

TITLE: Finance and the lever of the Demand-led Innovation for the decarbonisation: a Case study on foundation industries

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ABSTRACT

This paper aims to examine the extent to which demand-led innovation (DLI) can act as a driver for green transition, especially in the Italian cement and steel industries, which are currently extremely difficult to decarbonise and are referred to as “hard-to-abate”. Starting from a critical reading of the narrative of the so-called “*Green Mirage*”, where every change seems to weigh solely on citizens-consumers, we highlight the profound flaws of policies focused solely on emerging technologies or production growth as well as the limitations of the *Technology Push* approach. This paper, on the other hand, shows that favourable conditions arise when concrete, measurable and stable demands shape corporate choices. Such stimuli not only reduce unpredictable risks but also steer technological development towards truly viable options, making financing for low-emission projects more accessible.

The research develops a conceptual framework that links demand signals to the perception of financial risk and capital allocation mechanisms in the banking system, showing how demand can act as a de-risking factor by affecting market risk, transition risk and credit risk. This analytical framework is applied to foundation industries, which are characterised by high capital intensity, long investment cycles and strong exposure to international competition, all of which amplify the negative effects of the lack of stable demand for low-emission products.

Starting from a mixed analysis of theory and practical evidence, a prototype financial instrument emerges: the Green Commitment Bond (GCB). This design was created to introduce dynamics that stimulate demand into green finance. Unlike traditional approaches, it links capital inflows to measurable commitments to purchase low-carbon materials. As a result, it promotes the development of markets for industrial products aligned with climate objectives. Although it does not go so far as to define all the technical details, the research outlines a viable path for introducing it in Italy. It indicates concrete start-up stages, who leads the process, how to coordinate institutions and private individuals, ensure regulatory compliance and manage possible critical issues along the way.

Overall, the work contributes to the debate on sustainable finance and innovation policies, bridging the gap between demand-oriented climate policies and financial decision-

making processes, and proposing a market shaping perspective to integrate finance, demand and public governance in support of the decarbonisation of hard-to-abate industrial sectors.

METHODOLOGY

This thesis adopts a qualitative, interdisciplinary and exploratory research design aimed at analysing the role of demand-led innovation in accelerating the ecological transition of hard-to-abate industrial sectors through the lens of sustainable finance. The methodological approach combines conceptual analysis, review of scientific literature, analysis of the regulatory and policy framework, case studies and the development of an experimental project proposal.

First, a structured review of the literature is conducted in order to frame the theoretical foundations of demand-led innovation and market shaping approaches, drawing on contributions from studies on innovation, political economy and sustainable transitions. This theoretical framework is integrated with the literature on green finance and the financial risks associated with climate change, with the aim of constructing a coherent analytical framework that links demand signals to the perception of financial risk and the bankability of low-carbon industrial investments.

Secondly, the thesis develops a qualitative analysis of the regulatory and policy framework for sustainable finance, with particular reference to the European and Italian contexts. The main regulatory and supervisory instruments (including the EU Taxonomy, the CSRD, the EBA guidelines and international reporting standards) are examined in order to assess how regulatory pressure translates into changes in business models, risk management processes and financial intermediation practices in the banking system. The regulatory analysis is accompanied by consultation of reports and documents produced by international institutions, IEA, OECD, BIS, UNIDO for instance, which provide empirical context on the challenges of decarbonisation in hard-to-abate sectors.

Thirdly, the work uses illustrative case studies to analyse how the logic of demand-led innovation translates operationally into the financial system. The fintech cases (Greenomy, Lendosphere and Clim8 Invest) are selected according to a purposive sampling logic, as they are representative of different types of external demand (regulatory demand, retail investor demand, demand for transparency and accessibility). At the same time, a sectoral analysis of the cement industry (and, more generally, hard-to-abate industries) is conducted in order to highlight the interaction between climate risks, regulatory constraints and demand dynamics in the configuration of financial

instruments and investment strategies. These cases are not intended to be statistically representative, but rather to provide analytical depth and theoretical relevance.

Finally, based on the evidence emerging from the theoretical framework, regulatory analysis and case studies, the thesis develops an experimental proposal for financial innovation in the form of the *Green Commitment Bond (GCB)*. The approach adopted is project-based and exploratory: the instrument is not defined through comprehensive financial modelling, but is conceptualised as a policy and market hypothesis, accompanied by an operational roadmap to assess its potential introduction in the Italian context. This approach allows for the integration of theoretical analysis and applied reflection, recognising the limitations of immediate quantitative validation and opening the door to future empirical experimentation.

Overall, the methodology reflects the exploratory nature of the research question and is consistent with the thesis's objective of contributing to the theoretical and policy debate on how demand mechanisms can be integrated into sustainable finance to support the decarbonisation of industrial sectors that are most difficult to reduce in terms of emissions.

LITERATURE REVIEW

The demand-led innovation (DLI) paradigm is a key area for the study of innovation processes, especially when placed in the context of ecological transition and industrial transformation towards decarbonization. The concept of DLI can be broadly defined as the set of dynamics that determine the activation or acceleration of innovation by stimulations coming from the demand side. These inputs can arise either from end users, from forms of interaction between customer and supplier, or, with increasing frequency, from demand-side actors made operational by public bodies through regulatory and public procurement instruments (Edler, Jakob, and Luke Georghiou, 2007. “Public procurement and innovation. Resurrecting the demand side.” *Research Policy* 36 (7): 949–963)¹. This is an innovative approach that differs significantly from the traditional pure technology-push approach, which is oriented towards research and development independent of any market needs, as it is based on the idea that the direction of technological change is not determined solely by supply but also, and above all, by the needs and incentives arising from the demand side (OECD, 2011. *Business Innovation Policies: Selected Country Comparisons*. OECD Publishing)².

Demand-led innovation's conceptual foundations were laid down in the 1960s and strengthened in the 1990s, but because it has evolved from a theoretical framework to a key policy approach for the green transition, the paradigm now is considered to be "innovative." What started out as an academic debate has evolved into procurement and regulatory instruments that establish reliable markets for low-carbon technologies, lower investment uncertainty, and facilitate the transformation of whole industrial sectors.

The theoretical framework of this approach, based on the dichotomy between “demand-pull” and “technology-push,” allows us to return to the fundamental question when it comes to the debate on innovation economies. Schmookler (Schmookler, Jacob. 1966. *Invention and Economic Growth*. Cambridge, MA and London, England: Harvard University Press.)³, in what is now considered a classic work, provided empirical evidence

¹ Edler, Jakob, and Luke Georghiou. 2007. “Public procurement and innovation. Resurrecting the demand side.” *Research Policy* 36 (7): 949–963.

² OECD, 2011. *Business Innovation Policies: Selected Country Comparisons*. OECD Publishing

³ Schmookler, Jacob. 1966. *Invention and Economic Growth*. Cambridge, MA and London, England: Harvard University Press.

of the expansion of inventiveness, linking it largely to demand pressures rather than to the effects of endogenous technical progress alone, thus affirming the role of the market-led dimension in “innovation growth.” These propositions were partly contested by Mowery and Rosenberg (Mowery, David C., and Nathan Rosenberg. 1979. “The influence of market demand upon innovation: a critical review of some recent empirical studies.” *Research Policy* 8 (2): 102–153)⁴, who drew attention to the complexity and interactivity of the phenomena and argued, on the one hand, that it was impossible to attribute them to a single force among those at work.

This vision would later be recognized, in a consolidated form, in Kline and Rosenberg's chain-linked model (Kline, Stephen J., and Nathan Rosenberg. 1986. “An Overview of Innovation.” In *The Positive Sum Strategy: Harnessing Technology for Economic Growth*, edited by Ralph Landau and Nathan Rosenberg, 275–305. Washington, DC: National Academy Press.)⁵, according to which the initiative often starts with a market demand and expands as a result of continuous feedback between design, production, accumulated knowledge, and basic research. On the theoretical front, Lundvall's (Lundvall, Bengt-Åke. 1988. “Innovation as an Interactive Process: From User-Producer Interaction to National Systems of Innovation.” In *Technical Change and Economic Theory*, edited by Giovanni Dosi et al., 349–369. London: Pinter.)⁶ user-producer interaction perspective emphasized the importance of knowledge exchange between producers and users as the main vehicle for mutual learning, while von Hippel's (von Hippel, Eric. 1986. “Lead Users: A Source of Novel Product Concepts.” *Management Science* 32 (7): 791–805.)⁷ research highlighted the role of so-called lead users capable of anticipating future needs and guiding change.

On this theoretical basis, there is now growing attention in the field of ordinary policies. Edler and Georghiou (Edler, Jakob, and Luke Georghiou, 2007. “Public procurement and

⁴ Mowery, David C., and Nathan Rosenberg. 1979. “The influence of market demand upon innovation: a critical review of some recent empirical studies.” *Research Policy* 8 (2): 102–153

⁵ Kline, Stephen J., and Nathan Rosenberg. 1986. “An Overview of Innovation.” In *The Positive Sum Strategy: Harnessing Technology for Economic Growth*, edited by Ralph Landau and Nathan Rosenberg, 275–305. Washington, DC: National Academy Press.

⁶ Lundvall, Bengt-Åke. 1988. “Innovation as an Interactive Process: From User-Producer Interaction to National Systems of Innovation.” In *Technical Change and Economic Theory*, edited by Giovanni Dosi et al., 349–369. London: Pinter.

⁷ von Hippel, Eric. 1986. “Lead Users: A Source of Novel Product Concepts.” *Management Science* 32 (7): 791–805.

innovation. *Resurrecting the demand side.*” *Research Policy* 36 (7): 949–963)⁸ highlight public procurement of innovation (PPI) as one of the most powerful tools for directing innovation towards objectives of public interest. In fact, Edquist and Zabala (*Edquist, C., & Zabala-Iturriagagoitia, J. M. (2012). Public Procurement for Innovation as mission-oriented innovation policy. Research Policy, 41(10), 1757–1769. <https://doi.org/10.1016/j.respol.2012.04.022>)⁹ link PPI to the mission-oriented policy perspective, according to which the state, using demand-side levers, aims to govern entire socio-technical systems with long-term objectives, such as climate neutrality.*

In this specific sense, DLI becomes a market shaping strategy which, in addition to acting as a driver for technological research, systematically promotes markets for innovative solutions, defusing investment uncertainty and opting for teaming up with collective learning processes, as well as learning-by-doing and learning-by-using.

The importance of this approach is particularly evident in the European landscape of the last decade, characterized by progress in climate policies. With the green light for the Green Deal and the Fit for 55 package of measures, binding emission reduction targets have been set, such as the target of a 55% reduction by 2030 compared to 1990 levels, accompanied by legislative frameworks capable of directing demand for low-carbon technologies (*European Commission, 2019. Communication on the European Green Deal. Brussels: European Commission*)¹⁰.

The European emissions trading system, reinvigorated with the implementation of the fourth phase (2021-2030), and the introduction of the carbon border adjustment mechanism on a transitional basis from 2023 and fully operational from 2026, have created significant market incentives for low-carbon products such as steel, concrete, substances, aluminum, and fertilizers, internalizing carbon costs and putting pressure on manufacturers to innovate (*ICAP, 2023. Emissions Trading Worldwide: Status Report 2023. Berlin: International Carbon Action Partnership*)¹¹. At the same time, the new RED III

⁸ Edler, Jakob, and Luke Georghiou, 2007. “Public procurement and innovation. *Resurrecting the demand side.*” *Research Policy* 36 (7): 949–963.

⁹ Edquist, C., & Zabala-Iturriagagoitia, J. M. (2012). Public Procurement for Innovation as mission-oriented innovation policy. *Research Policy, 41(10), 1757–1769. <https://doi.org/10.1016/j.respol.2012.04.022>*

¹⁰ *European Commission, 2019. Communication on the European Green Deal. Brussels: European Commission.*

¹¹ *ICAP, 2023. Emissions Trading Worldwide: Status Report 2023. Berlin: International Carbon Action Partnership.*

directive has raised the binding target for the share of renewables in 2030 to 42.5%, setting an additional target of 45% and highlighting a series of sectoral targets aimed at promoting the use of green hydrogen in industry (*European Union, 2023. Directive (EU) 2023/... on the promotion of energy from renewable sources (RED III). LXX, volumes matter*)¹². The amendment to emission standards for cars and vans, which requires zero emissions for new cars from 2035, has also had the power to generate credible demand for low-carbon materials and components for downstream sectors from the automotive to the construction sector. These measures show how different the DLI is from approaches aimed at boosting supply.

While traditional technology push delights in strengthening the technological capabilities of businesses through subsidies, tax credits, and research funding, DLI acts to reduce market risk, creating contexts in which innovations can find commercial outlets. Even with respect to simple supply chain management, which optimizes logistics and production flows along existing supply chains, DLI plays an upstream role, shaping the very nature of demand flowing along value chains and forcing suppliers to modify products and processes in line with new environmental standards and specifications (McMeekin, A., Green, K., Tomlinson, M., & Walsh, V. (Eds.)(2002). *Innovation by demand: An interdisciplinary approach to the study of demand and its role in innovation*. Manchester University Press)¹³.

The importance of DLI is particularly evident in foundation industries (FI) which are highly energy-intensive and considered hard to abate, but at the same time fundamental to overall industrial competitiveness.

In England, 15% of annual carbon dioxide emissions are attributable to the steel industry, which is dependent on the existence of a general and constant incentive to use raw materials with low emission volumes (Markkanen, S., Ali, M., Devlin, A. and Sheikh, A. Y. (2023). "The role of demand-led innovation in supporting decarbonisation in foundation industries: Challenges, opportunities and policy implications." *Cambridge: Cambridge Institute for Sustainability Leadership (CISL)*.

¹² *European Union, 2023. Directive (EU) 2023/... on the promotion of energy from renewable sources (RED III). LXX, volumes matter.*

¹³ McMeekin, A., Green, K., Tomlinson, M., & Walsh, V. (Eds.)(2002). *Innovation by demand: An interdisciplinary approach to the study of demand and its role in innovation*. Manchester University Press.

<https://www.cisl.cam.ac.uk/resources/publications/market-driven-decarbonisation>)¹⁴ .

According to a recent policy briefing by the Cambridge Institute for Sustainability Leadership (*Cambridge Institute for Sustainability Leadership (CISL)*, 2023. New research maps out demand-led decarbonisation pathways for UK foundation industries to improve competitiveness.)¹⁵, there are four methods of decarbonization that sometimes lead to four different demonstrations of a very specific distinctive signal of demand. These are electrification, circular development, harmonization with new and revolutionary machines, and the introduction of new initiative objects. However, these paths face a real “supply-demand catch-22,” meaning that without credible demand, manufacturers cannot scale emerging technologies, but without scaled supply, consumers have no incentive to change specifications or procurement practices.

This dynamic appears even more complex when considering that 98% of the industrial fabric of FI in the United Kingdom is composed of SMEs (*The Innovation Caucus*. 2022, 28 november. The Innovation Caucus: Impacting policy making from the grassroots to largescale enterprise. *Innovation Caucus*. Estratto da innovationcaucus.co.uk/news/the-innovation-caucus-impacting-policy-making-from-the-grassroots-to-largescale-enterprise/)¹⁶. These companies face significant barriers in terms of capital, technical and managerial skills, and willingness to collaborate in networks. The ‘innovation readiness’ framework proposed by the Innovation Caucus, divided into three axes of ‘willingness, capability, and capacity’, provides a useful tool for diagnosing the starting conditions of SMEs and identifying where policy intervention can enable the effective adoption of demand-driven innovations.

In recent years, several studies have described climate change not only as an ecological issue, but also as a factor capable of threatening the stability of the economic system as a whole. Emanuele Campiglio (Campiglio et al., 2018, *Climate change challenges for*

¹⁴ Markkanen, S., Ali, M., Devlin, A. and Sheikh, A. Y. (2023). “The role of demand-led innovation in supporting decarbonisation in foundation industries: Challenges, opportunities and policy implications.” *Cambridge: Cambridge Institute for Sustainability Leadership (CISL)*. <https://www.cisl.cam.ac.uk/resources/publications/market-driven-decarbonisation>.

¹⁵ Cambridge Institute for Sustainability Leadership (CISL), 2023. *New research maps out demand-led decarbonisation pathways for UK foundation industries to improve competitiveness*.

¹⁶ *The Innovation Caucus*. 2022, 28 november. The Innovation Caucus: Impacting policy making from the grassroots to largescale enterprise. *Innovation Caucus*. Estratto da innovationcaucus.co.uk/news/the-innovation-caucus-impacting-policy-making-from-the-grassroots-to-largescale-enterprise/

central banks and financial regulators, *Nature Climate Change*) identifies physical and transition risks as two main channels through which this crisis is transmitted to the credit and financial sector, altering capital estimates, loan distribution, and capital allocation choices. According to them, central banks would have room to gradually steer these movements toward cleaner assets¹⁷. Added to this picture we can find Patrick Bolton's (Bolton et al., 2020, *The Green Swan: Central Banking and Financial Stability in the Age of Climate Change*, BIS) network-based perspective which analyses how climate transition risks can propagate among interconnected financial institutions. Through stress test models, they show that the financial sector is highly vulnerable to climate transition risks¹⁸. Stefano Battiston (Battiston et al., 2017, *A climate stress-test of the financial system*, *Nature Climate Change*) further enriches this debate by adopting a network-based perspective to analyze how climate transition risks can spread among interconnected financial institutions. Through climate stress test models applied to financial networks, the authors demonstrate that vulnerabilities arise not only from direct exposure to carbon-intensive sectors, but also from indirect contagion effects through financial linkages. This systemic view reinforces the interpretation of climate risk as a macrofinancial phenomenon and provides a methodological basis for integrating climate scenarios into macroprudential policy frameworks¹⁹. All of this converges to show how climate tensions can exacerbate existing imbalances through collective and interdependent mechanisms, suggesting that policy decisions and demand developments affect not only production processes, but also the very structure of banking relationships and the assessment of risk in financial equilibria.

However, there remains a gap in the scientific literature, in that, although there are a large number of studies on demand-side policies and supply-side instruments, the literature lacks systematic analyses capable of directly linking demand signals deriving from climate policies with the perception of financial risk by the companies involved. In

¹⁷ Campiglio, E., Dafermos, Y., Monnin, P., Ryan-Collins, J., Schotten, G. & Tanaka, M. (2018), 'Climate change challenges for central banks and financial regulators', *Nature Climate Change*, vol. 8, pp. 462–468.

¹⁸ Bolton, P., Després, M., Pereira da Silva, L. A., Samama, F. & Svartzman, R. (2020), *The Green Swan: Central Banking and Financial Stability in the Age of Climate Change*, Bank for International Settlements, Basel.

¹⁹ Battiston, S., Mandel, A., Monasterolo, I., Schütze, F. & Visentin, G. (2017), 'A climate stress-test of the financial system', *Nature Climate Change*, vol. 7, pp. 283–288.

particular, there is a need to investigate how DLI relates to the risk allocation models used by banks and to build frameworks for measuring the impact of standards, CBAM, and PPI on the bankability of industrial projects. Furthermore, the problem of potential market distortions that demand-side mechanisms can lead to, such as the concept of lock-in, has not yet been sufficiently focused on, nor has any empirical study been carried out on private buyer alliances (e.g., SteelZero, ConcreteZero), even though this is an emerging market shaping tool.

If we wanted to place demand-led innovation within the framework of the green transition and study how demand signals, originating from climate policies, translate into investment decisions and risk structures on the part of credit institutions, the merit and benefit of such a contribution would therefore lie not only in enriching the theoretical discussion on DLI, but also in the possibility of filling a serious empirical gap regarding the problem of how foundation industries can effectively finance their Net Zero transition while significantly reducing risks and losses.

CHAPTER 1 – How could DLI impact business and consumers

1.1 The Theory of the Greater Utility Convenience

For several decades now, especially with the emergence of the term “sustainable development” in the Brundtland report in 1987²⁰, the issue of sustainable innovation has become increasingly pressing, or at least so one would expect. While there is widespread recognition of climate change as a serious problem among the public and the scientific community, many experts and reports suggest that it is not being taken seriously enough by governments, industries, and individuals to the scale and speed required to avoid the most severe consequences, according to news and reports from organizations like the BBC and the World Health Organization (WHO). There's, in fact, a disconnect between acknowledging the threat and implementing the necessary actions, with a "brief, rapidly closing window" for effective global action²¹.

The so-called “green” development is now on everyone's lips internationally, starting at an institutional level and then becoming a commonly used term, even at a corporate level. In fact, there are several initiatives by companies, such as adherence to ESG criteria²², the promotion of investments in sustainable projects, and more accurate waste and production management so that it can be part of the broader concept of “circular economy”²³. All this is to keep up with the times, adhere to the standards imposed by

²⁰ Sustainable development was first defined in the World Commission on Environment and Development's 1987 Brundtland report 'Our common future' as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'.

²¹ Gregory, R. D., Bridle, J., & Wilson, J. D. (2024, 19 giugno). What is the role of scientists in meeting the environmental challenges of the twenty-first century? *Royal Society Open Science*, 11, Article 240498.

²² ESG is a set of criteria, detailed eventually in quantitative metrics, across environmental, social and governance dimensions that may have material effects on business performance. Considerations are incorporated into business decisions, corporate management and investor's portfolio choices. ESG is an investing framework by which firms can maximize financial returns and minimize risk while aligning with socially responsible business practices.

²³ A circular economy is an economic model that replaces the traditional "take-make-waste" linear system with one that aims to eliminate waste and pollution by keeping products and materials in use for as long as possible. It achieves this by sharing, leasing, reusing, repairing, refurbishing, remanufacturing, and recycling materials, essentially regenerating nature and decoupling economic growth from the consumption of finite resources.

(Ellen MacArthur Foundation. (s.d.). The Circular Economy: Definition & model explained. Estratto il 1 settembre 2025, da <https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview>)

governance and take part in the “just transition”²⁴. Despite this, we are still a long way from achieving the goals set to emerge unscathed from the climate emergency crisis we find ourselves in, and the transition, instead of progressing at the speed dictated by the urgency of the situation, seems to be slowing down.

One might therefore wonder how this is possible, given that sustainability is an issue that concerns everyone, from the highest echelons of political power to the CEO of a large company to everyday consumers. How is it possible that in this great marathon, we are slowing down instead of making a final sprint to cross the finish line?

In order to begin to answer these questions, it is best to proceed step by step, starting from the assumption that the theory of “greater utility convenience” is, for many, false.

In traditional economic philosophy, in the context of launching a new product or service, there is a tendency to think that for an investment to be considered successful, consumers must be willing to pay a higher price, known as a “premium”. Similarly, consumers' unwillingness to pay this price indicates the market's rejection of the new product or service in question.

Unfortunately, it is precisely these two assumptions that have predominantly influenced and guided the conception of sustainable products and services. The vast majority of business leaders, in fact, start from the assumption that consumers must pay more for goods that incorporate a sustainable solution, as it is seen as an added value²⁵.

Consequently, if the market is not prepared to accept higher prices, then this is a sign of its lack of interest and sustainability can no longer be considered a successful investment. Unfortunately, it is precisely these principles that have guided the concept behind the so-called “sustainable” products and services, assuming that consumers should bear the

²⁴ A just transition is a framework to manage the shift to environmentally sustainable economies and societies in a way that is fair, inclusive, and leaves no one behind, ensuring the benefits and burdens of change are shared equitably and no groups are unfairly disadvantaged. It aims to create decent work and new opportunities while providing support, such as retraining and social protection, for workers and communities affected by the loss of jobs in carbon-intensive industries, as well as addressing historical inequities.

