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European Green Deal, digital economy, and blockchain: the path to sustainability?

European Green Deal, digitalização da economia e blockchain: o caminho para a sustentabilidade?

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Abstract: In January 2020, the European Parliament approved the European Green Deal (EGD). This document is intended to have a global impact and can affect public policies in countries like Brazil. It is the most ambitious plan to reduce greenhouse gas emissions ever presented. It foresees, among its pillars, the digitalization of the European economy and the encouragement of the use of distributed networks to minimize carbon emissions. This paper investigates the compatibility of blockchain networks with the sustainable digital economy proposal presented in the EGD. The descriptive exploratory method was used, supported by bibliographic research, which sought, from the database "Portal Periódicos Capes/ MEC" and "Google Scholar", to develop a broad search for scientific articles. The search focused on

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articles whose titles mentioned the following terms: European Green Deal; European Green Deal and digital economy; digital economy; digital economy and blockchain; blockchain and sustainability. From the literature review analysis, two hypotheses were raised: a) the new technology's lack of compatibility with sustainability precepts, given its large carbon footprint; b) the offsetting, which results in a negative carbon footprint, if one considers all the carbon emission reductions caused by the adoption of the new blockchain technology. The elements gathered in the research allow to drop a preliminary conclusion asserting that blockchain is compatible with the EGD fundamentals, even considering its high energy consumption, given its disruptive potential and the possibility of reducing carbon emissions in the industrial production chain and the economy.

Keywords: European Green Deal. Digital economy. Blockchain. Sustainability. Decarbonization of the economy.

Resumo: Em janeiro de 2020 o Parlamento Europeu aprovou o *European Green Deal* (EGD). Trata-se do mais ambicioso plano de redução de emissões de gases de efeito estufa já apresentado e que prevê, entre seus pilares, a digitalização da economia europeia e o incentivo ao uso das redes distribuídas como forma de minimizar as emissões de carbono. O objetivo do presente trabalho é buscar elementos científicos que indiquem a compatibilidade das redes *blockchain* com a proposta de economia digital sustentável apresentada no EGD. Utilizou-se do método exploratório descritivo, com suporte em pesquisa bibliográfica, onde se buscou, a partir da base de dados do "Portal Periódicos Capes/MEC" e do "Google Scholar", fazer uma ampla pesquisa de artigos científicos que trouxessem em seus títulos os termos *European Green Deal; European Green Deal and digital economy*; *digital economy; digital economy and blockchain; blockchain and sustainability*. A partir da análise da revisão bibliográfica, levantou-se duas hipóteses: a) ausência de compatibilidade da nova tecnologia com os preceitos de sustentabilidade, haja vista seu grande volume de pegada de carbono; b) a compensação, que resulta em uma conta negativa de emissão de carbono, se se considerar todas as reduções de emissões de carbono causadas pela adoção da nova tecnologia *blockchain*. Ao final, a partir dos elementos científicos angariados na pesquisa, concluiu-se pela compatibilidade da *blockchain* com os fundamentos do EGD, mesmo considerando seu alto consumo de energia, haja vista seu potencial disruptivo e possibilidade de redução de emissão de carbono na cadeia de produção industrial e na economia.

Palavras-chaves: *European Green Deal*. Economia digital. *Blockchain*. Sustentabilidade. Descarbonização da economia.

1 Introduction

It is necessary to highlight the importance of studying the European Green Deal (EGD) starting from its pillar of digitizing the economy outside the Old Continent. An illustrative example is the case of Brazil. The analysis of the Brazilian trade balance data shows that Europe is its second-largest trading partner. In 2020, even midst the COVID-19 crisis, Brazil exported to Europe the equivalent of US$28.33 billion and imported the equivalent of US$26.82 billion, which generated a surplus of US$1.52 billion. Among Brazilian commercial partners, Europe stands only after China, which in the same period imported from Brazil the equivalent of US$70.08 billion.[1] These data reveal the relevance of the EGD outside Europe, namely for Brazil.

[1] FAZCOMEX. *Balança comercial 2020*. 2021. Brasil. Available at: https://www.fazcomex.com.br/blog/balanca-comercial-de-2020/. Accessed: 02 jul. 2021.

Indeed, the EGD has ambitions that go beyond the borders of the European Union since it is a document that seeks to protect the local population from foreign products that may degrade the environment and harm the health of its citizens. As of the EGD, the bloc has increased pressure for its trading partners to adapt to the new environmental standards, under the penalty of surcharging or even banning them from the European market. The primary goal of the EGD is not economic, but environmental preservation. It is noticeable that the European Union is much more advanced in its environmental legislation and discourse than most countries globally, notably Brazil.

From the perspective of EGD-driven sustainability, the topic of blockchain is still relatively new and with great potential for further scientific exploration. Blockchain networks have a decentralized architecture, in contrast to traditional networks, in which transactions are authenticated by a consensus mechanism, without the need for a validating third party. Blockchain networks are beneficial in interaction scenarios with multiple untrusted agents because they inhibit fraud in the system, as will be further explained in the following topics.

This article aims at tracing a temporal framework that establishes the evolution of international agreements on environmental protection until today. Thus, it begins with the analysis of the environmental policy of the 1960s, when the environmental degradation that occurred due to the sizeable post-war industrialization began to be perceived. Subsequently, it delves into the ecological pacts promoted by the UN, non-binding, until the most recent approval of the EGD by the European Parliament. This agreement goes beyond the existing one and materializes crucial environmental protection and greenhouse gas emission reduction measures. After this chronological analysis, the EGD pillar of the digitalization of the economy is scrutinized, especially what concerns the goal to increase the use of ICTs to curb carbon emissions. Then, narrowing down the research further, the article discusses the possibility of using blockchain networks as a tool for the digitalization of the economy, its advantages and disadvantages, mainly with regards to the degree of new energy consumption technology.

2 The evolution of international agreements on environmental protection

Although environmental degradation has been occurring since the emergence of the Industrial Revolution, the environmental movement originated only in the 1960s, when harmful effects on the climate and human health were most strongly felt. From this point on, several environmental groups have denounced the indiscriminate use of pesticides and fertilizers, the transformation of the natural landscape, the loss of

biodiversity, the contamination of the air and water through fossil fuels, and other negative environmental developments.

