore, companies must be able to adapt quickly to new technologies and trends, and take advantage of the opportunities they present. The authors describe today's business environment as the Industry 4.0 era, characterised by digitisation and automation of industrial processes through advanced technologies such as the Internet of Things (IoT), artificial intelligence and machine learning.
On the other hand, when thinking more globally, the world is in serious trouble. According to the World Economic Forum, in 5 to 10 years, the world's biggest problems will have to do with the environment.

Figure 1: Problems of the future



Source: World Economic Forum, Global Risks Perception Survey 2022-2023

That is why the main objective of this work will be to find the relationship between these two concepts, and reply to the following question, how digitalisation can help us to improve the green economy?.

The paper will be divided into three main blocks, digitalisation, the green economy and a third where I will study how these two concepts can be related with the help of several examples.

In the first section I will discuss various aspects of digitalisation. First, I will define what digitalisation is and explain why it is crucial for companies to adapt to it. Next, I will examine COVID impact on digitalisation. After this, I will discuss some key concepts, such as artificial intelligence and Big Data. Finally, I will discuss some of the main obstacles that companies may face during this process.

In the second section, I will focus on the green economy. I will start by giving an overview of what the green economy entails and why it is essential. I will also discuss the key concepts surrounding the green economy. To conclude this section, I will discuss the main problems of the green economy.

After taking a closer look at these two concepts and before looking at specific case studies, I will look at the relationship between digitalisation and the green economy from a theoretical point of view.

In the last section, I will talk about the relationship between these two concepts, how digitalisation can and should help the green economy, as well as the study of some cases where it is already happening.

2. THEORETICAL FRAMEWORK

2.1 Digitalisation

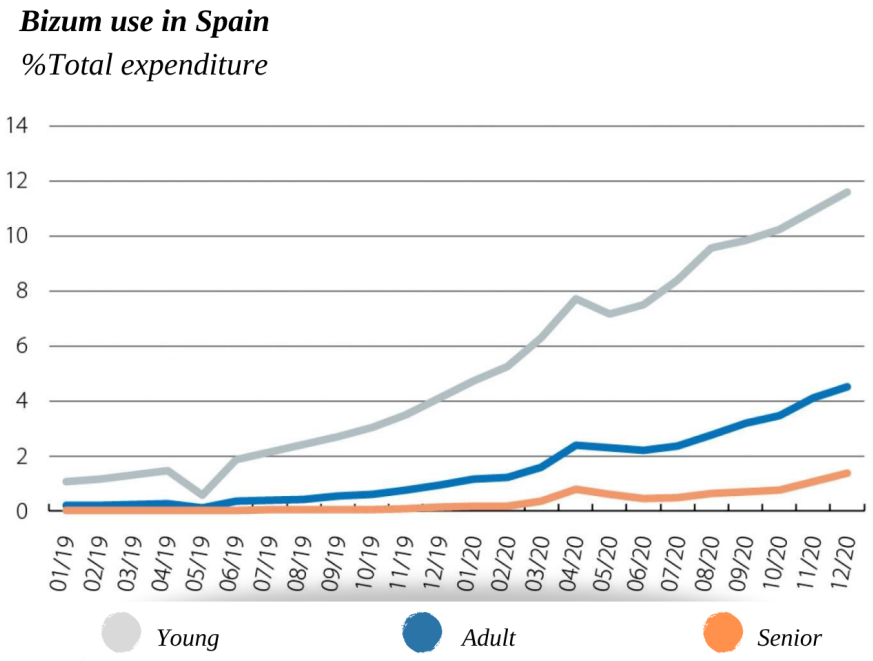
Digitisation, according to the RAE, is the action of digitising. But, what is digitising? Digitising refers to recording data digitally. When can we say that a company or society has been digitised?, It occurs when the company has carried out the process of digital transformation. If we focus on business digitisation, according to Patton (2002: p. 456) "digitisation is a procedure that compiles the set of activities that the organisation undertakes to introduce digital technologies into its operations". It is this concept that we will try to understand in this section.

Everyone, whether the head of a company, an employee or an individual, must adapt to technology to some extent. As a manager or director, it's important to stay aware of technological changes in your industry. The current environment is constantly changing and dynamic. For example, traditional banks now need to have the bizum function to stay relevant. This change means fewer people physically go to banks to solve problems. 15 years ago, these tools were unimaginable. And bank managers were the ones who had the obligation not to be left behind, and to implement this type of digitalisation quickly.

On the other hand, there are the employees, there is a change in the way they work, in their day to day, they need to learn how the new tools work perfectly to be able to solve any doubts that customers may have. This implies a lot of training, workload and extra effort that they are obliged to make to keep adapting to the environment.

Finally, people. The following graph shows how people's use of bizum has evolved:

Figure 2: Use of bizum



Source: *https://www.caixabankresearch.com/es/economia-y-mercados/mercado-laboral-y-demografia/del-billete-bizum-empujon-intergeneracional*

The case of young people is the most striking: from less than 2% of total spending at the beginning of 2019 to almost 13% by the end of 2020. Not only young people, but all age groups saw their use of this tool increase. The reason for this growth can be explained by two reasons, the tool was the right fit, easy to use and convenient, and COVID19 accelerated the digitisation of many organisations as we will see later.

This example provides a clear view of the process of digital transformation. What began as a collaborative effort among Spanish banks has proven to be a successful endeavour, resulting in a cost-effective and transparent payment and transfer method. Ultimately, it has brought about a significant cultural shift.
Digitalisation is a way to gain a competitive advantage, but also to achieve a benefit for customers, a more sustainable development, increase profitability, etc.

According to Borland and Coelli (2017), it is also quite common to hear phrases like robots will take our jobs . Is this true?, in part yes. According to a report by the World Economic Forum, it is estimated that by 2025, 85 million jobs will shift from people to machines. This is not a problem, as according to the same report, 97 million new jobs may emerge. This may represent a great opportunity for many, and a great responsibility for society as a whole. We will have to adapt, to be sufficiently qualified for the new jobs that will arise from digital

evolution. Later on, we will see through some examples, how digitalisation should not be related to job loss, but to job improvement.

In this block we will talk about how important is digitalisation, the main problems or disadvantages that we may encounter and that can cause us various problems, how it affects the COVID, what Big Data and AI are and some examples.

2.1.1 Concept and process

Digital transformation, according to Al-Debei et al., (2020:p.5), is "the process by which an organisation uses digital technologies to improve efficiency, effectiveness and innovation in its business processes and ultimately create value for its customers and stakeholders". . How does this process take place?

The digital transformation process

According to Al-Debei et al., (2020), digital transformation affects all areas of the organisation, from marketing to design and distribution. It involves a restructuring of the company

On the one hand, the emergence of the Internet has meant the transformation of products, for example in music or films, from physical CDs or digital disc downloads to content such as films. As digital transformation takes place, business operations will need to change both externally and internally to adapt to technological changes and customer demands. According to Randstad (2017), it will also require changing the way you communicate with customers, as well as the decision making and decision-making process. This process will involve significant changes such as an overhaul of the company's organisation, strategy and operations.

According to Al-Debei et al., (2020), for these changes to be successful, they must be fast, scalable and valuable. It stands to reason that stronger, leading companies will benefit more from digital transformation, because they have more resources than smaller companies to make the change successful.

The authors say that digital transformation means the introduction of newer and more efficient products, services and business models, so companies must become digitally enabled. A new approach is needed, and to assess the global changes from the value chain to manufacturing, materials, packaging…

Therefore, you can choose to make drastic changes, find new external managers and let them bring their technical skills to the company as soon as possible, even if this may cause a cultural conflict between the new managers and the existing managers in the organisation.

On the other hand, opt for more modest changes, so that the transformation is carried out by internal managers, although this option is not as effective as radical changes, because technologies develop quickly and managers cannot implement them. Once a company has embedded its digital culture and established transformation processes, the process must be deliberate.

Therefore, to keep it going, it needs to constantly update and upgrade itself to gradually adopt new technologies. Simplify technical processes for differentiation. Increase digital investment more than competitors to have more digital opportunities in more areas.

Finally, involve employees who are interested in the digital transformation process and who are not afraid of change and risk from the very beginning.

Once we have seen the process, let's talk about the importance of digitalisation.

2.1.2 Importance of digitalisation

Digitalisation has had a significant impact on today's society, transforming the way people communicate, work and live. Digitalisation has changed the way businesses operate and has enabled the creation of new ways of working. This section will examine the importance and impact of digitalisation on society and the global economy, as well as its impact on people's values and orientations.

According to Blštáková et al. (2020), digitalisation is transforming the way companies manage their employees and that this is having an impact on business values. These authors focus on people management, which is being transformed by digitalisation in terms of how employees are hired, trained and managed. Their paper presents the results of

empirical research conducted in a Slovakian company, which examines the values of people management in the digital age. The authors identify three key values that are emerging in the digital era: flexibility, innovation and sustainability. They also discuss how these values are transforming people management in the digital age. In particular, they argue that flexibility is becoming a core value in people management as digitalisation allows employees to work remotely and have more flexible working hours. Innovation is also emerging as an important value in the digital age, as technology is enabling companies to develop new ways of working and create new products and services. Finally, sustainability could be a key value in the digital age, as technology is enabling companies to reduce their environmental and social impact.

In the same stream of literature, Nikitenko's (2019) study focuses on the impact of digitalisation on people's value orientations in modern digital society. The study examines how digitalisation has influenced people's values, attitudes and behaviours in society. The results show that digitalisation has led to significant changes in people's value orientations, and has led to an increased focus on freedom, individuality and self-determination. Digitalisation has led to an increased interest in innovation and creativity, and to an increased importance of connectivity and social interaction through digital media. In addition, the study shows that digitalisation has meant an increased focus on sustainability and the environment.

