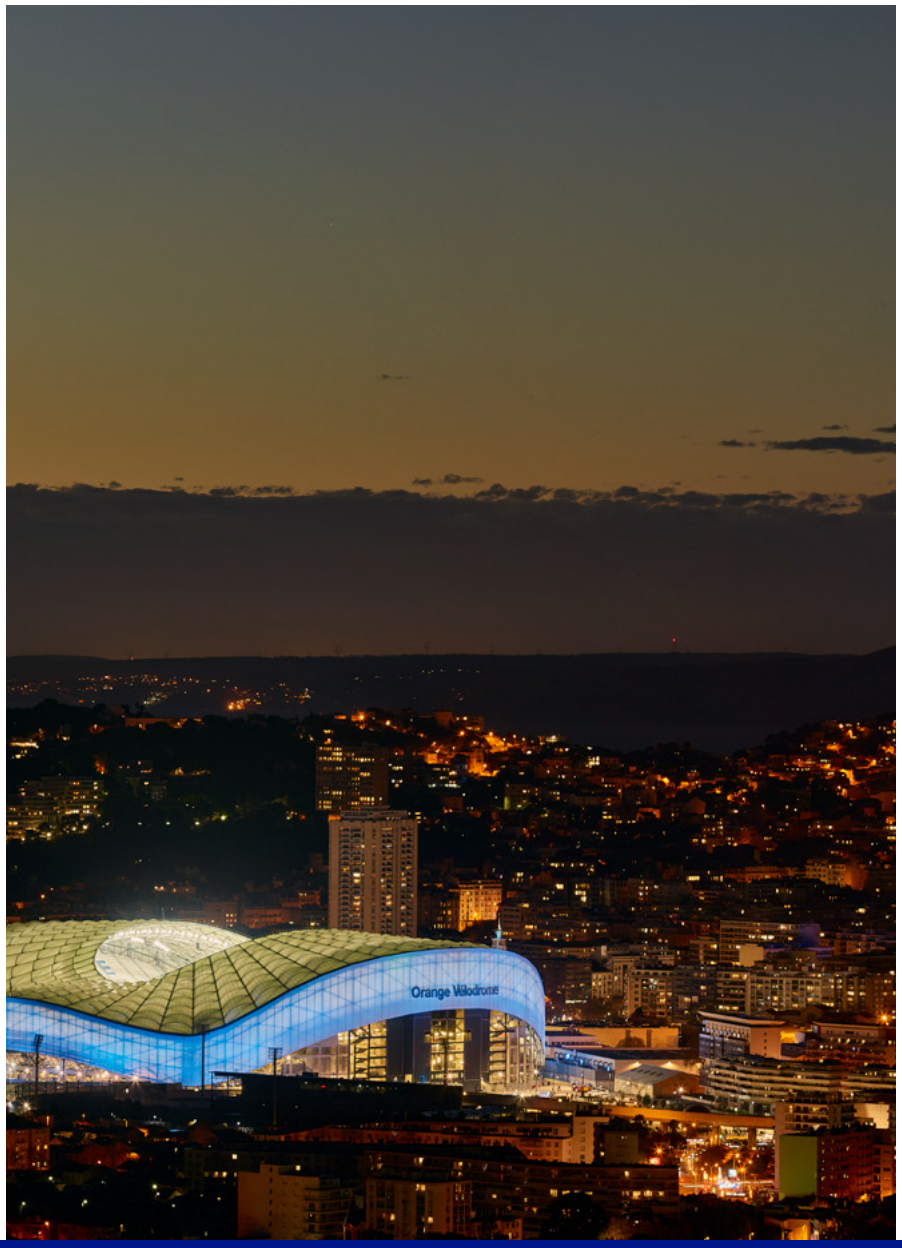

INFRASTRUCTURE FOR CLIMATE

A COMPREHENSIVE AND VALUE-DRIVEN APPROACH — **2021**

Altermind

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Altermind is a boutique strategy consultancy.
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Vauban Infrastructure Partners is a leading Infrastructure Asset Manager focused on the European core infrastructure investments. Based in Paris and having a subsidiary in Luxembourg, it employs 50 professionals working together since a decade. Vauban is the fully fledged affiliate of Natixis Investment Managers, dedicated to sustainable infrastructure equity investments. Vauban targets predominantly European brownfield mid-market assets pursuing a long-term yield-driven strategy matching the underlying nature of assets and long-term commitment to all stakeholders' interests through a strong focus on creating sustainable value. Vauban has raised c. €6 billion across 6 funds in core infrastructure from over 70 investors within 15 different countries and has invested in over 60 assets in mobility, energy transition, social & digital infrastructure across 10 different geographies.

FOREWORD

Since its creation, Vauban Infrastructure Partners has engaged in the long-term development of assets providing essential services to local communities: clean water, safe and efficient transportation, very high-speed communication networks, and a broad range of social services around education, health, justice and leisure. We believe that we have a shared responsibility as investors to build and maintain vital infrastructure systems so that communities can thrive and create new possibilities for us all.

Society is subject to a threefold transition: it faces a host of far-reaching environmental, social and digital challenges. The digital transition brings new opportunities but also raises questions. Climate change is a threat which requires urgent action. The territorial divide, social inequalities, generational cleavages also need to be addressed to ensure social cohesion.

We, at Vauban Infrastructure Partners, want to contribute to taking up these challenges and embedding them in our investment approach. It is a critical success factor for each and every investment Vauban Infrastructure Partners is involved in. Stakeholder engagement and social license to operate are key to manage the essential infrastructures we invest in.

In 2020, in the study on "Infrastructure 4.0" conducted with Altermind, we focused on the impact of the digital transition on infrastructures and showed how, in the aftermath of the Covid-19 crisis, digitalization of infrastructure is an agent of both resilience and upside in an uncertain world.

The World Meteorogical Organisation has made it clear that "2021 is a make-or-break year for climate action, with the window to prevent the worst impacts of climate change." We have a collective responsibility to step up with much more ambitious emissions reduction targets and adaptation requirements. In this context, sustainable infrastructures are more than ever a prerequisite.

This is why we have decided, with the help of Altermind, to engage in a thorough reflection about climate strategies for infrastructure, combining academic and business perspectives.

Vauban IP is committed to working towards a gradual improvement of its investments' temperature alignment and carbon footprint, and is already ahead of market practices, driven by the concrete actions implemented at investment level.

This study is intended to help us enhance and strengthen our climate strategy as well as contribute to the collective reflection.

Gwenola Chambon,
CEO, Founding Partner

Mounir Corm,
Deputy CEO, Founding Partner

EXECUTIVE SUMMARY

On 9 August 2021, the Intergovernmental Panel on Climate Change (IPCC) released its sixth assessment report (AR6), in the midst of a series of extreme weather events around the world (heat waves in North America and Siberia, droughts, extreme rainfalls in Europe, China or India, etc.). This report reiterates the previous warnings made by the IPCC on the **consequences of climate change on human life and biodiversity,** while underlining the acceleration of these phenomena.

At the opening of the IPCC session, UN climate change executive secretary Patricia Espinosa warned that the current trajectory is taking the world towards a 3°C rise, far beyond the goals of the Paris Agreement[1].

This situation requires strong mitigation actions to be taken to achieve net zero by 2050 – **a "narrow but feasible" path,** according to the International Energy Agency (IEA)[2] . Likewise, while it has generally been given a secondary status, adaptation to climate physical risks is becoming vital.

Facing these challenges, a policy push and the mobilization of the private sector will be crucial. Private companies will have to **adapt to a fast-changing environment,** in which citizens are increasingly involved, as illustrated by the various experiences of Citizens' Conventions for Climate in Europe. Investors will also have **to adapt to new finance regulations, notably the EU Green Taxonomy,** which defines a common classification system for sustainable economic activities.

Infrastructures have a critical role in the development of low-carbon and climate-resilient economies and societies. In this respect, they raise specific issues: most infrastructures were **not designed to be climate-proof,** are involved, through their uses, in a large part of worldwide GHG (greenhouse gas) emissions and are exposed to both climate and transition risks (i.e. changes in regulations, usage patterns or business models).

Sustainable infrastructures are the answer, in order to meet the population's essential service needs, based on all-round sustainable principles. In particular, as they account for up to 70% of global emissions today and represent over 70% of the global demand for infrastructure for the next 15 years, **cities will be at the forefront of the rise of sustainable infrastructures.**

In this context, the key challenge for infrastructure stakeholders is to determine a **relevant climate strategy.** This imperative is essential for all sectors of activity, but is both more urgent and more complex in the field of infrastructure, given their generally long lifespan (and the risks of "stranded assets" that hang over them in a changing world, under climate pressure).

This study, conducted by Vauban Infrastructure Partners and Altermind, argues that climate strategies must concurrently be comprehensive and value-driven.

Comprehensive climate strategies mean:

→ **Combining mitigation and adaptation, building on their complementarities.** This plays at two levels: (i) deploying infrastructure assets which are, in themselves, favorable to mitigation (such as electric mobility equipment and infrastructures) or adaptation (such as coastal defenses), and (ii) transforming all infrastructures

[1] UN News, UN climate science talks open amid heatwaves, floods and drought, July 26, 2020.
[2] And it should be noted that, by early 2021, more than 70% of global emissions are covered by mid-century net-zero commitments (also according to the IEA).

in order to be low-GHG and climate-resilient. From this perspective, infrastructure assets should focus on scopes 1 and 2 but also on scope 3, which requires an ecosystemic approach to be put in place, with reinforced cooperation with suppliers, business partners and clients;

→ **Giving more consideration to enabling technologies, in particular Information Communication Technology (ICT):** the debate on energy consumption should better take into account their abatement potential, through the improvement of energy efficiency or the replacement of more carbon-intensive usages;

→ **Favoring synergies,** which occur when interactions between adaptation and/or mitigation measures lead to greater benefits than when they are implemented separately. Sector coupling – i.e. a strategy that provides greater flexibility to the energy system in order to achieve a more cost-effective decarbonization – is one of the main opportunities for promoting such synergies, especially in transport, buildings, industry or data centers;

→ **Enhancing co-benefits,** which are the additional positive social, environmental, health (such as air quality improvement) and economic benefits attributed to climate projects above and beyond the main benefits of expected GHG reduction. Co-benefits are achieved in the short term, whereas adaptation and mitigation impacts may take a longer time horizon to be realized.

Value-driven climate strategies mean:

→ **Supporting a value perspective combining business performance and collective value,** i.e. environmental and social, near term and long term. This is all the more relevant as academic research shows that Environmental and Social Governance (ESG) strategies are now part of the levers that can improve profitability;

→ **Implementing sustainable business models,** which create competitive advantage through superior customer value and contribute to sustainable development. From that perspective, some business models are currently emerging in infrastructure sectors around various sources of cost savings, efficiency gains and additional services.

The work undertaken, by Altermind, with academic experts from various fields, industrial partners and portfolio assets from several sectors as well as investors, has enabled Vauban IP's to **sharpen its vision of climate strategy.**

Vauban IP is therefore **reasserting its ambition, as a multi-sector infrastructure investor, to accelerate the transition towards sustainable infrastructure.**

Through its climate strategy, Vauban IP aims to **create and maximize value for all infrastructure stakeholders** – investors, public authorities, industrial partners, infrastructure assets, citizens, etc. – with a comprehensive and long-term approach to value.

Methodology of the study

Reflecting Altermind's DNA, this study combines academic expertise with business insights, relying on the review of the existing literature and the outcome of thematic workshops organized with academic experts, investors and managers of Vauban IP's portfolio.
Altermind has mobilized its network of academics and experts in order to bring perspective to this study, with a cross-sector approach. They have presented their views and interacted with professionals during four workshops dedicated to (i) the changing regulatory environment of infrastructure, (ii) mitigation, adaptation, and beyond, (iii) climate strategy and value creation and (iv) Vauban IP's climate strategy. The biographies of the experts are presented in Appendix 1 and the participants to all workshops are listed in Appendix 2.

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A comprehensive and value-driven approach

The acceleration of the climate agenda: an unparalleled challenge to be met

Section | **1**

Key takeaways

→ Facing the urgency of the climate crisis, climate agendas have accelerated. The path towards carbon neutrality by 2050 is "narrow but feasible." But it requires radical changes by 2030: the 2020 decade will therefore be crucial to reach the Paris Agreement targets. Likewise, while it has generally been given a secondary status, adaptation to climate physical risks is becoming more and more vital

→ Facing these challenges, the regulatory environment is evolving rapidly, with the extension of carbon pricing schemes and new regulations. Citizens tend to be increasingly involved with this process, in order to ensure its social acceptability

→ These regulatory changes impact business strategies as well as investors, as illustrated by the EU Green Taxonomy

CARBON NEUTRALITY AND PHYSICAL RESILIENCE, NOW

LOOKING BACK TO THE PARIS AGREEMENT

Since the adoption of the **Paris Agreement** at the 21st Conference of Parties (COP21) in 2015, a global momentum to tackle the climate crisis has been building. The Paris Agreement introduced an ambitious country-led framework to advance the global response to the threats posed by climate change and reframed global efforts around three common goals[3]:

- **Transforming economies and societies to limit global warming** "to well below 2°C", pursuing efforts to limit the temperature increase to 1.5°C, and achieving a "balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases (GHG)" in the second half of the 21st century. This requires **mitigation actions,** in order to reduce or limit GHG emissions or protect and enhance GHG sinks and reservoirs;

- **Fostering the adaptation of individuals, assets, economies and societies** to the physical impacts of climate change over the near and long term. This requires **adaptation actions;**

- **Making all financial flows consistent with long-term climate goals,** including all public budgets and spending, operations of the financial system as a whole including public and private actors, as well as investments of companies and individuals.

→ Still, insufficient progress has been made at this stage, **driving the climate system into unknown territory with severe projected consequences[4].** The economic costs of climate change are estimated to range from 2% to 10% of global GDP loss by the end of this century[5], it being specified that this type of calculation cannot really take into account the effects of increased geopolitical instability and the risks of conflicts that will inevitably result from it;

→ Facing such pressing uncertainties, to reach the Paris Agreement targets, **climate agendas have recently accelerated.**

> **As evidenced by the IPCC, the climate system is entering into unknown territory."**

> **The EU, the US and even China have strengthened their commitments to achieving carbon neutrality."**

LOW CARBON BY 2030, NET ZERO BY 2050

Governments' reinforced commitments

To comply with the Paris Agreement, more and more governments have recently committed to carbon neutrality by 2050:

→ In December 2019, the European Commission presented the European Green Deal, its flagship plan to **reduce the EU's GHG emissions by at least 55% by 2030** compared to 1990 levels, thus to make Europe climate neutral by 2050. In July 2021, the European Commission unveiled its most ambitious plan aiming to turn green goals into concrete action in the 2020 decade: **the "Fit for 55"** package puts the bloc on track to **"give humanity a fighting chance"** against climate change. Without the package, under current EU climate legislation, Europe will only achieve a 60% emissions reduction by 2050[6];

→ The United States (US) will rejoin the Paris Agreement with the ambition to reach net-zero emissions no later than 2050: the first milestone of this ambition, the **Biden Plan** – which will amount to $1.2 trillion over the next eight years – aims to ensure the US achieves a 100% clean energy economy by 2035[7], with a strong stimulus for infrastructure ($312 billion for transportation projects, $266 billion for water infrastructure, telecommunications, energy and resilience)[8];

→ **China** still lags behind but announced in September 2020 its ambition to start lowering GHG emissions in 2030, to achieve **carbon neutrality by 2060[9]:** as the world's largest emitter of CO_2 (about 30% of total GHG emissions), China's commitment is crucial to ensuring the success of limiting global warming to well below 2°C. This could be a "game-changer" for the climate change fight as it could encourage other countries and stakeholders to act faster than they otherwise would have[10].

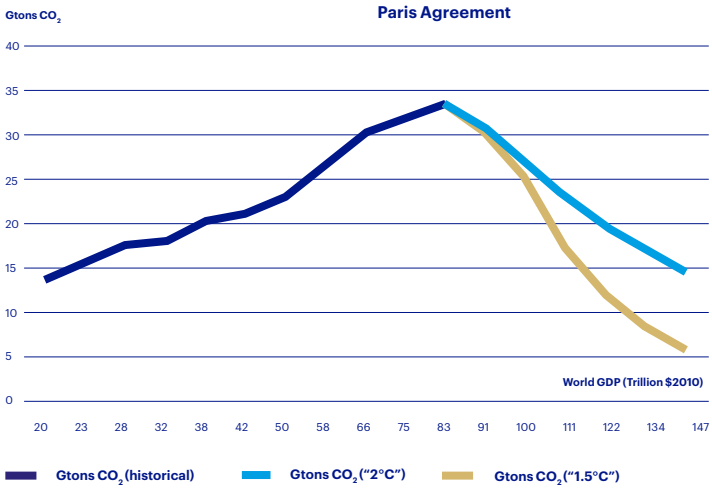
The breadth of this challenge should not be underestimated: to limit the temperature increase to 1.5°C in 2050, the imperative is to return to **the 1950 level of CO_2 emissions in 2050, with a GDP ten times greater and a population multiplied by four[11]** (Figure 1). These developments open up a new macro-economy (where GDP and CO_2 will be decoupled), the characteristics of which are still unclear especially because of the resulting risks of economic (stranded assets), social, and geopolitical instabilities.

[3] I4CE, A Framework for Alignment with the Paris Agreement: Why, What and How for Financial Institutions?, September 2019.
[4] IPCC, Special Report on Global Warming of 1.5 ºC, October 2018.
[5] Corfee-Morlot J., Kete N., Erdenesanaa D., Building resilience and infrastructure in a warming world, building back better in response to COVID-19, OECD Development matters, August 2020.
[4] Tagliapietra S., Fit for 55 marks Europe's climate moment of truth, Bruegel, July 14, 2021.
[5] Trabish H. K., "Biden's $2.3 trillion infrastructure plan meets power system needs but leaves room for political dealing", Utility Dive, April 2021.
[6] The White House, Statement by President Joe Biden on the Bipartisan Infrastructure Framework, June 26, 2021.
[7] Garcia-Herrero A., Tagliapietra S., China has a grand carbon neutrality target but where is the plan?, Bruegel, April 2021.
[8] Nature, How China could be carbon neutral by mid-century, October 20, 2020.
[9] Geoffron P., Vers une société post-carbone, Note de la Fondapol, 2019.
[10] Nature, How China could be carbon neutral by mid-century, October 20, 2020.
[11] Geoffron P., Vers une société post-carbone, Note de la Fondapol, 2019.

FIGURE 1

The urgent need to decouple CO_2 emissions from global GDP

Source: P. Geoffron, 2019, data from UNFCCC, IEA, World Bank



This transformation is **technically possible** but **will require significant policy reforms** and **additional technological innovation.** To quote the latest report of the International Energy Agency (IEA), the path to be taken is **"narrow but feasible"[12].**

The time horizon is shorter and shorter, given the urgency of the climate crisis: the 2020 decade will be crucial.

Engaging the private sector in the climate fight

Achieving net zero by 2050 will require policy reforms and huge public investment. But it also depends on the **private sector.** As 100 companies are responsible for 71% of carbon emissions since 1998, the private sector has a key role to play and strong leverage in this transition[13]. It can mobilize **financial resources and technical capabilities, develop innovative climate services and adaptation technologies** and leverage the efforts of governments.

These emissions are usually classified in three categories called "scopes":

Scope 1: direct emissions from owned or controlled sources (fuel combustion in boilers, furnaces, vehicles, etc.);

> **The private sector should be at the forefront of climate action, focusing on all direct and indirect emissions."**

Scope 2: indirect emissions from the generation of purchased energy (electricity, steam, heat, cooling);
Scope 3: indirect emissions that occur in the value chain, including emissions upstream and downstream.

Since the adoption of the Paris Agreement, a growing number of economic actors has thus taken commitments and actions to "align" their activities with the goals agreed to by national governments in 2015. Private companies tend to focus their climate strategies on their own direct and indirect emissions (scopes 1 and 2) and, more and more, on indirect emissions occurring in the value chain, upstream and downstream (scope 3). Under the **Science Based Targets initiative** (SBTi), over 1,000 companies have committed to set emissions reduction targets in line with the Paris Agreement, and more than 340 have committed to set net-zero targets across their operations and value chains.

PHYSICAL RESILIENCE: A RISING CONCERN

Climate-related extreme events are on the rise in both **frequency and intensity** since the last decades of the 20th century, with a significant uptick in floods and hydrological events[14].

Despite this, **adaptation concerns have usually been neglected.** The main share of global climate finance flows is dedicated to mitigation measures, with some 5% only going to adaptation[15]. Although climate adaptation finance flows have increased by 35% in recent years[16], they still fall short of what is needed to avoid severe impacts from climate change, especially in developing countries.

Recent events however show how adapting to climate change has become crucial. For instance, the heatwave in North West America in the summer 2021 showed the increasing importance of adaptation and the need to prepare for more frequent extreme events and improve resilience.

Still, according to a study by the Carbon Disclosure Project (CDP) of over 800 cities around the globe, nearly half of them do not have an adaptation plan. This is all the more worrying that, although Vancouver has been ranked in the A list of the CDP ("best adapted cities"), the Canadian city has been severely struck by the heatwave, in the summer of 2021, highlighting the need to put adaptation as a priority on climate agendas[17].

