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Chapter 10

Analytical Assessment of Green Digital Finance Progress in the Republic of Georgia

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Summary

Estimations show that approximately US \$23 billion is required for Georgia to meet its climate and environmental targets up to 2030. As the current Nationally Determined Contribution reveals, considering 1990 as a base year, the Republic of Georgia plans a 35% decrease in greenhouse gas emissions by 2030. If the country has financial and technical support, commitment to limit emissions may rise as high as 50%–57%. As part of the Paris Climate accord, developed nations pledged to channel US \$100 billion toward low-income countries between 2020 and 2025. Recent estimates by the OECD show that developed nations will be able to reach their US \$100 billion pledge only in 2023. Considering this lag for many developing countries, including Georgia, mobilizing private finance via green digital finance will be vital. The policymakers of the Republic of Georgia are very ambitious about adopting green digital finance solutions. This initiative has potential to fill the gap in public funding sources. Hence, this study analyzes the potential for private sector financing through the digitization of green finance. The current study illustrates the extent to which green finance and its digitization level are available in the Republic of Georgia. The major policy implication is that the country faces unintended consequences even though there is a robust regulatory attempt to mobilize private financial sources. This case study is relevant for many developing countries for drawing lessons on better policymaking.

Keywords: green digital finance, sustainable finance, regulatory sandbox, sustainable development goals (SDGs)

JEL classification: G20, G23, Q01, Q55

1. Introduction

Like many other developing economies, Georgia is also vulnerable to the negative impacts of climate change. Although 20% of the labor force is employed in the agriculture sector, the country still imports 80%–90% of its wheat consumption (WB and ADB 2021). Average temperatures in Georgia show steady increases since the 1960s. Furthermore, the temperature is expected to rise more than the global average. Roughly 80% of Georgia's domestic electricity generation comes from hydropower. Considerable falls in river flows in the summer months can bring about negative effects for GDP and balance of payments by increasing the importation of electricity and river-fed irrigation. The Prime Minister of the Republic of Georgia stressed one important detail in his speech at the 26th UN Climate Change Conference of the Parties (COP26): the Caucasus region has lost 40% of its glaciers due to climate change (UNFCCC 2021a).

The gradually increasing impacts of climate change can cause rapid depletion of hydropower electricity sources. “Irreversibility” is becoming a more visible consequence of climate change and is now mentioned frequently in discussions of climate change effects. In the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR 6), the terms “irreversibility” and “irreversible” are used 28 and 74 times respectively (IPCC 2021). The Georgian economy and people are not immune to this undesirable pathway. About 23% of Georgian GDP is linked to the tourism industry. As climate change continues to deliver higher temperatures, the resultant declining snowpack and shortened winter, together with dissatisfied tourists (WB and ADB 2021), can damage the tourism industry. The population ratio living below the national poverty line was 19.5% in 2019 (WB 2021a). The unemployment rate in 2020 was slightly over 12% (WB 2021b).

While Georgia continues to face economic difficulty and gradually increasing environmental challenges, a turning point for global climate action occurred with the 2015 Paris Agreement where nearly all nations gathered at the 21st Conference of the Parties (COP21). There was complete unanimity to combat climate change by setting a comprehensive goal that aimed to limit global temperature increase to 2 °C.

In changing the political outlook and priorities, the Paris agreement requires vast levels of investment for countries to embark on the path of carbon neutrality. On one hand, developed nations pledged US \$100 billion for 2020–2025, but it appears that they fell short of this mark by US \$20 billion in 2019. This shortfall was mainly attributed to a lack of private investment. The Organisation for Economic Co-operation and Development (OECD) estimates that the US \$100 billion target will be achieved from 2023 onwards (OECD 2021a). On the other hand, according to the estimations of OECD, the yearly investment volume to globally meet the Paris Agreement goals is 6.35 trillion EUR (OECD 2017). Here,

the major role is on the shoulders of the public sector that has to support innovation and redirect private capital to sustainable and green investment. In this respect, the required amount of investment can be raised through digitizing green finance, such as blockchain-based green bonds, sustainability bonds, sustainability-linked bonds, green loans, and social bonds. Innovations in green finance offer the potential to contribute to global goals and reshape the economy in favor of access to services such as energy, poverty reduction, and economic activity. Furthermore, they lower aggregate investment and operating costs and help to improve the country's capacity to achieve sustainable development goals (SDGs) (Nassiry 2018).