Complementarily, Basaev, Z. V. (2019) highlights that the digitalisation of the economy has become a major trend worldwide, and that this trend has led to a number of significant changes in the way business is conducted. In particular, Basaev notes that the digitalisation of the economy has enabled companies to improve their efficiency and reduce their costs. Digitisation has enabled companies to automate processes and improve data management, leading to greater efficiency and reduced operating costs. In addition, digitisation has enabled companies to reach new markets and audiences through digital platforms, which has broadened their customer base and increased their growth potential. The author also highlights that digitalisation has created new ways of working, such as remote working and freelancing, which has led to greater flexibility and freedom for workers. This has had a significant impact on the way businesses operate, as it has allowed companies to access talent from all over the world and enabled workers to find jobs that suit their needs and skills.

In addition, Basaev points out that digitalisation has led to the creation of new companies and business models, especially in the technology sector. Technology companies have been able to leverage digitalisation to create new products and services, and have been able to

reach new audiences through digital platforms. This has meant an increase in competition and has allowed consumers to access a wide variety of choices.

Finally, Basaev also highlights that digitalisation has had a significant impact on international trade. Digitalisation has enabled companies to access new markets and has removed many of the traditional barriers to trade. With digitalisation, new forms of commerce have emerged, such as e-commerce, which has enabled companies to reach customers around the world in a more efficient way.

On the other hand, digitalisation has also created new challenges, such as the digital divide between those who have access to technology and those who do not. This gap can perpetuate economic and social inequality and limit access to employment and educational opportunities.

In conclusion, digitalisation is a complex phenomenon that has transformed society and the global economy. While it has had a significant impact on efficiency, innovation and flexibility, it has also created challenges. It is therefore important to work to maximise its benefits and minimise its negative impacts.

2.1.3 COVID-19 and digitalisation boom in Spain

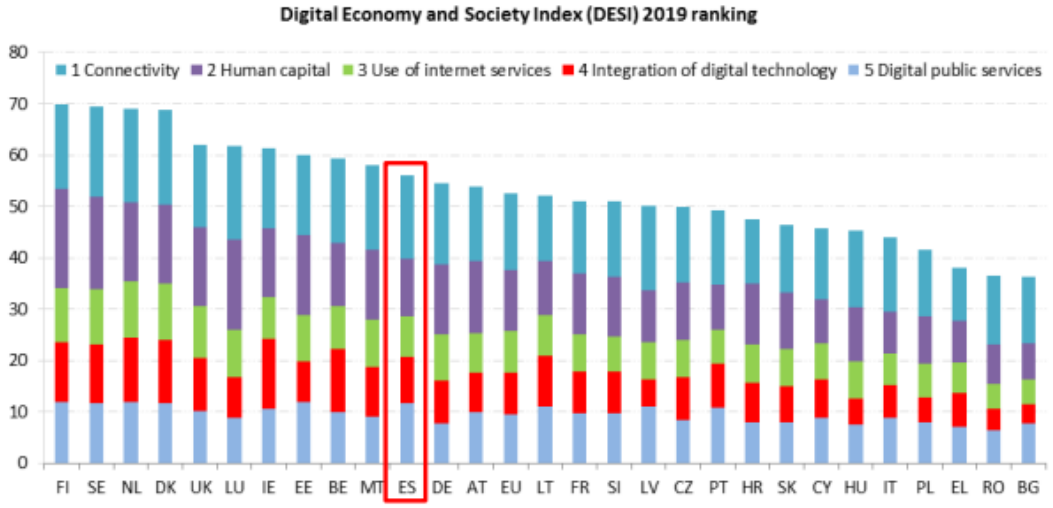
Now I will analyse how the famous pandemic in Spain affected this concept in Spain. In order to observe more precisely how COVID-19 affected our country, we are going to use the Digital Economy and Society Index (DESI). The DESI index is a way of monitoring the different digital advances of the member states of the European Commission. For this it takes 4 factors: human capital, connectivity, digital technology integration and digital public services (it should be noted that these factors are different in 2019 from 2022). In our case, we will look at the DESI index for Spain in 2019, the pre-pandemic year, and then at the index for 2022, in order to observe the progress of the Digital Economy and Society Index.

Table 1: DESI Spain 2019

	Spain		EU
	rank	score	score
DESI 2019	11	56,1	52,5
DESI 2018	11	53,2	49,8
DESI 2017	13	49,1	46,9

Source: Digital Economy and Society Index 2019, Country Report for Spain.

Figure 3: DESI Spain 2019



Source: Digital Economy and Society Index 2019, Country Report for Spain.

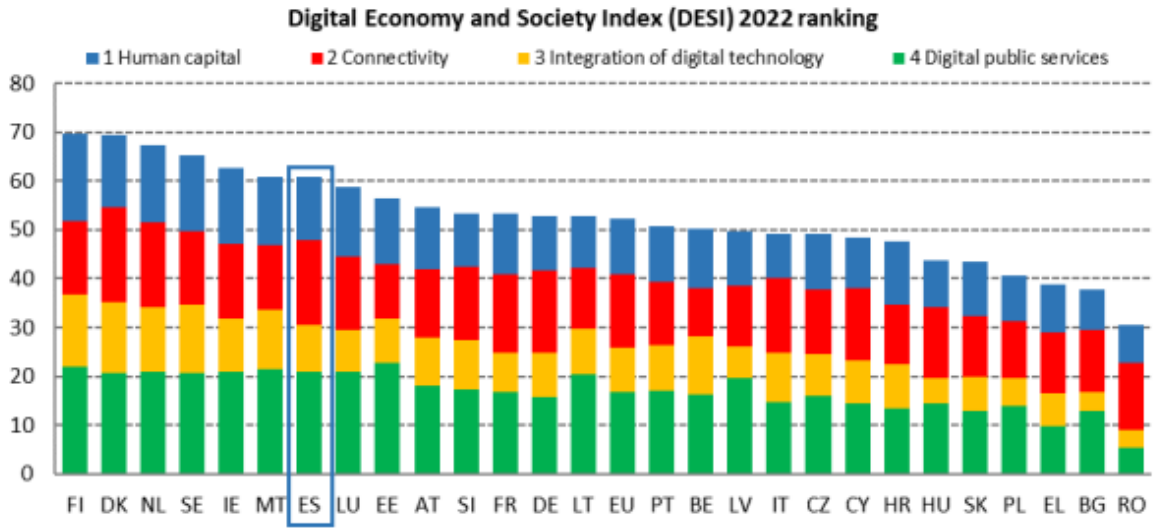
In 2019 we see Spain ranked eleventh out of twenty-eight, the same position as the previous year, and two above 2017, with a score above the EU average.

Table 2: DESI Spain 2022

	Spain		EU
	rank	score	score
DESI 2022	7	60,8	52,3

Source:Digital Economy and Society Index (DESI) 2022 Spain

Figure 4: DESI Spain 2022



Source:Digital Economy and Society Index (DESI) 2022 Spain

If we compare the year 2022 with 2019, we can see that Spain has benefited from the COVID-19 situation, moving from eleventh to seventh place, as well as increasing its total score while that of the European Union has remained intact, which leads us to think that Spain has taken advantage of the COVID to digitise itself even more, and continue with the growth it was already experiencing, with the difference that the EU was growing before, and has now stagnated in terms of digitisation while Spain has continued to grow. The analysis of these data leads me to ask the following question.

Has COVID-19 led to a boom in digitalisation in Spain?

Agree to Badal (2020), Yeeply, which is a staff outsourcing platform for digital and technological projects, during the confinement registered a 240% increase in advertised projects compared to the previous year. Luis Picurelli, founder of Yeeply believes that digital transformation has always been necessary, commenting that necessity makes human beings turn to innovation. In short, COVID has meant, at least in Spain, that what was once an option has become a necessity, thus accelerating digitisation in many organisations, leading to a boom in digitisation.

2.1.4 Key concepts

In the following, I will explain some of the most important concepts of digitalisation, I will talk about Big Data and artificial intelligence.

Big Data

Big Data, according to Reche (2019), is one of the tools with the most possibilities for an organisation, however many managers do not understand very well what it is, or how they can use it to their advantage.Big Data can be defined as a combination of all the tools and processes used for the management of large data sets, the principle on which it is based is: the more knowledge in any case, the better it can be analysed and the easier it is to predict what will happen in the future. On the other hand, according to Oracle (2019) Big Data is related to 'the three Vs', in this article it is understood that Big Data encompasses data with a greater variety, at a higher velocity, and which are presented in increasing volumes.
Now that we know what Big Data is, let's look at its real importance today.

The value of Big Data

To find out its real value, let's try to answer a few questions: is all the data useful, what is its real value, and do the world's leading companies use this tool?

Referring to the first question, it is logical to observe that nowadays data is everywhere, there is data on anything and anyone, some of which may seem really useless. Is it?
According to Oracle (2019) article mentioned above, all data has a value, the hard part is to find out which one, if we don't find out the value, the data will be completely useless. To discover this value we will need analysts, people who know how to use and understand this tool. To discover this value, you have to ask the right questions and identify patterns, so that you can predict behaviour.

As for the next two questions, Big Data is already an indispensable asset for some of the most influential organisations around the world, let's take a closer look at some examples according to Tomas (2023).

Netflix
This big company, known all over the world, was already using Big Data in 2006, when it launched the "Netflix Prize", a prize awarded to the person able to create the best algorithm to find out the opinion of subscribers on a series or movie, taking into account previous ratings. The winner of this prize received one million dollars.

Amazon

Amazon uses algorithms such as the "Amazon Elastic MapReduce platform for machine learning" to collect, store and use search and purchase history data. With this they manage to offer recommendations with a high probability of purchases, optimise the supply chain and prices or detect fraud, among other things.

Zara

In the case of a company like Zara, they use Big Data to predict new trends as early as possible, and ship clothes to shops at high speed. They collect data from their daily inventory, customer feedback and in-store orders.