New climate strategies try to be more compliant with adaptation requirements. For example, the European Commission adopted an **Adaptation Strategy in February 2021** in order to improve and accelerate the EU's efforts to protect nature, people and livelihoods against the unavoidable impacts of climate change and become climate-resilient by 2050[18].

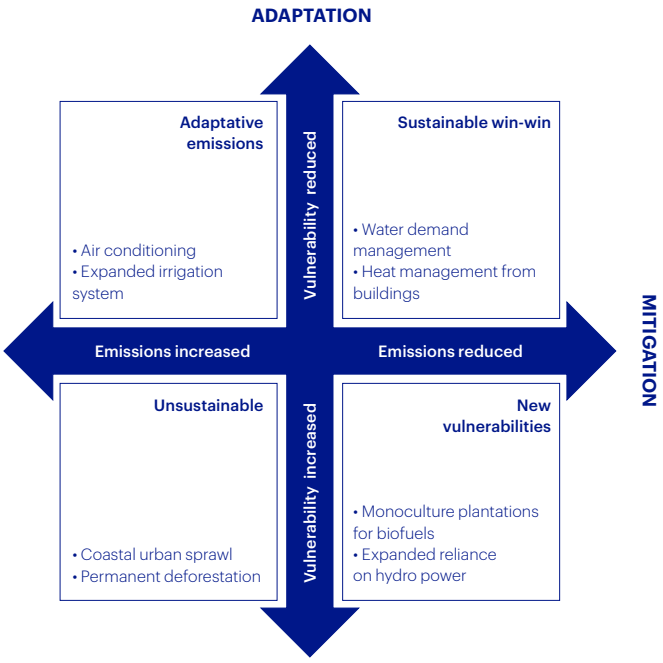
Mitigation and adaptation may be subject to conflicts: it is thus of paramount importance to foster complementarities between them and implement **actions enabling the achievement of both adaptation and mitigation goals[19].**

[12] International Energy Agency, Net Zero by 2050: A Roadmap for the Global Energy Sector, May 2021.
[13] Carbon Disclosure Project, Carbon majors report, 2017.
[14] The European Academies' Science Advisory Council (EASAC), Extreme weather events in Europe: Preparing for climate change adaptation: an update on EASAC's 2013 study, March 21, 2018.
[15] United Nations Development Programme, Climate change adaptation priorities help address everyday risks, March 2021.
[16] The World Bank, Unlocking Private Investment in Climate Adaptation and Resilience, March 2021.
[17] CDP, Cities on the route to 2030, Building a zero emissions, resilient planet for all, May 2021.
[18] European Commission, Forging a climate-resilient Europe – the new EU strategy on Adaptation to Climate Change, COM(2021) 82, February 2021.
[19] I4CE, A Framework for Alignment with the Paris Agreement: Why, What and How for Financial Institutions?, September 2019.

FIGURE 2

Examples of adaptation mitigation trade-offs and synergies

Source: IPCC, WGII. 2014. AR5, Chapter 2 "Foundations for Decision Making" [20]



A FAST-CHANGING REGULATORY ENVIRONMENT

THE NEED FOR AN AGGIORNAMENTO OF PUBLIC POLICIES AND REGULATIONS

In the **presence of externalities and path dependency,** public intervention is necessary to reach the Paris Agreement commitments and create a sustainable world, which is **not the least of the challenges.** To achieve the transformative change needed towards a more sustainable economy, governments can use a variety of policy options *(Figure 3)*.

Among these tools, **taxation and tradable permits** are generally considered as powerful tools but pose the problem of social acceptability and international coordination. There is indeed a "tragedy of horizons" (highlighted by Gov. Mark Carney[22]) between the need to prevent the catastrophic impact of climate change on future generations and the lack of incentives for the current generation to act coherently, meaning without further delay.

This explains why explicit carbon pricing systems (tax or carbon market) have been put in place in jurisdictions accounting for around **60% of global GDP** and more than 75% of emissions regulated by carbon pricing are still covered by **a price below $10**, while the international scientific consensus estimates optimal prices to be between $40 and $80/t CO_2 eq. in 2020 and between $50 and $100/t$CO_2$ eq. by 2030[23] *(Figure 4)*.

The most comprehensive carbon market today is the **European Union Emissions Trading System (EU ETS):** it is a key tool for

> **The IEA estimates that the path to carbon neutrality is 'narrow but feasible'."**

Explicit carbon pricing systems are a key tool against climate change but face social acceptability issues."

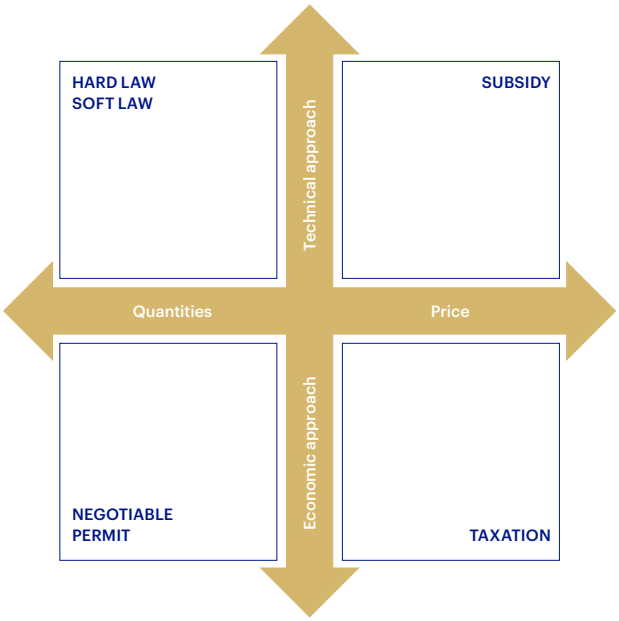
reducing, on a cost-effective basis, GHG emissions from the regulated sectors. The system covers around 40% of the EU's emissions from 10,000 installations in the power sector, manufacturing industry, and aviation within the European Economic Area[24]. At the end of August 2021, the EU carbon price exceeded the €60 level per ton, so that this variable is no longer a secondary factor for the sectors subject to it.

In its **"Fit for 55"** package presented in July 2021, the European Commission launched a revision process for the EU ETS and announced its intention to lower the overall emission cap and increase its annual rate of reduction, include transport and building in the process and set a new carbon border adjustment mechanism to put a carbon price on imports and avoid "carbon leakage."

FIGURE 3

Public levers for decarbonization

Source: Altermind [21]

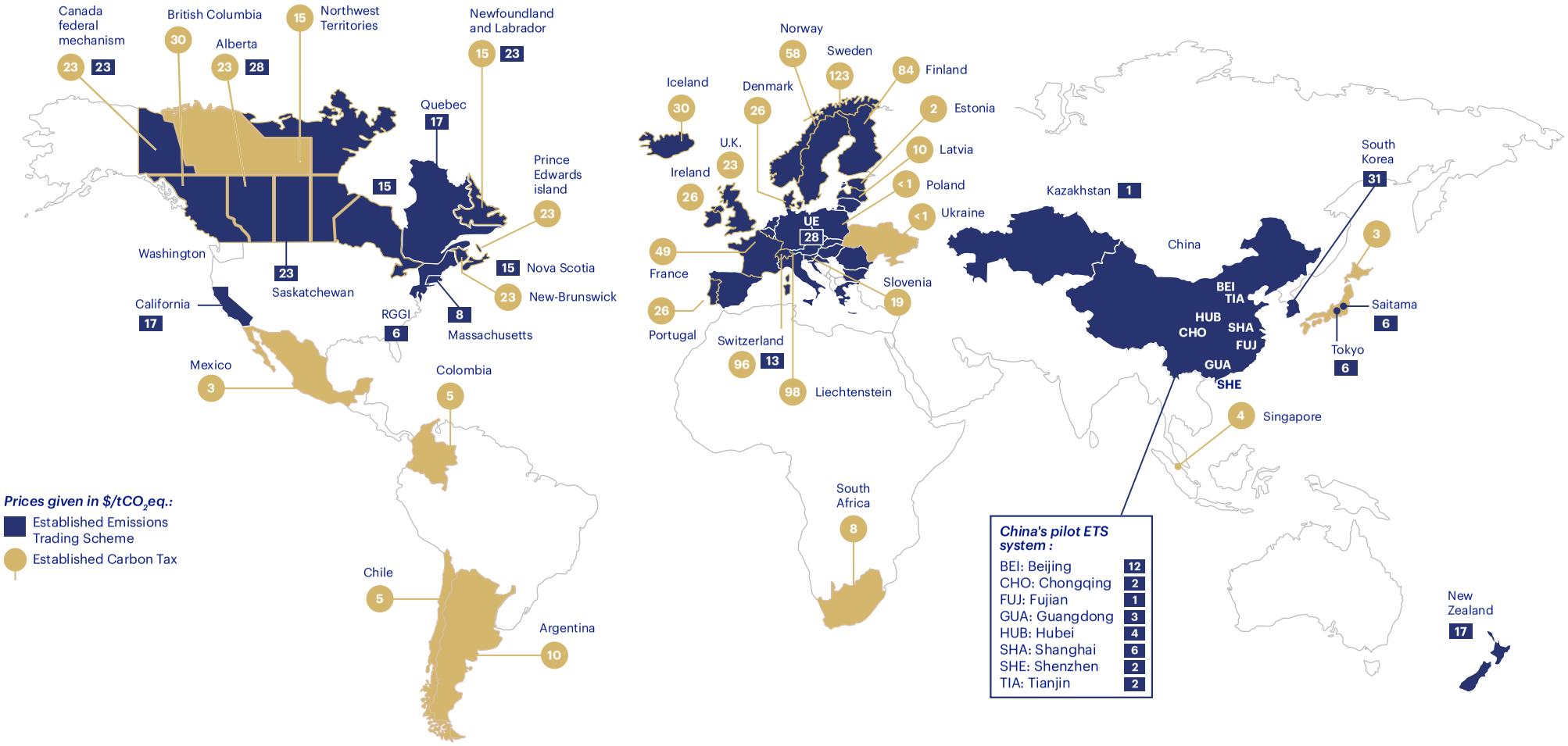


[20] IPCC, WGII. AR5, Chapter 2 "Foundations for Decision Making", 2014.
[21] Inspired from TDIE, Les effets externes des transports : définition, évaluation et implications pour les politiques publiques, July 2019.
[22] Mark Carney: Breaking the tragedy of the horizon – climate change and financial stability, Speech by Mr Mark Carney, Governor of the Bank of England and Chairman of the Financial Stability Board, at Lloyd's of London, London, September 29, 2015.
[23] I4CE, Global Carbon Account 2020, May 2020.
[24] European Commission, Climate Action, EU Emissions Trading System (EU ETS).

FIGURE 4

Map of explicit carbon prices around the world in 2020

Source: Institute for Climate Economics (I4CE) with data from ICAP, World Bank, government officials and public information, May 2020



[25] European Environment Agency, More national climate policies expected, but how effective are the existing ones?, 2020.
[26] European Commission, Directive (EU) 2018/844 of the European Parliament and of the Council of May 30, 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency, May 2018.
[27] Ministère de la Transition écologique, Politiques publiques / de A à Z, Construction et performance environnementale du bâtiment, September 2020.

To address climate change, governments tend to favor **subsidies** and **regulation** – hard or soft law. In 2019, EU Member States reported they had already adopted or were planning to adopt **1,925 national policies to reduce GHG emissions**, most of which were regulations targeting energy supply or energy consumption[25]. As an example, regulation plays a critical role in the building renovation sector *(Focus 1)* and in the waste industry.

A NEW CATEGORY OF ACTIVE STAKEHOLDERS: CITIZENS

The OECD's work on trust and public policy indicates that citizens' perceptions of fairness, in process as much as in outcome, is a critical dimension of their trust in

FOCUS 1

The construction sector: adaptating to new regulations

Key trends for building renovation towards 2030 and 2050
The construction sector must swiftly evolve given changing regulations, especially at the European level. The EU has already developed a comprehensive legal and regulatory framework for construction including European standards as well as financial tools, information platforms, labelling systems and related instruments. As part of the European Green Deal, the European Commission plans a potential revision of the EU energy performance of buildings directive (EPBD) to help identify specific measures to accelerate the rate of building renovations, contributing to energy efficiency and renewable goals[26]. More recently, buildings have been targeted, as well as transportation, as a priority of the new European decarbonization strategy "Fit for 55" with a stand-alone ETS by 2026 (see below).

Construction regulation in France
In order to achieve carbon neutrality by 2050, France is regulating construction by imposing an energy performance level to be reached, setting requirements for reducing energy consumption in tertiary buildings, and implementing measures and financial aid to build or renovate in an energy-efficient manner[27].
The environmental regulation for new buildings (the "RE 2020") is the standard that will regulate new construction from January 1, 2022.

EXPERT POSITION 1

Bouygues Construction's strategic move to adapt

At Bouygues Construction, we see the reinforcement of constraints on energy and carbon regulation for building as an ecological necessity and a business opportunity. Our strategy is focused on renovating existing buildings, constructing new high-performance buildings, decreasing energy demand due to uses and equipment, reducing the ecological impact of our cements, etc."

Pascal Minault, CEO of Bouygues Construction

FOCUS 2

Key learning from Citizens' Climate Convention[30]

→ While mitigation usually dominates the public debate, citizens have understood the importance of adaptating to the effects of climate change
→ Transport infrastructure is a central issue in the debate: constraints on the use of air transport, promotion of modal shift to rail, deployment of charging stations for electric vehicles, adaptation of urban space to public transport and cycle paths
→ Carbon taxation does not emerge as a central issue although taxes are envisaged on polluting activities (aircraft, heavy industry)
→ Citizens demand a clear display of the environmental footprint of their consumption of products and services and emphasize the need for sobriety and for circular economy mechanisms

"The French and UK Conventions have underlined the need to ensure the citizens' voice is heard and that climate packages are acceptable for the whole population. The conventions also show citizens that addressing climate change is not only a way to 'change the world' but also provides local benefits, such as the improvement of air quality."

Patrice Geoffron,
Professor of Economics at University Paris-Dauphine

government[28]. In this context, public authorities tend to **involve citizens directly** in solving some of the most pressing policy challenges, especially the climate crisis.
Several countries across Europe (France, UK, Belgium, Germany, Denmark) have launched **Citizens' Conventions to tackle climate change,** following a **deliberative** model. While direct involvement in public decision-making processes by citizens is not completely new, there is a wave underway towards greater experimentation in their purpose, design, combination with other forms of participation, and institutionalization.

The **French Citizens' Convention for Climate** (CCC) was the **leading political experiment** placing citizens' voices at the center of national conversations on climate policy. Meeting over seven sessions from October 2019 to June 2020, 150 randomly selected citizens were tasked by President Emmanuel Macron to craft recommendations for France to reduce its carbon emissions by 40% before 2030[29]. In June 2020, the French Convention submitted its report, calling for a **shift towards a low-carbon economy,** with extensive changes in infrastructure, in particular transportation.

A POWERFUL LEVER: SUSTAINABLE FINANCE

The financial sector plays a key role in the low-carbon transition by **contributing to the allocation of capital and sharing risks with economic actors.** The Paris Agreement has set a renewed context for the financial ecosystem regarding its contribution to climate actions: the concept of aligning finance with the Paris Agreement has emerged as the new paradigm for increasing climate action ambition within the financial sector.

Citizens are increasingly involved in climate policy processes."

The EU is particularly advanced in this subject. As part of the EU Action Plan on Sustainable Finance[31], the new climate regulation constitutes an exceptional momentum for investors to adopt an "impact-based approach" and deploy strategies to fulfill the European climate transition ambition. The EU Sustainable Finance framework is based on (i) the **Non-Financial Reporting Directive** (NFDR), which regulates the disclosure of non-financial information by corporations, (ii) the **Sustainable Finance Disclosure Regulation** (SFDR), which introduces rules for financial markets, participants and financial advisors to report on how they account for sustainability risks and (iii) **the EU Taxonomy** which will help investors assess whether investments are meeting robust environmental standards consistent with high standards such as the Paris Agreement.
The EU Taxonomy regulation, which entered into force in July 2020, reflects a common **European classification system for environmentally sustainable activities.** This new framework is essential for investors to prevent "greenwashing" – i.e. a situation in which financial products are marketed as being sustainable without meeting sustainability criteria.
Through its very wide scope, the European taxonomy regulation can be **a tool to guide companies and investors in transition towards sustainability** as it defines a

[28] OECD, Trust and Public Policy: How Better Governance Can Help Rebuild Public Trust, OECD Public Governance Reviews, OECD Publishing, May 2017.
[29] Convention Citoyenne pour le Climat, Rapport de la Convention Citoyenne pour le climat à l'issue de son adotion formelle dimanche 21 juin, June 2020.
[30] Source: Patrice Geoffron, Workshop 1.
[31] European Commission, Renewed sustainable finance strategy and implementation of the action plan on financing sustainable growth, March 2018.
[32] EU technical expert group on sustainable finance, Technical report, March 2020.
[33] Reuters, U.S. regulators seen developing 'green taxonomy' to provide guidance to financial firms, July 15, 2021.

common classification system for sustainable economic activities.

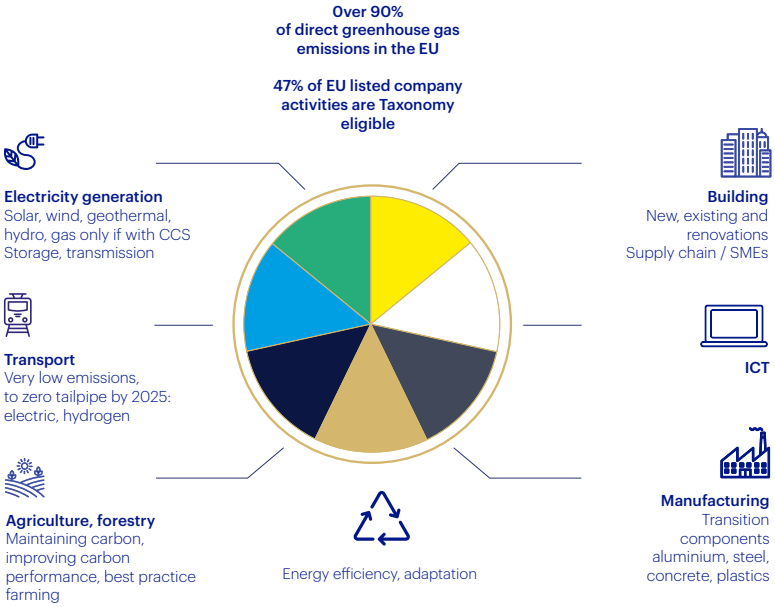
It defines **six environmental objectives** and considers an economic activity as sustainable if this activity contributes at least to one of these objectives without, at the same time, doing significant harm to any of the other objectives.

With the EU Taxonomy, activities that in and of themselves contribute substantially to one of the six environmental objectives will benefit from new funds. Two other categories of activities are included in the EU Taxonomy:
→ **Transitional activities** where there are no technologically and economically feasible low-carbon alternatives, that support the transition to a climate-neutral economy; and
→ **Enabling activities** which enable other activities to make a substantial contribution to one or more of the objectives where that activity (i) does not lead to a lock-in in assets undermining long-term environmental objectives, considering the economic lifetime of those assets, and (ii) has a substantial positive environmental impact on the basis of lifecycle considerations.
It is worth noting that, besides the EU, other governments (such as Singapore or China) are on the way to adopting their own taxonomy, with some regional adaptations. In the US, the EU Taxonomy might serve as a model for the future development of a common framework to help financial firms manage their climate risk exposures[33]. The development of green finance would be made more effective by being a **worldwide process.**

FIGURE 5

Scope of the EU Taxonomy

Source: European Commission



> **The EU Green Taxonomy is a tool to guide companies and investors in transition towards sustainability."**

FIGURE 6

Conditions of the EU Taxonomy

Source: EU Technical Expert Group on Sustainable Finance, 2020[32]

The EU Taxonomy regulation will have a significant impact on infrastructure, shifting allocation towards clean investments. It will open new opportunities for many sectors. Some risks will need to be addressed to ensure its success, such as financial bubbles."

Mounir Corm, Deputy CEO and Founding Partner of Vauban Infrastructure Partners

At AG Insurance, even before the strengthening of environmental regulations, we started to drive our investment policy in a more sustainable way, declining carbon-intensive projects."

Benoît Theys, Head of Infrastructure Finance of AG Insurance

The Green Taxonomy is a necessary tool to accelerate the ecological transition. It seems important to adopt a dynamic approach to this new instrument, in order to ensure that it will not prevent financing activities which may become essential for the ecological transition but may not meet its current criteria (such as the production of battery raw materials)."

Patrick Jeantet, Senior Advisor at Vauban Infrastructure Partners and Independent Director at Spie

EXPERT POSITION 2

Impact of EU Taxonomy on infrastructure stakeholders

The discussion regarding the Paris Agreement alignment is moving forward at Rail & OV. We have decided to strengthen our support to environmental and socially promoting investments, which classify under article 8 of the EU SFDR."

Simona Kramer, Portfolio Manager at Pensioenfonds Rail & Openbaar Vervoer

The Green Taxonomy represents a paradigm shift, as it is impact-based (and not industry-based): investors and industries will decide how to comply with impact criteria."

