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IV.5. SUSTAINABILITY: BRIDGING THE GAPS BETWEEN LAW, FINANCE, AND TECHNOLOGY

The state of play

Today, the demand for sustainable solutions has become more significant than the supply due to the increasing impact of climate change, twin transitions, and social inequality. Turmoil on many fronts, such as the ongoing hot war in Ukraine and the global inflation and upcoming recession, energy, and food crises, pushes the rethinking of many aspects of resilience to respond promptly. Finally, the EU and many regulators direct stakeholders in pursuing seventeen United Nations Sustainable Development Goals (UN SDG17). Many stakeholders, researchers, lawyers, financial experts, and engineers follow these outputs as a call for action and study metrics, even though this path is much harder than the obsolete business-as-usual strategy.

Researchers have begun to include externalities when considering sustainability, helping to underpin the notion that stakeholders should ensure sustainability without damaging the ability of future generations to live and prosper. People cannot live at the expense of the next generations anymore. The author explores the gaps between law, finance, and technology (LFT) by transferring autonomy within the so-called "LFT triangle" via integral cooperation to seek positive outputs. The system approach and holistic thinking are distinctive methods of this work.

The system approach includes classifying objects and tasks, input analysis of characteristics, thinking over models and simulating solutions. Since sustainable development is multidisciplinary, the author examines literature and data sources from different disciplines. Governments, the public and private sectors, and civil society have contributed, each on their own, to possible solutions for a more sustainable future in the framework of the EU taxonomy and the European Green transition. The needs of countries and public and private institutions are considered by dealing with: (i) regulation and deregulation; (ii) sustainable finance; and (iii) incumbent, trendy, and disruptive technologies. The applied methodology provides for the gender dimension, inclusivity in research and innovation content, and the quality of open science practices, including sharing and managing research outputs and engagement of stakeholders, university, academia, civil society, and end users where appropriate.

The sustainability, emergency response, resilience and recovery strategy is a vital priority today and is not optional. The existential threat of climate change overlapping with energy, food, the COVID-19 pandemic, a global supply chain crisis, inflation and the upcoming recession drive stakeholders to rethink and launch numerous international policy, regulatory and business measures.

The United Nations (2015) Sustainable Development, the EU Green and Tweens transition (European Commission 2019), and the Paris Agreement (European Commission 2015) have set the tone for sustainability and a green agenda. A solid scientific foundation stands behind these measures: the Triple Bottom Line principles were elaborated by John Elkington (2015); the "SDG wedding cake" was explored by the Stockholm Resilience Centre (2016); an understanding of planetary and social boundaries was produced by Kate Raworth (2017) and Meadows *et al.* (2004); and Tim Jackson (2016) argues for "prosperity without growth." Furthermore, Mariana Mazzucato (2011) proved that governing missions produce positive results, and Bill Gates (2021) drew attention to the crucial innovations that are needed. Time is of the essence, and is waiting for no one.

The practical toolkit for stakeholders has to include an objective transition from short-term to long-term values and to ensure the internalization of environmental, social, and governance (ESG) externalities. This represents a true paradigm shift for better sustainability.

Education for sustainability is essential through all levels of formal and non-formal education, including university, organizations (private and public) and lifelong learning. The effective incorporation of sustainability concepts and principles through all levels of the education system may pose specific challenges. Universities play a central role in developing knowledge, including many domains, such as engineering, sciences, architecture, law, management and economics. The extensive range of disciplines and backgrounds requires different approaches to consider the main aspects of sustainability in the curricula comprehensively. A multidisciplinary and interdisciplinary approach is also needed because sustainability encompasses several technical and scientific areas.

EU legal framework

The minimum EU safeguards support the United Nations Guiding Principles on Business and Human Rights (2011) and the International Bill of Human Rights; the ILO Fundamental Principles and Rights at Work include working rights, consumer rights, and communities (ILO Declaration 1998); and the Bribery and Corruption Laws and Regulations ensure that taxation respects both the spirit and the letter of the law, guaranteeing fair competition (Miralis *et al.* 2022). These instruments evaluate sustainable development from a social, governance, and environmental perspective as a frame of reference for regulation. Often, this might cause the state to become a better fit for both entrepreneurial and human rights. Good governance takes care of compliance and abiding by the rule of law. Meanwhile, this is a minimum requirement for what is acceptable for development and risk management. While high-income countries have enough capacity to meet new challenges, low-income countries are typically not self-sufficient, nor are they able to foresee future risks and respond to scenarios. This is why the role of international institutions and platforms is crucial.