(United Nations, Department of Economic and Social Affairs, Committee for Development Policy. (s.d.). Excerpt from CDP Report 2023 [PDF]. United Nations. Retrieved September 1, 2025, from <https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/CDP-excerpt-2023-1.pdf>)

²⁵ von der Gathen, A., Eckert, N. B., & Kastbjerg, C. (2024). The Demand Revolution: How consumers are redefining sustainability and transforming the future of business. *The MIT Press*.

higher price for this added value, thus shifting all the burden onto them and targeting them as solely responsible for the inefficient transition to a more sustainable market²⁶.

Furthermore, these assumptions permeate managerial thinking to such an extent that even the media, especially the economic media, instinctively speculate about the existence of a premium value when reporting on a company's attempts to bring its seemingly sustainable solutions to market.

When the Wall Street Journal published an article in 2022 about a disposable razor that US personal care products company Schick had designed to “attract environmentally conscious consumers”²⁷, it made a point of highlighting a potential appeal that could strengthen the razor's value proposition.

The article also quoted Selina Donald, director of sustainability at an advertising agency, who said that ‘highlighting responsibly sourced materials, reducing packaging and removing toxic or environmentally harmful ingredients are at the top of the list of priorities for today's informed consumers’. The article then continued noting that ‘there are challenges for marketers, including determining if and when consumers will be willing to pay additional costs.’ It then cited a study on consumers and sustainability, according to which 66% said they were not willing to pay more for sustainable products or services²⁸.

1.2 The Green Mirage

Considering the presumed absence of a surcharge as a rejection of a value proposition is a fatal mistake that contributes to creating what is called the Green Mirage²⁹.

Instead of pursuing innovative applications or developing products or services that are both sustainable and effectively irresistible, companies that follow the Green Mirage trend limit themselves to solutions that are more expensive or lower quality versions of products that consumers already buy and generally appreciate. In doing so, they

²⁶ von der Gathen, A., Eckert, N. B., & Kastbjerg, C. (2024). The Demand Revolution: How consumers are redefining sustainability and transforming the future of business. *The MIT Press*.

²⁷ <https://www.wsj.com/articles/schick-designs-a-disposable-razor-to-appeal-to-environmentally-conscious-consumers-1164984400>

²⁸ Simon-Kucher & Partners. (2025). *Consumer perspectives on sustainability in 2024 [Insight]*. Simon-Kucher & Partners. <https://www.simon-kucher.com/en/insights/sustainability>

²⁹ Ablin Joanes Carneiro Alphonso, D. (2025). *The Green Mirage: The Sustainability Spectrum of Perception, Policy and Practice*. *Notion Press*.

compromise by making small investments in sustainability that can improve their reputation or help them meet environmental, social and governance commitments, such as ESG.

Without the promise of a price premium, they believe that anything beyond these niche or symbolic efforts is bound to be unprofitable and therefore not worth pursuing. Supporting this theory about consumer response to new products on the market is a famous quote from anthropologist Margaret Read: “What people say, what people do, what people say they do are entirely different things”³⁰.

In short, when it comes to sustainability, the focus tends to be on consumer sacrifice rather than consumer benefit.

1.3 Case Study: Amazon

Although this type of economic approach is very common, there are cases, some of them quite well known, that contradict its effectiveness.

One of the most striking examples is the exponential growth of today's giant Amazon, whose story shows that success does not necessarily mean a premium price for consumers. Founded in 1994 as an online bookstore and starting out in a garage in Seattle, the company made a name for itself by offering a vast selection of products “if it's in stock, we have it” and discounts of 10% to 30% on most books. Interviewed by the now defunct Fortune magazine in 1996, Mr Bezos stated that it was a huge mistake not to offer discounts, and suggested that many online businesses failed because they misjudged their value proposition. Today, the result is well known: according to Kantar, Amazon is the fourth most valuable brand in the world, behind Apple, Microsoft and Google³¹. On the 11th of July 2023, known as “Prime Day”, a sales record was set. In two days, Prime members purchased 375 million items worldwide, saving a total of two and a half billion dollars on millions of offers. In September 2023, Amazon's market capitalisation was 1.29 trillion dollars. If Mr Bezos had started with a “premium” strategy, charging more

³⁰ Foxman, D., & Bateson, G. (1973). *Steps to an ecology of mind*. *The Western Political Quarterly*, 26(2), 345. <https://doi.org/10.2307/446833>

³¹ Kantar. (n.d.). *BrandZ: Most Valuable Global Brands* [Webpage]. Retrieved September 1, 2025, from <https://www.kantar.com/Campaigns/BrandZ/Global>

for the benefits of online shopping, the company and its early subscribers would probably have considered the business a failure, given that Amazon went through about 20 years of minimal profits or losses before consolidating.

There would have been a suspicion that, if the customer was not willing to pay more, the value of convenience was illusory and would have led to the abandonment of essential investments such as an intuitive interface, personalised notifications and buyer reviews. In short, Amazon's success is proof that there is more than one way to do business.

Despite this, most industries today base their vision on the dichotomy between purpose and profit, rather than opting for a strategy that can effectively create synergy between the two.

1.4 How to make Green solutions sustainable

However, this dichotomy, like sustainability as currently conceived, is not efficient, widening the gap between “green” and “grey” solutions.

One of the answers to this problem, which can no longer be ignored, is demand innovation, seen as a real revolution, i.e. the disruptive force of consumers capable of creating new markets and growth opportunities.

According to economic theory, profit consists of three variables: price, costs and volume³². Until now, one of the most glaring mistakes made by Green Mirage has been to eliminate volume from this equation, thereby reducing profit³³.

In fact, it offers its consumers only two choices: either pay a surcharge or accept a lower quality product or service in order to reduce production costs. But if Amazon's great rise has proven anything, it is precisely the fundamental role that quantity plays in generating profit, while remaining focused on affordable prices and good quality.

In short, what should be integrated and aspired to is the effect of scale.

A consumer's affordability, in fact, does not depend solely on their willingness to pay, but also on their ability to do so.

³² von der Gathen, A., Eckert, N. B., & Kastbjerg, C. (2024). The Demand Revolution: How consumers are redefining sustainability and transforming the future of business. *The MIT Press*.

³³ Ablin Joanes Carneiro Alphonso, D. (2025). The Green Mirage: The Sustainability Spectrum of Perception, Policy and Practice. *Notion Press*.

Removing these restrictions is not just a matter of understanding what consumers want, what they need or what they are willing to pay for, but also, and above all, understanding what motivates them and what barriers they face.

If more attention were paid to market segmentation, it would be clear how consumer behaviour is gradually changing in relation to sustainability and how this can actually create new profit opportunities.

It is imperative to understand that push and pull forces should go hand in hand, working together, just as it is necessary to build a new pyramid of innovation, in which commercial creativity and creative destruction allow the old to be broken down in favour of something new and better for everyone involved³⁴.

Commercial creativity covers the ability to swiftly develop business models in order to quickly and effectively bring solutions to market. In a broader sense, it refers to a business's readiness and capacity to completely reinvent each component of its revenue engine in response to customer demands. Creativity is used when a business aims to break away from conventional methods in order to overcome the obstacles that consumers face in terms of affordability, accessibility, knowledge, and trust. While creative destruction was defined by Joseph Schumpeter as the "process of industrial mutation that continuously revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one"³⁵.

Companies that are willing to move first in this direction could have the possibility to enjoy significant advantages such as upselling benefits and consumer loyalty, thus shifting their strategy from product-based to consumer-based.

1.5 Case Study: Tesla

One of the most concrete examples of this strategy is Tesla, which has brought to market a product, electric cars, that are not only more sustainable but also inherently better and more efficient.

According to Ford CFO John Lawler, Tesla's success demonstrates the connection between commercial creativity and creative destruction. It also sets a high standard for established original equipment manufacturers (OEMs) in the EV market. Beyond just

³⁴ Segers, J. P. (2020). From creative destruction to creative disruption.

³⁵ Schumpeter, J. A. (1942). *Capitalism, Socialism and Democracy*. New York: Harper & Brothers.

introducing a zero-emission electric vehicle to the market, Tesla accomplished more. It introduced a better electric vehicle that was backed by the company's own network of charging stations, sales, and service.

Additionally, the business has the long-term goal of providing EVs at a reasonable cost. This marketing approach directly addresses consumers' concerns regarding affordability, accessibility, knowledge, and trust in addition to highlighting the advantages of the product. Unlike established OEMs, Tesla does not rely on aftermarket sales and service to generate revenue, and it does not have a dealer network. According to Ford CEO Jim Farley, Tesla has "a cost advantage of \$2,000 a car" thanks to this marketing strategy³⁶. In addition, Tesla had never spent money on traditional advertising until 2023, unlike the established OEMs who spend billions on advertisements annually ³⁷ . Instead, the business has depended on social media, customer advocacy, and CEO Elon Musk's media appearances.

1.6 The importance of the perception gap

In order to avoid getting caught up in mere theoretical speculation, it was possible to quantify the difference between the “green mirage” and the “demand revolution” using what is known as the “perception gap”, which is illustrated graphically in Figure 1.1 and represents consumer adoption as a function of time.

³⁶ *WardsAuto*. (2022, June 2). Ford CEO Farley outlines bottom-line battle plan. *WardsAuto*. <https://www.wardsauto.com/ford-motor/ford-ceo-farley-outlines-bottom-line-battle-plan>

³⁷ *Macheforum*. (2022, June 2). Farley: Ford to stop traditional advertising for Mach-E, Lightning EV. *Mach-E Forum*. <https://www.macheforum.com/farley-ford-to-stop-traditional-advertising-for-mach-e-lightning-ev>

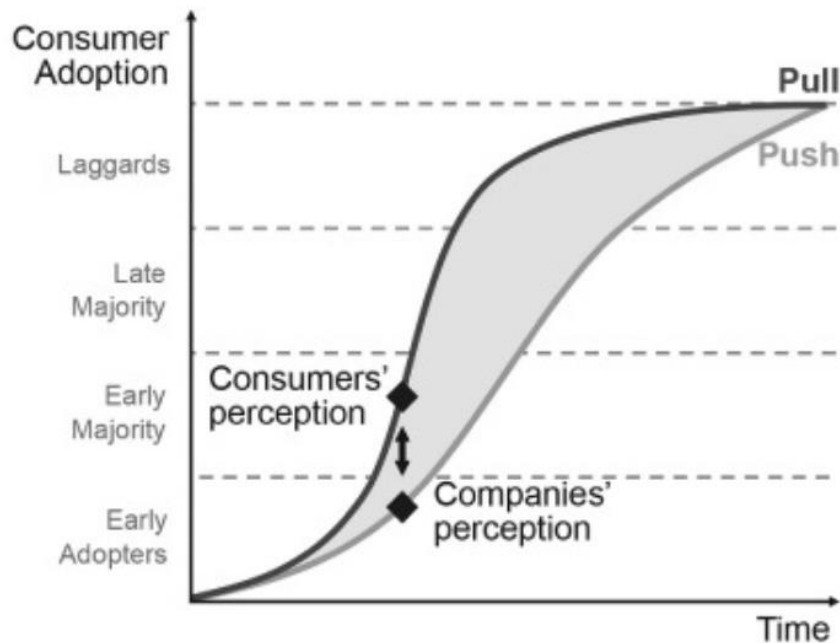


Figure 1.1 (von der Gathen, A., Eckert, N. B., & Kastbjerg, C. (2024). The Demand Revolution: How consumers are redefining sustainability and transforming the future of business. The MIT Press).

Analysing the figure, it can be seen that the lower adoption curve reflects confidence in traditional consumer adoption models, and business leaders place themselves on that curve when they believe that consumers, in sufficient numbers, are not willing to choose sustainable goods and services or pay for them, despite the continuous succession of sustainability advocates armed with surveys that claim the opposite. These leaders are therefore significantly influenced by the “green mirage”, convincing themselves that sustainability is not yet a priority for consumers at commercially decisive moments, such as when choosing from a supermarket shelf, in an online shopping cart or at the actual moment of payment.

On the contrary, the higher adoption curve reflects the baseline scenario of the “demand revolution”, in which business leaders have room to pursue consumer-driven commercial strategies capable of unlocking exponential growth.

Solutions that meet latent consumer needs can follow this curve thanks to unexpressed demand in the market.

The shaded area between the two curves is called “perception gap”. Consumers see themselves on the upper curve, while companies see them, at best, on the lower curve. Companies that continue to believe in the “green mirage” are, literally and figuratively, “behind the curve”. As a result, by operating below the perception gap, many companies fail to see the commercial opportunities offered by pursuing sustainable strategies, and very few seize them. Furthermore, they do not assess the risks of slow action or inaction, as they are too focused on regulatory compliance or business decisions that seem to separate purpose from profit, as if they were opposing forces.

Research conducted by First Insight and the Baker Retailing Centre at the Wharton School of the University of Pennsylvania indicates not only that consumers and retailers are not aligned on sustainability, but also that there is a significant disconnect between retail executives and consumers. “It is not surprising,” the report concludes, “that the sustainability imperative has been driven primarily by consumers”³⁸.

Another factor that reinforces the perception gap is that companies continue to measure progress using standard metrics, examples of which can be found in technological megatrends and the classic innovation paradigm. These metrics are geared towards serving a small number of “early adopters”, who are more inclined to understand the benefits of an innovation and pay a premium commensurate with its perceived value. Only over time, according to this principle, can the company expand into broader market segments.

1.6.1 Why is it urgent to fill the Perception Gap?

It follows from all this that it is imperative to bridge this perception gap. In particular, three main reasons have been identified why a demand-driven megatrend is considered to spread more quickly than a technology-driven megatrend, making the advantages of the upper curve in Figure 1.1 significant³⁹.

³⁸ First Insight, Inc., & Baker Retailing Center at the Wharton School of the University of Pennsylvania. (2022, January). *The sustainability disconnect between consumers and retail executives [White paper]*. First Insight. Retrieved September 1, 2025, from <https://www.firstinsight.com/white-papers-posts/the-sustainability-disconnect-between-consumers-and-retail-executives>

³⁹ Kerstin Hötte. (2021). Demand-pull, technology-push, and the direction of technological change.

First, unexpressed demand causes companies to experience accelerated adoption rates and gain clear first-mover advantages. This demand, which has accumulated over time, reduces the consumer learning curve, thus making the megatrend transformative. However, there would be a fundamental difference between sustainability and other transformative megatrends, which would be a further factor in its favour.

Globalisation and digitalisation, for example, in their early stages, when they were still considered novelties, were perceived as foreign and often intimidating. Sustainability, on the other hand, would appear less like a stranger and more like a familiar friend when companies are able to bridge the perception gap by serving the broader consumer market, as latent demand for sustainable solutions has been building for decades.

The second reason why a demand-driven megatrend would be desirable lies in the vacuum that often exists in leadership in defining sustainability positioning. In many markets, no company has become synonymous with sustainability in the eyes of consumers. When a company credibly fills that void, satisfying unexpressed demand, its positioning will allow it to scale more quickly.

Thirdly, as mentioned above, there is volume. Let us consider a situation in which every company manages to launch a sustainable strategy according to the classic innovation paradigm. In this process, goods and services would move over time from niche to mainstream and from the periphery to the core business, following the lower “push” curve in Figure 1.1.

However, even in this case, it is unlikely that the overall innovative impact would be sufficient to achieve the main global sustainability objectives. In other words, bridging the perception gap is not a choice, but a necessity. Without exponential growth, or at least a sharp increase in growth rates, the world will never achieve the climate targets set out in international agreements.

1.7 Why Companies Struggle with Sustainable Initiatives

The next revolutionary megatrend is going to be sustainability, which will generate exponential growth and result in long-lasting, net-positive changes for a significant

section of the global population⁴⁰. This claim raises two legitimate and important concerns: Why, after more than 60 years of the contemporary sustainability movement, hasn't this significant megatrend surfaced yet? And what can businesses do differently to meet the global sustainability goals more quickly and profitably?

Internal factors are among the causes. When the deadlines for announcing the success of certain sustainability initiatives are ten or twenty years off, it can be challenging to instill a sense of urgency among internal teams. For instance, companies have until 2035 to reach net-zero carbon emissions. Even the most visionary leaders, particularly those in public companies, may find it difficult to steer their organizations toward a goal that is unlikely to be achieved once the current executives have left. As we have stated, supply-side changes are not quick to implement.

Because the green mirage modifies the risk-reward calculation, it also makes it difficult for businesses to establish priorities. Given that they require a great deal of both commercial creativity and creative destruction, many of the initiatives supported by the demand led innovation can be regarded as high risk. But the green mirage turns these initiatives from “high-risk, high-reward” investments into “high-risk, iffy-reward” investments because of the limits it imposes on commercial creativity⁴¹. The restriction encourages businesses to find and pursue more “low-risk, low-reward” projects by making the status quo or small adjustments appear like better options.

⁴⁰ Mittelstaedt, J. D., Kilbourne, W. E., & Mittelstaedt, R. A. (2015). *Sustainability as megatrend: Two schools of macromarketing thought*. *Journal of Macromarketing*, 35(2), 253–264. <https://doi.org/10.1177/0276146715562313>

⁴¹ Ablin Joanes Carneiro Alphonso, D. (2025). *The Green Mirage: The Sustainability Spectrum of Perception, Policy and Practice*. *Notion Press*.



Figure 2.2 (von der Gathen, A., Eckert, N. B., & Kastbjerg, C. (2024). The Demand Revolution: How consumers are redefining sustainability and transforming the future of business. *The MIT Press*).

Chronic underinvestment in sustainable solutions, revisions to go-to-market strategies, and organizational transformations have resulted from the persistence of a perception gap that obscures the business opportunities for sustainable solutions in many sectors. The Figure 2.2 illustrates the seven failure modes triggered by this underinvestment. They embed the false assumptions that have kept businesses from seizing sustainable business opportunities, which are frequently the outcome of believing in the green mirage.

Consumers, who are ready and willing to react when the appropriate sustainable solutions become available, are directly impacted by these failure modes. They don't require scare tactics or lectures. They don't require a grand ESG purpose or fancy green packaging. They require large quantities of useful, reasonably priced, and less wasteful products. They are looking to businesses to offer them solutions that will give them the assurance that they are changing things and helping to create a better future, if not for society, then at least for themselves. As long as businesses' perceptions of customers are not in line

with what customers themselves say, they will continue to reinforce and perpetuate these seven failure modes.

1.8 Supply side efforts

However, it should be recognised that efforts on the supply side are already having a significant impact on reducing the global carbon footprint.

An analysis by BloombergNEF⁴² states that efforts on the supply side to address environmental damage and climate change are also reaching turning points. For the first time, in 2022, the world invested as much money in replacing fossil fuels as it did in producing oil, gas and coal. In detail, the analysis highlighted that “global investment in the transition to clean energy reached \$1.1 trillion in 2022, roughly equal to the amount invested in fossil fuel production. Never before has spending on the transition to renewable energy, electric cars and new sources such as hydrogen exceeded \$1 trillion”. Despite this, even if they achieve a successful energy transition on the supply side, companies cannot lose sight of the demand side, and the financial community is already showing awareness of the need for this balance. ‘Much of our research and investment analysis looks at companies that still produce high emissions today, assessing whether they really have credible and positive transition plans,’ said Jan-Marc Fergs, global head of ESG and managed solutions at HSBC, ‘because this will give us insight into whether these companies can achieve their published or stated net zero targets, as well as their ability to meet customer expectations.’

⁴² BloombergNEF. (2023, January 26). *Global low-carbon energy technology investment surges past \$1 trillion for the first time* [Press release]. BloombergNEF. Retrieved September 1, 2025, from <https://about.bnef.com/insights/finance/global-low-carbon-energy-technology-investment-surges-past-1-trillion-for-the-first-time/>

CHAPTER 2 – *Demand-Led Innovation in the Financial System: Regulation, Climate Risk and Market Transformation*

2. Introduction

As we saw in the previous chapter, the ecological transition towards climate neutrality represents a systemic challenge for contemporary economies. In this process, finance and, in particular, the banking system play a crucial role, not only as intermediaries of capital but also as actors capable of guiding investments and corporate behaviour. In this context, the paradigm of “demand-led innovation” is a pivotal element in accelerating this intermediation process, as it allows these transformations to be interpreted as responses to external pressures. Market agents such as customers, investors and regulators, due to increasingly numerous and stringent regulatory constraints and guidelines, require innovative solutions that combine economic competitiveness and environmental sustainability.

Through demand-led innovation, banks are therefore able to keep pace with new market requirements, protecting themselves, or at least minimising the risks associated with climate change, such as physical risks and transition risks, which will be explored in more detail in the following sections.

A key element that will be explored in this chapter is therefore the role of banks, and more broadly of the financial system, not only as a pillar but as a bridge. A bridge between the old and new economic models, between the brown and green economies, between businesses and stakeholders, between the need for change and the tools to implement it.

2.1 Regulatory framework for sustainable finance

The ecological transition process is not something that banks have been able to tackle independently or on a voluntary basis. It has, instead, been accompanied and guided by a regulatory framework that, since the last decade, has progressively required financial intermediaries to integrate environmental, social and governance considerations into their business models⁴³. Sustainable finance regulation currently takes the form of a complex

⁴³ European Commission. (2018). *Action plan: Financing sustainable growth*. Brussels: European Commission.

mosaic of various legal instruments, including international agreements, European regulations, supervisory authority guidelines, accounting standards and reporting frameworks, which together have transformed the banking sector from a simple financial intermediary to a catalyst for ecological transition.

The initial turning point was the Paris Agreement, adopted on 12 December 2015 during the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21)⁴⁴. For the first time, the international community adopted a binding commitment to limit the increase in global average temperature to well below 2 °C above pre-industrial levels, with the aim of limiting the increase to 1.5 °C. Paragraph 1(c) of Article 2 introduces an innovative principle, establishing the need to “align financial flows with a pathway towards low greenhouse gas emissions and climate-resilient development”⁴⁵.

This forecast has led to a necessary redefinition of the role of the banking system, as credit institutions can no longer limit themselves to accounting for direct emissions, represented by Scope 1 and Scope 2, but must also consider indirect emissions, Scope 3, which include those generated by loan and investment portfolios⁴⁶. In this context, the banking sector has been compelled to adopt methodological tools such as the principles of the Task Force on Climate-related Financial Disclosure (TCFD)⁴⁷ and the Partnership for Carbon Accounting Financials (PCAF)⁴⁸, which have provided guidelines for measuring and communicating exposure to climate-related risks.

2.1.1 The European Action Plan and Taxonomy (2018–2020)

⁴⁴ United Nations Framework Convention on Climate Change [UNFCCC]. (2015). *Paris Agreement*. New York: United Nations.

⁴⁵ United Nations Framework Convention on Climate Change [UNFCCC]. (2015). *Paris Agreement*. Paris: United Nations. Retrieved from https://unfccc.int/sites/default/files/english_paris_agreement.pdf

⁴⁶ World Resources Institute, & World Business Council for Sustainable Development. (2015). *Greenhouse Gas Protocol: A corporate accounting and reporting standard*. Washington, DC.

⁴⁷ Task Force on Climate-related Financial Disclosures [TCFD]. (2017). *Final report: Recommendations of the Task Force on Climate-related Financial Disclosures*. Basel: Financial Stability Board.

⁴⁸ Partnership for Carbon Accounting Financials [PCAF]. (2020). *The global GHG accounting and reporting standard for the financial industry*. Amsterdam.

Following the Paris Agreement, in March 2018 the European Union launched the Action Plan on Financing Sustainable Growth, consisting of ten priority actions, including redirecting capital flows towards sustainable activities, integrating sustainability risks into the financial system, and promoting transparency and long-term vision⁴⁹.

The main regulatory outcome of this process was the adoption of Regulation (EU) 2020/852, known as the EU Taxonomy Regulation, which came into force in 2020 and operational from 2022⁵⁰.

The Taxonomy is a uniform classification system for economic activities considered to be environmentally sustainable. It is based on six environmental objectives, which include climate change mitigation and adaptation, sustainable use and protection of water and marine resources, transition to a circular economy, pollution prevention and control, and protection and restoration of biodiversity and ecosystems.