Stéphane Voisin, Researcher at Institut Louis Bachelier, Member of the Platform on Sustainable Finance (EC Expert Group)

CASE STUDY 1

Acciona's alignment to the EU Taxonomy

A

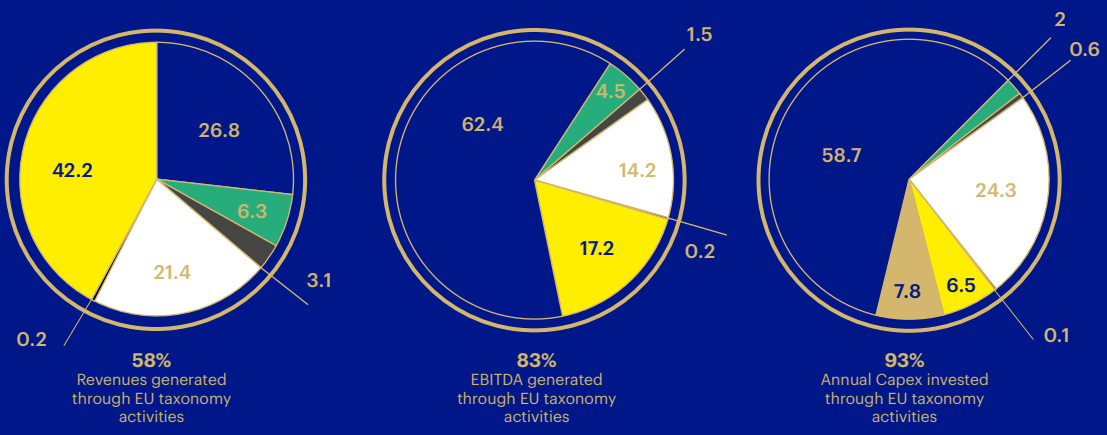
Acciona is a Spanish company dedicated to the development and management of sustainable infrastructure (construction, water, industrial and services) and renewable energy. Acciona has recently worked with the Technical Expert Group of the EU Low Carbon Taxonomy to assess its applicability and practicality to its business. The group has been one of the first to establish a system that classified their 2,000 assets worldwide, in accordance with criteria under the Taxonomy. Acciona's activities were analyzed using the classification of activities that, according to the Taxonomy, can make a substantial contribution to climate change mitigation.

The company undertook this exercise to assess its contribution to climate change mitigation and adaptation and to improve investors' understanding of its sustainable solutions business model.

FIGURE 7

Acciona's activities alignment to the EU Taxonomy

Source: Acciona, EU Low Carbon Taxonomy Acciona's Case Study, 2020



The critical role of infrastructures in the climate transition: towards sustainable infrastructures

Section | **2**

Key takeaways

→ Most infrastructures were not designed to be climate-proof: they are responsible, through their uses, for a large part of worldwide GHG emissions and particularly exposed to climate risks, especially since most of them are interdependent

→ Sustainable infrastructures should generate fewer carbon emissions than traditional infrastructures and help build resilience against climate change, especially in cities. Digital technologies represent a key lever to accelerate this transformation

→ Facing a deep financing gap, driving infrastructure investment towards low-emissions and climate-resilient pathways is necessary

THE COLD TRUTH: INFRASTRUCTURES ARE NOT "CLIMATE-PROOF" BY DESIGN

INFRASTRUCTURES AND CARBON EMISSIONS

Infrastructures are **the backbone of the economy:** they are a key driver for growth, employment, and better quality of life in developed and emerging markets. They represent a large economic value and an essential element in the functioning of the economy.

But this comes at a cost. Infrastructures have a long lifespan and most existing infrastructures (energy, transport, etc.) were designed for a world of cheap and abundant fossil fuels: **approximately 70% of GHG emissions** are directly related to infrastructure construction and operations such as power plants, buildings, and transport[34].

In 2018, transportation was the sector emitting **22% of the EU total emissions and almost 30% of French carbon emissions** (road transport accounts for 95% of transport emissions, of which more than half come from private vehicles).
This situation creates **risks of "stranded assets"** that hang over some infrastructure assets in a world under climate pressure.

INFRASTRUCTURES AND CLIMATE RISKS

While infrastructures represent major investments and a valuable resource for societies, they have not been designed to face frequent and intense climate-related events.

As a result, infrastructure networks are **increasingly vulnerable and affected by the physical impacts of climate variability and change:** rising sea levels, droughts, and violent storms are having far-reaching humanitarian and economic impact. Yet, due to the diversity of infrastructures, they are not all affected by the same risks both in terms of category and magnitude *(Table 1)*.

The impact of climate change on infrastructures is all the more hard to address as they usually function **within a large network with high interdependencies.** The relationships between such systems are often related to their interdependence, which allows for the existence of both positive and negative interactions between infrastructures. These relationships are made of multiple connections between infrastructures and create an intricate system, which can diffuse shocks from one infrastructure to the others. As a result, climate-related disruptions of services in one infrastructure system will almost always result in disruptions outside this area. Dependencies and interdependencies are therefore key characteristics to consider in a global infrastructure ecosystem: for instance, a hazardous event can result in a loss of a service (e.g. electric outage), which will impact the critical infrastructure using this service, and beyond by chain effect[36].

> **Most existing infrastructures were designed for a world of cheap and abundant fossil fuels."**

[34] World Bank Blogs, Low-carbon infrastructure: an essential solution to climate change?, April 2018.
[35] IPCC, Climate Change 2014, Impacts, Adaptation and Vulnerability, Part A: Global and Sectoral Aspects, Key Economic Sectors and Services, 2014.

FIGURE 8

Sectorial repartition of carbon emissions in France and the EU in 2018

Source: Altermind, from datalab

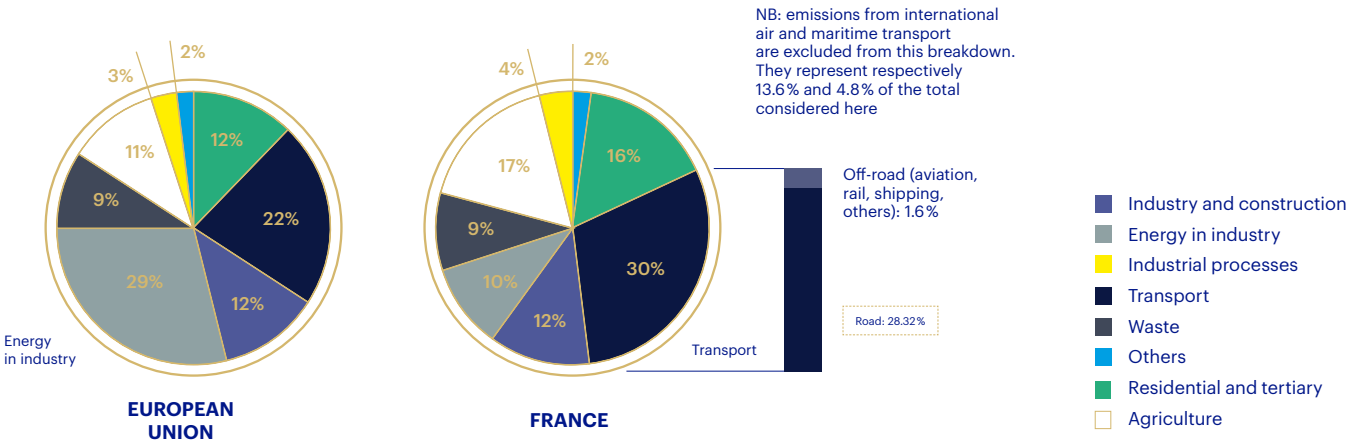


TABLE 1

Illustrative impacts of climate change in different sectors

Source: IPCC, 2014 [35]

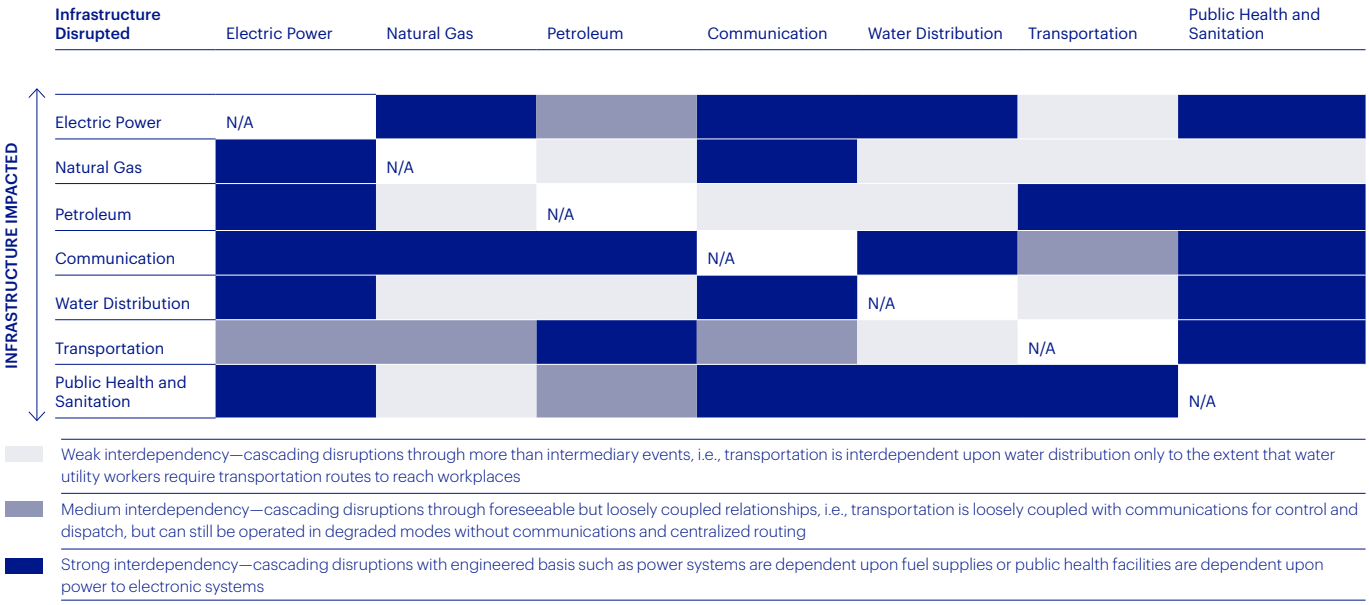
	Temperature changes	Sea-level rise	Changing patterns of precipitation	Changing patterns of storms
Transport	• Melting road surfaces and buckling railway lines • Changing demand for ports as sea routes open with the melting of arctic ice	• Inundation of coastal infrastructure, such as ports, road or railways	• Disruption of transport due to flooding • Changing water levels disrupt transport on inland waterways	• Damage to assets, such as bridges • Disruption to ports and airports
Energy	• Reduced efficiency of solar panels • Increased demand for cooling	• Inundation of coastal infrastructure, such as generation, transmission and distribution	• Reduced output from hydropower generation • Disruption to energy supply due to flooding	• Damage to assets (wind farms, distribution networks) • Economic losses due to power outages
Telecoms	• Increased cooling required for data centers	• Inundation of coastal infrastructure, such as telephone exchanges	• Flooding of infrastructure • Damage to infrastructure from subsidence	• Damage to above ground transmission infrastructure, such as radio masts
Urban development	• Increased cooling demand • Reduced heating demand	• Inundation and increased flood risk • Changes in land use due to relocation of people living in exposed areas	• Risk of drought • Flooding	• Damage to buildings • Deaths and injuries
Water	• Increased need for treatment • Increased evaporation from reservoirs	• Inundation of coastal infrastructure • Salinization of water supplies	• Increased need for water storage capacity • Risk of river embankments being overtopped	• Damage to assets • Decreased standards of protection offered by flood defenses

Dependencies and interdependencies between infrastructures increase climate risks."

FIGURE 9

Infrastructure disruptions according to interdependencies

Source: Fernandez, S. & Wilbanks, T., 2014 [37]



THE NEED TO INVEST IN SUSTAINABLE INFRASTRUCTURES

THE ERA OF SUSTAINABLE INFRASTRUCTURE

Sustainable principles for infrastructure

Although they were not originally designed to lead the transition towards a low-carbon world, infrastructures are **"transforming" to comply with global warming requirements.** It is the beginning of the era of "sustainable infrastructure", an ecosystem designed to meet the population's essential service needs — including roads, bridges, telephone pylons, renewable power stations, etc. — based on all-round sustainable principles.

These emerging sustainable infrastructures are expected to fulfill six key missions:
→ **Reduce GHG emissions,** consistent with the Paris Agreement;
→ **Contribute to the transition** to a low-carbon economy and to the decarbonization of the energy system;
→ **Promote high energy-efficiency standards;**
→ **Be resilient and help protect against extreme weather** events and other natural disasters;
→ **Consider climate change risks** in its design, maintenance and operation;
→ **Reduce vulnerability** to climate change risks and impacts.
These sustainable principles should apply both **to new infrastructure and to existing infrastructure,** which is a key challenge, especially in developed cities.

Urban areas at the heart of sustainable infrastructure

Accounting for up to 70% of global emissions[38], cities are at the forefront of infrastructure sustainability and have a vital role to play in meeting global targets. By 2050, two-thirds of the global population will live in cities, and over 70% of the global demand for infrastructure over the next 15 years is expected to be in urban areas[39]. As centers of population, consumption, energy, buildings and transport infrastructure, cities thus present **a unique opportunity to accelerate the transition to low-carbon resilient systems.**

[36] Argonne national laboratory, Analysis of critical infrastructure dependencies and interdependencies, June 2015.
[37] Fernandez S., Wilbanks T., Climate Change and Infrastructure, Urban Systems and Vulnerabilities: Technical Report for the U.S, Department of Energy in Support of the National Climate Assessment, 2014.
[38] UN Habitat, Global Report on Human Settlements 2011: Cities and Climate Change, 2011.
[39] United Nations, 68% of the world population projected to live in urban areas by 2050, says UN, May 2018.

CASE STUDY 2

Metro Málaga

Metro Málaga is the light rail network of Málaga, which consists of two lines currently in service. The network is managed by the concessionary company of the Junta de Andalucía.

The use of public transport makes, by nature, city journeys more sustainable and directly contributes to the reduction of GHG emissions: public transport, per passenger, represents 50 times less space, emits 70% less CO_2 than private vehicles and improves air quality[40]. Metro Málaga maximizes this contribution by answering Málaga citizens' mobility needs using advanced technology and connecting its facilities to other public transport systems.

Metro Málaga has also launched initiatives to improve its own carbon and environmental performance:

→ The network is particularly concerned about energy efficiency, implementing improvements that have led to annual savings of 15% in electricity consumption[41];

→ Since 2018, 100% of the energy electricity used comes exclusively from renewable sources, with a guarantee of origin certificate (GDO). Through the use of this electricity, the overall total emissions are reduced to minimum values of about 110 tm CO_2;

→ In order to improve the management of water resources, the tunnel wash of train units recycles up to 60% of the water used in each wash.

[40] Metro Málaga, Memoria de Sostenibilidad, 2018.
[41] Interview of Fernando Lozano (CEO of Metro de Malaga), El transporte público es un recurso básico para la movilidad sostenible, Málaga Hoy, May 2021.

Infrastructures are transforming following sustainable principles."

CASE STUDY 3

Axione: the deployment of FTTH in Nord-Pas-de-Calais

Axione, a major player in the digital development of rural and urban areas, designs, builds, finances and operates next-generation digital infrastructure.

The deployment of full-fiber networks is a rapid, efficient and sustainable way high-speed way to broadband and reliable connectivity. By providing the same quality of service to all inhabitants of rural areas, it also reduces the digital divide between territories. In this context, local authorities have started to be supported by various funders (through the Plan France Très Haut Débit) and have engaged in deployment programmes[45].

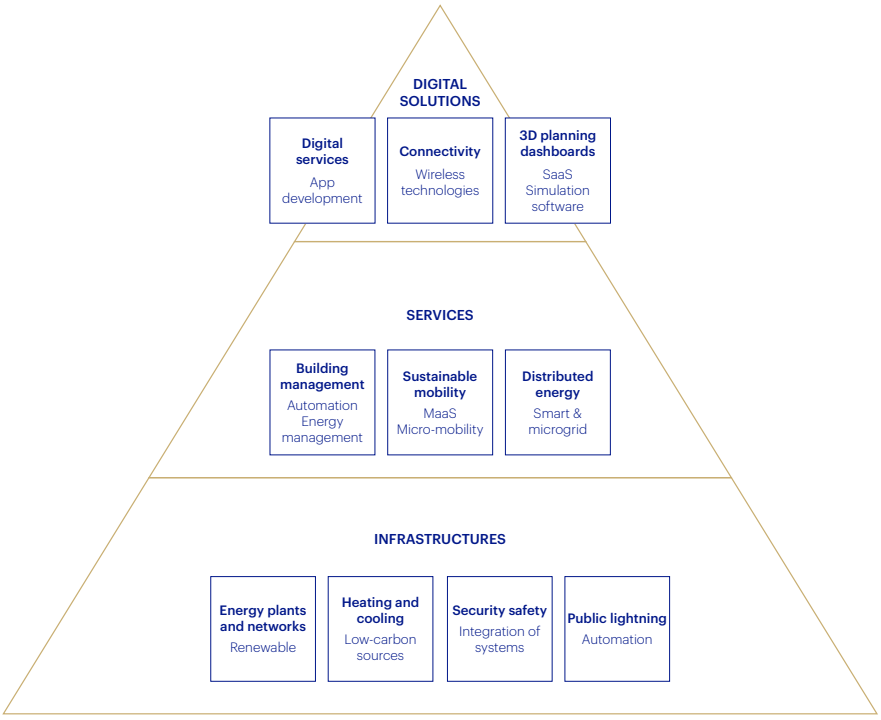
Axione has been a partner of this ambition: following a call for tenders, on November 4, 2016, the syndicat mixte "la Fibre Numérique 59/62" chose the public service delegation "Cap Fibre" created by Axione, in order to build, market, operate and maintain this Public Initiative Network. The mission has enabled the deployment of a new fiber optic network in two departments, serving 1,153 separate communities, with a total of 20,000km of cable and nearly 700,000 outlets in 2021[46].

[45] Axione, Benefits & uses of fibre optic, 2021.
[46] Axione, La fin des travaux du déploiement de fibre optique approche dans le Nord et le Pas de Calais, December 23, 2020.

FIGURE 10

Contribution of ICTs to smart cities

Source: Altermind, C. Staropoli



Technological developments are key to improve sustainability."

Still, **rural areas are increasingly lagging behind while infrastructures such as public utilities are critical to ensure the sustainable development of these zones.** Reducing the local population's climatic and economic vulnerability, emerging sustainable infrastructures can improve their access to appropriate basic services and reduce the existing spatial and digital divides[42].

Technology and sustainability

There is a strong link between sustainability and the digitalization of infrastructure, which changes how infrastructure is owned, planned, designed and built. In addition to optimizing service quality and delivery, technological developments can improve sustainability by (i) **increasing flexibility in the infrastructure sector** (especially energy and transport), (ii) **creating business-friendly environment and citizen-centric service delivery** and (iii) tapping urban data's potential for improving sustainability.

Smart cities are a perfect example of the way technologies can make a significant contribution to urban sustainability, by using information and communication technology (ICT) to gather urban data (mobility, parking, energy efficiency, public lighting, renewable energy, healthcare, security, etc.) and improve performance and management *(Figure 10)*. The digitalization of infrastructure requires the deployment of fixed and mobile telecom networks. It is worth noting in this respect that **full fiber networks** are able to cope with future data rate requirements and at the same time **increase energy efficiency of data transfers** and storage[43]. **"Fiber to the Home"** (FTTH) technologies have indeed been found to be more sustainable than "Fiber to the Curb" (FTTC)[44].