This situation is not black and white, by definition. For instance, the seventeen United Nations Sustainable Goals have internal conflicts between social, environmental, and economic goals, and stakeholders need to manage them. There is also a competition between major countries, such as the USA, China, and the EU, G20, and G7 members. Like the European Union, each country and its unions should have access to strategic toolkits that can be adjusted towards gaining sustainable capital and innovation policy and practice. Good governance implies obtaining and disseminating skills to steer, accelerate or brake policy regulation, which is complementary to financial needs and technological capacity.

The European Green Deal (European Commission 2019) is the EU regulatory framework. The Climate Law (2021), a political commitment and plan to make Europe a climate-neutral continent by 2050, is the main legislative package and is a legally binding commitment to reach net zero by 2050 and reduce GHG emissions by 55% in 2030, together with Fit for 55 (2021). Some legislative actions implementing the EGG commitments in specific areas include: The European Climate Law (Regulation (EU) 2021/1119); The European Climate Pact, December 2020; The 2030 Climate Target Plan, March 2020; and The EU Adaptation Strategy, December 2019. An overview of the European Green Deal can be found in ERCST (2022).

Sustainable finance

Mark Carney, former Governor of the Bank of England and a special envoy to the UN, said that climate change is the most significant risk and the most prominent commercial opportunity globally; we cannot reach net zero without significant capital. The question is how to support a transition to net zero by covering the gap between access to capital and its needs (United Nations 2021). More than 70% of this financial requirement must come from private capital. Spending towards net zero by 2050 will reach around $9.2 trillion annually on average, or $275 trillion in total from now (Kumra and Woetzel 2022). The world thus faces a double challenge linked to climate change and energy. The fact that over 1 trillion dollars will be spent on electricity in Europe in 2022/23, unlike the usual $100–$150 billion annually, is a result of severe energy crises and side effects of the war in Ukraine. Compared with the global total of $80–$100 trillion per year, Daniel Yergin points out that sizable demand makes the energy transition more difficult and time extensive (Tirschwell 2022). Financing net zero and meeting energy demands are rigid goals, and may be feasible only if there is access to sustainable finance. This is especially hard for middle- and low-income countries who need help (Columbia Energy Exchange 2022). War and Industrial Policy (Pozsar 2022), War and Interest Rates (Houses and Holes 2022), and "Bretton Woods III" (Equedia 2022) have become hot topics, where no country can stand aside.

Sustainable finance comprises sustainable, green, social, and sustainability-linked bonds, equity, loans, insurance, allocation issues and impact by bonds. It supports carbon, climate, green, and environmental finance (Sachs *et al.* 2019) and is connected to the policies of industrial and central banks. The ultimate goal of its infrastructure (the ecosystem) is to increase sustainability and resilience by achieving climate neutrality. EU Regulation identifies the core components of sustainable, green, social, and sustainability-linked bonds and standards (GBS) as follows: (1) green projects

should meet at least one of the environmental objectives as defined in the EU Taxonomy regulation, should "not have significant harm" on any of the other objectives, and should meet the Technical Screening Criteria; (2) green bonds fall within the voluntary alignment framework; (3) annual allocation and impact reporting are required; and (4) an external verifier and publicly available reports must be provided. High political risks, among others, could prevent investors from actively supporting any project, and public finance alone will not be enough to cover these needs. Financial leverage is powerful but insufficient because the eligibility of technology and affiliated criteria, such as being bankable and investable, impact the technology sector, and vice versa.

