Innovation and Sustainable Growth in a Digital Age

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Edited by

Rianne Ojo

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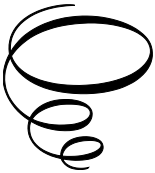

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INTRODUCTION AND PREFACE TO THE VOLUME

RIANNE OJO AND ELAINE WESLEY

The aims and objectives of this volume include the following:

- To identify the ways in which technology can facilitate innovation in the post-COVID era, during which the use of digital payment platforms which embrace the use of central bank digital currencies (CBDCs) and distributed ledger technologies has increased in terms of volume and importance;
- To highlight the role of regulation in regulating such innovative technologies;
- To illustrate how key actors, such as central banks, can facilitate the transition process to a net-zero based carbon emissions phase. Should central banks be held responsible for risks relating to climate change?
- To illustrate how innovative techniques and technology can interact with such concepts as green finance to facilitate a smooth transition to a net-zero carbon emissions economy;
- To highlight challenges which may be encountered during the transition process, and how to address such risks;
- To highlight how the role of private and public sector engagement can be enhanced through Fintech innovation.

The topics covered in this volume include a consideration of the role of sensor technologies—as well as those technologies which can facilitate a smooth gradual transition to a net-zero carbon emissions economy; Green finance; Central bank digital currencies, particularly retail-based CBDCs and wholesale CBDCs; Fintech; Digital payments in the post-COVID era (embracing wholesale and retail CBDCs, as well as other technological platforms); the role of central banks, technological innovation, and tech firms in addressing transition risks and enhancing sustainable growth; the feasibility of achieving a net zero based carbon emissions economy; as well as the role of renewable energy in the path towards a sustainable future.

These topics will be dealt with comprehensively under the following chapters:

Chapter One: **The Role of Public and Private Sectors in Facilitating Green Tech and Finance, Innovation and Sustainable Growth**

Chapter Two**: Balancing Public-Private Partnerships in a Digital Age: CBDCs, Central Banks and Technology Firms**

Chapter Three: **Assessing COVID Impacts, Sustainable Finance, Current and Future Implications for Banks and Monetary Policy: *"Breaking the Tragedy of the Horizon, Climate Change and Financial Stability"***

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PREFACE

Chapter One: **The Role of Public and Private Sectors in Facilitating Green and Finance, Innovation and Sustainable Growth**

This chapter contributes to the extant literature on the topic by identifying how risks have evolved with the digital age and how such risks have been, and can be addressed. Further, it draws attention to technologies that have been proposed in the transition to greener, net zero carbon emission economies through a consideration of concepts such as sensor technologies and "Smart Green Growth". Is it really possible to facilitate a transition to a net zero carbon emissions economy whilst the ongoing pandemic appears to be leaving a legacy in the rise of digital platforms which are widely acknowledged to be huge contributors to carbon emissions?

What roles exist for public and private partnerships within the context of central bank digital currencies (CBDCs), in an increasingly digitalized global system? Do central bank digital currencies (CBDCs) serve as public goods rather than tools which should primarily remain within the realm and governance of private sector firms?

To what extent can "Green Fintech" and Green Finance interact efficiently in the same capacity and importance of ensuring that regulators do not regulate or over regulate technology but rather, it uses? What roles should exist for central banks – particularly in relation to technologies?

Chapter Two**: Balancing Public-Private Partnerships in a Digital Age: CBDCs, Central Banks and Technology Firms**

What roles exist for public and private partnerships within the context of central bank digital currencies (CBDCs), in an increasingly digitalized global system? Do central bank digital currencies (CBDCs) serve as public goods rather than tools which should primarily remain within the realm and governance of private sector firms? What challenges or risks are presented through the use of CBDCs and how can such risks be mitigated through current existing structures – as well as models which have been propounded in relation to public – private partnerships? This paper aims to contribute to the literature on the topic through a consideration of several variants and models of CBDCs under which the public private partnership would

function, namely the synthetic CBDC (sCBDC) and the two-tiered CBDC. Further, two other types of CBDCs, namely the wholesale CBDC and the retail CBDC will be distinguished – as well as the account based CBDC, which is contrasted to CBDCs based on digital tokens. Whilst concerns for privacy and security remain paramount and cannot be undermined, particularly from the perspectives of distributed ledger technologies (and blockchains – through which such platforms operate), such concerns need to be weighed against the need for identification since regulators will be better supported in their goals in enforcing the law, as well as identifying fraudulent operations, where sufficient identification procedures have been put in place.