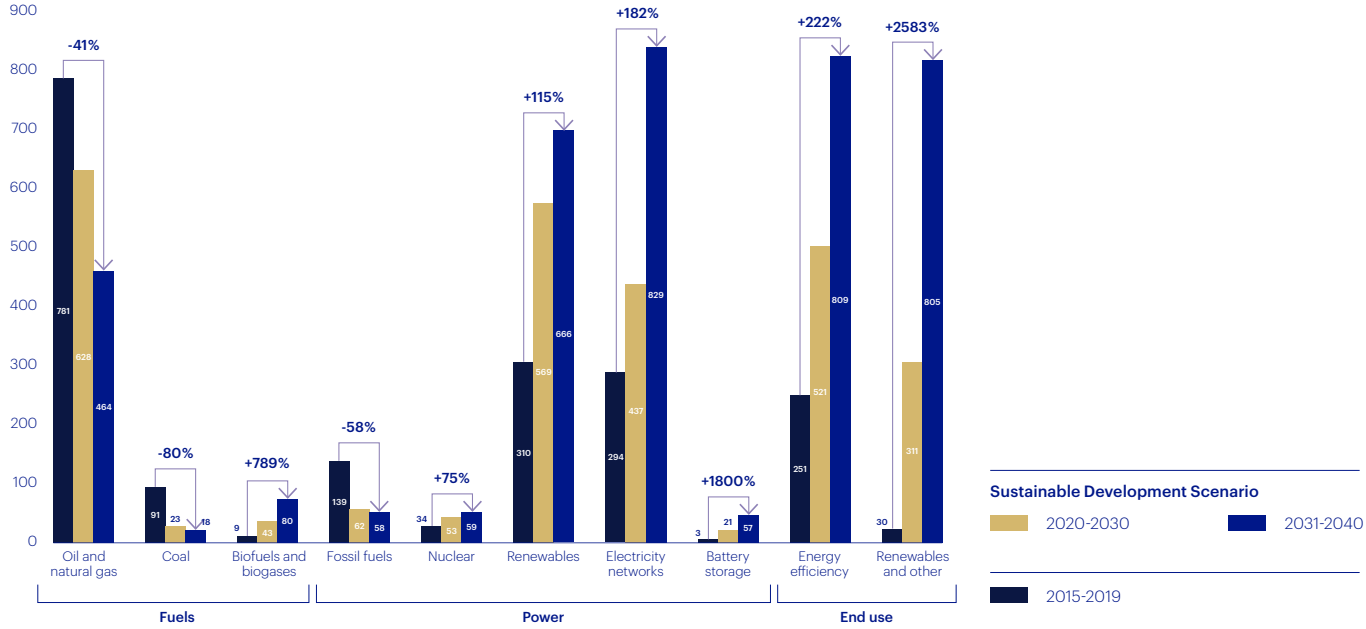
Still, from what precedes, infrastructures will have to go further and engage in an unprecedented transformation. It is imperative that infrastructures are designed, built, operated and maintained in a way that enables them to withstand current and future climate impacts.

[42] See for instance the communication from the European Commission, A long-term vision for the EU's rural areas - Towards stronger, connected, resilient and prosperous rural areas by 2040, June 30, 2021.
[43] FTTH Council of Europe, Contribution of fibre to FTTH Council of Europe, Contribution of fibre to sustainability, 2021.
[44] Obermann, I.K., Nachhaltigkeitsvergleich der Zugangsnetz-Technologien FTTC und FTTH, the University of Applied Sciences (Technische Hochschule) Mittelhessen from BREKO, May 2020.

FIGURE 11

World energy investments ($ billions, 2019)

Source: World Energy Outlook, 2020



DRIVING INFRASTRUCTURE INVESTMENT ON LOW-EMISSIONS AND CLIMATE-RESILIENT PATHWAYS

Bridging the sustainable infrastructure funding gap

Scaling up low-carbon and climate-resilient infrastructure will be key to meet the climate targets and ensure an inclusive economic growth. It creates huge investment needs, which therefore require a reorientation of finance towards sustainable infrastructure, as access to affordable finance is a major barrier to the scaling-up[47]:

→ OECD calculations show that an average of **$6.9 trillion of investment in infrastructure will be required annually until 2030** to support economic growth while meeting the United Nations (UN) Sustainable Development Goals (SDGs)[48] ;

→ In its 2018 report, the **Global Commission on the Economy and Climate** estimated that the overall investment for infrastructure will amount to **$90 trillion up to 2030 to make them sustainable[49].**

A new purpose-driven mindset or investors

In this context, **financial investors are asked to ensure their strategy is consistent with national pathways** to achieve the long-term goals of the Paris Agreement: climate financing not only needs to be increased, but also to be targeted in a different manner.

The process has already started, either through **the development of green finance instruments** or through **partnerships between financial investors and industrial stakeholders.**

The transition to net-zero emissions will require a substantial ramp up in world investments. According to the World Economic Outlook, there is a strong need to invest in power, especially renewables and electricity networks, and in energy efficiency *(Figure 11)*.

> **The climate transition creates huge investment needs."**

[47] Bak C., Bhattacharya A., Edenhofer O. and Knopf B., Towards a comprehensive approach to climate policy, sustainable infrastructure, and finance, Economics e-journal, November 2017.
[48] OECD, Financing Climate Futures, Rethinking infrastructure, 2018.
[49] Gencsu I., Mason N., Unlocking the Inclusive Growth Story of the 21st Century: Accelerating Climate Action in Urgent Times, The New Climate Economy, April 2019.

CASE STUDY 4

Vauban IP's BioSynergy project with Suez

Suez, an expert in water and waste management, offers innovative solutions throughout France to preserve and secure resources.

BioSynergy is a circular economy project in the waste sector.

This innovative project has been developed by Suez and Vauban IP for several years. It consists in a combustion plant that will provide more than 300GWh of heat per year, for both an urban heating network of Le Havre Métropole and key industrial sites based in le Port du Havre, one of the leading industrial clusters in France. The plant will be supplied by wastewood, then Solid Recovered Fuel.

The project will generate over 60 jobs, and secure a reduction in CO_2 emissions of c. 50,000 tons per year and offer an alternative valorization to 100,000 tons of non-recyclable waste annually, that would otherwise end in landfills.
In addition to benefiting from decarbonized power, the area's residents will benefit from cheaper energy, independent of fluctuations in the price of gas.

The BioSynergy project embodies a new generation of projects allying an active environmental approach and providing strong economic benefits to a variety of customers in a given territory. The project also demonstrates the strength of the combination of Suez's operational excellence and Vauban's financial expertise."

Jean-Marc Boursier, Executive Vice President, France and Operations, Suez

A comprehensive approach of climate strategies for infrastructures: mitigation, adaptation and beyond

Section | 3

Key takeaways

→ Climate strategies in the infrastructure field should combine mitigation and adaptation, building on their complementarities

→ These strategies play at two levels: (i) some infrastructure assets are, in themselves, favorable to mitigation (such as electric mobility equipment and infrastructures) or adaptation (such as coastal defenses) and should be developed, and (ii) in any case, all infrastructures have to transform themselves in order to be low-GHG and resilient

→ To maximize the impact of climate strategies, there is a need to adopt a more comprehensive approach, which gives more consideration to (i) enabling technologies, in particular ICT, (ii) synergies, notably through sector coupling and (iii) co-benefits, such as air quality improvement

MITIGATION AND ADAPTATION: THE TWO PILLARS OF CLIMATE STRATEGIES

INFRASTRUCTURES, MITIGATION AND ADAPTATION

As stated in section 1, effective climate strategies involve a portfolio of diverse actions, which traditionally rely on two main pillars:

→ **Mitigation,** which aims at reducing or limiting GHG emissions or protecting and enhancing GHG sinks and reservoirs;

→ **Adaptation**, which aims at limiting the negative impacts of climate change and maximizes its beneficial effects, by improving resilience.

Mitigation addresses the causes of climate change (accumulation of GHG in the atmosphere), whereas adaptation deals with its impacts. In any case, one of the key challenges of climate action is to transform infrastructures so that they contribute to mitigation and adaptation objectives.

The costs of inaction should not be underestimated. In this respect, the Task Force on Climate-related Financial Disclosures (TCFD) distinguishes between two main categories of climate-related financial risks, which must be properly addressed by infrastructure stakeholders through mitigation and adaptation actions:

→ **Transition risks,** which include extensive policy, legal, technology and market changes as well as reputation risks that should be addressed through risk adaptation and mitigation;

→ **Physical risks,** which can be event driven (acute) or longer-term shifts (chronic) in climate patterns and may have financial implications for organizations.

MITIGATION: REDUCING THE FLOW OF CARBON EMISSIONS

The case for electrification

In its report "Net Zero by 2050"[50], the IEA shows that the pathway to carbon neutrality will require the immediate and massive deployment of available clean and energy efficient technologies:

→ Electrification, combined with a clean energy mix, has a major role to play in this transition: by 2050, 90% of energy will come from renewable sources, in particular photovoltaic and wind power;

→ Energy efficiency efforts must be strengthened, with energy intensity gains of 4% per year by 2030;

→ But not all the necessary technologies are yet available on the market, in particular advanced batteries, hydrogen electrolyzers and capture and storage solutions. Close to half of the energy mix in 2050 will have to be derived from technologies which either do not exist today, or are still in the test phase or small scale projects.

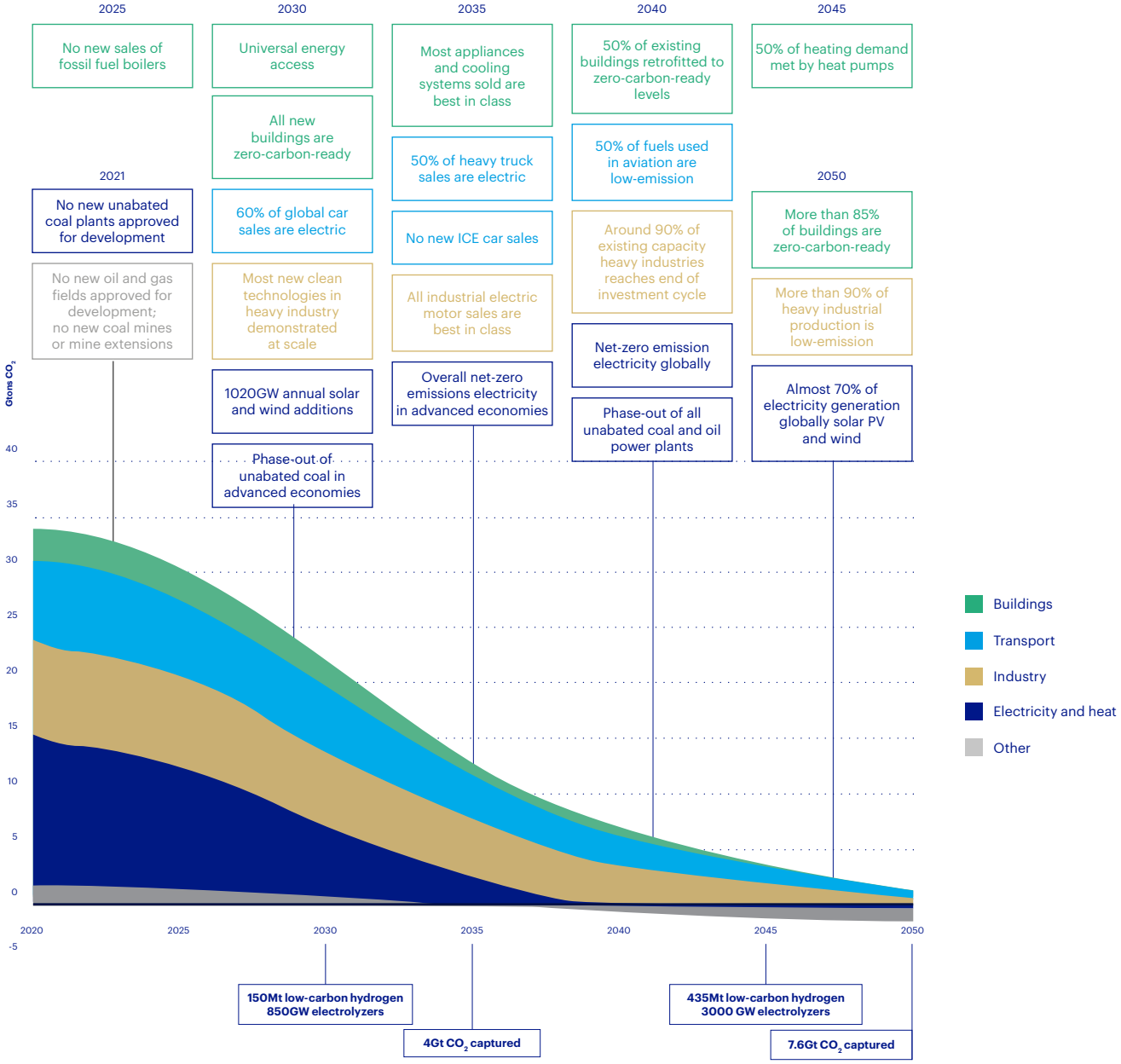
The IEA identifies key milestones the most emitting sectors should comply with, including infrastructure sectors such as energy, transport and buildings *(Figure 12)*.

> **Mitigation and adaptation are the two main pillars of climate action."**

FIGURE 12

Key milestones for achieving net-zero carbon by 2050

Source: IEA, Net Zero by 2050, 2021



Electrification will be a key lever of decarbonization."

Infrastructure stakeholders should properly address transition and physical risks."

FOCUS 3

Charging infrastructure: a prerequisite for the generalization of electric vehicles

As a major GHG emitting sector, transportation has a crucial responsibility in the ecological transition, especially with the generalization of electric vehicles (EVs). EVs can be an efficient lever in the short term as they are more efficient and use a cleaner fuel than the internal combustion engine: as a result, they feature as a priority in mitigation pathways.
Car manufacturers are taking the path of electrification. In reaction to tight carbon regulations and penalties for non-compliance, most automotive players have developed electric vehicle programs: equipment manufacturers have announced the launch of **600 new EV models by 2025**[51].
PSA plans to electrify its entire vehicle range by 2023 (compared to a previous target of 80%), Volkswagen will invest €30 billion by 2023 to launch production of 70 models (compared to 50 initially planned), etc. However, due to the limited autonomy of batteries, this dynamic involves an adaptation of the motorway infrastructure, by **deploying charging points on a large scale:** if not addressed, the issue of charging infrastructure deployment could hamper the transition to electric mobility.

In this context, governments have launched several plans, notably:
→ **Biden's plan** aims to increase the number of charging stations through grants and incentive actions for state and local governments and private companies to build 500,000 charging stations around America's motorways and in "hard-to-reach" areas by the year 2030[52];

→ As part of its Economic Recovery Plan, **Germany** will provide €5.5 billion euros of funding until 2024 for electric-car charging infrastructure (battery cell production, EV charging stations)[53], with the aim of having 1 million charging stations on German roads by 2030;

→ **In France,** in October 2020, the French Government set a target of 100,000 charging points open to the public by the end of 2021 (with a budget of €100 million). In February 2021 the government launched a €100 million plan to equip all service areas on the highway concessionary network with charging stations by January 1, 2023.

In the near-term, electrification has been identified as **one of the most powerful mitigation levers in the transportation sector,** by decreasing carbon intensity and improving efficiency. This creates **a strong need for new electric equipment and infrastructures,** regarding electric vehicle (EV) chargers as well as transport and distribution networks. **Existing road infrastructure also needs to be adapted**, in order to favor the development of electric mobility.

In this context, many industrial actors have launched EV charging services, such as Acciona or Proxiserve.

Enhance circularity to be energy efficient

Combined with current efforts on electrification and renewable energy, the transition to a circular economy is crucial to tackling GHG emissions, as the extraction, manufacturing and production of materials is responsible for 45% of GHG emissions[54].
The infrastructure sector has a dual role to play in this transition according to the Global Infrastructure Hub: first, by increasing the "circularity of infrastructure" (i.e. integrating circular economy principles into infrastructure itself), and second by implementing "infrastructure for circularity" (i.e. providing infrastructure that support circular economy activities) in line with the 6R principles *(Figure 13)*.

[50] International Energy Agency, Net Zero by 2050: A Roadmap for the Global Energy Sector, May 2021.
[51] IHS Markit, Alternative Propulsion Forecast, 2019.
[52] Government Tech, How Biden Plans to Build 500 EV Charging Stations, April 28, 2021.
[53] Bloomberg, German Car Industry Says It's Ready to Meet Tougher EU Climate Goals, March 21, 2021.
[54] Ellen MacArthur Foundation, Completing the picture: How the circular economy tackles climate change, 2019.

CASE STUDY 5

Acciona: EV charging infrastructure

Acciona is a Spanish company dedicated to the development and management of sustainable infrastructure (construction,water, industrial and services) and renewable energy.

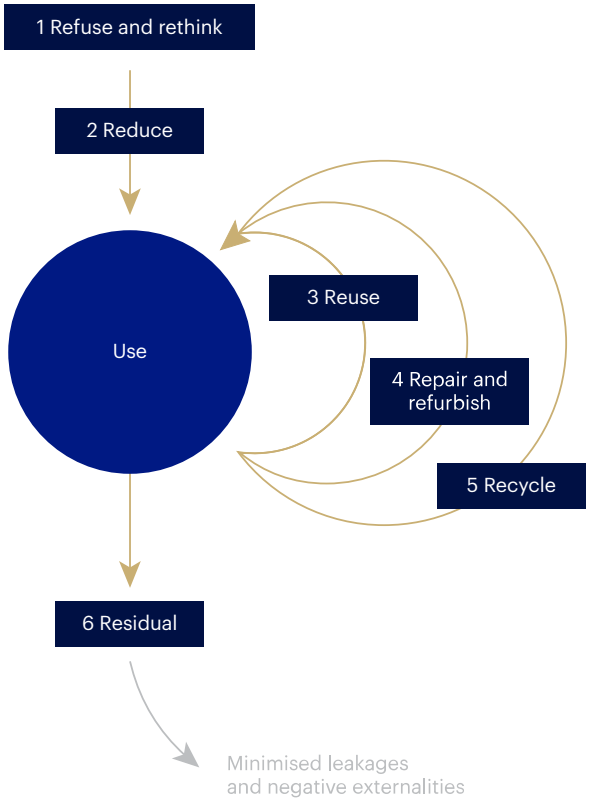
In July, 2021, Acciona Energia launched, alongside start-up BIA POWER, a **smart solution for efficient electric vehicle charging** in order to enhance the company's range of services to corporate and institutional clients to support their decarbonization. Its "Green Smart Charge" optimizes vehicle charging both economically and environmentally by prioritizing self-consumption renewable installations.

The platform uses predictive energy consumption models to optimize the charging process by selecting the optimum sequence according to time available for charging, consumption peaks of the installation feeding the charging point, electricity price and availability of self-consumption.

FIGURE 13

The 6R principles

Source : Global Infrastructure Hub



As shown by the example of Paprec, infrastructure players from the waste management industry are in the front line of this transition *(Case study 6)*.

Reduce infrastructure asset GHG emissions

Like all companies, infrastructure assets have to reduce their own emissions, focusing on all direct and indirect emissions.

To date, most enterprises have focused their effort on reducing emissions under their direct ownership or operational control *(scope 1)* and from their purchase of electricity, heat and steam *(scope 2)*. Key levers are to improve energy efficiency and increase the share of renewable energies.

CASE STUDY 6

Paprec: supporting a circular economy

Paprec is a major French player of the waste industry (€ 2billion turnover, 13,000 employees). The Group is dedicated to delivering best-in-class waste treatment solutions. Paprec is involved in the entire waste-management value chain: from collection from its customers – private and public – to the sale of recycled raw materials, production of energy from waste (bio-gas and RDF), and agro-waste recovery. Paprec's activities intrinsically contribute to reducing GHG emissions by enhancing circularity all along the value chain: producing recycled materials avoids the extraction of virgin raw materials and saves the energy needed to process them. As part of its climate strategy, the group aims to go further and support more sustainable and circular production methods. To do this, Paprec introduced a renewed investment policy based on two key commitments[56]:

→ Increase collection rates through investment in effective collection tools. For example the use of connected and geolocated collection vehicles, together with collection bins equipped with iOT boosts collection and quality. It relies also on cooperation with EPR (Extended Producer Responsibility) and development of public awareness;

→ Improve recovery rates: in 2020, Paprec pursued its investments to recycle new materials (plastic film, pots, tubs and trays, etc.) on its sorting lines and reduce the proportion of final waste at the end of the line through the digitalization of its tools (sorting robots using artificial intelligence, high-precision optical sorting lines, etc.).

[56] Paprec Sustainability Report, 2020.

At Paprec, we believe waste to be the 'raw material of the 21st century', which can contribute significantly to the fight against climate change and the reduction of GHG emissions. Circular economy has a key role to play in the ecological transition, notably by improving the products' eco-design, developing a closed-loop recycling cycle and being an active player of 'modern agriculture' by converting waste into fertilizers with better standards."

Sébastien Petithuguenin (CEO of Paprec group)

CASE STUDY 7

EDF’s climate strategy

The EDF group is the French leader in electricity, from engineering to distribution. The company's operations include electricity generation and distribution, power plant design, construction and dismantling, energy trading and transport. EDF is at the forefront of the transition towards a net-zero carbon world, with 90% of its production based on nuclear and renewable sources of energy. Worldwide, the group's carbon emissions are below those of other electricity producers, and are steadily declining, passing under the 100g of CO_2/kWh mark in 2015. The carbon intensity of EDF is now eight times lower than the sector’s average worldwide, and five times lower than the European average[57].

EDF has committed to reach carbon neutrality by 2050. It has set carbon emission reduction targets for 2030 which have been validated by the Science Based Targets initiative (SBTi) as being aligned with a “Well Below 2°C” trajectory:

→ Reducing scope 1 and 2 emissions by 50% (2017 basis), including emissions from non-consolidated generation assets and emissions associated with electricity purchased for sale to end customers;

→ Reducing its carbon emissions associated with the burning of gas sold to end customers (scope 3) by 28% (2019 basis)[58].

To reach this ambition, EDF has identified three priorities and launched a series of actions[59]:

→ Intensifying the decarbonization of its production activities: closing of the last coal-fired power plants operated by the group in France and the United Kingdom, greener heating networks, aligning the group’s gas activities with its climate commitments, etc.;

→ Innovating through new services for clients and territories: promotion of heat pumps and decarbonized heat to reduce the demand for natural gas used for heating (individuals, businesses and communities);

→ Transforming the group’s practices: managing energy consumption of the group's facilities, electrification of EDF's fleet of light vehicles, reduction of emissions associated with employee travel.