Technology

"Technology has become a commodity," (De Bono 1992, p. 72). Regarding the maturity of technology, Edvard De Bono was mostly fair, except when underlining the energy transition that we do not yet have (BBC News 2021). Following John Kerry, 50% of carbon emission reduction technology has not yet been invented. Initially, we can classify two groups: (1) mature technologies in sectors such as electricity, transport, buildings, industry, low-emission fuels, agriculture, and land use; and (ii) technologies needed (Gates 2021). The latter includes: producing hydrogen without emitting carbon; grid-scale electricity storage that can last an entire season; electro fuels; advanced biofuels; zero-carbon cement; zero-carbon steel; plant- and cell-based meat and dairy; zero-carbon fertilizer; next-generation nuclear fission; nuclear fusion; carbon capture; underground electricity transmission; zero-carbon plastics; geothermal plastics; pumped hydro; thermal storage; drought-and flood-tolerant food crops; zero-carbon alternatives to palm oil; and coolants that do not contain F-gas.

The energy transition impacts different nations differently. Recent McKinsey research has shown ten technologies on which Europe's future competitiveness and prosperity will depend (Smit *et al.* 2022): next-level automation; next-gen robotics; the future of connectivity; distributed infrastructure; next-generation computing; applied AI; trust architecture; the bio revolution; next-gen materials; and the future of cleantech.

Middle and low-income countries should greatly rely on mature and maturing technologies, with conservative investment into those that are developing and emerging. The Glasgow Financial alliance (Glasgow Financial Alliance for Net Zero 2021) devised four archetypes of decarbonization investment, but slightly omitted the prospective potential of states.

Recent severe energy crises have confused the plans of even high-income countries. The European Union, the United Kingdom, and the United States again turned to nuclear power, oil, and gas. Some countries accumulate coal stocks before winter, which means that clean technologies do not cover the existing demand to be resilient. In wartime, Ukraine used feedstock and wood fires to heat the population. These processes slow down a transition to net zero, but they must proceed in the absence of alternatives.

Examples of bottlenecks and opportunities

Cultivating cross-system interactions should be a norm. Some examples from practice include:

1. At the policy level, using gas and fossil fuels in the transition to net zero. Keeping the focus on renewable trends by ignoring fossil fuels, nuclear power, and gas as a transition resource to meet net zero could lead to negative consequences for SDG7, "Ensure access to affordable, reliable, sustainable and modern energy for all."
2. At the policy level, the Lithuanian government subsidizes industry because of geopolitical and energy shock (2022). The next step is to help companies with new markets and raw materials suppliers.
3. In terms of energy efficiency, boundaries for recurrent cash flow are relevant because energy-efficient buildings do not meet technical requirements and standards (Reeder 2010). Sophisticated storage, IoT (Internet of Things), and modern concepts of prosumerism might give rise to cost deductions. The legislation, regulation, and technical standards are reluctant to support innovations with positive cash flow.
4. Emergency responses with cumbersome procurement. Winterization is problematic during a war or climate disaster; citizens cannot live without water, electricity, and heating. Rarely do municipalities have enough money, but if they do, procedures are inflexible and long-lasting. Lawmakers must adopt procurement with options "in kind" or "fast-tracked" in an emergency.
5. Sustainable finance. Policy-based projects offer a contrast to those that are return based, such as green tariffs vs insolvency of the energy markets resulting from wishful thinking. Attempts to accelerate renewable energy have come to be at odds with diligent macro-financial calculations and risk assessment.
6. ESG vs promoting greenwashing. To protect 348 specific pension funds, the Texas Comptroller (Glenn Hegar) initiated divesting against BlackRock and nine other asset management companies that promote ESG. At first glance, the subject is an anti-ESG campaign, but researchers have assumed political motives because of the blacklisting of relatively small European financial institutions except for BlackRock (Rajgopal 2022).
7. Immature vs mature technology. Hydrogen is a prospective source, but investing 100% of capacity into its development is questionable. as a country could be vulnerable in case of a delay with hydrogen technology (Smil 2020).
8. The education bottleneck includes problems with disseminating knowledge and information about climate change, emergency, recovery, resilience, EU reporting, technology, and financial and non-financial risk assessment to receive capital, guarantee and insurance.
9. Nexus between Supply chain disruption and GHG protocol. Several megatrends heavily influence the supply chain in all sectors, including raw materials, logistics, procurement and end users. Pressure to reduce carbon emissions stems from three Scopes according to the GHG Protocol, scope-3-standard: Scope 1: direct GHG emissions from operations that are owned or controlled by the company; Scope 2: indirect GHG emissions from the consumption of purchased electricity, heat, steam and cooling; Scope3: all indirect GHG emissions (not included in scope2) that occur in the value chain of the reporting company. The supply disruption has caused socio-

economic consequences that impacted inflation, energy, food, and water crises, and even hot and cold wars.