The main innovation introduced by the Taxonomy is the establishment of technical assessment criteria, defined through subsequent Delegated Acts, which make it possible to determine whether a specific activity contributes substantially to at least one of the environmental objectives without causing significant harm to the others, in accordance with the “do no significant harm” principle⁵¹.

For banks, this has resulted in the obligation to report the proportion of assets that comply with the Taxonomy using indicators such as the Green Asset Ratio (GAR)⁵² and the Banking Book Taxonomy Alignment Ratio (BTAR)⁵³.

⁴⁹ European Commission. (2018). *Action plan: Financing sustainable growth*. Brussels: European Commission.

⁵⁰ Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088, OJ L 198, 22.6.2020.

⁵¹ European Commission. (2021). *Commission Delegated Regulation (EU) 2021/2178 supplementing Regulation (EU) 2020/852 on the disclosure of information by undertakings*. Brussels: European Commission.

⁵² A financial metric known as the Green Asset Ratio (GAR) calculates the percentage of a bank's or financial institution's total assets that are allocated to "green" initiatives in line with the EU Taxonomy, a framework for sustainable finance developed by the EU. By comparing an institution's exposure to sustainable assets to its total assets, the GAR, which is required in Europe, measures its dedication to environmental sustainability and its role in the green transition.

⁵³ A key performance indicator (KPI) called the Banking Book Taxonomy Alignment Ratio (BTAR) calculates the percentage of a bank's banking book assets that are in line with the EU Taxonomy, with an emphasis on exposures to businesses exempt from the Corporate Sustainability Reporting Directive (CSRD). With a larger client and activity base than the Green Asset Ratio (GAR), it offers a more comprehensive evaluation of how well a bank's credit portfolio aligns with sustainability objectives, like mitigating and adapting to climate change.

These tools have promoted greater transparency and comparability between institutions, but have also highlighted operational difficulties, in particular the lack of reliable data from customers, especially SMEs, and the technical complexity of eligibility and screening criteria.

2.1.2. The EBA's intervention and the integration of ESG risks

At the same time, the European Banking Authority (EBA) received three main mandates from the European legislator: to integrate ESG risks into the Supervisory Review and Evaluation Process (SREP), to develop disclosure standards under Pillar 3 of the Basel framework, and to assess possible differentiated prudential treatment for “green” or “brown” exposures⁵⁴.

In 2021, the EBA published draft Implementing Technical Standards (ITS) on ESG disclosure, which were approved in 2022, requiring credit institutions to publish data on exposures to carbon-intensive sectors, physical risks and transition risks, as well as progress towards climate alignment objectives⁵⁵. The GAR indicator has gained particular relevance, becoming the ‘green thermometer’ of European banks.

This intervention involved a significant overhaul of internal risk management systems, climate and ESG parameters, in fact, were incorporated into credit assessment models, lending processes and strategic planning. In addition, climate stress tests have been initiated, exercises aimed at assessing the resilience of bank balance sheets to adverse transition scenarios or extreme climatic events⁵⁶.

2.1.3. The Corporate Sustainability Reporting Directive (CSRD) (2022)

Another element of the regulatory framework is the Corporate Sustainability Reporting Directive (CSRD), adopted in December 2022 to replace the previous Non-Financial Reporting Directive (NFRD). The CSRD has significantly expanded the number of

⁵⁴ European Banking Authority. (2019). *EBA action plan on sustainable finance*. Paris: EBA.

⁵⁵ European Banking Authority. (2022). *Implementing Technical Standards (ITS) on Pillar 3 disclosures on ESG risks*. Paris: EBA.

⁵⁶ European Central Bank. (2022). *The 2022 climate stress test*. Frankfurt am Main: ECB.

companies subject to sustainability reporting requirements, including approximately 50,000 companies in the European Union, compared to approximately 11,700 under the NFRD⁵⁷.

The directive requires sustainability reports to be prepared in accordance with the European Sustainability Reporting Standards (ESRS) developed by EFRAG⁵⁸ and introduces the concept of double materiality: on the one hand, financial materiality, for instance ESG impacts that are significant for investors and for the economic performance of the company and on the other hand, impact materiality, that are the effects that the company has on the environment and society⁵⁹.

For banks, the CSRD has had a dual significance, as on the one hand it has made them subject to more stringent disclosure requirements and, on the other, the expansion of the range of companies involved has reduced information asymmetry, making more granular and reliable ESG data available on corporate clients.

2.1.4. IFRS Foundation e ISSB (2021–2023)

At the same time, in 2021, the IFRS Foundation established the International Sustainability Standards Board (ISSB) with the aim of creating a global set of sustainability accounting standards⁶⁰. The first two standards, IFRS S1 on general sustainability disclosures and IFRS S2 on climate-related risks and opportunities, were published in 2023⁶¹.

Unlike the CSRD, the IFRS takes a more focused approach to financial relevance, particularly factors that are important to investors and financial performance.

⁵⁷ Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting. OJ L 322, 16.12.2022.

⁵⁸ European Financial Reporting Advisory Group [EFRAG]. (2023). *European Sustainability Reporting Standards (ESRS): Final draft*. Brussels: EFRAG.

⁵⁹ Girella, L., Rossi, P., & Zambon, S. (2019). Exploring the boundary of financial reporting with non-financial information: The role of integrated reporting for communicating corporate sustainability. *Meditari Accountancy Research*, 27(4), 734–760. <https://doi.org/10.1108/MEDAR-06-2018-0367>

⁶⁰ IFRS Foundation. (2021). *IFRS Foundation announces International Sustainability Standards Board (ISSB)*. London: IFRS Foundation.

⁶¹ IFRS Foundation. (2023). *IFRS S1 General requirements for disclosure of sustainability-related financial information and IFRS S2 Climate-related disclosures*. London: IFRS Foundation.

Although they are not as binding as European standards, their adoption has promoted a process of international convergence, reducing the risk of regulatory fragmentation and allowing European banks to compete on equal terms with operators in other jurisdictions.

2.1.5. ESG as an operational paradigm

The development of regulations has helped to solidify the use of the acronym ESG as a crucial operational paradigm for the financial industry. While corporate social responsibility (CSR) was primarily based on voluntary efforts, the ESG approach incorporates verifiable and comparable metrics into the decision-making processes of financial institutions. For banks, this means not only implementing environmental and social policies, but also incorporating these aspects into governance, risk management systems, and business strategy definition.

2.1.6. The Net-Zero Banking Alliance (2021)

In addition to binding legislation, there are voluntary self-regulation initiatives. This is the origin of the Net-Zero Banking Alliance (NZBA), founded in 2021 under the auspices of the United Nations and currently comprising over 130 international banking institutions⁶². The above-mentioned banks are committing to aligning their portfolios with a path to climate neutrality by 2050, publishing interim targets for 2030 and 2040 and verifiable transition data.

Despite its voluntary nature, the NZBA has a significant impact because it obliges banks to set sectoral targets, engage their customers in decarbonisation efforts and make their climate strategies transparent. In this way, it complements the regulatory framework by exerting competitive and reputational pressure on industry players.

2.1.7 Wrap up and considerations

In order to steer the banking sector towards climate neutrality, the initiative described above creates a multi-level regulatory framework with binding and voluntary

⁶² United Nations Environment Programme Finance Initiative [UNEP FI]. (2021). *Net-Zero Banking Alliance: Commitment statement*. Geneva: UNEP FI.

commitments. The ISSB has contributed to a higher level of international coordination, the ESG approach has transformed sustainability into management parameters; the Taxonomy and delegated acts have introduced technical classification criteria, the EBA has made these criteria operational through prudential supervision and disclosure standards, the CSRD has expanded corporate transparency feeding data into the banking system, and finally, the NZBA has strengthened the scrutiny of banks beyond regulatory boundaries.

Ultimately, the story that emerges is one of a banking sector increasingly known for its ability to reconcile the past and the future, the old and new economies, climate risks and opportunities for sustainable innovation.

2.2 Climate risks for the banking system: threats and opportunities

The evolution of the regulatory framework described in the previous section was motivated by the need to address the growing risk of climate change in order to maintain financial stability. The banking sector, which has historically focused on credit, liquidity and market risk, is now known to have incorporated a new category of risk into its assessment models: climate-related financial risks. These risks fall mainly into two broad categories and include physical and transitional risks, which interact with traditional risks to produce complex systemic effects⁶³.

2.2.1. Physical risks

The direct effects of climate change on economic and financial activities have led to physical risks. These can take two main forms that are acute and chronic risks⁶⁴.

The first are linked to the occurrence of extreme events such as floods, fires, hurricanes, heat waves and can compromise the ability of businesses to continue operating, reduce the value of collateral held by the state and lead to biodiversity loss.

⁶³ Network for Greening the Financial System [NGFS]. (2020). *Guide for supervisors: Integrating climate-related and environmental risks into prudential supervision*. Paris: NGFS.

⁶⁴ Intergovernmental Panel on Climate Change [IPCC]. (2022). *Climate change 2022: Impacts, adaptation and vulnerability*. Cambridge: Cambridge University Press.

The other typology of physical risks are the chronic ones, linked to long-term structural changes such as sea level rise, desertification and loss of biodiversity, which mainly influence the agricultural production, water availability and the accessibility of geographical areas.

According to banks, these risks entail a decline in credit quality, as clients' assets have reduced their borrowing capacity and compete with falling property values, like real estate, real assets and infrastructure, in vulnerable areas⁶⁵.

2.2.2. Transition risks

In addition to physical risks, banks also take on transitional risks, such as those arising from the transition to a low-carbon economy⁶⁶. These could manifest themselves through a different number of channels:

- regulatory risks associated with the introduction of new environmental regulations, such as carbon taxes, emissions trading schemes and energy efficiency standards, which could increase operating costs for carbon-intensive businesses⁶⁷.
- technological risks arising from the rapid spread of innovations that render existing technologies obsolete, like the shift from internal combustion engines to electric vehicles⁶⁸.
- Reputational risks, linked to increased scrutiny by investors and consumers, which companies may abandon despite not being in line with climate policies⁶⁹.

⁶⁵ European Central Bank. (2021). *Climate-related risk and financial stability*. Frankfurt am Main: ECB.

⁶⁶ Task Force on Climate-related Financial Disclosures [TCFD]. (2017). *Final report: Recommendations of the Task Force on Climate-related Financial Disclosures*. Basel: Financial Stability Board.

⁶⁷ Organisation for Economic Co-operation and Development [OECD]. (2021). *Carbon pricing in times of COVID-19: What has changed in G20 economies?* Paris: OECD Publishing.

⁶⁸ International Energy Agency [IEA]. (2020). *Energy technology perspectives 2020*. Paris: IEA.

⁶⁹ Sullivan, R., & Mackenzie, C. (2020). *Responsible investment banking: Risk management framework and case studies*. London: Routledge.

- Market risks, arising from the valuation of “brown” assets and the potential for creating stranded assets, both financial and physical, which give value to the causes of decarbonisation policies⁷⁰.

Due to their exposure to “hard-to-decarbonise” sectors (fossil fuels, cement and heavy transport), banks are particularly vulnerable to these risks and may face financing difficulties or the need for significant restructuring⁷¹.

2.2.3. The response of banks: governance and compliance

In light of these new developments, the banking sector has gradually integrated climate risk into its governance architecture and compliance procedures. Guidance from regulators, notably the EBA⁷² and the European Central Bank⁷³, has tasked banks with developing a three-tiered structural approach:

- Board and senior management: the board is responsible for overseeing climate change strategies, implementing aircraft emissions reduction targets and monitoring progress on transition projects.
- Risk management: physical and transition risks are integrated into credit approval processes, stress test models and long-term forecasting scenarios⁷⁴. ESG indicators are a component of the due diligence process and risk pricing.
- Compliance and reporting: banks have internal structures in place for collecting and validating ESG data in order to meet the requirements of Pillar 3, CSRD and taxonomy. In order to strengthen stakeholder confidence, transparency becomes not only a regulatory requirement, but also a reputational one⁷⁵.

⁷⁰ Caldecott, B. (2018). *Stranded assets and the environment: Risk, resilience and opportunity*. Abingdon: Routledge.

⁷¹ Network for Greening the Financial System [NGFS]. (2021). *Scenarios for central banks and supervisors*. Paris: NGFS.

⁷² European Banking Authority. (2021). *On management and supervision of ESG risks for credit institutions and investment firms*. Paris: EBA.

⁷³ European Central Bank. (2020). *Guide on climate-related and environmental risks: Supervisory expectations relating to risk management and disclosure*. Frankfurt am Main: ECB.

⁷⁴ European Central Bank. (2022). *The 2022 climate stress test*. Frankfurt am Main: ECB.

⁷⁵ European Banking Authority. (2022). *Implementing Technical Standards on Pillar 3 disclosures on ESG risks*. Paris: EBA.

2.2.4. From risks to opportunities: competitive advantage

Although climate risks are a source of vulnerability, they can also act as a catalyst for innovation and competition for banks that appear to be anticipating the transition.

Firstly, integrating ESG risk improves institutional resilience, incorporating climate scenarios into portfolio models, infact, helps prevent unexpected shocks and reduces the likelihood of failure⁷⁶. Secondly, banks can benefit from diversifying their offering by developing green financial products (green bonds, sustainability-linked loans, transition finance) and responding to the growing market demand and strengthening their competitive position⁷⁷.

In summary, the ability to assess and manage climate risks strengthens the credibility of institutions, improves their access to international capital and reduces the cost of fundraising⁷⁸. In this way, financial and transitional risk management is not only a regulatory requirement, but also a real strategic advantage capable of transforming sustainability into an engine for growth.

2.3 From climate risk management to counterparty selection

Analysis of physical and transitional risks has shown that climate change doesn't always directly influence banks' capital stability, but inevitably affects the quality of their relationships with counterparties. In other words, climate risks are not limited to the banking institution and are transferred to relationships with creditors⁷⁹. An organisation that is unable to adapt to new environmental, regulatory or technological conditions poses a risk to the bank, and its decline can lead to creditor rejection, collateral valuation or, in the most serious cases, irrecoverable exposures.

⁷⁶ Network for Greening the Financial System [NGFS]. (2021). *Scenarios for central banks and supervisors*. Paris: NGFS.

⁷⁷ International Capital Market Association [ICMA]. (2021). *Green Bond Principles, Social Bond Principles, Sustainability Bond Guidelines*. Zurich: ICMA.

⁷⁸ Organisation for Economic Co-operation and Development [OECD]. (2020). *OECD business and finance outlook 2020: Sustainable and resilient finance*. Paris: OECD Publishing.

⁷⁹ Bank for International Settlements [BIS]. (2021). *Climate-related risk drivers and their transmission channels*. Basel: BIS.

2.3.1. Climate risk as counterparty risk

Due to the growing interdependence between climate factors and financial stability, climate change risk also becomes a conflict risk. The ability of businesses and households to withstand financial shocks, such as fires or floods, can be directly compromised, especially if insured assets are located in a vulnerable area⁸⁰. Conversely, transition risks associated with new regulations, carbon taxation, technological advances or changes in consumer demand can render business models obsolete and reduce the solvency of debtors⁸¹.

Therefore, banks are no longer limited to using traditional financial indicators such as operating margins, liquidity and debt/capital ratios, but must include ESG parameters in their rating models that enable them to assess the resilience of the parties involved in the decarbonisation process⁸².

2.3.2. Climate due diligence

This new approach is rooted in a type of climate-based due diligence that expands and complements traditional credit analysis. Banks are tasked with collecting and evaluating data such as:

- the ESG performance of companies, required by the CSRD for a growing number of companies⁸³.
- greenhouse gas emissions (Scope 1, 2 and, if possible, 3)⁸⁴.
- the share of assets in line with the EU taxonomy.

⁸⁰ Intergovernmental Panel on Climate Change [IPCC]. (2022). *Climate change 2022: Impacts, adaptation and vulnerability*. Cambridge: Cambridge University Press.

⁸¹ European Commission. (2023). *Recommendation on facilitating finance for the transition to a sustainable economy (2023/1425)*. Brussels: European Commission.

⁸² Network for Greening the Financial System [NGFS]. (2020). *Guide for supervisors: Integrating climate-related and environmental risks into prudential supervision*. Paris: NGFS.

⁸³ Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting. OJ L 322, 16.12.2022.

⁸⁴ World Resources Institute, & World Business Council for Sustainable Development. (2015). *Greenhouse Gas Protocol: A corporate accounting and reporting standard*. Washington, DC.

- The existence of credible transition plans, with verifiable interim targets and consistency with European and international climate objectives⁸⁵.

In this context, the bank does not simply finance the customer on the basis of a static snapshot of their economic situation, but assesses their potential for adaptation and their ability to remain competitive in future scenarios characterised by rapid regulatory and technological change.

2.3.3. Counterparty selection criteria

The counterparty selection process is a combination of inclusion, alignment and transition criteria. Firstly there is the “Exclusion criteria” where some institutions have policies that prohibit financing activities incompatible with the transition, such as the construction of new carbon-based plants or the financing of projects linked to deforestation⁸⁶.

Secondly, there is the “Alignment criteria” where preference is given to companies that demonstrate alignment with the European Taxonomy, have certified climate targets, for example through the Science Based Targets initiative, and operate in sectors that contribute significantly and positively to environmental objectives⁸⁷.

And finally there is the “Transition criteria” where banks can still continue to finance companies in ‘brown’ sectors, but they make credit conditional on the presentation of clear and monitorable conversion plans. In these cases, contractual instruments such as sustainability-linked loans allow financing conditions to be linked to the achievement of specific ESG objectives⁸⁸.

⁸⁵ European Commission. (2023). *Recommendation on facilitating finance for the transition to a sustainable economy (2023/1425)*. Brussels: European Commission.

⁸⁶ United Nations Environment Programme Finance Initiative [UNEP FI]. (2019). *Principles for Responsible Banking*. Geneva: UNEP FI.

⁸⁷ European Commission. (2021). *Commission Delegated Regulation (EU) 2021/2178 supplementing Regulation (EU) 2020/852 on the disclosure of information by undertakings*. Brussels: European Commission.

⁸⁸ International Capital Market Association [ICMA]. (2021). *Sustainability-linked bond principles*. Zurich: ICMA.

In this way, the selection of counterparties is not a binary process, inclusion or exclusion, but a continuum in which the bank becomes a partner in the transition, accompanying customers on a path of progressive improvement.

2.3.4. Implications for business customers

At this point, businesses are able to respond to these new banking requirements. In particular, small and medium-sized enterprises, which historically were not as interested in ESG performance, have been forced to invest in environmental monitoring tools, specialised governance and decarbonisation plans⁸⁹. Since the ability to access finance can compromise the ability to innovate and remain competitive, adaptation does not eliminate the requirement to obtain credit, but rather creates a condition for competitive survival⁹⁰.

2.3.5. Strategic opportunities for banks

Finally, the growing focus on counterparties offers banks the opportunity to transform a regulatory constraint into strategic leverage. ESG selection makes it possible to:

- strengthen the resilience of the loan portfolio by reducing exposure to vulnerable sectors that are potentially subject to sudden devaluations⁹¹;
- expand the range of sustainable financial products (green bonds, sustainability-linked loans, transition finance instruments), tapping into the growing demand for green capital⁹²;

⁸⁹ Organisation for Economic Co-operation and Development [OECD]. (2020). *OECD business and finance outlook 2020: Sustainable and resilient finance*. Paris: OECD Publishing.

⁹⁰ Battiston, S., & Monasterolo, I. (2020). A climate risk assessment of sovereign bonds' portfolios. *Nature Climate Change*, 10(4), 364–372. <https://doi.org/10.1038/s41558-020-0722-3>

⁹¹ Network for Greening the Financial System [NGFS]. (2021). *Scenarios for central banks and supervisors*. Paris: NGFS.

⁹² International Capital Market Association [ICMA]. (2021). *Sustainability-linked bond principles*. Zurich: ICMA.

- consolidate their reputation as responsible institutions, improving access to international capital and investor confidence⁹³.

Ultimately, climate risks are not only a threat to the bank-business relationship, but also redefine that relationship, transforming it into a channel for spreading sustainability and an opportunity to strengthen the competitiveness of the entire economic system.

2.4 Demand-led innovation as a driver of transformation in the banking and financial system

This analysis has shown how the European regulatory framework has changed, how climate risks have emerged, and how relationships with stakeholders have led banks to drastically change their business models. However, it is not enough to observe how these transformations translate into tangible innovations⁹⁴. The key to understanding this lies in the paradigm of demand-driven innovation, which helps us understand how innovative financing for autonomous growth or internally needed products responds and is influenced by increasingly pressing external demand⁹⁵.

Multiple factors are driving demand. In addition to regulations such as the European Social Dialogue, the CSRD or the EBA guidelines, new disclosure and transparency rules have been imposed, requiring institutions to use primary metrics, indicators and measurement systems that are not purely “aesthetic”⁹⁶. Pressure also comes from customers who, while facing environmental and technological challenges, have increased the need of financial products that can support them in their conversion⁹⁷.

⁹³ Organisation for Economic Co-operation and Development [OECD]. (2021). *OECD guidelines for multinational enterprises: Responsible business conduct matters*. Paris: OECD Publishing.

⁹⁴ Mazzucato, M. (2018). *The entrepreneurial state: Debunking public vs. private sector myths*. London: Penguin.

⁹⁵ Edler, J., & Georghiou, L. (2007). Public procurement and innovation—Resurrecting the demand side. *Research Policy*, 36(7), 949–963. <https://doi.org/10.1016/j.respol.2007.03.003>

⁹⁶ European Financial Reporting Advisory Group [EFRAG]. (2023). *European Sustainability Reporting Standards (ESRS): Final draft*. Brussels: EFRAG.

⁹⁷ Organisation for Economic Co-operation and Development [OECD]. (2020). *OECD business and finance outlook 2020: Sustainable and resilient finance*. Paris: OECD Publishing.

In summary, institutional and retail investors play a crucial role in ensuring not only financial returns, but also a positive and sustainable impact on society and the environment⁹⁸. In this context of intense pressure, the bank is not only an entity that manages risk, but also an innovator that pushes the boundaries of a multifaceted domain, transforming itself into a catalyst for change.

The most obvious example of this dynamic is the emergence of a new generation of financially sustainable products that embody the logic of demand-driven innovation.

For this reason, green bonds play a pioneering role by imposing financial obligations on projects that have a positive environmental impact⁹⁹. This encourages the adoption of the EU standard for green bonds, which aims to ensure transparency and uniformity in its criteria¹⁰⁰. Unlike green bonds, sustainability-linked bonds do not require the completion of a specific project, but are based on the performance of the security as a result of the intermittent implementation of predetermined ESG objectives¹⁰¹, making sustainability a variable directly related to credit risk.

Similarly, creditors have introduced green loans and sustainability-linked loans, which adjust capital costs based on the borrower's environmental performance¹⁰². As a result, if an organisation reduces its emissions or improves its ESG indicators, it can benefit from more favourable terms.

Even more significant in the context of the transition is the development of transition finance, which responds to a specific market need, that of "hard-to-abate" industries, such as carbon-intensive ones, which cannot make an immediate leap towards sustainability but instead require gradual tools to enter transition pathways¹⁰³.

In this case, the bank not only selects participants, but actively supports their development by offering financial products that are part of a framework for monitoring and progress towards climate goals.

⁹⁸ Sullivan, R., & Mackenzie, C. (2020). *Responsible investment banking: Risk management framework and case studies*. London: Routledge.

⁹⁹ International Capital Market Association [ICMA]. (2021). *Green Bond Principles, Social Bond Principles, and Sustainability-Linked Bond Principles*. Zurich: ICMA.

¹⁰⁰ European Commission. (2021). *Proposal for a regulation on European green bonds*. Brussels: European Commission.