Artificial Intelligence

Artificial intelligence is the current hot topic. According to Girasa (2020). Artificial intelligence is a disruptive technology that has the potential to transform a wide range of industries and sectors. According to Malik et al. (2020), artificial intelligence is a key factor in digitalisation, as it allows companies to automate processes and improve decision-making.But what is artificial intelligence really, will it change the world, and if it will change the world, when will it do so?

Artificial intelligence, according to Schmid. (2020: p4), is defined as "the ability of machines to learn from data and perform tasks that would normally require human intelligence, such as visual perception, abstract reasoning and decision making".

The value of artificial intelligence:

According to Girasa (2020), artificial intelligence has the potential to be a disruptive technology that transforms the economy and society in several ways.

First, artificial intelligence can change the way certain tasks are performed, improve the efficiency and accuracy of operations and enable the creation of new products and services. This can lead to the transformation of existing business models and the emergence of new companies and economic sectors.

Second, artificial intelligence can have a significant impact on the labour market. By automating tasks that were previously performed by humans, artificial intelligence may displace workers from certain jobs and require new skills and capabilities to work with the technology. Therefore, artificial intelligence has the potential to change the labour market and the way people work.

Third, artificial intelligence can have an impact on decision-making and governance. By using artificial intelligence to analyse data and generate recommendations, governments and organisations can make more informed and effective decisions. However, there is also a risk that artificial intelligence can introduce bias and prejudice into decision-making.

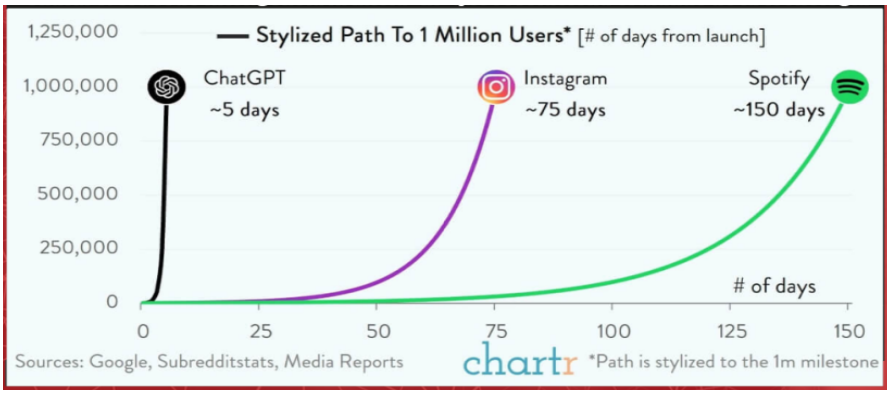
The author concludes that artificial intelligence is a disruptive technology that has the potential to transform the economy and society in multiple ways. As the technology continues to advance, appropriate policies and regulations will be required to ensure that artificial intelligence is used responsibly and its potential negative impacts are minimised.

When is the time for artificial intelligence?

Both Schmidt (2020) and Girasa (2020) agree in their views on this issue.

Girasa and Schmidt think that artificial intelligence is already transforming the economy and society. Both expect this impact to expand even further in the future. It is worth bearing in mind the year in which their articles were written, 2020. In that year, the use of artificial intelligence had not yet gone viral. However, in 2023, the use of AI as "GPT chat" is already normalised in society. This will lead to an unprecedented virilization in the world of technology.

Figure 5: Chat GPT



Source: https://gestion.pe/blog/innovar-o-ser-cambiado/2023/02/chat-gpt-crece.html/

In short, to the question we asked earlier: When? The answer is now.

2.1.5 Digitalisation problems

We have already talked about the need to digitise and how to do it, now we are going to talk about some problems or drawbacks that we may encounter in the process, which may deprive us of the desired benefits. This section is based on the main barriers to digital transformation, according to Reche (2020) and Elg et al. (2021), some of the barriers or problems, on which both sources agree, are the following:

Human factor

In the first place, we find humans, in his text on the main barriers to digital transformation, Alfredo Reche (2020). The author indicates that the main barrier we are going to find when we want to digitise an organisation is people. It is advisable to create a plan to manage human barriers in addition to the digital transformation programme. Digital transformation involves a cultural change, and the organisations that will reap the greatest benefits and successfully complete the process are those that manage to change the mindset of their employees. George Westerman defined the process with a curious comparison: 'when digital transformation is done well, it is like a caterpillar becoming a butterfly, but when it is done badly, all you get is a faster caterpillar'.

Therefore, it is logical to think that the more traditional companies, with workers who are more distant from technology, will have greater difficulties in achieving change, they will have to change the mentality of the employees, a change that is more cultural than technological. This is why many of the other barriers that we will find below will have to do with this factor, people.

Security

According to Elg et al. (2021), digitisation involves the collection, storage, processing and analysis of large amounts of data. This data can include sensitive information about the business, employees, customers and suppliers, so it is essential to ensure its security and privacy.

Digitisation can increase the risk of data security and privacy breaches due to increased exposure to threats such as hacking, malware and phishing attacks. In addition, digital quality management systems may require access to data from multiple sources, which increases complexity and the risk of security breaches.

It is important for organisations to implement appropriate security measures to protect data, such as the use of firewalls, data encryption and restricted access to sensitive information.

Budget

According to Elg et al. (2021) and Reche (2020) , digitisation of quality management may require significant investment in technology, software and hardware, staff training and other resources. In addition, the implementation of new technologies and systems may generate additional costs, such as the need to upgrade existing infrastructure and systems to ensure compatibility and integration.

Furthermore, it is important to keep in mind that digitisation of quality management is not a one-size-fits-all solution for all organisations. The needs and requirements of each organisation can vary significantly and therefore the required digital solutions can also be different and costly.

On the other hand, digitisation can also generate long-term savings in terms of efficiency and productivity, which can offset the initial costs of implementation. In addition, digitisation can enable better decision-making, greater transparency and a better ability to detect and correct quality issues, which can result in additional savings.

Skills and talent shortages

As we have already mentioned, people are very important when it comes to dealing with change, we do not always have the ideal people in our company. According to Elg et al. (2021), Digitalisation requires companies to have trained and digitally skilled staff to implement and use digital technologies effectively. However, not all organisations have the right staff with the necessary skills and knowledge to make the most of digital solutions.

Lack of digital skills can be a major barrier to the digitisation of quality management, as it can limit the organisation's ability to identify, select and implement digital solutions. In addition, a lack of digital skills can prevent the organisation from taking full advantage of digital tools and solutions, which can limit the benefits of digitisation.

Fear and resistance to change

Finally, one more barrier has to do with people.
Both articles agree that:
Change causes uncertainty, and uncertainty causes fear. It is very common to hear the phrase "we have always done it this way here", it is the phrase that most clearly exemplifies resistance to change, it is believed that the change will be worse, that it will fail.
Resistance to change can be more common in companies that work well, why change something that works? Here leadership plays a very important role, it has to make all employees understand that change is necessary, that it is for the better, and try to involve everyone in the change. One way to avoid fear of change may be to introduce change gradually, rather than opting for radical change.

Table 3: Summary of digitisation problems

Barrier	Description
Human factor	The human factor, including resistance to change and lack of digital skills, can hinder digital transformation.
Security	Digitization involves risks of data security and privacy, so it is important to implement appropriate safeguards.
Budget	Digital transformation may require significant investment in technology, staff training, and other resources.
Skills shortage	The lack of digital skills can limit an organisation's ability to identify and adopt digital solutions effectively.
Fear and resistance to change	Fear and resistance to change can impede the adoption of digital transformation in organisations.

2.2 Green economy

2.2.1 The concept

What is the green economy? This is the first question to be answered in this second section. To solve this question we will rely on Milačić, B., Bačić, M., & Anić Vučinić, A. (2019). This study analyses 140 definitions of green economy to observe common and different characteristics among them. Among the common characteristics, the study finds that for most authors the green economy concept is related to environmental sustainability, resource efficiency and social inclusion. The main difference between the different authors lies in the importance of each of these concepts.
We already know that for most authors the green economy is composed of three fundamental elements. That is why we will now delve deeper into these three concepts

- Environmental sustainability: According to Morelli (2011), environmental sustainability refers to the ability to maintain a balance between the use of natural resources and the protection of the environment to ensure that the needs of current generations are met without compromising the ability of future generations to meet their own needs.
- Resource efficiency: according to the aforementioned article by Milačić et al., (2019). Resource efficiency refers to the condition or ability to produce more goods and services using fewer natural and energy resources.
- Social Inclusion: According to Rawal (2008), social inclusion refers to all people having the opportunity to participate fully in the economic, social and political life of society. Related to the green economy, social inclusion refers to all individuals, communities and different social groups being able to receive or access the benefits of the green economy.

2.2.2 Importance and relevance of green economy

As we have seen in the introduction, in the next 10 years the main problems of humanity will be related to the environment. Can the green economy help to solve these problems?

According to Gunay et al. (2022), the green economy can contribute significantly to global sustainability through the promotion of sustainable economic practices and the

implementation of appropriate public policies at the regional level. To assess this claim, an empirical analysis is conducted using data from 28 European countries over the period 2010-2018.

The results show that regions with higher green economy indices have a significant positive impact on overall sustainability. Furthermore, the authors find that regional communities have a positive impact on global sustainability when they are actively involved in the implementation of the green economy through local initiatives and interregional cooperation.