One of the major innovations that can be applied to the financial sector is blockchain technology. According to Jones (2021), the sustainable debt market (green, social, and sustainability bonds) reached a cumulative US \$1.7 trillion at the end of 2020, while as of August 2020, the International Capital Market Association estimated that the overall size of the global bond market was approximately US \$128.3 trillion notional outstanding (see <https://www.icmagroup.org/Regulatory-Policy-and-Market-Practice/Secondary-Markets/bond-market-size/>). A rough calculation shows that the sustainable debt market comprises less than 2% of the total bond market share, which introduces a wide corridor for the potential exponential increase in the issuance of green, social, and sustainability bonds to meet the annual deficit for funding SDGs. In this respect, blockchain presents cost-saving opportunities to reduce the need for intermediaries by more than ten times. Also it enables smaller projects to issue bonds, which would initiate a huge number of smaller sustainable and green projects (Haahr et al. 2019).

According to the current and updated Nationally Determined Contribution (NDC) unconditional commitment, by 2030, Georgian greenhouse gas (GHG) emissions will not exceed 65% of 1990 levels. That is, the country has committed to a 35% decrease in GHG emissions by 2030. Broadly, SDG-13 and, specifically, indicator 13.2.2 cover this crucial detail. Also, if the country has financial and technical support, commitment to limit emissions may rise as high as 50%–57% (UNFCCC 2021b). This chapter analyzes the current and prospective contributions to green digital finance for reaching this and other SDGs. The major finding of this study is that even though the Republic of Georgia managed to create a favorable regulatory environment for crypto mining, the blockchain ecosystem remains incomplete. As a result, channeling domestically mined digital funds into the green projects has faced barriers. This book provides a discussion of legal frameworks, the role of governments in accelerating green digital finance trends, distributed ledger technology (DLT)–SDG relationships, and challenges in this field, while this chapter provides a case study for a small economy that is quite vulnerable to climate change and global warming.

2. Green Digital Finance in Georgia

The digitization of the banking industry in Georgia has been in progress since the beginning of the last decade, and some banks have already offered good digital banking services. In December of 2019, the European Bank for Reconstruction and Development (EBRD) launched the Green Economy Financing Facility (GEFF) program in Georgia to contribute to the development of the green economy in the country. GEFF is co-financed by the EBRD, the Austrian Federal Ministry of Finance, and the Green Climate Fund and received US \$54 million to finance investments in energy efficiency and climate mitigation via local partner commercial banks. GEFF announced that 227,630 kWh of energy and more than 45,830 tons of CO₂ emissions per year have been saved through its investments in projects related to environment and energy (GEFF 2021). This kind of outcome also creates additional gains for SDG 13.

The Republic of Georgia is very open to new technologies and supports innovation in multiple ways. Currently, Georgia has a long way to go to achieve complete digitization of the financial and banking industry. Starting from 2017, BBVA Research conducts an annual study in which it calculates the Digitization Index of 100 countries. In 2020, Georgia's Digitization Index was 0.48 (1 is a maximum value indicating complete digitization), which is an increase of 0.08 points since 2017 (Cámara 2020). The index evaluates six criteria: government adoption, enterprise adoption, user adoption, regulation, infrastructure, and cost. Moreover, Georgia ranked 43rd in the world for Digital Readiness Index by Cisco in 2019 (see https://www.cisco.com/c/m/en_us/about/corporate-social-responsibility/research-resources/digital-readiness-index.html#/country/GEO). Seven components (basic needs, business and government investment, ease of doing business, human capital, start-up environment, technology adoption, technology infrastructure) are considered in evaluating the Digital Readiness Index, and Georgia stood at 55th in the world for technology infrastructure, which indicates the availability of infrastructure for enabling activities and connecting users. This represents a large gap for further improvement that the Government of Georgia must consider.

According to the OECD report on access to green finance for small and medium-sized enterprises (SMEs) in Georgia (OECD 2019), there have been several estimations on the level of financing to meet Georgia's sustainable development and climate change targets:

- US \$8.3 billion for 2017–2030 for energy efficiency (National Energy Efficiency Action Plan) (NEEAP Expert Team 2017);
- US \$10.6 billion for 2017–2030 for energy efficiency, non-energy greenhouse gas and land use, land-use change, and forestry emission reduction (Low Emission Development Strategy) (Winrock and Remissia 2017);

- US \$2.4 billion for hydropower for 2017–2030 (Third National Communication of Georgia to the United Nations Framework Convention on Climate Change) (Government of Georgia 2015b);
- US \$1.5–2.0 billion for climate change adaptation over 2021–2030 (Intended National Contribution) (Government of Georgia 2015a).

In the Roadmap for Sustainable Finance in Georgia, sustainable finance is mentioned as a comprehensive approach that brings together different strategies for improving the social, economic, and environmental performance of the financial system (National Bank of Georgia 2019). The roadmap takes two urgent imperatives of sustainable finance into consideration in the report—“Financing a Sustainable European Economy”—by the European Commission (2018):

1. Improving the contribution of finance to sustainable and inclusive growth by funding society's long-term needs;
2. Strengthening financial stability by incorporating environmental, social, and governance (ESG) factors into investment decision-making.