The consolidation of the environmental movement is due, in part, to the growing material prosperity observed between the 1940s and the 1970s, for, even though the adverse effects of industrialization had been felt for a long time, they only received attention after 1969 when a large part of the population of developed western countries had already achieved a considerable level of material prosperity. Meaningful efforts to foster the alignment of environmental policy with economic, industrial, and social policies emerged in the new green policy of the 1970s, which combined advocacy for radical changes in economic policy and social behavior with activism around environmental issues. The environmental activism of this era challenged not only capitalist consumerism but also the redistributive growth model defended by social democracy.[2] In this scenario, the international community gradually established an appropriate forum for discussions regarding the environment and highlighted the importance of protecting the ozone layer, reducing deforestation, and controlling climate change.[3]

In the United States, the significant industrial and economic progress of the 1960s and 1970s made it possible to pass several environmental protection laws that are still in effect today. In 1972 the Club of Rome and the Massachusetts Institute of Technology (MIT) published the report "Limits to Growth" which stated serious concerns about the depletion of natural resources.[4]

In the same year, the Stockholm Conference (United Nations Conference on the Human Environment) was held, which was the first major international Conference on the environment under the United Nations.[5] The Conference was marked by the antagonism between developed and developing nations. The latter took a stand against environmental concessions that would limit their industrial

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2 MEADOWS, Donella H.; RANDERS, Jorgen; MEADOWS, Dennis L. *The Limits to Growth (1972)*. Universe Books: New York. 1972. Available at: http://www.donellameadows.org/wp-content/userfiles/Limits-to-Growth-digital-scan-version.pdf. Accessed: 29 jun. 2021.

3 ROSSI, Esteban. Un futuro por construir: la propuesta del ambientalismo moderno. *Revista Iberoamericana de Bioética*. Espanha. n. 04 ene. 2017. Available at: https://revistas.comillas.edu/index.php/bioetica-revista-iberoamericana/article/view/7714/7671. Accessed: 01 jul. 2021.

4 The Club of Rome was originally formed in 1968 by Italian businessman Aurelio Peccei, honorary president of Fiat, and Scottish scientist Alexander King, who joined with about 20 personalities of the time to assess political, economic, and social issues related to the environment. In 1970, at one of the Club's meetings, Jay Forrester, professor of systems at MIT (Massachusetts Institute of Technology), offered to use computer systems to simulate the interaction of man with the environment, considering the population increase and the depletion of natural resources. These analyzes gave rise to the study "Limits to Growth". Currently, the club has become a non-governmental organization that seeks to identify socio-environmental problems, discuss them and present them to the public. PENSAMENTO VERDE. *Clube de Roma e o relatório 'Os Limites do Crescimento' (1972)*. 2014. Available at: https://www.pensamentoverde.com.br/sustentabilidade/clube-roma-relatorio-limites-crescimento-1972/. Accessed: 29 jun. 2021.

5 UNITED NATIONS. *United Nations Conference on the Human Environment (Stockholm Conference)*. 1972. Available at: https://sustainabledevelopment.un.org/milestones/humanenvironment. Accessed: 29 jun. 2021.

and economic growth, upholding their right to develop and assume a role in the world economic scenario. Despite the lack of consensus, the Conference gave birth to an important document, the Declaration of the United Nations Conference on the Human Environment, the first international law instrument which recognizes the human right to a quality environment required by healthy dignified life.[6] In the 1980s, seeking to promote sustainable development, the UN tried to reconnect environmentalism with mainstream economic and social policy. Nonetheless, the advancement of this agenda and policy in the global arena would only flourish with the emergence of the discussion about climate.[7]

In the European scenario, environmental policy dates back to 1972, when the European Council was held in Paris (following the Stockholm Conference). The European Heads of State and Government asserted the need for a Community environmental policy which went hand in hand with economic expansion. The Single European Act of 1987, which aimed to eliminate the internal borders that impeded the free movement of citizens and goods in the European continent, had as one of its titles the topic "environment". This act provided the first legal basis for the standard environmental policy, which aimed at preserving the quality of the environment, protecting human health, and ensuring the rational use of natural resources.[8] The Maastricht Treaty (1993) made the environment an official policy area of the European Union. This treaty introduced the joint decision-making procedure and made qualified majority voting in the Council the general rule in environmental matters.[9]

In 1996, the European Union adopted limiting global warming to 2 degrees Celsius above pre-industrial levels.[10] In 1997, the Kyoto Protocol brought the hallmarks of neoliberal politics since it was based on carbon price market instruments and emissions trading. Nevertheless, the discussion held in Kyoto was fundamental in awakening a new sense of public purpose. To preserve the planet, it is necessary to establish binding targets for reducing greenhouse gases. Although the United

6 UNITED NATIONS. *Report of United Nations Conference on the Human Inviromental*.1972. Available at: https://www.un.org/ga/search/view_doc.asp?symbol=A/CONF.48/14/REV.1. Accessed: 29 jun. 2021.

7 BLOOMFIELD, Jon; STEWARD, Fred. The Politics of the Green New Deal. *The Political Quarterly*. Vol. 91, p. 770-779. Oct/dec. 2020. Doi: 10.1111/1467-923x.12917. Available at: https://onlinelibrary.wiley.com/doi/10.1111/1467-923X.12917. Accessed: 18 jun. 2021.

8 COMUNIDADE EUROPEIA. Ato Único Europeu. *Jornal Oficial das Comunidades Europeias*. 1987. Available at: https://eur-lex.europa.eu/legal-content/PT/TXT/PDF/?uri=CELEX:11986U/TXT&from=PT. Accessed: 29 jun. 2021. See: ECKERT, Eva; KOVALEVSKA, Oleksandra. Sustainability in the European Union: Analyzing the Discourse of the European Green Deal. *Journal of Risk and Financial Management*, v. 14, n. 2, p. 80, 2021. Available at: https://www.mdpi.com/1911-8074/14/2/80. Accessed: 22 jun. 2021.

9 UNIÃO EUROPEIA. *Tratado de Maastricht*. 1992. Available at: https://eur-lex.europa.eu/legal-content/PT/TXT/?uri=CELEX:11992M/TXT. Accessed: 29 jun. 2021. See: PARLAMENTO EUROPEU. Política Ambiental: Princípios gerais e quadro de base. 2021. Available at: https://www.europarl.europa.eu/ftu/pdf/pt/FTU_2.5.1.pdf. Accessed: 29 jun. 2021.

10 SIDDI, Marco. The European Green Deal: assessing its current state and future implementation. *Climate Policy*, v. 16, n. 5, p. 543-547, 2020.

