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INCENTIVES FOR INVESTMENT IN CLEAN TECHNOLOGIES

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Abstract

The fulfilment of the commitment to decarbonization at a global level implies the need to invest in clean technologies on a global scale that requires large volumes of financing in a complex context where there are significant technological uncertainties, and the distribution of resources is not homogeneous around the world. Against this backdrop, incentives for investment in clean technologies are an instrument that, when properly designed, can boost private investment to achieve environmental goals. This report addresses the funding needs for investment in clean technologies, the current financing gap to move towards environmental sustainability, and conceptualizing the term investment incentive. It proposes classifying the different incentives into six broad categories: economic, financial, fiscal, market, regulatory, and of knowledge and collaboration, and then describes how they are being implemented in the United States, the European Union, China, Canada, India and the United Kingdom. Finally, conclusions and reflections are presented on the elements and dimensions to consider when designing, implementing, monitoring and evaluating the impacts of incentives for investment in clean technologies.

Laburpena

Mundu mailan deskarbonizazioaren konpromisoa betetzeak teknologia garbietan inbertitzea eskatzen du, modu globalean. Horretarako, finantzaketa bolumen handiak behar dira, baina ingurunea konplexua da eta, gainera, zalantza teknologiko handiak daude eta baliabideak ez dira modu homogeneoan banatzen mundu osoan zehar. Egoera horren aurrean, teknologia garbietan inbertitzeko pizgarriek, behar bezala diseinatzen badira, inbertsio pribatua bultza dezakete ingurumen helburuak lortzeko. Txosten honek teknologia garbietan inbertitzeko funts beharrak, ingurumen jasangarritasunerantz aurrera egiteko gaur egun finantzaketan dagoen arrakala eta inbertsiorako pizgarria terminoaren kontzeptualizazioa lantzen ditu. Pizgarriak sei kategoria handitan sailkatzea proposatzen da: ekonomikoak, finantzarioak, fiskalak, merkatukoak, erregulazioak eta jakintza eta lankidetzakoak. Ondoren, hainbat herrialdetan (Ameriketako Estatu Batuak, Europar Batasuna, Txina, Kanada, India eta Erresuma Batua) nola ezartzen ari diren deskribatzen da. Azkenik, azterketaren ondorioak adierazi eta teknologia garbietan inbertitzeko pizgarriak diseinatu, ezarri, kontrolatu eta eragina ebaluatzeko kontuan hartzeko elementuen eta dimentsioen inguruko hausnarketa proposatzen da.

Resumen

Cumplir con el compromiso de la descarbonización a nivel mundial, supone la necesidad de invertir en tecnologías limpias de manera global. Para ello se requieren grandes volúmenes de financiación en un contexto complejo, donde además existen importantes incertidumbres tecnológicas y los recursos no están homogéneamente distribuidos por el mundo. Ante este

panorama, los incentivos a la inversión en tecnologías limpias son un instrumento que adecuadamente diseñados pueden impulsar la inversión privada para alcanzar las metas medioambientales. Este informe aborda las necesidades de fondos para la inversión en tecnologías limpias, el actual gap de financiación para avanzar hacia la sostenibilidad medioambiental y la conceptualización del término incentivo a la inversión. Se propone una clasificación de los diferentes incentivos en seis grandes categorías: económicos, financieros, fiscales, de mercado, regulatorios y de conocimiento y colaboración; para después describir cómo se están implementando en Estados Unidos, la Unión Europea, China, Canadá, la India y el Reino Unido. Finalmente se plantean unas conclusiones y un conjunto de reflexiones sobre los elementos y dimensiones a considerar a la hora de diseñar, implementar, monitorear y evaluar los impactos de los incentivos a la inversión en tecnologías limpias.

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Executive summary

Climate change poses enormous challenges for the coming decades in transforming the economy towards an environmentally sustainable model, which achieves decarbonization through the deployment of clean technologies such as renewable energies and others related to eco-design, water management, or sustainable agriculture. It implies the need to address worldwide high volumes of investment in a context of uncertainty (technological, geopolitical, regulatory, etc.) and funding shortfalls, where the key is to optimize the allocation and use of available resources.

Incentives, understood as an incentive or advantage granted to a person, group, or sector to induce investments in clean technologies, are classified into six main categories:

(i) Economic: to help defray the costs of an investment,
(ii) Financial: to address and facilitate access to financing,
(iii) Fiscal: inducers of changes in agents' behaviour, such as environmental taxes and tax benefits,
(iv) Market: usually determined by regulations, but where the economic component is defined as a result of the intersection of supply and demand,
(v) Regulatory: standards with environmental, social, or other requirements,
(vi) Knowledge and collaboration: incentives of different nature such as information offices, public-private collaboration agreements, improved training, etc.

While all countries have been adopting policies related to the transition to an environmentally sustainable economy for years, since its communication in 2022, the Inflation Reduction Act (IRA) in the United States (U.S.) has triggered an avalanche of responses in the form of economic-financial or legislative packages (e.g., Powering up Britain, the European Green Deal Industrial Plan and the Net-Zero Industry Act, etc.).

The **European Union (E.U.)** uses mainly economic, financial and regulatory incentives. It pioneered the creation of an emissions market and, due to its competencies, has few fiscal initiatives.

The **U.S.** primarily uses tax incentives such as tax credits in its IRA, but it also uses economic and financial incentives to cover issues tax credits cannot address.

Canada could be considered a combination between the E.U. and the U.S., having made a big bet on tax credits accompanied by economic and financial incentives.

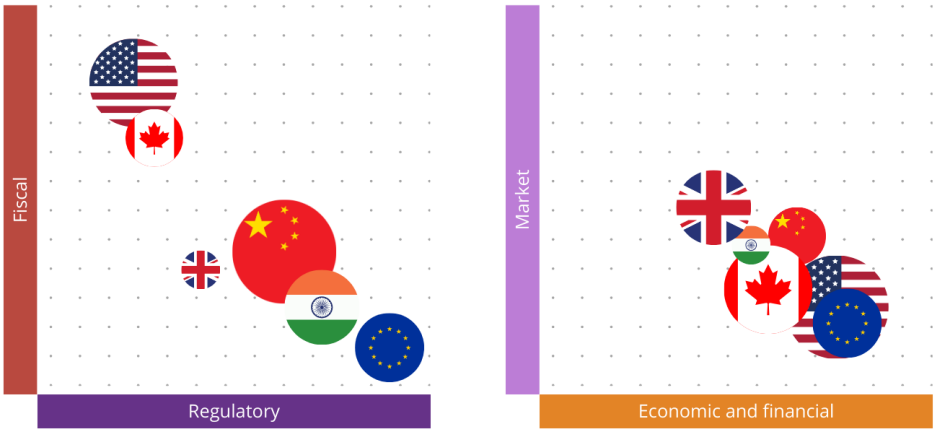
The **United Kingdom**, on the other hand, combines economic, regulatory, and market instruments. In fact, of the countries analyzed, it is the one that uses the greatest number of market incentives in relation to the other types of incentives.

China seeks to decarbonize by ensuring the security of supply and based on regulatory incentives.

Similarly, **India** employs, to a large extent, regulatory incentives, in addition to having a strong commitment to market incentives, as it looks to the transition to sustainability as a key driver for economic growth.

In summary, the following figure shows the different types of incentives for investment in clean technologies that were detected in the review of each territory, ordered according to the number of programs of each type.

Implementation of incentives for investment in clean technologies per territory



Note 1: The coordinates are calculated based on the number of programs in each category. They do not take into consideration the total volume of incentives. In the case of the E.U. and the USA, programs or incentives at the national or state level, respectively, are not considered.
Note 2: in the figure on the left, the size of the circles is in accordance with the level of GHG emissions of each territory. On the other hand, in the figure on the right, the size of the circles is a function of the GDP per capita of each territory.
Source: own elaboration.

In the analysis of the cases, problems and difficulties have been observed in developing and implementing incentives, which have led to reflection on possible recommendations for the design, implementation, monitoring, and evaluation of incentives for investment in clean technologies. These recommendations are summarized in the following figure.

Recommendations for designing, implementing, monitoring and evaluating incentives for investment in clean technologies.

Who receives? ☑	• Incentives should be targeted to individuals or entities that are **affected** by market distortions that prevent them from making the necessary investment decisions.
Who grants? ☑	• There is a wide variety of programs and institutions that grant investment incentives within a territory. Thus, those granting incentives must be **coordinated** among themselves in order to optimize the use of funds.
When is it received? ☑	• The incentive must come at the **right time**, maintain a **duration** that allows the necessary investments to be made over time and be **sustainable** in the long term.
What or how much is received? ☑	• The amount of incentives is relevant because large volumes of investment are required, but it is important to **avoid a race or war of incentives** that could harm all countries (to a greater or lesser extent).
Why are they received? ☑	• When applying for incentives there is a whole set of requirements that must be met. These requirements **should not become obstacles** for agents without adequate resources to apply.
How are they implemented and monitored? ☑	• Once the incentives reach their recipients, the entities that provide them must **follow up** to ensure their correct use, implementation and effectiveness.
How are they evaluated? ☑	• It is advisable to have **a body that assures** taxpayers that the incentive design, granting, monitoring and evaluation processes are rigorous. • It is necessary **to evaluate the impact** of the incentive programs being developed, **beyond their environmental objectives**.

Source: own elaboration.

However, it is important to note that incentives affect not only the economy, industry, and people in the territory where they are implemented but also the international panorama. For example, they can promote the relocation of companies to territories with better incentives or lower energy prices, as is happening in the United States, which, after the IRA, has become much more attractive for clean technology companies. They can also generate dependence on a country's production, as in the case of China, which, due to its specialization and sustained aid to its industry over time, has made the rest of the world dependent on its raw materials and products to develop clean technologies.

Because the goal of containing global warming is common and cross-cutting to countries' economic and financial interests, the need to close financing gaps for clean technologies to decarbonize the global economy must be met based on **cooperative frameworks that level the playing field and enable collaboration between countries and territories** in an area of fair competition.

This collaboration and cooperation should seek to **optimize the resources available to** each territory, **streamline the implementation** of incentives, and **coordinate programs** to avoid subsidy spirals that can generate risks at the geopolitical level and ultimately make the goal of sustainable development focused on people's well-being less feasible. For this reason, progress must be made in implementing incentives and aid programs based on **"coopetition" schemes**, where competition and cooperation between countries enable the achievement of climate neutrality as soon as possible.

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List of abbreviations and acronyms

ACBC	Autonomous Community of the Basque Country
AfDB	African Development Bank
AIF	Automotive Innovation Fund
AMR	Advanced modular reactors
ASIP	Automotive Supplier Innovation Programme
BECCS	Bioenergy with carbon capture and storage
BESS	Battery Energy Storage System
C$	Canadian dollar
C3IV	Crédit d'impôt "Investissement Industries Vertes"
CBAM	Carbon Border Adjustment Mechanism
CBD	China Development Bank / China Development Bank
CCC	Climate Change Committee
CCfD	Carbon offset contracts
CCUS	Carbon capture, utilisation and storage
CDEV	Canada Development Investment Corporation
CF	Final consumption
CFA	Central Financial Assistance
CfD	Contracts for Difference
CHP	High efficiency cogeneration
ckm	Circuit kilometer
CNC	Computer numerical control
CNY	Yuan
CO_2	Carbon dioxide
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation

CPF	Carbon Price Floor
CPSU	Central Public Sector Undertaking
CSA	Climate-Smart Agriculture
CTDS	Clean Technology Data Strategy
DCR	Domestic Content Requirement
DISCOM	Electricity Distribution Company
DOE	Department of Energy
DPA	Dispatchable Energy Agreement
EAFRD	European Agricultural Fund for Rural Development
EGD	European Green Deal
EIB	European Investment Bank
EIC	European Innovation Council
EPA	United States Environmental Protection Agency
EPC	Energy performance certificate
ESC	Energy savings certificate
ESO	National Grid Electricity System Operator
ESS	Energy Storage System
ETS	Emissions Trading Scheme
EU	European Union
EU-ETS	EU Emissions Trading Scheme
EuGB	European Green Bond
EVs	Electric vehicle
FAME	Faster Adoption and Manufacturing of Electric Vehicles Scheme
FDI	Foreign direct investment
FIF	Agricultural Investment Fund

FIT	Feed in tariff
FSO	Future System Operator
FSRU	Floating storage and regasification unit
FYP	Five-year Plans
GBI	Generation-Based Incentive Programme
GBN	Great British Nuclear
GDAM	Green Day Ahead Market
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEOA	Green Energy Open Access Regulation
GERI	Global Electricity Regulatory Index
GFC	Canada Growth Fund
GHG	Greenhouse gas
GITA	Green Investment Tax Allowance
GITE	Green Income Tax Exemption
GO	Guarantee of Origin / Guarantee of Origin
GST	Goods and Services Tax
GTAM	Green Term Ahead Market
HRD	Human Resource Development Plan
IA	Artificial Intelligence
IBI	Real Estate Tax
IEA	International Energy Agency
IEF	Economic and financial incentives
IETF	Industrial Energy Transformation Fund
IFP	Feed in premium or Agricultural Innovation Programme (depending on the context)

IMF	International Monetary Fund
InSTS GEC	Intrastate Transmission System Green Energy Corridor
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change
IPCEI	Important Projects of Common European Interest
IPCR	Canada's Infrastructure Investment Programme / Programme d' Infrastructure Investir dans le Canada
IPO	Initial Public Offering
IRA	Inflation Reduction Act
IRS	Internal Revenue Service
IS	Corporate taxation
ISTS	Inter State Transmission System
ITC	Investment Tax Credit
JPY	Japanese yen
K-ETS	South Korean Emissions Trading Scheme
KfW	Reconstruction Credit Institute / Kreditanstalt für Wiederaufbau
kg	Kilograms
KRW	South Korean Won
LCA	Life cycle assessment
LCR	Local content requirement
LPG	Liquefied petroleum gas
LULUCF	Land use, land-use change and forestry
LVTL	Basque list of clean technologies
M€	Millions of euros
MNRE	Ministry of New and Renewable Energy
MRR	Resilience and Recovery Mechanism

mt	Million tonnes
NAPCC	National Action Plan for Climate Change
NDC	Nationally Determined Contributions
NDRC	National Development and Reform Commission
NEA	National Energy Administration
NEMMP	National Electric Mobility Plan
NEV	New Energy Vehicle
NGHM	National Green Hydrogen Mission
NMEEE	National Mission for Enhanced Energy Efficiency
NSM	Misión Solar Nacional
NZA	Net Zero Accelerator
NZE	Net Zero Emissions
NZIA	Net-Zero Industry Act
OCTIA	Clean Technology Industry Association of Ontario
ODS	Strategic Aerospace and Defence Initiative
OECD	Organisation for Economic Co-operation and Development
PACE	Property Assessment Clean Energy Programme
PDA	Project Development Assistance
PLI	Production Linked Incentive
PLN	Zloty (Polish currency)
PM-KUSUM	Farmers' Energy Security and Improvement Campaign / Pradhan Mantri Kisan Urja suraksha evam Utthaan Mahabhiyan
PM JANMAN	Pradhan Mantri Janjati Adivasi Nyaya Maha Abhiyan
PoB	Powering Up Britain
PPA	Power purchase agreement
PPP	Public-private partnership

PSDS	Public Sector Decarbonisation Scheme
PTC	Production Tax Credit
QRT	Quick Response Training Program
RAB	Nuclear Regulated Asset Base
RAE	Royal Spanish Academy
R&D	Research and development
R&D&I	Research, development and innovation
REACT-EU	Recovery assistance for cohesion and the territories of Europe
RED	Renewable Energy Directive
RE-RTD	Renewable Energy Research and Technology Development Programme
RGO	Renewable Generation Obligation
RIIO	Regulatory framework for electricity distribution activity
RO	Renewable obligations
RPO	Renewable Purchase Obligation
RPS	Renewable Portfolio Standard
Rs	Rupees
RSDE	Programme of Fiscal Incentives for Scientific Research and Experimental Development/ Programme d'Encouragements Fiscaux pour la Recherche Scientifique et le Développement Expérimental
SAF	Sustainable aviation fuel
SDTC	Sustainable Development Technology Canada
SIF	Strategic Innovation Fund
SIGHT	Strategic Interventions for Green Hydrogen Transition
SMEs	Small and medium-sized enterprises
SMR	Small Modular Reactors
SR&ED	Scientific Research and Experimental Development Tax Incentive Program

SREP	Smart Renewables and Electrification Pathways
STEM	Science, Technology, Engineering and Mathematics
STEP	Strategic Technology Platform for Europe
STU	State Transmission Utilities
t	Tons
TANAP	Trans-Anatolian Natural Gas Pipeline
TDP	Technology Demonstration Program
TFEU	Treaty on the Functioning of the European Union
TPC	Technology Partnerships Canada
TRL	Technology Readiness Level
UKEF	United Kingdom Export Finance
UK-ETS	United Kingdom Emissions Trading Schemeelectric
UKIB	UK Infrastructure Bank
US$	United States dollars
USA	United States
V2X	Vehicle to all
VGF	Viability Gap Funding Scheme
VOC	Volatile organic compounds
WTO	World Trade Organisation
ZEVIP	Zero-Emission Vehicle Infrastructure Program
€	Euros
€/kg	Euros / kilogram

1. Context and objective of the work

Advances in the scientific community's understanding of climate change, its causes, its impact, and its likely evolution have led to a call for a profound transformation of the global economy in the coming years. Thus, the planet's average temperature increase can be contained, and the risks and effects associated with adverse climate events can be reduced.

The Paris Agreement, adopted at COP 21 in December 2015, is a milestone in multilateral climate change negotiations. A binding target was set to limit global warming to well below 2°C, preferably 1.5°C, compared to pre-industrial levels. However, the decarbonisation target, which has been maintained at subsequent international summits (see Glasgow, Sharm el Sheikh-Egypt, or Dubai recently), is at risk of not being achieved.

The latest IPCC (Intergovernmental Panel on Climate Change) Synthesis Report on Climate Change, published in March 2023, once again stressed the reality and risks associated with climate change, the difficulty of achieving an average global temperature increase of less than 2ºC given the current path of greenhouse gas (GHG) emissions and the need to make decisive progress in climate change mitigation and adaptation efforts and the urgency of promoting comprehensive climate strategies in the short term (IPCC, 2023).

Thus, investment in clean technologies that seek to reduce or eliminate pollution to achieve a sustainable transition is crucial but requires high financing volumes. Along these lines, according to the IEA (2023k), by 2030, global renewable energy capacity should be tripled, the rate of improvement in energy efficiency should be doubled, progress should be made on industry commitments, and a 75% reduction in methane emissions should begin, measures should be adopted to ensure an orderly decline in the use of fossil fuels and, for all this, large-scale financing mechanisms should be established to triple investment in clean energy in emerging and developing economies.

Investments in clean technologies, in general, and renewable energy, in particular, are facing high volatility in commodity prices and supply chain constraints, which have interrupted the path of reductions in the costs of these technologies[1]. In parallel, rising global interest rates to contain inflation have increased the cost of capital after a long period when access to finance was relatively cheap. These trends present the cleantech industry with new challenges and, in some cases, extreme financial pressures (Gould et al., 2023). The industry may even go out of business, as was recently the case for solar panel manufacturers, the Dutch Exasun (Acosta, 2024a) or the German Meyer Burger and, soon, to the Dresden plant of Solarwatt (Acosta, 2024b).

Signs of stress have been particularly evident in the wind sector and emerging and developing economies, where the rising cost of capital is exceptionally high and could threaten the transition to environmental sustainability. Also, in the PV sector, the tension is high due to

[1] IEA (2023c) estimates that the clean energy transition depends on clean energy technology supply chains.

China's capacity far exceeding global demand, and where the only option on the horizon relates to technological innovation (Acosta, 2024b).

Indeed, there are also pressures from the perspective of public institutions. The International Monetary Fund (IMF), in its latest report, indicates that scaling up the current policy mix, with a heavy reliance on subsidies and other components of public spending, to achieve net zero emissions will lead to a build-up of public debt of between 40 and 50 percentage points of gross domestic product (GDP) by 2050, for both advanced and representative emerging economies (IMF, 2023c).

In the next section, we discuss the investment needs in these technologies and the barriers to financing.

1.1. Investment needs in clean technologies for an environmentally sustainable transition

As indicated above, many financial resources will be needed to transition to environmental sustainability efficiently. Transformation in the making cannot be achieved without significant investment, research, and innovation efforts.

In 2022, investment in clean energy reached USD 1.4 trillion (US$), 10% more than in 2021, accounting for 70% of the total energy sector investment growth (IEA, 2023c).

According to McKinsey Sustainability (2023), the world will face a US$41 trillion mitigation investment gap by 2030, with emerging markets facing a larger gap as a proportion of their GDP. There is also an adaptation finance gap of US$600 billion annually until 2050, 10-18 times greater than current flows.

It is estimated that around $1.2 trillion of cumulative investment is needed to bring sufficient capacity of specific supply chains into place to meet the net zero scenario (NZE) targets for 2030. The investments announced so far by countries cover around 60% of this total. Considering project timelines, most investments should be undertaken between 2023 and 2025, at an average of US$ 270 billion per year, almost seven times the average investment rate of the 2016-2021 period (IEA, 2023c).

Along these lines, the energy crisis should prompt countries to accelerate the transition to clean energy with a stronger push for decarbonised energy (e.g., the European Union (EU) Innovation Fund for the demonstration of innovative low-carbon technologies) and more resilient and efficient energy systems (IMF, 2023b). In the same vein, the International Energy Agency (IEA) points out that the recent global energy crisis is a crucial moment for clean energy transitions around the world, driving a wave of investment in the industry in the coming years, with the development of sustainable supply chains for clean energy (IEA, 2023c).

The learning curve trends of the weighted average total installed costs of solar PV, solar thermal, and onshore and offshore wind between 2010 and 2022 have steadily decreased over time (IRENA, 2023), primarily due to technological advances. However, investors remain reluctant to take investment risks due to policy changes and the number of resources at stake,

making financing clean technologies, particularly renewable energy sources, one of the biggest challenges in the 21st century for advancing decarbonisation.

The IEA's latest energy efficiency report notes that in 2023, measures to promote energy efficiency were expanded, resulting in consumer savings and improved security and sustainability of the energy system (IEA, 2023b). However, further progress in annual energy efficiency improvements needs to double from 2% in 2022 to more than 4% per year on average by 2030 (IEA, 2023b).

A combination of instruments is needed to address the need for continued investment. These include carbon pricing, an instrument to correct remaining market failures, and fiscal transfers to support the costly adjustments that households, workers, communities, and businesses must bear.

Fiscal incentives (through tax deductions or reductions) can boost companies' investment in low-carbon technologies, especially when companies are confident about the impact of policies on their investment plans. Therefore, national policies should be well communicated to companies, including their horizon, coverage, and eligibility criteria; they should be stable and predictable over time. Targeting tax incentives can help minimise total fiscal costs, as some companies will invest even without government support.

In addition, the increase in energy prices in 2022, for example, has shown that companies can invest in energy efficiency and reduce energy consumption when faced with large energy price shocks. According to the IMF (2023b), regulations, incentives, and carbon pricing schemes can accelerate companies' decarbonisation efforts.

Green subsidies should comply with World Trade Organisation (WTO) rules to avoid unwanted trade distortions and a subsidy race between countries. This is although the clean technology sector, particularly solar PV, recognises the unfair practices of its Chinese competitors (Acosta, 2024b).

Against this background, the private sector also has a crucial role to play in the success of the transition to decarbonisation. According to the IMF (2023b), public policies must provide a framework favouring private sector participation in investment and finance. In 2021 and 2022, the IMF supported efforts in more than 150 states to improve fiscal capacity and strengthen the market for Treasury liabilities.

Indeed, the financing needs to cover all the necessary investments in infrastructures, services, and R&D&I, which are of such magnitude that they will require changes and adaptation of the financing ecosystems through various options (Fernández Gómez & Larrea Basterra, 2022a). These include (i) the creation of new financing channels, (ii) the development of public-private collaboration schemes in new financing mechanisms and tools[2], (iii) the generation of new capacities for financial services and knowledge on sustainability-related projects in all sectors, and (iv) innovation in new financing mechanisms and instruments. Efficiency of investments and optimal allocation of resources will also be crucial.

[2] For more details see Fernández Gómez (2024).

1.2. The funding gap. Barriers to funding

However, traditional financing mechanisms are insufficient to provide the investment levels needed to meet the challenge of all the required clean technology investment, creating a so-called financing gap.

Numerous authors have devoted articles to analysing this gap, such as Polzin & Sanders (2020), Sachs et al. (2019), Hafner et al. (2020), and Qadir et al. (2021). Others have delved into the risks associated with investments in new clean technologies due to the high levels of uncertainty that arise and their impact on cost-effectiveness (Yoshino & Taghizadeh-Hesary, 2018; Sachs et al., 2019).

The literature also reviews the barriers that promote the funding gap (see Polzin (2017), Hafner et al. (2019), Jones et al. (2020), and Gatzert & Kosub (2016), among others). Such barriers can be of different types, and Fernández Gómez & Larrea Basterra (2022a) classify them into six categories, as can be seen in Figure 1: (i) technological, (ii) financial, (iii) institutional, (iv) economic, (v) political and (vi) cultural.

Reducing the financing gap and facilitating the technological development needed to address the sustainable transition requires reducing barriers and developing an appropriate environment with stable and time-efficient regulation to create the necessary incentives and implement them appropriately.

For example, to promote innovation associated with decarbonisation, climate-related policies such as carbon taxes or emission allowance markets can raise additional funds to address the financing gap. Similarly, stricter regulation on GHG emissions could induce incentives for investment in clean technologies.

For all of the above, it is necessary to have the appropriate incentives adapted to the different realities or objectives to be addressed. Although, as mentioned, the role of private and business agents is fundamental and should not be overlooked, governments can play an important role in stimulating or providing incentives to tackle change. To this end, Fernández Gómez & Larrea Basterra (2022a) suggest five primary roles: (i) risk-taking, (ii) direct investment promotion, (iii) policy design and development, (iv) market creation, and (v) innovation promotion.

Figure 1 Examples of barriers to investment in innovation

Technological	• Lack of technological maturity • Doubts about the viability of new technologies • Existence of potential disruptive technologies
Financial	• Lack of technological, regulatory, policy knowledge • Investor short-sightedness and short-sightedness • Lack of maturity of the financial market in the area of sustainability.
Institutional	• Inertia in the support of conventional technologies • Regulations not focused on incentivising sustainable innovation • Lack of a systemic approach
Economics	• Failure to incorporate externalities into economic signals • Need for sophisticated demand deployment • Undeveloped or incomplete sustainability markets
Policy	• Insufficient coordination of the different levels of government • Lack of a coherent and predictable governance framework • Political uncertainty in relation to the vision for transitions
Cultural	• Lack of knowledge about the major transitions and their major objectives • Lack of financial and sustainability education • Rejection of the adoption of new technologies and new forms of consumption

Source: Fernández Gómez & Larrea Basterra (2022a).

1.3. Objective of the work

As mentioned above, governments can induce and stimulate private investment by promoting projects with high environmental profitability, reducing the risks faced by the different agents (business, academic or research, households, etc.). To this end, they can use different instruments or tools, such as guarantees or public funds, to reduce credit risk, facilitating access to financing for innovative projects with high technological risk. In addition, they can contribute to a just transition by supporting investment in clean technologies by agents such as small businesses, communities, and vulnerable people who have more significant barriers to accessing financing and who may also be exposed to more significant adverse effects of climate change (EPA, 2023; Ngcamu, 2023).

Given the above, this report examines the incentive schemes that can be developed to address the necessary investment in clean technologies. To this end, firstly, the term incentive will be conceptualised to differentiate it from financing mechanism as far as possible, as well as the term clean technologies, which include not only renewable energies (although they are the ones most frequently mentioned or referred to, mainly due to their cross-cutting nature as well as their relevance for decarbonisation and the consequent greater availability of data) but also

many other technologies for the production of goods and services, as well as water and waste management, among others.

After this section, the third section lists the main incentives that can be used, explaining what they consist of and the names used to refer to them[3]. The fourth section describes some of the most salient elements of the major incentive programmes recently launched in six countries/territories (the United States, the European Union, China, Canada, India, and the United Kingdom)[4] and analyses their main characteristics and differences. The document ends with a series of conclusions and final reflections.

[3] Examples for each of the incentives are given in Annex 1.

[4] Annexes 2, 3, 4, 5, 6 and 7 provide more detail on regulatory developments and measures adopted in favour of investment in clean technologies in each of the countries under study.

2. Conceptualisation

First, the difference between investment incentives and financing instruments is discussed, followed by a classification of clean technologies.

2.1. A brief introduction to the concept of investment incentives and differentiation from financing instruments

On numerous occasions, the terms investment incentives and financing instruments are combined and confused in the literature, two concepts that go hand in hand but should be differentiated because they have nuances. To approach this work, the first issue is to distinguish between them. In a simplified way, incentives seek to drive changes and promote actions by third parties that, *a priori*, would not be carried out without their concession[5]. On the other hand, financial instruments are tools to obtain financing and address investments that are not necessarily intended to be promoted.

2.1.1. Investment incentive

With regard to the term incentive, according to the Royal Spanish Academy (RAE), "incentive is any stimulus offered to a person, group or sector of the economy to raise production and improve yields".

While the general definition focuses on the objective of raising output and improving returns, the literature reviewed offers a broader range of objectives for incentives. Thus, foreign direct investment (FDI) incentives can be defined as any quantifiable advantage granted to specific firms or categories of firms by (or at the direction of) a government to encourage them to behave in a certain way. They include measures designed to increase a particular firm's rate of return or reduce (or redistribute) its costs or risks. They do not include broader policies such as infrastructure, the general legal regime for FDI, the general regulatory and fiscal regime for business operations, free repatriation of profits, or national treatment. While these policies influence the location decisions of transnational corporations, they are not incentives for FDI per se (UNCTAD, 2000).

Similarly, the OECD (2003) conceives incentives as measures to influence a foreign direct investment project's size, location, or sector by altering its relative cost or the risks involved through incentives not available to comparable domestic investors.