Stemming from the second imperative, the National Bank of Georgia (NBG) accepted the Supervisory Strategy for 2020–2022 (National Bank of Georgia 2020a) in which several strategic priorities and vital activities for their execution were set for the outlined period. To increase financial stability and inclusion and maintain technological integration into the banking and financial system, the National Bank of Georgia identified the development of ecosystems for sustainable financial technologies. This strategic priority has six directions, including (1) the development of digital banking, (2) the development of open banking, and (3) the regulatory sandbox (Box 1).

Following the introduction of the Supervisory Strategy, NBG released “Digital Banking Principles” and “Principles on which the Rule of Engaging in Open Banking will be Based” in 2020. These were the first steps in digital bank licensing and the open banking revolution (open banking has already been piloted with traditional banks). By that time, NBG had already established the Financial Innovation Office and Regulatory Laboratory to support innovative business models. The Financial Innovation Office promotes

Box 1. Abstract from Supervisory Strategy for 2020–2022

(1) Development of digital banking

- a. The use of technological capabilities to increase access to financial services and support the development of digital banking channels.
- b. Elaboration of the licensing framework for a digital bank.
- c. Support for the provision of banking services via electronic channels.
- d. Elaboration of the principles for cloud usage.
- e. Development of a modular banking model.
- f. Development of a cybersecurity framework for the digital bank.

(2) Development of open banking

- a. Promote the opportunities to integrate the services of various financial institutions based on the needs of consumers of the financial sector. Increase the opportunities for the use and control of private financial data by consumers.
- b. Support the use of Open Application Programming Interface (Open API) within the banking space as well as outside of it.
- c. Dynamic standardization of financial information and services in the electronic space.
- d. Development of machine-readable data.

(3) Regulatory sandbox

- a. Creation of a controlled environment to study the unknown risks and the use of a regulatory sandbox.
- b. Development of a risk examination framework for various technologies.
- c. The analysis of the experiment results, and upon necessity, a reflection of them in the supervisory framework.
- d. Cooperation with the supervisors of other countries in the framework of an initiative to create a global regulation laboratory.

responsible innovations in the financial sector and helps financial technology institutions and startups by providing direct communication with NBG. The Regulatory Laboratory allows and assists the progress in testing innovative services and products in a real environment under some control where termination of this process could be done at any time.

By supporting the digital transformation of the banking and financial industry, NBG aims to: promote the development of innovative business models and diversity of financial products; make better use of big data; develop a customized, convenient, fast, and affordable digital financial ecosystem utilizing the technological infrastructure close to the customer; use cloud services effectively; simplify integration with technology companies and develop banking as a service business model; facilitate entry of new technological players and increase competition in the financial sector (National Bank of Georgia 2020b). To provide an in-depth analysis of the Georgian experience on green digital finance, this section continues with the following subsections: Green digital bonds and securities, E-money, and Cryptocurrencies.

2.1 Green Digital Bonds and Securities

In general, green bonds have some drawbacks that make investors reluctant to invest in them. One of the biggest ones is the volume of emission, as investors most of the time require a minimum size threshold due to some liquidity concerns (i.e., not being able to sell green bonds later). Several studies state that the minimum size of green bonds ranges from US \$100 million to US \$500 million (Jun et al. 2016; Franklin 2016; Chiang 2016). This, in turn, creates a barrier against the SMEs to finance their green projects not only in Georgia but also around the world. The use of blockchain technology presents a solution by increasing investor confidence while reducing several costs and risks associated with green bond emissions. A security token offering (STO) via blockchain platform is a digital security asset that can be used for green financing. Compliance with all laws and regulations related to conventional bond emission combined with the transparency provided by blockchain technology makes STOs attractive for investors. Countries like the USA, UK, Singapore, and Hong Kong have already used a regulated STO market where tokenized securities are traded on virtual asset trading platforms like Coinbase and Gemini.

An example of blockchain-based bonds is Bond-i in Australia (CommBank 2021), the first publicly offered blockchain bond. It has been developed by the World Bank in partnership with the Commonwealth Bank of Australia (CBA) Digital Innovation Lab. Using blockchain, the CBA managed to eliminate costs associated with a registry, issuing, clearing, and custodian processes while guaranteeing full visibility of transactions and real-time reporting for regulatory bodies (Haahr et al. 2019). Several financial institutions have experimented issuing blockchain bonds, but BBVA issued the world's first blockchain green bond in 2019 in the volume of 35 million EUR. According to the Green Digital Finance Alliance, Luxembourg, Germany, Switzerland, Seychelles, Mauritius, China, Japan, Singapore, and the Philippines are the countries with the strongest state of regulatory readiness for blockchain green bonds (Haahr et al. 2019).