¹⁰¹ International Capital Market Association [ICMA]. (2021). *Green Bond Principles, Social Bond Principles, and Sustainability-Linked Bond Principles*. Zurich: ICMA.

¹⁰² Loan Market Association [LMA]. (2020). *Green Loan Principles*. London: LMA.

¹⁰³ Organisation for Economic Co-operation and Development [OECD]. (2021). *Transition finance: Investigating the state of play*. Paris: OECD Publishing.

Nevertheless, the retail sector is surprised by this demand-driven innovation. Green mortgages, based on age-appropriate conditions for energy-efficient buildings or refurbishment, have spread rapidly, aligning the goal of reducing emissions in the real estate sector with a higher level of credit security for banks¹⁰⁴, as more efficient properties maintain a lower market value.

Similarly, we are developing sustainable supply chain financing tools in which the financial conditions of a product supplier are linked to its ESG performance, encouraging virtuous behaviour that goes beyond the range of values¹⁰⁵.

These examples demonstrate how the bank is responding simultaneously to three main pressures that are, on the one hand, regulation, which requires measurement and reimbursement. On the other hand, corporate clients, who require tools to finance the transition, and last but not least, investors, who demand transparent and accessible products. In this context, demand-driven innovation is not a theoretical idea, but is reflected in products and services that are only available thanks to external pressures.

The fintech sector, which can be considered a prime example of demand-driven innovation, is helping to make this transformation even faster and more effective. Fintech companies are using digital technologies, artificial intelligence, blockchain and big data to tackle issues that traditional institutions are unable to handle. The demand for greater transparency has been met by distributed ledger-based platforms that have immutably guaranteed the destination of funds raised through green bonds. The problem of scarcity and fragmentation of ESG data is addressed by technological solutions that enable the collection, development and comparability of information from heterogeneous sources.

The need for speed and accessibility has led to the creation of digital marketplaces that directly connect investors and businesses seeking sustainable financing. Retail customers are also finding answers thanks to applications that allow them to direct their savings towards portfolios with a positive impact, monitoring the environmental and social effects of their investment choices in real time.

Fintech, therefore, is not only an innovative market segment, but a real sounding board for demand-led innovation as it arises in response to external needs for transparency,

¹⁰⁴ European Mortgage Federation. (2020). *Energy Efficient Mortgages Initiative: Final report*. Brussels: EMF.

¹⁰⁵ Global Reporting Initiative [GRI]. (2021). *Supply chain sustainability: A practical guide*. Amsterdam: GRI.

traceability and accountability, and helps to spread new practices in the traditional financial system. This is why it deserves to be analysed as a separate case study, as it shows how demand-driven innovation can reshape not only products and services, but also the business models and technological architectures of contemporary finance.

2.5 Fintech as a laboratory for demand-led innovation: three case studies

The evolution of the banking and financial system towards sustainability has not been driven by traditional institutions, but has instead found fertile ground in fintech companies, namely operators that combine technology and finance to develop innovative solutions. Fintech is a true independent laboratory of demand-driven innovation, because it develops precisely where external needs, economic, social and regulatory, are not adequately addressed by traditional channels¹⁰⁶. Using digital platforms, distributed ledger technology, big data and artificial intelligence, fintech is able to bridge the information gap, reduce transaction costs and ensure greater transparency and traceability, while meeting the needs of regulators, investors and consumers¹⁰⁷.

To fully understand the role of this sector, it is useful to analyse three case studies that show how the logic of demand-led innovation translates into concrete practices and tools and these respectively Greenomy, Lendosphere and Clim8 Invest.

2.5.1 Case study 1 – Greenomy: the answer to the regulatory question

The first example, Greenomy, illustrates the balancing act between regulatory authorities and technological innovation. This start-up was founded in Brussels in 2020 to respond to a specific need, namely to help banks and businesses comply with new European sustainability regulations, in particular the EU taxonomy and the CSRD¹⁰⁸. The Greenomy development platform automates the collection, classification and reporting of

¹⁰⁶ Arner, D. W., Barberis, J., & Buckley, R. P. (2020). The evolution of fintech: A new post-crisis paradigm? *Georgetown Journal of International Law*, 47(4), 1271–1319.

¹⁰⁷ Zetzsche, D. A., Buckley, R. P., Arner, D. W., & Barberis, J. N. (2020). Fintech for financial inclusion: A framework for digital financial transformation. *Journal of Banking Regulation*, 21(4), 333–348. <https://doi.org/10.1057/s41261-019-00148-1>

¹⁰⁸ Greenomy. (2023). *Company website*. Retrieved from <https://greenomy.io>

ESG data, enabling financial institutions to calculate metrics such as the Green Asset Ratio and generate reports that meet regulatory requirements¹⁰⁹.

Without the right tools, European lawmakers' requirements would have resulted in extremely high compliance costs and significant operational difficulties, particularly for medium-sized banks and companies without specialised internal resources. Greenomy therefore responds to an external demand for transparency and compliance by translating this regulatory requirement into technology¹¹⁰. It is not thanks to innovation “from within” the market, but rather a reaction to regulatory pressure that has led to a widespread need. In this regard, Greenomy demonstrates how the authority of legislators can stimulate the development of creative solutions that ultimately contribute to making the European financial system more effective and credible.

2.5.2 Case study 2 – Lendosphere: the answer to retail investor demand

A second example is provided by Lendosphere, a French crowdfunding platform specialising in financing innovative energy projects. In this case, external demand does not come from regulatory authorities, but rather from retail investors, citizens and savers who want to actively participate in the environmental transition¹¹¹. Lendosphere allows them to invest directly in local projects, such as solar panels or photovoltaic systems, obtaining a financial return and the satisfaction of participating first-hand in the fight against climate change.

This business model arose from the need to democratise sustainable finance, making it accessible to the community and individual investors, as well as large investment funds¹¹². The platform has two purposes: firstly, it channels private capital towards green projects; secondly, it facilitates the game of quotation and transition, promoting a

¹⁰⁹ European Banking Authority. (2021). *On the way to Green Asset Ratio (GAR) disclosure: EBA report on management and supervision of ESG risks*. Paris: EBA.

¹¹⁰ European Commission. (2021). *Commission Delegated Regulation (EU) 2021/2178 supplementing Regulation (EU) 2020/852 on the disclosure of information by undertakings*. Brussels: European Commission.

¹¹¹ Lendosphere. (2023). *About Lendosphere*. Retrieved from <https://www.lendosphere.com>

¹¹² Organisation for Economic Co-operation and Development [OECD]. (2020). *OECD business and finance outlook 2020: Sustainable and resilient finance*. Paris: OECD Publishing.

widespread sense of participation¹¹³. Lendosphere is therefore a clear example of innovation driven by demand and supported by civil society and without the growing abundance of simple, transparent and participatory financial instruments, this type of financing would not be able to develop.

2.5.3 Case study 3 – Clim8 Invest: the answer to the demand for transparency and accessibility

The third case study, Clim8 Invest, shows how fintech can respond to another type of need: transparency and accessibility for consumers. Founded in the UK in 2019, Clim8 is a sustainable investment platform that allows reinvestors to allocate their funds to constructive projects, monitoring the environmental and social effects of their projects in real time¹¹⁴.

The reasoning behind Clim8 is simple but revolutionary and it's grounded on the assumption that consumers are not satisfied with just a financial return and want to know for sure how their money will be invested and what specific contribution it will make to the climate change movement¹¹⁵.

The platform responds to this need by providing an intuitive interface, data analysis tools and periodic reports on the objectives achieved¹¹⁶. In this way, it converts transparency into added value, gaining the trust of users and expanding the pool of investors in sustainable finance. Here too, innovation stems from a social demand for clarity and accountability rather than from a concept internal to the traditional financial system.

2.5.4 Final take aways

The three cases examined, Greenomy, Lendosphere and Clim8, show how fintech can take different forms depending on the nature of the external demand. Greenomy was born

¹¹³ Schmidt, T. S. (2021). Financing the energy transition: Green bonds and beyond. *Nature Energy*, 6(1), 1–3. <https://doi.org/10.1038/s41560-020-00759-1>

¹¹⁴ Clim8. (2023). *About us*. Retrieved from <https://clim8invest.com>

¹¹⁵ Global Reporting Initiative [GRI]. (2021). *Supply chain sustainability: A practical guide*. Amsterdam: GRI.

¹¹⁶ Clim8. (2023). *About us*. Retrieved from <https://clim8invest.com>

out of regulatory pressure, Lendosphere out of citizens' desire to actively participate in the transition, and Clim8 out of the need for transparency and consumer consideration. One thing all these innovations have in common is that they are the result of external pressure and inputs¹¹⁷. This is the logic behind demand-driven innovation, whether social, regulatory or individual, to stimulate the supply of innovative solutions.

The lesson to be learned is that fintech is not only a complement to the traditional banking system, but also a laboratory where models capable of responding quickly to external stimuli are tested. When combined, these models tend to differentiate themselves even from the most traditional institutions, helping to profoundly transform the financial sector and align it more closely with global sustainability goals¹¹⁸.

2.6. Demand-led innovation and the decarbonisation of hard-to-abate industries: the case of cement

The environmental transition is particularly difficult for industrial sectors where it is hard to reduce emissions, such as those characterised by high carbon emissions and structural and technological challenges in reducing their emissions. This makes, for instance, the cement industry a key factor, responsible for around 7-8% of global CO₂ emissions due to high energy consumption in production processes and emissions from limestone calcination processes¹¹⁹. Therefore, decarbonisation of this sector is critical to achieving global climate goals, but it also offers costly technological solutions, long timeframes and strong financial incentives¹²⁰.

In this scenario, banks can play a crucial role, not only as providers of capital, but also as intermediaries capable of guiding and influencing industrial sectors using innovative tools. This is how the demand-driven innovation paradigm demonstrates all its advantages since innovation in the financial sector does not arise spontaneously, but rather as a result

¹¹⁷ Arner, D. W., Barberis, J., & Buckley, R. P. (2020). The evolution of fintech: A new post-crisis paradigm? *Georgetown Journal of International Law*, 47(4), 1271–1319.

¹¹⁸ Zetzsche, D. A., Buckley, R. P., Arner, D. W., & Barberis, J. N. (2020). Fintech for financial inclusion: A framework for digital financial transformation. *Journal of Banking Regulation*, 21(4), 333–348. <https://doi.org/10.1057/s41261-019-00148-1>

¹¹⁹ International Energy Agency [IEA]. (2020). *Tracking industry 2020: Cement*. Paris: IEA.

¹²⁰ International Energy Agency [IEA]. (2022). *Technology roadmap: Low-carbon transition in the cement sector*. Paris: IEA.

of pressure from regulators, investors and public opinion¹²¹, which has led to an increase in emissions reduction in areas that are more difficult to transform.

2.6.1 External pressure as a driver of change

Cement companies today face a range of external pressures such as European climate regulations, which through instruments such as the Emissions Trading System (ETS) have led to a gradual reduction in emissions¹²², growing interest from institutional investors, who demand transparency and credible transitions and social and political demands for sustainable solutions¹²³ for a sector that is perceived as particularly polluting¹²⁴.

These pressures, which form the basis of external dominance, directly target the banking system. Banks indeed, as part of the financial sector, must demonstrate not only that they are capable of managing the associated climate risks, but also that they actively support decarbonisation initiatives¹²⁵.

2.6.2 Selection of counterparties in the cement sector

As demonstrated in previous chapters, the risk of climate change also becomes a risk of conflict. In the case of the cement industry, banks have a responsibility to assess not only the financial stability of companies, but also, and perhaps more importantly, their ability to reverse the trend. This requires a more thorough climate due diligence process that

¹²¹ Mazzucato, M. (2018). *The entrepreneurial state: Debunking public vs. private sector myths*. London: Penguin.

¹²² Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading. OJ L 275, 25.10.2003.

¹²³ Principles for Responsible Investment [PRI]. (2020). *How investors can drive low-carbon transition in heavy industry sectors*. London: PRI.

¹²⁴ Intergovernmental Panel on Climate Change [IPCC]. (2022). *Climate change 2022: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (H.-O. Pörtner, D. C. Roberts, M. Tignor, E. S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, & B. Rama, Eds.). Cambridge, UK; New York, NY: Cambridge University Press. <https://doi.org/10.1017/9781009325844>

¹²⁵ Network for Greening the Financial System [NGFS]. (2021). *Scenarios for central banks and supervisors*. Paris: NGFS.

allows companies to present emission reduction plans in line with European targets for 2030 and 2050¹²⁶, investments in cutting-edge technologies, such as CO2 capture and storage, the use of alternative fuels and low-emission concrete, and circular economy strategies¹²⁷, as the use of recycled materials.

As a result, banks are selecting counterparties based on the credibility of their decarbonisation initiatives rather than solely on economic criteria. Those who do not demonstrate creditworthiness risk being denied credit or obtaining less favourable terms, while those with a transparent transactional history can benefit from more advantageous conditions¹²⁸.

2.6.3 Sustainable financial products for the cement industry

In this context, demand-driven innovation is demonstrated by the development of new financial instruments that can specifically help in the decarbonisation of cement.

Sustainability-linked loans are those in which interest repayments are linked to the cement company's achievement of specific emission reduction targets¹²⁹. This encourages virtuous behaviour because the customer benefits from better terms when they act responsibly.

Transition finance highlights instruments designed to support sectors that are difficult to decarbonise, such as cement, by financing incremental investments, for instance with the introduction of more efficient fuels, the use of alternative fuels or the implementation of pilot projects for carbon capture and storage, or CCS. In this case, the bank acts as a long-term partner, monitoring the progress of projects and adjusting financial conditions.

¹²⁶ European Commission. (2023). *Recommendation on facilitating finance for the transition to a sustainable economy (2023/1425)*. Brussels: European Commission.

¹²⁷ International Energy Agency [IEA]. (2022). *Technology roadmap: Low-carbon transition in the cement sector*. Paris: IEA.

¹²⁸ Organisation for Economic Co-operation and Development [OECD]. (2021). *Transition finance: Investigating the state of play*. Paris: OECD Publishing. <https://doi.org/10.1787/7c5d0e9c-en>

¹²⁹ Loan Market Association [LMA]. (2020). *Sustainability-linked loan principles*. London: LMA.

Then there are the sectoral green bonds issues requested by cement companies that exclusively finance innovative decarbonisation technologies. By obtaining certification based on the criteria of the Taxonomy¹³⁰, the bank acts as a co-locator and guarantees the environmental credibility of the projects.

Finally, the sustainable supply chain finance refers to solutions that reward the cement industry, from raw material suppliers to distributors, when it meets environmental standards¹³¹, encouraging the adoption of low-emission practices throughout the entire production cycle.

These instruments are not inventions of the banking system, but rather a response to external demands that are on the one hand, those of cement companies, which need financing to innovate their processes and on the other, those of regulators and investors, who guarantee transparency, accountability and measurable results¹³².

2.6.4 Opportunities for banks and the sector

The use of innovative financial instruments is not only a requirement for banks, but can also give them a competitive advantage. On one side, it eliminates the risk of exposing companies that are becoming obsolete or non-compliant with regulations and on the other, it allows them to position themselves as key players in the transition, identifying new market opportunities¹³³.

For the cement industry, the involvement of banks becomes a crucial component since decarbonisation requires large-scale investments that are difficult to sustain with internal resources alone. Through demand-driven innovation, banks are transforming themselves from mere financial institutions into strategic partners in the transition, driving and accelerating industrial conversion processes¹³⁴.

¹³⁰ Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088. *Official Journal of the European Union*, L 198, 13–43.

¹³¹ Global Reporting Initiative [GRI]. (2021). *Supply chain sustainability: A practical guide*. Amsterdam: GRI.

¹³² International Capital Market Association [ICMA]. (2021). *Sustainability-linked bond principles*. Zurich: ICMA.

¹³³ Principles for Responsible Investment [PRI]. (2020). *How investors can drive low-carbon transition in heavy industry sectors*. London: PRI.

¹³⁴ Battiston, S., & Monasterolo, I. (2020). A climate risk assessment of sovereign bonds' portfolios. *Nature Climate Change*, 10(4), 364–372.

2.6.5 The fintech perspective

Fintech can also play a complementary role in this regard. Digital platforms that collect and certify ESG data can help cement companies report on their progress, while blockchain-based tools can ensure the traceability of investments made in green projects¹³⁵. In addition, crowdfunding platforms dedicated to innovative projects in the cement sector have the capacity to mobilise widespread capital, encouraging experimentation with new technologies¹³⁶.

2.6.6 Conclusions

The decarbonisation of the cement industry, like that of other hard-to-abate sectors, cannot happen without the full cooperation of the banking system. Demand-driven innovation shows how external pressures, including social, regulatory and investor pressures, are pushing banks to develop new instruments that balance risk management with support for complex conversion pathways¹³⁷. In this context, banks act both as guarantors of financial stability and as architects of industrial transition, helping to make possible things that would be difficult to achieve without their intervention.

¹³⁵ Arner, D. W., Barberis, J., & Buckley, R. P. (2020). The evolution of fintech: A new post-crisis paradigm? *Georgetown Journal of International Law*, 47(4), 1271–1319.

¹³⁶ Zetsche, D. A., Buckley, R. P., Arner, D. W., & Barberis, J. N. (2020). Fintech for financial inclusion: A framework for digital financial transformation. *Journal of Banking Regulation*, 21(4), 333–348. <https://doi.org/10.1057/s41261-019-00148-1>

¹³⁷ Mazzucato, M. (2018). *The entrepreneurial state: Debunking public vs. private sector myths*. London: Penguin.

CHAPTER 3 - *Demand Signals, Bankability and Market Shaping in Foundation Industries*

3. Introduction to the Chapter

The last few chapters have demonstrated how the ecological transition goes beyond a mere technological and regulatory challenge to take on the contours of a process deeply influenced by the structure and orientation of demand¹³⁸. While the first chapter sought to show how demand, if correctly interpreted and stimulated, can become a powerful lever for innovation, and the second chapter investigated the role of the banking and financial system in managing climate risks and directing capital flows, there remains an analytical gap to be filled. To date, there is still insufficient understanding of how demand translates into variables that are relevant to financial decisions¹³⁹. This chapter fills precisely this grey area, aiming to demonstrate how demand, when manifested in a structured, credible and verifiable signal, becomes a financially relevant factor capable of changing the perception of risk, the bankability of projects and, ultimately, access to capital¹⁴⁰. Through an in-depth conceptual analysis, this chapter has constructed an interpretative framework that associates demand signals with credit assessment processes, with a particular focus on foundation industries, sectors that are key to the economy on the one hand, but structurally fragile in terms of the transition to climate neutrality on the other. In this sense, this chapter serves as a theoretical and analytical bridge, laying the groundwork for the subsequent discussion on innovative financial instruments capable of activating demand as a lever for de-risking and market shaping.

3.1 The concept of demand signal: definition and typologies

The concept of demand signals plays a crucial role in understanding the ability of demand to profoundly influence innovation processes and, more recently, to guide investment decisions. A demand signal can be defined as persistent, observable and reliable information that clearly indicates the existence of current or imminent demand for goods,

¹³⁸ Mazzucato, M. (2018). *The Entrepreneurial State*. Penguin.

¹³⁹ Edler, J., & Georghiou, L. (2007). Public procurement and innovation—Resurrecting the demand side. *Research Policy*, 36(7), 949–963.

¹⁴⁰ OECD (2011). *Demand-side Innovation Policies*. OECD Publishing.

services or technologies¹⁴¹. However, this should not be confused with latent consumer preferences or a simple intention to buy. Demand signals affect the expectations of economic operators and directly influence individual investment choices. The existing literature on DLI also emphasises that not all types of demand are equally effective. There is therefore an important distinction between weak demand signals and strong demand signals. The former include market surveys, sustainability statements, awareness campaigns or emerging trends in consumer behaviour¹⁴². Although useful for guiding long-term strategies, these signals are often insufficient to support capital-intensive investments, as they do not significantly reduce economic uncertainty. Strong demand signals, on the other hand, are characterised by a high degree of bindingness and predictability. This second category includes legal obligations, binding technical requirements and standards, long-term purchase contracts, formalised contractual procurement commitments and alliances between large buyers. These instruments make it possible to convert demand from a random variable into a structural market factor, making it a point of reference not only for businesses but for the financial system as a whole¹⁴³. In the more specific context of the ecological transition, four categories of demand signals can be distinguished. The first consists of regulatory signals. Among these, some of the most well-known examples and applications are mechanisms such as the Emissions Trading System, the Carbon Border Adjustment Mechanism, vehicle emission standards and minimum sustainability requirements for building materials, which do not impose individual technologies but influence the market by gradually making high-carbon solutions less competitive¹⁴⁴. In this way, regulation creates an indirect but systemic demand for low-carbon products and processes. The second category is represented by public procurement and innovation-oriented procurement. Green public procurement is one of the most powerful tools for demand-led innovation, as it is the vehicle through which policy objectives are transformed into operational contracts¹⁴⁵. It makes the demonstration and technological scale-up phase less stressful

¹⁴¹ von Hippel, E. (1986). Lead Users. *Management Science*, 32(7), 791–805.

¹⁴² CISL (2023). The role of demand-led innovation in supporting decarbonisation in foundation industries.

¹⁴³ European Commission (2018). Public Procurement for Innovation Guidance.

¹⁴⁴ European Union (2023). Carbon Border Adjustment Mechanism (CBAM) Regulation.

¹⁴⁵ European Commission (2018). Public Procurement for Innovation Guidance.

and risky for businesses, and as far as the financial system is concerned, the existence of a reliable public purchaser contributes significantly to the credibility of future revenues. Another category consists of private demand signals, such as buyer alliances, voluntary commitments by large corporations and long-term purchase agreements. Initiatives such as SteelZero and ConcreteZero demonstrate the impact that such signals can have in the field of coordination, especially in sectors such as basic industries, where a few large buyers can exert a decisive influence on the entire value chain. This category plays a very important role, as it manifests itself regardless of direct regulatory constraints, but is still capable of creating a market for low-carbon solutions¹⁴⁶. The fourth and final category comprises private standards and certifications. Although often considered soft governance tools, these mechanisms play an important role in making demand observable and verifiable, reducing information asymmetries between producers, financiers and end users¹⁴⁷. In a context characterised by increasing regulatory and technological complexity, the standardisation of demand is a fundamental prerequisite for its translation into financial variables.

3.2 Demand and risk: the banks' perspective

To understand the role that demand signals play in the banking system, it is necessary to consider how banks assess the risk of industrial projects. The assessment of loan demand is traditionally based on a combination of quantitative and qualitative indicators, such as the soundness of the business model, the predictability of cash flows, the cost structure and the borrower's ability to meet its financial commitments¹⁴⁸. In decarbonisation projects, particularly in foundation industries, meeting this criterion is often problematic. Low-carbon technologies usually require high initial investments, are often characterised by a degree of uncertainty linked to technological maturity, and usually operate in market areas that are not yet fully defined and developed. In the absence of credible demand signals, banks tend to perceive such projects as experimental or excessively risky, and therefore apply high risk premiums or restrict access to credit. From a banking

¹⁴⁶ SteelZero (2022). Buyer alliances for low-carbon steel.

¹⁴⁷ ISO (2021). Environmental labels and declarations – Principles.