CASE STUDY 8

Bouygues Construction's climate strategy

Bouygues Construction designs, builds and operates projects in the building, civil works, energy and services sectors.

In 2017, Bouygues Construction adopted a climate strategy with quantified targets covering its entire value chain (scopes 1, 2 and 3).
In early 2021, Bouygues Construction strengthened its climate strategy to reduce the carbon footprint of its activities and promote low-carbon solutions in line with the Paris agreement.

The strategy is based on three main axes to reduce GHG emissions by 30% by 2030:

→ A 40% reduction in direct emissions (which represent 11% of the group's carbon footprint) and a 30% reduction in indirect emissions (which represent 89% of the carbon footprint). This ambition will notably go through the reduction of 40% of the cement's carbon intensity and the development of wood construction with a target of 30% of building projects in wood in Europe by 2030[60];

→ The development of a portfolio of innovative and sustainable offers to position the group as an integrator of low-carbon solutions: production and distribution of low-carbon energy (renewables, green hydrogen), energy performance of buildings, neighborhoods and cities, and development of low-carbon mobility;

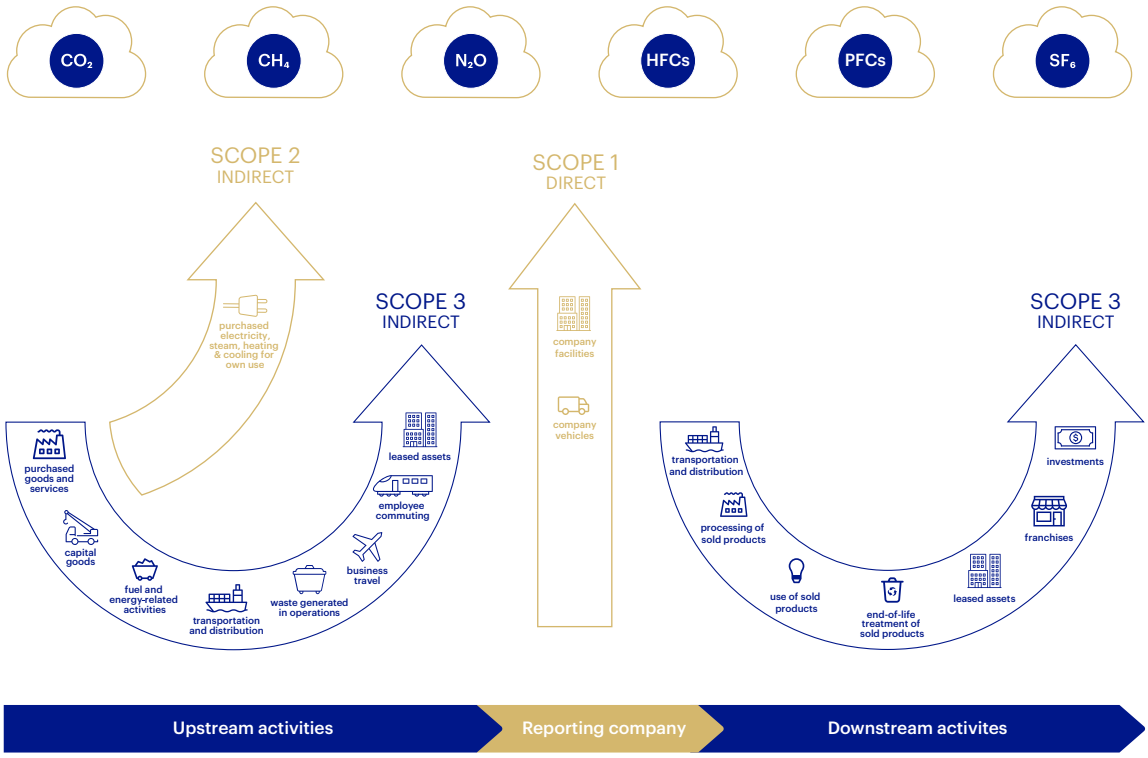
→ The emergence of a "low-carbon culture" with mandatory training for all employees (supervisors and managers) on environmental issues and integration of the climate issue into all internal procedures.

[57] EDF, Doing even more to reduce CO_2 emissions, 2021.
[58] EDF, Document d'enregistrement universel 2020.
[59] Ibid.
[60] Wewood, L'ambition bois de Bouygues Bâtiment France Europe, 2020.

FIGURE 14

Upstream and downstream scope 3 activities

Source: WRI/WBCSD Corporate Value Chain (Scope 3) Accounting and Reporting Standard



Scope 3 is often a major part of infrastructure GHG emissions and the most difficult to address."

Scope 3 emissions usually represent the main part of a company's emissions (based on data from more than 8,000 companies, a study from CDP estimates that supply chain emissions are more than 11 times higher than operational emissions)[61] . However, they are still more difficult to address, because of the lack of direct control and difficulty collecting quality data. Scope 3 represents a key challenge for most companies, both upstream and downstream *(Figure 14)*, requiring a reinforced cooperation with their whole ecosystem, from suppliers to clients.

ADAPTATION: ADJUSTING TO CLIMATE RISKS

Building infrastructures dedicated to adaptation

Efforts to significantly reduce GHG need to be complemented with a coordinated response to build resilience. Adapting to climate change means **taking action to prepare for and adjust to both the current effects of climate change and the predicted impacts in the future.**

As part of the adaptation strategy, **coastal defense** constitutes one of the main issues. Sea level rise can cause flooding, storms exposure, coastal erosion and the loss of low-lying coastal systems: impacts on coastal areas architecture and urban infrastructure can be huge[62]. For example, from 1999 to 2011, the municipality of Timmendorfer Strand in Germany (located in the Baltic Sea Region with a large part of it laying no more than 3 meters above sea level[63]), developed and implemented a coastal flood defense strategy: the coastal defense infrastructure has then been reinforced and also adjusted to the needs of tourism activity, e.g. the height allows the sea to be viewed from the beach promenade, and retention walls were built close to shops[64].

Adapting infrastructure to climate risks

Improving infrastructures' physical resilience is critical as these assets are very exposed to the impacts of climate change. This is particularly the case of water facilities.

EXPERT POSITION 3

Scope 3 emissions reduction: a critical but complex challenge

Since companies' scope 3 emissions overlap with other companies' emissions, their reductions are hard to monitor. But this also means the scope 3 can have a potential driving effect as it is a particularly fertile ground for collaboration and synergies. It must be addressed on a large scale. In this perspective, Air Liquide has put in place an ecosystem approach relying mainly on innovation to reduce customers' emissions (rolling-out carbon offerings and solutions, co-developing innovative processes) and contributing to the growth of a low-carbon economy (hydrogen development for mobility, use of cryogenic expertise for clean transport solutions, promotion of a circular economy, etc.)."

Olivier Blachier, APAC Vice President, Hydrogen & Energy Transition of Air Liquide

Schneider Electric has recently increased its climate commitment, including scope 3 activities: the company has set an ambitious goal to reduce scope 3 emissions from purchased goods, services and product usage by 35% in order to achieve carbon neutrality in the end-to-end value chain by 2040. The group is also offering a Climate Change Advisory Service to help organizations tackle scope 3 emissions through a combination of supplier engagement, measurement and strategy setting."

Vincent Petit, Senior Vice President Global Strategy prospective & External Affairs at Schneider Electric

[61] CDP, Global supply chain report 2020: Transparency to Transformation: A Chain Reaction, February 2021.
[62] Climate ADAPT, Coastal areas, 2015.
[63] European Environment Agency, European Climate Adaptation Platform, Climate Adapt: 10 Case studies: How Europe is adapting to climate change, 2018.
[64] Climate ADAPT, Timmendorfer Strand coastal flood defence strategy, Germany, 2021.

EXPERT POSITION 4

The high costs of misadaptation

Adaptation is too often neglected, whereas global warming is accelerating and the costs of inaction are extremely high. There are only few infrastructures dedicated to adaptation. But the most important issue is to adapt the existing infrastructure to the consequences of climate change."

Benoît Leguet, Managing Director of I4CE

TOWARDS A MORE COMPREHENSIVE APPROACH OF CLIMATE STRATEGY [68]

ENHANCING ENABLING TECHNOLOGIES: THE DEBATE ON ICT

Innovation – based in particular on digital technologies – will be key to address the challenge of climate change. However, in the context of climate transition, a debate has arisen on the role of information and communication technologies (ICT). Indeed, the energy consumption of ICT is an increasingly-discussed issue with, on the one hand, significant gains in efficiency and, on the other hand, a dynamic of uses that erases them, opening up a debate in terms of "restraint"[69].

This debate often neglects the levers offered by these technologies in terms of environmental transition, such as improving energy efficiency or replacing more carbon-intensive practices. Leaving aside all ICT solutions, total global emissions of CO_2 could be cut by 12Gt by 2030: therefore, ICTs are a key lever of the decarbonization path, enabling rapid emission reductions while improving quality of life and supporting economic growth. Figure 15 shows the ICT contribution to global emissions mitigation of the main sectors: the total emissions mitigation enabled by ICT alone would be sufficient to keep emissions at their current level[70].

EXPERT POSITION 5

Climate strategy for highly exposed infrastructure

Some infrastructures are particularly exposed to climate change and require an adequate and realistic approach for climate strategy. For instance, while it is a critical infrastructure, water facilities are very exposed to climate risks. Incidence of extreme events, such as floods, can lead to disturbances and huge damage to water treatment plants and distribution networks. To account for these climate vulnerabilities, we need to evaluate the degree of vulnerability and exposure of infrastructures, determine the "acceptable level of risk" and develop the proper resilience strategy, inclusive of control technologies as well as alternatives for rapid repair and managing degradation."

Vincent Petit, Senior Vice President Global Strategy prospective & External Affairs at Schneider Electric

CASE STUDY 9

Suez's climate adaptation initiatives

As the frequency, volatility and intensity of extreme climate events impact its activies, Suez is committed to offer its customers resilience plans to the effects of climate change[65].

In some regions, Suez has already adapted to the consequences of climate change on its operations and on the urban environments[66]:

→ To face the rise in the 0-degree isotherm in the Andes and its consequences in the Mapocho River, Suez has increased the autonomy of the installations for up to 48 hours in order to ensure the continuity of service;

→ In the regions most vulnerable to climate change (Southern Europe, Middle East, Australia), the group offers seawater desalination solutions to its customers, making it possible to ensure the avaibility of drinking water in areas exposed to repeated droughts;

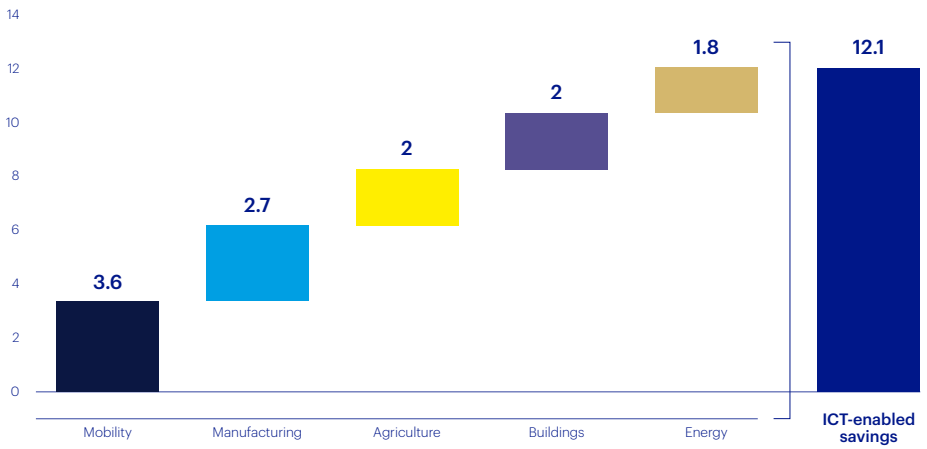
→ Suez has also developed partnerships with cities, notably with Dijon as part of the smart city project: as a way to control the risk of urban flooding, the Aquadvanced Urban Drainage system records real-time rainfall measurements delivered by the DREAL (Regional Directorate for Environment, Planning and Housing). The system has created a hydrological and hydraulic model to simulate the flows of the Ouche river upstream and downstream of Lake Kir in Dijon, as well as the lake levels, several hours in advance[67].

[65] Suez, 2017-2021 Sustainable Development Roadmap, Integrated Report, 2021.
[66] Suez, Document d'enregistrement universel, February 2021.
[67] Smart solutions, Prevent the floods in Dijon.
[68] Source: Anna Creti and Patrice Geoffron, Workshop 2.
[69] On this debate see for instance The Shift Project, Lean ICT: Pour une sobriété numérique, October 2018.
[70] Global e-Sustainability Initiative, Accenture, #SMARTer2030, ICT Solutions for 21st Century Challenges, 2015. "The 12.1 Gt CO_2e reduction in 2030 enabled by ICT includes 1.8 Gt CO_2e abatement from integration of renewable energy production into the grid. In its business-as-usual emissions forecast IPCC expects emissions to rise by 11.1 Gt by 2030. This rise already considers the CO_2e abatement from renewable energy. Therefore, the additional ICT-enabled CO_2e reduction against the IPCC emissions forecast for 2030 is 10.3 Gt CO_2e (based on a total of 12.1 Gt CO_2e minus 1.8 Gt CO_2e from renewable)."

FIGURE 15

ICT CO_2 abatement potential by sector (Gtons, 2030)

Source: WRI, IPCC, World Bank, GeSI, Accenture analysis & CO_2 models



The debate on ICTs should better take into account their abatement potential."

Telecoms are key drivers of the decarbonization based on ICT. By increasing connectivity and improving efficiency, mobile network enabled technologies help avoid emissions: indeed, although the total annual emissions of the mobile communication sector are approximately 220 $MtCO_2$ (0.4% of total global emissions), **the level of avoided emissions enabled by mobile communications technologies is ten times greater,** especially for fuel consumption (521 billion liters of fuel avoided) and electricity and gas (decrease of 1.44 billion MWh)[71]. For instance, in the transport sector, mobile telecommunications technologies can act as a catalyst to enhance electric vehicles by easing the use of charging stations and to improve vehicle fuel efficiency through telematics[72].

ENHANCING SYNERGIES WITH "SECTOR COUPLING"

Synergies occur when interactions between adaptation and/or mitigation measures lead to greater benefits than when they are implemented separately.

Sector coupling is a specific type of synergies which tends to develop. Sector coupling referred primarily to the "electrification of end-use sectors like heating and transport, with the aim of increasing the share of renewable energy in these sectors and providing balancing services to the power sector"[73]. More widely, sector coupling is a strategy that provides greater flexibility to the energy system in order to achieve a more cost-effective decarbonization. The electricity system moves from "a system where generation adapts to inflexible demand, to a system where flexible demand adapts to variable generation"[74].

Sector coupling has started for transport, buildings and industry and should develop among other sectors, such as data centers *(Focus 4)*.

Sector coupling fosters positive synergies between infrastructure assets."

FOCUS 4

Data centers, catalysts of sector coupling and climate transition

Data centers are becoming a growing critical part of the infrastructure for the digitalized society. They consist of a dedicated space within a building to house computer systems and associated components, such as telecommunications and storage systems. They have a potential role to play as a catalyst of sector coupling and climate transition.

ENHANCE THE FLEXIBILITY OF THE GRID

Given the energy usage and the high degree of automation – due to the integration of technologies such as IoT devices and machine learning algorithms, data centers provide a **great opportunity to increase the flexibility of grids through demand-side management.** This flexibility allows grids to integrate **higher shares of variable sources of energy,** such as solar and wind[75] and favors **decarbonization by (i) minimizing the overall energy consumption and (ii) reducing the peak power demand** during demand-response periods[76]. This new management approach could also provide more than 10 GW of demand response in the European electricity system in 2030[77].

APPLICATION: USING WASTE HEAT FROM DATA CENTERS

Using renewable electricity for operations and waste heat (a natural product of servers) allows large amounts of water to be warmed for nearby houses or businesses, data centers indirectly electrify with renewables the heating sector[78].

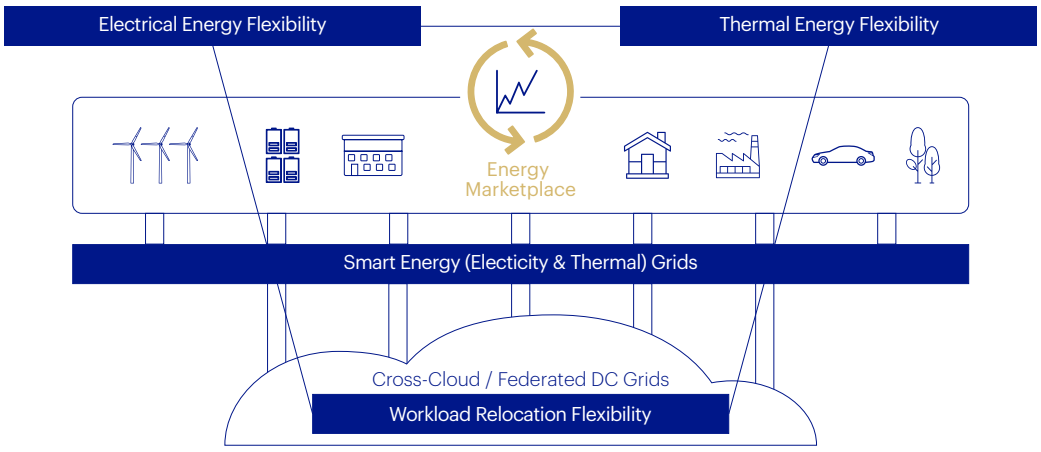
For instance, Facebook's DC in Odense, Denmark, captures excess heat generated by their servers and recycles it to provide heat (supported by 100% renewable energy) to the local community, which is then directed into the local district heating system, operated "by district[79] heating company."

[71] GSMA, The Enablement Effect, The impact of mobile communications, technologies on carbon emission reductions, 2019.
[72] Ibid.
[73] European Parliament, Sector coupling: how can it be enhanced in the EU to foster grid stability and decarbonise?, November, 2018; Deutsche Umwelthilfe, Sector Coupling – Using electricity for heating and transport to protect the climate, 2017.
[74] Gea-Bermúdez J. and al., The role of sector coupling in the green transition: A least-cost energy system development in Northern-central Europe towards 2050, Applied Energy, Volume 289, May 2021.
[75] Ratka S., Boshell F., The nexus between data centres, efficiency and renewables: a role model for the energy transition, Energy Post, June 26, 2020.
[76] Basmadjian R., Flexibility-Based Energy and Demand Management in Data Centers: A Case Study for Cloud Computing, Energies, MDPI, 2019.
[77] Koronen C., Åhman M., Nilsson L. J., Data centres in future European energy systems—energy efficiency, integration and policy, Energy Efficiency, volume 13, pages 129–144, December 2019.
[78] Ratka S., Boshell F., The nexus between data centres, efficiency and renewables: a role model for the energy transition, Energy Post, June 26, 2020.
[79] Data Center Dynamics, Facebook begins data center and district heating expansion in Odense, Denmark, October 2020.

FIGURE 16

Sector coupling for grid flexibility

Source: A. Creti



The integration of sector coupling in climate strategies can lead to a change in paradigm in the green transition. According to a study from Bloomberg, sector coupling could lower emissions by 60% over 2020–2050 across transport, buildings and industry (equivalent to a 71% reduction on 1990 levels)[80]. Sector coupling must combine **the "doing the right infrastructure" approach with the additional strategy of "doing infrastructure right."**

ENHANCING CO-BENEFITS

Co-benefits: a new axis of climate strategy

Climate action can also provide **multiple non-climate benefits – called co-benefits –** that include improvements – beyond job creation – in public health, increased energy security, and reductions in poverty and inequality, etc. Co-benefits of climate action were first mentioned in the fourth Assessment Report of the IPCC in 2001. They stand for the additional positive social, environmental, health and economic benefits attributed to climate projects above and beyond the main benefit of expected GHG reduction or adaptation[81] *(Figure 17)*.

> **Climate action can generate other economic, environmental or health co-benefits in the short term."**

One of the main co-benefits of climate action is **air quality**, which has been a growing concern of public authorities. Between 2000 and 2015, fine particulate concentration across the European Union declined by 20%, boosting the EU GDP by 2.4%.