States has withdrawn from the Kyoto Protocol, on the grounds that meeting the agreement's targets would harm its economy, in 2001, the European Union, showing signs of its global leadership, secured enough signatures for the protocol to enter into force.[11] Following the carbon emissions reduction plan, in 2005, the European Union launched the EU Emissions Trading System (EU ETS). This primary greenhouse gas emissions trading strategy has become a centerpiece of the European climate policy.[12] Moreover, the Paris Climate Agreement, made in December 2015, encouraged the European Union to revise its emissions reduction targets and renew its energy efficiency targets upward.[13]

In recent years, several extreme weather events and civil society demonstrations on behalf of the environment have served as a backdrop for the discussion to emerge with full force.[14] The Intergovernmental Panel on Climate Change (IPCC) created in 2018 a special report entitled "Global Warming of 1.5°C" aiming to study the impacts of a 1.5°C global warming, as established by the UN during the 21st Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC), formalized in the 2015 Paris Agreement. It was believed that the upper limit that the Earth's system could withstand without triggering catastrophic natural phenomena was warming in the range of 2°C. However, following analyses and studies in 2014, where it was found that the polar ice was becoming much more unstable than previously predicted, there was an increase in the level of attention. As a result, the IPCC created a study group that reassessed the global targets, concluding that it would be fundamental that warming is kept to a maximum of 1.5ºC.[15] The IPCC report estimates a 50 to 66 percent chance of keeping global warming below 1.5°C. So, emissions need to be cut by half of their current level by 2030 and reach zero by 2050 – an urgent need for countries to adopt concrete plans for emission reductions.[16]

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11 BLOOMFIELD, Jon, STEWARD, Fred. The Politics of the Green New Deal. *The Political Quarterly*. Vol. 91, p. 770-779. Oct/dec. 2020. Doi: 10.1111/1467-923x.12917. Available at: https://onlinelibrary.wiley.com/doi/10.1111/1467-923X.12917. Accessed: 18 jun. 2021.

12 EUROPEAN COMMISSION. *EU Emissions Trading System*. Available at: https://ec.europa.eu/clima/policies/ets_en. Accessed: 29 jun. 2021.

13 SIDDI, Marco. The European Green Deal: assessing its current state and future implementation. *Climate Policy*, v. 16, n. 5, p. 543-547, 2020.

14 BLOOMFIELD, Jon, STEWARD, Fred. The Politics of the Green New Deal. *The Political Quarterly*. vol 91, p. 770–779. Out/dez 2020. doi:10.1111/1467-923x.12917. Available at: https://onlinelibrary.wiley.com/doi/10.1111/1467-923X.12917. Accessed: 18 jun. 2021.

15 WWF – WORLD WILDLIFE FOUND. *Novo relatório do IPCC sobre aquecimento de 1,5ºC pede mais esforços para ação climática*. 08out.2018. Available at: https://www.wwf.org.br/?67822/Relatrio-do-IPCC-2018-sobre-aquecimento-global-de-15C-incita-mais-esforos-para-ao-climtica-global. Accessed: 20jun.2020. See: INTERNATIONAL PANEL ON CLIMATE CHANGE. *Global warming of 1.5°C*. 2019. Available at: https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf. Accessed: 30 jun. 2021.

16 MASTINI, Riccardo; KALLIS, Giorgos; HICKEL, Jason. A Green New Deal without growth? *Ecological Economics*, v. 179, p. 106832, 2021/01/01/ 2021. ISSN 0921-8009. Available at: https://www.sciencedirect.com/science/article/pii/S0921800919319615. Accessed: 20 jun. 2021.

Parallel to these studies, in 2015, the United Nations member countries signed the UN Agenda 2030 for Sustainable Development. It is a non-binding international declaration, but it aims to guide development policies for all signatory countries. In addition, Sustainable Development Goals (SDGs) have been outlined, which are to be implemented by states. The fundamental idea is to promote sustainable economic growth, foster innovation, ensure sustainable production and consumption patterns, and take urgent action to combat climate change and its impacts.[17] The SDGs are the successors of the Millennium Development Goals (MDGs), which were launched in 2000 and lasted until 2015, and whose main objective was to structure public policies around poverty reduction, universal primary education, gender equality, reducing child mortality, improving maternal health, combating diseases, environmental sustainability, and global partnership for development.[18]

In addition to these international events and environmental movements the Green New Deal movement emerged in 2007 in the United States. Although this term has appeared in political and economic debates since the 1970s, it gained momentum. It took over the American debate in 2007 when New York Times columnist Thomas Friedman asserted that the candidate capable of presenting ambitious energy and environmental agenda would have a clear advantage in the 2008 presidential race in the United States. The writer called the plan the Green New Deal (GND), referring to the American New Deal which stood out for a wide range of industrial programs and projects to revitalize America between 1933 and 1937 under President Franklin Delano Roosevelt. Friedman's idea, then, was to link industrial and economic development and the use of clean energy, thus stimulating sustainable growth.[19]

The financial crisis which resulted from the collapse of Lehman Brothers in September 2008 led many economists to view the GND as a strategy to get the American economy back on its feet. Making good on his campaign promises, Barack Obama, elected in 2008, was able to pass a $976 billion economic recovery and reinvestment package, of which $117 billion was directed toward energy efficiency and renewable energy. However, despite the efforts and promises in investments in clean energy generation, as of 2010, due to the economic crisis, the global economic

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17 UNITED NATIONS. *Transforming our world: the 2030 Agenda for Sustainable Development.* 2015. Available at: https://sdgs.un.org/2030agenda. Accessed: 27 jun. 2021.

18 DENNY, Danielle Mendes Thame; PAULO, Roberto Ferreira; CASTRO, Douglas de. 2018. *Blockchain* e Agenda 2030. *Revista Brasileira de Políticas Públicas*, v. 7, n. 3, p. 122-141, dez. 2017. Available at: https://www.publicacoes.uniceub.br/RBPP/article/view/4938. Accessed: 27 jun. 2021.