¹⁴⁸ Brealey, R., Myers, S., & Allen, F. (2020). Principles of Corporate Finance. McGraw-Hill.

perspective, risk is not a monolithic concept, but is divided into several interconnected dimensions. Demand signals primarily affect market risk, reducing uncertainty related to the market's ability to absorb low-carbon products. Regulatory obligations, purchase agreements or procurement commitments make demand more predictable, improving the visibility of future revenues. Secondly, demand signals affect transition risk. Projects aligned with emerging standards and credible regulatory trajectories are less exposed to the risk of regulatory or technological obsolescence. For banks, this means a lower probability that the investment will lose value due to sudden changes in the regulatory environment. Finally, structured demand affects credit risk, strengthening cash flow stability and, consequently, the debtor's repayment capacity. In this sense, demand signals act as an indirect form of guarantee, improving the overall risk profile of the project without necessarily resorting to traditional hedging instruments¹⁴⁹. However, to understand why demand signals are actually relevant to the banking system, it is necessary to analyse the process through which banks assess the risk of industrial projects. Traditionally, the bankability of an investment depends on the predictability of cash flows, the soundness of the business model and the debtor's ability to meet its financial obligations over time¹⁵⁰. In the specific case of decarbonisation projects in foundation industries, as previously mentioned, these criteria are particularly critical¹⁵¹. Demand signals come into play precisely at this point, changing the perception of risk along various dimensions. They therefore contribute synergistically to reducing market risk by making future demand for decarbonised products more predictable, and transition risk by signalling that the project is consistent with regulatory trajectories and evolving market standards. Finally, they affect credit risk by improving revenue stability and thus the debtor's repayment capacity¹⁵².

3.3 Demand signals and bankability: a causal link

¹⁴⁹ BIS (2021). Climate-related risk drivers and transmission channels.

¹⁵⁰ Brealey, R., Myers, S., & Allen, F. (2020). Principles of Corporate Finance. McGraw-Hill.

¹⁵¹ NGFS (2021). Scenarios for Central Banks and Supervisors.

¹⁵² BIS (2021). Climate-related risk drivers and transmission channels.

The relationship between demand signals and bankability is one of the key issues that needs to be addressed in order to understand how demand can have a real impact on capital allocation in the ecological transition. First of all, we need to define the concept of bankability itself, as well as the actual ability of a project to meet the requirements necessary to obtain financing on terms that are sustainable in terms of both cost of capital and debt duration and structure. It therefore depends not only on the technical soundness of the project, but also on the possibility of forecasting cash flows and, of course, on the reduction of the main sources of risk. In the case of decarbonisation projects, particularly in foundation industries, the lack of certain demand is one of the main barriers to access to credit. Banks tend to favour investments characterised by mature markets and stable demand, while they are more cautious about emerging technologies or products for which there is not yet an established market. In this context, demand signals act as a bridge connecting the demand sphere to the financial sphere¹⁵³. From a causal point of view, the presence of credible demand signals allows banks to incorporate additional information into their assessment models. Long-term purchase contracts, public or private procurement commitments and clear regulatory standards help to make future revenues more predictable, reducing the uncertainty associated with the commercialisation phase. This effect translates into an improvement in the project's risk profile and, consequently, greater availability of financing¹⁵⁴. A useful parallel can be drawn with the renewable energy sector, where the spread of long-term contracts and demand support mechanisms has historically facilitated access to bank credit. Similarly, in foundation industries, demand signals can perform an almost “offtake” function, providing an implicit guarantee of future demand without resorting to direct price support schemes¹⁵⁵. It is important to emphasise, however, that this causal link does not imply the elimination of risk, but certainly its reallocation and reduction. Demand signals do not replace the need for sound technical design or efficient management, but they do amplify financial credibility, making it possible to mobilise private capital on a larger scale.

¹⁵³ ICMA (2021). Sustainability-Linked Bond Principles.

¹⁵⁴ IEA (2022). Corporate PPAs and market formation in renewables.

¹⁵⁵ IRENA (2022). Corporate sourcing of renewable energy.

3.4 The specific role of foundation industries

Foundation industries occupy a strategic but vulnerable position within ecological transition processes. Sectors such as steel, cement, glass, basic chemicals and paper form the backbone of industrial value chains, providing essential inputs for numerous downstream sectors. However, they are also among the largest contributors to greenhouse gas emissions and have structural characteristics that make decarbonisation particularly complex. However, they are also among the largest contributors to greenhouse gas emissions and have structural characteristics that make decarbonisation particularly complex. A first relevant characteristic is their high capital intensity. Production facilities in foundation industries require very high initial investments and have a long useful life, often exceeding thirty years. This creates a high risk of technological lock-in, as investment decisions made today will influence emissions and competitiveness for decades to come¹⁵⁶. In the absence of clear and stable demand signals, companies tend to postpone or scale back investments in low-carbon technologies. A second factor concerns reduced operating margins and significant exposure to international competition¹⁵⁷. Foundation industries often operate in highly competitive global markets, where small cost increases can translate into significant losses in market share. This makes it particularly risky to invest in solutions with higher unit costs, unless they are accompanied by sufficient demand to absorb them. In this context, demand signals play a crucial role in reducing uncertainty and making decarbonisation investments economically sustainable. Strong demand signals, such as minimum low-carbon content standards or purchase commitments by large buyers, allow companies to internalise market expectations and plan investments consistent with long-term time horizons. Another important aspect concerns the structure of the productive fabric. In foundation industries, a significant proportion of companies are small and medium-sized enterprises, which often have limited financial resources and managerial capacity. For these companies, access to credit is essential for innovation¹⁵⁸. The presence of credible demand signals can therefore make the difference between the possibility of taking on a transition path and the exclusion from future markets. From the banks' point of view,

¹⁵⁶ OECD (2020). Business and Finance Outlook: Sustainable and Resilient Finance.

¹⁵⁷ IEA (2023). Emissions from Industry and pathways to net zero.

¹⁵⁸ EIB (2021). Access to finance for SMEs in energy-intensive industries.

financing projects in foundation industries without adequate demand signals entails high exposure to market and transition risk. Conversely, the presence of structured demand makes it possible to improve risk assessment and develop more targeted financial instruments capable of accompanying companies along credible decarbonisation trajectories. In summary, in foundation industries, demand is not just a market variable, but an enabling condition for industrial and financial transformation. The ability to generate and interpret demand signals therefore becomes a central element in overcoming the apparent trade-off between competitiveness and sustainability, paving the way for development models compatible with long-term climate goals. In this context, demand signals can take on the value of a strategic asset in all respects, as they make it possible to overcome the so-called supply-demand catch-22, according to which without demand it is not possible to invest, but at the same time without investment supply cannot develop. From a financial point of view, this translates into the fundamental assumption that the creation of demand is a precondition for the mobilisation of private capital.

3.5 The Demand–Risk–Bankability Transmission Framework: a policy market shaping perspective

In light of the analysis developed in the previous sections, there is a clear need for an interpretative framework capable of systematising the role of demand signals as market shaping tools and clarifying the mechanism through which they affect the bankability of industrial projects. The Demand–Risk–Bankability Transmission Framework proposed in this section responds to this need, offering an integrated interpretation that connects demand policies, financial risk management and private capital mobilisation. The framework is based on the idea that demand, when activated through policy instruments and market coordination, does not merely react to existing supply, but helps to shape the structural conditions of the market. In this sense, demand signals represent the main transmission channel through which public objectives, such as decarbonisation and industrial competitiveness, are incorporated into the decision-making processes of companies and financial intermediaries¹⁵⁹. The first level of the framework consists of

¹⁵⁹ Mazzucato, M., & Ryan-Collins, J. (2019). Putting value creation back into finance. UCL IIPP.

structured demand, generated through public policies and demand coordination initiatives. Climate regulations, technical standards, innovation-oriented public procurement and alliances between large purchasers contribute to making demand observable, credible and persistent. At this stage, the role of the state and collective actors is not to replace the market, but to reduce uncertainty and guide expectations, creating a space conducive to innovation. The second level concerns the transmission of the signal to the financial sphere. Once demand signals have been made visible and verifiable, they are incorporated into the risk assessment models of banks and investors. At this stage, demand acts as a de-risking factor, reducing market risk, transition risk and, indirectly, credit risk. The financial market therefore does not respond to isolated incentives, but to a coherent policy context that signals the long-term direction of industrial development. The third level of the framework is represented by the bankability of projects. Reducing perceived risk improves access to credit, reduces the cost of capital and extends financing horizons. At this stage, finance no longer acts as a simple selective filter, but as an enabler of industrial transformation. Decarbonisation projects, particularly in foundation industries, become financeable not because they are risk-free, but because they are part of a demand ecosystem that supports their economic sustainability. From a policy market shaping perspective, the Demand–Risk–Bankability Transmission Framework highlights how the creation of markets for low-carbon solutions cannot be entrusted exclusively to supply-side interventions or pricing mechanisms. On the contrary, it is the combination of demand-side instruments, stakeholder coordination and integration into financial processes that determines the ability to scale up innovations and attract private capital. In this context, banks take on an intermediate but strategic role. By integrating demand signals into their risk management practices, they become key players in market shaping, helping to translate policy priorities into capital allocation decisions. This approach allows us to overcome the traditional dichotomy between public intervention and the market, showing how finance can act as a transmission channel between collective objectives and competitive dynamics¹⁶⁰. The proposed framework therefore constitutes a conceptual bridge between the literature on demand-led innovation, the debate on the role

¹⁶⁰ UNEP FI (2021). Net-Zero Banking Alliance Guidelines.

of the entrepreneurial state, and the emerging practices of green finance. It paves the way for the analysis of innovative financial instruments capable of activating demand as a lever for systemic transformation, which will be discussed in the following chapters. The integration of demand signals into credit assessment processes requires an evolution of the analytical tools used by banks. In addition to traditional financial indicators, it becomes necessary to consider qualitative and forward-looking variables, such as the consistency of the project with regulatory trajectories, the presence of verifiable demand commitments and the ability of the company to adapt to emerging standards. This evolution is consistent with the forward-looking approach promoted by prudential regulation on climate risks and paves the way for a more dynamic assessment of the bankability of industrial projects.

3.6 Conclusion

This chapter has shown how demand signals are a key element in the link between demand-led innovation and green finance. By making demand observable, credible and financially relevant, they reduce perceived risk and facilitate access to credit for decarbonisation projects in foundation industries. In the following chapters, this analysis will be further developed, exploring how green finance can evolve from a simple capital allocation tool to a true market shaping mechanism¹⁶¹, leading to the proposal of innovative financial instruments capable of activating demand as a lever for systemic transformation.

¹⁶¹ NGFS (2022). Transition plans and forward-looking supervision.

CHAPTER 4 – Demand-led innovation in foundation industries: structural barriers, market creation and policy implications

4.1 Foundation industries as a critical hub for ecological transition

As already discussed at length in Chapter 3, the ecological transition in production systems does not depend solely on the availability of low-carbon technologies, but on the coordinated interaction between demand structure, market configuration and investment feasibility conditions. In light of these assumptions, this chapter focuses on foundation industries, such as steel, cement, basic chemicals, glass and paper, as sectors that are critical to the overall success of industrial decarbonisation strategies¹⁶². Foundation industries play a systemic role in advanced economies, providing essential inputs to a variety of downstream sectors, including construction, infrastructure, automotive and manufacturing. The availability of low-emission materials and intermediate products is undoubtedly a necessary condition for the decarbonisation of downstream supply chains. It follows that, in the absence of a radical transformation of upstream sectors, efforts to reduce emissions in end sectors are also likely to remain partial or ineffective¹⁶³. If this has not yet happened, it is because, unlike other sectors characterised by greater technological flexibility, foundation industries are characterised by capital-intensive plants, long asset life cycles and production processes that are difficult to reconfigure in the short term. As we have said, these characteristics amplify the risk of technological lock-in and make the transition particularly exposed and sensitive to circumstantial factors, including demand predictability, regulatory stability and the availability of support infrastructure. In this sense, these sectors represent an extremely ambitious test bed for assessing the ability of demand-led approaches to influence innovation trajectories characterised by strong structural rigidities¹⁶⁴.

¹⁶² International Energy Agency (IEA). (2023). Emissions from Industry and Pathways to Net Zero. Paris: IEA.

¹⁶³ IEA. (2020). Iron and Steel Technology Roadmap. Paris: IEA.

¹⁶⁴ IEA. (2018). Technology Roadmap: Low-Carbon Transition in the Cement Industry. Paris: IEA.

4.2 Structural barriers to decarbonisation in foundation industries

In order to effectively find ways to use effective tools to overcome the barriers that currently separate hard-to-abate industries from low-carbon innovation, it is important to identify these barriers. A first barrier concerns the high capital intensity of production facilities, as the investments required for potential technological transformation are often concentrated at specific moments in the life cycle of assets, making it economically burdensome to anticipate the decommissioning of infrastructure that is still operational¹⁶⁵. This therefore leads companies to favour incremental strategies that increase effectiveness and efficiency rather than transformative interventions. A second barrier is technological uncertainty. Many of the emerging solutions for the decarbonisation of industrial processes have not yet reached full commercial maturity. High costs and the absence of well-defined benchmarks make it difficult to evaluate these technologies in terms of expected economic returns (ROI), especially in market contexts characterised by significant competitive pressure. A further constraint stems from international competition and the risk of carbon leakage. In the absence of protection mechanisms, such as border adjustment instruments or common minimum standards, companies that invest in production processes with higher unit costs risk suffering competitive disadvantages compared to producers operating in jurisdictions with less stringent environmental standards. This factor contributes to reinforcing the stalemate and passive wait-and-see attitude of many industries in these sectors. Finally, the very structure of the productive fabric, often characterised by a significant presence of SMEs, accentuates the difficulties of accessing credit and absorbing innovation. Consequently, even when potentially effective technological solutions exist, the ability of companies to translate them into concrete investments depends largely on the predictability of future revenue streams and the perception of risk by financial intermediaries, which, as we have seen, is often a grey area¹⁶⁶.

¹⁶⁵ OECD. (2022). *Industry and the Low-Carbon Transition*. Paris: OECD Publishing.

¹⁶⁶ European Commission. (2020). *A New Industrial Strategy for Europe*. COM(2020) 102 final.

4.3 The supply–demand catch-22 in hard-to-abate sectors: application examples

Starting from the idea of the paradox between supply and demand analysed in Chapter 3, it is clear that this mechanism has a significant but also restrictive effect on basic industries. In sectors where reducing emissions is complex, obtaining low-impact semi-finished materials requires higher expenditure than standard methods, at least until a certain technological maturity is reached that can reduce initial costs. Without concrete signals from the market, such as an accepted premium price or stable and consistent orders, companies tend to postpone investments in innovative solutions. To move beyond generalisations and see what is happening in reality, let us consider the steel industry. Today, producing steel using green hydrogen costs much more than established processes, which is why customers such as those in the vehicle or infrastructure sectors may avoid this choice if there are no stringent regulations or visible economic advantages¹⁶⁷. So, for now, eco-friendly steel remains relegated to experimental trials or limited supplies. The situation is no better with cement, where alternatives with less clinker or based on CO₂ capture are struggling to take root. They are held back not only by complex regulations, but also by rigid technical parameters and opposition along the supply chain. In these areas, without stable demand, each individual piece costs too much. This fuels a cycle that is difficult to break, blocking the expansion of low-carbon options. It is possible to break out of this cycle, but it requires coordinated action from the beginning to the end of the production process. Tools that stimulate demand, together with agreements between buyers, mitigate the uncertainty typical of today's markets. Guaranteeing minimum quantities helps to move from testing to larger-scale production¹⁶⁸.

4.4 Technological pathways for decarbonisation in foundation industries

¹⁶⁷ European Commission. (2021). Fit for 55: Delivering the EU's 2030 Climate Target. COM(2021) 550 final.

¹⁶⁸ European Commission. (2023). Carbon Border Adjustment Mechanism (CBAM) Regulation.

Although the obstacles and barriers described above remain, we must not underestimate the fact that there are several options available, making the path to decarbonisation in these sectors particularly varied. In the steel sector, the main trajectories include the adoption of low-emission hydrogen-based processes for direct iron reduction (DRI) and the expansion of scrap-based electric arc furnaces. However, these solutions require a major reconfiguration of energy infrastructure and large-scale availability of renewable electricity and green hydrogen¹⁶⁹. In the cement sector, process emissions linked to the chemical decomposition of limestone require the adoption of carbon capture and storage technologies, as well as the development of alternative binders and the reduction of clinker content. In the basic chemicals sector, decarbonisation options include the electrification of processes, the use of green hydrogen as an energy carrier and the replacement of fossil feedstocks with bio-based or recycled raw materials. Here too, the transition requires systemic investments in infrastructure and logistics, reinforcing the need for coordination policies and stable demand signals.

4.5 Industrial clusters, shared infrastructure and territorial coordination

An important factor to consider, which could prove to be a winning ally when approaching the cost-benefit analysis of the ecological transition of hard-to-abate industries, is that of so-called “industrial clusters”. This term was coined in the 1990s by economist and distinguished academic Michael Porter in his book “The Competitive Advantage of Nations”¹⁷⁰, where he defines a cluster as 'a geographical concentration of interconnected companies, specialised suppliers, service providers and associated institutions, such as universities and trade associations, in a given sector. These groups are linked by commonalities and complementarities, which determine a competitive advantage and, consequently, greater productivity and innovation'¹⁷¹. The idea of the benefits of industrial agglomeration had already, in the past, begun to take shape in the ideal of economic and competitive strategy. Towards the end of the 1890s, in fact, the

¹⁶⁹ European Commission. EU Emissions Trading System (ETS) – official documentation.

¹⁷⁰ Porter, M. E. (1990). *The Competitive Advantage of Nations*. New York: Free Press.

¹⁷¹ Porter, M. E., “Clusters and the New Economics of Competition”, *Harvard Business Review*, vol. 76, n. 6, 1998, pp. 77–90.

British economist Alfred Marshall introduced the concept of “industrial districts” in his work “Principles of Economics”¹⁷² to describe certain positive externalities resulting from geographical proximity, such as spillovers of know-how and skilled labour, as well as knowledge and trust in local suppliers. It was Porter, however, who systematised this concept and made it central to debates on industrial policy¹⁷³.

It is precisely from this contemporary formulation that we can understand how this principle can be combined with the attempt to create decarbonisation pathways in basic industries that are not only environmentally sustainable, but also economically viable. Starting from the fundamental assumption that, in most national and European contexts, energy-intensive industrial activities are by nature already concentrated in clusters or industrial districts, it is essential to be able to grasp every potential advantage. Firstly, industrial clusters allow economies of scale to be exploited in the creation of shared infrastructure for hydrogen, CO₂ capture and transport, and the electrification of production processes. Furthermore, sharing infrastructure reduces the unit costs of the transition and improves the bankability of infrastructure projects, making private capital investment more attractive¹⁷⁴.

In this sense, the territorial approach helps to overcome some of the structural barriers that limit decarbonisation at the individual company level¹⁷⁵. From a demand policy perspective, clusters facilitate coordination between public and private actors along local and regional value chains. Territorial public procurement initiatives, supply agreements between companies located in the same district, and coordinated pilot projects can create market niches for low-carbon industrial products, acting as experimental laboratories and hubs for the creation of new business models and innovative financial instruments¹⁷⁶.

4.6 The Italian context: foundation industries, structural constraints and transition opportunities

¹⁷² Marshall, A. (1890). *Principles of Economics*. London: Macmillan.

¹⁷³ ANAC. (2023). Linee guida sul Green Public Procurement (GPP) in Italia.

¹⁷⁴ MASE. (2022). Criteri Ambientali Minimi (CAM) per l’edilizia.

¹⁷⁵ MIMIT. (2023). Politiche industriali per la transizione dei settori hard-to-abate.

¹⁷⁶ European Investment Bank (EIB). (2021). Access to Finance for SMEs in Energy-Intensive Industries.

In Italy, foundation industries, particularly steel, cement and basic chemicals, play a systemic role in manufacturing and infrastructure value chains. These sectors provide essential inputs to strategic sectors such as construction, transport infrastructure, mechanical engineering and automotive, which account for a significant share of national industrial value added¹⁷⁷. However, their decarbonisation trajectory is characterised by structural constraints similar to those observed in other European countries, namely high capital intensity, rigid production processes, exposure to international competition and a significant presence of SMEs along the supply chain¹⁷⁸.

In the steel sector, the debate on the conversion of Italian plants to lower-emission technologies emblematically highlights the trade-off between environmental sustainability, production continuity and economic sustainability. The available technological options, such as furnace electrification, hydrogen-powered DRI processes and greater use of scrap, involve significant infrastructure investments and a profound reconfiguration of energy supplies.

Similarly, in the cement sector, process emissions necessitate solutions such as reducing clinker content, adopting alternative binders and, in the medium term, implementing CO₂ capture technologies. Although technically promising, these pathways involve high costs and regulatory and market uncertainties¹⁷⁹.

In this context, the main limitation lies not only in technological availability, but also in the lack of structured demand for low-carbon industrial products. As discussed in Chapter 3, the absence of credible demand signals directly affects the bankability of decarbonisation projects. The Italian case shows that, in the absence of market creation mechanisms, transition initiatives tend to remain confined to pilot projects or localised experiments, with difficulties in terms of scalability¹⁸⁰.

4.6.1 Case study – Acciaierie d'Italia and the decarbonisation of steel in Italy

¹⁷⁷ NGFS. (2022). Transition Plans and Forward-Looking Supervision.

¹⁷⁸ BIS. (2021). Climate-related risk drivers and transmission channels.

¹⁷⁹ UNEP FI. (2021). Net-Zero Banking Alliance – Guidelines for Climate Target Setting.

¹⁸⁰ SteelZero Initiative. (2022). Buyer Alliances for Low-Carbon Steel.

The paradox of the decarbonisation process in hard-to-abate industries, with particular reference to the steel sector, is illustrated by the striking and topical example of Acciaierie d'Italia, formerly Ilva in Taranto¹⁸¹.

One of the reasons why the latter was chosen as a case study in this paper is because this plant is not only the largest integrated steelworks in Europe but also one of the most significant in terms of size and economic and environmental impact in the country¹⁸².

Despite this, and despite all the intentions to undertake a significant ecological transition process, it has encountered and continues to encounter many obstacles and difficulties on several fronts¹⁸³.

As mentioned in the previous paragraph, there are several possible paths that can be taken to achieve decarbonisation of the steel industry, and in particular, the official strategies outlined at government and institutional level aim at the progressive elimination of coal-fired plants and the replacement of traditional technologies with those with lower emissions, with the stated goal of making Italy the first European country to produce “green steel”.

During meetings at the Ministry of Enterprise and Made in Italy (MIMIT), it emerged that the national steel industry, thanks in part to the spread of electric furnaces in other Italian contexts, can serve as a benchmark for production processes with less environmental impact¹⁸⁴. However, it should not be underestimated that the full decarbonisation of the Taranto site requires a complex process of technological conversion.

It was Senator Adolfo Urso, Minister of Enterprise and Made in Italy, who, during his meeting at Palazzo Piacentini with the main players in the Italian steel industry, outlined the plan for the full decarbonisation of the former Ilva plant in Taranto ahead of the

¹⁸¹ ConcreteZero Initiative. (2022). Creating Demand for Low-Carbon Concrete.

¹⁸² Ministero delle Imprese e del Made in Italy (MIMIT), Ex Ilva: verso la piena decarbonizzazione del polo siderurgico di Taranto, comunicato stampa, 2023. <https://www.mimit.gov.it/it/notizie-stampa/ex-ilva-urso-a-operatori-siderurgia-con-piena-decarbonizzazione-taranto-italia-prima-in-ue-su-acciaio-green>

¹⁸³ Acciaierie d'Italia S.p.A., Piano Industriale 2023–2027, documentazione societaria (sintesi disponibile sul sito ufficiale), 2023. <https://www.acciaierieditalia.com>

¹⁸⁴ Acciaierie d'Italia S.p.A., *Dichiarazione Non Finanziaria e Report di Sostenibilità 2022–2023*, sezione “Sostenibilità”. <https://www.acciaierieditalia.com/it/sostenibilita>

signing of the interinstitutional programme agreement scheduled to take place at the MIMIT itself¹⁸⁵. The meeting was attended by the president of Confindustria, Emanuele Orsini, and the president of Federacciai, Antonio Gozzi, together with the top management of Acciaierie Venete, AFV Acciaierie Beltrame, Arvedi Cremona, Cogne Acciai Speciali, Danieli & C. Officine Meccaniche, Feralpi Group, Gruppo Pittini, Marcegaglia Group, Valbruna and Renexia. The extraordinary commissioners of Ilva and AdI in extraordinary administration also took part in the meeting.