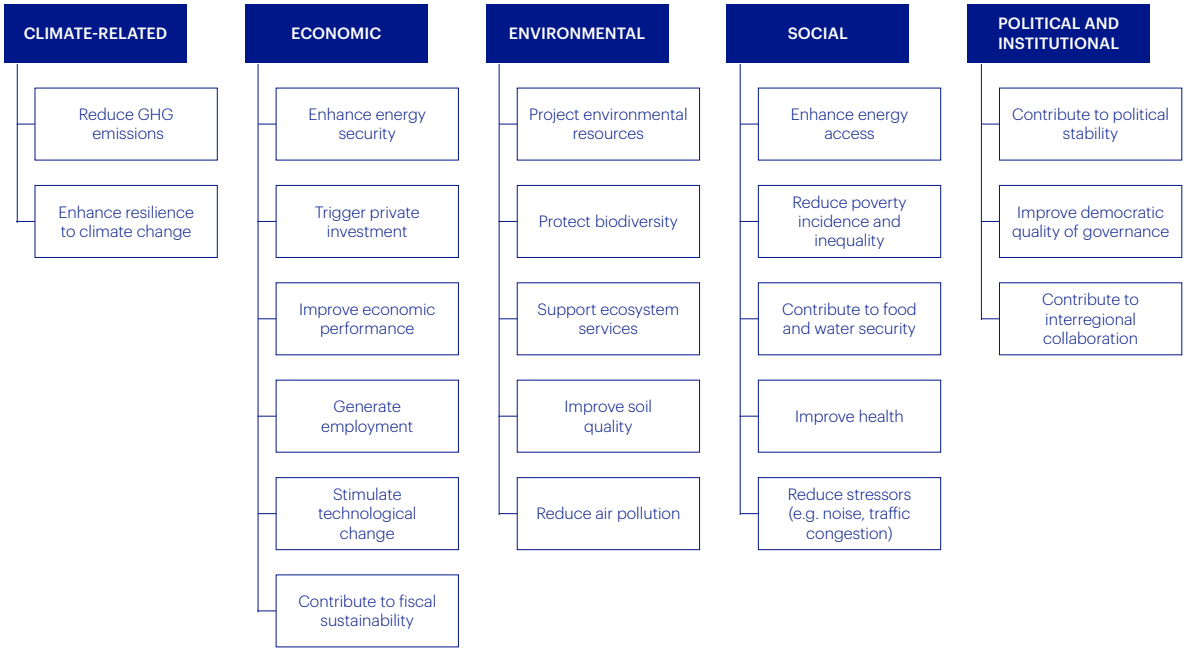
Although public authorities – and in particular city-level and regional governments (as co-benefits manifest themselves mainly on a local scale) are well-placed to incorporate co-benefits into their decision-making and climate strategies, the private sector can also build on this more comprehensive approach[83].

Many infrastructure sectors produce co-benefits, such as building renovation, the deployment of low-carbon cars, public transport infrastructure, railway infrastructure, cycling facilities, and renewable electricity production[84].

FIGURE 17

Co-benefits categories

Source: Mayrhofer and al., 2016[82]



FOCUS 5

Co-benefits generated by the development of rail transport

According to a 2019 study of the European Commission[85], the total external costs of transport in the EU28 are estimated at € 987 billion. The most important cost category is accident costs equating to 29% of the total costs, followed by congestion costs (27%), while environmental costs (climate change, air pollution, noise, well-to-tank and habitat damage) make up the remaining 44% of the total costs.

Large differences exist between transport modes. Road transport (and particularly passenger cars) being the largest contributor to external costs (83% of the total costs, € 820 billion), which is partly explained by the large share of road transport in the total EU28 transport performance.

In this context, though road will remain the main transport mode in the future, the development of rail transport — both for passengers and for freight — can substantially reduce GHG emissions and create significant other co-benefits (in particular air quality improvement and reduction in accidents). As an example, in France, rail freight generates 3 to 4 times fewer negative externalities than road (congestion, CO_2, air pollution, accidents) *(Figure 18)*.

TABLE 2

External costs in the EU28 in 2016

Source: CE Delft, 2019

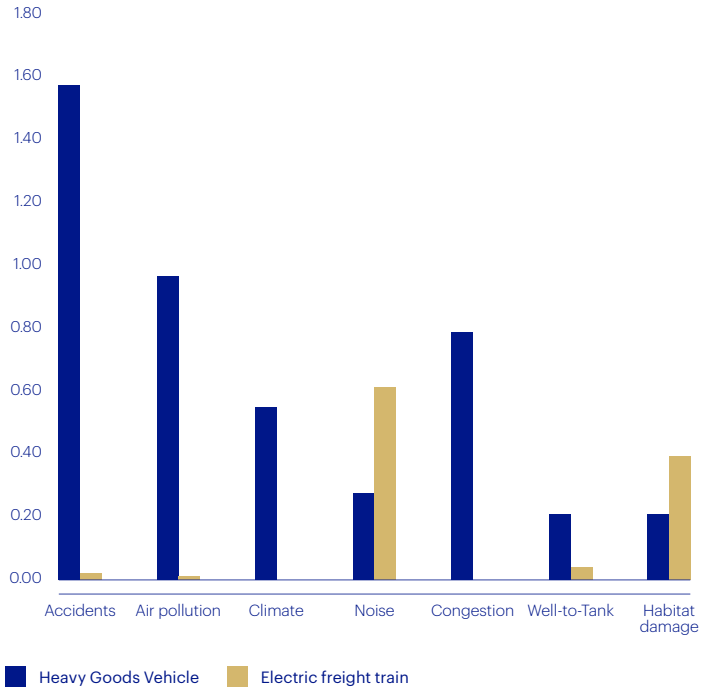
Vehicule category	Total external costs	Average external costs
Passenger transport modes	**Billion €**	€-cent/pkm
Passenger car	**565**	12.0
Bus/coach	**19**	3.6
Motorcycle	**41**	24.5
High speed train	**1**	1.3
Electric passenger train	**11**	2.6
Diesel passenger train		3.9
Aircraft	**48**	3.4
Light commercial vehicles	**Billion €**	€-cent/pkm
Light commercial vehicle	**118**	24.7
Freight transport modes	**Billion €**	€-cent/pkm
Heavy Goods vehicle	**78**	4.2
Electric freight train	**5**	1.1
Diesel freight train		1.8
IWT vessel	**3**	1.9
Maritime vessel	**98**	0.7

[80] BloombergNEF, Electrification Can Cut Emissions of Transport, Buildings and Industry in Europe by 60% by 2050, February 11, 2020.
[81] Future Carbon Fund, Delivering Co-Benefits for Sustainable Development, Asian Development Bank, 2017.
[82] Mayrhofer J. and al. The science and politics of co-benefits in climate policy, 2016.
[83] Jennings N., Fecht D., De Mattei S., Mapping the co-benefits of climate change action to issues of public concern in the UK: a narrative review, The Lancet, Volume 4, Issue 9, September 2020.
[84] I4CE, Geoffron P., Leguet B., Environmental and health co-benefits of public action: «it's (also) the economy, stupid!», May 2020.
[85] CE Delft, State of play of Internalisation in the European Transport Sector, May 2019.

FIGURE 18

Average external costs of freight transport in France (c€/t.km)

Source: CE Delft, 2019



In a 2020 study focusing on rail freight in France, Altermind estimated that doubling of the modal share of rail freight by 2030 would avoid between €16 and €30 billion of negative externalities over the period 2021-2040[86]. This amount can be compared to the amount of investment in the railway network which is considered necessary (€13 billion, partly benefitting passenger transport).

EXPERT POSITION 6

Co-benefits as a paradigm shift

The co-benefits approach represents a real paradigm shift as it allows not only economic benefits to be taken into account but also externalities, such as health benefits. Co-benefits are realized in the short term, whereas adaptation and mitigation impacts may take a longer time horizon to be achieved."

Anna Creti, professor of economics at University Paris-Dauphine

The regulatory framework should be adapted to help infrastructure stakeholders take co-benefits into account."

The recognition and integration of co-benefits opens up a **"window of opportunity" for both public and private infrastructure stakeholders** to maximize the global impact of their actions by addressing the "side effects."

Give the proper regulatory incentives to address co-benefits

The far-reaching benefits of sustainable infrastructure can fail to materialize if infrastructures are planned based on an incomplete understanding of its potential, in isolation from interconnected systems, and without the enabling policies to ensure the desired outcomes[87].

Acting as a driver of co-benefits promotion, the UN has recently stressed the importance of an integrated assessment of infrastructure, highlighting the importance of co-benefits. Still, in spite of the growing interest in the "narrative" of co-benefits, **there is no standardized tool or approach to include them effectively in decision-making and in particular for infrastructure investment** while it is an essential step to accurately assess the environmental, social, and economic costs / benefits of different infrastructure and the balancing trade-offs between them.

In this context, the building of an efficient and incentivized framework for sustainable investment and maximized co-benefits should rely on:

→ **A clear vision on sustainability:** the International Good Practice Principles for Sustainable Infrastructure constitute one of the first guiding principles that policymakers can follow to help integrate sustainability into infrastructure planning, management, and delivery, creating the "enabling environment for sustainable infrastructure";

→ **Shared methods for categorizing, measuring and presenting co-benefits** and a better integration of co-benefits data into policy-making;

→ **A renovated legal framework which includes co-benefits measurement together with a practical solution:** public-private partnerships (PPPs) have always been attractive to maintain and develop public infrastructure. PPPs should embed environmental and social considerations in their goals, designs and specifications, along with tender evaluation, supplier selection, etc. The focus should shift from conducting environmental impact assessments as a simple part of the process to "integrate sustainability across the PPP lifecycle[88]."

Coordination between public authorities at various levels will be a key lever to effectively implement policies facilitating co-benefits in **infrastructure, in a way that really maximizes its impact[89].** This process must also integrate the bottom level of governance (citizens, businesses, etc.) as co-benefits are perceived differently and can be monetized.

[86] Geoffron P., Thirion B., Rapport pour l'Alliance « Fret Ferroviaire Français pour le Futur », Les co-bénéfices du fret ferroviaire : éléments d'évaluation et propositions, Altermind, June 2020.
[87] UN Environment Programme, International good practice principles for sustainable infrastructure, Integrated, systems-level approaches for policymakers, February 2021.
[88] International Institute for Sustainable Development, Perera O., Sustainable Development: Is there a role for public–private partnerships?, Policy Brief, October 2011.
[89] Institute for the Advanced Study of Sustainability, Dreyfus M., The legal co-benefits approach at the local level: legal perspectives, Policy brief, N°3, 2015.

Key value creation levers for infrastructures in the context of climate transition

Section | **4**

Key takeaways

→ For infrastructure stakeholders, transitioning to a low-carbon and resilient economy is not only essential to limit climate change impacts but also makes good business sense

→ New sustainable business models can help companies improve their impact on the three pillars of sustainability – profit, people, and planet (economic, social, and environmental)

→ To incentivize the amount of investment in sustainable infrastructure needed for the climate transition, an enabling contractual environment must be promoted

DRIVING THE CLIMATE TRANSITION WITH A NEW BUSINESS VALUE PERSPECTIVE

A NEW CONCEPTION OF VALUE[90]

Tangible and intangible value

To date, business strategies have mostly been built through the prism of economic and financial value proposition, value capture, value creation and delivery: facing the climate crisis, **a more comprehensive understanding of value is spreading to promote sustainable behaviors.**

With increasing environmental constraints restricting their ability to pursue business value as usual, companies have been increasingly adopting a new approach to broaden growth opportunities and value creation, **taking into account "intangible"** value (environmental and social) and developing tools to monitor this. Part of this evolution has been polarized within the concept of Environmental and Social Governance (ESG), generally considered as the basis of companies sustainability strategies.

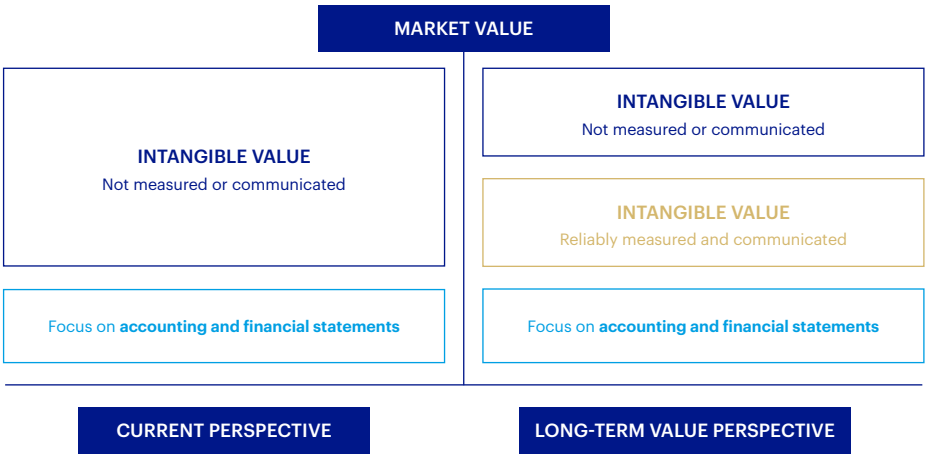
Business sustainability

In this perspective, "business sustainability", i.e. the management and coordination of environmental, social and financial demands in the business strategy, must now reconcile value with **sustainability through new approaches,** more or less advanced[91].

FIGURE 19

The emergence of "intangible value": a long-term perspective

Source: R. Durand



[90] Source: Rodolphe Durand, Workshop 3.
[91] Hoffman A. J, The Next Phase of Business Sustainability, Stanford Social Innovation Review, March 2018.

CASE STUDY 10

Schneider Electric's impact monitoring[92]

Schneider Electric is the leader in the digital transformation of energy management and automation, ranked #1 world's most sustainable corporation in 2021 (Corporate Knights Global 100).

The Group announced its 2021-2025 Sustainability targets aligned to six commitments supporting the United Nations Sustainable Development Goals. Amongst them, three key targets to act for a climate positive World: 80% green revenues; 800 million tons of carbon emissions saved and avoided for customers since 2018; 50% emissions reduction of their 1000 top suppliers' operations through The Zero Carbon Project. As part of its five-year sustainability program, Schneider Electric is monitoring every quarter its performance through a best in class **"Sustainability Impact"** report, as follows:

[92] Schneider Electric, Bridging progress and sustainability for all, Sustainability report, 2020-2021.

FIGURE 20

Schneider Electric Sustainability Impact report

Source: Schneider Electric reports

SCHNEIDER SUSTAINABILITY IMPACT

Q1 2021 Results

Score[1]: Q1 3.38 | Q2 | Q3 | Q4 | 2021 Target 3.75[1]

6 long-term commitments	11+1 targets for 2021-2025	Baseline	Q1 2021	2025 Target
CLIMATE	1 Grow our green revenues[2]	70%	72%	80%
	2 Help our customers save and avoid millions of tons of CO_2 emissions[3]	23M	276M	800M
	3 Reduce CO_2 emissions from top 1000 suppliers' operations[4]	0%		50%
RESOURCES	4 Increase green material content in our products[4]	-		50%
	5 Primary and secondary packaging free from single-use plastic and using recycled cardboard[4]	-		100%
TRUST	6 Strategic suppliers who provide decent work to their employees[4]	-		100%
	7 Level of confidence of our employees to report unethical conduct[4]	-		-
EQUAL	8 Increase gender diversity in hiring (50%), front-line management (40%) and leadership teams (30%)	41/25/24	44/25/25	50/40/30
	9 Provide access to green electricity to 50M people	30M	30.7M	50M
GENERATIONS	10 Double hiring opportunities for interns, apprentices and fresh graduates	4.939	x1.11	x2.00
	11 Train underprivileged people in energy management[5]	281.737	287.601	1M
LOCAL	+1 Country and Zone Presidents with local commitments that impact their communities	0%	84%	100%

Climate action creates value for companies through various channels."

→ **"Enterprise integration"** is founded on a model responding to market shifts to strengthen competitive positioning by integrating sustainability into pre-existing business considerations;
→ Conversely, **"market transformation",** the next phase of business sustainability, is founded on a transformative model: instead of expecting for a market shift to create incentives for sustainable practices, firms prefer creating those changes to enable new forms of business sustainability.

Companies are starting to integrate **business sustainability and the wider notion of "impact" in their strategies and monitor their ESG performance.**

KEY BENEFITS FOR BUSINESSES

Climate action is creating value for companies through various channels: help comply with policy changes and new rules, reduce exposure to climate risks, generate innovation that can create new business models and value, avoid reputational risk, etc.

From a general perspective, academic research shows that the **impact of ESG strategies on operating profitability** tends to become positive: corporate and social responsibility (CSR) favors unit and operational efficiency, enhances innovativeness, helps sustain competitiveness during crises, has minimal effect on share value but stimulates long-term shareholding, and favors balance-sheet terms in particular through cost of debt. While such an observation is certainly not universal (especially in sectoral terms and depending on local policy frameworks), it is important to stress that CSR does not necessarily come at the expense of profitability.

FOCUS 6

Review of some academic articles on business benefits from CSR actions

→ **Favoring unit and operational efficiency**
Carbon efficiency can partly be regarded as "resource efficiency in disguise." There is evidence of higher operating performance and lower risk levels in carbon-efficient ("best-practice") firms while, inversely, firms producing relatively abundant carbon emissions exhibit some resource use inefficiencies[93]. For instance, waste prevention and management lead to financial gains and higher returns on assets for businesses. In other words, waste prevention alone is responsible for the "association" of lower emissions and profitability[94]. To avoid the under-exploiting of these opportunities by managers – especially due to information cost acquisition – governing authorities may gather information and provide statistics to businesses to update their expectations about the profitability of engaging in certain practices[95].

→ **Enhancing innovativeness**
Taking Chinese manufacturing companies as an example, a study showed low-carbon technological innovation promotes enterprise performance. This relationship is partially mediated by green core competence[96].

→ **Helping sustain competitiveness during crisis**
CSR, particularly investment aimed at secondary stakeholders, represents a potential method of creating value for shareholders in the face of certain types of negative events. Managers of firms who engage in CSR activity can create value at times for their shareholders through the creation of "insurance-like" protection[97].

→ **Having minimal effect on share value but stimulating long-term shareholding**
Confronted with the mounting demands of civil society and the daunting climate challenges, the impact of sustainability indices cannot but grow over time with the development and the structuring of the ESG investment industry[98].

→ **Favoring balance-sheet terms**
Both better stakeholder engagement and transparency around CSR performance are important in reducing capital constraints: this relation is driven by both the social and environmental dimensions of CSR[99].

The focus of a company's activities around the SDGs creates value for the company and society, which contributes to its competitive positioning. This value creation needs to be monitored through specific tools adapted to each company's stakes."

Rodolphe Durand, HEC Foundation
Chaired Professor of Strategy at HEC-Paris,
Academic Director of the Society
and Organizations Center

Proxiserve is involved in the environmental services sector: it creates value through energy savings, water savings or the development of electric vehicles. We have also reinforced our CSR policy as we strongly believe that it will create value in the long term."

Stéphane Caine, CEO of Proxiserve

EXPERT POSITION 7

CSR: a key factor of attractiveness and value creation

At Indigo, CSR is a key topic as it can bring a strategic advantage and benefits for the company. The CSR strategy relies on 3 pillars: the Go for climate initiative, our in-house program which aims to achieve neutral carbon in Scope 1 and Scope 2 emissions by 2025, a quantitative evaluation (with international KPIs and metrics) and focus on people, especially young people. Our company offers solutions to the cities of the future: we can offer parking services that could help diminish the impact of cars in the city, which make us competitive and attractive because of the associated CSR. All fostered by our new purpose 'Opening Space for peaceful city motion'."

Serge Clemente, CEO of Indigo

[93] Trinksa A., Muldera M., Scholtensab B., An Efficiency Perspective on Carbon Emissions and Financial Performance, Ecological Economics, Volume 175, 2020.
[94] King A., Lenox M., Exploring the Locus of Profitable Pollution Reduction, Management Science 48, no. 2, page 289-99, 2002; Durand R., Paugam L., Stolowy H., Do investors actually value sustainability indices? Replication, development, and new evidence on CSR visibility, Strategic Management Journal, 40(9), 1471-1490, April 2019.
[95] Lenox M., Agency and Information Costs in the Intra-Firm Diffusion of Practice. Unpublished Ph.D., Massachusetts Institute of Technology, Cambridge, MA, 1999.
[96] Li F., Can low-carbon technological innovation truly improve enterprise performance? The case of Chinese manufacturing companies, Journal of Cleaner Production, Volume 293, April 2021.
[97] Godfrey P. and al., The relationship between corporate social responsibility and shareholder value: An empirical test of the risk management hypothesis, Strategic management journal, 30(4), 425-445, April 2009.
[98] Durand R., Paugam L., Stolowy H., Do investors actually value sustainability indices? Replication, development, and new evidence on CSR visibility, Strategic Management Journal, 40(9), 1471-1490, April 2019.
[99] Cheng B., Ioannou I., Serafeim G., Corporate social responsibility and access to finance, Strategic management journal, 35(1), 1-23, April 2013.

Assessing the benefits and costs of infrastructure investment is complex."

The challenge is now to maximize the value created by climate strategies for infrastructure stakeholders and to reconcile the short term and the long term with the implementation of adapted business models.

CAPTURING THE UNTAPPED VALUE OF SUSTAINABLE INFRASTRUCTURE

SEARCHING FOR NEW BUSINESS MODELS FOR SUSTAINABILITY

From the Government's perspective

In the infrastructure sector, the Government (at the supranational, national or local level) is often the **initiator and enabler of projects.** In order to accelerate the shift to sustainable infrastructures, it is necessary to take into account the new conception of value (incorporating environmental externalities and the non-action costs) arising in the context of climate strategies. It is also necessary to involve all relevant stakeholders and explicitly take into consideration their acceptability and support which are key to implement new projects.

Key questions the Government has to address in this context are: does sustainable infrastructure bring more value-for-money than business-as-usual alternatives? Where does the value come from and where is it delivered to? Who should operate the service? Who can access that service? Who will profit from it? How should it be regulated in order to maximize this value?

However, assessing the benefits and costs of infrastructure investment is a **complex exercise:** it traditionally prioritizes economic aspects over social and environmental objectives and faces difficulties in valuing positive social and environmental externalities (e.g. spillover or co-benefits)[100].