19 FRIEDMAN, Tomas Lorem. The power of green. *The New York Times*. 2007. Available at: https://www.nytimes.com/2007/04/15/opinion/15iht-web-0415edgreen-full.5291830.html. Accessed: 30 jun.2021. See: MASTINI, Riccardo; KALLIS, Giorgos; HICKEL, Jason. A Green New Deal without growth? *Ecological Economics*, v. 179, p. 106832, 2021/01/01/ 2021. ISSN 0921-8009. Available at: https://www.sciencedirect.com/science/article/pii/S0921800919319615. Accessed: 20 jun. 2021.

consensus changed and investments in sustainable development have been left aside. There came a time of spending cuts, what explains why the discussion around the GND has cooled.[20]

The issue only regained attention in November 2018, when US Congresswoman Alexandria Ocasio-Cortez, along with dozens of young activists from the Sunrise Movement, occupied US House of Representatives Speaker Nancy Pelosi's office requesting concrete measures to address the climate change crisis.[21] As early as March 2019, Alexandria, along with Senator Ed Markey, introduced US House of Representatives Resolution 109. This non-binding act sets goals for US economic policy, namely addressing the climate and economic stagnation crisis with measures to achieve net-zero greenhouse gas emissions within ten years. Another important goal is to decarbonize the transportation, agriculture, manufacturing, and infrastructure sectors as technologically feasible. Moreover, Resolution 109 sets social sustainability goals such as creating high-quality jobs and training workers affected by the green transition, expanding the welfare state by providing free health care and affordable housing for all citizens, and redressing the historical oppression of vulnerable communities through environmental justice.[22]

Ricardo Mastini calls the projects GND 1.0 (2009) and GND 2.0 (2019), pointing out that their differences are evident; the 2009 project established proposals from the top down to restore the post-2008 financial crisis economy, while the more recent one sees itself as part of the construction of popular movements in the context of struggles for environmental justice.[23] GND 1.0 focused investments on technological solutions, channeling resources to research and providing subsidies from a neoliberal approach to climate policy. It promoted market-friendly regulation, enabling resource mobilization and capital accumulation. GND 2.0 emerged after 16 G20 states did not follow UNEP's (United Nations Environment Program) 2009

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20 MASTINI, Riccardo; KALLIS, Giorgos; HICKEL, Jason.A Green New Deal without growth? *Ecological Economics*, v. 179, p. 106832, 2021/01/01/ 2021. ISSN 0921-8009. Available at: https://www.sciencedirect.com/science/article/pii/S0921800919319615>. Accessed: 20 jun. 2021.

21 GRIM, Ryan; GRAY, Briahna. Alexandria Ocasio-Cortez joins environmental activists in protest at democratic leader Nancy Pelosi's office. *The Intercept*. 2018. Available at: https://theintercept.com/2018/11/13/alexandria-ocasio-cortez-sunrise-activists-nancy-pelosi/. Accessed: 30 jun. 2021.

22 MASTINI, Riccardo; KALLIS, Giorgos; HICKEL, Jason. A Green New Deal without growth? *Ecological Economics,* v. 179, p. 106832, 2021/01/01/ 2021. ISSN 0921-8009. Available at: https://www.sciencedirect.com/science/article/pii/S0921800919319615. Accessed: 20 jun. 2021. See: UNITED STATES CONGRESS. *H.Res.109: Recognizing the duty of the Federal Government to create a Green New Deal*. 2019. Available at: https://www.congress.gov/bill/116th-congress/house-resolution/109/text. Accessed: 30 jun. 2021.

23 MASTINI, Riccardo; KALLIS, Giorgos; HICKEL, Jason. A Green New Deal without growth? *Ecological Economics,* v. 179, p. 106832, 2021/01/01/ 2021. ISSN 0921-8009. Available at: https://www.sciencedirect.com/science/article/pii/S0921800919319615. Accessed: 20 jun. 2021. See: COHEN, Daniel Aldana; RIOFRANCOS, Thea. Latin America's Green New Deal. *NACLA Report on the Americas,* v. 52, n. 2, p. 117-121, 2020/04/02 2020. ISSN 1071-4839. Available at: https://doi.org/10.1080/10714839.2020.1768726. Accessed: 20 jun. 2021. See: BARBIER, Edward B. How to make the next Green New Deal work. *Nature*, v. 565, p. 6, 2019. ISSN 00280836. Available at: https://link.gale.com/apps/doc/A573389561/HRCA?u=anon~594070da&sid=googleScholar&xid=8d6a5d40. Accessed: 20 jun. 2021.

recommendation to spend 1% of GDP on GND initiatives. Its measures clearly reject the use of market-based environmental policy instruments, adopting environmental regulation that prioritizes the decarbonization of the economy, making use of more significant public investment in sustainable energy matrices.[24]

The timeline below shows the historical events that led to the decision-making regarding GND 1.0 and GND 2.0, ultimately influencing the EGD headed by European Commission President Ursula von der Leyen:[25]

As can be seen, a long way has already been traveled in the search for environmental sustainability. Since the 1960s, governments worldwide, together with international organizations, have been discussing plans to reduce greenhouse gas emissions and make the economy more sustainable. The most recent attempt to realize this goal is the European Green Deal, which will be the subject of the next topic, and which is undoubtedly an ambitious plan that has obtained worldwide attention, given the impacts that its rules and policies might bring to the world economy.

3 *European Green Deal* and digital economy

In mid-2019, the Green Parties performed relatively well in the European Parliament elections reaching the 74-seat mark.[26] Soon after the elections and the appointment of the new Commission and Council, it was agreed that the climate issue would be the management's main priority.[27] The European Commission presented the European Green Deal (EGD) on December 11, 2019, and after deliberation held

[24] SAMPER, Juan Antonio; SCHOCKLING, Amanda; ISLAR, Mine. Climate politics in green deals: Exposing the political frontiers of the European Green Deal. *Politics and Governance*, v. 9, n. 2, p. 8-16, 2021. Available at: https://www.cogitatiopress.com/politicsandgovernance/article/view/3853. Accessed: 22 jun. 2021.

[25] MASTINI, Riccardo; KALLIS, Giorgos; HICKEL, Jason. A Green New Deal without growth? *Ecological Economics,* v. 179, p. 106832, 2021/01/01/ 2021. ISSN 0921-8009. Available at: https://www.sciencedirect.com/science/article/pii/S0921800919319615. Accessed: 20 jun. 2021.

[26] PARLAMENTO EUROPEU. *Os Sete Grupos Políticos do Parlamento.* 2020. Available at: https://www.europarl.europa.eu/news/pt/headlines/eu-affairs/20190612STO54311/os-sete-grupos-politicos-do-parlamento. Accessed: 18 jun. 2021.