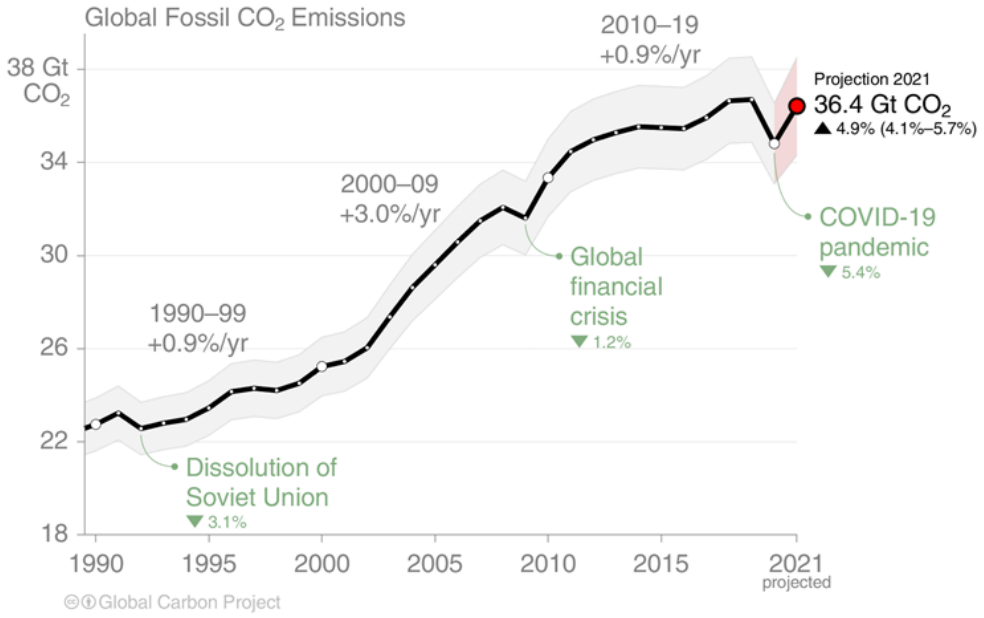
2.2.3 Key components

We will now discuss some key concepts of the green economy. To do so, we will look at their definition, their importance and their evolution.

Carbon footprint

The carbon footprint is defined by Wiedmann and Minx (2008:p.2106) as "the set of greenhouse gas (GHG) emissions that are released into the atmosphere as a direct or indirect result of human activities, such as the production of goods and services, transportation, heating and cooling of buildings, and waste management". In addition, the authors also mention that it is a key measure for assessing the environmental impact of human activities. Its reduction is fundamental to reducing climate change. Having understood the emission and importance of carbon footprint let's look at its evolution.

Figure 6: Global Fossil CO2 Emissions



Source: Global carbon Project

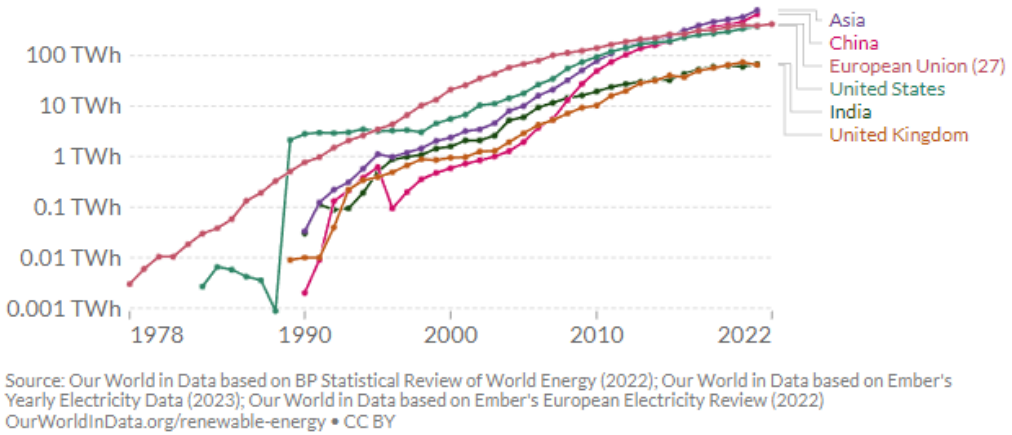
One way of looking at the carbon footprint is by Global Fossil CO2 Emissions. In this graph we see only three points where the carbon footprint has been reduced. Two of them are COVID-19 and the financial crisis. The reality that the graph shows is that the carbon footprint continues to increase with each passing year. It is also true that the increase is less than in previous years, however, the emission of greenhouse gases has not been reduced except in very specific cases.

Renewable energy

When it comes to climate change solutions, renewable energy is often the first thing that comes to mind, but what is it? Is it really that simple? What is renewable energy?

In answer to the first question, according to the RAE, renewable energy sources are those energy sources that come from almost inexhaustible natural resources. It is worth mentioning that there are many types of renewable energy sources (solar energy, wind energy, hydropower, biomass and biofuels, geothermal energy, and energy generated by waves, tides and ocean currents). To observe the importance and evolution of renewable energies, let's look at some graphs.

Figure 7: Wind energy

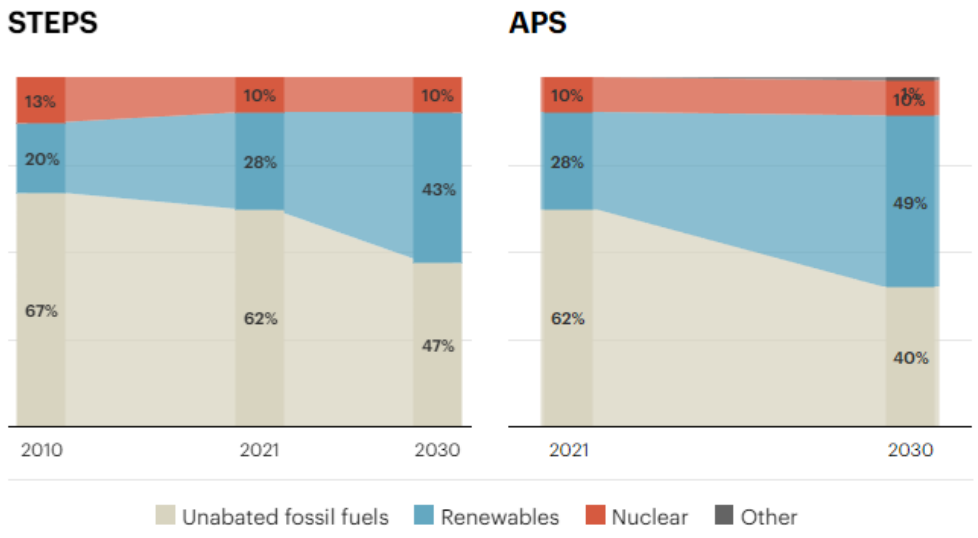


Source: Our World in Data based on BP Statistical Review of World Energy (2022); Our World in Data based on Ember's Yearly Electricity Data (2023); Our World in Data based on Ember's European Electricity Review (2022)
OurWorldInData.org/renewable-energy • CC BY

In this case, as we can see in the graph, it is constantly growing, it is being used more and more, before 1990 it was barely registered as a source of energy, however, it is already the main source of green energy in a large part of the world.

Will it continue to grow in the future? To find out, we have looked at two scenarios, known as STEPS and APS, which attempt to forecast the trajectory of different types of energy.

Figure 8: STEPS AND APS



Source: https://www.iea.org/reports/world-energy-outlook-2022/outlook-for-electricity

In these scenarios, there is a clear trend towards greater use of renewable energy sources, leading to a reduction in the use of fossil fuels, which has a positive impact on the environment by reducing greenhouse gas production and pollutant emissions.

The downside is that renewables are highly volatile and require backup power, a type of electricity that is supplied when other sources fail. In addition to another quite logical problem, the sun doesn't shine and the wind doesn't blow all day, so it is important to use batteries to store energy. This may not seem like a big problem at first, but this is because batteries are expensive, have a large environmental impact, are inefficient and degrade over time. However, this energy needs to be scaled up to reduce climate change.

Circular economy

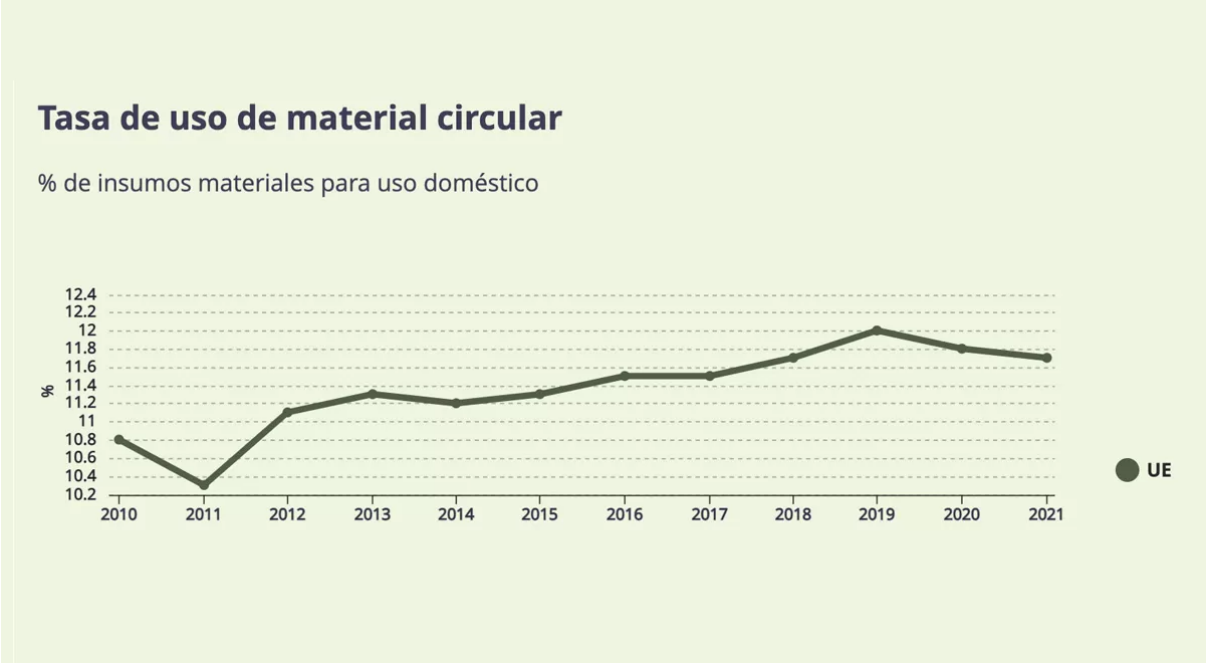
According to Kirchherr et al. (2017), in the circular economy there is some confusion surrounding its concept. However, they conclude that most definitions focus on reducing resource consumption and creating more sustainable systems.