[5] Therefore, as will be seen below, in the case of financial incentives, financing instruments such as the granting of soft loans or reduced interest rates are presented. Here the incentive that promotes change is given in the form of a financial instrument.

Thomas (2007) describes investment incentives as a subsidy that seeks to influence investment location. The objective may be attracting new investment or maintaining an existing facility.

Drahokoupil (2023) defines them as the policy implemented by the government to promote the establishment of new firms or to encourage existing firms to expand or not relocate to another location[6]. In their view, the overall objective of investment incentives is to influence investors' location decisions and benefit from the positive effects of FDI. Investment incentives can also be provided to shape the benefits of FDI by encouraging foreign affiliates to operate in the desired manner or to direct them towards regions or industries deemed needing investment. For example, investment incentives may relate to subsidies to firms to invest in advanced technologies or subsidies to foreign firms to invest in a particular locality.

Incentives can take different forms. On the one hand, the most common are economic and financial incentives (EFI), which are measures that provide agents with monetary compensation for investing or engaging in certain behaviour. They can take the form of grants, soft loans, and other forms of support. Traditionally, they have been introduced to mobilise higher levels of capital investment (Curtin et al., 2017a).

On the other hand, education, information, labelling, community involvement in policy-making, community engagement, and awareness campaigns are recommended to address citizen and community acceptance issues (Curtin et al., 2017b). In the case of clean technologies, sometimes the incentive for investment could be to remove an existing incentive for another technology (e.g., eliminating fossil fuel subsidies).

The Spanish Government (2022) focuses on the regional sphere and defines regional incentives as "*financial aid granted by the General State Administration to productive investment to promote business activity, orienting its location towards previously determined areas. They consist of non-refundable subsidies and aim to alleviate inter-territorial imbalances*".

These definitions have elements in common. First, incentives are not granted to just any project or investor. In other words, it is necessary to specify a scope or objective, i.e., the incentive seeks to influence a decision, e.g., the location of an investment, the attraction of foreign direct investment[7], or others. Incentives can be targeted at companies, communities, or individuals. They can be granted by different levels of public administration (local, regional, national, and supranational governments).

Next, incentives allow recipients to obtain quantifiable benefits. Furthermore, most definitions focus on economic and financial incentives, although there are other types of incentives, such as regulatory measures or information and technical services.

While, like financial instruments, there are a multitude of incentives to promote different types of projects, as well as different ways of designing and administering them, depending on the objectives of the Institutions, incentives tend to seek to compensate for market failures that

[6] *Investment incentive: policy implemented by government to promote the establishment of new businesses or to encourage existing businesses to expand or not to relocate elsewhere* (Drahokoupil, 2023).

[7] This is because it can bring important benefits in terms of capital or technology transfer, among other things (Tavares-Lehman & Lundan, 2016).

push agents not to invest in a given project or geographical environment and are created, granted and managed by public bodies or institutions.

A relevant issue related to incentives we will discuss later is their appropriateness and whether they are efficient and effective (Wells et al., 2001).

2.1.2. Financing instrument

A financial instrument has different definitions: "A financial instrument is a contract between two parties that can be traded and settled" (Díaz Zúñiga, n.d.). The contract has two parties: the holder of the financial asset and the issuer or liability of the financial asset. Consequently, the buyer will have the right to receive specific economic resources, while the seller will have the obligation to settle that right.

According to Kenton (2023), financial instruments are assets or bundles of capital that can be traded. Most financial instruments provide a flow or transfer of capital between investors. These assets may take the form of cash, a contractual right to deliver or receive, or evidence of ownership of an entity. A financial instrument is a real or virtual document representing a legal agreement involving monetary value.

Another definition states that financial instruments are contracts on monetary assets that can be bought, traded, created, modified, or liquidated (IFC Team, 2023). In other words, a contractual obligation exists between the parties involved during a financial instrument transaction.

CFI Team (n.a.) defines a financial instrument as a contract that gives rise to a financial asset for one entity and a financial liability or equity instrument for another. By referring to assets, liabilities, and equity instruments, it relates to the financial statement. Furthermore, as can be seen, the definition describes financial instruments as contracts.

Following Fernández Gómez & Larrea Basterra (2021), financial instruments are organised according to three main elements, namely (i) the destination of the funds in the life-cycle framework, (ii) the origin of the resources (i.e., public or private), and (iii) the rights and obligations associated with the funds (equity, debt or grants).

In summary, the different definitions coincide in two elements: the contractual nature and the consequent existence of rights and obligations between the parties and the economic nature.

2.2. Clean technologies

Clean technologies (cleantech or low-carbon technology) seek to avoid environmental damage using materials, processes, and practices that reduce or eliminate pollution or waste. In other words, all product or process life cycle phases should be carried out to prevent or minimise short- and long-term risks to human health and the environment (Muralikrishna & Manickam, 2017).

There are different classifications of clean technologies. Based on Criscuolo & Menon (2014), Table 1 presents a classification of the different clean technologies according to the sector or field of application.

Table 1 Clean technology application sectors

Sector	Subsector
Agriculture and food chain	Land management; natural pesticides
Environment and air quality	Sanitation; emission control; monitoring and compliance; carbon sequestration; trading and mitigation
Energy efficiency	Advanced packaging; biofuels; buildings; buildings; chemicals; glass; lighting; monitoring, control and compliance; smart manufacturing and production; energy transport and distribution; lighting; advanced packaging; biofuels; chemicals; glass; monitoring, control and compliance; smart manufacturing and production; energy transport and distribution.
Power generation	Biofuels; green hydrogen; geothermal; hydro/marine; solar; wind
Energy infrastructures	Smart grids; network management; data management; energy transport and distribution
Energy storage	Advanced batteries, fuel cells, hybrid systems
Materials and manufacturing processes	Bio-, chemical, glass and nano materials; advanced packaging; monitoring and control; smart production
Recycling and waste management	Recycling and waste treatment
Transport and logistics	Advanced batteries, fuels, logistics, structures, vehicles.
Water and wastewater	Cleaning/safety; wastewater treatment; water conservation; water treatment

Source: adapted from Criscuolo & Menon (2014).

Map 1 shows the area of clean technology projects under development in the EU. They are based on a different thematic classification than in Table 1. Despite the category names (green transition; social and territorial cohesion; digital transformation; smart, sustainable, and inclusive growth; institutional, social, economic, and health resilience; and policies for the next generation), all the projects considered are related to clean technologies.

Map 1 Transnational clean technology projects and project selection

Source: European Union (n.d.-b).

Another example of classification is the Basque List of clean technologies[8] (LVTL) of the Autonomous Community of the Basque Country (ACBC), which is used as an instrument to obtain tax benefits for investors in these technologies, to promote sustainable development and facilitate the application of environmental policy through technology transfer and the implementation of equipment with improved environmental performance. The Netherlands, the United Kingdom, and Belgium have similar instruments in place (Basque Government et al., 2016).

This list incorporates selected technologies based on their best environmental performance and reduced implementation in the industrial fabric. They share that they are technologies developed and available on the market that "*have a positive overall environmental impact and*

[8] The current list is from 2016. A new one is pending entry into force. According to Ihobe (2022) the new list will include eight new technologies to support the deployment of environmental and energy planning in the ACBC, in terms of circular economy and energy transition (such as hydrogen or facilitating the circularity of foundry moulding sands and construction and demolition waste). In addition, obsolete technologies will be removed from the list.

that exceed the minimum environmental records established by legislation" (Basque Government et al., 2016).

This LVTL consists of 92 technologies, categorised into six groups. In total, 32 energy-related technologies (e.g., solid biomass boilers with efficiencies above 90%), 26 emission-related technologies (e.g., Volatile Organic Compound-VOC emission treatment unit by adsorption with solvent recovery), 12 water-related technologies (e.g., static filter for water intake), 11 for waste (e.g., paint stripping and induction coating), 10 for resources (e.g., industrial washing machine with biodegradable detergent) and 1 for noise (absorbing silencer).

Another categorisation of clean technologies is given for energy in the IEA's most recent study on the outlook for energy technologies (IEA, 2023c). In this case, these technologies can be divided by sector, technological readiness level (TRL), cross-cutting issues, and value chain, which could also be applied to clean technologies related to waste or water management. The following is a list of the different classifications taken from the data tool of the IEA report (IEA, 2023e).

Table 2 IEA classification of energy technologies

Classification by sector	
Building	Building construction and renovation; food cooking processes; heating and cooling; lighting; systems integration in buildings
Industry	Aluminium; cement and concrete; chemicals and plastics; cross-industry; e-waste recycling; iron and steel; pulp and paper
Transport	Aviation; Rail; Road transport; Freight transport
Carbon dioxide management (CO_2)	Capture, storage and transport of CO_2
Energy transformation	Biofuels; heat systems; hydrogen; electric power; refining; synthetic fuels; hydrogen; biofuels; synthetic fuels
Classification by level of technological maturity, cross-cutting issues and value chain	
TRL	Concept; initial prototype; scaled-up prototype; demonstration; market introduction; maturity
Cross-cutting themes	Renewables; materials; digitisation; bioenergy; hydrogen; electrochemistry; carbon capture, storage and utilisation (CCUS); critical materials
Value chain	Aluminium; batteries; biomass and biofuels; buildings; cement; chemicals; CO management$_2$; heat systems; hydrogen; iron and steel; metals; electric power; pulp and paper; synthetic fuels; transport; transportation; energy and energy efficiency.

Source: taken from IEA (2023e).

As can be seen and mentioned, the term clean technology is comprehensive, and many clean technologies are classified into different categories. Moreover, it is expected that new ones will continue to appear as R&D&I progresses.

Considering the above, this report aims to identify incentives for investment in clean technologies. Where possible, examples of these incentives will be presented. Bearing in mind that a large part of clean technologies, as has just been presented, are related to the energy cycle (production, transport, distribution, storage, and use) and that the information available in this field is very extensive due to their role in achieving the objectives of decarbonisation of economies, this study will include examples of incentives in clean technologies in general, but with a possible bias towards clean energies due to the availability of data. In any case, the approaches outlined throughout the document could also apply to clean technologies in general.

3. Main incentives for investment in clean technologies

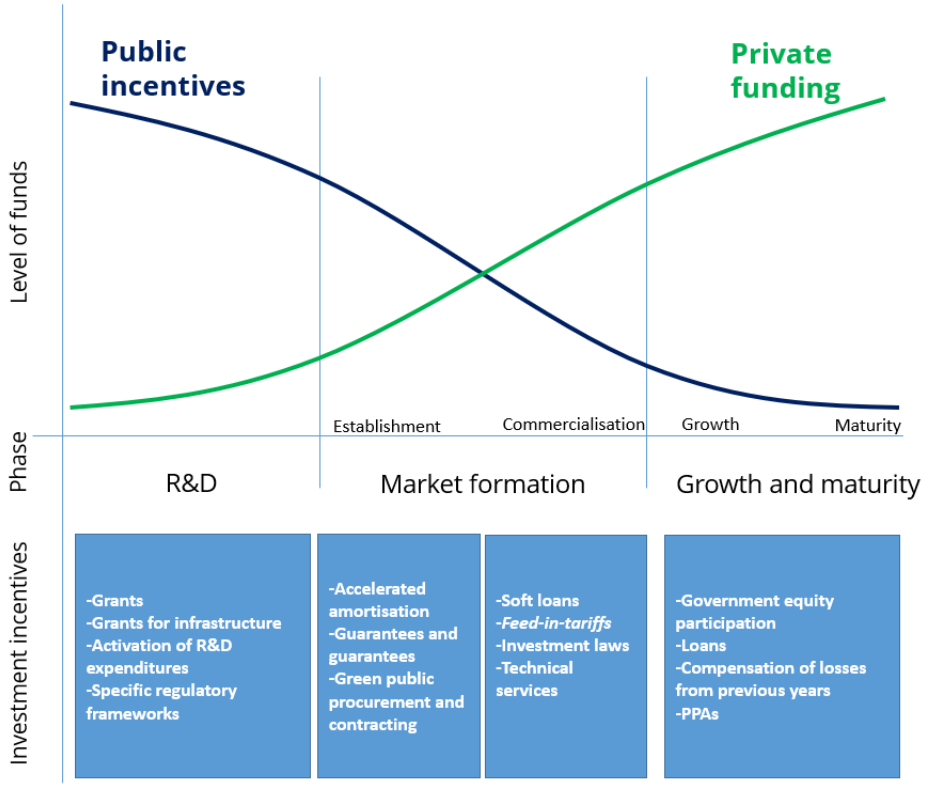
As mentioned, there is a wide variety of categorisations and types of incentives. Drahokoupil (2023) differentiates between three main categories of investment incentives in general, which can be applied at local, regional, national and supranational levels: (i) financial incentives, such as grants and loans; (ii) fiscal incentives, such as tax exemptions and reduced tax rates; and (iii) other incentives, such as subsidised infrastructure, market preferences and regulatory concessions. For its part, Tavares-Lehman & Lundan (2016) recognise five types of incentives, namely (i) financial, (ii) fiscal, (iii) regulatory, (iv) information and technical services, and (v) investment agencies.

Incentives can be selective and discriminate according to the size of the investment or its origin. Developed countries and transition economies generally use financial incentives, while developing countries prefer fiscal measures. According to Tavares-Lehman & Lundan (2016), resource-constrained governments find it easier to forego revenues than to raise funds for revenue sharing. In addition, many developing countries have established free trade zones where the usual domestic regulatory requirements do not apply.

Another categorisation differentiates between demand-side and supply-side incentives. In addition, there are incentives that are more appropriate for one or the other phase of clean technology development or utilisation (see Figure 2).

In many cases, as seen in the next section on large incentive programmes, governments tend to offer a set or package of different types of incentives. These packages can vary widely across countries and between levels of government (Tavares-Lehman & Lundan, 2016).

Figure 2 Examples of the evolution of public incentives according to the stage of clean technology investment projects



Source: own elaboration based on Owen et al. (2018), Fernández Gómez & Larrea Basterra (2022a), Noh (2019), and Polzin & Sanders (2020).

The following subsections present the main investment incentives according to the literature and following a new categorisation. The first column indicates the incentive's name and the second one lists alternative terms found in the literature. The third or fourth column offers a definition of each incentive[9].

The different incentives have been classified into (i) economic incentives (which may include labour incentives such as subsidies for hiring or training employees), (ii) debt or equity financial incentives (which may include incentives or guarantee schemes), (iii) fiscal instruments (which may be taxes or tax benefits), (iv) market incentives (related to prices or quantities traded), (v) regulatory incentives (non-economic, financial or fiscal), (vi) knowledge and collaboration incentives (such as technical support services or public-private partnerships). Figure 3 summarises the classification with the name of the incentives.

[9] Examples of the different incentives are given in Annex 1.

Figure 3 Incentives analysed by category

Economic incentives	Financial incentives	Fiscal incentives (taxes)	Fiscal incentives (incentives or benefits)	Market incentives	Regulatory incentives	Knowledge and collaboration
• Subsidies • Wage subsidies • Subsidies on social security contributions • Training subsidies • Subsidies for infrastructure	• Loans (soft loans) • Guarantees, collateral, other risk mitigation instruments • Government equity participation • Activation of R&D expenditures	• Excise taxes (on energy): electricity tax, hydrocarbon tax, coal tax, etc. • Carbon taxes • Carbon border adjustment mechanism • Tax on means of transport: road tax, registration tax, etc. • Transport tax: road tax, registration tax, etc. • Taxes on natural resources • Taxes on pollutants • Waste taxes	• Accelerated depreciation • Deductions in the instalment (tax credit) • Tax credit as a payment • Tax credit rebate programme • Tax reductions (on the taxable base), additional or increased reductions • Tax exemptions or tax holidays • Tax rate reduction • Tax relief, exemption • Tax refund • Offsetting of tax losses from previous years • Compensation of losses against taxable profits • Monetisation and/or carry-forward of tax credits • Monetisation and/or transfer of tax credits	• Premiums, regulated prices, guaranteed tariffs • Net metering (virtual, aggregated etc.) • Net invoicing (wholesale or retail) • Contracts for difference • Electricity purchase contracts • Renewable quotas or portfolio • Certificates of origin, guarantees of origin (renewables) • Renewable auctions • Emissions trading schemes (allowances)	• Stable, fair and predictable regulatory framework • Investment laws • International treaties, international investment agreements • Energy efficiency obligations • Energy saving certificate, energy efficiency certificate • Specific regulatory frameworks • Special clean economic zones	• Information and technical services • Training • Public-Private Partnership Agreements, • Green innovation awards • Green public procurement and contracting • International, global partnerships • Green taxonomy, list of green technologies, identification of projects of (common) interest

Source: own elaboration.

3.1. Economic and financial incentives

According to Abdmouleh et al. (2015) economic and financial incentives employed by governments can take different forms. They address one of the main barriers to investment, namely access to finance. These are public funds used by the government to invest in specific projects. These incentives reduce the initial burden of investment and lower equipment costs. The total amount of money available for this support is usually capped.

Table 3 Financial incentives

Incentive	Equivalent terms	Description / Purpose
Subsidies	Grants, tailored grants, cash grants, R&D grants, subsidies, capital subsidies[10], rebates	A financial contribution towards the costs of a project. They are non-refundable unless the beneficiary has not complied with the corresponding obligations for receiving the grant. They can be operating grants (to cover operating or operational expenses) or capital grants (to cover the full amount or part of an investment) for an asset that will remain in place over time. The difference lies mainly in the recipient's accounting impact, whether it is a company or not.
Wage subsidies		A financial contribution to employers to recruit and retain eligible workers for continuous and sustainable jobs. It is intended to cover some initial costs of hiring a person.
Rebates on Social Security contributions		Social Security offers discounts to companies and self-employed employers for hiring or training people belonging to specific groups and subjects related to the company's objective.
Training subsidies	Job training subsidies	This type of grant is aimed at supporting trainees in companies and training newly recruited employees or established staff.
Infrastructure grants	Infrastructure investment	This consists of making an investment that makes another investment attractive, in this case, clean technologies. This can include the improvement or development of infrastructure (e.g., roads) or the concession of land for new activities. It can be understood as an incentive that frees up capital for other commitments.

Examples of these incentives can be found in Annex 1, Table 10.

Source: own elaboration based on Abdmouleh et al. (2015), Cox (2016), Criscuolo & Menon (2012, 2014), Curtin et al. (2017a), Qadir et al. (2021b), Tavares-Lehman & Lundan (2016).

[10] The terms *subsidy* and *grant* are often used interchangeably. However, they have nuances that differentiate them. *Subisdies* are current payments intended to influence production levels or prices. *Grants* are direct financial contributions for specific activities that support the policy objectives of the EU or public administrations.

Table 4 lists the financial incentives. These can be debt, equity or other.

Table 4 Financial incentives

Type	Incentive	Equivalent terms	Description / Purpose
Debt	**Loans (soft)**	Loans, soft loans, concessional loans, non-concessional loans	A contract whereby an agent undertakes to repay a sum of money previously lent to him. It can be concessional (or soft) or non-concessional. These loans (concessional or non-concessional) may be granted by commercial banks with the government's support or directly by government agents. Concessional or soft loans are those loans granted on better-than-market terms, e.g. interest-free or below-market interest rates, longer maturities, or both. They are usually provided by multilateral institutions, development banks (e.g., subsidiaries of the World Bank), governments, or government agencies. They are usually granted to developing countries that could not borrow at market interest rates. Non-concessional loans are granted at the same rate and under similar conditions as market rates. They are helpful for small and medium-sized enterprises (SMEs) that do not have a strong capital structure or significant assets to secure the loans.
Debt	**Guarantees, sureties, other risk mitigation instruments**	Loan guarantees, de-risking instruments	Support companies by providing a guarantee to borrow from credit institutions that would not be willing to grant them loans or would only be willing to lend to them at higher rates without such guarantees. They involve a promise to assume a debt obligation (limited or not) in the event of default by the borrower.
Capital	**Government equity participation**[11]		Government capital contribution reduces the project's overall risk or avoids high leverage levels. It is applicable to almost all infrastructures and must be based on the project's profitability, which must be satisfactory. Its objective is often to attract private investors to the project by demonstrating their support and confidence in the project's viability. It can help reduce certain political risks.
Other	**Activation of R&D expenditure**[12]	R&D capitalisation	An accounting treatment that recognises certain expenses on a company's balance sheet as an intangible asset. These expenses will, therefore, represent an additional asset of the company, with its value, from which returns are expected to be obtained. In the activation process, the expenses are taken out of the profit and loss account of the current year, thereby increasing the company's profit.

[11] As financing is offered on more attractive terms than the market, it is important to ensure that it is justified from an economic and social point of view, avoiding crowding out private investment and ensuring that tenders are competitive processes. This public investment should encourage more private companies to invest or close a potential financing gap.

[12] This is an accounting (financial) measure, but has important fiscal implications.

Examples of these incentives can be found in Annex 1, Table 11.
Source: own elaboration based on Cox (2016), Criscuolo & Menon (2012, 2014), Curtin et al. (2017a), Qadir et al. (2021b), Tavares-Lehman & Lundan (2016).

3.2. Fiscal instruments

Tax instruments are provisions tailored to qualified investment projects that represent a "*favourable deviation from general tax laws and regulations*" and aim to increase the return on a given investment or reduce its risks and costs by reducing the tax burden (Tavares-Lehman & Lundan, 2016). Tax instruments can focus on profits earned, costs incurred, or damages incurred or constitute tax exemptions or reductions in tax payments, among other things. Generally, governments combine these instruments to make investment in their territory more attractive.

In this area of taxation, this paper interprets two types of instruments as incentives, although one of them tends not to be conceived as such, given its mandatory nature: environmental taxes. In effect, the two groups of tax instruments are used, one as a deterrent ("stick") and the other as a "carrot" or the more traditional concept of incentive.

Environmental taxes (the stick) seek to make those with the most significant adverse environmental impact pay the most. However, for this reason, they are interpreted as an incentive in this work; they tend to promote changes in agents' behaviour, to promote R&D towards more environmentally sustainable processes, etc. In this sense, the literature

recognises the value of environmental taxes[13] on pollutants and waste as an incentive for research, development, and innovation (R&D&I) (Manzoor & Ramay, 2013; Zhao et al., 2022), which has sometimes led to the adoption of measures to reduce the environmental footprint of taxpayers[14]. Carbon or energy taxation (e.g. on conventional energy sources) can drive changes in energy consumption levels.

There are different types of environmental taxes, as shown in Table 5, which vary according to the taxable event[15] (energy, transport, carbon, etc.). Their role as an incentive is that these taxes introduce adjustments in energy costs, e.g., from fossil or non-fossil sources. They act as a market regulator that will lead to environmentally fairer competition between energy generation technologies through applying an optimal environmental tax.

Table 5 Environmental taxes

Any compulsory and unrequited payment to public administrations levied on tax bases is considered to be environmental in nature.
Type of tax
Excise (energy) taxes: electricity tax, hydrocarbon tax, coal tax, etc.
Carbon taxes[16]
Carbon Border Adjustment Mechanism (CBAM)
Tax on means of transport: road tax (motor vehicle), registration tax, vehicle tax, etc.
Natural resource taxes
Taxation of pollutants
Taxation of waste: Waste (management) taxes, water (disposal) taxes, waste (water) taxes

Note: Examples of these incentives are given in Annex 1, Table 12 .

Source: own elaboration based on Cox (2016), Criscuolo & Menon (2012, 2014), Curtin et al. (2017a), Qadir et al. (2021b).

[13] The term *excise tax* refers to all excise taxes on consumption including environmental taxes, and others such as excise taxes on tobacco, alcohol, etc.

[14] While some of these taxes are initially aimed at broadening the tax base and thus raising revenue, some of them have encouraged the adoption of measures to reduce the environmental footprint of taxpayers. The Swiss Volatile Organic Compounds (VOC) tax (see example in Table 10) is a tax on volatile organic compounds (VOCs). Table 10, **Table 5** in Annex 1, shows specific effectiveness illustrated by the reduction of VOC emissions from industrial sources subject to the tax (48% reduction from 2000 to 2014), which is significantly higher than the reduction of VOC emissions from industrial sources not subject to the tax (23% reduction from 2000 to 2014) (Ballaman, 2016).

[15] The taxable event is the "element of the tax that is defined as the circumstance or factual assumption, of a legal or economic nature, that the law establishes to configure each tax, whose realisation originates the birth of the main tax obligation, that is to say, the payment of the tax" (Sage, 2023).

[16] They can take different forms and tax different taxable events. In the case of Spain, the carbon tax is levied on emissions of fluorinated greenhouse gases.

On the side of the carrots or tax benefits, there are two main types: (i) exemptions or reductions in the tax base and bonuses or deductions in the quota of these environmental taxes for those who pollute less by using technologies with lower negative impacts[17]; and (ii) tax credits (exemptions/ reductions/ bonuses/ deductions) in other taxes such as personal income tax or corporate income tax for taxpayers who make use of clean technologies. Table 6 lists the main tax incentives, in the form of tax benefits, that can be included or considered in different taxes.

Table 6 Tax incentives (tax benefits)

Incentive	Equivalent terms	Description / Purpose
Accelerated depreciation		A tax mechanism that allows companies to deduct a higher amount of depreciation expense from their taxes in the early years of a fixed asset's useful life, compared to traditional straight-line depreciation (e.g. in corporate income tax).
Tax credits	Capital investment tax credit, production tax credit	The amount of money that the taxpayer can deduct from the taxes owed. There are three basic types: non-refundable, refundable, and partially refundable. Non-refundable can reduce the tax owed to zero. Refundable or partially refundable is paid by providing a partial or full refund of the deduction, where this is greater than the tax due (e.g., corporation tax).
Receipt of a tax credit as payment		It consists of the possibility for certain groups to receive tax credits as a payment to enable them to continue investing in clean technologies.
Tax credit rebate programme	Bonus credit program	A bonus that provides an increase of a higher amount or percentage of investment or production tax credit under certain circumstances.
Tax reductions (on the tax base), additional or increased reductions	Tax allowances, tax deductions, enhanced deductions	A business expense that can reduce the amount of tax payable. It is deducted from gross income to calculate the tax base so that the tax base is reduced. *Enhanced deductions* are relief under enhanced conditions.
Tax exemptions or tax holidays		Incentive consisting of the temporary reduction or elimination of certain taxes. It aims to stimulate economic activity, promote growth, and encourage investment (e.g. in corporate income tax).
Tax rate reduction	Reduced tax rates	Application of a reduced rate of taxation compared to the level that would apply to it (e.g. VAT, corporate tax, etc.). This reduced rate can also be applied to equipment or spare parts needed for projects.
Rebate, exemption	Tax credit	An economic incentive or advantage granted by tax law to the taxpayer of a tax, which consists of reducing, totally or partially, the tax payable by the taxpayer by a percentage of the total taxable base (for example, in the case of Real Estate Tax).

[17] They are generally known as "tax *relief*" or "*tax relief*", a generic concept of tax savings that can operate both in base and quota or via a reduction in the tax rate.

Tax refunds	Tax rebate, recovery of tax, refund of tax, tax refund, tax reimbursement	Refund of the amounts derived from the regulations of each tax, corresponding to amounts paid or supported that have been overpaid, as well as the credit balance that has resulted from the tax return in the tax year that was declared as a result of the application of this.
Offsetting of tax losses from previous years	Loss carryforward	The action of offsetting tax losses (tax loss carryforwards) from one year against future years, so that less tax is paid in those years, with or without a time limit, with or without quantitative limits, more or less strict.
Offsetting of losses against taxable profits from previous years	*Loss carryback*	Offsetting of tax losses from one year against tax profits obtained in previous years. This would involve a refund of taxes paid previously.
Monetisation and/or transmission of tax credits [18]	*Monetising tax credits*	A right whereby tax deductions or reductions are transferable to a third party (government or private agent), so that the company entitled to the refund can sell it to an investor for a percentage of the total. For example, a tax refund of US$ 10,000 can be sold for US$ 8,000. In this way, the investor can apply the deduction to his tax liability of 10,000, and the company can use the cash (8,000) in its operations.

Note: Examples of these incentives are given in Annex 1, Table 13.

Source: own elaboration based on Cox (2016), Criscuolo & Menon (2012, 2014), Curtin et al. (2017a), Qadir et al. (2021b).

Tax incentives are one of the main instruments used globally, often to attract foreign investment and make the territory more attractive. They are popular in developing and developed countries (which also employ economic and financial incentives). Very often, they are the main type of incentive used in developing economies (with more limited resources), as they do not have as many resources to offer economic or financial incentives.

Box 1 provides the details associated with one type of tax incentive: *tax credits*. In the United States, these are implemented through the Inflation Reduction Act, as detailed in the Subsection below. 4.1 on large incentive programmes.

Box 1 Investment tax credit (ITC) vs production tax credit (PTC)

An investment tax credit (ITC) is an incentive to promote technologies regardless of their production level. An ITC provides a direct tax deduction of a certain percentage of the investment in a qualifying asset or business. Companies can take advantage of the deductions by investing in assets or other businesses that meet specific requirements. It takes the form of

[18] It is common to apply monetisation when a company does not have sufficient tax liability to benefit from the full amount of a deduction to which it is entitled. Through monetisation, it can assign it and in return obtain financing from a third party (Doran, 2024). In Spain it can only be applied with the tax administration and for R&D deductions, for an amount of 20% of the deduction generated.

a rebate that mitigates the investor's tax liability. It is generally estimated as a fixed percentage of the amount invested. For example, the US federal government offers an investment tax deduction of 30% for investments in solar, fuel cell and wind energy technologies (Doran, 2024).

When the cost of the installation is reduced (e.g., solar PV panels) and the efficiency of the technology in question improves, a production tax credit (PTC), where a deduction is granted per unit of production, which covers the operating costs over the life of the installation, creating an incentive to generate as much clean production as possible, maybe more beneficial (Evergreen Action, 2023b).

A PTC provides a tax rebate based on a company's production amount. For example, PTCs for renewable energy producers are common. Thus, the PTC provides a tax deduction on the output of a company operating a wind farm or solar panel in the form of a fixed amount per kWh of energy generated by the installation. The goal is to help more expensive production technologies compete with traditional sources (U.S. Department of Energy's Wind Energy Technologies Office, 2023).