[27] BLOOMFIELD, Jon; STEWARD, Fred. The Politics of the Green New Deal. *The Political Quarterly*. Vol. 91, p. 770-779. Out/dez. 2020. doi:10.1111/1467-923x.12917. Available at: https://onlinelibrary.wiley.com/doi/10.1111/1467-923X.12917. Accessed: 18 jun. 2021.

on January 20, 2020, the European Parliament decided to support the agreement. The EGD is an ambitious deal, which aims to make Europe carbon-free by 2050, without disregarding its economic competitiveness. The goal is to reduce greenhouse gas emissions by at least 55% by 2030, take 1990 emissions into account, and then make the continent emission neutral by 2050.[28] It is intended to mobilize a budget totaling 1 trillion euros of investments for the green transition.[29] The EGD is not a law but can be conceptualized as a key policy roadmap for the European Union's climate agenda. The European Commission has started to develop legislative proposals and strategies from 2020 onwards.[30] Moreover, the plan is to make the economy sustainable without leaving anyone behind; a large part of the involved budget should be allocated towards professional repositioning for people who lose their jobs or have their income reduced due to the green transition.[31]

The EGD established maps and roadmaps on crucial issues that enable a transition to a sustainable society to advance the climate policy agenda. It sought to come up with concrete measures to change sectors of the economy responsible for a large share of carbon emissions, such as energy, industry, building, mobility, and food. Perhaps the most outstanding merit of the EGD is to bring coherence between the discourse of environmental protection and economic development.[32]

Innovation is one of the essential strategies for the European Union to achieve the sustainable goals outlined by the EGD. Europe is expected to become a global powerhouse of innovation for clean energy technologies, clean mobility, and smart buildings. To foster the achievement of its goals, the European Union has created the European Innovation Council, which aims to support innovative companies. Another important institution is the Innovation Fund,[33] set up by the European Commission for 2019-2021 to sustain the development of low-carbon technologies in energy industries processes, carbon dioxide capture, utilization and storage, and innovative renewable energy and energy storage technologies.[34]

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28 JAEGER, Carlo *et al*. The European Green Deal–More Than Climate Neutrality. *Intereconomics,* v. 2021, n. 2, p. 99-107, 2021. Available at: https://www.intereconomics.eu/contents/year/2021/number/2/article/the-european-green-deal-more-than-climate-neutrality.html. Accessed: 22 jun. 2021.

29 MUNTA, Mario. The European Green Deal: A game changer or simply a buzzword. *Friedrich Ebert Stiftung,* 2020. Available at: https://www.researchgate.net/publication/344161380_The_European_Green_Deal_A_game_changer_or_simply_a_buzzword. Accessed: 20 jun. 2021.

30 SIDDI, Marco. The European Green Deal: assessing its current state and future implementation. *Climate Policy,* v. 16, n. 5, p. 543-547, 2020.

31 FETTING, Constanze. *The European Green Deal*. 2020. Available at: https://www.esdn.eu/fileadmin/pdf/Conferences/2020_Berlin/ESDN_Conference_2020_Report_Final.pdf. Accessed: 18 jun. 2020.

32 BLOOMFIELD, Jon; STEWARD, Fred. The Politics of the Green New Deal. *The Political Quarterly*. Vol. 91, p. 770-779. Out/dez. 2020. Doi:10.1111/1467-923x.12917. Available at: https://onlinelibrary.wiley.com/doi/10.1111/1467-923X.12917. Accessed: 18 jun. 2021.

33 Available at: https://ec.europa.eu/clima/policies/innovation-fund_en.

34 CLAEYS, Grégory; TAGLIAPIETRA, Simone; ZACHMANN, Georg. *How to make the European Green Deal work*. Bruegel, 2019. Available at: https://www.bruegel.org/wp-content/uploads/2019/11/PC-14_2019-041119.pdf. Accessed: 22 jun. 2021.

It is meaningful to notice that the COVID-19 crisis that began in the first months of 2020 has given the EGD even more strength, accelerating its implementation since it has made humanity's fragile relationship with the planet evident. The European Parliament has approved an economic recovery package of 750 billion euros, which is called "green recovery" since all incentives and financial aid will be distributed according to the rules of the EGD with a focus on carbon emission reductions.[35]

On June 09, 2020, the Council of the European Union released a study regarding the pressing need to digitize the European economy in order to help reduce greenhouse gases and thus meet the EGD targets. The document aims to disseminate the "Council conclusions on building Europe's digital future." The document highlights the importance of the following issues: data and cloud computing; artificial intelligence; digital enabling technologies and value chains; cybersecurity; 5G/6G networks and connectivity; environmental sustainability; e-health; legislative package on digital services; media policy; electronic identification and trust services, public administrations, standards, and blockchain; skills and education; international dimension and taxation of the digital economy. Regarding blockchain specifically, the Council recognizes its importance for the digitization of the economy and its application in COVID-19 related measures. As for environmental sustainability states that digital infrastructure, technologies, and applications are key factors in addressing Europe's climate and environmental challenges. Notwithstanding all the advantages brought about by the massive use of ICTs – Information and Communication Technologies, the study also observes that they currently contribute to increasing emission of greenhouse gases, given the extensive use of energy for their operation. Therefore, it considers that the ICT sector must seek mechanisms to reduce its greenhouse gas emissions resulting from innovation.[36]

It seems clear that the information and communications technology industry produces greenhouse gas emissions through its own energy consumption. But this impact is not as significant as its emission reduction potential. New technologies can lead to much more substantial reductions in energy consumption through the modernization of buildings, transportation, industry, household livelihoods, and agriculture.[37] Thus, there is a consolidated understanding that ICTs can significantly reduce greenhouse gas emissions. Still, for this goal to be achieved, ICT structures

[35] BLOOMFIELD, Jon; STEWARD, Fred. The Politics of the Green New Deal. *The Political Quarterly*. Vol. 91, p. 770-779. Out/dez. 2020. Doi:10.1111/1467-923x.12917. Available at: https://onlinelibrary.wiley.com/doi/10.1111/1467-923X.12917. Accessed: 18 jun. 2021.

[36] CONSELHO DA UNIÃO EUROPEIA. Construir o futuro digital da Europa: conclusões do Conselho. Jun. 2020. Available at: https://data.consilium.europa.eu/doc/document/ST-8711-2020-INIT/pt/pdf. Accessed: 23 jun. 2021.

[37] JAEGER, Carlo *et al*. The European Green Deal–More Than Climate Neutrality. *Intereconomics,* v. 2021, n. 2, p. 99-107, 2021. Available at: https://www.intereconomics.eu/contents/year/2021/number/2/article/the-european-green-deal-more-than-climate-neutrality.html. Accessed: 22 jun. 2021.

themselves will have to evolve and become more sustainable and efficient in their use of energy and resources.