In this context, academic research has extended **the business model canvas (BMC) approach[101]** to design business models and evaluation methods that can incorporate, in addition to economic values, social and environmental value streams and propositions in order to facilitate genuinely sustainable infrastructure investment. Indeed, the classic BMC framework is not able to fully capture value concepts beyond consumption and revenue exchanges, but can be extended to incorporate new conceptions of value.

The BMC makes it possible to identify a number of components that are constantly interacting and evolving throughout the life span of a business. It can thus be extended in a sustainable perspective and applied to infrastructures, notably in urban areas and cities, and help identify the vulnerabilities and opportunities that are tied to environmental and societal issues. The City Model Canvas (CMC) is seen as an application of the BMC to cities taking implicitly the Governments' perspective of the collective value creation.

[100] Foxon T. and al., Low carbon infrastructure investment: extending business models for sustainability, Infrastructure complexity, June 2015.
[101] Osterwalder A., Pigneur Y., Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, August 2010.
[102]Timeus K., Creating business models for smart cities: a practical framework, Public Management Review, Issue 5: Special issue: Management, Governance and Accountability for Smart Cities and Communities, Volume 22, pp 726-745 , 2020.

FIGURE 21

The nine building blocks of a classic business model

Source: Osterwalder and Pigneur, 2010; Foxon and al., 2015

<table>
<tr><th colspan="5">Business Model Canvas</th></tr>
<tr><td rowspan="2">Key partners
Network of suppliers and partners that make business model work</td><td>Key activities
Most important things a company does to make its business model work</td><td rowspan="2">Value proposition
The bundle of products and services that create value for a specific Customer Segment</td><td>Customer Relationships
Relationship a company establishes with its Customer Segments</td><td rowspan="2">Customer Segments
The different groups of people or organizations an entreprise aims to reach and serve</td></tr>
<tr><td>Key resources
Most important assets required to make the business model work</td><td>Channels
How a company communicates and reaches its Customer segments</td></tr>
<tr><td colspan="3">Cost Structure
All costs incurred to operate a business model</td><td colspan="2">Revenue Streams
The money a company generates from each Customer Segment</td></tr>
</table>

FIGURE 22

Application of the BMC to cities: the City Model Canvas (CMC)[102]

Source: Timeus, 2020

<table>
<tr><th colspan="5">1. Mission statement : what is the ultimate goal that the city seeks to achieve?</th></tr>
<tr><td rowspan="2">6. Key partnerships
Who can help the city deliver the proposed value to the beneficiaries? Who can access key resources that the city council does not have?</td><td>7. Key activities
What must the city council do to create and deliver the proposed value?</td><td rowspan="2">2. Value proposition
What specific benefits are created and what specific problems does the proposed service solve or alleviate?</td><td>4. Buy-in & support
Whose buy-in is needed in order to deploy the service (legal, policy, procurement, etc.)?</td><td rowspan="2">3. Beneficiaries
Who will directly benefit from the proposed services?</td></tr>
<tr><td>8. Key infrastructure and resources & key regulatory framework
What key resources does the city have to create and deliver the value? What infrastructure does it need? What is the key regulatory framework required?</td><td>5. Deployment
How will the city solve the problems of the value proposition specifically?</td></tr>
<tr><td colspan="3">9. Budget cost structure
What costs will the creation and delivery of the proposed services entail?</td><td colspan="2">10. Revenue streams
What sources of revenue for the city do the proposed services provide? What other sources of revenue does the city have?</td></tr>
<tr><td colspan="3">11. Environmental costs
What negative environmental impacts can the proposed service cause?</td><td colspan="2">12. Environmental benefits
What environmental benefits will the proposed services deliver?</td></tr>
<tr><td colspan="3">13. Social risks
What are some of the potential social risks that the proposed service entails? Who is the most vulnerable as a result?</td><td colspan="2">14. Social benefits
What social benefits will the proposed services bring about? For whom will these benefits materialize?</td></tr>
</table>

Firms need to adapt their business models to capture the value created by their climate action."

Overall, **environmental values need to be explicitly incorporated into business models in order to monetize them at an early stage[103]:** this extended BMC could be used as a tool for public authorities to compare options at the beginning of the procurement process of infrastructure.

From the firms' perspective

Firms also need to adapt their business models – i.e. firms' strategic choices to create, capture and share value within a value network – to be able to capture the "untapped" value of climate actions[104]. A sustainable business model would therefore "create a competitive advantage through superior customer value and contribute to the sustainable development of the company and society[105]".

Academic research on business model innovation shows that the uncaptured identified value can trigger the discovery of new value opportunities which lead to new business models with higher sustainable value *(Figure 23)*[106].

While it is difficult to identify a single, stable business model for sustainable infrastructure, some business models are currently emerging **around various sources of cost savings, efficiency gains and additional services.** All business models usually coexist : there is no exclusive business model, but a **diversity of business models**, which differ in value creation and the conditions under which the services are delivered. Firms have to carefully decide what to own in order to capture value, and they need to prioritize investment in those assets. These business models identify revenue streams and value capture opportunities and require cooperation and coordination between private and public actors.

Table 3 presents the various current business models around sustainable infrastructure and their main areas of application.

[103] Foxon T. and al., Low carbon infrastructure investment: extending business models for sustainability, Infrastructure complexity, June 2015.
[104] Larosaab F., Mysiakab J., Business models for climate services: An analysis, Climate Services, Volume 19, 2019.
[105] Lüdeke-Freund F., "Towards a conceptual framework of business models for sustainability", Environmental Management, Vol. 49 No. 0, pp. 1–28, September 2010.
[106] Yang M. and al., Value uncaptured perspective for sustainable business model innovation, Journal of Cleaner Production, July 2016.

New business models are emerging around sustainable infrastructures."

FIGURE 23

Sustainable business model

Source: Altermind, inspired by Yang and al., 2016

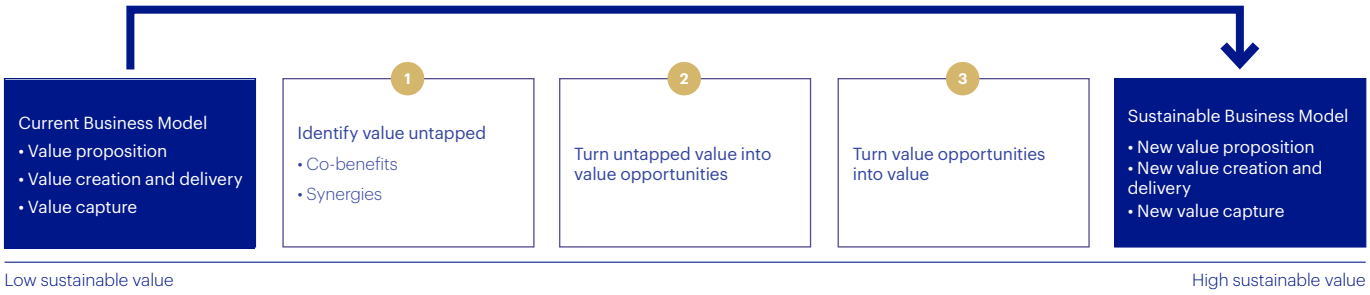


TABLE 3

Emerging business models for infrastructure

Source: Altermind, C. Staropoli, inspired by Ibicity, Acadie, Espelia, Etude sur les nouveaux modèles économiques urbains, Qui paiera la ville (de) demain ?, January, 2017

Typologie	Vector	Effects	Value creation lever	Examples
Infrastructure as a service	Adaptation to real needs and efficiency of services, circular economics	Integrated services	• Substitution of the sale of a good for the sale of a service or an integrated solution (economy or functionality) • Economic valuation of the rental of services	• Mobility as a Service model as an integrated solution for transportation (scooters, cars, dockless bikes) • Lighting as a Service (design, installation, operation and maintenance of lighting system) through energy performance contracting
Data-driven infrastructure	Data optimization	Optimization of services in quality and cost	• Assets are profitable thanks to clear visibility in their use • Permanent search for optimization of the pricing and investment relationship	• Smart meters for water and energy services
Smart Infrastructure	Digital technology generating savings and efficiencies	Energy and operating savings Direct and indirect savings	• Reduction of maintenance costs • Efficiency improvements • Awareness and less consumption (or rationalization) • New services	• Low-energy LED lights with intelligent public lighting networks (flow sensors) • Communicating meters in public buildings • Video projection/ video surveillance
Restrained Infrastructure	Energy saving or non-consumption	Saving, not consuming or postponing consumption	• Valuation of non-consumption or deferred consumption to avoid spikes	• Valuation of non-consumption or deferred consumption to avoid spikes
Dynamic-pricing Infrastructure	Accessibility conditions	Diversification of users	• Provision of a free basic universal service financed by revenues from premium offers • Incentive-based pricing to reduce external costs	• Higher rates for water and electricity when exceeding a certain consumption threshold covering basic needs • Discounted rates to favor clean mobility modes
Peer-to-peer Infrastructure	Exchanges	Privatization of services	• Sharing of goods and services between prosumers (producers & consumers)	• Bike-sharing and carsharing • Pooling of private energy production means (micro-grids)
Multifaceted Infrastructure	Diversification of the third party use	Diversification of revenue sources • Billing below cost price	• Billing third parties for other related services	• Financial investment through advertising • Naming of stadiums • Multi-function street lighting poles

CASE STUDY 11

Indigo: a smart and multifaceted infrastructure

Indigo manages several businesses: off-street parking, on-street parking, individual mobility, digital and proximity logistic services. With more than 20 000 employees, Indigo manages over 5 600 car parks, more than 2.3 million parking spaces and 2200 km of on-street parking across over 750 cities in 11 countries.

Indigo has invested in innovation in mobility, notably in enhancements to the urban mobility and parking value chains:

→ **Systems and apps** like Streeteo and OPnGO are bringing fully digitalized parking solutions to cities to improve urban traffic management;

→ **Soft mobility services** like Indigo Weel and Smovengo fostering eco-friendly shared mobility in city centers (over 60 municipalities and 420 000 users of the Smovengo e-bicycle-sharing scheme in the Greater Paris area).

Indigo's car parks are in city centers and have space that can be used for storage and to improve the flow of traffic. Their locations and layouts are key assets when it comes to developing new urban logistics services. Several car parks are now used for different purposes other than parking in order to develop new streams of revenue:

→ Indigo is opening 100,000m² of parking spaces for last mile logistics and storage programs;

→ Solutions to transform car parks into vehicle maintenance centers are in the test phase in the Île-de-France region;

→ At the Porte de Saint-Cloud and Harlay Pont-Neuf car parks in Paris, car parks are becoming fresh product delivery platforms. Orders are made on a smartphone app and the logistics chain includes storage areas, product preparation and delivery by cargo-tricycle.

Our strategy is to position ourselves as the partner of cities for parking, but also for the individual mobility of tomorrow. Developments affecting the car will increase the use of this mode of transport, so we are working to reinvent the parking experience."

Serge Clemente, CEO of Indigo[108]

[108] Les Echos, Indigo se place sur le parking du futur, February 13, 2018.

CASE STUDY 12

Proxiserve: a data-driven infrastructure

Based on its expertise, Proxiserve has developed a data-driven and smart infrastructure with various applications and business opportunities, especially in its housing activities. Proxiserve participates in sustainable housing and associated services through **innovative offers** to improve housing's ecological impact (boilers and heat pumps) generating energy efficiency certificates, as well as smart-metering for better control of water and energy consumption.

Proxiserve has developed a data warehouse and specific software to analyse the data generated by its connected devices (smart meters, controlled mechanical ventilation, boilers, electric vehicule charging stations, etc.). With this software, Proxiserve can help its customers (in particular large social housing companies) to reduce their **energy and water consumption.** Next steps: Proxiserve intends to use artificial intelligence tools to develop a deeper analysis of data and therefore generate even more environmental performance.

FOCUS 7

The Bristol City Leap Project

City Leap is a series of energy and infrastructure investment opportunities to build a cleaner and greener Bristol. Bristol City Council is seeking **long-term partners (up to 2050) to coordinate, finance and deliver multiple smart and low-carbon energy infrastructure projects** (supply, generation, efficiency and smart): Bristol is expected to be the **UK's first carbon neutral city by 2030**[110].

The project – whose procurement process is ongoing – will support delivery of **£1 billion of investment on a range of projects,** including low-carbon heat networks, renewable energy from wind, and solar, as well as energy efficiency, electric vehicles and smart energy systems[111].

TOWARDS NEW TYPES OF PUBLIC CONTRACTS FOR SUSTAINABLE INFRASTRUCTURE

The contractual framework for infrastructure must be renovated to better integrate sustainability objectives and principles into contracts and contracting processes. In this perspective, it is generally considered that including sustainability criteria in procurement would shift public financing and influence the private sector to invest in sustainable infrastructure by sending the appropriate market signals[109].

Besides, the characteristics of sustainable infrastructure and the objective of maximizing value creation favor new types of contracts taking into account new risks (technological obsolescence, climate risks) and assessing co-benefits better.

Public contracts tend to become:
→ **Global:** global contracts are developing with private operators in order to (i) include all stages of the infrastructure lifecycle and (ii) manage public services more transversally. They include all stakeholders (public actors, consumers, producers, infrastructure operators, urban planners, etc.);
→ **Outcome-based:** outcome-based contracts are user-centric and services-oriented contracts with systematic KPIs and attractive incentives: they usually tie at least a portion of a contractor's payment (or extensions, renewals) to the achievement of measurable performance standards;
→ **Innovative contracts:** contracts should aim to improve public service, stimulate innovation, reinforce transparency. They generalize open data provisions and improve regulation to facilitate data sharing with other players.

[109] International Institute for Sustainable Development, Contracts for Sustainable Infrastructure: Ensuring the economic, social and environmental co-benefits of infrastructure investment projects, December 2017.
[110] Energy Service Bristol, Bristol's City Leap, website consulted on July 28, 2020.
[111] Bristol Post, Three firms shortlisted for £1b zero carbon energy venture in Bristol, November 2020.

"The contractual framework of infrastructure should evolve to favor sustainability."

TABLE 4

The Bristol City Leap Project expected investments

Source: Bristol Council

Sector	Estimated investment	Description
District heating	£300m	Extension of the network, heat generation sources
Smart energy systems	£125m	Demand-side management, ICT platform, smart metering, EV charging
Building efficiency	£400m	Consumer engagement (service), financial aid programs to fund energy efficiency measure (retrofit, equipment), build the supply chain
Energy generation	£40m	New renewables capacities (wind, solar)
Evaluation/ monitoring/ dissemination	£10m	Evaluation of the program's success socio-economic benefits Dissemination (government, academic, businesses,..)
Others	NA	Transport planning, Hydrogen applications, Marine Energy, Urban planning

The Bristol City Leap Project is a very good example of the development of new public contracts to implement a comprehensive approach of sustainable, low-carbon and resilient infrastructure, resilient and improving the quality of life of citizens. It will be very interesting to see how the value created by this project will be shared between various stakeholders."

Carine Staropoli, Professor at PSE and Maître de Conférences at the University Paris 1 Panthéon-Sorbonne

As an investor on behalf of a Local Government Pension Scheme pool based in Bristol, and as a worker in and commuter to the city, I am supportive of pioneering greenfield infrastructure investments such as those proposed by the Bristol City Leap Project. They are scarce and provide a model for other UK cities to aspire to. The roll-out of these projects will constitute a key challenge: to transform the city while maintaining its day-to-day functioning and minimizing disruption to residents."

Richard Fanshawe, Head of Private Markets of Brunel Pension Partnership Limited

CASE STUDY 13

The Montgomery County facility : an innovative “Energy as a Service” agreement with Schneider Electric

Following the aftermath of a violent storm in 2012, the Montgomery County (Maryland) launched in 2017 ***two microgrid projects to improve the resiliency of public facilities, reduce their environmental impacts and decrease operational costs.*** These projects were accomplished thanks to a partnership with Schneider Electric and Duke Energy Renewables.

An innovative public-private partnership allowed microgrids to be installed without any upfront costs to the County through a **25-year “Energy-as-a-Service” (EaaS) agreement[112]. Schneider Electric played a comprehensive role in designing and implementing this solution,** including microgrid protection control and optimization, electrical equipment, distributed energy resource management, electrical design services, cybersecurity and network design.

The local power systems now use clean and renewable energy sources on an ongoing basis, such as solar panels, combined heat and power systems, batteries, and advanced controllers. The sites are anticipated to generate over 11 million kWh of electricity, enough to reduce GHG emissions by as much as taking over 1,400 cars off the road or planting more than 178 000 trees[113].

In May 2021, AlphaStruxure, a joint venture of The Carlyle Group and Schneider Electric, announced a new EaaS agreement to deploy **an integrated microgrid and electric bus charging infrastructure,** enabling at least 44 buses to become electric[114].

[112] Microgrid Knowledge, Energy-as-a-Service Microgrids in the Real World, February 25, 2019.
[113] Montgomery County, MD, Office of Energy and Sustainability, About microgrids, website consulted on July 28, 2021.
[114] Business Wire, AlphaStruxure, a joint venture of The Carlyle Group and Schneider Electric, Announces Integrated Fleet Electrification Infrastructure Project to Support Montgomery County, Maryland’s Growing Electric Bus Fleet, May 12, 2021.

Vauban IP's guidelines for climate strategy : maximizing impact and value in essential infrastructures

Section | 5

Key takeaways

→ Vauban IP is an infrastructure player investing and managing a diversified portfolio, ensuring its consistency with its sustainability goals.
In the context of the acceleration of global carbon neutrality commitments and the urgency to adapt to climate change, Vauban IP is reasserting its ambition as a "transformative" investor

→ To be transformative, Vauban IP strategy is deployed at three levels: the investment strategy level ("Invest"), the asset management level ("Influence") and the cooperation with other stakeholders level ("Involve"). Vauban IP is implementing a comprehensive climate strategy coupling mitigation and adaptation actions and maximizing its impacts through the integration of co-benefits

→ Vauban IP's purpose is to create and maximize value for all infrastructure stakeholders with a comprehensive and long-term approach. Its climate strategy is intended to perfectly fit into this purpose, creating a "virtuous circle"

TRANSFORMATIVE CLIMATE STRATEGY: ACCELERATING THE TRANSITION TOWARDS SUSTAINABLE INFRASTRUCTURE

VAUBAN IP: A MULTI-SECTOR INVESTOR IN ESSENTIAL INFRASTRUCTURES

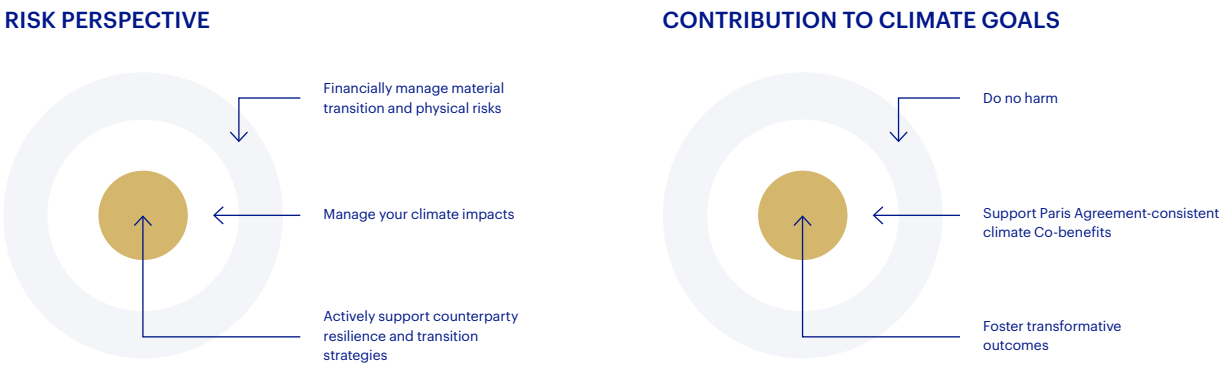
Vauban IP is active in four key sectors: mobility (tramways, motorways, parking garages, EVCS, high-speed rail lines), social infrastructure (hospital, school, leisure, justice), energy transition (heating networks, clean water, smart metering, waste management, electricity) and digital infrastructure (optic fiber, data center).

It invests and manages infrastructures **with a long-term commitment approach,** based on a 25-year "buy and hold" strategy. It aims at delivering infrastructure bringing essential benefits to the society, even if, by nature, some of those assets are exposed to carbon emissions. As a result, Vauban is obviously aware that the transformation work to be done to reach the global climate goals is important and decisive.

FIGURE 24

Defining Vauban IP's climate positioning

Source: I4CE, 2019 and forthcoming



DEFINITION OF THE SCALE OF CONTRIBUTION TO CLIMATE GOALS

DO NO HARM	SUPPORT PARIS AGREEMENT-CONSISTENT CLIMATE CO-BENEFITS	FOSTER TRANSFORMATIVE OUTCOMES
Low-GHG Development: scale-down and stop non-consistent operations. Avoid locking-in emissions	**Low-GHG Development:** contribute to the decarbonization of the entire economy and society	**Low-GHG Development:** facilitate the transformation to low-GHG systems and value chains
Adaptation: avoid decreasing resilience, increasing vulnerability, and contributing to maladaptation	**Adaptation:** contribute to increasing adaptation, resilience and adaptative capacity of investments	**Adaptation:** facilitate and reduce the cost of adaptation actions to long-term climate change
Financial flows: stop support of non-consistent flows whether direct or through intermediation	**Financial flows:** foster contributions of own flows and those of partners	**Financial flows:** support the "consistency" of the broader financial system (regulation, norms, transparency)

[115] As per the recommendations of I4CE, A Framework for Alignment with the Paris Agreement: Why, What and How for Financial Institutions, September 2019.
[116] This categorization is inspired from INSEAD, Recommendations to CDC for its Climate Strategy approach with Financial Institutions, 2020.