In November 2021, the BIS Innovation Hub and the Hong Kong Monetary Authority (HKMA) (BIS 2021) introduced two accomplished prototype digital platforms as part of Project Genesis to enable trading of digital green securities. The platforms enable investors not only to track accrued interest over the

bond's lifetime but also to observe their green impact, which includes (but is not limited to) the amount of green energy generated and CO₂ emissions reduction linked to the investment. In addition, full transparency and high security, ease of ownership, and resale procedures are aimed to increase public participation in green project financing.

In this respect, Georgia can vastly benefit from adopting the STO approach and raising the funds required to finance its environmental goals. Adoption of current best practices and experience in green bond issuance combined with already present blockchain technology applications within the country puts Georgia in an advantageous position for further digitization of the financial sector. Regulatory sandboxes can be very crucial in creating digital platforms and testing them in real-time. Moreover, the use of already established platforms, such as Green Asset Wallet, may be a supplementary option for Georgia to raise required funds to meet SDG goals. Green Asset Wallet is an initiative by Stockholm Green Digital Finance, which aims to amplify the market for green and sustainable investments using technological advancements to support SDGs and the Paris Agreement objectives. The key benefits of Green Asset Wallet are 1) increased trust, transparency, and immutable history; 2) efficient and quantifiable impact data reports; and 3) validation of green bond market commitments (Patel 2020). All these factors might provide good grounds to build trust in investors and make digital green securities more attractive.

2.2 E-Money

According to the Law of Georgia on Payment Systems and Payment Services, the National Bank of Georgia, by granting Payment Services Provider License, allows the issuance of electronic money (ICO, token sales), exchange of cryptocurrencies to and from fiat money, execution of payment transactions using e-money through a mobile phone, Internet, or any other electronic device. Currently, a few electronic money organizations are operating in the country. They offer their customers making payment transactions (buy services and goods, transfer money to another customer's e-money account) via the Internet using their e-money account.

Furthermore, in May of 2021, NBG announced a Digital GEL (GEL, Georgian Lari) project in which it is considering launching a publicly available central bank digital currency (CBDC) to use new technologies to maximum advantage, embellish efficiencies of the domestic payment system, and promote financial inclusion (National Bank of Georgia 2021). The CBDC is going to be developed in accordance with the technical standards of the Bank for International Settlements. Turning legal tender into computer code with Digital GEL, Georgian policymakers will be able to benefit from it in terms of providing a better environment for fulfilling the indicators of SDGs. Considering Target 13.1 (strengthening resilience and adaptive capacity to climate-related hazards and natural disasters in all countries), the digital national currency will allow NBG, as a lender of last resort, to provide direct and speedy relief to disaster victims.

Digital currency also may have an expiration date. It will be especially useful in addressing SDG-1, ending poverty in all forms. There are more than 140,000 people in Georgia suffering from extreme poverty. By 2019, 19.5% of the Georgian people lived under the national poverty line (WB 2021a). With the wide application of Digital GEL, Georgian policymakers can directly reach the poor without any intermediary institution.

In addition, business-to-government and person-to-government payment platforms via digital currency are related to SDG-16 and are specific to Target 16.5: to substantially reduce corruption and bribery in all their forms. The proliferation of digital money may also have hidden environmental costs, and because of this reason, central banks are supposed to keep environmental sustainability in their policy prescription (IMF 2021a).

2.3 Cryptocurrencies

The abundance of cheap energy and tax exemptions in Georgia played a crucial role in the country becoming one of the favorite destinations for crypto miners. The Georgian Ministry of Finance published a public decision on 28 June 2019 (the decision) regarding the taxation of cryptocurrency in Georgia (Barshovi 2019). According to the decision:

- individuals in Georgia are exempted from income tax on any profit received from selling cryptocurrency;
- selling cryptocurrency (exchanging it into Georgian or other national currencies) is not taxable by value-added tax (VAT) (applies to both corporations and individuals);
- selling computing (hash) power from Georgia abroad is not taxable by VAT. Moreover, right on input VAT on these types of operations is preserved (applies for both individuals and corporations);
- selling computing (hash) power in Georgian territory (from a Georgian resident to a Georgian resident) is a VAT taxable operation;
- purchasing computing (hash) power by a Georgian resident from abroad is subject to reverse VAT in Georgia.