The degree of interest in one or the other incentive depends on each case, with a crossover point between the two. In general, the decision will be project-specific and based on various factors. A differentiating element is that, in the case of the JTI, only the initial investor benefits from the incentive. In contrast, in the case of the PTC, as it is an incentive over the life of the investment, different investors may benefit, depending on the duration of the PTC itself and the entry of new investors into the project (Pickerel, 2022).

There are arguments against PTCs because they would have generated distortions (Doran, 2024). Thus, wind power producers can sell the energy they produce at prices below the cost of production because the PTC will more than compensate for this loss. Moreover, in wind-rich regions, the ability of wind power producers to supply electricity at a loss would have forced power producers with other technologies to reduce their prices as well, discouraging investment in these technologies. Critics point out that PTCs pass on the cost of production to taxpayers rather than consumers and harm competition from other forms of production.

3.3. Market incentives

This is followed by market incentives, which are usually determined by regulation but have an economic component, as does taxation, which is also established by a regulatory framework. These incentives include fixed and guaranteed prices, competitive auctions (which allow differentiation by level of technological development)[19], and renewable quotas or portfolios. All of them have in common their relationship with the market signals that are sought to promote investment.

[19] According to Abdmouleh et al. (2015) investors prefer regulated prices to auctions, as they offer greater guarantees and the level of competition in auctions sometimes result very aggressive.

Table 7 Market incentives

Incentive	Equivalent terms	Description / Purpose
Premiums, regulated prices, guaranteed tariffs	Feed-in tariffs (FIT)	An instrument designed to promote investment in renewable energy. It usually consists of granting renewable energy producers a price above the market price for the energy they supply for some time, considering each technology's generation cost.
	Feed-in premium (FIP)	It is a type of *feed-in tariff* where the objective is to limit the premium granted. To this end, the producer sells electricity directly to the regulated market to control market revenues. Producers receive a premium above the market price for their electricity production. The premium can be fixed (i.e. at a constant level independent of market prices) or variable (depending on the evolution of market prices).
Net measure (virtual, aggregated, etc.)		Net metering is a billing arrangement between solar energy system owners and electricity companies. It allows solar panel owners to feed excess electricity they generate back into the grid in exchange for credits. These credits can be used to offset future electricity consumption when their solar panels do not produce enough energy to meet their needs. The net measure ensures that solar panel owners are compensated for the surplus electricity they feed back into the grid.
Net invoice (wholesale or retail)	Net billing	Wholesale: pricing scheme for self-consumption in which surplus energy fed into the grid is remunerated with reference to the wholesale electricity market price. Retail: In this case, surplus energy fed into the grid is remunerated according to the electricity supply price.
Contracts for Difference (CfD)		An agreement between a "buyer" and a "seller" whereby they agree to base the financial settlement of a contract on the difference between the current price of an underlying asset (shares, currencies, commodities, indices, etc.) and the agreed price.
Electricity purchase contracts	Power purchase agreements (PPAs)	A PPA is an agreement in which a developer installs, owns, and operates a facility. The customer purchases electricity production for a pre-determined period. A PPA allows the customer to receive electricity with no upfront costs while allowing the facility owner to receive revenue from the sale of electricity.
Renewable quotas or portfolio	Renewable portfolio standard (RPS)	An instrument under which utilities have to ensure that a certain percentage of the electricity they supply is of renewable origin.
Certificates of origin, guarantees of origin (renewable)		A document that accredits the renewable character, as well as details on the production of a MWh of energy (electricity, gas, etc.). Its function is to demonstrate to the final consumer that a certain quota or quantity of energy has been obtained from renewable sources. It can be linked to the renewable quota or portfolio.
Renewable auctions	Public competitive bidding	A mechanism whereby the government, through the relevant ministry, organises a tender in which different companies will receive a financial entitlement or remuneration based on the bid they have made.

Emissions trading schemes (permits, emissions allowances)	A system where a regulator defines an upper limit on GHG emissions (*cap*). Permits or allowances are allocated to covered entities. Each entity must surrender several allowances corresponding to its emissions at the end of a period. Installations that have emitted less than the number of allowances they hold can sell the excess to other participants.

Note: Examples of these incentives are given in Annex 1, Table 14.

Source: own elaboration based on Cox (2016), Criscuolo & Menon (2012, 2014), Curtin et al. (2017a), Qadir et al. (2021b).

3.4. Regulatory incentives

While incentives for investment that come from applying regulations have been described above, another type of regulatory incentive for investment of a more general nature is presented here. According to Tavares-Lehman & Lundan (2016), regulatory incentives (discussed here) aim to attract firms by repealing national, regional, etc. regulations. In practice, these derogations have involved easing environmental, social and labour market regulatory requirements placed on investors. Regulatory incentives can take the form of laws, which can establish *free trade zones* with a unique legal framework for labour, taxation, or others, constituting an investment incentive. Along these lines, regulatory restrictions of a commercial nature on non-clean technologies, such as import duties and tariffs, can also be considered.

Table 8 Regulatory incentives

Incentive	Equivalent term in English	Description / Purpose
Stable, fair and predictable regulatory framework		A fair, transparent, and predictable regulatory framework is attractive to investors[20]. Strong property rights protection and company law principles are often central to investors' location decisions and behaviour.
Investment laws[21]		They are the framework of international, national, and/or subnational laws and contracts that govern international investment. They are a key factor in determining whether, when, and how countries and communities can benefit from the capital flows produced by investment. They are more common in developing countries.
International treaties, international investment agreements[22]		Instrument that develops legal protection for foreign investors beyond the legal protection of the country's system. According to the Organisation for Economic Co-operation and Development (OECD), around 2,500 international investment treaties and agreements exist.

[20] See Erzurumlu & Erzurumlu (2013).

[21] For more details on investment law, see UNCTAD (2024).

[22] For more details on international investment treaties, see UNCTAD (2024).

Energy efficiency obligations schemes		A legislative mechanism that commits "obligated parties" to quantitative energy savings targets across their entire customer base. Obligated parties can be retail energy sales companies, energy distributors, transport fuel distributors, and/or retailers.
Energy saving certificate, energy efficiency certificate	Energy savings certificates (ESC), Energy performance certificates (EPC)	An official document drawn up by a specialised technician includes information on the consumption of an electronic appliance or the CO_2 emissions it emits into the atmosphere. It is also done for buildings, where energy efficiency is measured in terms of energy loss. It can be related, among others, to energy efficiency obligations.
Specific regulatory frameworks	Sandboxes	A framework created by a regulator to allow private companies to test small-scale innovations in a controlled environment under the regulator's supervision. It consists of developing a testing ground that aims to match regulatory compliance with innovation so that rules do not constrain innovation, and neither is consumer protection relaxed.[23]
Clean special economic zones	Free, clean trade zones	It is a type of special economic zone. It consists of a geographical area where goods can be imported, stored, handled, manufactured, or reconfigured and re-exported under specific customs regulations and are generally not subject to customs duties. This analysis incorporates the need for them to be considered clean as well.

Note: Examples of these incentives are given in Annex 1, Table 15.

Source: own elaboration based on Cox (2016), Criscuolo & Menon (2012, 2014), Curtin et al. (2017a), Qadir et al. (2021b).

3.5. Knowledge and collaboration incentives

Finally, according to the definition of incentive, other mechanisms or instruments can be considered, although they are not always conceived in this way. For example, the transition towards environmental sustainability generates new green job profiles requiring specific skills. With few exceptions, few training programmes are clearly aligned with these needs. Hence, the availability of qualified personnel is key for investing in clean technologies[24].

Other incentives for developing clean technologies include eliminating other incentives, in this case for non-clean technologies, such as removing exemptions for fossil fuel consumption in aviation or maritime transport[25]. The latest report of the European Scientific Advisory Board on Climate Change has pointed out the need to propose and implement plans and deadlines for the elimination of all fossil fuel subsidies in the EU (by modifying the aforementioned energy

[23] The development of *sandboxes* requires a number of instruments (Carlson & Nciri, 2020)These include: (i) innovation hubs (e.g. places for stakeholder collaboration, knowledge and information exchange), (ii) information services (customised guidance and assurance), (iii) regulatory testing (e.g. temporary exemptions from existing rules for testing, development of new regulations or changes to existing regulations, formal and public assessment and evaluation) and (iv) regulatory and policy learning (results and findings to be used by regulators and policy makers for debate on the future).

[24] For more details, see Fernández Gómez & Larrea Basterra (2022b).

[25] For example, the Netherlands granted a total of 31 fossil fuel subsidies amounting to approximately 37.5 billion euros per year between 2020 and 2022 (Stöckl, 2023).

taxation), which, far from decreasing in recent years have been maintained or even increased (European Scientific Advisory Board on Climate Change, 2024).

On the other hand, advancing the development of some technologies can become an incentive in itself to develop others (e.g. developing batteries or distribution grids to deploy renewables further).

Table 9 Incentives for knowledge and collaboration

Incentive	Description / Purpose
Information and technical services (consultancy, guidance, advisory, advisory, accounting or legal services; organisation of missions, partner search services - contact platforms between actors, *lobbying* activities, reduction of bureaucracy or simplification of procedures, reduction of administrative burden, one-stop-shop, etc.)	The objective is to reduce the information asymmetry with investors unfamiliar with the country receiving the investment (lack of knowledge of the market, legal and judicial system, business culture, etc.), with the technology developed, etc. In this way, the investment risk is reduced. They are generally more beneficial for SMEs. They can be paid or free services provided by public or private consultancy firms, more or less tailor-made. They can be provided at different stages of the investment (in the planning phase, during the investment process, etc.).
Training	Development of programmes for the qualification of people in the necessary green skills.
Public-private partnership agreements, Public-private partnerships	PPPs involve a relationship between a government agency and a private sector company that can be used to finance, build and operate projects. This mechanism allows it to be completed earlier or possibly from the outset. It can take different forms, although *joint ventures* are common.
Green Innovation Awards	Competitive award programmes for clean technology innovations
Green public procurement and contracting	An instrument for achieving objectives such as the fight against climate change, efficiency in using natural resources, the development of small and medium-sized enterprises or eco-innovation, where environmental, social and economic aspects are considered throughout the life cycle of products, works and services. To this end, mandatory instructions set out minimum environmental clauses that all government departments and their public sector must incorporate in tenders.
International, global partnerships	Governments can support the development of international clean technology partnerships that aim to overcome divergent views between sectors on the path to transition and achieve significant progress through collaboration and joint work.
Green taxonomy, list of green technologies, identification of (standard) interest projects	Classification systems aim to clarify and classify which investments and economic activities are sustainable in a given environmental context. They both facilitate financing and establish other incentives to promote them (e.g. tax incentives, facilitation of procedures, faster permitting, etc.). They can include technologies related to (i) climate change mitigation and adaptation, (ii) sustainable use and protection of water and marine resources, (iii) transition to a circular economy, (iv) pollution

	prevention and control, and (v) protection and restoration of biodiversity and ecosystems.

Note: Examples of these incentives are given in Annex 1, Table 16.

Source: own elaboration based on Cox (2016), Criscuolo & Menon (2012, 2014), Curtin et al. (2017a), Qadir et al. (2021b).

Finally, and not considered in any of the previous categories, it is proposed, on the one hand, the combination of incentives[26] and, on the other hand, the need to address with incentives a problem associated with the rejection generated by clean technologies (a notable example is the case of renewable energies) and the prejudices existing in society in the face of the changes and investments that clean technologies generate. In this case, incentives should be provided to the agents who consider themselves affected by these technologies, employees of companies that are not involved in the sector and may see their jobs at risk, the aforementioned training of people, or consumers and citizens who may see their patterns of behaviour modified in an undesirable way[27].

[26] For example, in Japan, the incentive for a carbon neutral investment (one that reduces GHG emissions in the production process and contributes to manufacturing products that accelerate decarbonisation) of up to 50 billion Japanese yen (JPY) (USD 500 million) certified under an environmental adaptation plan made before 31 March 2024 will be eligible for a 5% to 10% tax credit or 50% special depreciation (Ernst and Young, 2021).

[27] For more details on this subject we recommend Mosquera López & Fernández Gómez (2023) y WHY project (2024).

4. Case studies of large incentive programmes

Considering the above classification of the main investment incentives, this section aims to present the main lines of incentives for clean technologies adopted in different territories and analyse how they are currently structured.

Six territories have been selected as case studies to analyse the types of incentives and objectives of their main programmes[28]. These territories are the United States (US) (see Subsection 4.1), the European Union (see Subsection 4.2), China (see Subsection 4.3), Canada (see Subsection 4.4), India (see Subsection 4.5) and the United Kingdom (see Subsection 4.6)[29].

On the one hand, the territories were selected for their significant public budgets for R&D investment, where the United States, the European Union, the United Kingdom, and Canada were in the top 10 of the budgets published by the IEA in 2021 (IEA, 2023d). Although the list does not include data from China and India, both countries have large incentive programmes for investment in clean technology due to their size.

The territories were also selected based on their GHG emissions. China, the United States, and India have the highest emissions levels globally, accounting for around 43% of global emissions. In fact, the six selected territories account for more than half of the world's GHG emissions (52% in 2021).

In any case, the above selection of territories in which the analysis of incentives for clean technologies will go into detail should not be understood as a lack of action in the rest of the world. On the contrary, incentives of a different nature are currently being developed in all countries (as an example, see Box 2 for the case of South Korea) as, to a large extent, the context is moving towards a context in which environmental sustainability is becoming a key factor. In this sense, it will be seen that each country's response is different, taking into account the means at its disposal, its specialisation, interests, future potential, and many other factors.

Box 2 Investment Incentives in South Korea

South Korea is developing various programmes and incentives to transition to clean technologies. In 2020, it announced the New Deal, which planned to invest 160 trillion South Korean won (114.1 trillion won in fiscal investment) by 2025 to transform the economy to make it greener, with more digital services and stronger safety nets implemented through fiscal

[28] The review of each case is not exhaustive; it is a general analysis that seeks to show the most relevant elements of the different incentives and to approximate the analysis of the incentives to how they are applied. This review has focused mainly on the last five years, although there are earlier references (for details of the territories see Annexes 2-7). As will be seen from the summary figures, the US and Canadian cases differ to some extent from the others in having a greater focus on *tax credits.* This analysis has been carried out with own translations of the original documents in the language of each territory, when this is not Spanish.

[29] For a small detail on socio-economic and environmental indicators see Figure 12.

support. To strengthen climate action and achieve a green economy, investment will focus on green infrastructure, renewable energy, and the promotion of green industry (IEA, 2021c).

South Korea plans to offer tax incentives for research and development (R&D) of green technologies aimed at reducing carbon emissions to encourage new industries. The country lists 235 technologies in 12 sectors, including next-generation vehicles and bio-health, as "*original and new growth technologies*", to which it has offered a tax credit rate[30] of 30-40% for smaller companies and 20-30% for larger ones. In particular, the country plans to offer R&D spending tax incentives to 48 carbon-neutral technologies, including CCUS, hydrogen, and renewable energy (Soo-Yeon, 2022).

Related to energy, since 2012, Korea has had an RPS in place to replace the feed-in tariffs programme and requires large electricity producers or integrated energy operators with an installed capacity of 500 MW or more to purchase a percentage of electricity from renewable sources through certificates (S. Lee et al., 2023).

In addition, starting in spring 2023, the South Korean Ministry of Trade, Industry, and Energy will offer tax rebates worth KRW 244.7 billion (USD 185.5 million) for rooftop PV and other small renewable energy systems (Bellini, 2023). Similarly, the government provides subsidies for establishing new and renewable installations (solar PV, solar thermal, geothermal, small wind, and fuel cell) on residential buildings (Korea Energy Agency, n. d.). In the agricultural sector, long-term, low-interest loans are offered to farmers to combine PV installations with agricultural activities.

The Korean government plans to use tax incentives, as much of the world is doing, to support hydrogen deployment and will lay the groundwork for a clean hydrogen certification system (Collins, 2023).

In the regulatory framework, it is noteworthy that in April 2023, the Korean government published the first National Basic Plan for Carbon Neutrality and Green Growth (Basic Plan) to respond to the climate crisis and promote sustainable development (Y. J. Lee et al., 2023). This plan will be accompanied by emission reduction targets, further regulation, and documentation, but also plans to strengthen support for Korean companies that have joined the RE100[31] by: (i) providing preferential interest rates and insurance, (ii) recognising performance in reducing GHG emissions, (iii) set up related funds, and (iv) prioritising loan support for power generation projects.

[30] In general, the term tax credit is understood in international cases as a deduction from the tax liability.

[31] RE100 is a global initiative joined by companies that aim to replace all electricity generated by fossil fuels with renewable energy by 2050.

For industry, this Basic Plan envisages improving South Korea's Emissions Trading Scheme[32] (K-ETS), strengthening fiscal support for carbon reduction technologies, supporting project financing through loans, and developing carbon neutrality standards.

In the area of transport, where there is a target to supply 4.2 million electric vehicles and 300,000 hydrogen vehicles by 2030, it is proposed to: (i) provide purchase subsidies, (ii) tax exemptions, (iii) broaden the scope of vehicle models to be purchased by the public sector, (iv) establish a roadmap for the conversion of commercial vehicles, and (v) strengthen the certification system for cars and spare parts. It also provides for (vi) revising the Life Cycle Assessment (LCA) of internal combustion vehicles, (vii) strengthening standards for GHG emissions and fuel efficiency, (vii) reforming the car tax system to reflect GHG emissions, and (viii) developing lightweight materials and low-carbon fuel technologies. For other modes of transport, it envisages: (i) introducing green trains, (ii) expanding the use of bio-aviation fuels and green fuels (sustainable aviation fuels, SAF), and (iii) promoting a conversion to low-carbon systems.

Regarding waste and carbon capture and storage, the measures on the table relate more to the regulatory sphere, establishing action plans, cooperation agreements with third countries, etc.

South Korea responded to US subsidies from the US IRA (to which more later) with a semiconductor package of its own called the K-Chips Act. Indeed, Yeo Han-koo, a former South Korean trade minister now at the Peterson Institute for International Economics, described the US chip law as a "*catalyst*" for Korean companies and the Korean government to "*crack down as soon as possible*".

Passed in March 2023, the K-Chips Act increases tax credits for companies investing in the manufacture of "*national strategic goods*", including semiconductors. In parallel, in April 2023, the government announced a series of initiatives to support battery manufacturing, including $5 billion in loans and guarantees from the Export-Import Bank of Korea and state-owned Korea Trade Insurance to boost the domestic industry.

4.1. USA USA

In 2021, the United States committed to reduce greenhouse gas emissions by 50-52% below 2005 levels by 2030, to generate 100% clean electricity by 2035, and to achieve climate neutrality by 2050 at the latest. Actions and strategies to achieve these goals are embodied in the US National Climate Strategy (roadmap to reach the 2030 goal) and the US Long-Term Strategy to Achieve Zero Net Emissions (Kerry & McCarthy, 2021).

As part of this climate strategy, the United States passed the Bipartisan Infrastructure Act in late 2021, with a budget of US$ 550 billion for 2022 to 2026. The Act aims to: (i) invest in roads, bridges, and railways, taking into account climate change mitigation and safety for users; (ii)

[32] The K-ETS is the main market solution in the Republic of Korea. Launched in 2015, it covers 74% of national GHG emissions (from the sectors: waste, domestic aviation, transport, buildings, industry and electricity). In early 2023, the government cancelled plans to auction 3.7 million allowances (S. Lee et al., 2023).

improve transport options by investing in public transport and promoting the reduction of greenhouse gas emissions; (iii) invest in airports and ports to strengthen value chains, increase competitiveness and create more jobs; (iv) creating a national network of electric vehicle chargers; (v) upgrading the electricity transmission and distribution grid and deploying cutting-edge technologies to achieve zero net emissions; (vi) expanding access to clean water; (vii) ensuring access to high-speed internet for all; (viii) mitigating the climate crisis, and (ix) promoting environmental justice (The White House, 2021).

The second and third pieces of legislation passed since the end of 2021 that seeks to promote industrial competitiveness, innovation, and productivity in the United States are the CHIPS & Science Act and the Inflation Reduction Act of 2022 (IRA) (McKinsey & Company, 2022).

The CHIPS & Science Act aims to foster semiconductor research, development, and production, seek US leadership in semiconductor technology, and boost R&D and commercialisation of cutting-edge technologies such as quantum computing, artificial intelligence, clean energy, and nanotechnology. The Act also seeks to create regional innovation and technology centres in manufacturing sectors, bringing together state and local governments, higher education institutions, unions, businesses, and community organisations. In addition, it seeks to promote opportunities for people to access skilled, well-paying jobs in science, technology, engineering, or mathematics (STEM) fields (The White House, 2022).

The Act allocates US$280 billion over the next 10 years, of which US$200 billion is for R&D in different target technologies, US$52.7 billion for semiconductor manufacturing, R&D, and workforce development, US$24 billion for investment tax credits of 25% to cover capital expenditures for semiconductor and related equipment manufacturing, and US$3 billion for the development of wireless technologies (Badlam et al., 2022).

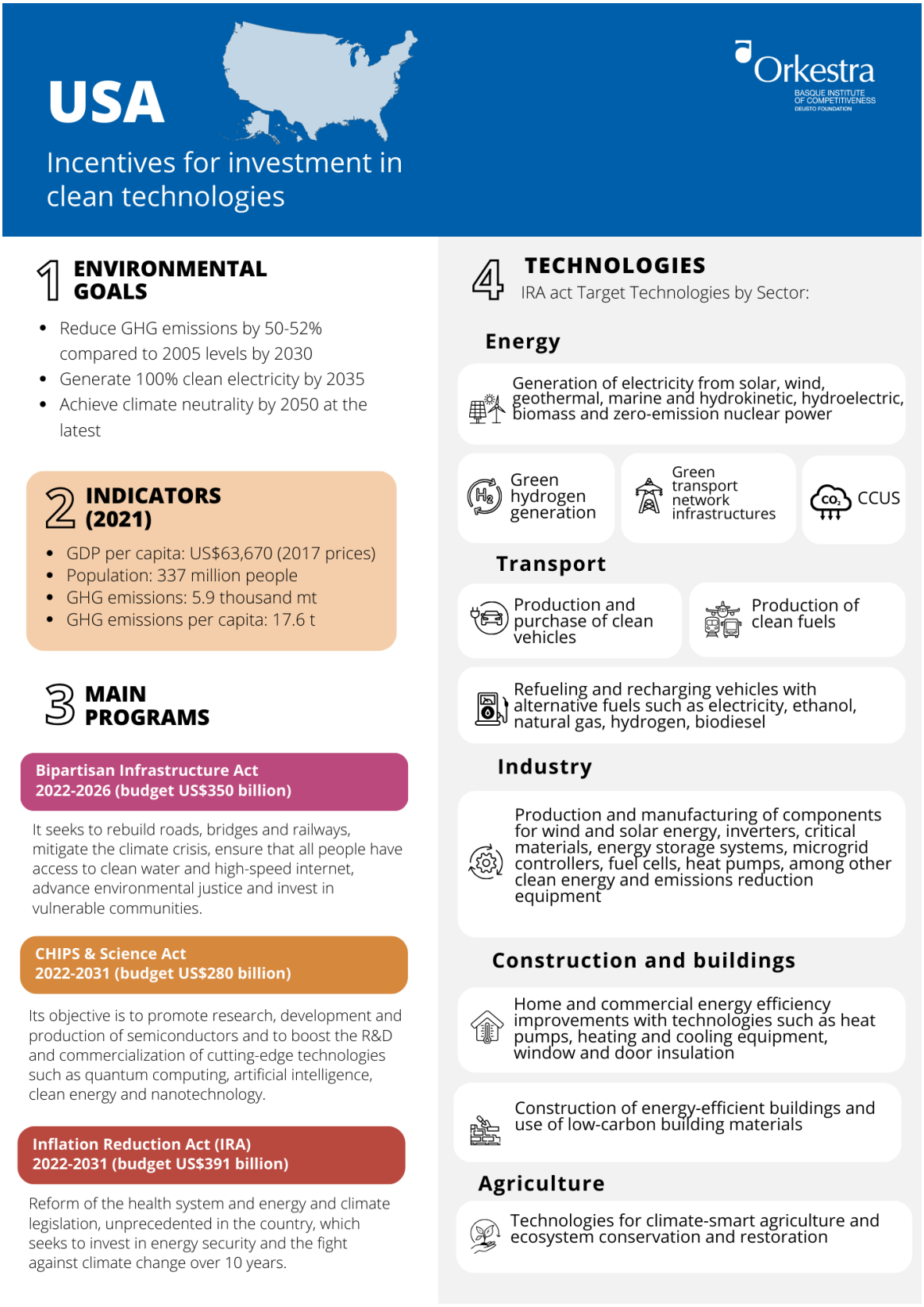
The Inflation Reduction Act consists of tax reform, health care reform, and unprecedented energy and climate legislation that aims to invest around US$ 391 billion over 10 years (2022-2031) in energy security and combating climate change (Kleimann, Poitiers, et al., 2023). As it is a piece of legislation focused on the deployment of clean technologies in the United States, the main characteristics of the Act, the incentives it provides for investment, and the main aid programmes by technology and sector are presented below (see summary sheet for the country in Figure 4).

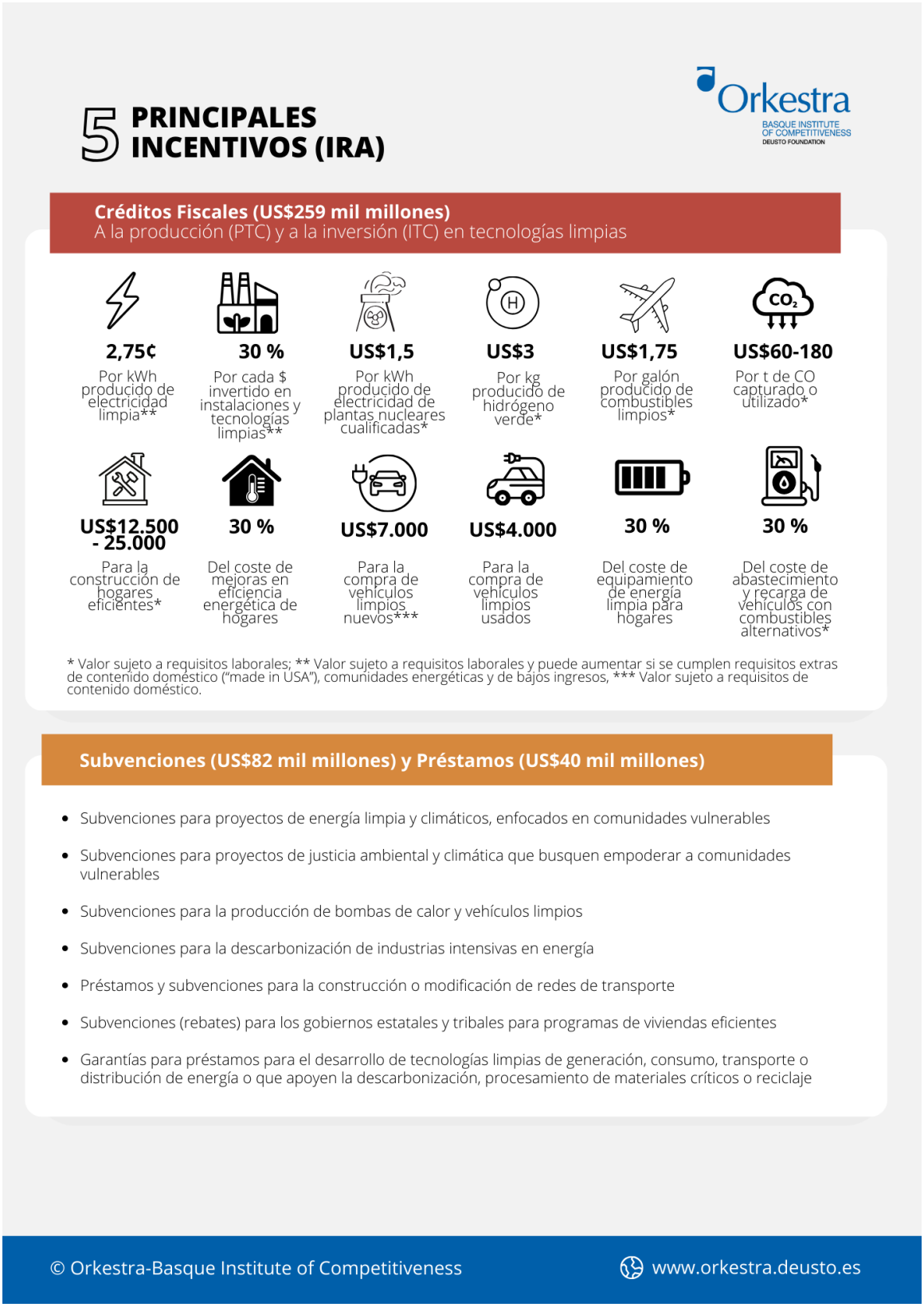
4.1.1. IRA Act

The IRA seeks to raise US$738 billion, and unlike the EU approach, which finances its policies primarily through debt issuance, the IRA does not create new funds but seeks to finance itself through redistribution of existing resources, tax reform, and prescription drug pricing reform. According to the Congressional Budget Office estimates, the IRA will result in a net decrease in the federal deficit of about $238 billion, thus achieving its goal of lowering inflation and the fiscal deficit. However, given that many tax credits are not capped, if the programmes are taken up more than expected, they may need to be offset by debt issuance and would not achieve its objective of reducing the fiscal deficit (Scheinert, 2023).

Of the nearly $500 billion that the Inflation Reduction Act seeks to invest in tax relief and incentives, about 22% of the funds are earmarked for an extension of Affordable Care Act health spending (colloquially known as "*Obamacare*"), and the remaining 78% for investment in clean energy (Boehm & Scalamandrè, 2023; Committee for a Responsible Federal Budget, 2022). This Act aims to reduce GHG emissions by about 40% by 2030 compared to 2005 levels; it includes more than 20 tax incentives, subsidy and grant programmes, and loan programmes. These investments are aimed at the energy transition and making it fair for families, native communities, and rural communities. The Act aims to lower energy costs, create good-paying jobs, especially in the lowest-income and most vulnerable communities, and promote technologies developed and produced in the United States (The White House, 2023a).