10. The EU bottlenecks. The Climate policy in the EU is too far to be holistic in terms of how supply chain emissions are managed and calculated. The EU climate policy and corporate compliance mainly focus on Scope 1 emissions and, to some extent, on Scope 2 emissions linked with energy efficiency and renewable energy. The EU Sustainable Finance Taxonomy, The EU Climate Law, capital needs, and changing demography also led to the stress that the supply chain faces.
11. The Ukraine bottlenecks. Ukraine obtains full support from European institutions. The country specifically addressed speeding up emergency response against attacks and repairing critical energy infrastructure for functioning systems by ensuring supply chain recovery, speedy procurement, creating databases, and the transition from post-Soviet to modern equipment and EU standards.

Bottlenecks are known as signposts for future opportunities, but what is the institutional way to engage professional advice and seize an opportunity?

Solutions and innovations

As defined above, there are legal, financial, and technical gaps in the market, but is the market in these gaps? If so, how can stakeholders manage capital, technology, and governance? If not, can stakeholders hedge against the consequences? Can the state shape the market? What is the impact on the planet and people? Sustainability is still evolving regarding methodology, legislation, and data availability. Gradually growing sustainable financial ecosystems have provided a tailwind to better strategic conditions. These ecosystems have access to or comprise data providers, knowledge hubs and academia, patents, project accelerators, public, private, and blended capital providers, insurance, ESG-rating and verification agencies, emission trade systems, and green (sustainable) stock and commodity and raw minerals exchanges.

This works in the coalition between public and private non-profit and for-profit stakeholders (Schoenmaker and Schramade 2018). Ecosystems, adaptation, and disaster risk reduction research (Sushchenko *et al.* 2020) continue in Germany. The United Nations Development Programme in Ukraine supports emergency response and recovery, non-financial risks, and green taxonomy studies (United Nations Development Programme 2022). Professional platforms accelerate access to capital providers and low-carbon technologies to support sectors as part of these ecosystems. Private stakeholders often do not have the capability or resources, or are too risk-averse, to delve into start-ups and innovation. The role of the government becomes exceptional in shaping incentives, markets, and innovation. Energy, climate change, supply chain, or raw materials disruption can be priorities in a different order on the specific situation – political instability, insecurity and inflation, access to finance, quality of human capital, policy, standards, and technology readiness level (TRL) are impactful. Even highly developed countries can rarely execute large projects. Although it is time extensive, human-centric activity can increase capacity for all. So, high-quality education and internalisation of R&D become a focus. The sustainable solutions will embrace the topics of Sustainable

Finance Platforms, Access to Sustainable Capital, Artificial Intelligence for Supply Chain, and Supply Chain Sustainability Management by applying the analyzed case studies and the theories used for research.

From "Silos" to the "System"

Sustainability is multidisciplinary, so it implies integrity, not an isolated mono-disciplinary mode of law, finance, and technology. Conventional shareholder silos mean privatizing gains and internalizing losses. A conflict between "silos" and "systems" must be accepted and actively managed (Serrat 2017). An expert partnership to meet the EU taxonomy and SDG17 criteria should be a holistic and flexible platform for a more sustainable future as a shared value. This platform cannot simply maximize output from each element because system properties, or shared values, are not equal to the sum of the properties of their elements.

Since systems are complex and resources are limited, experts prioritize legal, financial, and technological means via binary considerations. Binary integration (LF, LT, FT) is better than mono-disciplinary but is still limited, and it needs to move closer towards the integrated system and shared values. As such, it is correct to move along two axes and even more; the first is a "bottom-up" process where stakeholders, not only shareholders, and the government react at the top in a doubly effective manner – both from a financial perspective and concerning the magnitude of impacts. The second axis mirrors upstream and downstream value and supply chains, in scopes of one, two, and three. Experts can propose recommendations that initiate further development.