Consequently, all these factors affected the crypto industry in the country, and cryptocurrency mining has become even more popular in recent years in Georgia. Nearly 5% of households are either mining, have joined pools, or have invested in mining through local data centers like the ones built by Fulcrum Mining (Fulcrum Mining 2018). Bitcoin, Ethereum, Litecoin, Dash, Monero, and Zcash are among the most mined cryptocurrencies in Georgia. However, the Bitcoin boom starting from 2017 attracted a lot

of attention, so that in 2019 an estimated 200,000 people in villages across Georgia secured mining computers to set up in basements and garages (Alderman 2019). Despite the popularity of Bitcoin mining, Independent Commodity Intelligence Services report that legal cryptocurrency mining accounts for around 5% of Georgia's total electricity consumption (Sabadus 2021).

Bitfury, one of the world's largest Bitcoin miners, built a 20-MW data center in Gori and a 40-MW mining facility in Tbilisi with funding from the Georgian Co-Investment Fund. Afterward, the country ranked third in the world for Bitcoin mining (WB 2018). Bitfury itself, with its all facilities in Canada, Iceland, Norway, and Georgia, controls about 10%–15% of global mining. The government even expanded an entire power station next to the Bitfury facility to pump in electricity at no extra cost (charging only 5–6 cents per kWh). According to BBC Sounds podcast Business Daily, a Bitfury-owned mining farm is consuming around 4% of the country's hydroelectric power energy, and this consumption is equal to 389 GWh. According to the World Bank, Bitfury's daily revenue from mining activities in Georgia is US \$250,000–\$400,000 (WB 2018). Overall, mining companies in the country bought 785.5 GWh in 2019, and this amounted to 6.15% of Georgian electricity consumption. Moreover, one can find cryptocurrency ATMs in malls, vape shops, and casinos. There are 34 cryptocurrency ATMs/Tellers in Georgia. However, not all countries welcome the crypto-related financial industry, given that in 75 countries, there are only 24,268 crypto ATMs (see <https://coinatmradar.com/countries/>). Considering all this information, the environmental damage and CO₂ emission volume stemming from mining and other cryptocurrency-related activities have never been tracked in Georgia, while it is well known that cryptocurrency mining produces a significant amount of CO₂ worldwide.

Cryptocurrency mining requires energy mainly for two purposes:

- 1) To maintain the operation of mining devices;
- 2) To maintain optimal operation of these devices by thermal regulation.

The required amount of electricity depends on the characteristics of mining and cooling/thermal devices. Devices with higher hashrate consume more energy and require more intense cooling. From 2014 to 2018, global power requirement estimates for the Bitcoin network have rocketed by around 50 times (Clark and Greenley 2019). Consumption of a vast amount of electricity causes vast emissions of CO₂. Carbon footprint and energy consumption by the global Bitcoin network have reached levels that are comparable at country levels. Digiconomist (see <https://digiconomist.net/bitcoin-energy-consumption>) illustrates this comparison:

- Annualized total Bitcoin carbon footprint is equal to 64.18 Mt CO₂, which can be compared to the carbon footprint of Serbia and Montenegro.

- Annualized total electricity usage by the Bitcoin network is equal to 135.12 TWh, and it is comparable to the power consumption of Sweden.
- Annualized total electronic waste of the Bitcoin network is 6.47 kt, which is comparable to the e-waste generation of Luxembourg.
- A single Bitcoin transaction produces 813.29 kg CO₂, which is equivalent to the carbon footprint of 1,802,525 VISA transactions or 135,548 hours of watching YouTube.
- A single Bitcoin transaction consumes electrical energy equal to 1712.18 kWh, which is equivalent to the power consumption of an average US household over 58.69 days. This amount of energy could power 1,151,975 VISA transactions.
- Electronic waste from a single Bitcoin transaction is equal to 82 grams, which is equivalent to the weight of 1.26 size C batteries or approximately two golf balls.

Even though the above-presented numbers are up to date, those were shocking a couple of years ago and raised some concerns, which led to a number of studies on whether future growth of Bitcoin mining will adversely affect energy consumption and subsequent CO₂ emission levels. Mora et al. (2018) found that the associated energy consumption of Bitcoin usage could potentially produce enough CO₂ emissions to lead to an increase of 2 °C in the global mean temperature within 30 years. Another study on continuously increasing demand for energy and future consumption levels of electricity by Bitcoin resulted in a call for reform in the cryptocurrency industry (Foteinis 2018). On the contrary, several studies have asserted that cryptocurrency mining will not significantly contribute to the global CO₂ emission levels because the main mining centers are located in areas with plentiful and affordable renewable energy. Masanet et al. (2019) argue that there are some flaws in the calculations by Mora et al. (2018), and results of CO₂ emissions leading to an increase in global temperature are not that catastrophic. Furthermore, a new report from financial services company Square Bitcoin Clean Energy Initiative (2021) claims that Bitcoin miners are unique energy buyers who require cheap and abundant energy sources. In this regard, as society starts deploying more solar and wind, the levelized cost of energy will fall and potentially unlock profitable new use cases for that electricity, like desalinating water, removing CO₂ from the atmosphere, or producing green hydrogen.