REASSERTING VAUBAN IP'S TRANSFORMATIVE AMBITION

Facing the acceleration of the urgency to adapt to climate change, Vauban IP intends to **reassert its position as a "transformative" investor,** supporting the transition of its invested assets towards a low-GHG and climate-resilient economic system.

To define the positioning of investors in the context of climate transition, two perspectives can be combined, with different scales of impact[115]:

→ **A risk perspective,** which can comprise (i) financially managing material transition and physical risks, (ii) managing climate impacts and (iii) actively supporting counterparty resilience and transition strategies;

→ **A contribution to climate goals perspective,** which can comprise ensuring that all activities (i) do no harm (meaning that they do not hinder nor are counterproductive to the achievement of climate objectives), (ii) support Paris Agreement-consistent climate co-benefits and (iii) foster transformative outcomes, supporting the large-scale, systemic and structural changes needed for the ecological transition.

Vauban IP's claim is to support the transformation of its invested assets to **accelerate their transition towards sustainable infrastructure.**

A "COMPREHENSIVE" CLIMATE STRATEGY

COMBINING ADAPTATION, MITIGATION AND CO-BENEFITS

As shown in section 3, adaptation and mitigation help address climate change, but no single option is sufficient by itself. Mitigation has been the highest priority, often driven by national and international policy commitments to reduce emissions of GHG, but, facing more frequent extreme weather events, adaptation concerns have recently increased.

Moreover, beyond climate impacts, other co-benefits should be taken into account (biodiversity, air quality, etc.), all the more as they represent a real intrinsic economic value. Co-benefits may be realized in the short term, whereas adaptation and mitigation impacts may take a longer time horizon to be achieved.

FOCUS 8

Vauban IP's impact methodology

Each opportunity of investment is reviewed through Vauban IP's impact methodology, with sector specific criteria, during the screening and due diligence phases. The Investment Committee takes into consideration ESG risks and opportunities to (i) go ahead, (ii) stop the investment process, or (iii) define an action plan with KPIs when necessary. Sustainability risk criteria are also taken into consideration in the valuation process (a sustainability risk premium can be included into the discount rate).

In this context, Vauban IP intends to ensure its climate strategy is combining mitigation and adaptation actions and maximizing its impacts through the integration of co-benefits.

INVEST, INFLUENCE, INVOLVE: A 3 I'S CLIMATE STRATEGY[116]

To be transformative, an investor's climate strategy must include **three levels of action:** the investment strategy level ("Invest"), the asset management level ("Influence") and the cooperation with all stakeholders: public authorities, co-investors, industrial partners, final clients, etc. level ("Involve"). The sustainability policy of Vauban is reflected on those three levels.

"Invest"

With respect to climate issues, Vauban IP has committed to align with the Paris Agreement. This is reflected at the investment strategy level:

→ All Vauban IP's funds are classified under article 8 of the SFDR, acknowledging the promotion and application of the sustainability criteria to their assets;

→ Vauban IP excludes assets related to exploration and production of fossil fuels (coal, oil, shale gas, gas) from its portfolio;

→ **Vauban IP has notably integrated in each phase of its investment process an impact methodology,** a holistic approach of ESG matters throughout the stages of each asset's entire lifecycle, based on a comprehensive materiality analysis. Material impacts are mapped under both GRESB and UN Sustainable Development Goals (SDG) frameworks to monitor, report and analyze assets' sustainability performance.

The climate impact therefore matters in the process of investment selection, as illustrated by the Proxiserve transaction in 2019 *(Case study 14)*.

Vauban IP has put in place a series of measures to enhance and monitor its climate impact."

CASE STUDY 14

Proxiserve, active player of the energy transition

Proxiserve is a leading player in the French market of smart metering and energy services. It provides installation, maintenance, and sub-metering services for heating and water equipment in co-ownerships and social housing in France. Proxiserve also develops other businesses: it installs and maintains electric vehicle charging stations; it provides energy solutions-electricity supply, sub-metering, and billing services – to office buildings, hotels, and logistics platforms.

In 2019, Vauban IP acquired a share of Proxiserve with the consideration of its alignment with Vauban IP's ESG policy, and contribution to the long-term value creation expected by Vauban IP. Proxiserve benefited from a balanced portfolio of activities, cutting-edge technologies and a highly diversified customer base through a broad national coverage to provide sustainable services to all:

→ **Participation in sustainable housing:** innovative offers (boilers and heat pumps in particular) to improve the housing sector's ecological impacts, generating energy efficiency certificates, as well as smart metering for a better control over water and energy consumption. An ADEME statistical study in 2019 showed that the changes in energy consumption before/after the installation of individual heat meters are on average around -15% (median changes range from -9% to -25%)[117];

→ **Contribution to the ongoing transition in the mobility sector through the installation of EV charging stations (EVCS):** starting this activity in 2013, Proxiserve has become the French leader with more than 70 000 EVCS installed in 7 years and many innovative services, such as EVCS smart monitoring. Since 2019, Proxiserve has increased its contribution to the energy transition, thanks to the acquisition of the n°2 for EVCS installation on the French market becoming the undisputed leader for EVCS on the French market and has decided to operate all these merged activities under one single brand: ZEborne. Proxiserve / ZEborne intends to futher invest in order to develop, beyond intallation and maintenance, new added value services (such as supervision, smart metering and billing or electricity consumption monitoring) for individuals and professionals. By the end of 2021, the group will have installed more than 100 000 charging stations throughout the country.

Proxiserve has also committed to limit its environmental footprint at the corporate level. This commitment has been verified year after year: in 2020, the group reduced its GHG emissions by 2.6%, mostly through the renewal part of its vehicle fleets and promoted waste reduction and recycling efforts, with 100% of paper and packaging waste being valorized.

[117] ADEME, L'individualisation des frais de chauffage, September, 2019.

FOCUS 9

ESG, a keystone of asset management at Vauban IP

As board members, the investment managers have the possibility to introduce ESG related topics in the agenda to be covered at board of directors' level, as well as audit & risk committee level (when relevant), of each asset to measure the risk and spur on improvements. Additionally the asset management team asks the assets teams to report each quarter on the material ESG incidents that may have occurred (or immediately in case of contractual breach or in case the situation requires).

The overarching framework enables consistent measurements over time and guides the investment teams to engage the portfolio companies. With the tools, the team explains the rationale of risk and opportunity rating, records the status of projects, and defines action plans as priority level is agreed upon. Sustainability risks and impact performance of each of the invested assets are reported during the annual communication with the investors.

The investment team is totally onboarded. They took part in the impact methodology creation, reviewing and helping to fix each sector specific criteria. They receive regular updates and training, for (i) new comers, (ii) evolution of Vauban IP ESG policy, or (iii) studies to enhance their knowledge on potencial adaptation/ mitigation solutions (as training regarding the energy transition market with specific country/technology focuses).
Moreover the sustainability performance of Vauban IP investments is one of the KPIs used in assessing the yearly evaluation of team members' and their variable remuneration.

→ Vauban IP systematically undertakes climate impact assessment strategies by:
• Monitoring and accounting for all CO_2 emissions induced by its portfolio assets' operations;
• Analyzing its assets' physical resilience against high-temperature-rise climate scenarios;
• Assessing how its investments' contribute to the Paris Agreement objective to limit global temperature to 2°C compared to pre-industrial levels.

"The fight against climate change" is one of the KPIs listed in the sustainability-linked equity bridge facility signed by Vauban IP for its Core Infrastructure Fund III SCS ("CIF III");

→ Vauban IP has signed the internationally recognized Principles for Responsible Investment (PRI), a market initiative presenting a climate risks strategy aligned with TCFD guidelines since 2019. **Vauban IP has obtained the highest achievable score, with an A+ certification.**

"Influence"
At Vauban IP corporate level, ESG considerations are gradually being introduced in its contracts with its partners. The practice is in the process of being generalized and to include carbon emission considerations.
Regarding Vauban IP's investments, one of the major outcome of the impact methodology is to highlight the positive and negative sustainability impacts of each of its assets. Based on a regular review, the investment team is incentivized to fix and follow up KPIs with their asset operators to improve their sustainability. Based on those KPIs Vauban IP may support the asset operators' strategic decisions (in the design of roadmaps with adapted solutions and milestones, with specific research or workshops, etc.).

Climate impact is therefore key in the asset management and the way Vauban IP helps its assets operators going forward in their ambitious and targeted climate strategies. Vauban IP has witnessed its commitments and endeavors translated into tangible actions, with, for instance, Indigo pledging to reach carbon neutrality by 2025, or Axione shifting towards a 100% renewable energy procurement.

As a result Vauban IP has supported key players in their sustainability journey, such as Indigo *(Case study 15)*.

Vauban IP's climate strategy aims to support the transformation of its invested assets and ecosystems."

CASE STUDY 15

Indigo's Go for climate initiative

Indigo is managing several businesses: off-street parking, on-street parking, individual mobility, digital and proximity logistic services. With more than 20 000 employees, Indigo manages over 5 600 car parks, more than 2.3 million parking spaces and 2200 km of on-street parking across over 750 cities in 11 countries.

Vauban IP invested in 2019 in Indigo. Since then, Vauban IP initiated and supported the group in its sustainability journey, from the creation of a CSR committee to the launch of an ambitious and robust climate strategy. As a result of the work of Indigo's team alongside Vauban IP, Indigo pledged in 2021 to achieve net zero in Scope 1 and Scope 2 emissions by 2025. The group launched tangible actions as part of its climate strategy:

→ **Eco-friendly car parks:** car parks now include natural lighting and ventilation, landscaping and vegetation, which contribute to thermal regulation, improve air quality and protect the soil. The Ars-Belcier car park in Bordeaux offsets part of its GHG emissions thanks to a green roof and a rainwater recovery system;

→ **Energy-efficient car parks:** Indigo intends to minimize the electricity consumption by controlling the lighting station (low consumption lighting installation, presence detectors, live monitoring of consumption by operating staff, etc.), equipping air monitoring systems and using green service vehicles. By 2025, 50% of Indigo's car parks will switch to LED lighting, generating -40% of electricity consumption per car park;

→ **Long-life buildings:** new car parks aim at preserving the ecosystem, using less polluting materials, managing and reusing materials and waste, saving resources and promoting compliance with good practices;

→ **Purchasing green electricity:** on scope 3, Indigo pledged to influence its stakeholders to control Scope 3 emissions by 2050. It includes offering charging stations,implementing digital solutions for parking or promoting soft mobility.

"Involve"
Vauban IP is one the founders of GRESB Infrastructure and an active member of its Advisory Board, aiming to enhance the market guidelines for/with its peers.

In respect of other stakeholders' involvement, Vauban IP is supporting, on a case-by-case basis, market initiatives working towards the enhancement of the sustainability guidelines and regulatory changes favoring sustainable infrastructure. Among other topics, Vauban IP is advocating the evolution of the infrastructure projects contractual framework, to accelerate the transition towards sustainable infrastructure.

A "VALUE-DRIVEN" CLIMATE STRATEGY: MAXIMIZING VALUE FOR ALL STAKEHOLDERS

As a multi-sector infrastructure investor, Vauban IP's purpose is **to create and maximize value for all infrastructure stakeholders** – investors, public authorities, industrial partners, infrastructure assets, citizens, etc. – with a comprehensive and long-term approach of value – tangible and intangible, financial and socio-economic. Its climate strategy is intended to perfectly fit into this purpose.

Vauban IP's ambition is indeed to create a "virtuous circle" between the implementation of a comprehensive climate strategy and the creation of value, to the benefit of all infrastructure stakeholders. This "virtuous circle" can be represented as a "flywheel" *(Figure 25)* a corporate strategy concept developed by Jim Collins.

EXPERT POSITION 8

The need for more flexible contracts

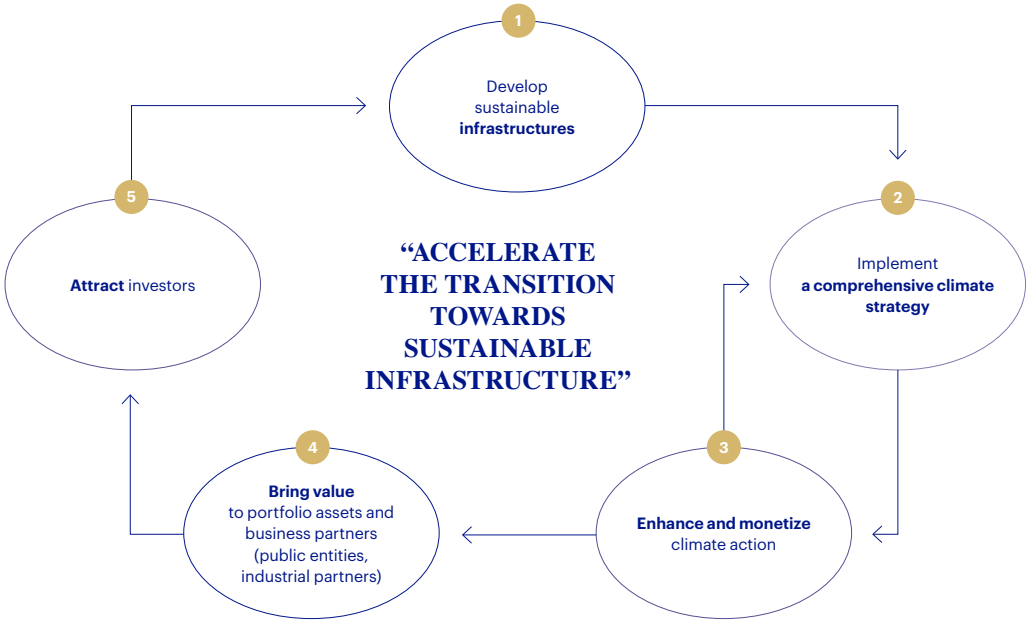
"Infrastructure has a long lifespan and has often been designed and built at a time when climate issues were less pressing. Furthermore, we operate within the framework of long and rigid concession agreements. This can hamper the deployment of new investments or solutions favorable to the climate. Public contracts should be more flexible to integrate climate needs better. For instance, the modification of contracts should be eased if it has a significant impact on GHG emissions or resilience."

Serge Clemente, CEO of Indigo

FIGURE 25

Vauban IP's value-driven climate strategy for all stakeholders

Source: Altermind



EXPERT POSITION 9

Team work

We at Vauban IP are determined to contribute to the development of sustainable infrastructure to benefit all our stakeholders. Our investment and asset management strategy is therefore designed to meet this ambition. There is a lot of value to be created in investing in low-carbon and resilient infrastructure as well as transforming other infrastructure assets to be consistent with long-term climate goals. It is an ongoing journey. In this perspective, we will continue to support the public and private sectors (financial and industrial) initiatives to reach more and more urgent transformation towards a sustainable future."

Gwenola Chambon and Mounir Corm, CEO and Deputy CEO of Vauban IP

Biographies of experts

Anna Creti

→ ANNA CRETI is Professor at the University of Paris-Dauphine and the Director of the Chair of Climate Economics (Paris-Dauphine) and of the Chair of Gas Economics (Paris-Dauphine, Toulouse School of Economics, IFPEN, École des Mines). She is a research fellow at the École Polytechnique, Paris, and affiliated with the Siebel Institute, Berkeley.

Anna holds a PhD from the Toulouse School of Economics and a post-doc from the London School of Economics. She has studied extensively the competition and regulation of network utilities (telecommunications, gas, electricity...), as well as the link between energy, climate and environmental regulation. Co-editor of the journal Energy Economics, Anna has numerous publications in leading economic journals and is also a contributor to several media.

Rodolphe Durand

→ RODOLPHE DURAND is the Joly Family Professor of Purposeful Leadership at HEC-Paris, and the founder and academic director of the Society and Organizations Institute launched in 2009. His areas of research are corporate leadership and CSR policies, and their links to performance and competitive advantage. For his work, he has received awards from the American Sociological Association (2005) and the European Academy of Management (2010), was elected Fellow of the Strategic Management Society (2014), and received an honorary doctorate from UC Leuven (2019).

As an advisor, senior advisor, and member of boards and mission committees he has helped numerous organizations establish their competitive advantage and develop and implement strategies with high social and environmental impact.

Patrice Geoffron

→ PATRICE GEOFFRON is Professor of economics at the University of Paris-Dauphine and is a member of the "Cercle des Économistes." Founder of the Dauphine Economics Research Laboratory (LEDa), he now runs its energy-climate team and coordinates various research chairs (notably the Climate Economics Chair created in 2010). He is the editorial manager of the Economics and Policy of Energy and the Environment journal and the Journal of Management and Network Economics.

Patrice was a partner for ten years in an information technology consulting firm and has participated in numerous expert missions in the transport sector (SNCF, ADP, etc.). He was a member of the support team for the Citizen's Climate Convention.

Patrice is a special academic advisor at Altermind.

Benoît Leguet

→ BENOÎT LEGUET is the Managing Director of Institute for Climate Economics, the think tank created by the Caisse des Dépôts and Agence Française de Développement. He is also a member of several expert groups: the French Climate Change Committee, the Advisory Board on Economic matters to the French Minister for Environment, the Goodplanet Foundation's Scientific Committee, the Kyoto Protocol's Article 6 Supervisory Committee. In 2013, he was a member of the panel of experts for the National Debate on the Energy Transition. He was also a Lecturer in the University Paris-Dauphine, focusing on Energy, Finance and Climate.

Carine Staropoli

→ CARINE STAROPOLI is Senior Lecturer in Economics at the University of Paris I Panthéon-Sorbonne and Professor at the Paris School of Economics. Her research work focuses on the Economics of Regulation and the Economics of Contracts. She is the co-director the Urban New Deal Chair at PSE which is a new program dedicated to the economic analysis of the zero carbon, resilient and inclusive cities. Carine has numerous publications in international economic reviews such as Energy Economics, Review of Industrial Organization, Annals of Public and Cooperative Economics, Industry and Innovation, and Revue d'Economie Industrielle.

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List of participants to the workshops

Appendix | 2

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Dominique Astier is the Executive Vice President, Operator Division and business development of Axione, a global player in the telecommunications infrastructure sector.

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STÉPHANE CAINE
→ (PROXISERVE)
Stéphane Caine is the CEO of Proxiserve, one of the French leaders in housing services.

GWENOLA CHAMBON
→ (VAUBAN INFRASTRUCTURE PARTNERS)
Gwenola Chambon is the CEO and Founding Partner of Vauban Infrastructure Partners.

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→ (INDIGO GROUP)
Serge Clemente is the CEO of Indigo, the world leader in parking and individual mobility.

VINCENT CASSAGNE
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Vincent Cassagne is a Partner and Investment Director of Vauban Infrastructure Partners.

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Juan Macias is the CEO of AlphaStruxure, a company created by Schneider Electric and the Carlyle group to build a new critical infrastructure that is digital, sustainable and energy efficient.

DENIS MICHEL
→ (VAUBAN INFRASTRUCTURE PARTNERS)
Denis Michel is a Partner and the Chief Risk and Compliance Officer of Vauban Infrastructure Partners.

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Pascal Minault is the CEO of Bouygues Construction, a global player in construction with operations in 60 countries.

VINCENT PETIT
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Vincent Petit is the Senior Vice President Global Strategy prospective and External Affairs of Schneider Electric, driving the Schneider Electric Sustainability Research Institute.

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Benoît Theys is the Head of Infrastructure Finance of AG Insurance, the first insurance company in Belgium.

Glossary

Appendix | 3

AI	**Artificial Intelligence**
BMC	Business Model Canvas
CCC	**Citizen's Convention for Climate**
CIF	Core Infrastructure Fund
CMC	**City Model Canvas**
CO_2	Carbon dioxide
CSR	**Corporate Social Responsibility**
DHC	District heating and cooling
EPBD	**Energy performance of buildings directive**
EPPP	Economics of Public-Private Partnerships
ESG	**Environmental, Social and Governance**
ETS	Emissions Trading System
EU	**European Union**
EVC	Electric vehicles charging
FTTC	**Fiber to the Curb**
FTTH	Fiber to the Home
GDP	**Gross domestic product**
GHG	Greenhouse gas
ICT	**Information and Communication Technology**
IEA	International Energy Agency
I4CE	**Institute for Climate Economics**
NFRP	Non-financial Reporting Directive
OECD	**Organisation for Economic Co-operation and Development**
PPP	Public-private partnership
PPPP	**Public-private-people partnership**
SDG	Sustainable Development Goals
SFDR	**Sustainable Finance Disclosure Regulation**
SRF	Solid Recovered Fuel
TCFD	**Task Force on Climate-related Financial Disclosures**
UN	United Nations
UNFCC	**United Nations Framework on Climate Change**

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