Figure 4 United States Factsheet





Source: own elaboration.

In fact, the Act is expected to yield over US$5 trillion in cumulative economic benefits from GHG abatement. However, these estimates only consider the benefits of mitigating climate change without considering the benefits of improving local air quality, which would improve people's health and productivity. These improvements could have benefits of US$ 20 to 49 billion in 2030 alone (Levinson et al., 2024).

Outside the US, the IRA was welcomed for its pro-decarbonisation of the economy and fight against climate change but initially generated controversy for some of its measures that may violate WTO free trade principles. Many of the subsidies are subject to local content requirements (LCRs) where certain "*Made in America*" requirements must be met, for example, in the components and manufacture of electric vehicles and batteries or other technologies such as biofuels and hydrogen (Scheinert, 2023).

While the EU initially resisted the US initiative because of its protectionist nature, the challenges of climate change and the ecological, digital, and demographic transition have led governments to seek new economic and growth structures. Thus, the EU has followed the lead of the IRA and is responding with policies that support domestic production of semiconductors, batteries, and other industries critical to the transitions (see 4.2 and Stokes (2024).

One year after the implementation of the IRA, in August 2023, The White House (2023b) stated that the private sector had announced more than US$100 billion in investment in clean energy technology production, including more than US$70 billion in the electric vehicle value chain and more than US$10 billion in the solar industry. The government also announced that more than 170,000 of the additional 1.5 million jobs it expects to create have already been created. Households are expected to save US$ 27-30 billion on their electricity bills, and businesses are expected to reduce their electricity costs by 13-15% between 2022 and 2030 (Stokes, 2024). In addition, the IRA has already provided more than US$ 1 billion to communities to make them more resilient to the impacts of climate change, and GHG emissions are expected to be reduced by 1 billion tonnes by 2030.

Although investment in electric vehicles[33] is booming as expected, the same has not been true for renewable electricity generation. Problems in value chains, permitting, and local social opposition to project development have meant that wind, solar, and other clean generation sources are not being deployed at the rate expected by law (Plumer, 2024).

Furthermore, there is uncertainty about the future of the IRA if Donald Trump returns to the presidency in 2025, as, although amending the Act requires congressional action, the Republican candidate's hostile agenda towards combating climate change may create difficulties for the implementation of the Act's programmes (Helm, 2024). In fact, according to estimates by Evans & Viisainen (2024), 4 billion additional tonnes could be expected between now and 2030 if Trump wins the November presidential election, compared to Biden's plans.

[33] In March 2024, the Biden Administration issued one of the most significant climate regulations in US history, which seeks to ensure that the majority of new cars and light trucks sold in the country are fully electric or hybrid by 2032 (Davenport, 2024).

4.1.2. IRA investment incentives

The IRA is mainly composed of tax incentives in the form of tax credits and, to a lesser extent, loan programmes, risk guarantees, and grants (Scheinert, 2023). The Congressional Budget Office budget divides funding for energy security and climate change into:

- Clean electricity tax credits (US$ 161 billion),
- Air pollution, hazardous materials, transport and infrastructure (US$ 40 billion),
- Individual incentives for clean energy (US$ 37 billion),
- Clean manufacturing tax credits (US$ 37 billion),
- Tax credits for clean fuels and vehicles (US$ 36 billion),
- Conservation, rural development and forestry (US$ 35 billion),
- Efficiency in buildings, electrification, transmission, industries, DOE grants and loans (US$ 27 billion),
- Other energy and climate expenditure (US$ 14 billion).

The following is a brief discussion of the different incentives present in the IRA, which, although they are conventional incentives for financing clean technologies, present innovative elements that promise to boost investment even further.

Tax credits[34]

According to estimates by McKinsey & Company (2022), the IRA will fund at least US$259 billion in tax incentives (corporate and consumer), and in a revised projection (WSJ, 2023), this value could be three times higher because of its uncapped nature and its only constraint is the uptake by businesses and consumers.

Consumer tax incentives, estimated at around US$ 43 billion, aim to reduce emissions by making it more affordable for individuals and households to purchase electric vehicles, efficient appliances, solar panels, batteries, and geothermal heating systems. Corporate tax incentives, representing around US$ 216 billion, are expected to have the greatest impact on the energy transition (McKinsey & Company, 2022). These are divided into production tax credits (PTCs) and investment tax credits (ITCs). PTCs support clean electricity generation, green hydrogen, clean fuels, etc., and ITCs support investment in clean facilities and technologies.

Projects can apply to either (ITC or PTC), but not both, to reduce a percentage of the cost of the renewable or clean energy system from their federal taxes. In addition, the IRA allows these tax deductions to be available to tax-exempt entities, such as state, local, and native governments or local energy communities[35].

Although these two types of tax incentives are conventional investment incentives, the IRA introduces innovative or "enhancement" elements to them, which aim to have a greater impact on their adoption and their incentive to invest in clean technologies. Specifically, there are four innovative elements (Evergreen Action, 2023b):

[34] From tax credits, meaning deductions from the tax liability.

[35] Table 17 in Annex 2 presents the projects that are eligible for production or investment tax credits.

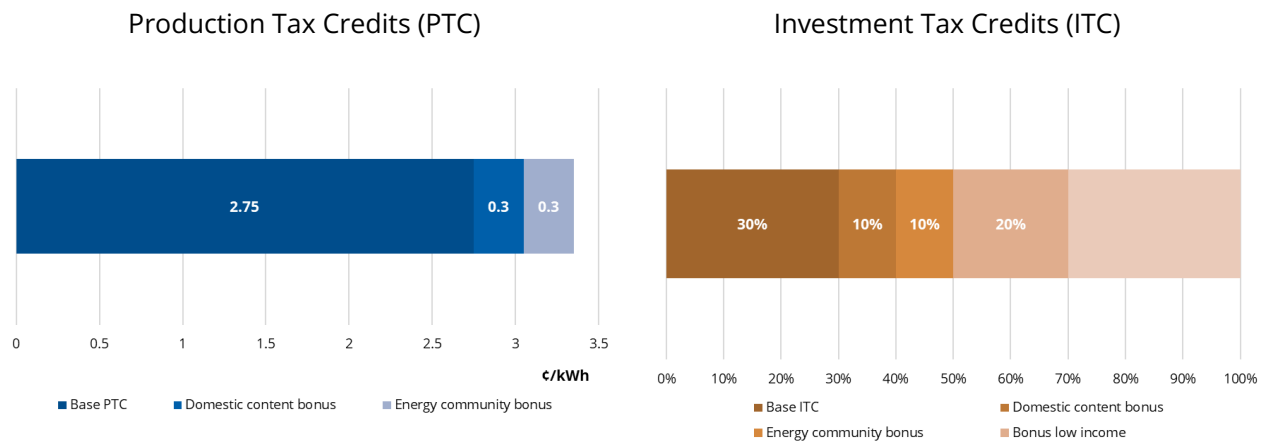
- Wage and labour hiring requirements: Projects larger than 1 MW get the full value of the tax credit only if they comply with wage requirements (the average wage must be paid given the occupation and geographic area) and skilled labour hiring requirements (a percentage of the total hours must be performed by skilled apprentices). In other words, incentives for investment in clean technology are increased if the projects contribute to workforce training and green job creation,
- Direct payments and transferability: direct payments refer to the possibility of paying the tax credit directly in cash to tax-exempt entities such as state, local, or tribal governments[36]. Transferability refers to the possibility of transferring or selling tax credits between companies so that those companies whose tax payment is less than the amount received for the tax credit can benefit,
- Link tax incentives to targets: tax credits can be extended beyond their end date if decarbonisation targets are not met. For example, tax credits ending in 2032 will only end if GHG emissions in 2032 are 25% lower than in 2022,
- Bonus: the tax credit base can be increased if projects support the strengthening of domestic value chains and contribute to a just transition. Investments that meet minimum domestic content requirements (products manufactured in the US or countries with free trade agreements), are in energy communities (e.g., former mining areas)[37], are in low-income communities or indigenous territories, or are in low-income residential buildings, will qualify for a higher value of the tax credit, which is also cumulative.

Figure 5 shows the coverage breakdown of PTCs and ITCs with their respective extra payment possibilities.

[36] Entities eligible for the direct payment can make use of 12 tax credits in the Act, including: electricity generation from clean sources such as solar and wind, battery storage projects, construction of community solar projects, installation of infrastructure for electric vehicle charging and for the purchase of electric vehicles, and the installation of infrastructure for electric vehicle charging and for the purchase of electric vehicles (The White House, n. d.).

[37] However, according to the study by Graham & Knittel (2024), because of the way the IRA is structured, it takes into account areas that are not particularly vulnerable to moving away from fossil fuels and does not take into account almost half of the most carbon-intensive communities in the US.

Figure 5 Breakdown of PTC and ITC coverage



Note: Generation projects have a PTC that, for each kWh generated, the IRA pays 2.75 cents and up to 0.6 cents more per bonus. Investment projects have an ITC that pays 30% for every dollar invested (if they meet labour requirements) and up to an additional 40% for meeting extra requirements. The amount of the tax credit base, both the PTC and the ITC, is subject to meeting certain wage and labour hiringrequirements and depends on the project size.
Source: own elaboration with data published by the United States Environmental Protection Agency (EPA).

Grant and loan funds[38]

The IRA Act has budgeted US$ 82 billion in grant programmes and US$ 40 billion in loan programmes (McKinsey & Company, 2022). What is new within these programmes is the role the Act seeks for vulnerable communities and neighbourhoods to play. Vulnerable people across the states are expected to access the benefits of the energy transition by financing clean energy projects designed and led by communities and local governments.

Below are some of the grant and loan programmes and their energy and climate justice objectives[39] and climate justice objectives:

- The Greenhouse Gas Reduction Fund is the largest grant programme under the IRA, with a budget of US$ 27 billion, and has three programmes: The National Clean Investment Fund (US$ 14 billion), the Clean Communities Investment Accelerator (US$ 6 billion), and the Solar Competition for All (US$ 7 billion).
- These programmes seek to deploy investment in clean energy technologies and reduce pollution, with a focus on communities that have been neglected in energy policy in the past. The programmes target communities, non-profit institutions, financial institutions, and state, local and native governments, with 55% of the fund going to vulnerable communities in the country. In addition, it seeks to bring states and communities to the

[38] For an overview of the aid scheme beyond the investment incentives and their innovative elements, Annex 2 summarises in Table 18 the main support provided by the IRA by type of technologies and sector, following the clean technology classification presented in Table 2.

[39] See Mosquera López & Fernández Gómez (2023) for a discussion on the concept of energy justice and its relation to the social acceptability of local energy projects.

forefront of project decision-making for successful implementation that contributes to a just transition (Evergreen Action, 2023e). The main features of each programme are:

i. The National Clean Investment Fund seeks to promote investment by companies and communities in clean projects, where the recipient entities design these according to the needs and characteristics of the communities and regions where they are to be carried out,
ii. The Clean Communities Investment Accelerator aims to bring together lenders, community development financial institutions, credit unions, green banks, and housing finance agencies to provide financing for green projects for small businesses, schools, communities, and non-profit institutions,
iii. The Solar for All Competition is a fund with 60 grants for state, local, or native governments and non-profit institutions to develop residential and community solar energy projects, storage technologies, and infrastructure development in vulnerable communities or neighbourhoods.

- The Pollution Reduction Grant Programme has a budget of US$ 5 billion to support local and native state governments in reducing pollution and providing communities with clean energy. The programme consists of grants for planning, implementing, and administrating projects, programmes, policies and measures that contribute to reducing GHG emissions (Evergreen Action, 2023d),
- The Environmental and Climate Justice Block Grant is a US$3 billion programme to empower vulnerable communities to design and implement clean energy and pollution reduction projects. The funds are administered by non-profit organisations working with vulnerable communities. They can fund projects such as: pollution monitoring, prevention, and mitigation; mitigating the health impacts of climate change and pollution; climate change adaptation; indoor pollution mitigation; funding and increasing community participation in decision-making and policy processes (Evergreen Action, 2023c),
- The Empowering Rural America Programme has a budget of US$9.7 billion to finance rural electricity generation cooperatives to decarbonise rural electricity generation. The Clean and Affordable Energy Programme has a budget of US$ 1 billion to provide partially repayable loans for electricity generation through renewable sources (wind, solar, hydro, biomass, and geothermal) and storage systems. This programme targets state, local and tribal governments, community-based organisations, electricity generation, transmission and distribution cooperatives, and other stakeholders (Evergreen Action, 2023a).

4.2. European Union

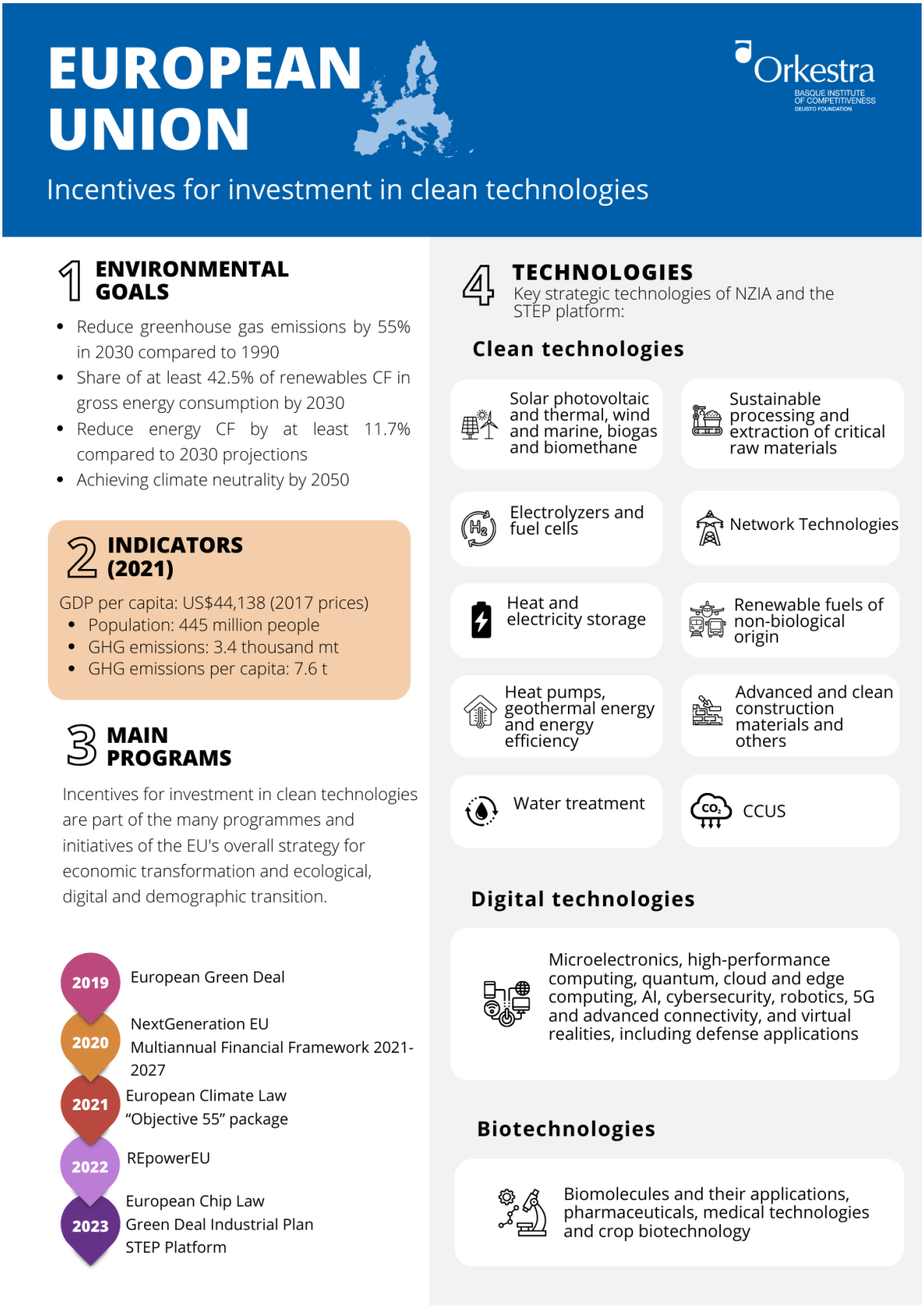
The EU does not have a single large or flagship clean technology investment incentive programme, as in the US with its IRA (see Subsection 4.1). However, it has multiple policy tools and initiatives within its overall strategy for economic transformation and ecological, digital, and demographic transition. Its strategy is mainly based on a broad regulatory framework through the European Climate Act, passed in 2021 and framed within the European Green Pact.

The European Climate Law sets legally binding targets for Member States to achieve climate neutrality, adaptation strategies, climate change mitigation measures, mechanisms for monitoring and evaluating progress on targets at national and supranational levels, as well as recommendations for Member States whose measures and actions are not consistent with climate objectives.

The main EU clean technology investment incentive programmes are presented below (see country summary sheet in Figure 6)[40].

[40] In addition, given the diversity of packages and schemes focused on different areas, a summary of these programmes, detailing budgets and types of incentives used, is presented in Annex 3.

Figure 6 European Union Factsheet



Source: own elaboration.

4.2.1. Main EU investment incentive programmes

With the European Green Deal (EGD) adoption in December 2019, the EU made a global public commitment to reduce GHG emissions by 55% by 2030 compared to 1990 levels. The EGD is a long-term, comprehensive, and cross-cutting growth strategy that became the basis of the European Union's economic recovery plan to address the crisis generated by the coronavirus pandemic. It includes a package of measures to achieve climate neutrality by 2050, with a holistic and cross-sectoral strategy based on climate, environment, energy, transport, industry and sustainable financeinitiatives. The EGD sets out the guiding principles and implementation roadmap for a medium to long-term growth and competitiveness strategy for the EU economy.

Within the EGD is the Fit for 55 package, which is a set of legislative proposals to achieve the target of reducing emissions by 55% by 2030. It was presented in 2021, and different measures were negotiated and approved throughout 2022 and 2023. The proposals included to achieve the emission reduction target are (European Council, n. d.):

- The update of the EU Emissions Trading Scheme (EU ETS), including a target of a 62% reduction in emissions from the sectors covered by the scheme by 2030, the inclusion of the maritime transport sector, the creation of a separate emissions trading scheme for the buildings, road transport, and fuels sectors. The revision of the rules applying to the aviation sector to ensure that it contributes to emissions reductions (e.g., the EU-ETS), the creation of a separate emissions trading scheme for the buildings, road transport, and fuel sectors, and the revision of the rules applying to the aviation sector to ensure that it contributes to emissions reductions (e.g., the Carbon Offsetting and Reduction Scheme for International Aviation - CORSIA),
- The Carbon Border Adjustment Mechanism (CBAM) aims to ensure that increases in emissions outside its borders do not offset the EU's efforts to reduce emissions due to a relocation of production, for example. In this way, imports of products from carbon-intensive industries will have to buy carbon certificates equivalent to what they would have paid if the products had been produced within the EU, thus avoiding the risk of "carbon leakage",
- Land Use, Land-Use Change and Forestry Regulation (LULUCF) establishes a binding commitment to reduce emissions and increase removals from these sectors. The objective at European level is to eliminate at least 310 million tonnes (mt) of CO_2 by 2030, with binding targets for each Member State,
- Sectors that are not included in the EU ETS, nor the LULUCF (domestic road and maritime transport, buildings, agriculture, waste, and small industries) have a higher target of 40% (previously 29%) reduction compared to 2005 values,
- Establishment of the Social Climate Fund to provide financial assistance to those individuals and companies most affected by the introduction of the buildings and road transport sectors into the EU ETS,
- Introduction of progressive emission reduction targets for cars and vans, with a 100% reduction target for new vehicles in 2035;

- The ReFuelEU Aviation and FuelEU Maritime initiatives for the reduction of the environmental footprint of the aviation and maritime sectors, respectively. The latter sets a target to reduce the emissions intensity of energy used in ships by 80% by 2050,
- Regulation of refuelling infrastructure for road transport vehicles and ships with alternative fuels, with targets such as having refuelling stations for road vehicles every 60 km and the development of hydrogen refuelling stations for cars and trucks,
- Regulation of methane emissions in the energy sector,
- Targets on the level of renewables in gross final energy consumption in 2030 (currently at 42.5%), on the reduction of final energy consumption in 2030 (currently at 11.7%), and the level of energy efficiency of buildings in 2030 and 2050 (new buildings should be zero emission in 2030 while existing buildings should be converted to zero emissions by 2050);
- The hydrogen and natural gas regulatory package aims to adopt renewable and low-carbon gases. It seeks to create a regulatory framework for hydrogen infrastructure and planning, strengthen the supply chain, and protect consumers,
- Revise the Energy Products and Electricity Taxation Directive to align taxation with environmental, energy, and climate objectives.

In 2020, the EU approved the NextGenerationEU recovery plan[41], with a package of funds providing €750 billion (in 2018 prices, or €806.900 million in current prices) to support Member States in the economic and social repair of the damage caused by the coronavirus pandemic, accompanied by the approval of funds under the Multiannual Financial Framework 2021-2027, within the EU's long-term budget, which will provide over €1.2 trillion (in current prices), of which at least 30% of resources will go to climate initiatives (Ministry for Ecological Transition and the Demographic Challenge, n. d.).

NextGenerationEU is composed of the following programmes: (i) Recovery and Resilience Facility (RRF) (current €723.8 billion), an instrument to provide grants and loans to support Member States' investments, (ii) the Recovery Assistance for Cohesion and Territories in Europe (REACT-EU) (€50.6 billion), (iii) Horizon Europe (€5.400 million) to support R&D&I, (iv) InvestEU (€6.1 billion), a fund to boost investment, (v) the European Agricultural Fund for Rural Development (EAFRD) (€8.1 billion), (vi) the Just Transition Fund (€10.9 billion), and (vii) rescEU (€2 billion), a fund that ensures that the EU Civil Protection Mechanism has the necessary capacities to respond to large-scale emergencies.

The areas to which these funds will be directed are very varied, with projects to boost energy and environmental transition (approximately one-third of the total funds) and other areas linked to major transitions, such as innovation and digitisation, cohesion and resilience, or immigration[42].

After the start of the Russian invasion of Ukraine, the EU, in May 2022, adopted the REPowerEU Plan, intending to decrease member states' dependence on Russian fossil fuels and tackle the climate crisis. The REPowerEU Plan focuses on four actions related to promoting energy savings,

[41] The clear orientation of the NextGenerationEU programme towards the three major transitions can be seen in the European Commission's description of it (European Union, n. d.e.f.).

[42] For more details on the allocation of funds between the different objectives, see European Commission (n.d.-b).

diversifying energy supply, investing in renewable energy, and securing energy supply at affordable prices (European Commission, n.d.-d).

In September 2023, the European Chip Law Regulation, proposed in February 2022, entered into force. Given the importance of chips in digital transformation and their relevance across industries, the Act aims to strengthen the EU semiconductor ecosystem to achieve a 20% global market share (double its current share).

In October 2023, the European Council approved the Commission's proposal to regulate European green bonds. The regulation adopts a green bond standard or "EuGB" which should be aligned with the European Taxonomy of Sustainable Activities[43](European Commission, n. f.-b). In this way, issuers benefit from demonstrating that their activities are indeed sustainable, and investors can lower the risk of investing in greenwashing projects[44], thus channeling more funds into green investments.

In November 2023, the Directive amending the 2018 Renewable Energy Directive (RED) entered into force, setting a new binding target of at least 42.5% renewables in gross final energy consumption in 2030 but aiming for 45%. The revised Directive (RED III), which builds on the 2009 (RED I) and 2018 (RED II) Directives, introduces more stringent measures to ensure that the full potential for the development and use of renewable energy is fully exploited (European Commission, n.d.-e).

In addition, within RED I, Guarantees of Origin (GO) were established, which are an electronic document issued to inform or demonstrate to the consumer the origin of the energy, i.e., the share or quantity of energy produced from renewable sources, as a mechanism for transparency and reliability of information, and not as an instrument that can be used in support schemes.

GOs can be issued for each MWh of electricity generated, and they must contain information on the installation where energy has been produced, whether it has received investment aid, the date and country of issue of the certificate, and the date of entry into operation of the installation. The GO system is voluntary, and energy producers can choose whether they want to apply for the issuing of GOs. GOs are valid for transactions for twelve months from the production of the relevant energy unit. Energy suppliers must disclose to customers where their electricity comes from, making GOs a key tool to provide information to consumers as well as to promote the uptake of renewable energy purchase contracts (European Union, 2023).

4.2.2. Most recent proposals and programmes

In February 2023, the European Commission presented the Green Deal Industrial Plan, which aims to boost the competitiveness of Europe's net zero industry and promote the transition to

[43] Non-monetary incentive to encourage private investment in sustainable activities.

[44] Greenwashing is the process of conveying a false impression or misleading information about how a company's products are environmentally friendly. It involves making an unsubstantiated claim to mislead consumers into believing that a company's products are environmentally friendly, have a greater positive environmental impact than they actually have, or have a lower environmental impact than they actually have.

climate neutrality. The Plan has three initiatives based on four pillars: (i) a stable and simplified regulatory framework, (ii) faster access to finance, (iii) improved skills, and (iv) open trade for resilient supply chains (European Commission, n. d.c.).

The first initiative of the Plan is the Zero Net Emissions Industry Act (NZIA), which aims to provide an appropriate regulatory framework for developing net zero industry to scale up the production of clean technologies within the EU. The Act seeks to promote key technologies and strategic projects and aims to reduce administrative and permitting times.

To this end, it proposes to ease the conditions for investment, based on a list of key technologies, simplifying licensing procedures and prioritising strategic projects. It also proposes (i) facilitating market access for strategic technology products (public procurement procedures to ensure secure, transparent, and harmonised requirements for net zero technologies, as well as diversification in the supply of strategic technologies to the EU), (ii) improving the skills of the European workforce in these sectors by replicating the European Battery Academy model (developing and delivering training content tailored to the needs of the net zero industry), (iii) creating a platform to coordinate EU action in this area and (iv) creating specific regulatory frameworks (sandboxes) for the development, testing, and validation of innovative technologies in the R&D field.

The key technologies in the Act are: solar photovoltaic and solar thermal; electrolysers and fuel cells; onshore wind and offshore renewables; sustainable biomethane; batteries and storage; carbon capture and storage; heat pumps and geothermal; and grid technologies.

In addition, the Act proposed the creation of the European Hydrogen Bank, a financial instrument of the Commission that seeks to attract private investment in green hydrogen value chains in the EU and third countries (targeting domestic production of 10 mt by 2030 and import of a further 10 mt). A pilot competitive bidding auction, launched by the Innovation Fund, was launched in November 2023, using the fixed premium contract mechanism (see Annex 3, Table 19).

In February 2024, the Council and the European Parliament reached a provisional agreement on the NZIA regulation, with the introduction of several improvements, such as rules on the procedures for granting construction permits, the creation of net zero industrial valleys (territories concentrating several companies engaged in a given technology to create clusters of net zero industrial activity to increase the attractiveness of the EU as a location for manufacturing activities and streamline administrative procedures) and greater clarity in the criteria for public procurement and auctions (European Council, 2024).

In the case of auction criteria, it was established that in auction designs for the deployment of renewable technologies, Member States could include both pre-qualification and award criteria unrelated to price, such as environmental sustainability, contribution to innovation, or integration of energy systems. These criteria must apply to at least 30% of the volume auctioned yearly per Member State and may give European manufacturers an advantage over foreign manufacturers (Packroff & Messad, 2024).

The second initiative of the Green Deal's Industrial Plan is the Critical Raw Materials Act, which seeks to secure the supply of critical raw materials for industry and key technologies for

decarbonisation. Finally, the Electricity Market Design Reform initiative seeks to protect electricity consumers, provide energy price stability and predictability, and boost investments in renewables.

As for faster access to finance, the second pillar of the Industrial Plan, the EU seeks to simplify and speed up the process of granting aid to member states through an extension of the temporary crisis framework (created in March 2022 as a response to the Russian invasion of Ukraine), now called the Temporary Crisis and Transitional Framework for State Aid (European Commission, 2023a) and a revision of the General Block Exemption Regulation (European Commission, 2023b).

The extension of the Temporary Crisis and Transition Framework for State Aid, which runs until 31 December 2025, aims to make Member States' rules for granting incentives and aid more flexible. Member States can implement schemes to incentivise investments in key NZIA technologies through subsidies or grants, tax incentives (e.g., tax credits[45]), loans or risk guarantees (Boehm & Scalamandrè, 2023)[46]. The framework also raises aid ceilings and limits aid to certain percentages of investment costs and nominal amounts.

In addition, to ensure compliance with single market rules and to review medium-term financing, the EU also proposed the creation of a European Sovereignty Fund. The aim is to achieve a "*Made in Europe*" net zero industry, which would finance strategic projects at the supranational level. This fund would again be financed by joint debt, as with NextGenerationEU, accumulating more debt at the EU level to finance European technologies and companies.

In June 2023, the Commission proposed the regulation to establish the Strategic Technologies for Europe Platform (STEP) that would come to reinforce existing EU instruments for funding strategic technologies for the EU and take the first step towards consolidating the European Sovereignty Fund. The STEP seeks to reinforce and redirect existing and new EU funds to incentivise investment and deployment in clean, digital, and bio-based technologies. It also aims to mobilise €160 billion of new investment by reallocating and prioritising projects within existing programmes (European Commission, n.d.-f).

The platform introduces the Sovereignty Label, a high-quality label for projects that aims to give them more visibility and attract more public and private investment for their development. Projects applying to programmes such as Horizon Europe, the Digital Europe Programme, the Innovation Fund, InvestEU, EU4Health, the European Defence Fund, the European Recovery and Resilience Mechanism, and the Cohesion Fund will be able to apply for the label if they obtain high scores during their evaluation process. In this way, projects that do not succeed in obtaining funding in their programme, but obtained the Sovereignty Label, will be able to access other funds within the STEP in a simplified way. This information will be concentrated in the

[45] In general, the term tax credit is understood in international cases as a deduction from the tax liability.