In terms of its importance, the article above explains that the circular economy is important in addressing current environmental and economic challenges such as climate change, resource scarcity and economic instability. Furthermore, it suggests that the circular economy can be a source of innovation and economic growth.

Moreover, in a second article, according to Geisendorf and Pietrulla (2018), it is noted that the circular economy has become a topic of global interest. It is also noted that it has received attention from governments, businesses and international organisations because of its ability to reduce environmental impacts. It is also highlighted that it can generate business and employment opportunities.

Once we have defined and analysed the importance of the circular economy, let's look at its evolution.

Figure 9: Circular material



Source: Eurostat (2022)

According to this graph published by Eurostat (2022). We note that despite the importance mentioned above, the evolution of the circular economy is negative. Currently in the European Union, the use of circular material is decreasing.

Sustainability

The word sustainable or sustainability has already been mentioned several times in this document. It is therefore essential to analyse this concept in depth.

According to Ruggerio (2021:p4), sustainability is "the ability to maintain a given condition or process over time, which implies the preservation of natural resources, environmental protection and social justice". The author also defines another fundamental concept in the green economy, sustainable development. He defines it as "a process of development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

It also defines the three basic dimensions of sustainability. The environmental, the economic and the social dimension.

- Economic dimension: Refers to the need for sustainable economic growth that does not deplete natural resources and promotes equity and social justice.
- Environmental dimension: Focuses on the preservation and restoration of the environment, including the protection of biodiversity, the proper management of natural resources and the reduction of greenhouse gas emissions.
- Social dimension: Refers to the importance of a just and inclusive society that ensures the well-being and quality of life of all its members, both now and in the future. All these dimensions are interconnected and necessary to achieve truly sustainable development.

The importance of sustainability, according to Şahin and Çankaya (2019:p.46), "sustainability is important because it seeks to create a balance between economic growth, social justice and environmental protection."

In other words, it seeks to meet our needs today without compromising the needs of future generations. In addition, sustainability fosters innovation, efficiency and resilience in socio-economic and environmental systems. It can improve people's quality of life and the health of the planet as a whole.

Assessing the evolution of sustainability is somewhat complex. However, some indicators suggest that significant efforts are being made to improve sustainability. For example, increased investment in renewable energy. However, the carbon footprint is still not being reduced and the circular economy is evolving at a very slow pace or even decreasing.

2.2.4 Green economy problems

After discussing the key concepts, I will discuss some of the main problems of the green economy.

Cost

Ali et al., (2021). examines the implementation of the economy in Ghana and how it can serve as a model for driving sustainable development.

The article mentions that the transition to a green economy can be costly. As the authors explain, the transition to a green economy involves significant investment in renewable energy, more sustainable waste management systems, energy efficiency technologies, etc. These technologies and practices often require significant investment in the development of new technologies and practices.

These technologies and practices often require high initial investment. This can be a barrier for countries with fewer resources. Moreover, the cost is not only economic, as the necessary skills and capacities must be developed to achieve the transition properly. Finally, the article concludes that despite high upfront costs, the green economy can be profitable in the long run. In this way, they will provide not only environmental but also economic benefits.

Lack of consensus and coordination

According to Vertakova and Plotnikov (2017), the lack of consensus and coordination in defining and implementing the green economy can have multiple negative consequences that hinder the effective implementation of sustainable policies and strategies. One problem is the lack of clarity and coherence in objectives and approaches, which hampers decision-making and resource allocation.

Lack of consensus can also lead to unwanted competition between countries and regions to position themselves as leaders in the green economy, which can lead to the adoption of protectionist and restrictive policies that hinder international cooperation and collaboration in the implementation of sustainable policies.

On the other hand, lack of coordination between the different actors involved in implementing the green economy can lead to duplication of efforts and lack of coherence in policy implementation. In addition, lack of coordination can also lead to conflicts between the different actors involved, which can make the implementation of sustainable policies more difficult and slower.

Lack of coordination can also be an obstacle to the development of sustainable initiatives and projects at the local level. For example, if governments do not work in a coordinated manner with business and civil society, opportunities to promote the green

economy at the local level may not be seized and active participation of society in the implementation of sustainable policies may not be achieved.

In short, the lack of consensus and coordination in defining and implementing the green economy can have negative consequences that hinder the effective implementation of sustainable policies and strategies. It is therefore important that stakeholders work together to develop a coherent and coordinated approach to the implementation of the green economy, and to ensure international cooperation and collaboration in the implementation of sustainable policies.

Political and civil society engagement

According to Attahiru et al. (2012), it is important to stress that the implementation of the green economy implies structural changes in the way economic activities are carried out. It is therefore necessary that governments and civil society understand the need for these changes and are committed to supporting them. This may include creating incentives and policies to encourage investment in more sustainable technologies and practices, as well as removing barriers that may prevent the adoption of green solutions.

In addition, the article highlights the importance of involving civil society in promoting the green economy. Civil society can play a key role in raising awareness and awareness of the importance of sustainability. For example, they can promote the adoption of green practices and technologies in their communities and in their daily lives, as well as put pressure on governments and businesses to adopt more sustainable solutions.

Table 4: Summary of green economy problems

Barrier	Description
Cost	Transitioning to a green economy involves significant investment in renewable energy, sustainable waste management systems, and energy efficiency technologies. High upfront costs can be a barrier, especially for resource-constrained countries.
Lack of consensus and coordination	The lack of consensus and coordination in defining and implementing the green economy can hinder the effective implementation of sustainable policies and strategies. It leads to confusion, duplication of efforts, conflicts, and hindered international cooperation.
Political and civil society engagement	Governments and civil society need to understand and support the structural changes required for the green economy. Incentives, policies, and the involvement of civil society are essential for promoting sustainable technologies and practices.

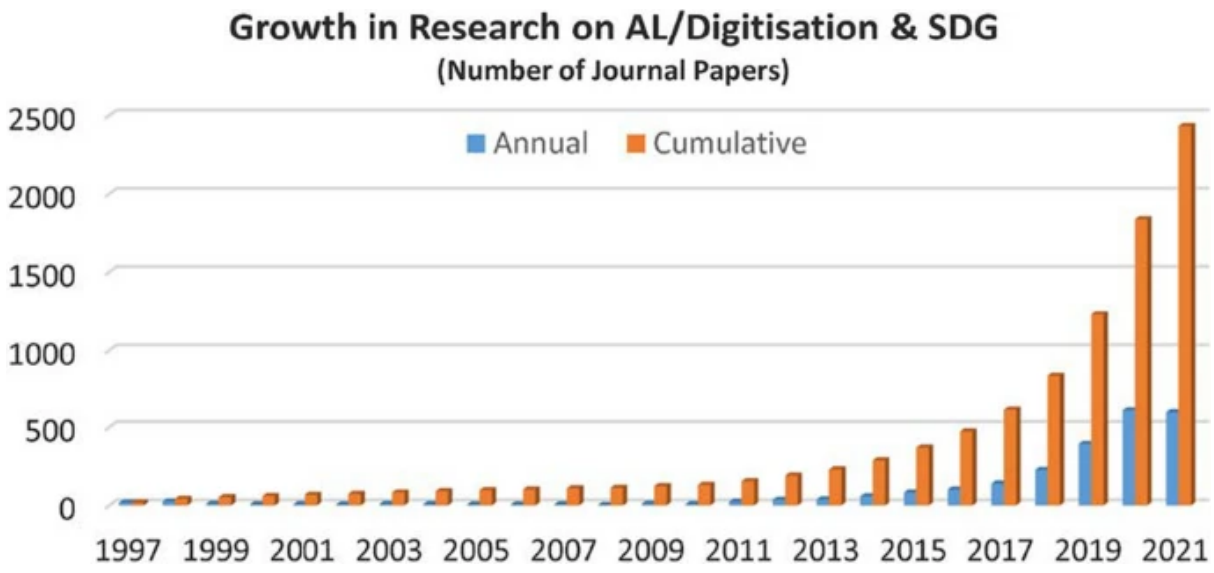
3. RELATIONSHIP BETWEEN GREEN ECONOMY AND DIGITALISATION

Having analysed the two concepts, let us now look at the relationship between the two. Go digital, as mentioned above, was the process by which an organisation used digital technology to improve its efficiency. On the other hand, the green economy was defined by most authors as the relationship between environmental sustainability, resource efficiency and social inclusion. Here we already see the first link between the two concepts, efficiency appears in both definitions.

If we join the two definitions together and leave out the recurring concept of efficiency, we are left with the following question: Can technology help sustainable development and social inclusion?If the answer to this question is yes, we could say that digitalisation can help improve the green economy. According to Faccia and Cavaliere (2020), digitalisation can be a driver for the green economy, as it enables the creation of new business opportunities and cost reduction through process optimisation and improved energy efficiency. The authors also mention that digitisation can help the management of natural resources and the implementation of sustainable policies through data collection and analysis, remote monitoring and predictive modelling. In this way, digitisation can help improve decision-making and promote more sustainable practices in different economic sectors.

According to Filho et al., (2022), digitalisation and artificial intelligence can contribute to sustainable development. In order to verify this claim, the authors conducted an analysis that addresses research on sustainable development, digitalisation and artificial intelligence.