Furthermore, it is also essential to train the population to operate ICTs, because as important as making technologies available is equipping the people with the technical knowledge to manage them. In this sense, the European Commission targets 80% of adults with basic digital skills by 2030.[38] In the same vein, it is also essential to educate the largest possible number of professionals with specific knowledge in programming and computer science to enable the continued development of technologies and skilled labor to work in various sectors of the economy and the public sector. The European Union's goal is to reach the mark of 20 million ICT specialists with convergence between men and women, as currently there is a significant imbalance, where for six ICT specialists, only one is a woman and for every three graduates in science, technology, engineering or mathematics only one is a woman.[39]

In summary, the EGD seems to be a very impactful document with an adequate presentation of corrective measures for the green transition, especially regarding the digitalization of the economy. In the next topic, blockchain technology will be introduced and whether it can help meet the carbon reduction targets set by the EGD.

4 Blockchain and sustainability

Blockchain, which first came to prominence in 2009 through Bitcoin, opens up multiple opportunities that will change the current business process by enabling collaborative business execution involving multiple dynamic untrusted services without a central authority or any particular participant. The tasks within the processes are performed by several selected services that can be operated and validated via intelligent contract.[40] Each block on the blockchain consists of two parts, being the header, which includes metadata such as a unique reference number, the time the block was created, and a link to the previous block; and the data, which typically

[38] For an interesting approach on the digital inclusion and exclusion, see RANCHORDAS, Sofia. The Digitalization of Government and Digital Exclusion: Setting the Scene (April 29, 2020). Forthcoming in MENDES, G. Ferreira; MORAIS, C. Blanco de (Eds.). Direito Público e Internet: Democracia, Redes Sociais e Regulação do Ciberespaço. FGV Publicações/IDP/Univ. Lisboa, (Public Governance 4.0, 2020). *University of Groningen Faculty of Law Research Paper No. 30/2020*. SSRN: https://ssrn.com/abstract=3663051 or http://dx.doi.org/10.2139/ssrn.3663051 Accessed: 11 jul. 2021.

[39] COMISSÃO EUROPEIA. *Comunicação da Comissão ao Parlamento Europeu, ao Conselho, ao Comitê Econômico e Social Europeu e ao Comitê das Regiões. Orientações para a digitalização até 2030: a via europeia para a década digital*. 2021. Available at: https://eur-lex.europa.eu/legal-content/pt/TXT/?uri=CELEX:52021DC0118. Accessed: 23 jun. 2021.

[40] VIRIYASITAVAT, Wattana *et al*. Blockchain and internet of things for modern business process in digital economy – the state of the art. *IEEE Transactions on Computational Social Systems*, v. 6, n. 6, p. 1420-1432, 2019. Available at: https://ieeexplore.ieee.org/abstract/document/8744245. Accessed: 26 jun. 2021.

includes a list of valid transactions performed, their values and the addresses of the parties that performed the transactions.[41] The blockchain is public. Anyone can see it at any time because it resides on the network and not within a single institution in charge of auditing operations and maintaining records. To keep digital security, it uses heavy cryptography involving private and public keys. Every ten minutes, all transactions performed are verified, released, and stored in a block linked to the previous block, thus creating a chain. Each block must authenticate the previous one to be valid. This structure permanently marks the time and stores the value exchanges, preventing anyone from altering the ledger.[42]

Blockchain networks, characterized as a secure, permanent, and tamper-proof digital transaction book maintained and distributed among the involved parties without a central validator, are a key component which reshapes modern business processes and disrupts traditional ones. To verify a new transaction, most parties must approve the transaction before it can be registered. The transactions to be added are approved by a consensus method, which means that no intermediary is involved in the process as the network users themselves approve the transaction.[43] Blockchain networks differ drastically from centralized networks, such as those used by the banking system, since in these cases, all transactions are processed and stored in a central server. In distributed networks, each of the blocks, distributed among the users in a decentralized way, has a complete copy of the ledger, which is constantly updated by the network, so there is no need for a central server. The great advantage of these distributed networks is the impossibility of a malicious agent invading them to alter the ledger since it would be necessary to access more than 50% of the blocks, performing fraud in each one. Another innovation of blockchain is that there is no need for a trusted third party to intermediate transactions because everything happens under the supervision of all nodes that make up the network. The elimination of vulnerable central points is one of the great blockchain revolutions. These characteristics enable its use in various sectors of Public Administration.[44]

The disruptive characteristics of blockchain technology place it at the center of attention in technological innovation. Its development has drawn analogies with

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41 DEPARTMENT OF INDUSTRY, SCIENSE, ENERGY AND RESOURCES – AUSTRALIAN GOVERNAMENT. *National blockchain roadmap.* Austrália. Available at: https://www.industry.gov.au/data-and-publications/national-blockchain-roadmap. Accessed: 04 jul. 2020.

42 TAPSCOTT, Don; TAPSCOTT, Alex. *Blockchain Revolution. Como a tecnologia por trás do bitcoin está mudando o dinheiro, os negócios e o mundo.* São Paulo: Senai-SP. 2019. E-book KOBO, Capítulo I, p. 10-12 de 58.

43 VIRIYASITAVAT, Wattana *et al.* Blockchain and internet of things for modern business process in digital economy— the state of the art. *IEEE Transactions on Computational Social Systems*, v. 6, n. 6, p. 1420-1432, 2019. Available at: https://ieeexplore.ieee.org/abstract/document/8744245. Accessed 26 jun.2021. See: TAPSCOTT, Don; TAPSCOTT, Alex. *Blockchain Revolution. Como a tecnologia por trás do bitcoin está mudando o dinheiro, os negócios e o mundo.* São Paulo: Senai-SP. 2019. E-book KOBO, Capítulo I, p. 9 de 58.

44 LYRA, João Guilherme. *Blockchain e Organizações Descentralizadas.* Rio de Janeiro: Brasport, 2019, p 11.

the very emergence of the digital computer and the Internet, such as the euphoria about its transformative potential. But, on the other hand, blockchain has also been criticized for its high energy consumption.[45]

As for the significant impact on energy consumption, blockchain transactions are validated by network members (also called "nodes") in a process called mining. This validation process characterizes DLTs (Distributed Ledger Technology) and blockchain, replacing the centralized trusted third-party model. So, the network participants compete with each other, using their machine power (Proof-of-work) to validate the transaction blocks every ten minutes. Proof-of-work is difficult to produce, but it is elementary for the other modules to do the verification. Hence, the majority of the network members establish the validity of the transaction.[46] For example, in the Bitcoin network, each participant in the network has constituted a node and is called a miner and has to solve a challenging computational problem to confirm the validity of the newly mined blocks. The first node that solves the problem is rewarded with Bitcoins. The probability of winning the reward is proportional to the computational power of the miner. Thus, an attack against the blockchain is only possible if the attacker has significant computational resources and the network's security is supported by the cost of resources. To increase the probability of winning the reward and creating a block, miners compete to have the most powerful computer, which is great for Bitcoin security, but not ecologically sustainable.[47] What is striking about this proof-of-work system is that miners invest their resources to validate transactions, which contributes enormously to the cryptographic security of the network and the fraud resilience of the system. That makes potential attackers prefer to participate as miners, with a real opportunity for reward, at a lower cost, rather than invest in defrauding the network.[48]