During the meeting, Minister Urso expressed his appreciation for the commitment of the Italian steel industry, which has already made Italy the most advanced country in the world in the production of green steel, thanks to the presence of 34 electric furnaces distributed across 29 Italian cities, with a total production capacity of 23 million tonnes. To quote Senator Urso verbatim, 'We must now complete this process, as we have already done in Terni and Piombino, with the full decarbonisation of the former Ilva plants, to make Italy the first country in Europe to produce only green steel.'¹⁸⁶ He went on to say, "We are talking about a technology that is already operational in 29 Italian cities, the most advanced solution both from a production point of view and in terms of environmental and health protection. This is what we will also achieve in Taranto, where the existing blast furnaces will be progressively replaced by latest-generation electric furnaces, based on the most modern and safest technology available on the market today, transforming the Ionian hub into the largest green steel plant in Europe.'¹⁸⁷

During the meeting, however, the Italian steel industry players were keen to point out that the sector's competitiveness depends directly on energy costs and the supply of scrap iron. Urso then reassured those present by emphasising the government's commitment at European level to supporting the steel sector, reiterating its efforts to limit exports of scrap iron and illustrating the two non-papers promoted by Italy. The first of these concerns the

¹⁸⁵ Camera dei Deputati – Commissione Attività Produttive, *Audizioni sulla riconversione del sito ex Ilva di Taranto*, resoconti stenografici, 2023–2024. <https://www.camera.it/leg19/1266>

¹⁸⁶ Ministero delle Imprese e del Made in Italy (MIMIT), *Ex Ilva: verso la piena decarbonizzazione del polo siderurgico di Taranto*, comunicato stampa, 2023. <https://www.mimit.gov.it/it/notizie-stampa/ex-ilva-urso-a-operatori-siderurgia-con-piena-decarbonizzazione-taranto-italia-prima-in-ue-su-acciaio-green>

¹⁸⁷ Agora Energiewende. (2022). *Breakthrough Strategies for Climate-Neutral Industry*.

revision of the CBAM, presented together with Poland, while the other focuses more specifically on the steel industry, drawn up with France, which gave rise to the Alliance for the Future of Energy-Intensive Industries, which sees Italy together with ten other EU countries committed to revising European regulations with the aim of making the European steel industry more sustainable and competitive. However, the need and urgency for solid and consistent regulatory support in order to achieve such ambitious results has certainly not gone unnoticed¹⁸⁸.

Although the promises may seem promising and the initiatives continue to paint an increasingly optimistic picture, there is still a lack of concrete action at the operational level rather than the strategic level.

One example is the inter-institutional agreement signed by the government, involving the Ministry of Enterprise, the Ministry of the Environment, the Puglia Region and local authorities, to promote the full decarbonisation of the industrial site, with the ultimate goal of balancing environmental sustainability, production continuity and job protection. 'This is an important turning point, which will finally encourage investors to present their industrial plans, focusing on the green conversion of the sector: Italy will become the first country in Europe to offer fully sustainable steelmaking,' said Senator Urso following the signing, which took place after seven hours of negotiations.

However, although the agreement may be a strong political signal, it is not yet able to define a clear timetable or the location of the pre-reduced production plants needed to support low-impact processes, leaving the contours of a project that, to be truly effective, should leave nothing to chance, somewhat blurred.

On the technological front, Acciaierie d'Italia is involved in research and innovation initiatives aimed at integrating hydrogen production processes with steelworks, as demonstrated by its participation in the European H2Loop project, which aims to develop sustainable solutions for hydrogen production and CO₂ emissions reduction by integrating advanced technologies at the Taranto site¹⁸⁹.

Alongside the technological prospects, however, significant economic and market constraints remain. Media reports indicate that Acciaierie d'Italia, currently under special

¹⁸⁸ Mission Innovation. (2021). Industrial Decarbonisation Roadmaps.

¹⁸⁹ Commissione Europea, *Clean Steel Partnership – Strategic Research and Innovation Agenda*, Bruxelles, 2022

administration, has experienced significant financial difficulties, including state support to ensure operational continuity, due to high energy costs and weak demand¹⁹⁰. In this context, the transition to truly “green” technologies, such as the use of green hydrogen produced from renewable sources, remains hampered by high costs and unfavourable market conditions¹⁹¹.

Furthermore, another example is the establishment and development of DRI d'Italia S.p.A., a company dedicated to the feasibility of Direct Reduced Iron production plants, i.e. pre-reduced iron, as well as a semi-finished product obtained from the reduction of iron ore using carbon monoxide and hydrogen. This company clearly demonstrates how the conversion of the production cycle is seen as one of the main ways to reduce emissions but, at the same time, requires infrastructure investments and a long time before it can actually have a significant impact on production¹⁹².

Overall, the case of Acciaierie d'Italia, a spokesperson for the Italian steel industry, illustrates how industrial decarbonisation is technically possible through the replacement of blast furnaces with electric furnaces and the gradual introduction of hydrogen-powered DRI processes, but the economic feasibility and bankability of investments depend crucially on the presence of stable demand signals for low-carbon steel and a favourable regulatory and market framework¹⁹³, elements that are still incomplete or fragmented in the Italian context as well as in the European context more generally¹⁹⁴.

4.6.2 The Buzzi case in the transition of the cement industry in Italy

¹⁹⁰ Acciaierie d'Italia S.p.A., *Piano Industriale 2023–2027*, documentazione societaria presentata al Ministero delle Imprese e del Made in Italy, 2023.

¹⁹¹ McKinsey & Company. (2022). Decarbonizing the Cement Industry: CCS and Clinker Substitution.

¹⁹² International Energy Agency (IEA), *Iron and Steel Technology Roadmap – Towards more sustainable steelmaking*, 2023.
<https://www.iea.org/reports/iron-and-steel-technology-roadmap>

¹⁹³ Banca d'Italia, *Rapporto sulla stabilità finanziaria*, sezioni dedicate al rischio climatico e al rischio di transizione per i settori industriali ad alta intensità di capitale, Roma, 2022–2023.

¹⁹⁴ Buzzi Unicem. (2022). Our Journey to Net Zero – Sustainability Roadmap 2030–2050.

After analysing a specific case in the steel industry, this section will explore in greater depth another basic industry sector which, in the Italian context, is equally emblematic in illustrating the difficulties of converting to low-emission production processes. The latter is the cement industry, and the company considered as a case study is Buzzi S.p.A., historically known as Buzzi Unicem. Buzzi S.p.A. is an international multi-regional corporate group based in Casale Monferrato in Piedmont, as well as one of Italy's leading producers of cement, concrete and aggregates, thus playing a significant role in the production of building materials both nationally and internationally¹⁹⁵.

In recent years, the company has formally adopted a sustainability strategy that is reflected in its “Our Journey to Net Zero” roadmap, shown graphically in the figure below. The ultimate goal of this journey is therefore to reduce CO₂ emissions and achieve climate neutrality by 2050, as well as intermediate targets for reducing specific emissions based on a targeted analysis of the company's Scope 1, 2 and 3¹⁹⁶.

The roadmap, whose results have been continuously recorded over the years to track the progressive reduction in emissions, aims to reduce Scope 1 net emissions to below 500 kg of CO₂ per tonne of product by 2030 and achieve climate neutrality by 2050, in line with the objectives of the European Green Deal.

¹⁹⁵ Buzzi S.p.A., Our Journey to Net Zero – Roadmap di decarbonizzazione al 2050, report di sostenibilità, 2022–2023.

<https://sustainability.buzzi.com/en/net-zero-roadmap/>

¹⁹⁶ European Court of Auditors. (2023). EU Industrial Policy and Decarbonisation Challenges.



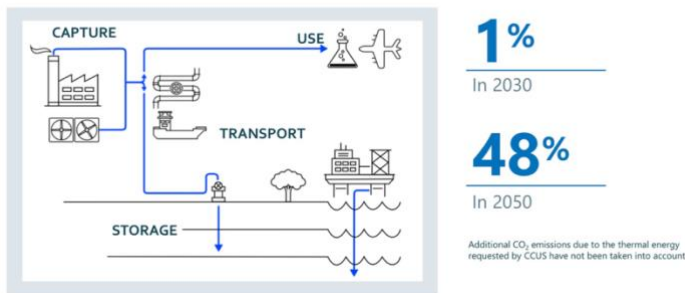
Figure 4.1 - Buzzi S.p.A., *Our Journey to Net Zero – Roadmap di decarbonizzazione al 2050*, report di sostenibilità, 2022–2023.

As can be seen from the graph, CO₂ emissions fell by 17% in 2021 compared to 1990, and a further 20% reduction is expected by 2030.

In order to achieve this ambitious goal, Buzzi's decarbonisation strategy is based on a combination of technological and process levers, including reducing the clinker-cement ratio, increasing the use of alternative fuels with biomass to replace traditional fossil fuels, the adoption of Circular Solid Substitutes (CSS) solutions to increase the use of secondary fuels, participation in CO₂ capture and storage (CCUS) initiatives, greater efficiency in concrete production and in the design and construction phase, greater efficiency in electricity and thermal energy consumption, and finally the development of decarbonization¹⁹⁷.

¹⁹⁷ OECD. (2021). Financing Climate Transitions in Hard-to-Abate Sectors.

CARBON CAPTURE, (USAGE) AND STORAGE



ALTERNATIVE FUELS WITH BIOMASS CONTENT

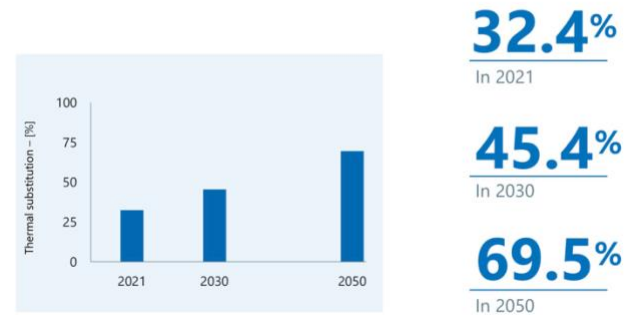


Figure 4.2 - Figure 4.3 - Buzzi S.p.A., *Our Journey to Net Zero – Roadmap di decarbonizzazione al 2050*, report di sostenibilità, 2022–2023.

As mentioned above, Buzzi S.p.A. is a multinational company, therefore its area of operation covers several geographical areas, as can be seen in Figure 4.4.

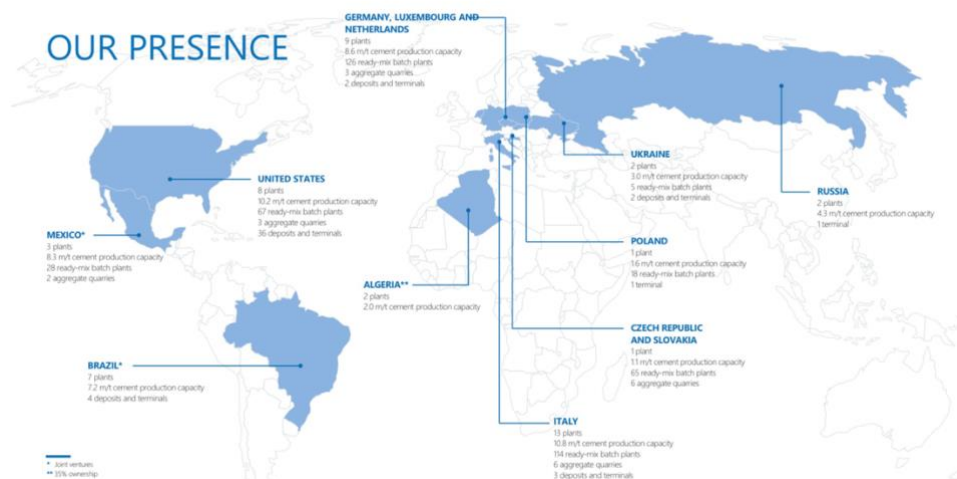


Figure 4.4 - Buzzi S.p.A., *Our Journey to Net Zero – Roadmap di decarbonizzazione al 2050*, report di sostenibilità, 2022–2023.

In order to outline strategic lines of action that are as effective as possible, specific roadmaps have been created for each country.

In this section, we will specifically consider the components of the Roadmap applied in Italy, where the key elements consist primarily of product innovation and the push towards the use of C Green.

C-Green cements are more sustainable and circular, with up to 70% recycled materials and a lower clinker content. The aim is to use up to 60% of volumes by 2030, which is double the amount used in 2021.

A second essential element in the strategic decarbonisation plan in the Italian context is the reduction of clinker content and greater substitution of fossil fuels.

In particular, the intention is to triple the use of alternative fuels, for instance to increase from 17% to 48% and to replace up to 30% of fossil fuels with natural gas.

Finally, a strong strategic component is an ambitious investment programme to fuel the transition. An investment of approximately €170 million is therefore planned, with over 30 initiatives in the field of renewable energy, with the aim of both decarbonising electricity and protecting against energy price inflation.

A concrete application of this strategy is the Robilante plant, where the recent integration of a new CSS plant has enabled a reduction in CO₂ emissions and other pollutants, thanks to the increase in the consumption of secondary fuels to replace fossil coal.

The focus on innovation also extends to international collaborations, as Buzzi Unicem USA, a subsidiary of the group, has become a strategic partner in initiatives such as the one with the start-up Queens Carbon, aimed at developing low-CO₂ cement using supplementary cementitious materials (SCMs) and production technologies that drastically reduce the environmental impact of the final product. This industrial collaboration, supported by private investment and venture capital, aims to test and scale technologies that enable the production of competitive cementitious materials without a significant “green premium” on costs.

The reductions achieved in recent years demonstrate progress, albeit modest in relation to the overall challenge: the specific ratio of Scope 1 CO₂ emissions fell, for example, from approximately 689 kg/t in 2021 to approximately 664 kg/t in 2022, highlighting how

progress, while tangible, remains limited in the face of the need for more profound structural reductions¹⁹⁸.

Despite its strategic and operational commitment, Buzzi's transition to fully low-carbon processes remains constrained by market and technological limitations. Cement production is characterised by intrinsic process emissions linked to the clinker production phase, which accounts for the most significant share of total CO₂ emissions in this sector. The availability of technical alternatives such as the use of supplementary cementitious materials and CCUS technologies still depends on factors such as costs, raw material accessibility and market conditions, as well as the existence of standards and demand requirements that recognise and promote such low-emission products.

In fact, it was Buzzi S.p.a itself that outlined a series of assumptions and prerequisites that would be necessary for the full implementation and complete success of the ultimate goal of the Roadmap discussed above. However, these conditions were not met, or at least not completely, and this undoubtedly affected the final result.

These prerequisites were as follows¹⁹⁹:

- Scope of application;

The roadmap was developed considering all companies within the scope of consolidation, excluding Russian companies due to the current uncertainty, and including BCPAR, as well as the Brazilian joint venture. Therefore, all would have to act simultaneously and jointly for collective success.

- Market projection;

Until 2030, the production scenario would take into account market forecasts provided by individual countries. An increase of between 5 and 10 per cent was expected between 2030 and 2050 compared to 2021.

- CCUS infrastructure;

¹⁹⁸ Buzzi Unicem. (2023). Sustainability Report.

¹⁹⁹ Buzzi S.p.A., Our Journey to Net Zero – Roadmap di decarbonizzazione al 2050, report di sostenibilità, 2022–2023.
<https://sustainability.buzzi.com/en/net-zero-roadmap/>

Successful cooperation between different actors was expected to build and operate the CO₂ transport network, identify storage or reuse sites, such as biofuel production, gain public acceptance and obtain adequate government support.

- Institutional support;

Institutional support was expected in terms of specific permits and authorisations to facilitate the use of alternative fuels and the implementation of innovative technologies.

- Availability of materials;

It was assumed that clinker substitutes, such as slag, pozzolans and fly ash, would remain available at competitive costs.

- Availability of electricity from renewable sources;

The roadmap would have taken into account the decarbonisation plans announced at national level for the electricity sector, which envisaged the progressive use of renewable sources and, for the remaining share of production with fossil fuels, the use of CO capture and storage.

In this sense, the Buzzi case clearly illustrates how the existence of a long-term strategy and investment in clean technologies is not sufficient on its own to bring about industrial transformation, as without stable demand signals for low-emission cementitious materials and an adequate regulatory and incentive framework, the scale and pace of the transition remain limited. These dynamics confirm the key role, mentioned in previous chapters, of market creation mechanisms and public procurement policies that favour low-carbon materials throughout the construction and infrastructure supply chains.

4.6.3 The demand bottleneck in the Italian construction and infrastructure supply chains

An interesting area for stimulating demand for low-carbon materials in Italy is the construction and infrastructure sector, which accounts for a significant portion of national

steel and cement production. However, current demand for low-emission materials remains limited and fragmented, even though awareness of sustainability criteria is growing in public procurement. This situation is exacerbated by overly rigid technical standards, a focus on short-term targets and the failure to integrate carbon footprint criteria into purchasing decisions throughout the supply chain. As a result, the vicious circle of supply-demand catch-22 is inevitable. Producers of basic materials do not invest in low-carbon production capacity due to a lack of stable demand, and downstream buyers fail in their attempts to find sufficiently competitive or standardised low-emission raw materials on the market. It is therefore clear that, in the absence of coordinated action, the market does not have the capacity to overcome this stalemate on its own, with the risk of structurally delaying the decarbonisation of the most emission-intensive industrial supply chains.

4.6.4 The drivers of demand-led innovation in Italy: public procurement, standards and demand coordination

Starting from the demand-led approach, a useful perspective emerges for identifying effective points of intervention in Italy. Public procurement, for example, has a significant influence on the market. State investments in construction, road networks and public works could become stable sources of demand for low-emission materials. This would require ecological standards to be applied more rigorously in public procurement. Doing so would generate constant levels of demand. All this would mitigate the perception of risk among producers of green steel and concrete. Only with clear conditions can the minimum confidence necessary for change be established.

In addition to public procurement, setting common criteria for the ecological characteristics of goods could also have a significant impact²⁰⁰.

When technical standards officially include materials with lower emissions, it becomes less difficult to use them in subsequent stages of production. As a result, these materials

²⁰⁰ International Energy Agency (IEA), *Cement Technology Roadmap – Towards Net Zero Emissions in the Cement Sector*, 2023.
<https://www.iea.org/reports/cement-technology-roadmap>

become more naturally integrated into construction or infrastructure. Thus, demand is not just a commercial choice: it changes the parameters necessary to enter the market with low-carbon products.

Alignment among private purchasers can also strengthen the DLI. When construction companies, network operators or industries with high demand join forces, there is a consistent demand for low-emission materials. This aggregate dimension mitigates commercial uncertainty, opening up space for stable long-term supply agreements. When accompanied by targeted regulatory measures, these collective processes resemble future purchase commitments. This gives early producers greater certainty about their expected earnings.

4.6.5 Implications for the bankability of investments and the role of the financial system

In Italy, consistently demanding low-emission industrial products can greatly change the possibility of financing interventions to upgrade plants in traditional industries. The third chapter shows that real demand helps banks see less commercial risk and less uncertainty about the ecological transition, making it easier to grant loans for heavy expenditure over extended periods²⁰¹.

Without these indicators, transition funding remains divided among many small projects, almost always linked to subsidies or state support. However, when banks begin to consider policies that stimulate demand within their risk measurement methods, a window of opportunity opens up: private investors enter with greater confidence, bringing the transition from traditional industries out of the laboratory and into concrete, widespread applications in the production system.

4.6.6 Critical assessment and potential for replication

²⁰¹ Commissione Europea, Industrial Carbon Management Strategy, 2024. https://climate.ec.europa.eu/eu-action/industrial-carbon-management_en

The example of Italy shows that the results of demand-driven strategies change as soon as we consider not only what is there, but how the regulatory system works as a whole. Without a clear connection between public procurement, technology standards, production guidelines and available economic resources, any demand-driven action could be limited to sporadic interventions, incapable of truly changing the existing balance. Although it seems counterintuitive, it is precisely the intertwining of different productive sectors in Italian supply chains, combined with the central role of public bodies in the procurement of infrastructure works, that creates favourable conditions for testing targeted interventions on the demand side. It is here, in the country's industrial system, that there is scope for trying out innovative approaches such as those of DLIs, especially in key sectors of the real economy; experiences that could then inspire similar paths elsewhere in Europe²⁰².

4.6.7 Conclusion of the case study

In Italy, it is not a lack of technology that is holding back change in key industries, but rather the absence of solid demand. An approach based on demand rather than supply could lead the way, breaking the deadlock typical of sectors that are difficult to decarbonise. This approach helps to make investments more sustainable and better directs innovation in the production system. However, for it to work, synergy is needed: public procurement, material regulations and economic support must move together if emissions reductions are to be translated into genuine industrial conversion.

4.8 Interim conclusions

Looking at key industries reveals that the green transition here is not based solely on technical support for supply. Often, obstacles rooted in the production structure, high

²⁰² Cambridge Institute for Sustainability Leadership (CISL), The role of demand-led innovation in supporting decarbonisation in foundation industries, 2023. <https://www.cisl.cam.ac.uk/resources/publications/market-driven-decarbonisation>

installation costs and rigid procedures require broader solutions: a mix of demand-side measures, dialogue between actors in the supply chain and a review of credit channels are needed. This text has shown that focusing on demand allows us to see more clearly how these areas are really changing, especially thanks to the push towards stable markets for low-emission industrial goods. Starting from here, the next step is to look more closely at the weaknesses of current environmental finance instruments when it comes to sectors where decarbonisation is difficult, together with the effects on future economic mechanisms designed to shape supply.

CHAPTER 5 – Beyond traditional green finance: limitations of existing instruments and the role of finance as a market-shaping lever in the transition of foundation industries

5.1 Introduction: why green finance is not unlocking foundation industries

Although Green Finance has been expanding rapidly in recent decades²⁰³, too few financial resources are still being allocated to hard-to-abate industries to reduce emissions, especially in Italy²⁰⁴²⁰⁵. The previous chapters show how these activities require a huge amount of investment in order to effectively move towards a type of innovation that can be defined as disruptive, as there are risks associated with technologies that are still changing and their limiting dependence on demand from downstream sectors in the production line²⁰⁶²⁰⁷. Although there is growing awareness of this issue, current green finance instruments are designed with safer, already established projects in mind²⁰⁸²⁰⁹, which are certainly not in step with the needs of steelworks or cement factories²¹⁰²¹¹.

In Italy, in particular, sectors that are difficult to decarbonise weigh heavily, and at the same time there are many small economic players scattered throughout the industrial chain, making the existing imbalance and misalignment even more pronounced²¹². The result is a persistent gap between policy ambitions for industrial transition and the ability of green finance to direct capital towards the most difficult, but at the same time most crucial, segments of the production transformation²¹³.

²⁰³ OECD (2021), *Sustainability-linked finance and corporate transition*.

²⁰⁴ IEA (2023), *Emissions by sector in Italy*.

²⁰⁵ Climate Bonds Initiative (2023), *Green Bonds Market Summary*. ICMA (2023), *Green Bond Principles*.

²⁰⁶ IEA (2018), *Technology Roadmap: Low-Carbon Transition in the Cement Industry*.

²⁰⁷ IEA (2020), *Iron and Steel Technology Roadmap*.

²⁰⁸ Ehlers, T. & Packer, F. (2017), *Green bond finance and certification*, BIS Quarterly Review.

²⁰⁹ ICMA (2021), *Green Bond Principles*.

²¹⁰ OECD (2022), *Financing climate action in heavy industry*.

²¹¹ Carbon Tracker (2022), *Steel and cement in a net-zero economy*.