Chapter Three: **Assessing COVID Impacts, Sustainable Finance, Current and Future Implications for Banks and Monetary Policy: *"Breaking the Tragedy of the Horizon, Climate Change and Financial Stability"***

As well as considering the current implications of measures that have been instigated to address the impacts of the pandemic, drawing from past and current lessons from selected jurisdictions, this chapter also considers why the transition to a net zero carbon economy may prove more challenging than may first appear. However, jurisdictional differences and historical developments will play a part in determining how sustainable certain implemented policies and measures are – as well as in facilitating a transition to normality. The chapter also aims to highlight not only the growing importance of the roles of central banks in financial stability, in particular with reference to the management of risks associated with climate risks, in managing financial stability risks, but also place an emphasis on longer term perspectives and a need to incorporate greater uncertainty elements, particularly consequential of COVID impacts, in monetary policy setting instruments. In respect of longer term perspectives, the relevance and importance of other financial sector regulators, namely the insurance and securities sectors, in managing other forms of risks, namely, liability risks, will be considered.

Chapter Four: **Decentralized Finance and its Future in the Global Financial System: Enhancing the Role of Innovative Techniques Through Regulation**

In enhancing the role of innovative techniques which involve the use of distributed ledger technology platforms, consequences or implications of such techniques could initially focus on more obvious risks – such as those

risks associated with financial stability, inadequate governance and control mechanisms in place, or cybercrime. However, consideration of climate risk related factors have increasingly made the aim of focus towards a sustainable future, a more popular and increasingly justified topic.

In a recent report by the European Environmental Agency, it was highlighted that "in comparison with alternative payment methods, Bitcoin was claimed to be 20,000 times more energy intensive than Visa – with an energy consumption for each Bitcoin transaction increasing to 635 kWh – an equivalent of electricity that could power approximately 21 US households for 1 day, based on 2019 estimates according to some analysts."

However, there are also potential benefits to be derived from block-chain technology – one of which includes environmental protection, as further highlighted in the report. Nevertheless, efforts and endeavours will still be required to address climate related impacts of engaging the use of such technologies. This chapter will focus on other risks – as well as benefits to be derived through the use of innovative techniques such as smart contracts and decentralized finance in a rapidly evolving financial landscape. It will also highlight why central bankers and financial regulation have to adapt and evolve rapidly in engaging the use of supervisory techniques which will not only enhance the efficiency of the use of such innovative techniques but also facilitate an adequate and well balanced approached to regulation – one which whilst not overly regulating technology, seeks to ensure that the abuse or misuse of such technologies are appropriately regulated.

Chapter Five: **Facilitating Green Tech and Green Finance between Public and Private Sectors: Innovation and Sustainable Growth**

Whilst concerns for privacy, governance and security remain paramount in relation to Fintech and distributed ledger technologies, such concerns need to be balanced against ways whereby "Green Fintech" and Green Finance can interact. Such interaction also prompts considerations relating to the engagement of the public and private sectors in ensuring that innovation is facilitated whilst the tendency for competitive imbalances are taken into account.

This chapter contributes to the extant literature on the topic by identifying how risks have evolved with the digital age and how such risks have been, and can be addressed. Further, it draws attention to technologies that have been proposed in the transition to greener, net zero carbon emission economies through a consideration of concepts such as sensor technologies

and “Smart Green Growth”. Is it really possible to facilitate a transition to a net zero carbon emissions economy whilst the ongoing pandemic appears to be leaving a legacy in the rise of digital platforms which are widely acknowledged to be huge contributors to carbon emissions?

To what extent can “Green Fintech” and Green Finance interact efficiently in the same capacity and importance of ensuring that regulators do not regulate or over regulate technology but rather, it uses?

Chapter Six: **Balancing Monetary and Fiscal Policy Objectives: Central Bank Independence During the Global Pandemic**

The use of unconventional monetary tools, and particularly the resort by central banks to asset purchase programs instigated as a means of addressing prolonged periods of low inflation, has not only heralded times during which new and innovative approaches to regulation can be expected, but also highlights the significance of a growing acknowledgement that changes in financial instruments, payment systems and trading platforms are significantly altering the financial landscape and also the need for monetary policies to adopt more accommodative approaches to regulation since traditional tools and inflation targeting mechanisms are not as relevant as they used to be – particularly against the backdrop of the impact of crypto currencies and the need to ensure that financial stability can be guaranteed where such assets, which have great potential to trigger systemically relevant risks, and more specifically, stable coins which are backed by a basket of commodities or government bonds, are in operation.

As well as highlighting why unconventional and conventional accommodative monetary policies have been propagated as being crucial to achieving dual mandates and goals of leading central bank economies, drawing from lessons and experiences whereby accommodative monetary policies have been instigated as a means of addressing prolonged periods of low inflation, this chapter highlights how such experiences can also be used to bolster the proposition that “since monetary policy space is limited, and since many of the challenges faced are beyond mandates of central banks, these should be addressed through structural and fiscal policies.”