But in fact, the proof-of-work method is considered expensive and criticized for being energy-intensive. Trying to address this issue, alternative mechanisms for work validation are being investigated closer to the SDGs and the precepts of the European Green Deal (EGD). An example is SolarCoin, which rewards solar energy generators with new coins, or GridCoin, which introduces a new algorithm based on

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45 TOMLINSON, Bill *et al*. Analyzing the sustainability of 28 'Blockchain for Good' projects via affordances and constraints. *Information Technology for Development,* v. 27, n. 3, p. 439-469, 07 mar. 2021. ISSN 0268-1102. Available at: https://doi.org/10.1080/02681102.2020.1828792. Accessed: 26 jun. 2021.

46 KEWELL, Beth; ADAMS, Richard; PARRY, Glenn. Blockchain for good? *Strategic Change,* v. 26, n. 5, p. 429-437, 2017. ISSN 1086-1718. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1002/jsc.2143. Accessed: 27 jun. 2021.

47 COCCO, Luisanna; PINNA, Andrea; MARCHESI, Michele. Banking on blockchain: Costs savings thanks to the blockchain technology. *Future internet*, v. 9, n. 3, p. 25, 2017. Available at: https://www.mdpi.com/1999-5903/9/3/25. Accessed: 03 jul. 2021.

48 KEWELL, Beth; ADAMS, Richard; PARRY, Glenn. Blockchain for good? *Strategic Change*, v. 26, n. 5, p. 429-437, 2017. ISSN 1086-1718. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1002/jsc.2143. Accessed: 27 jun. 2021.

work done in BOINC projects (Berkeley Open Infrastructure for Network Computing), where miners are encouraged to participate in scientific projects linked, for example, to health and space exploration, to provide benefits to humanity.[49] What seems to be the great advantage of blockchain networks is the power to eliminate potentially polluting steps and functions from the industrial and service production chain. It makes it possible to reduce the overall emissions of harmful gases.

In a study conducted by the Coolclimate Network at the University of California, Berkeley, it was estimated that the American banking industry emits 383.1 million tons of CO2/year for bank branches and 3.2 million CO2/year for ATMs. The Bitcoin network, on the other hand, produces 0.75 million tons of CO2 annually, leading to the conclusion that electronic currency has 99.8% fewer emissions than the American banking system. Therefore, if shortly it is possible to replace physical banks with digital currencies or cryptocurrencies such as Bitcoin, which works employing a blockchain, a positive environmental gain will be possible.[50]

Despite some criticism, blockchain solutions can be used to achieve good sustainability outcomes. Blockchain projects that move away from their exclusively financial character and help provide socially and environmentally beneficial results are called "Blockchain for good". The social aspect helps attract investment from international organizations such as the UN to fund studies to discover the real, sustainable capacity of the blockchain.[51] While there are positive expectations in the social use of blockchain, there is also some skepticism and even claims that it is a fad and that everything done through blockchain can be done through centralized systems. The added value of this new system is precisely the decentralization and approval of tasks by consensus mechanism, which removes the need for a central authority, as in traditional currencies, for example. And this is very innovative. It seems reasonable to assume, then, that the best alternative is not to set the technology aside but to improve it to suit sustainability objectives.[52]

Without disregarding the criticism presented, it seems possible to assert that blockchain will positively impact the economy, considering its confluence with Industry 4.0. Some technical characteristics of blockchain lead to this conclusion,

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[49] KEWELL, Beth; ADAMS, Richard; PARRY, Glenn. Blockchain for good? *Strategic Change*, v. 26, n. 5, p. 429-437, 2017. ISSN 1086-1718. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1002/jsc.2143. Accessed: 27 jun. 2021.

[50] MCCOOK, Hass. *Under the Microscope: The True Costs of Banking*. Coindesk. 2014. Available at: http://www.coindesk.com/microscope-true-costs-banking/. Accessed: 03 jul. 2021.

[51] KEWELL, Beth; ADAMS, Richard; PARRY, Glenn. Blockchain for good? *Strategic Change*, v. 26, n. 5, p. 429-437, 2017. ISSN 1086-1718. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1002/jsc.2143. Accessed: 27 jun. 2021.

[52] BARTOLETTI, Massimo *et al. Blockchain for social good: a quantitative analysis*. Proceedings of the 4th EAI International Conference on Smart Objects and Technologies for Social Good. Bologna, Italy: Association for Computing Machinery: 37–42 p. 2018. Available at: https://dl-acm-org.ez433.periodicos.capes.gov.br/doi/abs/10.1145/3284869.3284881. Accessed: 01 jul. 2021.

such as resilience, since distributed books are used to decrease the single point of failure; scalability, since blockchain-based solutions apply to any number of peers and the scale of the network in the application; security, since with cryptography it provides vital protection for process and business management; and autonomy, since cyber-physical systems allow all components to perform transactions autonomously without the intervention of third parties.[53]

Hundreds of socially and environmentally sustainable applications have been developed around the world. Even in cryptocurrencies, it is possible to instill socially and environmentally relevant values. All that is needed is to incorporate ethical principles and values into their codes, allowing individuals to align their spending with their principles.[54] A meaningful example of this is a blockchain-based Islamic cryptocurrency project, where Muslim transactions and values, including an anti-radicalization agenda, are aligned so that social principles of the community are incorporated into the currency.[55] In this case, the certification would occur through PoV – Proof of Value and would also demonstrate, for example, that the cryptocurrency would be compatible with Sharia, which is an Islamic law derived from the Koran, which among other principles, determines that the money allowed is that which is earned legitimately; that it is not usury; that it has incorporated principles that lead to social benefit and mutual sharing of risks. In this regard, PoV certificates would show the Islamic values behind each transaction of the blockchain-based currency.[56] The idea is that the certificates granted, which have intangible values, would help correct the vulnerability inherent in cryptocurrencies, such as high volatility due to low public trust.[57]

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53 VIRIYASITAVAT, Wattana *et al*. Blockchain and internet of things for modern business process in digital economy – The state of the art. *IEEE Transactions on Computational Social Systems*, v. 6, n. 6, p. 1420-1432, 2019. Available at: https://ieeexplore.ieee.org/abstract/document/8744245. Accessed: 26 jun. 2021.