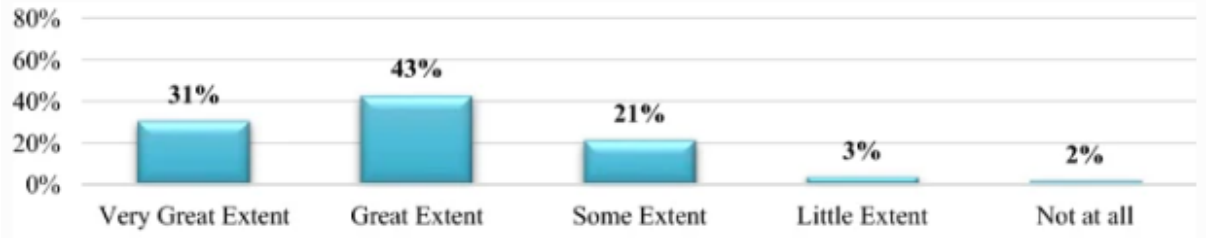
Figure 10: Growth in Research



Source: https://link.springer.com/article/10.1007/s10668-022-02252-3

This study shows an average annual growth of 59% over the last 15 years. If we take the last 25 years as a reference, an exponential growth rate of 123% is observed. In addition, the same study conducted a globally administered anonymous survey on this topic. The survey consisted of 23 questions.

Figure 11: Digitalisation and sustainable development



Source: https://link.springer.com/article/10.1007/s10668-022-02252-3

74% of respondents felt that AI and digitalisation can benefit sustainable development research.

The study concludes that digitalisation, technological innovation and green economic development interact with each other to achieve sustainable development. The use of digital technologies and innovation can improve energy efficiency and productivity, reduce emissions and waste, and encourage the adoption of sustainable practices in productive sectors. Likewise, green economic development can be driven by digitalisation and innovation, by promoting the use of clean energy, sustainable production and efficient management of natural resources.

Looking at this latest study, two things are clear. The first is that digitalisation and sustainable development are gaining more and more weight in society. And secondly, most of the people asked think that these two concepts are perfectly compatible, complementary and can benefit from each other.

But is this really the case? To find out, we are going to carry out a study of three specific cases in which we will try to find the answer to the question we asked ourselves at the beginning of the text: Can digitalisation help to improve the green economy?

4. CASE STUDIES

4.0 Methodology

In terms of methodology, we will use three case studies, AI and Big Data, industrial robots, and 5G. For the analysis of the different case studies, we will use secondary sources of information, among which we will distinguish empirical studies, academic articles and popular articles. We will observe whether the authors agree and whether there is evidence that digitisation can help the green economy.

4.1 Industrial robots

Context

The first case we are going to analyse concerns China. To begin with, let's contextualise where the country stands in terms of its relationship with the environment.

The Environmental Performance Index analyses 180 countries to compare, analyse and understand environmental performance. China is ranked 160th out of 180 countries, with a score of 28.4 out of 100. It is worth noting that China has improved 11.4 points over the last decade. Even so, it is still a very polluting country. If we combine this factor with the fact that it is the most populous country in the world along with India, the result is clear.

"The Global Energy Review: CO2 Emissions" published by the International Energy Agency (2021), indicates an increase of 3630 million tonnes in global emissions, caused by the recovery from the pandemic. Of this amount, 32.5% is contributed by China. This is why China's target for 2030 is to reduce carbon intensity by more than 65% compared to 2005.

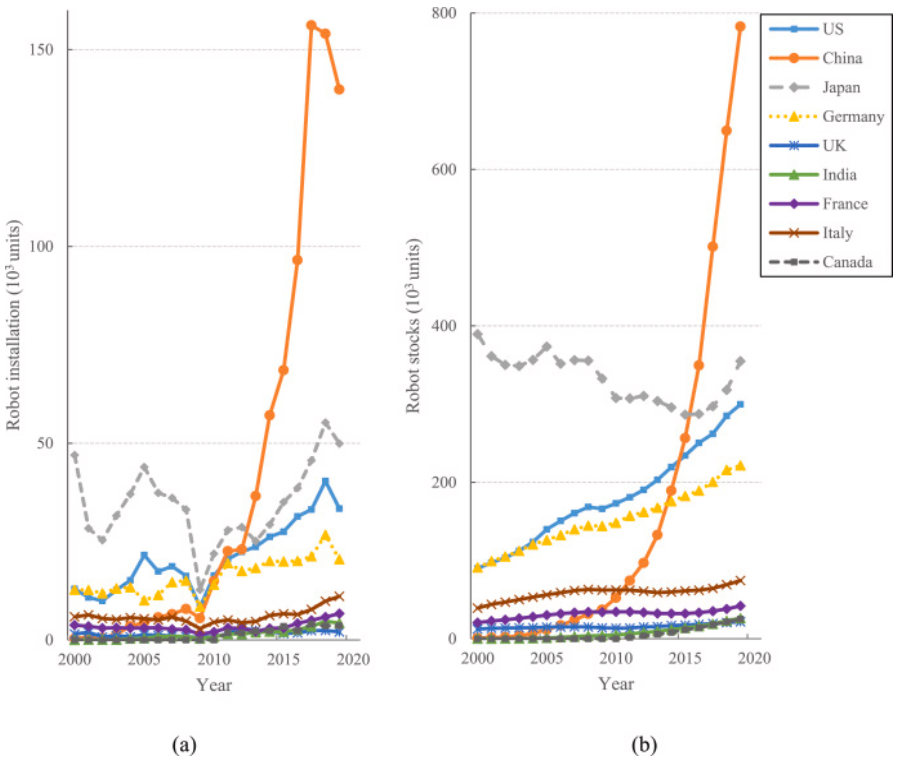
With these problems and targets in mind, one of the possible solutions for a low-carbon future that has emerged is industrial robots.

Industrial robots

Industrial robots are "multifunctional, programmable robotic manipulation systems used in manufacturing and industrial automation applications to perform repetitive and hazardous tasks autonomously" as defined in Ji, W., & Wang, L. (2019:p.1240). These machines are part of industrial automation and are designed to work in conjunction with enterprise IT systems. Therefore, the implementation of industrial robots in industry is considered a form of digitalisation, as it involves the integration of advanced computer technology into production processes.

The following illustration shows the implementation of industrial robots in the nine largest economies in the world between 2000 and 2019.

Figure 12: Industrial robots



Source: International Federation of Robotics (IFR).

The image shows an exponential rise in China, which makes it the leader by far in this sector.

Having seen China's position, how can industrial robots help with carbon emissions?
According to the authors Lingzheng et al., (2021), Industrial robots are expected to reduce energy intensity by promoting green technological progress and innovation, thus affecting energy conservation and emission reduction. In addition, their large-scale industrial production should improve total factor productivity, thereby reducing carbon emissions.

This is somewhat complex to put it this way, but if we look at the study by Lingzheng et al., (2021) we find empirical evidence that industrial robots have technological characteristics that are conducive to decarbonisation.

The most important findings obtained from this study are as follows:

- The use of industrial robots has led to significant reductions in carbon emissions in cities, achieving improvements in energy efficiency and green technology.
- This positive effect is found to be amplified in larger cities, in advanced manufacturing bases and in pilot cities with low-carbon policies, suggesting that the positive environmental effects are enhanced by the scale effect, the aggregation effect and support for low-carbon policies.

In addition, the study proposes to achieve low-carbon cities and enhance the importance of industrial robots in decarbonisation:

- Make an effort to promote the adoption of industrial robots in various industrial sectors, increase their coverage and maximise their positive impact on reducing carbon emissions.
- Encourage innovation and technological development to improve energy efficiency, increase expected output and reduce emissions in the production process.
- Indicate that large cities should act as leaders in reducing carbon emissions, promoting the expansion and efficiency improvement of industrial enterprises, and encouraging smart transformation and mechanisation.
- Promote the clustering and integration of industrialisation and computerisation into advanced manufacturing bases by introducing more robotic production lines in manufacturing.
- It notes that low-carbon pilot cities should promote high-tech industry, take full advantage of carbon reduction tools, including industrial robots, and focus on improving carbon emissions through technological transformation.

The case of industrial robots is not only applicable to China. In his narrative, Bogue, Robert (2022), discusses the potential use of industrial robots in three key sectors of the green economy, renewable energy, sustainable transport and waste management.

Regarding renewable energies, the author highlights different ways in which industrial robots can help to improve their use.

- Increasing levels of automation: Because of rising demand for renewable energies, and pressure on prices, manufacturers have turned to industrial robots. Their implementation has led to improved efficiency and higher levels of automation, significantly reducing prices.

- Specialised robots are being used to clean solar panels. They are solar-powered and can clean without the use of water.
- Drones to inspect areas more quickly and efficiently. In this way, defects and anomalies can be detected.

Turning to sustainable transport, he points out that in the manufacture of electric vehicles, robots play a crucial role. Tesla's factory in Fremont is a prime example of a highly automated facility, equipped with numerous robots that perform most of the production processes. Tesla has achieved considerable efficiency on its production line, manufacturing the Tesla Model 3 in less than 10 hours, faster than other electric vehicles.

In the waste management and recycling sector, digitalisation and robotics play a key role. Robots are used for sorting waste prior to recycling, improving the efficiency and accuracy of the process. Commercial systems have been developed that use machine vision and artificial intelligence techniques to identify and sort different materials with sorting rates of over 99%. AMP Robotics, for example, has sold AI-based sorting systems to recycling facilities in different parts of the world.

If we focus on the popularisation articles, according to García (2018), two powerful transitions are going to take place, the circular economy and the fourth industrial revolution. The author thinks that robotics can help to improve the circular economy. The article mentions that automation and robots can improve the performance of industrial processes, increase the lifetime of products and reduce waste. In the area of recycling, robots can distinguish between different types of waste and recover those that are recyclable or valuable. An example is given of a robot capable of dismantling a mobile phone and separating its components in just 11 seconds, allowing precious minerals to be extracted and the value of the materials to be recovered.