Chapter Seven: **Mitigating the "Emissions Gap" in the Path Towards Net Zero Carbon Emissions: Carbon Pricing Strategies and the Role of Innovative Technologies**

The 2021 COP 26 Summit held in Glasgow resulted, not only in ground breaking agreements, but also the involvement of private sector investment, the participation of formidable alliances such as the Global Energy Alliance – and, for the first time, the engagement of indigenous communities. Whilst ongoing negotiations and outcomes from the Summit appear promising, there are still concerns in relation to the lack of enforceability of agreements. This chapter, not only aims to highlight the rationales underlying such concerns, but also consider the merits and applicability of innovative techniques and technologies – as well as notable progress and developments made during the ongoing Summit. By way of reference to the concept of the "Emissions Gap", this chapter highlights how bridging the "Emissions Gap" or mitigating it, could be achieved – and this principally through first, technological developments; the "synergies between climate action and economic growth and development objectives", as well as other considerations which will be discussed in this chapter.

Since then, COP 27, even though considered disappointing – from the perspective of not "progressing commitments or showing evidence of significant action by countries to cut back on global emissions", was hailed as a success in respect of bringing matters of critical importance to developing economies – namely, and including climate adaptation and loss and damage, to the fore. (World Economic Forum, 2022).

The engagement of several economies in the asset purchasing programs and uncertainty in decision making by some in respect of when, how or whether to commence winding up activities, also bears several monetary policy implications. This could in turn, impact outcomes – both intended and unintended, in relation to carbon, and more specifically, oil pricing strategies – which are ideally targeted at mitigating carbon emissions, whilst fostering climate goals and objectives. Given the demands and pressures of governments and economies in deploying funds to households, businesses; central bank engagements in deciding how and when to wind down asset purchase programs, and the need by governments to focus on more urgent and pressing matters such as those related to health, education, in the light of ongoing global developments, how ready and willing are governments able to commit to environmental issues? Herein lies a role for the private sector and private sector investment.

Chapter Eight: **Monetary Policy Implications of Deviations in Inflation Targeting: The Need for a Global Cooperative, Coordinated and Correlated Response**

It is argued that "much of the variation in inflation is due to global factors such as imported goods and energy prices" and that much of that variation is expected to be transitory. However, there are growing signs that the transitory nature of inflation may not be as transitory as was initially considered. As rightly argued, the extent and deviations of current inflationary levels necessitates extraordinary intervention – such that cannot be easily compared to previous experiences. To which it has to be added that the prevailing nature of inflation also necessitates a coordinated, cooperative global approach which incorporates the harnessing of similarities and expertise in historical supervisory and regulatory practices in facilitating a harmonized and correlated result. In order to better appreciate the magnitude of the issue at hand, reference needs to be made to past and current levels of energy prices, as well as other major contributors to current inflationary levels, and their implications for inflationary targeting and monetary policy. The nature and relationships involved in the inflationary dynamics is also not as straightforward and clear cut as it used to be and as it may appear to be – other previously absent variables having been incorporated into the equation. This paper aims to provide a clearer picture of the nature and relationships involved in the inflation dynamics – as well as illustrate the complexity of the relationships involved.

Further, by highlighting similarities in the review frameworks and approaches by several major central banking economies and regulators, the paper also aims to highlight and illustrate that whilst coordination and cooperation may prove to be a daunting task, several approaches can be adopted to facilitate harmonization and coordination.

Chapter Nine: **From the Northern Ireland Protocol to the Windsor Framework: Green Technologies and Green Taxes**

Is the global climate really ready to give up its use of carbon/fossil fuels – particularly where certain governments are not yet technologically equipped to switch to solar, battery and other renewable energy sources of generating energy? As well as highlighting the significance of the draft agreement of the United Nations convention on the law of the sea, this chapter aims to highlight why legislative and regulatory convergence and harmonisation is vital – particularly in matters relating to Green Technologies – as well as a

consideration of progress made by other EU countries and globally in relation to renewable energy and Green energy.

Conclusion

The recent 2022 BIS Innovation considered, among other topics, the following:[1]

- Whether Disruptions in the Global Financial System Caused by Big Tech, De-Fi and Crypto are examples of "peak enthusiasm" as envisaged by the Gartner hype cycle or whether the landscape has fundamentally changed
- The extent to which such developments create new sources of risks to the financial system and how central banks should respond
- The potential for central bank digital currencies (CBDCs) to serve as a new foundation of sound and stable money for the digital economy and as alternative to less stable forms of private money

When asked about the future of money in the Euro system, and specifically on how she viewed the transformation of money, the ECB Head, Christine Lagarde responded by saying that payments, shopping, work, have all witnessed accelerated digitalization – even though she also admitted, in her opinion, that central banks have been a bit slow to begin with. But that public authorities are also being engaged in the process – indicating an urgency about the matter.[2] Further, she added that the Central Bank Digital Currencies (CBDCs) and the Digital Euro Project have been prompted by three elements, namely:

- Customers' Demand
- Competition threat: for example, when Meta (then Facebook) was threatened with the introduction of Libra
- Progress already undertaken by certain countries such as China

As well as indicating that sovereign currencies in the form of CBDCs will co-exist with stable coins, she concludes that CBDCs and sovereign currencies are anchoring currencies so they are here to stay.