[46] The extension of the Temporary Framework may generate friction within the EU because, on the one hand, temporary measures may become permanent, and on the other hand, although each Member State faces the same conditions for support, not all have the same capacity or can channel national funds in the same way to finance the green transition.

Sovereignty Portal, where all funding opportunities for investments within the platform will be displayed.

In September 2023, the Commission announced a new initiative called the European Wind Power Package, which aims to increase efforts to accelerate wind energy development by: (i) faster administrative and permitting processes (training for national permitting authorities will be funded); (ii) improvements in auction design; (iii) improvements in the skills and qualifications of workers; (iv) access to finance; and (v) increased support for the development of offshore wind energy projects.

The Package will rely on STEP, the Innovation Fund, and the European Investment Bank (EIB), which will be in charge of developing a €5 billion guarantee scheme for commercial banks to support the financing of around €80 billion in investments in the European wind sector.

In February 2024, the European Commission (2024) published the communication "Towards Ambitious Industrial Carbon Management in the EU," which sets out an Industrial Carbon Management Strategy. The Strategy has a carbon capture target of at least 50 mt per year by 2030, to achieve a target of 450 mt by 2050. This target implies an industry investment of between 3 and 10 billion euros, where investments should initially come from oil and gas companies. The strategy also considers the regulation of carbon transport, a plan for the necessary infrastructure, the revision of accounting rules in line with the EU ETS, and the creation of a platform for carbon trading and market development. In addition, the Commission announced the creation of an industry alliance to promote mini nuclear reactors (SMRs) (Esteller, 2024).

4.3. China

At the UN General Assembly in 2020, President Xi Jinping announced his country's goal to achieve climate neutrality by 2060 and to reach peak CO_2 emissions by 2030. Furthermore, in the same year, at the Climate Ambition Summit, he announced enhanced Nationally Determined Contributions (NDCs) by 2030, including: (i) reducing CO_2 emissions per unit of GDP by more than 65% from the 2005 level, (ii) increasing the share of non-fossil fuels in primary energy consumption by 25%, (iii) increasing forest stocks by 6 billion cubic metres above 2005 levels, and (iv) and reach a total installed wind and solar energy capacity of more than 1.2 billion kilowatts.

The government also aims to make China "*a great, modern, prosperous, strong, democratic, culturally advanced, harmonious and beautiful socialist country*" by 2050. To this end, it seeks to increase the country's economic, technological, and innovation capacity, raise GDP per capita to the level of moderately developed countries, modernise the governance system, boost culture and health, reduce inequalities between urban and rural areas, and promote environmentally friendly working practices and lifestyles (Xi, 2017).

In 2020, China was the second country in the world, after the United States, with the second highest public spending on energy R&D, at around US$8.4 billion. Although its spending on clean or low-carbon technologies has risen, it still invests a high percentage in fossil fuel

research. In 2019, 53% of the budget was allocated to clean technologies, while in the case of the EU, 97% of the R&D research budget went to clean technologies (IEA, 2022f).

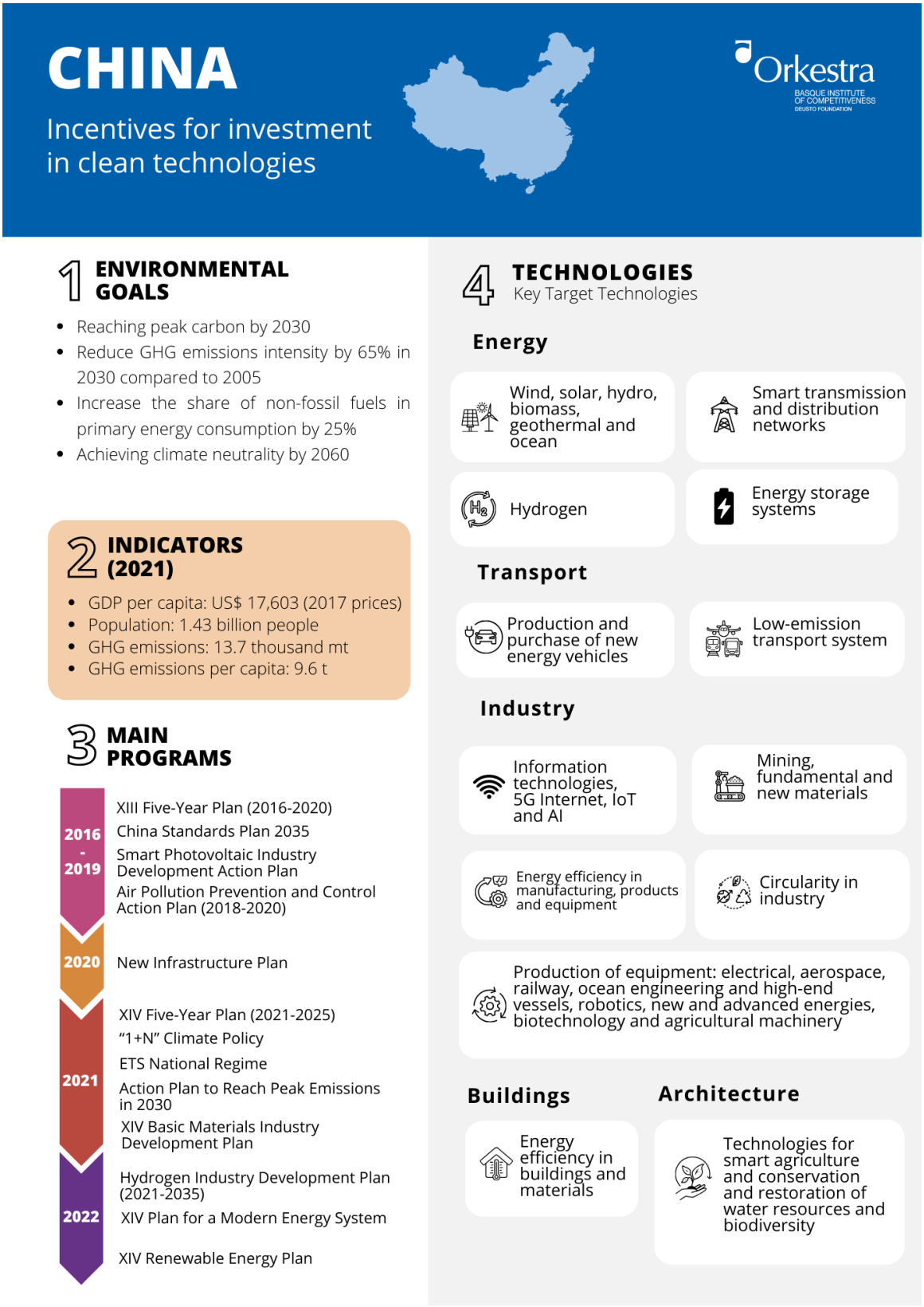
The Five-Year Plans, or FYP, present the key policy-making bases for guiding China's economic and social development. A set of sectoral plans, such as the Renewable Energy Development Plan or the Energy System Plan, further complements these. The relevant ministries usually publish the sectoral plans within one year of the publication of the Five-Year Plan. They provide more detailed sectoral targets and action plans and include targets at the provincial level.

The 14th Five-Year Plan, which covers 2021 to 2025[47], adopted in March 2021, is China's first development plan with climate targets and no quantitative GDP growth target (UNDP, 2021). The plan presents a new development concept that seeks to "*achieve higher quality, more efficient, fairer, more sustainable and secure development*" (Xinhua News Agency, 2021).

The following is a summary of the main aspects of the Plan related to incentives for investment in clean technologies, the relevant sectoral plans, and incentive schemes (see country summary sheet Figure 7). In addition, Annex 4 sets out the country's energy policy context before the 14th Plan, emphasising policies such as the 2005 Renewable Energy Law, previous FYPs, the Made in China 2025 initiative, and the National Emissions Trading Scheme, among others.

[47] Annex 4 contains information on Chinese energy and climate policy prior to the 4th Five-Year Plan.

Figure 7 China Factsheet



Source: own elaboration.

4.3.1. XIV Five-Year Plan

The 14th Five-Year Plan (2021-2025) represents a key milestone on China's path to carbon neutrality. It was published in March 2021, a few months after President Xi Jinping announced the new climate targets for 2030 and 2060. The Plan has five environmental targets, focusing on limiting energy and emissions intensity (energy consumption/GDP and GHG emissions/GDP) and not on reducing emissions *per se*[48]. The targets are: (i) to reduce energy consumption by 13.5% per unit of GDP; (ii) to reduce carbon dioxide emissions by 18% per unit of GDP; (iii) to increase the rate of forest cover by 24.1%; (iv) to achieve a rate of 87.5% of days with good air quality in cities, and (v) to achieve a rate of 85% of water surfaces with good quality.

The Government announced that the Plan aims to accelerate transformation and innovation, where its main areas of action are[49]: (i) optimising the energy structure and limiting fossil fuel consumption, (ii) promoting energy efficiency and circularity in industry, (iii) improving energy efficiency standards in buildings, (iv) building a low-carbon transport system, (v) promoting renewable energy and reforming the electricity system, (vi) encouraging green and low-carbon technological innovation, (vii) developing green finance, (viii) introducing incentive policies such as fiscal, tax, pricing and regulatory policies to support and guide the flow of funds to clean technology development, (ix) establishing and improving the carbon market and its pricing, and (x) implementing nature-based solutions that mitigate the effects of climate change on biodiversity (NCSC, 2021).

The Plan mentions economic, financial, fiscal, regulatory, and other types of incentives but does not detail the form and amount of these nor the funds available[50].

After the approval of the Five-Year Plan in October 2021, the Chinese central government published a work plan (Xinhua News Agency, 2021c) for the implementation of the new development concept set out in the FYP and the Action Plan (Xinhua News Agency, 2021a) to reach the peak CO_2 emissions by 2030. These documents are the basis of the country's climate policy called 1+N, where the "1" refers to the policy system to achieve peak carbon and climate neutrality, while the "N" represents the action plans of key sectors in energy, industry, urban and rural construction, transport and agriculture, among others. The "N" also includes measures to support the development of carbon sequestration technology and capacity, accounting, monitoring and evaluation of enterprise statistics, and fiscal, financial, and pricing policies (Xinhua News Agency, 2021b).

The Peak Emissions Action Plan for 2030 was also published in October 2021. It states that emissions targets and policies will be tailor-made for each region, industry, and sector. The guideline on policy support and measures is based on the following:

[48] The absence of the emission reduction target is due to the fact that the subsequently published sectoral plans have more information and guidance on energy development and climate action.

[49] For more details on the objectives of the 14th Five-Year Plan, see Table 20 in Annex 4.

[50] In Annex 4, Table 20 presents the Plan's objectives related to the energy strategy and the national environmental strategy, where incentives for investment in clean technologies are included.

- Develop, unify and standardise a system for measuring and counting carbon emissions,
- Improve laws, regulations, and standards to build a legal framework that supports the development of clean and low-carbon technologies. To this end, the government proposes to update energy efficiency and sustainability standards for businesses, and to review energy consumption caps, national energy efficiency obligations for products, equipment, and buildings. It also seeks to develop a system of green financing standards and establish standards for the production, storage, and use of hydrogen,
- Optimise incentive policies by implementing fiscal policies for energy conservation, water, and integrated resource use, as well as making better use of the role of taxation. Introduce tiered pricing for domestic electricity consumption and time-based electricity pricing. Develop financial instruments such as credits, shares, bonds, insurance, funds, and others,
- Significantly deploy the domestic carbon emissions trading market to expand its scope and support system (NDRC, 2021a).

The XIV Plan for the Development of the Fundamental Materials Industry was also presented in 2021 to promote and strengthen the enterprises in the sector (IEA, 2022a), and the New Energy Automotive Industry Development Plan (2021-2035), which aims to make public transport fully electrified, electric vehicles the majority of new vehicle sales, and fuel cells and autonomous vehicles commercially available (IEA, 2023g).

The Hydrogen Industry Development Plan (2021-2035) was launched in 2022 and is the industry's first medium- and long-term plan. The plan builds on previous documents and consolidates the various national government initiatives. It also sets targets such as deploying 50,000 fuel cell vehicles and constructing hydrogen refuelling stations by 2025. The plan aims to produce green hydrogen from renewable raw materials to reach 100,000-200,000 tonnes (t) per year by 2025. In addition to transport, the plan envisages using clean hydrogen in other sectors, such as energy storage, power generation, and industry (IEA, 2023f).

The next two sectoral plans published in 2022 were the XIV Modern Energy System Plan (XIV FYP) and the XIV Renewable Energy Plan. The XIV FYP for the Energy System, launched in March, has a new name with the inclusion of the word modern in its title, reflecting the need to change the country's energy system in line with the energy transition goals. The Plan lacks some key targets, such as caps on total energy and coal consumption, but it does set two new targets to be met by 2025: a non-fossil energy generation share of around 39% of total generation and electricity accounting for around 30% of final energy consumption. It also mentions the importance of coal in providing security and flexibility to the energy system (Carbon Brief, 2022).

The 14th Renewable Energy Plan targets a 50% increase in renewable energy generation by 2025 from the 2020 level, sets a renewable electricity consumption share of 33% by 2025, and stipulates that 50% of the increase in China's electricity and energy consumption should come from renewable energy by 2021-2025. The Plan has development areas for renewables in the country, such as centralised and distributed generation, onshore and offshore renewables, local consumption and long-distance transport, and multi-energy generation projects (Sino German Cooperation on Climate Change - Climate Partnership, 2022; Zhou et al., 2022).

4.3.2. Relevant incentive schemes

The National Development and Reform Commission (NDRC) announced in 2021 the end of national subsidies in the form of FIT to centralised and distributed solar renewable energy (in the case of commercial or industrial generation) and onshore wind, as they are considered sources with sufficient consolidation and competitive with other technologies such as coal. The government seeks to promote the efficient use of resources and to use the market through price signals to promote investment in these renewable sources. However, it also encourages local governments to develop instruments to incentivise different renewable generation sources (BTI, 2023; IEA, 2021d; NDRC, 2021b).

The mechanisms that remain in place for the promotion of renewable energies are:

- Renewable electricity consumption obligations and RPS, with a target for all provinces in 2030 of 40% renewable energy consumption (including hydro) in total electricity supply,
- FIP auctions with coal tariff reference price,
- Guaranteed purchase hours where the local grid purchases a minimum number of hours per year of energy generated from renewable sources,
- Green Electricity Certificates issued to wind and solar plants,
- Electricity trading through medium and long-term contracts,
- Preferential tax rates,
- China Development Bank (CDB) loans for the development of solar photovoltaic, offshore wind, and other energy sector projects[51] (BTI, 2023; Han & Dong, 2021; IEA, 2022c).

In 2021, the National Energy Administration (NEA) made rooftop solar PV mandatory in certain counties. The state entity established a requirement for 20% of residential buildings, 30% of commercial buildings, 40% of non-government public buildings (i.e., schools and hospitals), and 50% of government buildings to be covered with solar PV panels (Shaw, 2021).

Under the Made in China 2025 programme, a fund was created to support projects in the areas of the initiative, with support through direct grants, soft loans, credit guarantees, and insurance (IEA, 2021b). Similarly, the National Green Development Fund invests directly in environmental protection, pollution control, and ecological restoration projects, provides financial support for pollution mitigation, supports the development of green industries, and promotes R&D in clean technologies (IEA, 2022d).

In addition, in 2019, the World Bank approved US$7.3 million in grants for projects that promote the scaling up of distributed renewable energy in China. The funds come from the Global Environment Facility (GEF) and seek to subsidise studies or projects related to grid planning and access, market design, business models, and regulatory technical assistance at the provincial and national levels (World Bank, 2019).

The central government provides subsidies to New Energy Vehicle (NEV) manufacturing companies in the transport sector that meet certain economic, environmental, and social

[51] The loan package is part of the CBD's 500 billion yuan (CNY) work plan to support the achievement of the strategic goal of carbon reduction and carbon neutrality in the energy sector (IEA, 2022c).

requirements (IEA, 2023i), direct subsidies and tax exemptions for the purchase of electric buses (IEA, 2023h), and subsidies until 2023 for the purchase of NEVs including electric, hybrid, and fuel cell vehicles (IEA, 2023a).

Related to green finance, China updated its Green Bond Catalogue in 2021, eliminating carbon-intensive activities related to coal-fired power plants and oil and gas exploration. By 2020, 70% of the green bonds issued will follow the catalogue (Campos, n. d.; IEA, 2021a).

Finally, it is worth mentioning that China has special support for the "clean and efficient use" of coal to promote low-carbon development. Domestic banks' funds support safe, efficient, environmentally friendly, and smart coal mining, processing, and utilisation (IEA, 2022e).

4.4. Canada[52]

Canada aims to reduce GHG emissions by 40-45% by 2030 compared to 2005 and is committed to achieving net zero emissions by 2050. It also has numerous objectives related to the conservation and protection of biodiversity (coastal protection, beluga whales, tree planting, etc.), improving energy efficiency in buildings, etc. (Gouvernement du Canada, 2023).

With renewable electricity production accounting for 83% of consumption in 2022, it aims to reach 90% by 2030 (IEA, 2022b). Just about 6% of other fuels are currently renewable, and it aims to meet between 10% and 51% of Canada's national energy demand with clean fuels by 2050 and thus reach its net zero emissions target (IEA, 2022b).

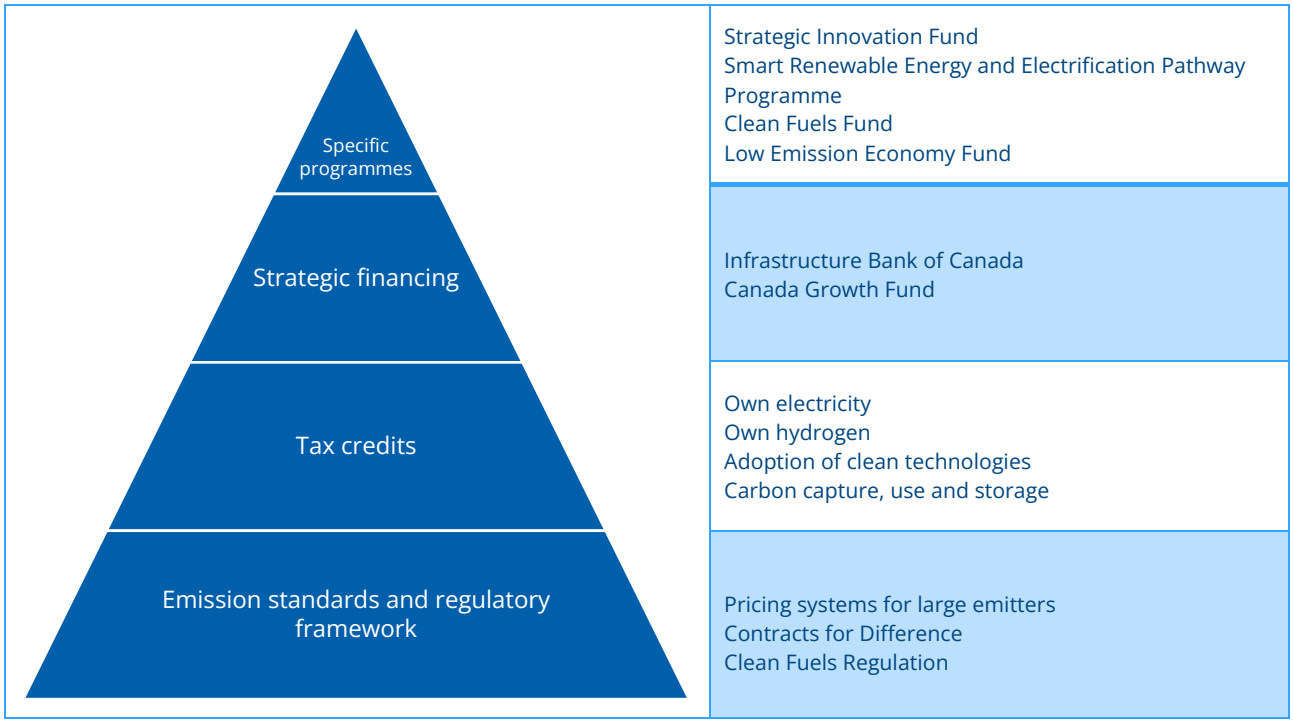
The Government of Canada has set priorities: the electrification of the country, the use of indigenous energy, indigenous manufacturing, emission reductions, critical minerals, infrastructure, electric vehicles and batteries for these major projects. To advance these priorities, the strategy developed and the main instruments are organised around four pillars[53]: (i) specific programmes, (ii) strategic financing, (iii) investment tax credits[54] and (iv) pollutant emissions pricing and regulatory framework. In addition, the country signs international agreements, conventions or treaties with third countries in this area (for example, it has signed agreements on raw materials that are essential for the transition to sustainability with different territories).

[52] In this section on Canada, where economic values are referred to, they are expressed in Canadian dollars. As of 17 January 2024 1 US$ = 1.35 Canadian dollars.

[53] For more details see Annex 5.

[54] In general, the term tax credit is understood in international cases as a deduction from the tax liability.

Figure 8 Canada's Clean Economy Plan



Source: Gouvernement du Canada (2023).

4.4.1. Main incentives: funds, programmes and others

Several types of incentives are being developed in Canada. On the one hand, the Strategic Innovation Fund (SIF) covers all sectors of the economy and is available to for-profit and not-for-profit organisations to support the Canadian innovation network. Created in 2017, the SIF incorporates several legacy programmes: (i) Automotive Innovation Fund (AIF), (ii) Automotive Supplier Innovation Program (ASIP), (iii) Strategic Aerospace and Defence Initiative (SADI), (iv) Technology Demonstration Program (TDP) and (v) Technology Partnerships Canada (TPC).

The SIF grants different types of incentives: (i) reimbursable contributions, (ii) non-reimbursable contributions and (iii) contribution amounts and participation ratios per project category.

SIF contributions[55] are reimbursable by default and are determined on a case-by-case basis. The amount of the contribution and the conditions of reimbursement will be determined after a due diligence assessment of the application, based on the overall benefits and risks of the project. These repayable contributions may be unconditional (beneficiaries will not repay more than the nominal value of the amount paid to them by the SIF, according to a fixed repayment schedule over a pre-determined period of time, after an initial grace period), conditional (beneficiaries will make repayments that may or may not exceed the nominal value of the

[55] The term contribution refers to the amount requested by the project promoters from the SIF.

contribution, subject to certain verifiable conditions), or a combination of both (beneficiaries will make repayments that may or may not exceed the nominal value of the SIF contribution).

Non-repayable contributions will only be considered for certain projects where the risk assessment confirms that significant benefits for Canadians will be generated. There are also project category participation contributions, which seek to refer projects or seek co-financing opportunities, the amount being different in each case.

The Net Zero Accelerator (NZA), an initiative launched in 2020 with a total volume of USD 8 billion, was launched as part of the SIF. It seeks to support large-scale investments in industrial sectors across the country to ensure that industry remains competitive and advances the goal of achieving net zero emissions. Its main pillars are: (i) decarbonisation of large emitters, (ii) industrial transformation and (iii) development of a clean technology and battery ecosystem. According to Government of Canada (2023) has been in high demand since its inception.

Also in 2017, the Clean Technology Data Strategy (CTDS) was developed as a joint initiative, led by Natural Resources Canada, Innovation, Science and Economic Development Canada, and the Clean Growth Centre, which supports regular data collection and reporting on clean technology activity.

Since 2019, Canada has had a Carbon Pricing Mechanism, which seeks to change consumer and business behaviour to reduce GHG emissions at a lower fiscal and likely economic cost than would be the case with large subsidies and grants (Hodgson, 2023). Consultations have been raised on the development of carbon contracts for difference, where a contract between the federal government and affected businesses is proposed to guarantee a fixed carbon price for a pre-determined period of time.

Another measure concerns the introduction of lower tax rates for manufacturers of zero-emission technology. To encourage zero-emission technology manufacturing in Canada, the 2021 Budget halved corporate income tax (CIT) rates for zero-emission technology manufacturers to encourage investment and create new jobs. These rates, 4.5% for small companies and 7.5% for others, will be phased out from 2029 and expire from 2032[56].

Another key element is the Key Raw Materials Strategy, which has been in place since 2022. In fact, Canada hopes to take advantage of its location and mineral resources as elements to benefit its industrial and business fabric in general and its population to seize the opportunity of the transition towards environmental sustainability. Thus, between 2021 and 2023, it has signed cooperation agreements in this area with South Korea, the EU and the Netherlands.

[56] The 2023 Budget proposes to extend the availability of these reduced rates by three years, so that they would cease to be in force for tax years starting after 2034, with a phasing-out from 2032.

They also propose to extend eligibility for the reduced rates to include the manufacture of nuclear power equipment and the processing and recycling of nuclear fuel and heavy water, with effect for tax years beginning after 2023.

Canada's main clean technology investment incentive programmes are presented below (see country overview in Figure 9)[57].

4.4.2. The 2022 Budget and the Canada Growth Fund. First response to the IRA

The 2022 Budget announced the government's intention to create the Canada Growth Fund (CGF)[58] in response to the IRA[59], which will be capitalised with $15 billion to attract private capital and reduce the risks associated with investment.

CGF investments will have three focus areas: (i) projects that use immature technologies and processes (proven in pilot projects but not yet widely adopted) to reduce emissions across the economy (e.g., CCUS, green hydrogen and biofuels); (ii) technology companies, including SMEs that are scaling up less mature technologies in development, demonstration or commercialisation stages; and (iii) companies, including SMEs, and projects in low-carbon or climate technology value chains, including the development of low-carbon natural resources.

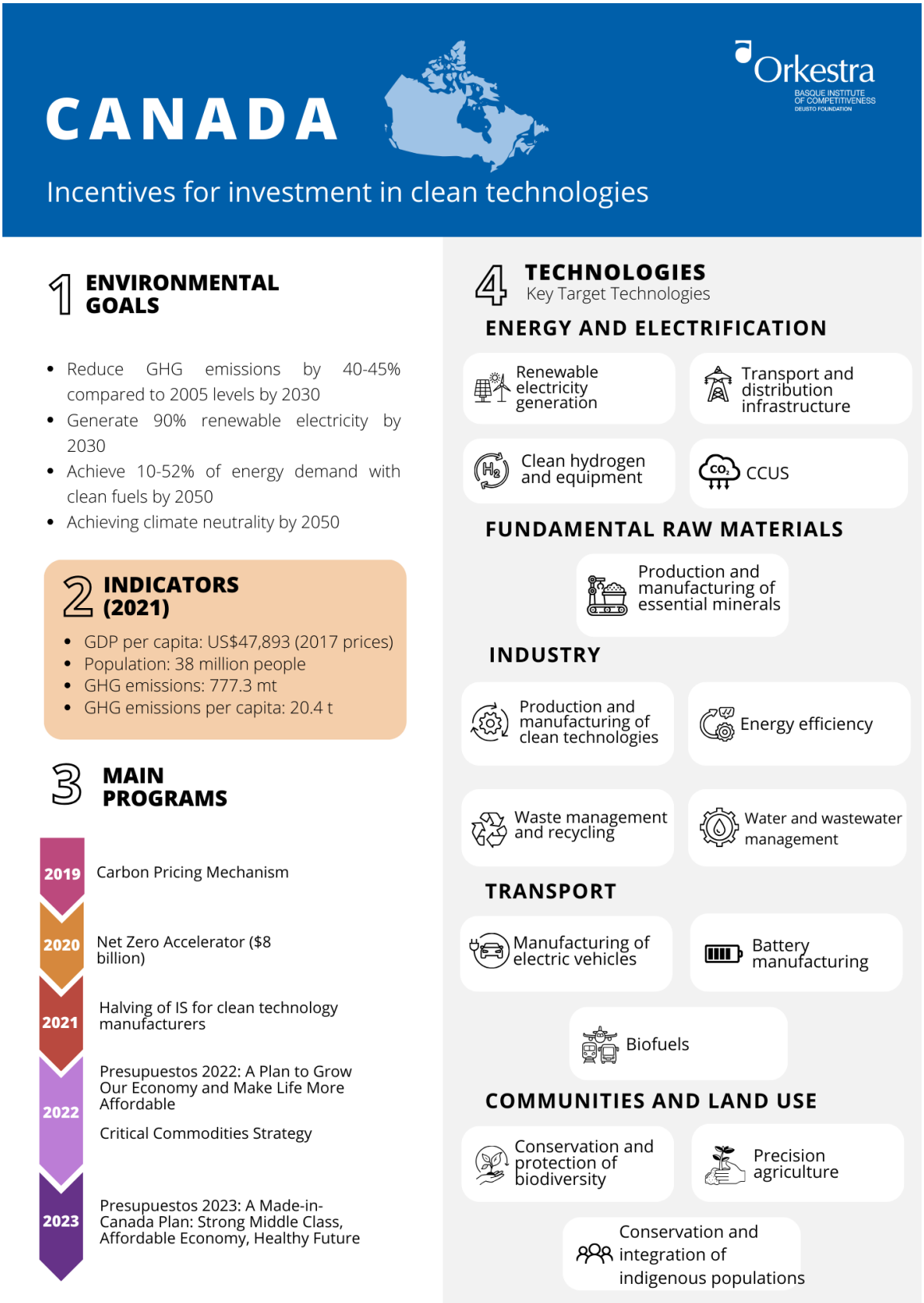
[57] In addition, given the diversity of packages and schemes focused on different areas, a summary of these programmes, detailing budgets and types of incentives used, is presented in Annex 5.