According to Enrique Palomeque (2022), industrial robots can contribute to the green economy and the implementation of the Sustainable Development Goals. The author points to several examples, including:

- Robotics is also being applied in the field of clean water and sanitation. For example, in the city of Cadiz, Spain, a robot is used to clean complicated areas of the sewerage network, improving speed, hygiene and worker safety.
- Digital automation is also playing a role in sectors such as logistics, construction and agriculture. In smart farming, robots help eliminate the use of chemicals by precisely

locating and removing weeds with laser shots. They also contribute to the control of crops, their development and harvesting, which improves efficiency and agricultural production.

According to inser-robotica (s.f) , industry absorbed 24.5% of total energy consumption, close to the European Union's 25.5% overall. The author comments that digitalisation and robotisation allow companies to optimise resources while increasing their sustainability.

The auth**or** points out that robots can operate in extreme environmental and temperature conditions, which reduces the energy consumption needed to maintain a suitable environment for workers. In addition, they do not require special lighting conditions and can work 24 hours a day, which translates into energy savings and increased productivity. Another outstanding advantage is the minimal generation of waste due to the precision of the robots in the production processes. This allows for a better use of materials and greater environmental sustainability. For example, at the end of the production line, wrapping tasks carried out by robots are more efficient and safer, which reduces the material used.

In conclusion, industrial robots play a crucial role in promoting the green economy. Their application in various sectors makes it possible to increase the efficiency, accuracy and safety of processes. The adoption of industrial robots in the green economy promotes environmental sustainability and contributes to building a cleaner future.

4.2 AI and Big Data

We have previously noted that data analytics and artificial intelligence are a key part of digitalisation. However, can they help to improve the green economy? To do so, we will look at several studies and articles that analyse this question.

According to Gotsch et al. (2023) focuses on the contribution of data science applications to a green economy. The authors argue that the use of data science and artificial intelligence can help achieve this goal by improving the efficiency and effectiveness of processes and systems related to the green economy.

To support this argument, the authors provide some examples, including the following:

- Environmental monitoring and conservation: Data science and artificial intelligence can be used to collect and analyse large amounts of environmental data, allowing scientists to better understand patterns of environmental change and make informed conservation decisions. For example, in the Netherlands, scientists are using satellite imagery and data analysis to monitor and assess the health of mangrove ecosystems.
- Natural resource management: Data science and artificial intelligence can also be used to improve natural resource management. For example, in the state of California, a water monitoring system based on sensors and data analytics has been developed that allows farmers to use water more efficiently and reduce waste.
- Renewable energy: Data science and artificial intelligence can be used to improve the efficiency and performance of renewable energy. For example, in Denmark, artificial intelligence is being used to predict wind energy production and thereby improve the planning and management of the electricity grid.
- Sustainable transport: Data science and artificial intelligence can be used to improve transport efficiency and reduce greenhouse gas emissions. For example, in Singapore, artificial intelligence is being used to optimise public transport routes and reduce waiting times for passengers.

The authors conclude that data science and artificial intelligence are of great importance in the improvement of a green economy. However, the article also discusses the challenges facing digitisation in relation to the green economy. These challenges are the lack of data, the difficulty to integrate different types of data, data privacy and security issues, the need to

develop accurate predictive models and the need to integrate different disciplines (computer science, environmental science and political economy).

Chang et al. (2023) highlight the importance of sustainable economic development and the need to harness artificial intelligence (AI) as a tool to achieve this goal. To test the accuracy of this assertion, the authors conducted a panel data analysis covering 30 countries and a 20-year period. In this study, a positive effect of AI on green total factor productivity was observed. This positive effect is understood to be due to the fact that AI allows companies and governments to optimise natural resource consumption and production. Thus increasing the efficiency and sustainability of the economy.

They also find that the availability of natural resources significantly affects total green factor productivity. This is why the authors suggest that countries can use AI to improve the management of natural resources and thereby increase total green factor productivity.

In addition, the study provides some examples similar to the previous study and adds some others such as:

- Precision agriculture: AI can help improve efficiency and sustainability in agriculture by monitoring soil and plant conditions, predicting yields and optimising the use of fertilisers and pesticides.
- Waste management: AI can help reduce the amount of waste generated and improve waste management by identifying waste generation patterns, sorting waste and optimising recycling and disposal processes.

Chang et al. (2023) conclude, following the study, that AI can be an important tool for achieving green economic development. They highlight the importance of sustainable natural resource management.

The above study is not the only one to explore the relationship between artificial intelligence and green economic growth. Qian et al. (2023) uses a panel data model of 30 provinces in China over the period 2003 to 2019. In this study the dependent variable was green economic growth and the independent variable was AI investment. Importantly, technology investment, fixed capital investment and education were considered as control variables.

The authors (Qian et al., 2023) found in the results that AI investment has a positive impact on green economic growth in China. Exactly, the authors found that a 1% increase in AI

investment is associated with a 0.33% increase in the growth rate of green value added. Investment in technology and education also had a positive impact on green economic growth. This was not the case for investment in fixed capital investment. As for the examples given in the study, they are very similar to those mentioned above: smart agriculture, environmental monitoring, optimising production and improving energy efficiency.

The conclusion of this study is similar to the previous one. The authors conclude that investment in AI can improve green economic growth in China. They believe that AI presents itself as a valuable tool to help the transition to a green economy, and think that governments and companies should consider investing in it. However, the authors also point out that investment in AI must have a strategic component and be well directed to maximise its impact on green economic growth. In addition, they point out the importance of investment in technology and education for green economic growth.

In terms of informative articles, according to García (2018), artificial intelligence (AI) and Big Data can contribute to improving the circular economy. She highlights that AI, machine learning and algorithms can optimise the use of resources, energy networks, transport and entire cities. This combination of AI and human skills has the potential to address complex global problems and have a positive impact on the preservation of natural capital.

The author comments that AI can play a crucial role in natural disaster prediction, climate analysis and biomimicry, which relies on nature to create innovative technologies. In addition, AI can be used for sustainable use of natural resources, such as water. Through analytical tools, it can monitor water resources for irrigation, predict shortages and help manage them in agriculture, industry and cities.

According to García (2018), the Internet of Things (IoT) and Big Data also play an important role in the circular economy. These technologies enable data collection through sensors, wearables and smart devices, facilitating remote monitoring of products and full traceability of materials. This provides real-time information on the condition and status of products, enabling informed decisions on when to disassemble, repair, reprocess or replace products.

According to Pombo (2021), Big Data and artificial intelligence (AI) can contribute to the green economy and help address sustainability challenges. Some of the challenges identified in the article are:

- ESG criteria: it is increasingly important for companies to meet environmental, social and governance (ESG) criteria, backed by investors and consumers. Investor interest in sustainable assets has increased significantly, especially among millennial investors.

- Sustainability assessment and measurement: To ensure that sustainability goals are met, a robust technology infrastructure and standardised measurement methods are needed. Fintech can play a role in this assessment by leveraging big data and AI to measure the environmental impact of companies, assessing alignment with the Sustainable Development Goals (SDGs) and analysing public opinion on sustainability.

In summary, after examining the three studies, there is statistical and empirical evidence that artificial intelligence and big data can be a very valuable tool for the green economy. And after examining the popular articles, there is a link between the statistics and the authors of the popular texts.

4.3 5G

1G, introduced around 1980, was based on analogue technology to enable voice communication on mobile phones. 2G (1990) introduced digital technology, improving voice quality and allowing the transmission of text messages. 3G (2000) enabled data transfer at higher speeds, which led to the start of mobile internet services and applications such as video calls. 4G, (mid-2000s), was characterised by improvements in capacity, latency and data rates, enabling online video streaming and online gaming services (Dangi et. al, 2022). But what about 5G?

According to Dangi et. al (2010:p26), ‘’5G is a new generation of mobile technology that offers faster data rates, lower latency, higher network capacity, greater energy efficiency and massive connectivity to enable the connectivity of billions of devices". 5G is a clear form of digitisation, as it uses digital technology to improve efficiency. Furthermore, if we look at the definition of 5G, the words 'energy efficiency' appear. Words that coincided both in the definition of green economy and in the definition of digitalisation. So, in principle, it seems that 5G could be useful for the green economy.

We will now take a closer look.

Intelligent transport system

Gohar, A. & Nencioni, G. (2021) elaborate on how 5G technology can be used to improve the transport system in a smart city. The authors describe how 5G technologies can facilitate the connectivity of autonomous vehicles and improve transport efficiency through traffic management and route optimisation. This would lead to the optimisation of intelligent transport systems.

This would contribute to the green economy in the following ways:

Reducing emissions: Implementing 5G technologies in intelligent transport systems can help reduce greenhouse gas emissions by improving transport efficiency and reducing congestion on roads.

Improved energy management: 5G technology can be used in intelligent transport systems to improve energy management, for example, by optimising the charging and uncharging of electric vehicles, which can reduce energy consumption and increase efficiency.

Improving air quality: Reducing congestion on roads by implementing intelligent transport systems can also help improve air quality, which can have significant public health benefits.

Waste reduction: Implementing intelligent transport systems can help reduce waste in the city by improving the efficiency of waste management and rubbish collection.

Smart agriculture

Tang et. al (2021) in their article "A survey on the 5G network and its impact on agriculture: Challenges and opportunities" studies how 5G can help agricultural production. The authors comment on the following benefits of 5G in agriculture:

- Increased agricultural efficiency and productivity through real-time data collection.
- Improved measurement accuracy and decision making through more accurate sensors and monitoring systems

- Increased capacity for automation of agricultural processes, such as planting and harvesting
- Possibility to implement smart and efficient irrigation systems that reduce water and energy consumption
- Increased capacity for connectivity and communication between devices and systems, enabling better integration and collaboration in farm management.

These will benefit the green economy by:

- Reduced waste of water and chemicals: Monitoring soil moisture and using sensors to measure nutrient levels in crops can enable accurate application of water and fertilisers, thereby reducing the need to waste these valuable resources.
- According to Mohamed et. al, (2021) the use of sensors and real-time data analysis could help improve crop management and decision-making, which in turn could lead to more efficient and sustainable production.