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[1] BIS Innovation Summit 2022: Day Two: In Conversation: Emerging Challenges for Central Bank Governors in a Digital World, March 23 2022

[2] BIS Innovation Summit 2022, Day One: In Conversation with Christine Lagarde About the Future of Money in the Euro system: The Potential Role for a Digital Euro. Interviewer: Josh Lipsky, March 22 2022

CHAPTER ONE

THE ROLE OF PUBLIC AND PRIVATE SECTORS IN FACILITATING GREEN TECH AND FINANCE, INNOVATION AND SUSTAINABLE GROWTH

MARIANNE OJO DELANEY

Abstract

Will there be a need to maintain a 1:1 exchange rate between private sector money and central bank money - with the consideration of the introduction of central bank digital currencies? What duties and responsibilities, in particular, should be undertaken by the public sector?

This chapter contributes to the extant literature on the topic by identifying how risks have evolved with the digital age and how such risks have been, and can be addressed. Further, it draws attention to technologies that have been proposed in the transition to greener, net zero carbon emission economies through a consideration of concepts such as sensor technologies and "Smart Green Growth". Is it really possible to facilitate a transition to a net zero carbon emissions economy whilst the ongoing pandemic appears to be leaving a legacy in the rise of digital platforms which are widely acknowledged to be huge contributors to carbon emissions?

What roles exist for public and private partnerships within the context of central bank digital currencies (CBDCs), in an increasingly digitalized global system? Do central bank digital currencies (CBDCs) serve as public goods rather than tools which should primarily remain within the realm and governance of private sector firms? To what extent can "Green Fintech" and Green Finance interact efficiently in the same capacity and importance of ensuring that regulators do not regulate or over regulate technology but rather, it uses? What roles should exist for central banks – particularly in relation to technologies?

Key words: Green Fintech, Green Finance, sensor technologies, climate risks, physical risks, transition risks, operational risks, financial disclosures

Introduction

The role of financial reporting, data and standards constitutes vital importance through a chain of relationships. The role of regulation, supervision in monitoring the enforceability, applicability of such rules and standards also being paramount. As financial institutions are able to influence businesses and households in reducing their carbon emissions, businesses and households will be able to act on information received through such mediums to impact their decision making with non-financial sector groups who serve as the greatest contributors to carbon emissions.

> "Innovation is part of the solution but also carries its own risk."

In addressing the question on how innovation is able to support sustainable growth, during the recent 2021 BIS Innovation Conference, the following points were highlighted by Christine Lagarde:

- What we're seeing at the moment is a momentum that has been accelerated by the pandemic. We need to leverage on that at the moment.
- To move towards sustainable future which combines growth and innovation, we need to: include whatever is external and not accounted for, inform and invest (particularly in innovation) – because without money we won't reach where we need to get to.

Furthermore, she expands on the concept of "Smart Green Growth", which she considers as being advocated in Europe.

Smart Green Growth:

- Smart urban mobility;
- Use of sensor technologies
- Use of simple devices as smart thermostats in order to reduce the bills of energy in energy and the construction sectors

The importance of incentives is also highlighted through a reference to the synergies between the sustainable future and innovation, prompting the following questions:

- How can we move from fossils if there are no incentives?

- In relation to solar panels and batteries: What do we do with these when their useful life is over? Can we recycle?

As well as addressing the above-mentioned questions, this chapter aims to expand on the risks and costs of innovation in the current financial environment. In this sense it will make reference to the Basel Committee on Banking Supervision's classifications and definitions of risks as highlighted in its 2021 publication "Climate-related risk drivers and their transmission channels".

The issues involved with the use of batteries as alternatives for energy storage has been brought to the fore, with increased considerations in the use of gravity-based energy storage systems. Even though it is highlighted that "the cost of lithium-ion batteries will be significantly reduced over the coming years" (Bloomberg, BNEF; www.iberdrola.com), their limitations as an ideal source of storage have been highlighted, not only in their i) maximal capacities for storage – short term, with up to a period of six hours, but also in their ii) limited availability as resource; as well as iii) their potential harm to the environment – through their mining – with iv) ever increasing rise in the cost of batteries over the years owing, as further illustrated, as a result of demand exceeding supply (CNN: 2022).

Because of such limitations in the use of batteries, a method involving the use of hydro power as a means for storing renewable energy, a process whereby "an AI-powered management system determines the optimal time to discharge energy, depending on levels of supply and demand – based on a similar method which was developed over 100 years ago", will also be considered later on in the chapter.