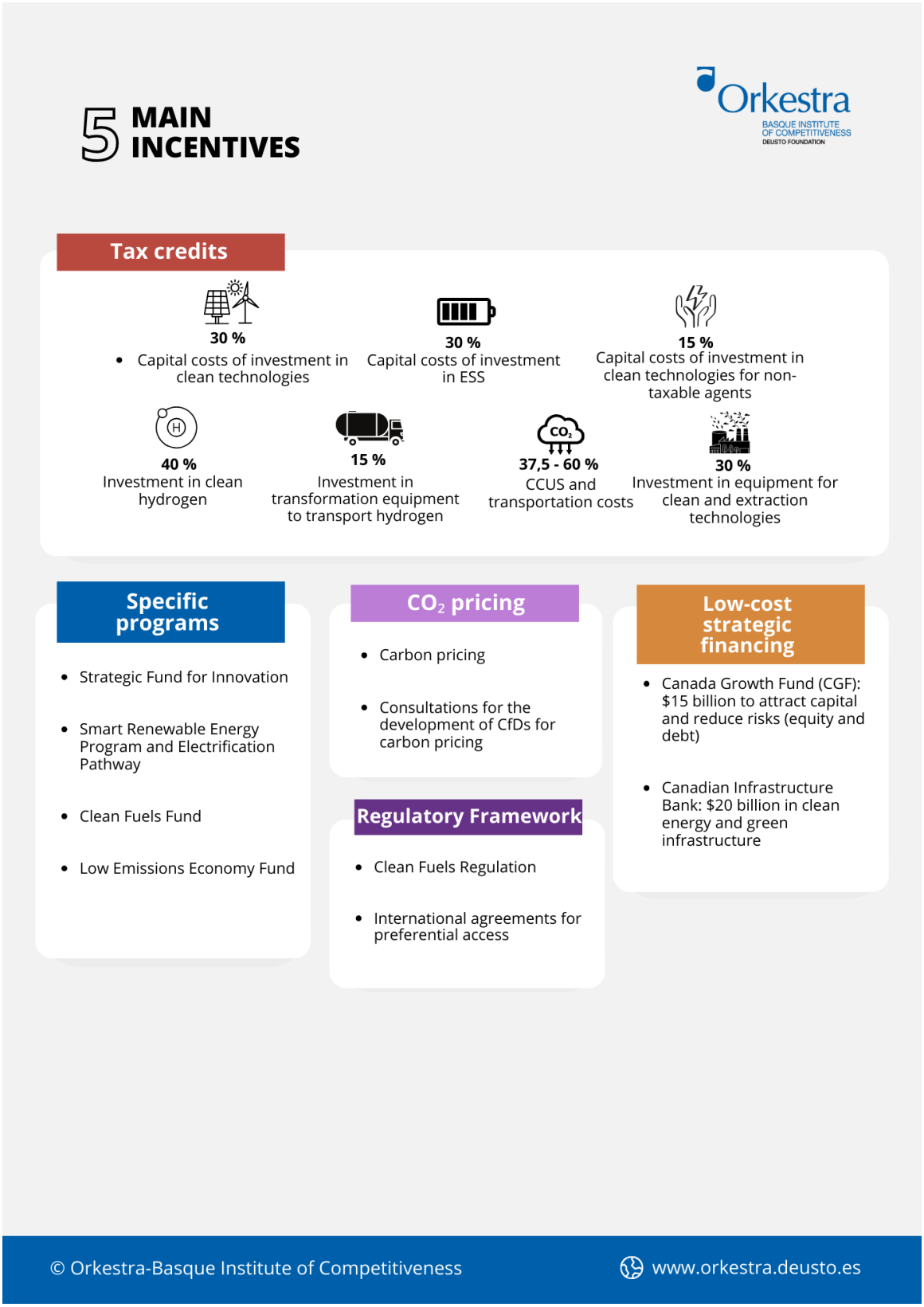
[58] For more details see Annex 5.

[59] The IRA poses a competitiveness challenge for industries that will drive Canada's clean economy. However, the country will benefit from the IRA given the IRA's concessions to include Canada and Mexico. In this way, the IRA represents both an opportunity and a challenge for Canada and for climate policy where the government sees opportunities that should be supported, or where there are obstacles that require attention (Fong, 2023).

In 2023, figures showed that Canada was making larger outlays proportionate to its size, which is seen as necessary to compete for similar foreign investment with countries such as the United States, Germany and China, which have historically been able to attract more capital and form innovation hubs.

Figure 9 Canada Factsheet





Source: own elaboration.

Under no circumstances will the CGF participate in R&D or technology pilot projects, nor will it make venture capital investments. Other government policies and programmes cover such investments. While the CGF will focus on projects, companies and technologies beyond the technology demonstration phase, it will accept some risks associated with new technologies. In any case, it will not provide grants or invest in general where it does not have a reasonable expected return on capital.

The CGF will invest on favourable terms, accepting, where necessary, below-market returns concerning the risk it incurs. Three principles will guide the structure of these concessional investments: (i) minimise the level of concessionality required for the private sector to proceed with an investment, for example, by seeking a minimum discount to its return or by increasing its exposure to losses relative to what a traditional private sector actor would accept, (ii) the CGF will share in the benefits generated by the investments and ensure that private investors do not obtain a disproportionate share of the benefits (i.e. benefits above what the private sector needs to undertake an investment given the level of risk it takes on, taking into account the participation of the CGF) and (iii) private sector actors will also share in the downside of the investments.

The CGF will support investment through:

- Equity instruments where the CGF earns below-market returns and/or greater exposure to losses, such as first loss shares or limited return shares where the CGF shares in the benefits of an investment.
- Debt instruments where the FVC earns below-market returns and/or has a higher exposure to losses (e.g. through low-interest loans or subordinated debt).
- Contracts for difference (and other price guarantees) to address demand and policy risk. Contracts can help manage perceived uncertainty around, for example, the evolution of carbon price or a commodity such as hydrogen[60].
- Anchor capital to provide funding when the level of risk and capital required constrain private capital.
- Procurement contracts to address demand risk and improve project economics, favouring a volume of production where sufficient demand is still developing from potential private buyers.

The CGF will not replace government initiatives like the Net Zero Accelerator or tax policies that incentivise investment.

Canada's 2021 Budget included the announcement of a *tax credit* for planned investment in CCUS projects and USD 319 million over seven years through the CCUS Energy Innovation

[60] There are two types of contract: (i) two-way contract: when the market price is lower than the 'strike price', the project would receive a payment from CGF equal to the difference between the strike price and the market price. When the market price is higher than the strike price, CGF would receive a payment from the project equal to the difference between the market price and the strike price, (ii) one-way contract: when the market price is lower than the strike price, the project would receive a payment from CGF equal to the difference between the strike price and the market price. The CGF can participate in the improvement of the project through revenue-sharing guarantees. Profit-sharing through the receipt of guarantees can also be applied to other CGF investments.

Program. In the 2022 federal budget, the government outlined the *tax credit details*, which will apply to CCUS projects that permanently store captured CO_2 through dedicated geological storage or CO_2 storage in concrete. Enhanced oil recovery projects are not eligible for this *tax credit*. From 2022 to 2030, the rates were set at (i) 60% for investments in CO capture equipment$_2$ in direct air capture projects, (ii) 50% for investment in CO capture equipment$_2$ in all other CCUS projects and (iii) 37.5% for investment in transport, storage and use equipment. These rates will be reduced by 50% from 2031 to 2040 to encourage the industry to reduce its emissions rapidly.

A consultation on the draft legislation and other design features was launched in August 2022. In August 2023, the Department of Finance published an updated draft investment *tax credit* legislative proposal for CCUS for comment (Ernst & Young, 2023).

The 2022 Budget provided for up to $3.3.8 billion to implement Canada's first-ever Key Minerals Strategy, including a new key minerals exploration *tax credit* of 30% for certain exploration expenditures for nickel, lithium, cobalt, graphite, copper, rare earth elements, vanadium, tellurium, gallium, scandium, titanium, magnesium, zinc, platinum group metals or uranium, which investors may waive in flow-through shares after 7 April 2022 and before 1 April 2027. They also included 1.56 billion for the Smart Electrification and Renewables Pathways Programme over eight years.

Also, in 2022, Natural Resources Canada announced investments in installing electric vehicle chargers in distributed areas nationwide. These investments will be funded through Natural Resources Canada's Zero Emission Vehicle Infrastructure Program (ZEVIP), which aims to make electric vehicle charging more accessible.

4.4.3. **Budget 2023: A made-in-Canada plan**

In parallel to the US IRA, the Government of Canada has developed a major ("unprecedented") incentive package for the country's cleantech industry, which was presented in Budget 2023: A Made-in-Canada Plan: Strong Middle Class, Affordable Economy, Healthy Future (Budget, 2023). A Made-in-Canada Plan: Strong Middle Class, Affordable Economy, Healthy Future. This plan seeks to advance emission reduction targets for 2030 and the goal of zero net emissions by 2050, accelerate the country's electrification and develop the potential to expand exports of zero-emission products. The third chapter of the Plan for Canada: Affordable Energy, Good Jobs and a Growing Clean Economy is the focus of what follows. However, some elements of other chapters are also included.

The Canadian plan focuses on three federal incentives to attract new investment, create middle-class jobs and build Canada's clean economy. At its core is a transparent and predictable system of investment *tax credits*, widely available to eligible organisations. Many of these new *tax credits* will be accompanied by elements that will ensure that workers benefit from a clean economy. Secondly, there is low-cost strategic financing. Third, there is a set of targeted investments and programmes, where necessary, to meet sectors' specific needs or projects of national economic

importance[61]. Given the specific programmes, the IMF (2023a) recommends that the country avoids distorting investment decisions through measures in response to other countries' performance.

Overall, these investments will be based on the Canadian emission pricing system and credit markets for large issuers, as well as other tools, such as contracts for difference, which Budget 2023 proposes to introduce.

Incentives offered by the Canadian budget include:

- Clean technology investment *tax credits*[62]: refundable tax credit of 30% of the capital cost of investments made by taxable entities in wind, solar, photovoltaic and energy storage technologies.
- Clean electricity investment *tax credits*: refundable tax credit of 15% on the capital costs of investments made by non-taxable entities such as indigenous communities, municipally owned utilities and Crown corporations that invest in renewable energy, energy storage and interprovincial transmission and other non-emitting electricity infrastructure.
- Clean manufacturing investment *tax credits*: refundable investment tax credit of 30% for investment in machinery and equipment to manufacture clean technology and extract relevant key minerals. This tax credit is available for manufacturing renewable energy and energy storage equipment and recycling key minerals.
- *Tax credits* for investment in clean hydrogen: Starting from the 2023 budget, a 40% refundable tax credit will be available for investment in green hydrogen. A 15% tax credit will be extended to equipment needed to convert hydrogen into ammonia for transporting it.
- Support for net zero transmission projects: A consultation on "best means" to support intra-provincial transmission that supports Canada's net zero network objectives was proposed.
- Canadian Infrastructure Bank: $20 billion of support for clean electricity investments, including at least $10 billion through the clean energy priority area and at least $10 billion through the green infrastructure priority area.

[61] In the particular case of clean electricity, the plan foresees (i) an investment tax credit to provide critical support for clean electricity investment; (ii) low-cost, targeted financing for clean electricity provided by the Canada Infrastructure Bank; and (iii) electricity-specific programmes, where necessary, to ensure the construction of critical projects such as battery manufacturing projects.

[62] The 2022 Fall Economic Statement proposed a 30% refundable tax credit for clean technology investments made beginning in Budget 2023, with a phase-out beginning in 2032, for investments in: (i) Electricity Generation Systems, including solar PV, small modular nuclear reactors, concentrating solar power, wind and hydro (small hydro, wave and tidal); (ii) Stationary electricity storage systems that do not use fossil fuels in their operation, including, but not limited to: batteries, flywheels, supercapacitors, magnetic energy storage, compressed air storage, pumped hydro storage, gravity energy storage and thermal energy storage; (iii) Low carbon heat equipment, including active solar heating, aerothermal heat pumps and geothermal heat pumps; and (iv) Zero emission industrial vehicles and related charging or refuelling equipment, such as hydrogen or heavy electric equipment used in mining or construction.

- Recapitalisation of the Smart Renewables and Electrification Pathways Programme (SREP): USD 3 billion will be received to support regional priorities and Indigenous community-led projects.

There is also an extension of incentives for purchasing zero-emission vehicles until March 2025 and funding to build a national network of electric vehicle charging stations (Hodgson, 2023).

Despite the programme's relevance, the clean technology sector has called for greater clarity and broader support. Indeed, the scope of clean technologies included is considered to be limited, implementation is slow, there is a lack of production-related tax credits, and there is confusion around language.

Some of the key points of the programme are summarised below: (i) all credits are refundable, are filed along with taxes and will be phased out over time; (ii) the recipient company does not need to be a Canadian-controlled private company to generate these credits, (iii) all credits will require the applicant to maintain documentation in various forms, from project plans to capital expenditures to project performance metrics; (iv) CCUS and hydrogen credits will be generated based on a project plan approved and reviewed by Natural Resources Canada; and (v) it may be worth exploring partnerships, joint ventures and/or other corporate structuring options to maximise the credits a company can accumulate and ensure that all peripheral systems, which enable the operation of a particular technology, generate credits.

Unlike the IRA, no tax credits are offered for biofuels. By contrast, following in its wake, it envisages the participation of the provinces in its design and determination of the level of incentives. It foresees the need to comply with territorial labour requirements in the future.

The budget does not increase subsidies for green vehicles based on the existence of a carbon price. There is no compelling competitive reason to provide subsidies for energy use in vehicles, homes or commercial buildings, especially with a Canadian national carbon pricing framework (with revenue recycling) already in place. Instead, the focus could be on securing clean investments and ensuring that Canada gets a share of North American industrial and energy production to reduce or eliminate emissions commensurate with its capabilities.

There is also no federal commitment to expand the use of green procurement[63], such as direct air capture purchases, which means that there are no measures to address hard-to-reduce federal emissions, such as those from military activity.

Furthermore, a review of the Scientific Research and Experimental Development Tax Incentives Programme (Programme d'Encouragements Fiscaux pour la Recherche Scientifique et le Développement Expérimental, RSDE), which is a cornerstone of Canada's innovation strategy, supporting research and development to encourage Canadian businesses of all sizes to invest in innovation that will drive economic growth, is being considered. This review aims to ensure

[63] Procurement remains a major problem. For example, the Department of Defence spent significantly less on its targets and recently reduced them when it recognised that it could not meet them (Hemmadi, 2024). Innovation Solutions Canada also spent significantly less.

adequate support and improvement of intellectual property development, maintenance and commercialisation. In particular, it will consider the adoption of a preferential patent regime.

Another measure is to use university research to help companies grow. In this regard, universities, polytechnics and other institutions use their facilities, equipment and expertise to solve applied research problems on a daily basis. Students at these institutions develop the skills they need to succeed in their careers after graduation, and by partnering with these institutions, businesses can access the talent and tools they need to innovate and grow.

To help more Canadian companies access the expertise and research and development facilities they need, Budget 2023 proposes to provide $108.6 million over three years, from 2023 to 2024, to expand the University and Community Innovation Program, administered by the Natural Sciences and Engineering Research Council of Canada.

The federal government funds the Canada Infrastructure Investment Programme (PIIC, Programme d'Infrastructure Investir dans le Canada), with more than $33 billion in public infrastructure across the country and projects in municipalities to strengthen communities. Under this programme, provinces and territories set priorities and submit projects to Infrastructure Canada for consideration. By 2023, 5,400 projects had received almost $24.2 billion.

The 2024 Budget announced an additional $600 million over four years from 2025-26 ($150 million per year) for the Scientific Research and Experimental Development (SR&ED) Tax Incentives Program, however, as of spring 2024, the second phase of consultation had not yet closed (Government of Canada, 2024a).

In all of this, a relevant issue is that Canada has a highly competitive corporate tax, with the lowest effective marginal tax rate in the G7 on new business investment (Gouvernement du Canada, 2023).

Despite all of the above, the context is not as positive as one might think *a priori*. Financing needs are estimated to be much higher than those presented here (between four and eight times more), which poses a major challenge in terms of mobilising funds in the private sector and developing measures to encourage investment in clean technologies (RBC, 2022). There is also the complexity of accessing the mechanisms developed by the private sector to promote clean technologies (Bataille, 2023), the slow disbursement of funds (Lowey, 2024)[64] and delays in implementation (Thurton, 2023).

[64] For example, the CGF as of April 2024 had granted only $340 million of the $15 billion allocated to it because of the need to meet a whole series of criteria to ensure a return on investment (Lowey, 2024).

4.5. India[65]

India published the National Action Plan on Climate Change (NAPCC) in June 2008, which set out the national strategy for adapting to climate change and promoting sustainable development. It stressed that maintaining a high growth rate is essential to increase the living standards of the Indian population and reduce their vulnerability to the effects of climate change.

The plan includes eight initiatives divided into the following missions: (i) National Solar Mission, (ii) National Mission for Enhanced Energy Efficiency, (iii) National Mission for Sustainable Habitat, (iv) National Water Mission, (v) National Mission for Sustaining the Himalayan Ecosystem, (vi) National Mission for Green India, (vii) National Mission for Sustainable Agriculture, and (viii) National Mission on Strategic Knowledge for Climate Change (MoEF, 2021).

The National Solar Mission (NSM) was launched in 2010 as an initiative of the Government of India and State Governments to promote and make the country a world leader in solar energy. The NSM aligns with the country's high solar potential, so solar energy is central to energy and climate policy. Furthermore, the NSM is aligned with the national target to reach 50% of cumulative installed electricity capacity from non-fossil resources by 2030 and reduce the emissions intensity over GDP by 45% compared to the 2005 level (MNRE, n.d.-c).

India also committed to achieving climate neutrality by 2070 at COP 26 in Glasgow in 2021, as despite having low per capita emissions, it is the country with the third highest total level of GHG emissions in the world. Below is a summary of the main government policies and regulations to develop and implement clean technologies in the country (see country summary sheet in Figure 10). Then, an in-depth analysis of the measures taken in the fields of solar, wind, electricity, energy storage, green hydrogen, and transport is presented[66].

4.5.1. Solar energy

The NSM has been revised twice, with the third phase covering the years 2017 to 2022 and targets to reach a cumulative grid-connected solar PV of 100,000 MW and a cumulative off-grid of 2,000 MW. Within the mission are different schemes to promote solar energy in the country.

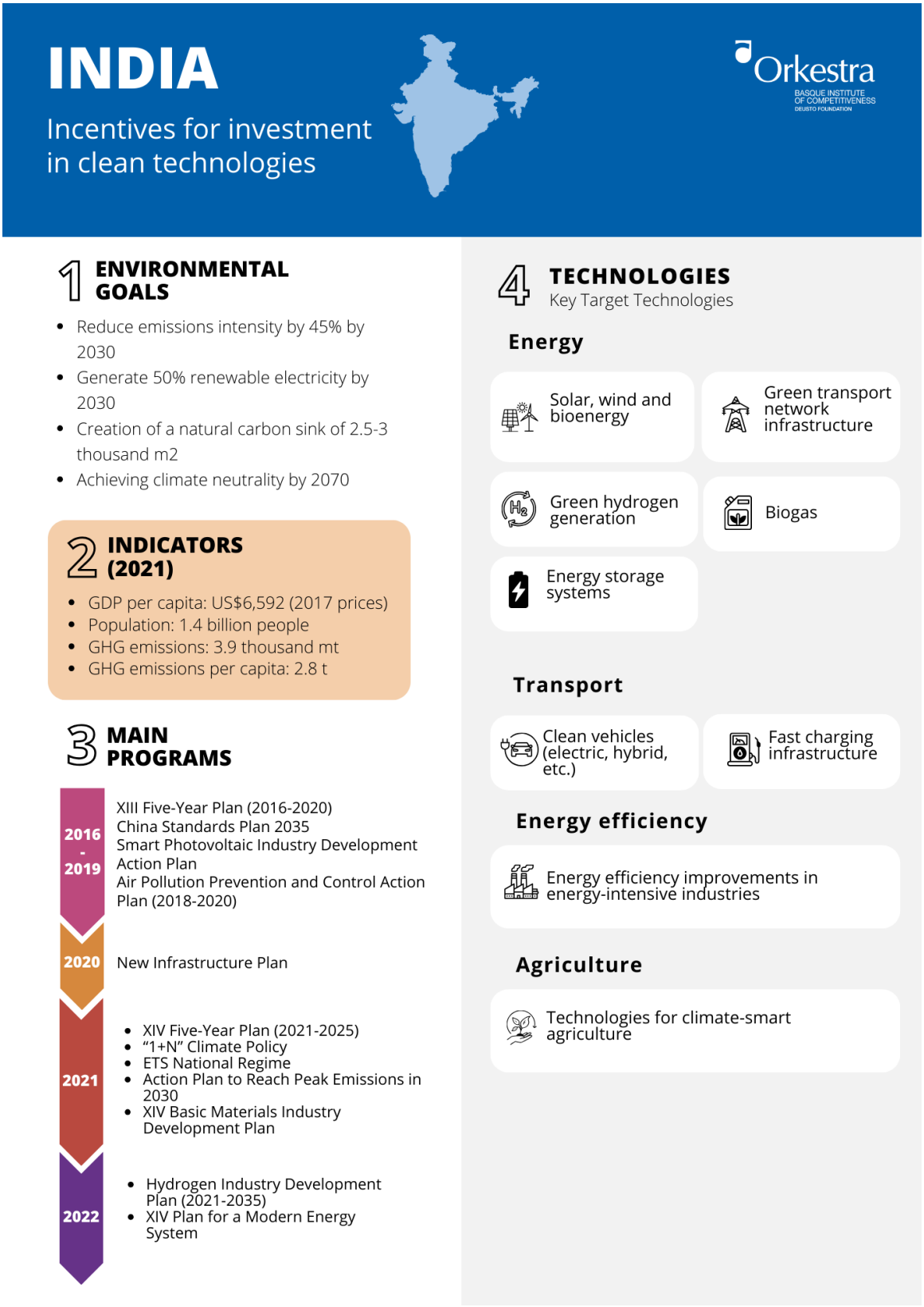
In 2011, incentives were created to promote solar power deployment, such as the Viability Gap Funding (VGF) Scheme, a grant or equity infusion from the Central or State Government of India to make viable and fund PPP partnership projects (Kumar, 2024) and Bundling Schemes, which is a mechanism to sell renewable energy and thermal energy in a bundle, so that end-users can get uninterrupted power supply.

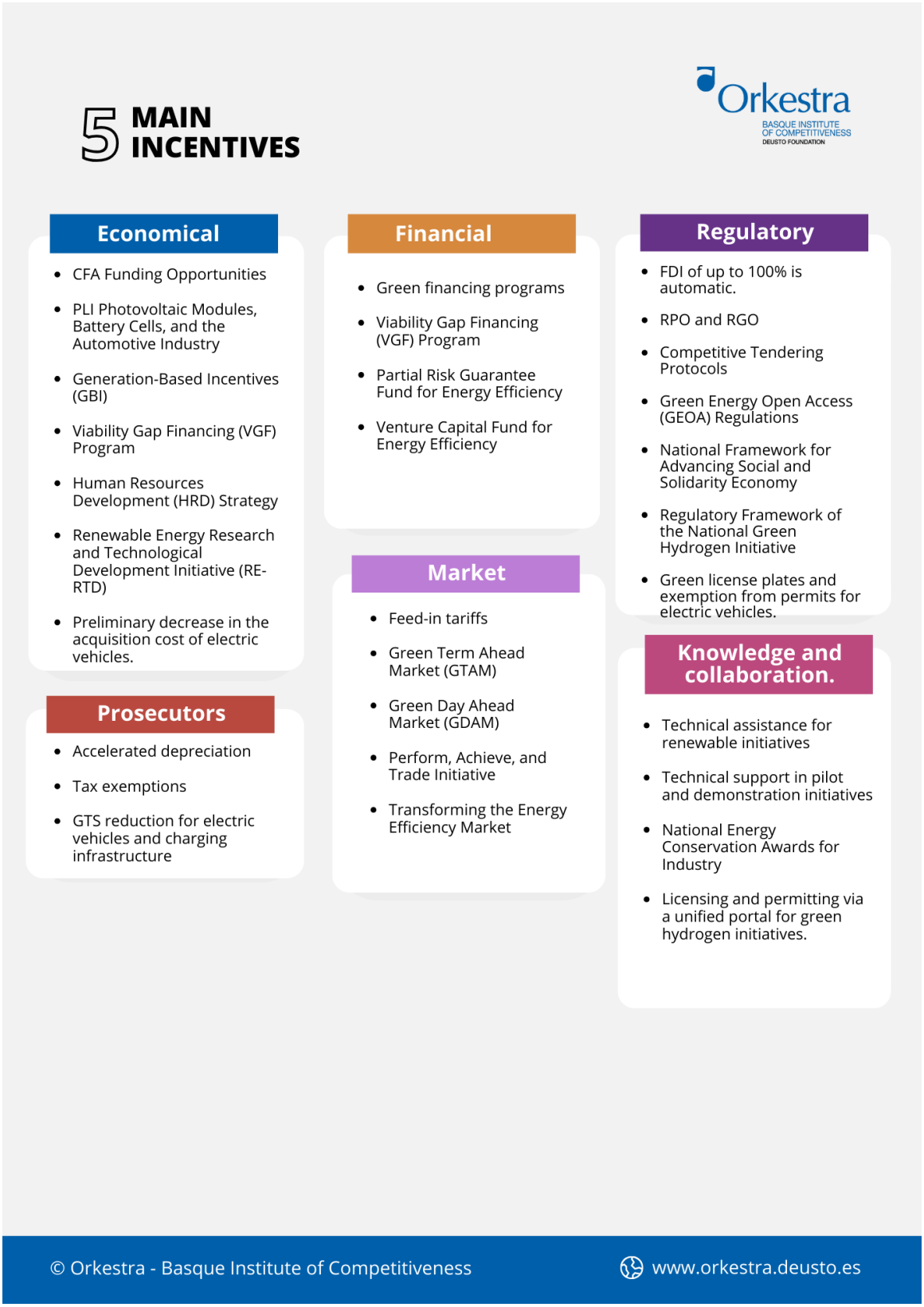
[65] In this section on India, where reference is made to economic values, these are expressed according to the Indian numeral system in rupees (Rs) Rs. lakh, which are equivalent to one hundred thousand rupees, and Rs. crore, which are equivalent to ten million rupees or Rs. 100 lakhs. As of 4 February 2024, 1 euro was equivalent to Rs. 90.21.

[66] Other policies to promote investment in clean technologies related to energy efficiency, bioenergy, smart agriculture, labour market and training, and research and development are presented in Annex 6.

At that early stage of the NSM, projects were financed through feed-in tariffs and tax incentives such as tax holidays, accelerated depreciation, and exemption from excise duty. It also established the Renewable Power Purchase Obligation (RPO), which requires large-scale industries and power distributors to comply with a minimum percentage of power supply from renewable sources, and the Renewable Generation Obligation (RGO), which obliges coal and lignite-fired power generation companies to generate part of their power from renewable sources (Fanjul Fernandez, 2022).

Figure 10 India Factsheet





Source: own elaboration.

In late 2014, the Scheme for Development of Solar Parks and Ultra Mega Solar Power Projects was launched and then extended up to 2023-24. Under this scheme, the Ministry of New and Renewable Energy (MNRE) provides Central Financial Assistance (CFA or Central Government grants) of up to Rs. 25 lakh per solar farm for preparation of detailed project report, a CFA of up to Rs. 12 lakh/MW for development of internal solar farm infrastructure and Rs. 8 lakh/MW for development of external power evacuation infrastructure of the solar farm, or 30% of the project cost, including the cost of connectivity (MNRE, 2022).

Phase III of the Off-grid and Decentralised Solar PV Applications Programme was launched in August 2018 to meet the electricity and lighting needs of local communities, institutions and individuals in rural areas. Under the programme, a CFA of between 30% and 90% of the baseline or bid cost is provided, depending on the State where the project is located.

Phase II of the Central Public Sector Undertaking (CPSU) for grid-connected solar PV projects by central government or government entities was approved in 2019 (MNRE, 2022). The scheme operates through a VGF, where funds are allocated through competitive bidding among government organisations. The scheme requires the use of domestically manufactured solar PV cells and modules (domestic content requirement or DCR).

In 2019, the scheme PM-KUSUM (Farmers' Energy Security and Upgradation Campaign, Pradhan Mantri Kisan Urja suraksha evam Utthaan Mahabhiyan) was also approved to promote off-grid solar generation. The Scheme consists of three components: (i) 10,000 MW of decentralised ground-mounted and grid-connected solar power plants, (ii) installation of 20 lakh autonomous solar-powered agricultural pumps, (iii) solarisation of 15 lakh grid-connected agricultural pumps. Thus, the scheme will open up a stable and continuous source of income for rural landowners. The total value contributed by the scheme is Rs. 34,422 crore.

In the case of Component (i), the incentives are based on the performance of the solar plant, where the lower of Rs 0.40 per unit generated or Rs 6.6 lakh rupees per MW of installed capacity can be paid. Components (ii) and (iii) provide a CFA of 30% of the benchmark cost or the bid cost, whichever is lower. The State Government provides a subsidy of at least 30%, and the remaining 40% has to be contributed by the farmer, where they can obtain bank finance to cover 30% of the cost; in this case, their contribution is only 10% (MNRE, 2023).

Phase II of the Grid-connected Rooftop Solar Programme was approved in February 2019, with the aim of reaching a cumulative capacity of 40,000 MW by 2022. The programme provides a CFA of up to 40% of the reference cost for projects up to 3 kW capacity and 20% for projects with capacity between 3 kW and 10 kW in residential sectors. For collective housing societies, the CFA is limited to 20% of the reference cost, with capacities of up to 500 kW used to supply energy to common areas. The scheme is implemented through energy distribution companies (DISCOMs), where they will receive incentives for capacity additions above the baseline capacity as of 31 March of the previous year (MNRE, 2022).

As part of the programme scheme, the National Rooftop Solar Portal was launched in July 2022, allowing residential consumers to apply to the programme without waiting for DISCOM to finalise the tender and select suppliers. Since its launch, the portal has received applications for 117 MW of solar capacity, and more than 18 MW of projects have been awarded (MNRE, 2023).

In February 2024, the PM Surya Ghar: Muft Bijli Yojana scheme was sanctioned, which picked up the earlier Grid Connected Rooftop Solar Programme. This year's scheme approved has a budget of Rs. 75,021 crore for installing rooftop solar panels on one crore (10 million) households.