²¹² Banca d'Italia (2022), *Climate risks and the Italian financial system*.

²¹³ Mazzucato, M. & Penna, C. (2016), *Beyond market failures: shaping and creating markets*, SPRU Working Paper.

5.2 The limitations of green bonds in supporting industrial transformation

One of the most common instruments in green finance is green bonds, designed to channel money into initiatives that produce verifiable environmental benefits²¹⁴²¹⁵. Almost always, these are bonds whose proceeds fund activities classified as “green”, established by a specific regulatory framework and subsequently monitored with reports on the effect achieved²¹⁶. These activities often involve clean energy, energy consumption reduction, eco-friendly transport or responsible water use²¹⁷. Thanks to this structure, issuers can attract funds at sometimes better rates by targeting parties interested in sustainability; at the same time, purchasers come into direct contact with actions with a documented environmental footprint.

In Italy, the green bond market has developed mainly thanks to public issuers and companies active in the energy and infrastructure sectors²¹⁸; here, the funds raised often end up in renewable energy, building efficiency or low-pollution transport systems. These areas have limited risks, unlike other interventions such as industrial modernisation, where the environmental effects are less immediately measurable.

For example, established renewable energy plants generate stable revenues and clear impact data, such as CO₂ reduction per megawatt supplied, which is valued by green bond buyers and useful for standard certification of sustainable financing²¹⁹.

In industries that are difficult to decarbonise, such as steel or cement, the use of green bonds immediately encounters practical and economic limitations²²⁰. Precisely because most of the solutions for cutting emissions are still in the experimental phase, the results remain uncertain and prices high²²¹. This instability makes it difficult to adapt them to the standards required by green bonds, which are designed for interventions with measurable

²¹⁴ European Commission (2023), *European Green Bond Standard*.

²¹⁵ ICMA (2021), *Green Bond Principles*.

²¹⁶ European Commission (2020), *EU Taxonomy Regulation*.

²¹⁷ Climate Bonds Initiative (2022), *Use of Proceeds Taxonomy*.

²¹⁸ Banca d'Italia (2022), *Sustainable finance in Italy*.

²¹⁹ BIS (2021), *The green bond market: trends and challenges*.

²²⁰ IEA (2022), *Achieving Net Zero Heavy Industry Sectors*.

²²¹ OECD (2022), *Decarbonising heavy industry*.

and certain effects²²². Thus, fears about untested innovations discourage the most cautious financial institutions, precisely those that typically focus on low-risk bonds²²³²²⁴.

Another problem arises from the specific nature of green bonds, which are linked to isolated projects rather than widespread changes²²⁵.

Financing a new plant is not enough when there is no stable system capable of purchasing ecological goods on a large scale. This is the case in the steel and cement industries, where carbon-free production is currently much more expensive, so few choose these solutions without clear incentives. The challenge then becomes attracting buyers willing to pay a little more or implementing regulations that disadvantage high CO₂ intensity versions. All this is beyond the scope of green instruments, which focus only on initial investments and never on future circuits where real success is decided²²⁶.

Let's take a practical example: if a steel factory obtains funds through green bonds to modernise its plants, perhaps by switching to electric furnaces or using less polluting technologies, this only makes sense if it can then sell that ecological product despite having spent more. Without long-term agreements with customers that guarantee profitable long-term collaboration, or without government intervention that guarantees certain outlets, such as environmentally friendly public procurement or standards on the use of materials, the market remains too unstable. Therefore, although green securities can lighten the burden of initial financing, they leave the real difficulty unresolved: making the entire project sustainable over time when no one guarantees who will ultimately buy it.

Ultimately, green bonds often focus on gradual change rather than truly revolutionising production methods. Taking cement as an example, it is more common to find funds to reduce energy consumption or replace part of the clinker, actions that fit better within the schemes envisaged by these financial instruments. On the other hand, investing heavily in CO₂ capture and storage systems appears less straightforward: there are too many obstacles related to high prices, changing regulations and the complexity of the technologies involved. As a result, the economy could move towards choices with limited

²²² Mission Possible Partnership (2021), *Net-Zero Steel and Cement*.

²²³ ICMA (2021), *Impact Reporting Handbook*.

²²⁴ IEA (2021), *Technology Perspectives for Heavy Industry*.

²²⁵ Mazzucato, M. (2018), *The Entrepreneurial State*.

²²⁶ World Economic Forum (2022), *First Movers Coalition: demand commitments*.

benefits for the real environment, while maintaining the appearance of progress. Without profound changes, however, future climate goals remain out of reach²²⁷.

Overall, green bonds help to increase the availability of funds for interventions with a positive environmental impact; however, they present challenges when it comes to truly transforming traditional industries. Without additional policies to stimulate demand for low-emission industrial goods or mitigate trade barriers, these instruments may remain limited to individual transactions. As a result, in sectors that are difficult to decarbonise, their effect may not profoundly alter either the production or financial models associated with the green transition²²⁸.

5.2.1 The ArcelorMittal case: access to sustainable finance and limitations linked to demand for low-carbon steel

A concrete example of the limitations of green bonds is the case of ArcelorMittal, which reveals how complex it is to push heavy industries towards climate transition without adequate market demand. Starting in 2018, the company outlined significant targets for cutting emissions in EU countries, focusing on innovative systems such as direct iron reduction using clean hydrogen, together with the energy modernisation of its plants. Although it has obtained increasing green financing thanks to state and European incentives, the results remain constrained by external dynamics in the real economy. In fact, the instruments available today are struggling to align with capital-intensive industrial commitments. The emerging picture does not depend solely on corporate will or mobilised resources. Often, what blocks change is the absence of clear signals from consumers and institutional buyers. Without this pressure, even well-conceived projects can run aground.

Instead, many plans to transform the steel sector have suffered delays, cuts or constraints related to economic feasibility over time. On closer inspection, the problems arise not only from a lack of funds for new production facilities, but above all from uncertainty

²²⁷ Newell, R., Pizer, W., Raimi, D. (2014), *Carbon market design and demand-side policies*, Energy Policy.

²²⁸ UNIDO (2022), *Industrial Deep Decarbonization Initiative (IDDI)*.

about how stable the demand for low-emission steel will be. Today, manufacturing “green” steel costs more than traditional steel, so the profitability of these plants depends heavily on finding companies willing to pay more for it or on regulations that shift the balance between competitors.

Here, the use of financial instruments linked to sustainability could lower the price of the capital needed to start up, but this is not enough to make projects viable without multi-year supply agreements or policies capable of building solid markets for low-emission steel. Thus, the example of ArcelorMittal clearly shows that financing production, even with resources defined as “green”, does not solve the main problem: the real profitability of innovative industrial interventions still depends heavily on future demand throughout the production cycle.

5.3 Sustainability-linked instruments: insufficient incentives for structural change

Sustainability-linked instruments, such as sustainability-linked loans (SLLs) and sustainability-linked bonds (SLBs), are designed to incentivise improvements in the overall environmental performance of the issuing company by linking the economic conditions of the financing (e.g. the interest rate) to the achievement of specific sustainability targets (Key Performance Indicators, KPIs)²²⁹²³⁰. Unlike green bonds, these instruments do not restrict the use of proceeds to individual projects, but aim to integrate sustainability into the overall corporate strategy²³¹.

In the Italian industrial context, SLLs have been progressively adopted mainly by medium and large companies, often in traditional manufacturing sectors²³². However, the effectiveness of these instruments in supporting the transformation of hard-to-abate industries appears to be limited by a number of structural factors. Firstly, the KPIs used to define the contractual conditions tend to favour indicators that are easily measurable in the short to medium term, such as emission intensity or energy consumption per unit of

²²⁹ LMA (2022), *Sustainability-Linked Loan Principles*.

²³⁰ ICMA (2022), *Sustainability-Linked Bond Principles*.

²³¹ OECD (2021), *Sustainability-linked finance and corporate transition*.

²³² Banca d'Italia (2022), *Sustainable finance in the Italian corporate sector*.

output²³³. This favours incremental efficiency improvements rather than transformative investments in basic production processes, which require longer time horizons and involve high technological risks²³⁴²³⁵.

Secondly, sustainability-linked instruments do not directly address the issue of the bankability of individual low-carbon industrial investments. Since the financial benefit associated with achieving KPIs often translates into marginal changes in financing conditions, the economic incentive may be insufficient to offset the costs and risks associated with large-scale technological conversion projects²³⁶. In the case of foundation industries, where the investments required for decarbonisation are capital-intensive and subject to market uncertainty, such instruments risk creating a misalignment between environmental ambitions and the actual capacity to mobilise capital for more profound transformations²³⁷.

Finally, similar to green bonds, sustainability-linked instruments operate mainly on the supply side and do not affect demand conditions for low-carbon industrial products. Companies can improve their ESG indicators without this automatically translating into greater competitiveness for decarbonised products on the end market²³⁸. In the absence of mechanisms that explicitly link environmental performance to the market positioning of products, SLLs and SLBs risk remaining instruments of 'financial compliance' rather than levers for structural transformation of industrial markets²³⁹²⁴⁰.

Sustainability-linked instruments, such as sustainability-linked loans (SLLs) and sustainability-linked bonds (SLBs), are designed to incentivise improvements in the overall environmental performance of the issuing company by linking the economic conditions of the financing, such as the interest rate, to the achievement of specific sustainability objectives, a prime example of which are Key Performance Indicators (KPIs). When it comes to these agreements, the proceeds can be used freely, unlike green bonds. More favourable terms only emerge if specific environmental indicators are met.

²³³ OECD (2021), *OECD Business and Finance Outlook*.

²³⁴ IEA (2018), *Technology Roadmap: Low-Carbon Transition in the Cement Industry*.

²³⁵ IEA (2020), *Iron and Steel Technology Roadmap*.

²³⁶ Berrada, I. et al. (2022), *Do sustainability-linked bonds drive real change?*, Energy Policy.

²³⁷ OECD (2022), *Financing climate action in heavy industry*.

²³⁸ Mazzucato, M. & Penna, C. (2016), *Beyond market failures: shaping and creating markets*.

²³⁹ Mazzucato, M. (2021), *Mission Economy*.

²⁴⁰ Mazzucato, M. (2018), *The Entrepreneurial State*.

Rather than limiting itself to a single green investment, what counts here is the overall direction of the company. Alignment with the objectives is monitored periodically, making real progress transparent. The interest rate may fall or rise based on measurable data reported annually. There is no need to allocate funds to specific projects: it is sufficient to demonstrate improved performance on agreed parameters. These mechanisms drive widespread change within the organisation, not just simple accounting adjustments. The pressure increases as the final review dates approach. While green bonds depend entirely on the use of capital, here it is overall behaviour that counts.

In the country's industrial sectors, SLLs are gradually spreading, particularly in medium-sized and large companies, especially in traditional manufacturing sectors. However, deep-rooted obstacles are hampering their effective use in industries that are difficult to decarbonise. Upstream, the parameters chosen to set up the agreements focus on quantities that are easy to quantify within a short time frame, such as emissions per unit produced or energy consumption relative to the volume processed. As a result, actions aimed at small steps forward in the use of resources are emerging, rather than profound reconversions of primary production cycles, which would require extended periods of time and would face uncertainties related to innovation.

It should also be added that sustainability-related instruments do not resolve the issue of economic feasibility for certain low-emission industrial investments. Often, when the targets are met, the financial advantage consists only of minor adjustments to the loan conditions, which is too weak an incentive given the high costs and concrete risks of radical technological change. In basic industries, where substantial financial reserves are needed and future demand remains unclear, these mechanisms can create a clear gap between the stated climate goal and what is actually financed in the field.

Ultimately, as with green bonds, sustainability-linked instruments mainly affect capital providers, ignoring the dynamics of demand for low-carbon industrial goods. Despite an improvement in corporate ESG indicators, there is no guarantee that decarbonised products will become more attractive to consumers. If there are no direct links between ecological results and actual commercial success, these instruments, whether SLB or SLL, end up resembling accounting obligations rather than real drivers of industrial change.

5.4 Project finance and the bankability of investments in foundation industries

Project finance is a well-established tool for financing large infrastructure and energy projects, based on separating the project risk from that of the sponsoring company and on the expectation of relatively stable cash flows over time²⁴¹²⁴². Long-term agreements, such as guaranteed purchases of the energy generated, which stabilise future revenues, help to facilitate this approach in the field of renewables²⁴³.

When it comes to industries that are difficult to decarbonise, the use of project finance faces significant obstacles. Despite good intentions, in the steel and cement sectors there is often a lack of binding agreements on the sale of production, which is commonplace in the green energy sector²⁴⁴²⁴⁵. Without multi-year commitments to supply low-emission goods, it becomes difficult to predict future economic inflows. As a result, banks are reluctant to lend, as financial stability appears fragile²⁴⁶. Long-term capital operators therefore tend to steer clear of such initiatives.

Instead of following established paths, many low-emission industrial projects face technical uncertainties combined with regulatory instability and market price volatility²⁴⁷²⁴⁸. In view of this situation, financial institutions demand strict conditions or the participation of state entities to reduce potential losses linked to changes in the energy sector²⁴⁹. In Italy, such dynamics end up relying heavily on government support or ad hoc measures, slowing down the stable entry of private investors during the growth of new sustainable production technologies²⁵⁰.

An additional limitation of project finance emerges when it comes to accompanying slow and widespread industrial changes. Although effective for isolated projects with clear boundaries, it struggles to apply where joint action is needed on active plants, auxiliary networks and production chains²⁵¹. It is precisely this internal articulation that hinders the

²⁴¹ Yescombe, E. (2014), *Principles of Project Finance*.

²⁴² Gatti, S. (2018), *Project Finance in Theory and Practice*.

²⁴³ World Bank (2020), *Utility-scale renewable energy finance and PPAs*.

²⁴⁴ OECD (2022), *Decarbonising heavy industry*.

²⁴⁵ IEA (2021), *Net Zero by 2050: A Roadmap for the Global Energy Sector*.

²⁴⁶ BIS (2021), *Climate-related financial risks*.

²⁴⁷ Carbon Tracker (2022), *Steel and cement in a net-zero economy*.

²⁴⁸ IEA (2022), *Achieving Net Zero Heavy Industry Sectors*.

²⁴⁹ World Bank (2021), *Public guarantees and risk-sharing mechanisms for climate investments*.

²⁵⁰ CDP (2022), *Public finance and industrial transition in Italy*.

²⁵¹ Gatti, S. (2018), op. cit., capitoli su multi-asset project finance.

creation of financial agreements compatible with the usual standards of bankability in the classic model²⁵².

5.5 The supply-side bias of green finance and the structural problem of demand

An observation of green finance in Italy shows a clear trend: the focus is mainly on those who provide resources, not those who request them²⁵³²⁵⁴. The instruments available often aim to stimulate environmentally friendly initiatives or strengthen companies' environmental performance. However, little is being done to change the market dynamics that influence the long-term viability of low-emission industrial investments²⁵⁵²⁵⁶. Despite this, many programmes overlook the crucial role of demand in the real economy. Failing to consider target markets often leads to ignoring how crucial they are in determining whether an industrial project is actually feasible. Especially in basic industries, selling low-emission goods requires buyers willing to pay higher prices or regulations that penalise options with higher carbon use²⁵⁷. Without these factors, investing in new clean production facilities or methods involves significant commercial uncertainty²⁵⁸. The current means offered by green finance struggle to balance this type of exposure.

In Italy, this asymmetry is particularly noticeable in sectors closely linked to the production chain, such as construction or public works, where final demand often responds to immediate economic convenience and technical standards that are not conducive to change²⁵⁹²⁶⁰. Without a stable market for low-emission industrial materials, green finance instruments struggle to support significant technological expansion; as a

²⁵² Yescombe, E. (2014), op. cit., sezione su limitations of project finance.

²⁵³ Mazzucato, M. & Penna, C. (2016), *Beyond market failures: shaping and creating markets*.

²⁵⁴ Mazzucato, M. (2018), *The Entrepreneurial State*.

²⁵⁵ Polzin, F. et al. (2017), *Public policy influence on financing for clean energy innovation*.

²⁵⁶ Mazzucato, M. (2021), *Mission Economy*.

²⁵⁷ Newell, R., Pizer, W., Raimi, D. (2014), *Carbon market design and demand-side policies*.

²⁵⁸ OECD (2021), *Carbon pricing and industrial competitiveness*.

²⁵⁹ MASE (2023), *Criteri Ambientali Minimi (CAM) per l'edilizia pubblica*.

²⁶⁰ European Commission (2021), *Green Public Procurement in the EU*.

result, capital tends to flow elsewhere, to areas less constrained by deep organisational constraints²⁶¹.

5.6 From finance as a capital allocator to finance as a market shaper

Given the emergence of certain constraints, it is clear that the financial sector must change its role in the industrial transformation process: no longer merely a distributor of funds to already profitable initiatives, but rather an entity capable of helping to create the market foundations necessary to expand low-carbon technologies²⁶²²⁶³. From this point of view, the financial system is moving beyond the habit of analysing risks after projects have been launched, preferring instead to incorporate factors related to demand strategies, technical standards under development and interactions between links in the production chain in advance²⁶⁴²⁶⁵.

Thus, financiers will have to adjust their methods of measuring risk by incorporating new elements: not only traditional economic data, but also precise signals on climate-related public procurement policies²⁶⁶. Stable, long-term commitments between green producers and energy-intensive industries, capable of guaranteeing predictable revenues, are playing an increasingly important role²⁶⁷²⁶⁸. Future choices on carbon prices also influence the analysis, if they appear clear and achievable²⁶⁹. These components slowly change the assessment of a project: it is not only its immediate financial health that counts. The regulatory system and the concrete dynamics of the sectors are included in the assessment as structural factors, no longer marginal ones²⁷⁰.

²⁶¹ Banca d'Italia (2022), *Climate-related risks and financial flows in Italy*.

²⁶² Mazzucato, M. (2021), *Mission Economy*.

²⁶³ Mazzucato, M. (2018), *The Entrepreneurial State*.

²⁶⁴ Polzin, F. et al. (2017), *Public policy influence on financing for clean energy innovation*.

²⁶⁵ Mazzucato, M. & Penna, C. (2016), *Beyond market failures: shaping and creating markets*.

²⁶⁶ European Commission (2021), *Green Public Procurement in the EU*.

²⁶⁷ UNIDO (2022), *Industrial Deep Decarbonization Initiative (IDDI)*.

²⁶⁸ World Economic Forum (2022), *First Movers Coalition: demand commitments for steel and cement*.

²⁶⁹ World Bank (2021), *State and trends of carbon pricing*.

²⁷⁰ OECD (2022), *Financing climate action in heavy industry*.

Without closer alignment between markets, governments and productive sectors, there remains a high possibility that investments will only follow already known paths²⁷¹. As a result, economic support arrives too late in relation to regulatory indications. Sometimes resources are directed where no real change is needed, while key areas for energy transformation are neglected²⁷². This results in an unbalanced distribution of capital, with advantages for the advanced stages of the conversion process²⁷³. When there is a lack of constant dialogue, uncertainty about future demand volumes grows. This is precisely where the need for common forecasts emerges, capable of guiding more timely choices²⁷⁴.

5.7 Operational implications for the Italian context: integration of demand into credit assessment processes

In Italy, an active push by the financial sector towards new forms of market regulation could profoundly change how corporate solvency is analysed or loans are designed²⁷⁵. Depending on the case, incorporating specific criteria related to demand policies, green public procurement or standards on low-impact materials into banks' credit assessments, for instance, can lower the perceived risk associated with climate-focused industrial investments²⁷⁶²⁷⁷.

An example could be seen when public procurement includes strict rules on low-environmental-impact building materials, more stable demand is created in the cement and steel sectors²⁷⁸²⁷⁹. This trend has a positive influence on the estimation of future scenarios linked to the transition to lower-carbon economies²⁸⁰. Similarly, official standards that value products with low CO₂ content can open up new avenues for green

²⁷¹ Mazzucato, M. (2021), *Mission Economy*.

²⁷² IEA (2021), *Net Zero by 2050: A Roadmap for the Global Energy Sector*.

²⁷³ Mazzucato, M. & Penna, C. (2016), op. cit.

²⁷⁴ World Economic Forum (2021), *Building common forecasts for net-zero pathways*

²⁷⁵ Banca d'Italia (2022), *Climate-related risks and financial stability in Italy*

²⁷⁶ OECD (2021), *Integrating climate-related demand signals into credit risk assessment*.

²⁷⁷ European Commission (2021), *Green Public Procurement in the EU*.

²⁷⁸ UNIDO (2022), *IDDI – Public procurement for low-emission cement and steel*.

²⁷⁹ European Commission (2022), *Public procurement of low-carbon construction materials*.

²⁸⁰ IEA (2022), *Achieving Net Zero Heavy Industry Sectors*.

innovators²⁸¹. With less uncertainty about commercial acceptance, it becomes easier to obtain the financing needed to support profound technological change²⁸².

Banks also play a role in bringing producers and buyers together. Through long-term agreements or by creating spaces where important industries and customers can meet, they help to stabilise trade²⁸³. In doing so, the financial sector alleviates market uncertainty, especially in the early stages when low-emission technologies are beginning to spread²⁸⁴. As a result, projects become more accessible to credit lines, even without relying solely on state aid extended to all²⁸⁵.

5.8 Conclusions: towards a process-based approach to the design of demand-driven financial instruments

What emerges from this chapter is clear; traditional green finance has made it easier to find funds for green projects, but it falls short when it comes to truly changing core industries²⁸⁶²⁸⁷. Despite the capital available, many initiatives remain fragile because there is an imbalance between supply and demand²⁸⁸²⁸⁹. To complicate matters, current schemes favour those who give money rather than those who have to spend it²⁹⁰. As a result, investments in low-emission businesses remain exposed to market uncertainties²⁹¹. The bottom-up push rarely enters into the calculations of financiers²⁹². The result is of course the fear of not selling enough continues to hold back bold choices.

Despite these constraints, the following paragraph does not aim to present a financial instrument that can be measured with economic precision, but rather seeks to outline a theoretical and practical framework for building financing mechanisms linked to real

²⁸¹ ISO (2018), *ISO 14067 – Carbon footprint of products*.

²⁸² OECD (2022), *Financing climate action in heavy industry*.

²⁸³ World Economic Forum (2022), *Public-private partnerships for industrial decarbonisation*.

²⁸⁴ Mission Possible Partnership (2021), *Net-Zero Industry Pathways*.

²⁸⁵ CDP (2022), *Public finance and industrial transition in Italy*.

²⁸⁶ Carbon Tracker (2022), *Steel and cement in a net-zero economy*.

²⁸⁷ Flammer, C. (2021), *Corporate Green Bonds*.

²⁸⁸ Newell, R., Pizer, W., Raimi, D. (2014), *Carbon market design and demand-side policies*.

²⁸⁹ Polzin, F. et al. (2017), *op. cit.*

²⁹⁰ Mazzucato, M. & Penna, C. (2016), *op. cit.*

²⁹¹ OECD (2021), *Carbon pricing and industrial competitiveness*.

²⁹² BIS (2021), *Climate-related financial risks*.

demand²⁹³²⁹⁴. Starting from here, we will examine the steps in the development of such mechanisms, who is involved and what policies are needed to integrate them smoothly into the existing institutional system²⁹⁵. With this approach, the goal is to offer a practical reference for implementing economic solutions that can help shape markets for low-emission industrial goods, contain commercial uncertainty, and make investments in key industries more sustainable, both in Italy and in Europe²⁹⁶.

²⁹³ NBER (2020), *Advance Market Commitments and demand creation*.

²⁹⁴ Kremer, M. (2020), *Advance Market Commitments*.

²⁹⁵ UNIDO (2022), *Demand-side policies for industrial decarbonisation*.

²⁹⁶ European Commission (2021), *Industrial Strategy for Europe*.