The chapter will also highlight the importance of the parties in the relationships which are vital to securing a gradual and smooth transition to a net zero carbon economy, primarily by way of reference to important points identified by the Task Force on Climate Related Financial Disclosures.

The current financial environment in which innovative techniques are operating is rapidly evolving and it should come as no surprise that information or indeed devices which appeared to be up to date or modern, have become obsolete just within a relatively short space of time. The public sector, regulators – and not just private sector firms, need to evolve relatively at a pace which is reasonable to address challenges which are presented as a result of the fast evolving financial environment. Challenges

such as those relating to governance issues – as well as risks from operating in a new unchartered and unguarded territory.

Literature Review and Background to the Topic

Conceptual Framework

Climate risk drivers can be grouped into one of two categories (BCBS, 2021a:5)

- Physical risks, which arise from the changes in weather and climate that impact the economy; and
- Transition risks, which arise from the transition to a low-carbon economy.

Physical risks can be further classified into:

Acute physical risks

and

Chronic physical risks

Acute physical risks are generally considered to consist of: lethal heatwaves, floods, wildfires and storms, including hurricanes, cyclones and typhoons as well as extreme precipitation whilst Chronic physical risks are generally considered to include: rising sea levels, rising average temperatures, and ocean acidification.

Transition risks

Transition risk drivers are the societal changes arising from a transition to a low-carbon economy. They can arise through: changes in public sector policies; innovation and changes in the affordability of existing technologies (e.g. that make renewable energies cheaper or allow for the removal of atmospheric GHG emissions); or investor and consumer sentiment towards a greener environment.

In respect of the Paris Climate Agreement, whose impacts can be classified under this heading, several observations were also made during the recent 2021 BIS Conference:

> Lagarde: The "signaling effect of the new US administration in rejoining [the] Paris Climate Agreement is hugely significant. Great signaling effect

> […] brings the power of the largest economy in the world behind an objective we share passion about. Previous problems of non-standardization constitute one of [the] priorities."
>
> Carney: The "US rejoining [the] Paris Agreement signals greater inclusiveness. Architecture of carbon emissions is important because it involves absolute reduction of carbon emissions. We are rewiring our economy through [a] digital transformation and this comes through innovation in finance."

However, as reported (BCBS, 2021:13), "Corporates may be affected through changes in production, sales and profitability in the transition towards a low-carbon economy. Current and future expectations of profitability in turn affect creditworthiness. For instance, firms may face higher operating expenses because of a higher tax on GHG emissions. The impact of this tax could reduce earnings and therefore also reduce the corporation's creditworthiness. Increases in credit costs for corporates in certain sectors may curtail their ability to repay outstanding debts to banks. Empirical evidence suggests that the 2015 Paris Agreement resulted in a higher cost of credit for corporates in polluting industries".

The process of transition to a net zero carbon economy will therefore require cost benefit analyses between the attributed benefits of innovative and Fintech instruments, digital payment platforms, so to say, and related risks and costs. Considerations of such trade-offs will be crucial in determining the pace of transition – such that economically important sectors are not detrimentally impacted by such transition whilst aiming to attain the ultimate objectives of a net zero carbon economy.

The motivations behind the use of digital payments include the following (Callesen, 2021:3):

- First, the large number of countries and regions with less developed payment systems, for instance, without instant payments. In these countries and regions, one account for all at the same bank will make it easier to receive instant payments.
- Second, it will stimulate additional competition that may spur innovation, also in the private sector.
- Third, some people see access to direct "settlement in central bank money" as a particular advantage; this is possible when paying in cash although more and more people are opting out of cash.

What safeguards operate to ensure that the attributed benefits of greater engagement in Fintech innovation do not outweigh costs and risks? In matters of governance, it is evident that issues related to the balanced engagement of private and public sector partnerships and arrangements need to be addressed. Further, it is important to note that whilst benefits can be derived through such innovative platforms, adequate arrangements need to be in place to ensure that risks emanating particularly through operational risk channels, in particular, are adequately catered for.

Facilitating Green Tech and Green Finance

Perrazzelli (2021) highlights how the phenomenon "Green Fintech", namely the possibility of using "new digital technologies and solutions (such as distributed ledger technology or artificial intelligence) may contribute significantly to meet sustainability goals in financial products and services and make green finance an integral part of the daily lives of people and businesses." A phenomenon which she adds, is not only growing rapidly, but also becoming "a driving force for the creation of a more environmental-friendly financial system."

In this respect she illustrates ways whereby Green Fintech and Green Finance can interact (2021: 1):

- The use of artificial intelligence or machine learning algorithms can help in measuring the sustainability and the societal impact of investments.
- Fintech solutions applying Big Data analytics may help financial firms in coping with the large amount of information related to ESG factors and in taking decisions that direct capital flows towards more sustainable assets and projects. From the demand side, the digitalization of distribution channels and the spread of platforms can help investors to access green and sustainable investment products while artificial intelligence can facilitate the offering of personalized financial services.