When it comes to the supply chain, there are gaps between Sustainable Finance Principles and the demands of the Supply Chain. Stakeholders and companies face growing pressure from asset owners, customers, employees, lawmakers, and activists to reduce emissions across the entire value chain. The environmental and non-financial risks associated with Scope 3 emissions become access to credits, ESG ratings, and blended capital. Another problem is poor automation of supply chain sustainability management. The supply chain function ensures integrated operations from customers to suppliers with a necessity to secure data collection, validation, analysis, and reporting of how Artificial Intelligence (AI) and Data processing, Internet of Things (IoT), and Robotic can impact the supply chains for better sustainability and resilience with recommendations. To meet these trends and cope with the changed requirements for financial, IT, and material-procurement flows, supply chains need to become much faster, granular, and more precise.

Policy and EU taxonomy

Platforms should make it a mandatory policy to align the following: EU Taxonomy article 20 Platform (Regulation (EU) 2020/852); the triple bottom line principles for the planet, people, and profit; the ethics and culture code; UN SDG17; the Principles of Responsible Investment (PRI); the Task Force on Climate-Related Financial Disclosures (TCFD); the Sustainability Accounting Standards Board (SASB); the International Integrated Reporting Council (IIRC); the Global Reporting

Initiatives (GRI); ESG disclosure, regulation, and standards; and the European Commission advisory body. The sector-specific case studies will include EU Taxonomy, ESG and SDG metrics. Typically, ESG is more input-driven, and SDG17 is more output and outcomes. It is mainstream for sustainable finance, leading to rethinking supply chains. The case studies will consider energy, buildings, environment and resources, industry, transport, and food sectors. The results of the case studies will serve as stepping stones in raising awareness of implementing the measures for improvement. Policy provides a compact guide to help design an effective strategy, leaving room for flexibility, creativity, and competition. A bias that EU Taxonomy is scientific and somewhat cumbersome, while the China catalogue or the United Kingdom taxonomy is relatively flexible and bold (Climate Bonds Initiative 2021), may be an exaggeration. We can identify the differences across Europe and between states, and facilitate harmonization worldwide. This concept can be instrumental in the law by slowing, steering, or accelerating changes (Soininen *et al.* 2021). The entrepreneurial state confronts myths against financing innovation. Mariana Mazzucato (2011) has shown that the public sector can solve problems and shape markets. The Defense Advanced Research Projects Agency's (DARPA) flexible structure assumes a mix of university-based researchers, start-up firms, and businesses, suggesting that governments should invest, not only spend (2022). This policy provides a principal impetus and direction for revising rules and regulations, but a transition to net zero is specified in it.

Platforms to Bridge Gaps

According to EU Taxonomy Article 20 (Regulation (EU) 2020/852), the Platform of Sustainability incorporates the Task Force and Working Groups; experts could find cohesive solutions to enhance sustainability in the multidisciplinary framework and opt for long-term values. Stakeholders from private and public sectors adjust charters to meet individual needs, such as GHG, water consumption and sewage, biodiversity, minerals, and land use. They want to understand projects' bankability and investability criteria. Balancing resilience and efficiency must include non-financial factors such as ESG externalities.

The advisory process obtains many forms that each have something in common. McKinsey identified three ways of cooperation (McKinsey & Company 2022) in decision-making, creative solutions, and coordination and information sharing. Because success depends on ability and diversity, experienced US researcher Scott E. Page (2018) recommends that multi-modelling platforms look through many windows. Collaboration mechanisms from (Serrat 2017), with author additions, include: 1. appreciative inquiry; 2. working in teams; 3. drawing mind maps; 4. collaborating with wikis; 5. wearing six thinking hats; 6. managing virtual teams; 7. learning in strategic alliances; 8. improving sector and thematic reporting; 9. a primer on corporate values; 10. bridging organizational silos; 11. organizational configuration; 12. fighting corruption with ICT and strengthening civil society's role; 13. policy-driven, market-driven approaches; 14. hybrid and social driven approaches; and 15. facilitation, involving mediation, litigation, arbitration, and conflict resolution. Examples of platforms include: 1. the European Commission – the Platform on Sustainable Finance (European Commission 2021); 2. the European Roundtable on Climate Change and Sustainable

Transition (ERCST 2022); 3. the Green Growth Knowledge Partnership – UNEP, UNIDO, the OECD, the World Bank, the Green Policy Platform, the Green Industry Platform, and the Green Finance Platform (2012); 4. the cloud-based SaaS collaborative platform Persefoni (n.d.); and 5. BlackRock's Aladdin platform, which supports enterprise reporting for the EU's Sustainable Finance Disclosure Regulation (Kerencheva 2022).