To meet the domestic and agricultural electricity needs of all households in Modhera, Mehsana district, Gujarat, with solar energy, the MNRE launched a plan in March 2020 to Solarise Modhera. The plan envisaged setting up various renewable energy facilities, including a 6 MW grid-connected solar PV power plant, a 15 MWh battery energy storage system, 1,297 rooftops solar PV systems of 1 kW each, 305 kW total capacity of rooftop solar PV systems on public buildings, smart meters, vehicle charging stations, and an energy management system. The scheme involved an investment of about Rs. 76.66 crores, with up to 50% CFA from the Government of India and the remaining 50% from the Gujarat Government (MNRE, n.d.-d).

The Production Incentive Scheme (PLI[67]) for High-Efficiency Solar PV Modules (MNRE, n.d.-b.) is a new scheme for producing solar PV modules (MNRE, n.d.-b)) entered its second phase in October 2022, with incentives of about Rs. 24,000 crore over and above Rs. 4,500 crore in the first phase. The PLI seeks to incentivise domestic solar PV panel module component production (IEA, 2023j). In addition, import tariffs on PV modules have been increased to favour domestic producers. The incentive is based on sales, and its value depends on performance-based criteria and local value added (Bhardwaj, 2022).

In 2023, the Pradhan Mantri Janjati Adivasi Nyaya Maha Abhiyan (PM JANMAN) scheme was launched to implement the New Solar Energy Scheme for vulnerable tribal groups with a Rs. 515 crore budget. The scheme aims to electrify by providing off-grid solar systems to 100,000 households in 18 states (MNRE, n.d.-a).

In summary, the Indian government's solar energy incentives are as follows (Fanjul Fernandez, 2022; MNRE, n. d.-c):

- Allow Foreign Direct Investment of up to 100% through the automatic route (no government approval required),
- Exemption from Interstate Transmission System (ISTS) fees for the interstate sale of solar energy for projects that enter service before 30 June 2025,
- Statement of the trajectory of the Renewables Purchase Obligation until 2029-30,
- Notification of standards for the deployment of solar photovoltaic systems and devices,
- Accelerated depreciation of 40% and corporate tax exemption for companies in the first 10 years of operation,
- CFA grants of a percentage of the capital costs of projects,
- Incentives for the production of solar modules through the PLI scheme,
- Standard bidding guidelines for the tariff-based competitive bidding process for the purchase of power from grid-connected solar PV projects,

[67] The government has an incentive scheme called Production Linked Incentive (PLI) that seeks to promote local production of industries with a budget of Rs. 1.97 lakh crore. 14 key sectors have a PLI, including solar photovoltaic panels, batteries, electronics, automobiles and components, and manufacturing (Invest India, n. d.).

- The government has issued orders for power to be dispatched against letters of credit or advance payment to ensure timely payment of distribution licences to renewable energy generators,
- Notification of Promotion of Renewable Energy through Open Access Rules for Green Energy 2022 (see Subsection 4.5.3),
- Launch of the Green Term Ahead Market (GTAM) to facilitate the sale of renewable energy, including solar energy, through exchanges (see Subsection 4.5.3).

4.5.2. Wind energy

The local wind industry has led the country's wind energy sector, which has shown steady progress, with India ranking fourth in the world in installed wind capacity (with 41.93 GW in 2022). The government has promoted wind energy projects by providing various incentives, such as accelerated depreciation and exemption from customs duties on certain components of wind turbines. The Generation Based Incentive (GBI) Scheme for wind projects commissioned before March 2017 was also in place (MNRE, 2022).

Additionally, the following measures have been taken to promote the installation of wind capacity in the country: (i) declaration of Wind Renewable Purchase Obligation trajectory till 2030, (ii) exemption from ISTS tariffs for inter-state sale of wind power for projects commissioned before June 30, 2025, (iii) guidelines issued for tariff based competitive bidding process for procurement of power from grid-connected wind power projects, and (iv) technical support through National Institute of Wind Energy, Chennai.

4.5.3. Electrical system

To achieve the target of 50% of the cumulative installed capacity of electricity from non-fossil resources, India set a target of 500 GW of renewable energy by 2030. In this context, India has carried out a series of regulatory reforms in the electricity market, the most relevant for renewable energy deployment being the following: (i) the introduction of the 2022 Central Electricity Regulatory Commission regulations that changed the transmission system scheme, where generation facilities now have free access without identifying the consumer, increasing flexibility in planning and dispatch, (ii) in 2020 the elimination of transmission costs for 25 years for renewable generation approved before June 2025 was approved, (iii) the Ministry of Electricity approved in 2022 the Green Energy Open Access Regulations (Green Energy Open Access Regulations or GEOA) which aim to promote the use of clean energy by removing capacity limits for commercial and industrial consumers (Pinge et al., 2023).

In 2015, the Intrastate Transmission System Green Energy Corridor Scheme (InSTS GEC) was approved with a total target of 9,700 ckm (circuit kilometres) of lines. The programme is currently being implemented by the State Transmission Undertakings (STUs) of eight States (Andhra Pradesh, Gujarat, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Tamil Nadu). The funding mechanism consists of a 40% central grant from the MNRE (Rs. 4,056.67 crore), a 40% loan from the German Reconstruction Credit Institute (KfW) (EUR 500 million) and 20% equity from the STUs (MNRE, 2023).

Phase II of the InSTS GEC scheme, with a total target of 10,750 ckm of intrastate transmission lines, was approved in January 2022. The scheme is currently being implemented by the state transmission companies of seven states (Gujarat, Himachal Pradesh, Karnataka, Kerala, Rajasthan, Tamil Nadu, and Uttar Pradesh), and the funding consists of central financial assistance from MNRE of 33% of the project cost (MNRE, 2023).

In 2020 and 2021, new electricity trading platforms were launched specifically for the renewables market. The GTAM and Green Day Ahead Market (GDAM) were launched to allow renewable energy developers to sell electricity in the market without signing PPAs.

4.5.4. Energy storage systems

The Advanced Chemistry Cell Battery Storage PLI 2021 promotes domestic battery manufacturing. Its objective is to reach a production capacity of 50 GWh (IEA, 2023j) and has a budget of Rs. 18,100 crore. In 2021, a mandatory offset for renewable energy power plants was also made mandatory to avoid curtailments and thus incentivise the adoption of energy storage systems (ESS). In addition, ESS projects that were initiated before October 2023 were not subject to interstate transmission tariffs for 25 years (Pinge et al., 2023).

In 2022, ESS was granted legal status, energy storage ancillary services were included in secondary and tertiary reserves, consumers using diesel generation were mandated to move to cleaner sources within five years, and renewables and storage were mandated to account for 4% of telecommunication companies' consumption by 2030 (Pinge et al., 2023).

In August 2023, the National Framework to Promote SSE was established, presenting the strategy for developing storage systems in the country. The framework includes sovereign green bonds and green loan schemes for developing SSE infrastructure, investment in R&D in SSE technologies, the possibility of establishing carbon credits for projects using renewable sources, fiscal incentives, and financial and technical assistance in pilot and demonstration projects (Ministry of Power, 2023b).

In addition, the Framework establishes principles of circularity in auctions and general circularity standards for ESS components, mandatory installation of ESS for renewable projects over 5 MW, and a regulatory framework for project developers to offer market-based energy and electricity products (Ministry of Power, 2023b).

No import duty on components for manufacturing lithium batteries and a VGF with a budget of Rs. 9,400 crore was also approved in 2023. The VGF for Battery Energy Storage Systems (BESS) seeks to fund up to 40% of the capital cost of projects and deploy 4,000 MWh of BESS capacity by 2030-2031 (Ministry of Power, 2023a).

4.5.5. Green hydrogen

In August 2021, the Government of India launched its National Green Hydrogen Mission (NGHM) with a budget of Rs. 19,744 crore till 2029-30 with the objective of making the country a global green hydrogen hub. The mission has a production target of 5 mt by 2030, 60-100 GW of electrolyser installations, and deployment of 125 GW of renewable energy capacity (MNRE, n.d.-d).

The mission seeks to encourage the generation of hydrogen and green ammonia with incentives to producers such as: (i) producers will be able to have free access to renewable energy within 15 days of making the application (see GEOA rules in section 4.5.3), (ii) producers will be able to deposit unconsumed renewable energy for up to 30 days with the distribution company and use it when required, (iii) electricity distributors will be able to purchase and supply hydrogen and green ammonia producers with renewable energy at reduced prices, (iv) elimination of interstate transmission tariffs for 25 years, (v) licensing and permitting will be done on a single portal to streamline all administrative procedures for projects, (vi) producers of hydrogen and green ammonia will be given priority for grid connection, (vii) producers will be able to install bunkers near ports to store ammonia and facilitate its export, (viii) space for this purpose will be provided by port authorities at appropriate rates, and (ix) national funds will be made available for R&D investments that contribute to each link in the green hydrogen and ammonia value chain and prioritise technologies, infrastructure and safety (Ministry of Power, 2022).

In 2023, the government announced the Strategic Interventions for Green Hydrogen Transition (SIGHT) programme under the National Hydrogen Mission, with incentives worth Rs. 17,490 crores. The programme seeks to establish a VGF to finance the production of electrolysers, through competitive auctions and green hydrogen production through subsidies capped at per kilogram produced. In addition, India's Ministry of New and Renewable Energy has introduced green hydrogen standards. These set the thresholds of carbon emissions allowed in hydrogen production to be labelled as green (Pinge et al., 2023).

4.5.6. Transport

The government introduced in 2020 the National Electric Mobility Mission Plan (NEMMP) to promote the country's production and adoption of electric vehicles (EVs). Under this plan, Phase II of the Faster Adoption and Manufacturing of Electric Vehicles Scheme (FAME) is being implemented. Phase II of the scheme was launched in 2019 with a budget of Rs. 10,000 crores. Incentives are provided to EV buyers in the form of an initial reduction in the purchase price of EVs. In 2023, the draft of the third phase was presented, which seeks to facilitate the development of the industry by building vehicle charging infrastructure, support for EV deployment in public transport as a continuation of incentives for EV and hybrid buyers in the form of reduced prices (Ministry of Heavy Industries, 2023).

Other tax incentives include the reduction of the GST (Goods and Services Tax[68]) for EVs from 12% to 5% and for EV chargers and charging stations from 18% to 5%. The Ministry of Road Transport and Highways also announced that EVs will receive green number plates and be exempted from permits (Ministry of Heavy Industries, 2023). Furthermore, the PLI for the

[68] The goods and services tax is an indirect tax that came into force on 1 July 2017. It replaced many indirect taxes in the country such as excise duty, VAT, service tax and others. It applies to the supply of goods and services. It is a comprehensive, multi-stage, destination-based tax levied on each value added. All interstate sales are subject to the integrated GST (Cleartax, 2023).

automotive sector was approved in 2021 with a budget of Rs. 25,938 crores to support domestic vehicle manufacturing, including electric vehicles (Pinge et al., 2023).

4.6. United Kingdom

In 2008, the UK government became the first country to introduce a legally binding long-term emissions reduction target (80% reduction by 2050 compared to 1990) by passing the Climate Change Act. This target was updated in 2019 to a 100% reduction target (Larrea Basterra & Bilbao Ozamiz, 2020). In 2009, the UK Low Carbon Transition Plan and the National Energy and Climate Strategy were published (HM Government, 2009).

The Ten Point Plan for a Green Industrial Revolution was published in 2020. It includes, among other things, a push for offshore wind energy, low-carbon hydrogen growth, new and advanced nuclear power supply, a move to zero-emission vehicles, green public transport, Jet Zero and green ships, investment in CCUS, protection of the natural environment, and green finance and innovation.

In 2021, £40 million was announced for some of the UK's most polluting industries to help them cut their carbon emissions while reducing their energy bills. Companies in energy-intensive sectors, such as pharmaceuticals, steel, paper and food and drink, could access *grants* of up to £14 million through the government's Industrial Energy Transformation Fund (IETF) Phase 1, giving a total funding of £289 million up to 2024.

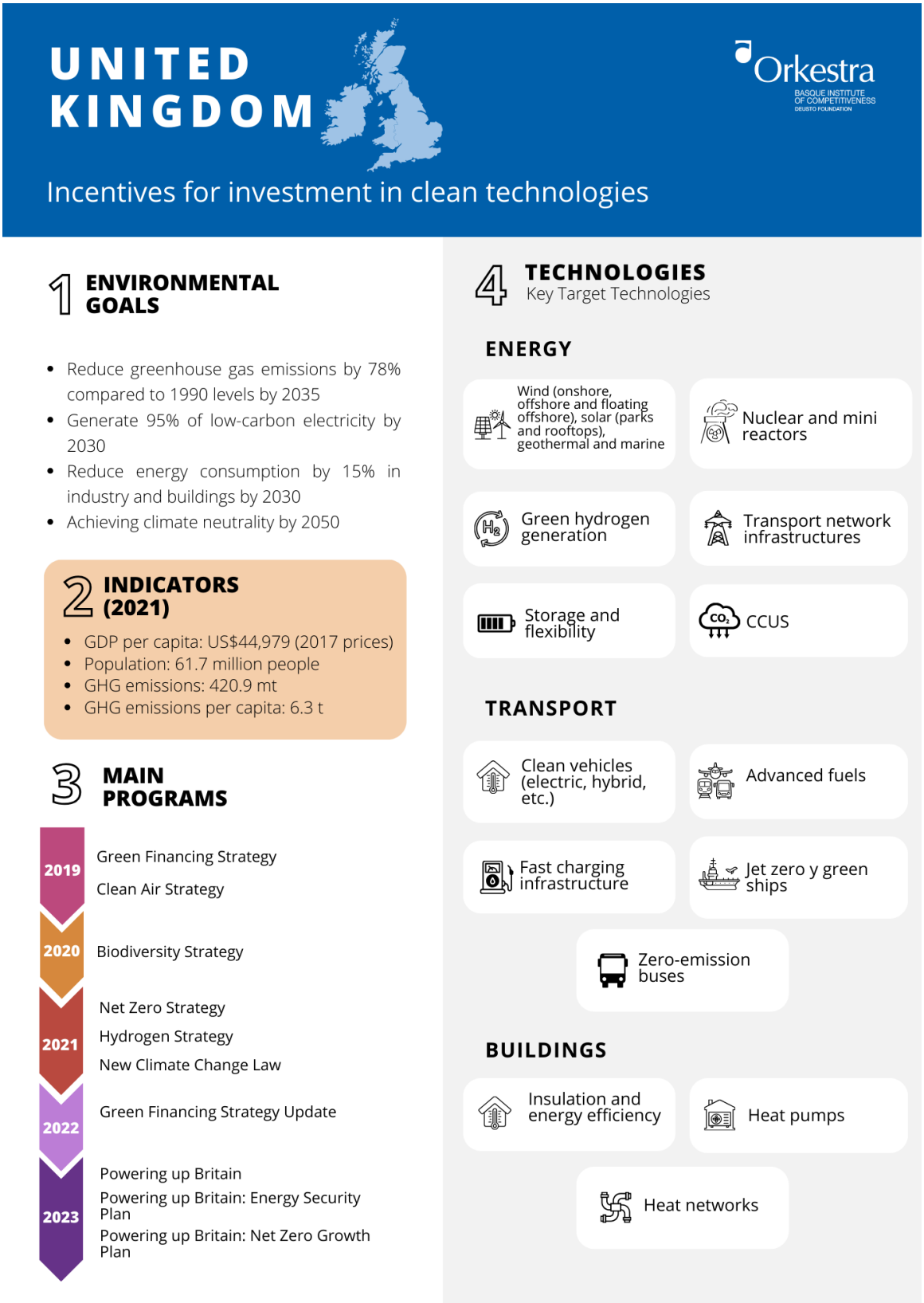
The new Climate Change Act was passed in 2021, and an amendment to allow CO_2 removals to contribute to the UK's carbon budget will be included. The Energy Bill is currently going through Parliament (HM Government, 2023c).

It also established the Net Zero Strategy in 2021, which outlines the Government's vision for a market, and technology-driven transition to decarbonise the UK economy and achieve net zero by 2050. This Strategy states that the Government supports developing and growing resilient supply chains in the UK and strategically directs public funding to key energy industries such as floating wind and heat pumps (HM Government, 2023c).

In 2022, the new Industrial Decarbonisation Strategy was published with over £1 billion to reduce emissions from industry and public buildings such as schools, hospitals, and councils.

In addition, over time, the British government has reached international agreements with different countries to make progress on different issues, including, most recently, the supply of *critical raw materials* with Canada and Australia. Below is a summary of the government's central policies and regulations for developing and implementing clean technologies in the country (see country summary sheet in Figure 11).

Figure 11 United Kingdom Factsheet



Source: own elaboration.

4.6.1. Powering Up Britain (PoB)

In spring 2023, the UK Government published Powering Up Britain, its blueprint for the future of energy in the UK. It brings together the Energy Security Plan and the Net Zero Growth Plan and explains how it will diversify and make energy production more renewable, investing in indigenous renewables and nuclear to secure the country's own energy supply.

By focusing on the security of supply, the government has, to some extent, neglected to set out how the UK will meet its emissions targets and respond to the challenge of the US IRA to support the development of clean energy industries (Mcgowan, 2023).

Notwithstanding the above, Powering Up Britain opens up opportunities related to technologies such as carbon capture, use and storage, floating offshore wind manufacturing and hydrogen (GOV.UK, 2023). The package of measures associated with the PoB includes (GOV.UK, 2023): (i) *Delivering Great British Nuclear* (GBN) on nuclear energy which will include a competitive process to select the best small modular reactor technologies, (ii) 8 projects to advance carbon capture, use and storage, (iii) Net Zero Hydrogen Fund which will fund a couple of projects and others are to be confirmed, (iv) contracts for difference for wind and solar energy deployment and a £160m funding package for pilots of the Floating Offshore Wind Manufacturing Investment Scheme, (v) a heat pump investment accelerator, (vi) an energy company obligation scheme, (vii) a Large *British* Offshore Wind Energy Manufacturing Obligation scheme, (viii) the Great British Insulation Scheme (GOV.UK, 2023), and (viii) the Great *British Nuclear* (GBN), (vi) an energy company obligations scheme, the Great British Insulation Scheme, (vii) a consultation on the zero emission vehicle mandate, an investment of over £350 million in electric vehicle charging infrastructure and a consultation on a long-term trajectory for the adoption of sustainable aviation fuel, (viii) an Action Plan for Nationally Significant Infrastructure Projects, (ix) an updated Green Finance Strategy 2023 and action by the UK Infrastructure Bank with its £22.22 billion of capital and (x) the 2030 Strategic Framework for International Climate and Nature Action and the HM International Climate Finance Strategy.

For its part, the Powering Up Britain—Energy Security Plan (HM Government, 2023b) sets out measures to improve energy security following the publication of the British Energy Security Strategy in April 2022. Measures include encouraging indigenous energy production and continuing to invest in reducing demand, as well as securing diversified sources of supply with strong and reliable partners. It also shows the need to improve energy efficiency through the Great British Insulation Scheme.

The Boiler Upgrade Plan 2028 will encourage the uptake of clean heat technologies. An extension of the Industrial Energy Transformation Fund is also being announced, increasing the total *grant* funding available by £185 million.

A Clean Heat Market Mechanism was also proposed, which will come into force in spring 2024. It consists of a market-based incentive for manufacturers to increase the installation of low-carbon heating systems over fossil fuel boilers. Manufacturers will earn "credits" for each heat pump installation, with a minimum number to be achieved. Each manufacturer's target will vary, as it will be relative to the number of oil and gas boilers they sell, and if the target is not met, the Government will fine the manufacturer £3,000 for each missing credit.

On the other hand, the need to proceed with regulatory development for heat networks and subsidies in the Industrial Energy Transformation Fund framework is determined. In the field of biomass, it is proposed that the deployment of biomass with carbon capture and storage be incentivised through the development of a tailor-made business model.

Powering Up Britain - The Net Zero Growth Plan (HM Government, 2023c)[69] includes (i) reforms to capital allowances that give the UK the most generous regime in the OECD, (ii) three-year spending to support business investment, with a commitment to make reform permanent when fiscal conditions allow, (iii) tax relief for R&D intensive SMEs, (iv) long-term policy certainty and smart, agile regulation to drive investment, (v) revenue models, financing mechanisms and market frameworks: clear market frameworks for private investment are being established in emerging sectors, including revenue models that give investors greater certainty about the returns they will earn (from CfD and business models for hydrogen, to the Regulated Nuclear Asset Base (RAB) model and models for CCUS); (vi) targeted public investment, e.g. to make schools and hospitals greener through the Public Sector Decarbonisation Scheme (PSDS), (vii) co-investment by Government alongside the private sector to ensure that good projects are delivered in areas where investors face greater risk due to the novelty or scale of the projects.

Since the introduction of the Net Zero Strategy[70], the Government has confirmed a portfolio of net zero investment in research and innovation of around £4.2 billion over the period 2022-2025 (HM Government, 2023c). In addition, a pathway has been established for all new heating equipment in homes and workplaces from 2035 to be low carbon, including (i) a £450 million Boiler Upgrade Scheme and (ii) £1.65 billion for Heat Assistance Programmes, including the Social Housing Decarbonisation Scheme and (iv) home improvement grants. In December 2023, the government increased funding for aerothermal systems to £7.5 billion, tripling the budget available until 2028 (£1.5 billion) (Cooling Post, 2023).

In the area of mobility, it set out to accelerate the shift to zero-emission vehicles and boost zero-emission international travel and shipping, including (i) ending the sale of new petrol and diesel cars by 2030 and (ii) £620 million for zero-emission vehicles grants and electric vehicle infrastructure.

A *grant* for small-scale demonstrations of novel vehicle-to-everything (V2X) energy technologies providing flexible storage and services under Phase 2 of the V2X Innovation Programme (V2X Innovation Programme: Bi-directional Charging Demonstrations) of up to £9.4 million was also launched in 2023.

Furthermore, to protect the natural environment and build resilience to climate change, this includes, among others, (i) supporting low-carbon agriculture and agricultural innovation through the Agricultural Investment Fund (FIF) and the Agricultural Innovation Programme (FIP), (ii) setting a legally binding target to increase tree and woodland cover to 16.5% of England's

[69] For more details see Annex 7.

[70] The creation of a new Department for energy security and Net Zero was promoted.

total land area by 2050 and (iii) working to restore approximately 280,000 hectares of peatland in England by 2050.

In the area of developing and deploying GHG removal technologies at scale, this includes (i) developing markets and incentives for investment, (ii) up to £100 million of innovation funding and (iii) launching a call for evidence exploring the role of the UK ETS as a potential long-term market.

The government is also supporting the country's industry to increase exports. Between 2021 and 2022 alone, the economic impact of new loans, insurance and guarantees provided by UK Export Finance (UKEF) amounted to £4.3 billion.

According to Clougherty (2022), the UK's business tax system is one of the most competitive of the world's major economies due to, among other things, a flat tax rate of 19%, tax relief for small and medium-sized R&D-intensive businesses, and long-term policy certainty and smart, agile regulation to drive investment. The Government will remove barriers to enable projects and investments to happen faster, revenue models (e.g. CfDs and hydrogen business models), financing mechanisms and market frameworks (including through the Energy Bill) to be developed so that the private sector can invest with confidence.

4.6.2. More recent approaches

As can be seen, various levers are used in the UK to secure the necessary investment, from taxation to regulation, planning reforms, targeted spending and international collaboration. In this respect, the UK sees international collaboration as an instrument to advance transformation. According to GOV.UK (2023), the country "*does not wish to engage in a discriminatory subsidy race, which will be detrimental to the transition intentions of many* nations"[71]. Instead, it focuses on incentivising private investment with a "*pro-growth regulatory regime*". The approach is to reduce debt, cut taxes, reward work, provide education, and achieve home-grown renewable energy generation (Gabbatiss & Lempriere, 2023).

Its approach is based on responding to calls from investors and industry to provide long-term certainty, reduce strategic risks and build confidence to invest in the technologies and infrastructure needed to achieve energy security and net zero emissions targets[72]. In this way, public spending plays an important role, whereas industries and households cannot, e.g., greening schools and hospitals[73] through PSDS. Furthermore, in areas where investors face a

[71] In August 2023, the United Kingdom proposed to publish a possible response to the US IRA by autumn 2023 (Boscia, 2023). However, a US-style approach is not initially envisaged.

[72] In this vein, there is a demand from stakeholders to liberalise planning rules and allow more onshore wind projects to send a strong signal about the UK's openness to investment. However, they do not see a more ambitious CfD regime as sufficient to compete with the ambitious measures adopted by the United States, China and Europe (Boscia, 2023).

[73] The National Health System is leading efforts to achieve decarbonisation, having already reduced its emissions by 30% since 2010. In September 2021, a roadmap was approved to help suppliers align with the net zero ambition by 2030 (NHS Net Zero Supplier Roadmap). This approach is based on the UK's public procurement policy (NHS England,

higher risk due to the novelty or scale of a project, the government can co-invest with the private sector to ensure the quality and standard of projects.

In September 2023, the UK Prime Minister confirmed that the UK would delay the deadline for selling new petrol and diesel cars and phase out gas boilers. However, he was "*absolutely unequivocal*" about meeting the commitment to achieve net zero carbon emissions by 2050.

In the automotive case, in January 2024, the Pathway for Zero Emission Vehicle Transition by 2035 became law. This means that 80% of new cars and 70% of new vans sold in Britain will have zero emissions by 2030, reaching 100% by 2035. To this end, more than £2 billion is being invested in expanding charging infrastructure and incentivising zero-emission vehicles (Department for Transport et al., 2024). At the end of 2023, the Government introduced a minimum sales obligation for manufacturers to achieve a progressively higher trajectory of zero-emission vehicle sales (virtually all electric). By 2024, the obligation was set at 22%. Subsidies are also available for the purchase of vans.

In the autumn (November) 2023 declaration on energy and climate, it was stated that (Gabbatiss & Lempriere, 2023) (i) in networks, reducing overall connection delays from five years to no more than six months and an action plan that will halve the time needed to build new network infrastructure to seven years; (ii) did not include references to storage; (iii) in green industries, £4.5 billion was reiterated for strategic manufacturing sectors, including £960 million for the "*green industries growth accelerator*".

Also mentioned was (iv) the IETF, which provides funding to invest in energy efficiency and low-carbon technologies. The fund is in its third phase, with £185 million announced in March 2023. This funding will come from the £6 billion from the Autumn Statement 2022 to support energy efficiency from 2025 onwards. Further allocations are expected to come out "*in due course*".

Under the six-year Climate Change Agreement, starting in 2025, (v) the Government is providing around £300 million a year in tax relief in return for meeting energy efficiency targets. In addition, it is extending the VAT relief available for installing energy-saving materials in residential buildings or those used solely for relevant charitable purposes.

The Autumn Budget included (vi) plans to bring forward legislation to help unlock 20-30 GW of offshore wind rights by 2030. The government is also working with the Crown Estate to generate additional floating wind power in the Celtic Sea up to the 2030s. This would be in addition to the upcoming 4.5 GW auction round. In energy efficiency (vii), the 6 billion Industrial Sites Fund was mentioned. In January 2024, an additional £120 million was announced to accelerate the green industry.

The Autumn Statement confirmed that (viii) the energy gains tax will end no later than 31 March 2028. In addition, (ix) a reinvestment tax exemption was introduced for electricity generators. Thus, new electricity generation facilities or extensions of existing ones made on or after 22 November 2023 will not be subject to the tax. The tax on electricity generators will also end on 31 March 2028. The Government will freeze the main and reduced climate change levy rates in

n.d.). It currently works with its supply chains and has a sustainable procurement obligation for contracts over €5 million.

the UK in 2025-26. As such, tax on electricity and gas will be frozen at £0.00775/kWh, liquefied petroleum gas (LPG) at £0.02175/kWh and any other taxable product at £0.06064/kWh. The reduced rates will be frozen at 92% for electricity, 77% for LPG and 89% for gas and any other taxable product. In addition, (x) a package of reforms to the UK ETS was included.

5. Conclusions and final thoughts

The financing needs for the transition to environmental sustainability, translated into investment in clean technologies, are very high, and significant gaps are to be filled worldwide. To bridge these gaps, there is a wide range of investment incentives, which can be economic and financial, fiscal, market, regulatory, knowledge and collaboration. The main purpose of these incentives is to promote investment in clean technologies, many of which are not mature, develop high-risk projects and support vulnerable communities, and incentivise private investment, which ultimately has the means to achieve the financing goals.

Indeed, incentives, especially fiscal incentives, are common to correct market failures such as externalities and other risks associated with investment (e.g., political, regulatory, technological, etc.).