She, however, highlights the associated costs, in relation to energy consumption and accentuates the importance of trade-offs, between the need to innovate and environmental considerations.

In considering how innovation can be engaged whilst giving due regard to environmental concerns, with a focus on the reliance on renewables for consistent power, reference will now be made to the use of gravity in addressing issues associated with renewable energy – namely, and inclusively, storage.

It is acknowledged that "without potential energy, no energy could be saved for later use" (Sciencing.com, 2020). Three ways potential energy can be stored – as well as three types of potential energy, are as follows (Just Energy.com):

- Elastic potential energy
- Gravitational potential energy
- Chemical potential energy

Energy Vault's Gravity Based Energy Storage System

In adopting the use of gravitational potential energy,

- In the Swiss municipality of Arbedo-Castione, a steel tower: a mechanical energy storage system designed by the American Swiss start-up Energy Vault, which relies on gravity – as well as 35 ton of bricks to store and release energy, has been erected.

The operative functions of the system are as follows (CNN, 2022):

- With low demand for power, the crane uses surplus electricity from the Swiss grid to raise the bricks and stack them at the top;
- When the power demand rises, kinetic energy is released back to the grid through a lowering of the bricks

Gravitational potential energy also lies behind the rationale for the operation of turbines which generate electricity in dams. Water behind hydroelectric dams has gravitational potential energy since "it is at a higher level than water on the other side of the dam" hence as water falls, potential energy is converted to kinetic energy which rotates those turbines to generate electricity.

In emphasizing the importance of energy storage as a vital means for facilitating the reliance on renewables for consistent power, it is added that "unlike fossil fuel power station, which can operate night and day, wind and solar power are intermittent" – implying the inevitability of disruptions to

electricity generation in the event of clouds blocking the sun or in the event of wind disruptions.

In this regard, the Founder of Energy Vault, Roberto Piconi, concludes that "to compete with fossil fuels, renewables must be made more predictable: that is, the need to store excess energy as well as being able to dispatch such energy when required."

The use of lithium-ion batteries as a means of addressing storage problems, through charging such batteries with electricity generated from solar and wind energy – which is released upon demand, has been recommended. How limitations in their use as an ideal source of storage, are highlighted, not only because of their limited capacities to store – namely, for a maximum period of duration of six hours, but also in their limited availability as a resource, as well as their potential to generate harm to the environment through their mining – with ever increasing rise in the cost of batteries over the years owing, as further illustrated, to demand exceeding supply.[1]

Because of these limitations in the use of batteries, a method involving the use of hydro power as a means for storing renewable energy, has been adopted by Energy Vault: a process whereby "an AI-powered management system determines the optimal time to discharge energy, depending on levels of supply and demand."

Hereby the role of technologies in determining the best time to discharge energy can also be extended to addressing supply and demand issues in supply chains.

A similar method to that adopted by Energy Vault, "a method developed over 100 years ago", is distinguished from the process adopted by Energy Vault in the sense that "instead of using water, composite blocks are used – even though both processes and methods rely on gravity."

As further illustrated, "during off peak periods, a turbine pumps water from a reservoir on low ground to one on higher ground, and during periods of peak demand, water is facilitated to flow down the turbine, generating electrical energy."

[1] "According to a recent study by Bloomberg NEF (BNEF), the cost of lithium-ion batteries will be significantly reduced in coming years." See www.iberdrola.com

So how can we efficiently store such energy since electrical energy cannot really be stored as such?