However, the authors also identify a number of drawbacks that 5G will face in its use in agriculture.

- Infrastructure and equipment costs, especially for smaller farmers and in remote regions.
- Lack of communication standards and protocols for interoperability of devices and systems coverage and signal problems in rural and remote areas
- Data security and user privacy concerns
- Need to train and educate farmers and agricultural workers on the use and management of 5G systems and technologies.

Renewable energy

Another area where 5G can be important to improve the green economy is in the area of renewable energy. 5G according to Israr et. al,(2021) could improve the efficiency and reach of renewable energy technologies.

Some ways mentioned by the authors to achieve this improvement are:

- Monitoring and control: 5G can enable better monitoring and control of renewable energy generation systems, allowing for greater efficiency and better management of energy use.
- Optimisation of energy use: through the implementation of IoT solutions and data analytics, 5G could help optimise the use of renewable energy and reduce energy waste.
- Renewable energy adoption in remote areas: 5G could be a key driver for the adoption of renewable energy technologies in remote or rural areas, where access to traditional energy may be limited.

In the narrative of Han et. al, (2021) agrees with the above article in the three cases above and also adds flexible grid support

- Flexible grid support: 5G can provide flexible grid support for the integration of renewable energy systems, allowing for better adaptation to fluctuations in power generation and better coordination between different system components.

Some of the main challenges encountered by the authors are as follows. According to Israr et al. (2021):

- Deployment costs: the cost of implementing renewable energy technologies and 5G networks can be a barrier to the widespread adoption of these technologies.

According to Han et al. (2021):

- Coordination and optimisation: Coordination and optimisation of renewable energy systems and 5G networks can be challenging due to the complexity of the system and the need for effective communication and coordination.
- Electromagnetic interference: Electromagnetic interference between renewable energy systems and 5G networks can be an issue, as the frequencies used by these technologies are similar.
- Data security and privacy: Data security and privacy may be an issue in the integration of renewable energy technologies and 5G networks, as data is sensitive and may be vulnerable to cyber-attacks.

Greenhouse gas reduction

"Greenhouse gas emissions from digital traffic are already similar to those of the aviation sector" (World Economic Forum, 2020).

It may seem curious, since we don't see smoke coming out of our phone, we don't see anything remarkable that would make us think that our phone is polluting. However, this article from the World Economic Forum (2020) comments that the internet has an energy consumption similar to that of Russia. It would rank as the sixth most energy-consuming country.

How will 5G affect greenhouse gas emissions?

Well, according to the article, 5G would reduce energy consumption per bit by up to 60% compared to 4G, because its use would require only a tenth of the energy currently needed by networks.

This would translate into 15% less CO2 emissions into the atmosphere.

5G could help in many different ways. But, for this to happen it has to be able to deal with some of the challenges mentioned above. Shukurillaevich et. al, (2019) mention its high cost, the security and privacy of data or the need to invest in new infrastructure.

Table 5: Summary case studies

Case Name	Brief Description	Key Benefits of Digitalisation on the Green Economy
Industrial Robots	Industrial robots are multifunctional, programmable robotic manipulation systems used in manufacturing.	- Industrial robots reduce energy intensity and promote green technological progress and innovation, leading to energy conservation and emission reduction.

		- Large-scale industrial production of industrial robots improves total factor productivity and reduces carbon emissions.
		- Industrial robots have a positive effect on carbon emissions in cities, especially in larger cities, advanced manufacturing bases, and pilot cities with low-carbon policies.
		- Promoting the adoption of industrial robots in various industrial sectors and increasing their coverage can maximize their positive impact on reducing carbon emissions.
		- Encouraging innovation and technological development in energy efficiency and emissions reduction improves the production process.
		- Industrial robots contribute to the development of low-carbon cities and the expansion of robotic production lines in advanced manufacturing bases.
AI and Big Data	Data science and artificial intelligence (AI) contribute to a green economy.	- Environmental monitoring and conservation benefit from data science and AI by collecting and analysing large amounts of environmental data, leading to informed conservation decisions.

		- Natural resource management improves with data science and AI, allowing efficient use of resources and reducing waste.
		- Renewable energy benefits from data science and AI in terms of improved efficiency and performance, leading to better planning and management of the electricity grid.
		- Sustainable transport becomes more efficient and emits fewer greenhouse gases with the help of data science and AI, optimising transport routes and reducing waiting times for passengers.
5G	The introduction of 5G technology in mobile communication.	- 5G technology enables faster and more reliable communication, which enhances various sectors of the green economy, such as remote monitoring, smart grids, and autonomous vehicles.

5. CONCLUSION

As I said in the introduction, the main objective of this paper was to find out how digitalisation could help to improve the green economy. In order to do so, the two concepts were explored in depth and then a case study methodology was used.

First of all, we looked in depth at the concept of digitalisation. No one is unaware of the importance of technology today. 25 years ago there was not even the internet, and now it is practically impossible to find a person who does not use the internet in their daily lives. As Blštáková et al. (2020) rightly say, digitalisation has changed everything. It has changed society and the economy. It has changed not only the way we work, or the way we live, but

also the way people are. Technology is constantly evolving, and proof of this are several issues we have discussed at work.

Nobody could have expected a pandemic, but if the pandemic has caused a boom in digitalisation in countries like Spain. It means that technology is advancing more than society or people are advancing in their understanding of it. What I mean is that society has had to see itself in a case of global emergency in order to take better advantage of some of the many opportunities that technology can offer, at least in the case of Spain. Further proof that technology is advancing faster than people can be seen in the key concepts discussed: are we prepared for the use of such useful tools as Big Data or Artificial Intelligence?

If we reflect on these two concepts, we find ourselves in very delicate situations that we are going to encounter in the coming years.

As we have seen in the section on the problems of digitalisation, many barriers have to do with human beings and their capabilities. Therefore, we can conclude that technology is advancing faster than humans.

To conclude on the subject of digitalisation, I believe that technology offers infinite possibilities to improve everything. The problem is that perhaps we are not ready to assimilate or take advantage of them. What is undoubtedly true is that it improves human efficiency. This can be very useful for areas such as the green economy.

The green economy has gone from being first an option, then an obligation, and finally an urgency. If I said earlier that technology is advancing faster than people, people are advancing faster than the planet can keep up with.

This translates into what I said in the introduction: the main problems 10 years from now will have to do with the planet. One solution to these problems can and must be the green economy.

Analysing the key concepts, we see that the problem of the planet does not seem to have a clear solution. If we look at the carbon footprint, we see that it is simply starting not to increase. If we look at the circular economy, we see that its use is decreasing. However, a boom in renewable energies is expected. Not because of forecasting, but because there will be no other options. This is why the fourth concept, sustainability, seems to me to be very

difficult to achieve. It could be utopian, because creating a balance between economic growth, social justice and environmental protection seems impossible.

If we look at the problems of the green economy, the authors point to cost, lack of coordination and political and civil society commitment. In my opinion these problems are solvable. The cost is never high if the problem is to save the planet, so when it is urgent, the cost will not be a problem. The lack of coordination, coming at a time when the whole world has come together to end the pandemic, makes it clear that coordination also depends on the urgency of the situation, and that everyone's interests coincide. Finally, the political and civil. The transition to a green economy has to be led by the right people. And not only that, civil society has to have a real understanding of what the problem is, so that the right people can be chosen to get the transition right.

People are moving faster than the planet, and if I said earlier that there was a global urgency for people to accelerate their use of technology, maybe, it will take another global urgency for people to slow down and put our eyes on the environment.

Having delved deeper into the green economy, I went on to look at the theoretical relationship between the green economy and digitalisation. This is where I found the most important finding of this work. The definitions coincided in the search for efficiency. This allowed me to simplify the initial question of the paper. I have eliminated the word efficiency from the definitions, as both had it as a common point. The result was the following question: Can technology help sustainable development and social inclusion? This finding simplifies the objective to be addressed in the case studies.

After analysing the different case studies, the result has been as expected. Both in the case of industrial robots, AI and big data, as well as 5G. I have found evidence that digitalisation can indeed be a key instrument to help the green economy. Moreover, both academic papers and popularisation articles coincide in all three cases.

Analysing in depth the contribution of AI and Big Data to the green economy I found the second major finding of the paper. There is empirical evidence that 1% increase in AI investment is associated with a 0.33% increase in the growth rate of green value added. For me, this makes it much easier to answer the initial question. At this point, the answer was already clear to me.

Finally, looking at 5G, I have a better understanding of what this generational change means for the technology, and what it means for the green economy. It can improve it in countless cases.

Definitely answering the main objective of the paper. Digitalisation can help the green economy in many cases. Digitisation means seeking greater efficiency; the key to digitalisation being fundamental, and really improving the green economy, is that in addition to greater efficiency, it also seeks better sustainability.

It is clear that digitalisation has the potential to play a key role in boosting the green economy. While there are legitimate challenges and concerns about its implementation, it is important to recognise that technology can be a powerful tool for tackling environmental problems and moving towards sustainable development.

However, to fully harness the potential of digitalisation for the benefit of the green economy, we need to take concrete steps. It is crucial to foster greater awareness and understanding of the benefits and opportunities that technology can offer in this area. This means promoting education and training in green technology, as well as collaboration between governments, businesses, organisations and civil society.

In addition, it is essential to put in place appropriate regulatory frameworks and policies that encourage the adoption of sustainable digital solutions and promote innovation in this field. It is also necessary to address the economic and financial barriers that may hinder the transition to a digitised green economy.

Ultimately, we must remember that technology is not an end in itself, but a tool to be used responsibly and consciously. Digitalisation can be a key instrument for positive change in the green economy, but it is up to us as a society to harness its potential and ensure that it is used in an equitable and sustainable way to preserve our planet for future generations.

With a collaborative approach and a long-term vision, we can harness technological advances to drive the green economy forward and build a more prosperous and sustainable future for all.

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