The Platform framework can help cope with the abovementioned problems and bottlenecks. For instance: The Problem: Nexus between Supply chain disruption and GHG protocol. Solution. Education for sustainability raises awareness of the need to identify how ESG externalities (scope 1,2,3) impact Supply Chains with the recommendations. This way, finding and applying the proper solutions. The Problem: Gaps between Sustainable Finance and demands from Supply Chain. Solution. Education for sustainability enables the device of a toolkit to bridge gaps between Sustainable Finance and the Supply Chain. The Problem: Poor automating supply chain sustainability management. Solution: Education for sustainability, raising awareness and promoting research on how Artificial Intelligence (AI) and Data processing, Internet of Things (IoT), and Robotic can impact the supply chains for better sustainability with recommendations. The sustainability course applies multidisciplinary and interdisciplinary approaches to analyze the present problems and possible solutions. Sustainable Finance Platforms during poly-crises will engage multidisciplinary expertise. SDG17, ESG approach to tackle Climate change, Adaptation, and Mitigation in Supply Chain transition to net zero.

The skills gap and education

Prioritizing sustainability, resilience, emergency, and recovery has become imperative and mandatory. Hence, sustainability managers, board members, and public servants will provide leadership. Experts foresee the solvent demand for education and retraining services, with the unique role of education, academia and universities in partnership with financial practitioners and changemakers (Waygood 2022; https://www.sustainability.ei.columbia.edu/).

The global green energy market will exceed $1.1 trillion by 2027. Demand for jobs will rise 8% annually until 2030, with up to 14 million jobs by 2030 (Haanaes 2022). The regulatory landscape means that corporate reporting has become mandatory. The EU drives the Sustainable Finance Disclosure Regulations (SFDR); the UK the Task Force on Climate-Related Financial Disclosures, TCFD (UN Environment Programme Finance Initiative 2015); and the US the Securities and Exchange Commission (SEC). The extension of board members' fiduciary duties for listed companies is common in many countries. Being aware of the historical pioneer role of Europe in the Green Deal, Twin Transition, EU Taxonomy, and sustainable finance, education aims to teach how to access Sustainable Capital by raising awareness of the subject. Here raising awareness through education for sustainability also enables the stakeholders to implement adequate policies which ensure a Sustainable Finance Platform for better supply chains.

Savvy sustainability managers will be able to manage climate risks, natural disasters, and other emergencies, including wars. Emotional awareness is part of the job description for managers to build a more sustainable future (Caruso and Salovey 2004).

Conclusions

Sustainable solutions are demand-driven. The planet, people, and profit concept; the fact that governing can be progressive; the understanding of 'growth without growth' and economic boundaries; the transition from short-term to long-term shared values; and the necessity of internalizing ESG externalities – all of these form the basis of a paradigm and mindset shift for a more sustainable future. With toolkits and advice based on system thinking and simulation, this transition can work, in which the role of education for sustainability managers and leaders overwhelmingly increases. The designed sustainability course will aim to educate managers with a broad multidisciplinary and interdisciplinary upskilled and reskilled approach.

Sustainable ecosystems and platforms embrace all aspects of regulation, financial mechanisms, and modern trends in technology to choose strategic priorities to meet existential threats and act in many sectors and geopolitical arenas. Mapping takes ESG data inputs and reworks them into pieces of advice to obtain UN SDG17 as an output. This bridges the gaps between law, finance and technology, and enhances the transfer from "silos" to "systems." Stakeholders like to see metrics on their dashboards to pursue interim and ultimate objectives, and in this sense middle and low-income countries can adapt ecosystems and platforms to meet specific needs.

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