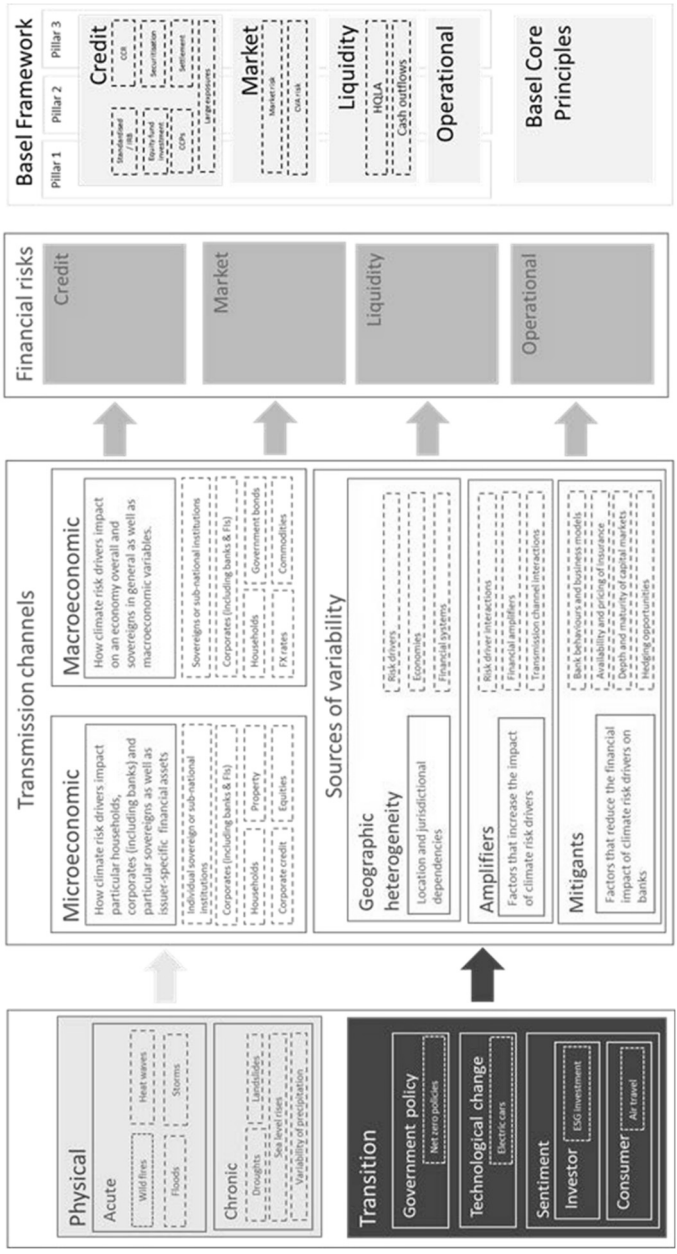
It is not only argued that "storage systems can add value at every stage of the supply chain", but that main technologies which allow efficient energy transformation and storage are as follows:

- Hydro-electric pumping
- Compressed air
- Thermal storage
- Super capacitor
- Fly wheels
- Batteries
- Hydrogen fuel cells

In drawing upon those technologies that can support the "broader transition", reference is made by Mark Carney to the Task Force on Climate Related Financial Disclosures (Directive). He adds that "Sensor technologies will be deployed and may address the latency of using satellite technologies. In addition to tracking emissions, using satellite mapping to identify where biggest opportunities exist for regenerative agriculture. This is a big part of the climate solution puzzle. With markets, there's a 'chicken and egg' issue."

The TCFD recommendations which were published in its 2017 report, focus on four "thematic" areas which are representative of how organizations operate (TCFD, 2021:14):

- Governance
- Strategy
- Risk Management
- Metrics and Targets



Source: BCBS (2021:4)

Further, specific disclosures which organizations are obligated to include in financial filings or other reports, which serve to provide useful information for investors and other interested stakeholders in reaching their decisions, support the four recommendations – as well as key features of the recommendations, which are as follows (see TCFD, 2021:16):

- Adoptability by all organizations
- Strong focus on risks and opportunities related to transition to low carbon economy
- Designed to solicit decision useful, forward looking information on financial impacts
- Disclosure under the strategy and metrics and targets recommendations in financial filings is subject to materiality assessment – even though organizations are still encouraged to disclose publicly if necessary.

Lagarde, in consolidating on Mark Carney's reference to the Directive on disclosures adds,

> "There is a lot of uncertainty as to the validity of these disclosures […] How do we know that information is accurate? It is hoped that technologies will help in the near future".

The above mentioned concerns highlight the importance of the Basel Committee's focus on risks such as operational risks, whose application has been revised in view of recent Covid developments – as well as technological advances. Where risks persist with technologies which are to be relied upon, operational safeguards need to be in place to ensure that such risks do not materialize to the extent that wider and far reaching systemic effects are generated. The Basel Committee issued revised principles on operational risk which focus on change in management and information and communication technologies (ICT), in addition to principles for operational resilience (which aim to increase banks' capacity to withstand disruptions due to potentially sever events), adding that COVID-19 has made operational resilience and mitigating operational risk even more important.

Non-financial sector groups such as energy, transportation, materials and buildings, agriculture, food and forest products, as identified in the TCFD report (2021:22), are considered to account for the largest proportion of GHG emissions, energy and water usage. In highlighting the role of the financial sector, Breeden (2021:2) states that the success of such financial sector groups in reaching net zero will instead be driven by their ability to reduce the emissions of the businesses and households they lend to, insure or invest in – their so-called "financed emissions".

As well as highlighting challenges in the way of "increasing sustainable finance in the EU", such obstacles ranging from the lack of green investment opportunities to the fragmented capital markets within the EU, Nykänen (2021) lists the following as being important in the path towards sustainable finance:

> "a taxonomy and common standards for sustainable investments": these will create certainty and eliminate the need for all actors to verify the greenness of an investment; as well as lower the costs associated with green investments, which she considers one of the requirements for further mainstreaming sustainable finance.