By May of 2021, the total number of debit and credit card transactions in Georgia was 6734270 (requires 10009.14 kWh of electricity of which 2001.83 kWh was produced by non-renewable energy sources). If we assume that only one transaction was made through each crypto ATM in Georgia during May of 2021, then its total electricity consumption equaled 56501.94 kWh, which was 5.64 times higher than the total electricity consumption of all card transactions in the country. Considering the fact that the renewable energy share in total electricity production in Georgia is approximately 80%, then one can

roughly estimate that 11300.39 kWh (20% of 56501.94 kWh) of this electricity was generated by non-renewable energy sources. Accordingly, this amount of produced electricity left 5530.37 kg CO₂, which was approximately 9.1 times higher than the total amount of CO₂ emissions produced by all card transactions powered by non-renewable energy sources (which is 607.69 kg CO₂).

According to Invest, the government sustainable development group in Georgia, the country enjoys an energy surplus. Today, only 25 % of the Republic of Georgia's renewable energy production potential is exploited. Liberalization and deregulation of the energy market in Georgia started in 2008 and the Build-Own-Operate (BOO) principle is applied to all new renewable energy projects. Investors enjoy freedom of choosing buyers and negotiating prices on the open market while connection to the transmission grid is free. There is no license requirement for electricity export and for all hydro power plants that are smaller than 13 MW. Also there is no requirement for an environmental impact assessment for hydro power plants smaller than 2 MW. This favorable regulatory environment incentivizes investment in the energy sector. VAT exemption of electricity generation and export also creates appropriate grounds for new investments.

Currently, most of Georgia is actually powered by renewable energy. According to statistics from the International Energy Agency (IEA), hydropower is responsible for the supply of more than 80% of the country's electricity (see <https://www.iea.org/countries/georgia#data-browser>). Moreover, in the framework of SDGs, Georgia set certain goals to achieve by 2030 that are directly related to SDG-7:

- By 2030, Georgia intends to achieve considerable progress in ensuring nationwide access to affordable, durable, and modern energy services. The target is to provide access to electricity to 100% of the population (SDG-7; Target 7.1; Indicator 7.1.1.).
- Renewable energy share (hydro, geothermal and solar, biofuels and waste) in the energy mix will equal approximately 30% by 2030 (SDG-7; Target 7.2; Indicator 7.2.1.).
- Energy intensity will equal 5.787 MJ per Purchasing Power Parity (PPP) of GDP (according to prices in 2014 and baseline energy consumption intensity minus 10%) (SDG-7; Target 7.3; Indicator 7.3.1.).

Considering the abovementioned contrast between cryptocurrency mining and targets for renewable and sustainable energy resources, our analysis shows that the blockchain ecosystem in the Georgian case is incomplete. Nassiry (2018) suggests that blockchain has the potential to accelerate the flow of capital. It seems that in the Georgian case, this potential is almost untapped. Georgia designed a permissive regulatory environment for cryptocurrency mining, but the lack of relevant policies to retain domestically mined cryptocurrencies and channel digital funds into green projects are unaddressed to date.

Especially in the energy sector, blockchain technology can provide dis-intermediation of utility business models of centralized generation and grid distribution; that is, it can provide peer-to-peer energy trading. Taghizadeh-Hesary and Yoshino (2020) show that compared to fossil fuel projects, green energy projects face two primary barriers: lower rate of return and high risk of investment. Taghizadeh-Hesary and Yoshino (2019) find that DLT-based green funds will have a relatively low risk of investment and a high rate of return. Given that DLT technology will increase the transparency, traceability, and auditability of green funds, it will induce private sector participation in green projects. The implications and findings of Taghizadeh-Hesary and Yoshino (2019) are mainly related to small green energy projects, which means that their suggestions are quite relevant for the Georgian case. Their study is about the enhancement of Japanese-originated Hometown Investment Trust (HIT) Fund with DLT technology. The HIT fund is a successful community-based approach that is designed to connect local investors with projects in their own neighborhood. Liu et al. (2021) describe NRG coin as an example of green energy cryptocurrency blockchain. When a prosumer produces 1 kWh of environmentally friendly energy and infuses it into the network, a return of 1 NRG coin is generated. That is, regardless of retail power prices, NRG coin costs 1 kWh of renewable energy used from the grid. NRG coin generates affordability for prosumers. To illustrate blending green energy projects with digital solutions, we suggest the above example use two different approaches to utilize the potential of blockchain and cryptocurrencies. With such an approach, Georgia will be able to retain domestically mined cryptocurrencies. In particular, public or open access blockchains can grab the attention of small investors. Furthermore, in January 2021, electricity tariffs increased considerably for commercial use, and it undermined Georgia's competitive edge on crypto mining (Girardot 2021).