54 KEWELL, Beth; ADAMS, Richard; PARRY, Glenn. Blockchain for good? *Strategic Change*, v. 26, n. 5, p. 429-437, 2017. ISSN 1086-1718. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1002/jsc.2143. Accessed: 27 jun. 2021.

55 TAGHIYEVA, Maryan *et al*. *Seratio Blockchain. White Paper. Currency of intangible nonfinancial value*. 2016. Available at: https://www.researchgate.net/publication/316701664_Currency_of_Intangible_Non-Financial_Value_ SERATIO_BLOCKCHAIN_Seratio_Blockchain_Internet-of-Value_capturing_Total_Value_through_Social_Earnings_Ratio_integration_of_intangible_non-financial_attribute. Accessed: 29 jun. 2021. See: KEWELL, Beth; ADAMS, Richard; PARRY, Glenn. Blockchain for good? *Strategic Change*, v. 26, n. 5, p. 429-437, 2017. ISSN 1086-1718. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1002/jsc.2143. Accessed: 27 jun. 2021.

56 The point here is not to evaluate this system in its wholeness or to offer a critical approach on the values behind it. At the moment the idea is only to illustrate the discussion pointed out in the text giving a tangible example.

57 TAGHIYEVA, Maryan *et al*. *Seratio Blockchain. White Paper. Currency of intangible nonfinancial value.* 2016. Available at: https://www.researchgate.net/publication/316701664_Currency_of_Intangible_Non-Financial_Value_ SERATIO_BLOCKCHAIN_Seratio_Blockchain_Internet-of-Value_capturing_Total_Value_through_Social_Earnings_Ratio_integration_of_intangible_non-financial_attribute. Accessed: 29 jun. 2021.

The Internet of Value (IoV) is a movement of value realized over TCP/IP that transcends the Internet of Things (IoT) as shared data manifests itself in value creation. One could say that today blockchain is one of the vehicles through which such value can be transacted. Financial value is just one of the values that can add to a tangible asset class. Expressions like love, kindness, and sustainability are also values that define and determine everyday decisions. One does not decide to buy a car or a house just because of its reasonable price. There are other (intangible) values that are considered when making a choice. Therefore, the total value of an asset is the sum of the tangible financial value plus the intangible value.[58]

As stated above, the criticism regarding the environmental sustainability of blockchain networks deserves all the attention, and it is clear that if its use implies an increase in the average total carbon emissions, its use should be reviewed. However, several alternatives for validating transactions are currently being studied to reduce the technology's carbon footprint. Therefore, it is believed that there will be an alternative that makes the use of technology even more advantageous from an environmental point of view in a short time. However, the inclusion of the technology already seems to be desirable because its positive characteristics tend to outweigh its negative externalities.

5 Conclusion

The EGD results from a historical conjuncture that began in the 1960s, still with incipient and timid environmentalism. This period saw the beginning of the discussion regarding the harm of industrialization to human health and the environment, evolving in the debate held by the 1972 Club of Rome report, which was concerned with the depletion of natural resources; followed by the Stockholm Conference; the 1987 Single European Act; the 1993 Maastricht Treaty; the 1997 Kyoto Protocol, GND 1.0 (2007) and GND 2.0 (2018) and the 2019 Paris Climate Agreement. All these protocols and agreements followed a line of evolution, culminating with the European Green Deal, which seeks to break the line of the mere non-binding protocol of intent to, using the power of the market economy, pressure and induce economic actors to pursue sustainable practices and standards.

The timeframe is tight for such a complex mission. Reducing carbon emissions by 55% by 2030 and making the continent emission-neutral by 2050 seems like a Herculean task for Europeans. However, considering how dependent their economy

[58] TAGHIYEVA, Maryan; MELLISH, B.; TA'EED, O. *Seratio Blockchain. White Paper. Currency of intangible nonfinancial value*. 2016. Available at: https://www.researchgate.net/publication/316701664_Currency_of_Intangible_Non-Financial_Value_SERATIO_BLOCKCHAIN_Seratio_Blockchain_Internet-of-Value_capturing_Total_Value_through_Social_Earnings_Ratio_integration_of_intangible_non-financial_attribute. Accessed: 29 jun. 2021.

is on hydrocarbons, the limited timeframe and the complexity of the mission should serve as motivating ingredients to enforce the EGD rules, fostering effective green transition projects. As already happened in 2009 with GND 1.0 in the United States, one might think that the COVID-19 crisis would discourage the European Union from following through with its ambitious carbon neutrality plan; after all, they would first have to save their economy before thinking about saving the planet. On the contrary, they found in the COVID-19 crisis, which occurred a few days after the approval of the EGD by the European Parliament, an opportunity to accelerate their green transition plan by approving an extra package of 750 billion euros, which is being used to recover the economy according to the rules established by the green pact. In other words, only companies and projects that conform to the rules of the green transition will receive public funding and support. No wonder the Europeans have been calling this policy "green recovery".

As the digitalization of the economy is one of the pillars of the EGD, European institutions have been looking for technological alternatives that can be used to make the digital economy more energy-efficient, meeting carbon emission reduction targets. As presented in this paper, blockchain is a strong candidate to become one of the core technologies of this new phase of the European digital economy. The criticism that is made to its high energy consumption should be discussed and scrutinized. In any case, it should be considered that the reduction in carbon emissions resulting from the application of blockchain networks may be greater than the increase from the operation of the network, generating a positive environmental balance. An example of this, as highlighted in the previous topics, is the study conducted by the University of California, Berkeley, which highlighted that the entire US banking system emits 386.3 million tons of CO2 annually and that Bitcoin, operated through the blockchain, has approximately 99.8% fewer emissions than the US banking system. Therefore, even if the statement that the blockchain network has a high energy consumption is true, it is reasonable to argue that the benefits of the technology might bring, over time, a reduction of greenhouse gas emissions.

What further strengthens this conclusion is the existence of new techniques other than PoW – Proof of Work, to validate the transactions performed through the blockchain, which consume less energy or seek to add sustainable value to the blockchain. PoV – Proof of Value, for example, adds sustainable and ethical ideas to electronic currencies, which can help reduce emissions with greater awareness of the population in their financial transactions.

Since blockchain is a technology that is still being experimented with, it is not possible to say objectively what its environmental benefits will be and whether it will effectively revolutionize the way people relate to the digital economy. Nonetheless, it seems possible to gauge, based on its technical characteristics, that it has disruptive

potential, being an excellent tool to support Europeans pursue their sustainable objectives established by the EGD.

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