CHAPTER 6 – *Operational Roadmap for Green Commitment Bonds in Italy*

6.1 Green Commitment Bonds: what they are and the purpose of this chapter

This final chapter introduces an experimental financial instrument called the Green Commitment Bond (GCB), designed to accelerate the ecological transition in industries with high emissions that are difficult to reduce. It was created to address the recurring problem in green finance, discussed throughout this paper and in particular in Chapter 5, namely that there is too often a lack of solid demand for low-carbon materials, which is crucial for clean technology projects to remain viable over time²⁹⁷²⁹⁸²⁹⁹. Without this market pressure, even the most advanced interventions can stall³⁰⁰.

6.1.1 What is a Green Commitment Bond?

The idea behind the Green Commitment Bond combines the classic approach to debt securities with a premium conditional on controllable purchasing choices³⁰¹³⁰². This combination allows action to be taken simultaneously on several levels, in particular on two fronts, as well as:

- **Financial level (capital raising)**

The GCB is based on a form that is familiar to the collective imagination, namely that of a bond issued on the market and aimed at savers, companies or specialised institutions³⁰³³⁰⁴³⁰⁵. The initial value is repaid together with a predetermined return, following rules that are clear from the outset. In this way, the instrument fits effortlessly into the existing landscape of financial assets and, as a result, operators do not have to learn new logic in order to accept it³⁰⁶.

²⁹⁷ Carbon Tracker (2022), *Steel and cement in a net-zero economy*.

²⁹⁸ OECD (2022), *Financing climate action in heavy industry*.

²⁹⁹ IEA (2022), *Achieving Net Zero Heavy Industry Sectors*.

³⁰⁰ UNIDO (2022), *Industrial Deep Decarbonization Initiative (IDDI)*.

³⁰¹ IEA (2022), *Achieving Net Zero Heavy Industry Sectors*.

³⁰² Kremer, M. (2020), *Advance Market Commitments*.

³⁰³ Mazzucato, M. (2018), *The Entrepreneurial State*.

³⁰⁴ European Commission (2021), *Green Public Procurement in the EU*.

³⁰⁵ IEA (2022), *Achieving Net Zero Heavy Industry Sectors*.

³⁰⁶ World Bank (2021), *Blended finance for climate investments*.

- **Market plan (demand activation)**

At the same time, however, unlike traditional green instruments, the GCB includes a logic that rewards purchasing behaviour geared towards goods and services with lower carbon content³⁰⁷³⁰⁸. In this way, the funds raised not only finance industrial production but also help to create demand for low-emission products³⁰⁹. The system shifts the focus from disbursement to actual results. It is not simply a matter of supporting businesses, but rather of progressively shaping market choices³¹⁰. The impact comes from the combination of resources and strategic direction. In the long run, this approach influences competitive dynamics in favour of cleaner options³¹¹.

6.1.2 How the GCB Works: Operational Logic

The process and operation of the GCB is represented by an orderly series of phases, following specific steps, which are as follows:

1. Raising financial resources through bond issuance

The operation begins when the issuer introduces the security to the market, obtaining liquidity. Through pre-established rules, the proceeds are directed towards expenses related to the reduction of industrial emissions, such as plant modifications, low-carbon solutions or upgraded production networks³¹²³¹³. In terms of operational relevance, revenues must be used in a transparent and controllable manner; only in this way can

³⁰⁷ BIS (2021), *Climate-related financial risks*.

³⁰⁸ OECD (2021), *Sustainability-linked finance and corporate transition*.

³⁰⁹ CDP (2022), *Public finance and industrial transition in Italy*.

³¹⁰ International Energy Agency (IEA). (2020). *Iron and Steel Technology Roadmap*.

³¹¹ International Energy Agency (IEA). (2018). *Technology Roadmap: Low-Carbon Transition in the Cement Industry*.

³¹² ICMA. (2022). *Sustainability-Linked Bond Principles*.

³¹³ European Commission. (2023). *European Green Bond Standard (Regulation (EU) 2023/2631)*.

unfounded accusations be avoided³¹⁴. To this end, rigorous traceability of expenditure helps to maintain the confidence of the stakeholders involved³¹⁵. In fact, every decision must be implemented without ambiguity, and this can be achieved through transparency and clarity in the use of the funds available³¹⁶.

2. Activation of demand commitments

With the GCB, certain cost- or image-related rewards are associated with purchasing decisions. These decisions include orders, agreements with suppliers, tenders or other methods of purchasing low-polluting goods³¹⁷. The logic of the system rewards those who request low-emission items and, in practice, the benefits emerge when specific criteria are adopted in procurement³¹⁸. However, not all purchases are included, only those that meet certain environmental standards³¹⁹. Thus, the push towards sustainable products comes from demand, as it matters little if involvement remains only a promise; it needs to be translated into concrete actions³²⁰³²¹. It is not enough to make statements; it is necessary to demonstrate through visible behaviour. Without real action, words lose their value, and true commitment is seen in daily actions, never in mere intentions. Only in this way can this tool make sense in the operational context.

3. Monitoring, reporting and verification (MRV) system

It is necessary for demand actions to be monitored, reported and verified by independent third parties, through certification protocols, audits or digital traceability systems³²²³²³. Operationally speaking, the MRV system gives the GCB reliability, providing it with an

³¹⁴ Loan Market Association (LMA). (2022). *Sustainability-Linked Loan Principles*.

³¹⁵ World Economic Forum. (2021). *Building common forecasts for net-zero pathways*.

³¹⁶ Mission Possible Partnership. (2021). *Net-Zero Industry Pathways*.

³¹⁷ OECD. (2021). *Mission-oriented innovation policy and market creation*.

³¹⁸ European Commission. (2022). *Public procurement of low-carbon construction materials*.

³¹⁹ European Commission. (2021). *EU Industrial Strategy*.

³²⁰ World Bank. (2022). *State and Trends of Carbon Pricing*.

³²¹ OECD. (2021). *Carbon pricing and industrial competitiveness*.

³²² BIS. (2022). *Climate transition risks and financial stability*.

³²³ UNIDO. (2023). *Demand-side policies for industrial decarbonization*.

adequate level of rigour to preserve its validity³²⁴. At the same time, however, it is important that the burden is not so excessive as to hinder its application³²⁵.

4. Incentive mechanism linked to verified actions

Reaching certain commitment or procurement thresholds can trigger economic benefits, such as additional return components or improved conditions³²⁶. However, it is essential to establish the operating procedures before launch so that investors receive transparent information ex ante and understand how the risk-return relationship is formed in the GCB³²⁷.

6.1.3 Why the GCB is relevant for hard-to-abate sectors

The contribution and added value of the GCB is clearly evident in areas where the green transition faces difficulties and obstacles that slow down the necessary changes³²⁸³²⁹. Where traditional policies falter, an alternative approach takes shape, capable of bypassing the factors that have so far created a stalemate, identified in this discussion as a 'demand-supply catch-22', which are as follows:

- **High market uncertainty for low-carbon products**

Where emissions are difficult to reduce, products with lower carbon footprints tend to be more expensive than traditional ones. Without continuous demand, launching new projects becomes uncertain, complicating access to capital³³⁰³³¹.

- **Need for coordination between supply chain players**

³²⁴ European Commission. (2023). *Regulatory sandboxes for sustainable finance*.

³²⁵ ISO. (2019). *EN 15804: Environmental product declarations for construction products*.

³²⁶ International EPD System. (2022). *Environmental Product Declarations (EPD): Programme overview*.

³²⁷ European Commission. (2021). *Corporate Sustainability Reporting Directive (CSRD)*.

³²⁸ Author's elaboration, this dissertation (Roadmap design and operational assumptions for the GCB in Italy).

³²⁹ OECD. (2022). *Industrial policy for net-zero transitions*.

³³⁰ World Economic Forum. (2022). *Clean Demand for Low-Carbon Materials: A Guide for Buyers*.

³³¹ Newell, R., Pizer, W., & Raimi, D. (2014). *Carbon market design, stability, and reform*. Energy Policy.

Reducing emissions requires companies, customers, transporters and institutions to work together³³²³³³. To this end, the GCB could act as a meeting point where shared motivations can be developed³³⁴.

- **Misalignment between finance and market adoption**

Green finance instruments often support ecological projects without ensuring the actual end use of the goods produced³³⁵. Unlike these approaches, the Green Consumption Bond aims to bridge the gap by linking the disbursement of capital to actual consumption by users³³⁶.

6.1.4 Purpose of the chapter

This chapter does not intend to provide an exhaustive and quantitatively detailed design of the Green Commitment Bond, an activity that would require econometric analysis, advanced financial modelling and market testing³³⁷. Instead, the aim is to outline a realistic operational roadmap for the introduction of the GCB in the Italian context, specifying:

- implementation phases;
- the actors involved and their respective roles;
- governance and coordination tools;
- policy requirements and regulatory alignment;
- main operational risks and mitigation strategies.

6.2 Key points and guiding principles for the development of the Roadmap

³³² European Commission. (2021). *EU Industrial Strategy*.

³³³ OECD. (2022). *Industrial policy for net-zero transitions*.

³³⁴ UNIDO. (2023). *Demand-side policies for industrial decarbonization*.

³³⁵ Flammer, C. (2021). *Corporate Green Bonds*. Journal of Financial Economics.

³³⁶ Ehlers, T., & Packer, F. (2017). *Green bond finance and certification*. BIS Quarterly Review.

³³⁷ BIS. (2022). *Climate transition risks and financial stability*.

- **Focus on actual implementation**

Built on clear stages, the roadmap must include actions that can be implemented by both public bodies and private companies. Each stage must correspond to verifiable deliverables such as documents, protocols, agreements and pilot tests³³⁸.

- **Progressiveness and controlled experimentation**

The tool is launched on the market in stages, starting with limited experimentation, then moving on to targeted testing and, finally, if there is positive feedback and traction, it is rolled out more widely³³⁹³⁴⁰. In this way, side effects are more controllable and initial problems are reduced to inputs for improvement.

- **The centrality of public-private coordination**

Along the supply chains that are most difficult to decarbonise, i.e. in hard-to-abate industries, a complex governance structure and multi-level governance are emerging, in which the state plays a leading and enabling role while the private sector contributes practical expertise and commercial connections³⁴¹³⁴². Thus, a functional balance is taking shape between institutional direction and corporate know-how.

- **Environmental and economic added value**

An intrinsic goal of each step of the process must be to clearly show how the GCB generates results that would be impossible without this tool, not only by stimulating demand, but also by spurring productive evolution³⁴³. This is determined by tangible effects linked to both growth in demand and concrete progress in industrial sectors.

³³⁸ European Commission. (2023). *Guidance on regulatory sandboxes for sustainable finance*.

³³⁹ OECD. (2021). *Integrating demand signals into investment and credit risk assessment*.

³⁴⁰ World Bank. (2021). *Public guarantees and risk-sharing mechanisms for climate investments*.

³⁴¹ Mission Possible Partnership. (2022). *Demand aggregation for net-zero materials*.

³⁴² European Commission. (2021). *Public procurement of low-carbon construction materials*.

³⁴³ International Energy Agency (IEA). (2023). *Emissions intensity benchmarks for steel and cement*.

6.5 Actors involved and operational roles

- **Public entities (ministries, local authorities, contracting authorities)**
 - In this context, guidelines are drawn up that outline the GCB's scope of action and policy framework³⁴⁴.
 - Depending on political choices, they can guide purchasing preferences towards solutions that are less harmful to the environment³⁴⁵.
 - Sometimes, their effectiveness only emerges when combined with broader regulations, but they are not always applied consistently in official tenders.
 - They contribute to the institutional legitimisation of the instrument³⁴⁶.
- **Financial issuer/project vehicle**
 - The security is created and then released on the market³⁴⁷.
 - Thanks to the management of cash flows, the instrument complies with the rules. Its main function is to ensure that each transaction complies with the regulations in force³⁴⁸.
 - It manages dialogue with financiers and interacts directly with those who financially support the initiative. Those involved in this aspect coordinate updates and information for those who believe in the project.
- **Investors (retail, corporate, institutional)**
 - They provide the capital³⁴⁹.
 - In the presence of corporate investors, they can sometimes take on the role of generating demand commitments³⁵⁰.

³⁴⁴ European Commission. (2020). *EU Taxonomy Climate Delegated Act*.

³⁴⁵ ISO. (2019). *EN 15804: Environmental product declarations for construction products*.

³⁴⁶ International EPD System. (2022). *Programme instructions for EPD verification*.

³⁴⁷ European Commission. (2022). *Corporate Sustainability Reporting Directive (CSRD)*.

³⁴⁸ Task Force on Climate-related Financial Disclosures (TCFD). (2017). *Final Recommendations*.

³⁴⁹ European Commission. (2023). *European Green Bond Standard (EuGBS) – Implementing guidance*.

³⁵⁰ OECD. (2022). *Blended finance and de-risking instruments for industrial decarbonization*.

- **Industrial beneficiaries**

- In some cases, revenues from the GCB are used as a resource to support interventions aimed at reducing carbon emissions³⁵¹.
- An explanation of how the resources are used is necessary, together with a clear indication of their role in environmental outcomes³⁵².

- **Bodies responsible for monitoring and validating compliance**

- More specifically, they are responsible for implementing MRV systems³⁵³.
- Rather than leaving room for doubt, they keep the commitment system intact, and the accuracy of the data is supported by this stability³⁵⁴.

6.6 Stages of the operational roadmap

- **Stage 0: Preliminary analysis and definition of the scope**

The context is carefully examined, step by step. At that point, the scope of the areas involved takes shape. Once the boundaries are clear, we move on. In particular, the stages of this phase are as follows³⁵⁵:

- **Identification of priority sectors and supply chains**

The selection of sectors must be based on criteria of emission intensity, technological maturity of low-carbon solutions and strategic relevance to the national industrial system. All these factors contribute to decisions regarding the projects and sectors in which to invest as a priority³⁵⁶³⁵⁷.

³⁵¹ World Economic Forum. (2021). *Public-private collaboration models for industrial decarbonization*.

³⁵² International Organization for Standardization (ISO). (2006). *ISO 14040: Life Cycle Assessment – Principles and framework*.

³⁵³ Author's elaboration, this dissertation (Operational roadmap for GCB implementation in Italy).

³⁵⁴ Author's elaboration, this dissertation (Risk assessment and mitigation framework for the GCB).

³⁵⁵ OECD. (2021). *Mission-oriented innovation policy and market creation*.

³⁵⁶ Carbon Tracker Initiative. (2022). *Steel and cement in a net-zero economy*.

³⁵⁷ IEA. (2022). *Achieving Net Zero Heavy Industry Sectors*.

- **Mapping of potential demand**
In line with emerging needs, it is necessary to select specific portions of demand capable of sustaining an initial operational phase, thus assuming the metaphorical role of an 'anchor'. These include large-scale interventions such as complex construction sites or collective networks and private operators with high purchasing power, i.e. relevant buyers, who can take on a central role from the outset, thus making the choice of contexts capable of generating initial stability attractive³⁵⁸³⁵⁹.
- **Building a coalition of actors**
The initial phase should end with a general agreement between public bodies, the bidding company and interested companies, clarifying the aims and responsibilities of each party³⁶⁰³⁶¹.
- **Phase one: shared design between technicians and representatives of institutions**
 - **Definition of the basic structure of the GCB**
Based on the type chosen, the key features of the bond are defined: residual life, how the return matures, together with the conditions that projects must meet in order to be included. The result is a clear profile of what can be included in the investment package³⁶²³⁶³.
 - **Design of the MRV system**
A number of indicators are chosen, together with methods for verifying them and systems for tracking them, taking into account how much they

³⁵⁸ UNIDO. (2022). *Industrial Deep Decarbonization Initiative (IDDI)*.

³⁵⁹ World Economic Forum. (2022). *First Movers Coalition: Demand commitments for low-carbon materials*.

³⁶⁰ OECD. (2022). *Industrial policy for net-zero transitions*.

³⁶¹ Mazzucato, M., & Penna, C. (2016). *Beyond market failures: shaping and creating markets*.

³⁶² European Commission. (2023). *European Green Bond Standard (EuGBS)*.

³⁶³ ICMA. (2021). *Green Bond Principles*.

cost, whether they work well and the possibility of using them on a large scale³⁶⁴³⁶⁵.

- **Alignment with legal requirements**

The tool is tested against current financial and environmental laws. Where necessary, changes or tests within the existing regulatory framework are recommended³⁶⁶³⁶⁷.

- **Phase Two: Pilot Project**

- **GCB pilot issue**

An initial trial, with a small volume, verifies the functioning of the planned structure. The measured start allows its actual behaviour to be observed and, starting from this phase, data useful for monitoring the system is collected³⁶⁸.

- **Activation of the commitment mechanism**

The parties involved initiate the required procurement procedures, the stakeholders launch the activities related to demand , and all the specific steps in the procurement process are implemented. This marks the start of the execution of the planned phases for the requests, while the operational launch mainly concerns tasks related to procurement³⁶⁹³⁷⁰.

- **Monitoring and evaluation**

The monitoring of results focuses on capital raising. With regard to demand, its actual activation is assessed, while industrial investments are

³⁶⁴ ISO. (2006). *ISO 14040: Life Cycle Assessment – Principles and framework*.

³⁶⁵ ISO. (2018). *ISO 14067: Carbon footprint of products*.

³⁶⁶ European Commission. (2022). *Corporate Sustainability Reporting Directive (CSRD)*.

³⁶⁷ European Commission. (2020). *EU Taxonomy Regulation (Regulation (EU) 2020/852)*.

³⁶⁸ World Bank. (2021). *Blended finance for climate investments*.

³⁶⁹ Edler, J., & Georghiou, L. (2007). *Public procurement and innovation*.

³⁷⁰ European Commission. (2021). *Green Public Procurement in the EU*.

monitored to verify their progress. At this stage, particular attention is paid to any critical issues that arise at the operational level³⁷¹³⁷².

- **Phase Three: Evaluation and Scaling**

- **Overall impact assessment**

The outcome of the instrument is examined retrospectively in relation to the established goals and desired results, thus focusing the analysis on the concrete results obtained³⁷³.

- **Refinement of the model**

Following the results of the pilot test, the GCB is adjusted to better meet the needs that have emerged. Its update responds to what was observed during the test phase³⁷⁴.

- **Possible expansion and upscaling**

If favourable outcomes and promising traction emerge, the procedure could be applied in other production sectors or geographical areas³⁷⁵³⁷⁶.

6.5 Main risks and mitigation strategies

- **Risk of low investor participation**

- Mitigation: involvement of public entities or guarantee institutions in the pilot phase³⁷⁷³⁷⁸.

- **Risk of excessive complexity of the verification system**

³⁷¹ BIS. (2022). *Climate transition risks and financial stability*.

³⁷² OECD. (2021). *Policy monitoring and evaluation for green industrial transitions*.

³⁷³ OECD. (2022). *Evaluation frameworks for climate and industrial policy*.

³⁷⁴ Polzin, F. et al. (2017). *Public policy influence on financing for clean energy innovation*.

³⁷⁵ UNIDO. (2023). *Demand-side policies for industrial decarbonization*.

³⁷⁶ Mission Possible Partnership. (2021). *Net-Zero Industry Pathways*.

³⁷⁷ OECD. (2022). *Blended finance and de-risking instruments for industrial decarbonization*.

³⁷⁸ World Bank. (2021). *Public guarantees and risk-sharing mechanisms for climate investments*.

- Mitigation: modular design of the MRV, with increasing levels of sophistication³⁷⁹³⁸⁰.
- **Risk of poor supply chain coordination**
 - Mitigation: creation of platforms for dialogue and multi-level governance.
- **Reputational risk (greenwashing)**
 - Mitigation: transparency, independent audits, periodic publication of results³⁸¹³⁸².

6.6 Conclusion of the chapter

The Green Commitment Bond is an experimental proposal that aims to overcome one of the main bottlenecks in the industrial transition: the lack of credible demand for low-emission products³⁸³³⁸⁴. The roadmap outlined in this chapter does not claim to offer a definitive solution, but provides a concrete operational framework for testing the instrument in the Italian context, highlighting the need for a gradual, coordinated and learning-oriented approach³⁸⁵³⁸⁶. In this sense, the GCB can be interpreted as a laboratory for financial innovation applied to industrial and climate policy, whose main value lies in its ability to integrate finance, the market and public governance into a single framework for action³⁸⁷³⁸⁸.

³⁷⁹ ISO. (2006). *ISO 14040: Life Cycle Assessment – Principles and framework*.

³⁸⁰ ISO. (2018). *ISO 14067: Carbon footprint of products*.

³⁸¹ BIS. (2021). *Greenwashing and climate-related disclosure risks*.

³⁸² ICMA. (2022). *Sustainability-Linked Bond Principles*.

³⁸³ IEA. (2018). *Low-Carbon Transition in the Cement Industry*.

³⁸⁴ IEA. (2020). *Iron and Steel Technology Roadmap*.

³⁸⁵ OECD. (2021). *Learning-by-doing and experimental policy approaches for sustainability transitions*.

³⁸⁶ Author's elaboration, this dissertation (Operational roadmap for GCB in Italy).

³⁸⁷ European Commission. (2019). *The European Green Deal*.

³⁸⁸ Mazzucato, M. (2021). *Mission Economy*.

CONCLUSIONS

Attempting to tackle the ecological transition without considering demand appears increasingly difficult. Not only do policies focused solely on supply reveal obvious limitations, but they often ignore the weight of real industrial dynamics. Clear signals from the market become essential, especially where emissions remain high despite new technologies. Even when promising innovations are developed, there is often a lack of context that would allow them to be exploited in practice. Traditional forms of green financing favour safe areas, avoiding those sectors that would actually need more support. In fact, it is precisely the most critical sectors that remain marginal in collective investments. Without robust and constant demand, even significant progress risks stalling before it really takes off.

In the Italian cement and steel sectors, some of the typical weaknesses of industries that are difficult to decarbonise are clearly emerging. Industrial structures that require large amounts of capital have very long production cycles, while global competition weighs heavily on operational flexibility and the additional costs associated with the transition find little room in company budgets. It is here, however, that the role of demand goes beyond its traditional function as an economic indicator and becomes a driving force for structural change. Mandatory standards shape more sustainable purchasing behaviour, public procurement with environmental criteria guides upstream strategic choices, coalitions between large customers generate predictable markets, and stable agreements over time guarantee certain future revenues. All this directly influences the perception of financial actors, as the risk associated with clean plants appears lower, credit conditions are gradually easing, and investments in low-emission technologies are gaining ground. The thesis presents a model that combines social demand, uncertainty and access to credit, showing how demand indicators can be transformed into useful elements for financial decisions. From this point of view, the Green Commitment Bond emerges as concrete proof of application, incorporating levers to stimulate demand in the design of green instruments. It is not the technical accuracy of the GCB that makes it significant, but the fact that it embodies a radical change: no longer just distributing money, but shaping conditions for new climate-sustainable markets to take shape.

This is not a closed recipe, but an open process: the map in the concluding chapter points to a concrete direction for testing models in the national system. Gradually, together with private entities and institutions, through rigorous controls and continuous adjustments, a flexible approach is formed. From this point of view, the GCB makes sense when seen as a space for testing new forms of credit at the service of industry and ecological transition. What matters is its function as a link between economic instruments, market dynamics and collective decisions, all held together by a coherent design.

In conclusion, new directions for research are emerging. Concrete studies will be required to measure how signals from demand influence risk models in the financial system; at the same time, small-scale tests will need to verify how well demand-based financial instruments actually work in real market situations. Examining different countries or distinct production sectors would reveal useful details about the regulatory and organisational characteristics that favour certain forms of demand-driven finance. With the climate crisis accelerating, linking demand strategies, sustainable investments and industrial planning is no longer just a theoretical exercise but becomes an essential part of the process of defining practicable changes in industrial areas where reducing emissions is particularly complex.

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