3. Conclusion and Policy Recommendations

This study illustrates the level of available green finance in Georgia and to what extent it has been digitized. The country made notable progress in developing several important strategies and policies to meet the goals set by the Paris Agreement and SDGs. This study considers the importance of green finance and how digitization can help to raise required funds to meet the country's climate and environmental goals and targets. For example, digital currency can be related to SDG-1, SDG-13, and SDG-16. However, Georgia needs to regulate new digital financing channels because some undesirable consequences have already emerged. In addition, the crypto-mining industry has to be under more scrutiny to avoid serious environmental and social problems because it is not well regulated. Also, the findings and policy implications of this study are important for countries in which the share of renewable sources in electricity production is relatively high (WB 2021d). To avoid facing the same unintended consequences and negative

externalities, the Georgian case can provide insightful lessons for: Costa Rica, El Salvador, Estonia, Guatemala, Honduras, Iceland, Kenya, Lithuania, Nicaragua, Romania, and Uruguay.

GHG emissions in Georgia mainly take place in the energy sector, which is responsible for 62% of the total. Energy projects account for 50.4% of planned or ongoing infrastructure projects, which equates to US \$23.1 billion. Investment planned for energy infrastructure or under construction totals US \$11.6 billion. Electricity generation projects make up 89% of this value and 98% of these electricity generation projects fall into the category of renewables: hydropower, wind power, and solar photovoltaic (OECD 2021b). There are ongoing and planned renewable investments worth more than US \$10 billion. Furthermore, the country has a very favorable business environment for cryptocurrency mining. The primary policy recommendation of this study is that domestically mined cryptocurrencies can be channeled into these renewable projects with very favorable tax incentives and regulatory frameworks. The rise of public and private digital money has prompted the IMF to propose new policies and explore options for reform (IMF 2021b). The same flexibility should also be adopted by national regulatory bodies. The tax modernization program, which adopted digital tax payments between 2005 and 2011, generated US \$4 billion in additional revenue for public finance (UNDESA 2021). It is a good sign that there is a political will to adopt digital solutions with green components.

The digital finance industry benefits from a very favorable environment in the Republic of Georgia as depicted earlier in this study. A certain share of this digital finance falls into the category of “green.” To fully utilize green finance, Georgia has the potential to attract US \$10 billion in planned or ongoing investment in the renewable energy industry. A favorable business environment only for digital finance is not sustainable considering the increasing impact of climate change in the country. By early March 2021, after the first year of the COVID-19 pandemic, 3553 lives were lost. To provide contrast, in 2018, 4056 lives were lost due to air pollution, and corresponding welfare loss of air pollution has been in the magnitude of 3% of GDP (WB 2020b). Between 1993 and 2020, Georgia’s population declined by almost 1.2 million (WB 2021c). Land degradation brings about a widening poverty gap. The main reason behind this relationship is the low productivity in the agriculture sector. Agriculture and forest-based economic activities make up 7% of GDP while providing 39% of total employment (WB 2020b). As mentioned in the main body of this chapter, by utilizing digital finance more into the green category, specifically Georgia will most likely see improvements in the following SDG targets and indicators:

- Target 13.1: Strengthening resilience and adaptive capacity to climate-related hazards and natural disasters.
- Target 16.5: Substantially reduce corruption and bribery in all their forms.
- Indicator 1.2.1: Proportion of population living below the national poverty line.

- Indicator 3.9.1: Mortality rate attributed to household and ambient air pollution.
- Indicator 7.2.1: Renewable energy share in the total final energy consumption.
- Indicator 13.2.2: Total greenhouse gas emissions per year.

Given that Georgia generates only 0.03% of global GHG emissions (OECD 2021b), commitments and goals are easily achievable. The country's SDG indicators set a target of 30% for the share of Georgia's energy consumption derived from renewables. By 2018, the share of renewables in the total energy mix was 28%. However, successful official commitments do not provide an exemption for Georgia from climate change. The capital city of Georgia, Tbilisi, with its population of more than 1 million is considered to be an urban heat island (UHI) (WB 2021). In 2001, total GHG emissions in Georgia, excluding land use, land-use change, and forestry activities, were 21% of the 1990 level. That is based on 1990 levels, the country achieved a better result in 2001 than the targeted 65%. Since then, GHG emissions have shown an increasing trend and reached 39% of 1990 levels (UNFCCC 2021b). Therefore, Georgia does not feel great constraints stemming from NDC commitments. Goals and commitments are extremely easy to achieve and this creates a misperception as the country has room for additional environmental degradation. This is a pitfall for policymakers as well as citizens. There is a considerable discrepancy between ongoing climate change and climate change mitigation policies. Landslides, heat waves, air pollution, floods, coastline deterioration, declining river flows, and lax climate mitigation commitments are not in tandem with each other. Poverty and unemployment, together with external sector fragility, still require long-lasting remedies. In 2020, the current account deficit was 12% of GDP, with an unemployment rate around the same figure of 12%. By 2019, before any COVID-19 ripple effects, 19.5% of the population was living under the national poverty line.