The quality of information and data is also highlighted in supporting such standards – hence the need for adequate financial reporting which in her view needs to be timely. Timely, accurate, verifiable, complete data which is not only relevant to users of such information, but also reliable, constitutes such attributes that add to the quality of data and on which its usefulness should be judged – rather than the quantity of data which might be outdated, irrelevant – and of more importance, given the speed at which information changes, the timeliness (and relevance) of such information.

The current financial environment in which innovative techniques are operating is rapidly evolving and it should come as no surprise that information or indeed devices which appeared to be up to date or modern, have become obsolete just within a short space of time. The public sector, regulators – and not just private sector firms, need to evolve relatively at a pace which is reasonable to address challenges which are presented as a result of the fast evolving financial environment. Challenges such as those relating to governance issues – as well as risks from operating in a new unchartered and unguarded territory.

In further highlighting the role of central banks, it is added that "Helping the financial institutions in analyzing their climate risks is not the only thing that central banks do. Many central banks want to lead by example and are measuring the climate risks in their own portfolios, while embracing responsible investment policies."

As a result, we can draw a trend in the roles and relationships between parties as follows:

Central banks ---------→ financial institutions----------→
businesses and households----------→ non-financial sector groups

The role of financial reporting, data and standards constitutes vital importance through the chain of relationships. The role of regulation, supervision in monitoring the enforceability, applicability of such rules and standards also being paramount. As financial institutions are able to influence businesses and households in reducing their carbon emissions, businesses and households will be able to act on information received through such mediums to impact their decision making with non-financial sector groups who serve as the greatest contributors to carbon emissions.

It has also been argued that focus should be on those who account for the lion's share of carbon emissions. Whilst such arguments are plausible, such focus should also balance costs and benefits of unduly imposing unfeasible regulations within a short period of time – such considerations including competitive disadvantages to be gained by competitors of such non-financial sector groups who are not subject to the same sets of rules or standards – particularly other international rivals located in different non complying jurisdictions.

Other Main Issues to be Addressed

Is Climate Change the Responsibility of Banks?

> "In relation to central banks, central bankers are always associated with conservative approaches. With such an approach, innovation is part of the DNA of central bankers. Central bankers can apply such innovative instincts. Climate change is not the prime responsibility of central banks. Considerations of how climate change is impacting price stability being undertaken. Identifying what can be addressed now in terms of risk management" – Lagarde

In bolstering the role played by central banks in the chain of relationships, Hauser (2021:4) adds that the Bank of England's primary engagement with the financial sector on climate issues has been "to ensure that banks and insurers can manage their large transition and physical risks effectively, and in ways that do not threaten system-wide stability."

Further, Hauser adds that selling all high-emission bonds, using the proceeds to buy low-emission ones would reduce the carbon print of Corporate Bonds Purchase Scheme (CBPS), which could consequentially raise the financing costs of high emissions firms. However, he adds two reasons why "indiscriminate 'portfolio de carbonization' of this kind" could not be the best strategy for investors like the Bank seeking to incentivize economy-wide transition to net zero (2021:7-8):

- First, the high-emissions firms whose bonds we would be selling are the ones we most need to be at the vanguard of emissions reduction. But selling their bonds doesn't destroy them as assets, it simply transfers them to other investors.
- Second, simply selling anything with a high carbon footprint penalizes those with strong and credible emissions reductions plans just as much as it does those with no such plans.

It is further added that the Bank intended to "propose to tilt future CBPS purchases towards issuers which are performing relatively strongly in support of net zero, and away from those that are not" whilst supporting net zero without compromising the Scheme's primary monetary policy purposes (2021:13,18).

In relation to how the private sector can be engaged, namely the engagement of SMEs, and large companies, Carney is of the opinion that this concerns "not just the direct emissions of the company but also its suppliers […] This constitutes the type of information that one would wish to know. Value chains. […] What is required for disclosure is some sort of taxonomy that can track progress from where it is currently, to where it needs to get to. The digital payments system needs to be conscious of its carbon footprints. This is part of the system of bringing together a sustainable future. Digital money (smart contracts) can unlock a huge potential in respect of sustainable growth."

How can we mitigate financial risks related climate risk drivers? Particularly such risks as credit, market, liquidity and operational risks? Whilst these have been provided for in the Basel Core Principles, with revisions being made to the principles, and particularly to the sound management of operational risk, the uncertainty attributed to climate risk drivers, is also highlighted (BCBS, 2021a:9):

Climate risk drivers have a number of features that makes their evolution highly uncertain. These include the following:

- Climate-related changes, and the speed with which they are evolving, are unprecedented in human history to such an extent that very little reliance can be placed upon historical experience to assess their magnitude or to identify patterns. This gives rise to a high level of uncertainty when attempting to assess the magnitude and timing of climate risk drivers;