The experience in green financing and some progress in digitizing their activities pose great promise for future development and digitization of green finance in Georgia. Additionally, forming a legal and regulatory base and the availability of regulatory sandboxes can push the digitization process even further. Georgia's openness for innovations and new technologies is another plus, which can speed up the development of green digital finance. For example, Georgia has already been implementing blockchain technology since 2016. Georgia's National Agency of Public Registry signed a memorandum of understanding with Bitfury, and in 2018 the country registered more than 1.3 million land titles on their blockchain-based system, which is jointly developed with Bitfury (ADB 2019). Moreover, the government, together with the Norwegian blockchain trading platform WiV Technology, put some of its 94 billion bottles of wine exports on the blockchain (see <https://www.nasdaq.com/articles/georgia-to-put-its-wine-on-the-blockchain-2021-07-20>). However, there are some points that Georgia needs to consider to make a smooth and quick transition to full digitization of green finance available in the country:

1) Georgia has already had experience in the issuance of green bonds and has already started exploiting blockchain technology, even though in different spheres. It indicates that the country has the potential to develop blockchain bonds or STOs. For this purpose, Georgia needs to make some investment in research and consulting from international organizations, such as the World Bank, BIS, or other countries that have already issued blockchain bonds. Moreover, a regulatory sandbox will enable Georgia to transfer gained knowledge from best experiences into practice and eliminate any possibilities of encountering problems or issues in the exploitation of digital green bonds. Adoption of several security protocols and vital technological advancements or alternatively, use of external platforms, such as the Green Asset Wallet, will serve to build and increase investor confidence and trust in digital securities as well as amplify public participation in green project financing.

2) Even though cryptocurrency mining is mainly powered by electricity produced from renewable energy, Georgia still needs to track its environmental damage. The country is currently experiencing some problems due to legal and illegal crypto-mining activities. Abkhazia, where the population is about 240,000, is a home for approximately 625 crypto farms. During the winter of 2020, Abkhazia faced energy collapse as electricity lines became overloaded and some power stations caught fire (Bacchi 2021). Then the government asked crypto miners to stop mining for some time, and banned cryptocurrency mining in the region until June of 2021 (Bacchi 2021). Hence, Georgia needs to keep track of the environmental damage of crypto-mining farms and individuals and introduce a policy or regulation that will take control of the current crypto-mining boom. This will not be a major obstacle in achieving the goals set by the Paris Agreement and SDGs. Also, Georgia can cooperate with the Crypto Climate Accord initiative, which aims to make the cryptocurrency industry carbon-free, and channel finance flow within this industry into renewable projects.

3) Georgia ranks very low in cybersecurity in Europe and Central Asia. According to Kaspersky Lab research, in 2018, Georgia ranked in the top five countries for phishing scams in the region (WB 2020a). Moreover, in 2020 according to World Bank data, Georgia had only 3505.6 secure internet servers per 1 million people, which was around three times lower than the world average of 11,515.5. Hence, digitization of financial services and the banking industry brings serious risks, and Georgia needs to put a lot of resources and effort into overcoming cybersecurity issues.

4) Georgia itself has to be interested in the development of green digital finance. All the relevant policy documents and regulations that exist to date are results of “enforcement” by the international treaties that Georgia signed or international organizations with which Georgia is associated. Georgia needs to take some initiative and develop comprehensive strategies and regulations and needs to set up more challenging goals related to climate and environmental issues. For example, the country’s target to

unconditionally reduce its GHG emissions by 35% below the business-as-usual scenario for the year 2030 was achieved in 1993, according to World Bank data. In 2019, GHG emissions were about 63% below the business-as-usual scenario. Hence, setting challenging but achievable goals related to Paris Agreement and SDGs will push the development and digitization of green finance in Georgia.

5) Currently, international financial organizations are the main finance sources of green finance in the forms of loans and credit lines. In this respect, Georgia needs to reduce its dependence on financial support from international financial organizations and should form a fund to provide cheaper financial means for green projects. Domestically mined cryptocurrencies can be channeled into green investments with another favorable regulatory framework or tax incentives.

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