5.1. Conclusions on the implementation of clean technology investment incentives in the case studies

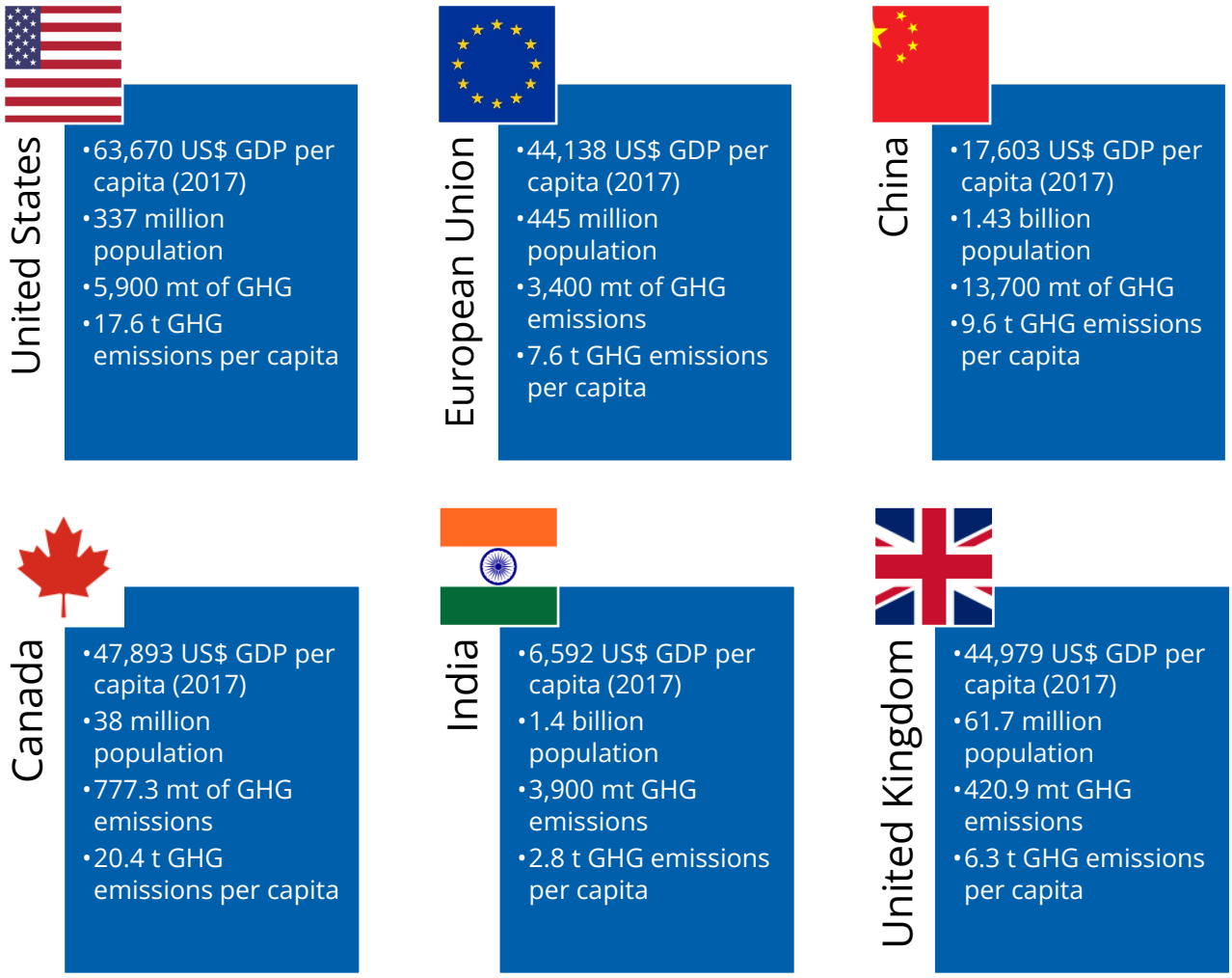
Different countries use incentives in different ways, making comparisons difficult

In order to better understand how investment incentives for clean technologies are organised and implemented, six cases have been selected for their high GHG emissions, as well as for the amount of public spending on clean technologies. These cases are the United States, the European Union, China, Canada, India and the United Kingdom, some of whose basic data are collected in Figure 12.

However, this is not unique to the countries under analysis, as other countries have also responded. This includes Japan's Green Transformation (GX) initiative, which includes measures to boost battery manufacturing with up to USD 1.8 billion in subsidies (Leussink, 2023) and a plan to issue $150bn in "green transition" bonds[74] (Allen & Overy LLP, 2023). In addition, it has instruments such as a voluntary CO market$_2$ (J-credit scheme), a carbon tax (on fossil fuel imports in 2028-2029) and a border carbon adjustment mechanism. In addition, it has collaborative agreements on clean technologies, decarbonisation technologies, and hydrogen with the EU, Australia and Indonesia, among others (Tsurumaki et al., 2023).

[74] The package covers nuclear energy, renewables, grid upgrades, energy efficiency measures, electric vehicles, carbon taxes, an emissions trading scheme and a border adjustment mechanism. More than a third of the budget will be dedicated to building "clean" hydrogen and ammonia value chains (Supply Chain Grants). Some of the money will be spent domestically and some overseas (in Australia or the Middle East), with the hydrogen/ammonia then shipped to Japan for storage and use (Cluster Support). The subsidies are designed to ensure that "clean" hydrogen and ammonia are sold at the same price as LNG and coal, respectively. Producers will be compensated for the difference between the target price (based on the estimated cost of production and operation for the entire supply chain) and the reference price (i.e. what end-users pay for the product) (Allen & Overy LLP, 2023).

Figure 12. Main indicators of the territories under analysis



Source: own elaboration with data from Our World in Data.

In addition, the incentives selected by each country are adapted to their main characteristics

Each country's response to the challenges is different, considering the means at its disposal, its specialisation, interests, future potential, and many other factors.

The EU, a regulatory specialist

The analysis shows that the EU mainly employs economic, financial, and regulatory incentives. Regulation is a key issue that is the subject of debate and criticism due to its excess[75], which may jeopardise the territory's leadership vis-à-vis others such as China or the US.

[75] In April 2024, the President of the French Republic in a speech pointed out the need to "*stop over-regulation*" of the EU, among other measures, in order to maintain its global positioning (Geslin et al., 2024). There are other forums beyond clean technologies where this issue has also been addressed (i.e. telecommunications and artificial intelligence or the business sector in general, among others).

The EU has also pioneered, in the wake of the Kyoto Protocol, the creation of a GHG emissions market, the EU ETS, and a border carbon adjustment mechanism to protect the competitiveness of EU companies subject to stringent environmental regulation and the EU ETS vis-à-vis competitors from third countries that are not subject to regulation of this nature and level of stringency.

The EU has few tax initiatives at the EU level, which is due to the limited scope of EU competence in this area (mainly focused on indirect and excise taxes and thus on energy and environmental taxation, as well as VAT) compared to others, where each country has preferred to keep its tax policy competences to itself.

Is the IRA and tax credits a mechanism to be replicated?

For its part, the US primarily uses tax instruments, most notably *tax credits* in its Inflation Reduction Act (IRA), but also economic incentives to cover issues that *tax credits* cannot address (e.g., subsidies for disadvantaged groups) and other market mechanisms such as net metering, net billing, or the RPS for renewables at the state level[76].

While the EU is calling for a shift towards such incentives, especially *tax credits*, because of their ease of access and comprehension, it is also calling for a shift towards tax credits (Packroff, 2024) (in fact, European companies are emigrating to the US, such as Power Electronics, to develop their activity there and benefit from these incentives); on the other side of the Atlantic, difficulties are observed in accessing US *tax credits* due to a lack of knowledge of the mechanisms employed (Leiserowitz et al., 2023). In addition, *tax credits* are seen as an incentive supporting an international race to the bottom that violates WTO principles (Kleimann, Tagliapietra, et al., 2023).

The EU vs. the US

The US IRA differs fundamentally from the EU's Green Deal as an industrial policy and response to climate change. The EU quantifies numerous climate targets to set strict limits on GHG emissions. However, the US aims to develop new technologies that mitigate climate change competitively against conventional ones through *tax credits* (whose duration is tied to meeting the IRA's emission reduction targets) and market incentives rather than strict regulation, as in the EU.

Also noteworthy is the European commitment to expanding and issuing public debt to meet the objectives as opposed to using contractionary fiscal policy to finance the IRA tax incentives. However, the final amount of tax incentives in the US is not entirely predetermined, as it depends on the reception of the incentives among agents, so it is not guaranteed that the country will not have to issue debt to finance the *tax credits.*

China: Fine words, grandiose intentions and media obscurity

In China, *a priori*, and in contrast to the other cases, doubts arise about boosting private investment through incentives. There is no data on the amounts of these incentives nor overall

[76] For more details see Álvaro Hermana et al. (2018).

volumes or estimates. Government is everywhere, especially in activities such as R&D, training, energy, infrastructures, primary activities, etc. In this case, the objective is to decarbonise by ensuring the security of supply and, to a large extent, by becoming the global supplier of raw materials and equipment for clean technologies.

Canada: The relevance of diagnosing the baseline situation of the cleantech industry and its potential and innovation

Canada could be seen as a mix between the EU and the US. It has something of both and seeks to fit into the global picture. Hydrocarbon producers have much weight in the economy of specific regions. They are not giving them up, but at the same time, they are looking for decarbonisation and technological development with their assets and limitations (*offshore* wind generation capacity to produce green hydrogen) in mind. Given the rapid technological change, the approach to electric vehicles (and their batteries in particular) will require a cautious approach.

In any case, it strongly focuses on the cleantech *start-up* ecosystem, where it is achieving good performance that it monitors regularly.

In parallel, it aims to benefit from the IRA as much as possible, especially in areas related to raw materials, where it has high potential. However, it has lower incentive volumes than the US in batteries, for example, which could mean this advantage does not materialise. However, its bias is more towards tax incentives than aid per se, although market incentives such as the ETS are also key.

Canada must avoid policies that could distort investment decisions and push investment in or out of the country (in line with what is happening with the IRA, which is driving investment incentives in cleantech worldwide and business movements), contributing to global fragmentation.

India: a big country with significant challenges and considerable solar potential

Due to its size, India has been analysed for its high GHG emissions. In this case, it is an economy that, despite its differences with the rest of the case studies (fundamentally in economic terms), is looking to the transition towards sustainability as a tool to get its economy off the ground. Its neutrality goal is the furthest away (2070) of all the case studies.

Its clean technology development plans are organised around these and not so much in more generic packages, where, for example, solar energy is fundamental along with storage batteries and hydrogen. It tries adapting and finding its niches, using size to promote change.

Indeed, it seeks to attract international investment with its investment incentives leveraged by its size, which can boost the possibility of achieving economies of scale. However, the administrative machinery does not appear as straightforward as the documents suggest.

The UK, from a cleantech pioneer to cautious in the face of technological uncertainty but not lacking in ambition

Conversely, the UK combines economic, regulatory and market-based instruments (i.e., ETS, contracts for difference). Due to its size, it cannot address the volumes of incentives put forward

in the US or the EU. However, it has preferences in the technological field, where support for nuclear energy can be highlighted. Faced with the uncertainties of betting on less mature technologies, the speed of change that has continued over the last three decades has slowed. However, it has not changed its environmental goals, which remain among the most ambitious.

The size of investment incentives is not the only relevant factor for developing clean technologies.

With all of the above, it can be concluded that the total incentive figures are not an instrument that allows a correct comparison of the levels of support or the quality of this support, as will be discussed below, given that there are other factors (for example, the natural resources available to each country) that allow one territory to position itself in relation about nother.

The combination and timing of the various incentives are key in the design of clean technology investment packages.

On the other hand, and as can be inferred from the analysis, some incentives are used more in some phases of the life cycle of clean technologies than in others. This can be seen, for example, with incentives such as *feed-in tariffs*, auctions, and PPAs. The former is more common in the initial phases of developing and commercialising clean technologies; the latter comes into operation after a learning period, and, lastly, PPAs when the technology is already mature.

5.2. Reflections and recommendations on the design, implementation and monitoring of incentives for clean technology investments

In the following, we present a series of reflections on their design, implementation, and monitoring that have emerged from reviewing the different incentives and their applications and problems in the case studies.

On the multidimensional nature of clean technology investment incentives in their design

The design of investment incentives has an evident multidimensional character that implies the need to ask the typical journalistic questions: who receives the incentives, who grants them when they are received, what is received, why they are received or the conditions for obtaining them (fair wages, job creation, manufacturing capacity, vulnerable communities) and how they are implemented and monitored.

Ultimately, the key question is whether the incentive is reaching the projects that need to be done but would not be developed without it (due to lack of resources, knowledge, etc.) or, on the contrary, whether it is being granted to entities that would have made the investment regardless of the aid received, thus narrowing the funding gap.

Who receives?

Investment incentives are intended to correct market distortions that prevent agents from making the necessary investment decisions (e.g., due to a lack of knowledge, technological maturity, high levels of risk and uncertainty, lack of necessary resources, lack of awareness of

the need for investment, etc.). Therefore, incentives should be targeted at those persons or entities affected by these distortions.

In this sense, the *policymaker* must ask himself how to design the incentive to reach the affected entities without prejudging possible technological solutions. As far as possible, incentives should be technology-neutral and consider the physical, natural, competitive, institutional and market capacities of the country or territory to which they apply.

Who grants?

A wide variety of programmes and institutions granting investment incentives should be coordinated with each other to optimise the use of funds. In general, these initiatives are not coordinated and sometimes conflict, failing to capitalise on economies and synergies of scale, with possible inefficiency in the use of public resources. In this sense, the EU, with its recent NZIA initiative, still fails to address the issue of coordination of the different programmes at the Member State level and, on the contrary, relies on the relaxation of state aid, putting the European single market at risk (Tagliapietra et al., 2023).

When?

Assuming that incentives reach the right agents, another variable to consider in the design is timing, which has three dimensions. First, the incentive must arrive at the right time, which requires flexibility. In the US and the EU, recent cases of companies have had to close operations and activities because incentives have come "too late". For example, the Dutch solar panel manufacturer Exasun declared bankruptcy due to its inability to compete with China and its low prices. In this line, a relevant issue in the context of the publication of technology investment incentive programmes is to shorten the timeframe for allocating incentives to reach the recipients sooner.

Second, the incentive must maintain a duration that allows the necessary investments to be made over time and sustainable in the long term. Clean technology projects are generally capital intensive, have long payback periods, and sometimes even long construction or deployment periods for the technologies (i.e., an *offshore* wind project can take between 7 and 11 years). Moreover, they tend to have high levels of risk even in the case of sufficiently developed technologies. Therefore, having incentives with the appropriate duration is crucial to undertaking the investments and obtaining the expected return.

Along these lines, the duration of the incentive should be appropriate for each technology so that once a sufficient level of technological maturity and market development is reached, the incentive does not distort the market's functioning (e.g., *feed-in tariffs* for renewables such as wind and solar have been gradually eliminated in different countries as a consequence of their large-scale development and commercialisation).

Third, assuming that the incentives come at the right time and for the right duration, ensuring that the incentive is sustainable and not dependent on political cycles is also important. At present, there are doubts about whether a possible change of government in the US could jeopardise the entire IRA support package, especially as the Republican candidate has promised to eliminate *tax credits* from the start of his term. On the other hand, and aligned with this concern is the European situation, where the current president of the European Commission

has managed to establish relations with North America that are relevant to achieving decarbonisation, which could be affected by a change on both sides that would require work to establish new relations, which could add geopolitical tension.

What or how much?

The amount of incentives is another relevant issue when establishing them, given that, as indicated above, large volumes of investment are required. However, it is important to avoid a race or war of incentives, which is difficult to sustain in the long term, can harm all countries in one way or another and to a greater or lesser extent, and also jeopardises international trade rules (Kleimann, Tagliapietra, et al., 2023).

China's policy, as the ultimate exponent of the prolonged use of high incentives with little international transparency, and where there are doubts as to whether they comply with WTO commitments, is leading to such high levels of production of certain goods that they end up flooding the markets with products at prices below the production costs of other countries, pushing companies to close down in other territories as mentioned above and even deteriorating the country's economy in the long term.

The response to this situation through the development of protectionist incentives, where specific domestic production criteria can increase incentive volumes, as in the case of the US IRA or others in Canada or India, only aggravates tensions between countries over possible violations of international trade rules, increasing geopolitical tensions.

In this context, the EU case shows specificities related to the State aid regime adopted in the Treaty on the Functioning of the European Union (TFEU) and modified by the Temporary Crisis and Transition Framework. This regime allows Member States to provide the necessary incentives for decarbonisation and reduction of their dependence on fossil fuels.

This means that aid ceilings are conditioned by the financial capacity of Member States, which can lead to a fragmentation of the internal market and damage other countries. The relaxation of the state aid regime benefits countries with more financial resources, such as Germany, which accounts for almost half of green subsidies, tax incentives, preferential loans, and risk guarantees, compared to almost a quarter in France (Stokes, 2024).

In general, providing disproportionate incentives between territories has negative consequences not only for those with insufficient resources to offer but also for those that do, as large volumes of long-term incentives deteriorate states' public finances and can generate undesirable distributional impacts.

The resources used are public and can have different origins, primarily tax revenue or debt issuance. In both cases, the citizens are ultimately responsible and accountable for properly using these scarce resources.

For example, the case of the Sovereign Wealth Fund developed by the EU has caused debate around how to raise the amounts to implement it, with the use of resources from other funds (further complicating the structure of EU investment incentives) such as those originating from the EU-EU ETS, the CBAM or even through a new tax on multinational companies' profits (Stokes, 2024).

In this sense, the design of incentives must consider the opportunity cost of allocating resources to one area by taking them away from others, which may be more urgent for the population in the short term (health, agriculture, etc.). This situation is replicated in the business sphere, where funds can be withdrawn from companies for public institutions to decide how to reallocate them, a model that has advantages and disadvantages for new and existing investors and where perhaps one of the key roles of institutions is to achieve an appropriate balance that meets the needs of both types of investors without benefiting one over the other, and avoiding situations of dominance, control or *lobbying* and barriers to entry for new agents.

Why are they received, or what requirements must be met in order to receive them?

A whole set of requirements must be met when applying for the incentives required to boost investment. On many occasions, the variety of these and how to comply with them becomes an obstacle for actors such as SMEs that have to dedicate a high volume of resources, often unavailable to them, to organise applications. This is particularly notable in the case of the EU and many of its clean technology investment incentive packages.

This has led to the emergence of companies dedicated to preparing proposals, creating groups of actors to come forward, coordinating their activities, etc., but which are not always able to meet the challenge.

Equally, the opposite is sometimes true. For example, the approach to the requirements to be fulfilled seems straightforward, but the institutional structures (e.g., in India) make it difficult for applications to succeed.

On the other hand, there are other, more recent requirements related to the domestic production and content of investments, others related to the wages to be received, the employment generated, or the support for vulnerable communities (for example, in the cases of the USA and Canada) that are not always easy to comply with and which, as we have seen, raise other types of questions such as their impact at a global level (especially in the case of domestic content and protectionism).

How are they implemented and monitored?

The long lead times between communicating or publishing incentives and implementing them and the processes to be followed can be a barrier to accessing funds and implementing projects that require more immediate execution. This, in turn, relates to the dimension of the temporality of incentives, which is also the subject of debate in Canada, where, as in the EU, large incentive fund programmes do not seem to reach their recipients.

Once the incentives reach their recipients, the entities that provide them must monitor their use (whether subsidies, regulations, market instruments, etc.) to guarantee their correct use, implementation, and effectiveness by the recipient in terms of compliance with the expected objectives, both at environmental, economic, and social levels.

5.3. Evaluation of incentives

At this point, perhaps the key question is whether the incentives that are developed can reduce the existing funding gap and whether they succeed in having the desired impacts.

For taxpayers

Given the multidimensional nature of incentive design, citizens' evaluation of incentives and incentive packages is complex. This evaluation and the dimensions mentioned above depend on people's knowledge of these instruments. For example, only one-third of the US population is aware of incentives for purchasing electric vehicles, and only one-quarter is aware of incentives for producing solar panels and wind turbines (Stokes, 2024).

The assessment also depends on people's political ideology. However, it is generally found that the European population is in favour of developing incentives for investment in clean technologies as long as they are combined with other social and economic priorities (Abou-Chadi et al., 2024), as has been indicated to be important at times.

Another issue that should be assessed when evaluating incentives is whether specific requirements for domestic content, job creation, etc., have the desired impacts in these areas. For example, as discussed above, the IRA considers areas that are not particularly vulnerable to fossil fuel phase-out and does not consider almost half of the most coal-intensive communities (Graham & Knittel, 2024).

In any case, it is advisable to have a body that assures taxpayers that the processes for designing, granting, monitoring and evaluating incentives are rigorous. This will increase taxpayers' confidence in the incentives for investment in clean technologies.

For the addressees

There is often a lack of clarity when deciding which programmes to apply for. Add to this the different incentive offers at supranational (in the case of the EU), national, regional, and local levels, and this can create an additional barrier to accessing resources.

The scope and impact of incentives for investment in clean technologies is more complex than one might think.

As indicated above, assessing the impact of the incentive programmes being developed beyond environmental objectives is necessary. In this line, there are underlying objectives in the design of incentives, such as achieving new industrial and economic activity, improving people's well-being, and improving business and territorial competitiveness.

In the case of the US, the IRA had succeeded, by July 2023, in encouraging private investment in clean energy and clean energy technology production projects, with amounts equivalent to eight years of the country's past investment. In other words, in one and a half years of the IRA, it was possible to encourage investment in clean energy areas equivalent to eight years before its implementation. Furthermore, an increase in demand for one million electric vehicles in the country was achieved in one year of the Act, compared to the ten years it took to sell the first million electric vehicles in the country.

In this impact assessment, it is also necessary to differentiate how much of the impact is due to the direct incentive itself, the spill-over effect of incentives in earlier periods, and/or changes in people's attitudes and perceptions (e.g., reduced cost due to the learning curve on solar panels or electric vehicles, or increased public awareness of environmental issues). As noted

above, it also asks to what extent certain milestones would have been achieved without the need for incentives.

Uncertainty surrounds incentives' ability to achieve specific objectives due to effects induced by other interacting elements at the same level.

In any case, doubts are raised about the ability of (large) incentive packages or programmes to generate employment in clean technology industrial areas because other advances and developments, such as the automation of production processes, may work against them.

Moreover, incentive programmes have impacts (direct, indirect and induced) on the territory where they are implemented and on others. In this sense, they affect not only domestic industry but also industry in other countries differently. For example, it is possible to point out the emigration of companies to territories with better incentives (something that has already been mentioned is happening in Europe) or emigration because the advances caused by investments in clean technologies can lead to other results such as a reduction in energy prices, which attract industrial activity to their territory in other sectors, as is the case, for example, in the United States where considerable reductions in electricity prices are expected in the coming years (Stokes, 2024).

Incentive programmes for investment in clean technologies affect not only the competitiveness of the country in question but also the international scene, having global impacts.

China's specialisation has led to a high dependence on raw materials and products for the development of clean technologies from the rest of the world, a dependence that is now being identified as a risk factor as it can be used as a pressure mechanism (e.g. Russian gas). For example, the US is 35% dependent on batteries for electric vehicles and storage from China, in addition to being dependent on various raw materials needed to manufacture these clean technologies. This situation has already spread around the world (as reflected in the European Union and the United Kingdom, among many other territories) and where, for example, Canada sees an opportunity due to its natural resource potential.

Incentives for investment in clean technologies as a driver of international collaboration and competition for sustainable development

The goal of incentives for investment in clean technologies to decarbonise the global economy for the sake of humanity is of key importance, and it should oblige all countries to work together regardless of economic interests in an environment of fair competition. This requires developing cooperative frameworks that level the playing field so that business competitiveness is not affected and ultimately achieve international decarbonisation goals, as well as ensuring that subsidies are designed in a WTO-compatible way to counter geo-economic fragmentation.

Considering the above and the analysis carried out in this study, this collaboration should not be limited to having competitive collaboration frameworks in the market. However, it should also be carried out in the phases before entering the market, such as research, development and testing technologies. This would make it possible to optimise resources, streamline processes and coordinate programmes between countries, with each territory focusing, to a

greater extent, on what it is best equipped to do, avoiding spirals of subsidies and risks for trade policy. As a result, progress should be made towards a scheme of "*coopetition*" rather than competition or just collaboration.

Bibliography

Abdmouleh, Z., Alammari, R. A. M., & Gastli, A. (2015). Review of policies encouraging renewable energy integration & best practices. *Renewable and Sustainable Energy Reviews*, *45*, 249-262. https://doi.org/10.1016/j.rser.2015.01.035

Abou-Chadi, T., Jansen, J., Kollberg, M., & Redeker, N. (2024). *Debunking the Backlash. Uncovering European Voters' Climate Preferences* [Policy Brief]. Hertie School, Jacques Delors Centre. https://www.delorscentre.eu/fileadmin/2_Research/1_About_our_research/2_Research_centres/6_Jacques_Delors_Centre/Publications/20240307_Debunking_the_Backlash_Abou-Chadi_Janssen_Kollberg_Redeker.pdf

Acosta, S. (2024a). *El fabricante holandés de paneles solares Exasun se declara en quiebra en medio de la lucha contra China*. El periódico de la energía. https://elperiodicodelaenergia.com/el-fabricante-holandes-de-paneles-solares-exasun-se-declara-en-quiebra-en-medio-de-la-lucha-contra-china/

Acosta, S. (2024b). *La UE llega tarde: Solarwatt cierra su fábrica de paneles solares en Dresde este verano*. El periódico de la energía. https://elperiodicodelaenergia.com/la-ue-llega-tarde-solarwatt-cierra-su-fabrica-de-paneles-solares-en-dresde-este-verano/

Agencia de Noticias Xinhua. (2021a). *El Consejo de Estado emitió el Aviso sobre el pico de carbono antes de 2030. Aviso de plan de acción*. https://www.gov.cn/zhengce/content/2021-10/26/content_5644984.htm

Agencia de Noticias Xinhua. (2021b). *El plan general para el pico de carbono antes de 2030: Una entrevista exclusiva con el responsable de la Comisión Nacional de Desarrollo y Reforma sobre el «Plan de acción para el pico de carbono antes de 2030»*. https://www.gov.cn/zhengce/2021-10/27/content_5645109.htm

Agencia de Noticias Xinhua. (2021c). *Opiniones del Comité Central del Partido Comunista de China y del Consejo de Estado sobre la implementación completa, precisa e integral del nuevo concepto de desarrollo y la realización de un buen trabajo en materia de picos de carbono y neutralización de carbono*. https://www.gov.cn/zhengce/2021-10/24/content_5644613.htm

Agencia Tributaria. (2024). *Impuestos medioambientales*. https://sede.agenciatributaria.gob.es/Sede/impuestos-tasas/impuestos-medioambientales.html

Allen & Overy LLP. (2023). *Japan unveils green subsidy programme – can it compete with the U.S. Inflation Reduction Act?* https://www.jdsupra.com/legalnews/japan-unveils-green-subsidy-programme-6441356/

Álvaro Hermana, R., Larrea Basterra, M., & Álvarez Pelegry, E. (2018). *Autoconsumo eléctrico. Normativa actual y experiencias internacionales de promoción del autoconsumo* (39/2018;

Cuadernos Orkestra). Instituto Vasco de Competitividad-Fundación Deusto. https://www.orkestra.deusto.es/images/investigacion/publicaciones/informes/cuadernos-orkestra/Alvaro_Larrea_Alvarez_Autoconsumo_Electrico.pdf

Badlam, J., Clark, S., Gajendragadkar, S., Kumar, A., O'Rourke, S., & Swartz, D. (2022). *The CHIPS and Science Act: Here's what's in it*. McKinsey & Company. https://www.mckinsey.com/industries/public-sector/our-insights/the-chips-and-science-act-heres-whats-in-it#/

Ballaman. (2016). *Incentive tax on volatile organic compounds (VOC)*. UNECE. https://unece.org/DAM/env/documents/2016/AIR/WGSR/PPT_WGSR54/Item_5/Switzerland_Incentive_tax_on_volatile_organic_compounds__VOC_.pdf

Bataille, C. (2023, octubre 10). *Canada's cleantech incentives are a mess – we must get more serious about this*. THE GLOBE AND MAIL. https://www.theglobeandmail.com/business/commentary/article-canada-clean-tech-subsidies-us-inflation-reduction-act/

Bellini, E. (2023). *South Korea to allocate $185 million for renewables rebates in 2023*. Pv Magazine. https://www.pv-magazine.com/2023/04/06/south-korea-to-allocate-185-million-for-renewables-rebates-in-2023/

Bhardwaj, N. (2022). *What are Production-Linked Incentive Schemes and How Will They Improve India's Manufacturing Capacity?* India Briefing. https://www.india-briefing.com/news/what-are-production-linked-incentive-schemes-and-how-will-they-build-up-indias-manufacturing-capacity-23538.html/

Boehm, L., & Scalamandrè, C. (2023). *EU-US climate and energy relations in light of the Inflation Reduction Act* (PE 739.300; Briefing). European Parliamentary Research Service.

Boscia, S. (2023). *No thanks, Joe: Britain won't copy Biden's IRA spending splurge*. https://www.politico.eu/article/uk-jeremy-hunt-response-to-joe-biden-ira-us-protectionism/

BTI. (2023). *Análisis del mercado chino de energías renovables. Informe País*. Basque Trade & Investmet.

Campos, G. (s. f.). *China's Green Finance Market: Policies, Incentives, Investment Opportunities*. China Briefing. https://www.china-briefing.com/doing-business-guide/china/sector-insights/china-s-green-finance-market-policies-incentives-investment-opportunities

Carbon Brief. (2022). *China Briefing, 24 March 2022: 14FYP energy plan; More plans on energy storage and hydrogen; China's emissions analysis*. https://www.carbonbrief.org/china-briefing-24-march-2022-14fyp-energy-plan-more-plans-on-energy-storage-and-hydrogen-chinas-emissions-analysis/

Carlson, R., & Nciri, A. (2020). *Enter the sandbox. Developing innovation sandboxes for the energy sector*. Quest (Quality Urban Energy Systems of Tomorrow); Pollution Probe. https://questcanada.org/wp-content/uploads/2020/07/Innovation-Sandboxes-Report-1-EN.pdf

CFI Team. (2023). *Financial Instrument*. https://corporatefinanceinstitute.com/resources/wealth-management/financial-instrument/

CFI Team. (n.d.). *What is a financial instrument?* https://corporatefinanceinstitute.com/resources/wealth-management/financial-instrument/

Chipman Koty, A. (2020). *What is the China Standards 2035 Plan and How Will it Impact Emerging Industries?* China Briefing. https://www.china-briefing.com/news/what-is-china-standards-2035-plan-how-will-it-impact-emerging-technologies-what-is-link-made-in-china-2025-goals/

Cleartax. (2023). *Goods & Services Tax (GST) What is GST in India? Indirect Tax Law Explained*. https://cleartax.in/s/gst-law-goods-and-services-tax

Clougherty, T. (2022). *The UK's International Tax Competitiveness 2022 Update*. https://cps.org.uk/wp-content/uploads/2022/10/ITCI-2022-UK-Final-2.pdf

Collins, L. (2023). *«Greater speed» | South Korea to expand «tax support» for clean hydrogen and increase domestic production*. https://www.hydrogeninsight.com/policy/greater-speed-south-korea-to-expand-tax-support-for-clean-hydrogen-and-increase-domestic-production/2-1-1574620

Comisión Europea. (s. f.-a). *El Pacto Verde Europeo*. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_es

Comisión Europea. (s. f.-b). *Plan de recuperación para Europa*. https://commission.europa.eu/strategy-and-policy/recovery-plan-europe_es

Comisión Europea. (s. f.-c). *Plan Industrial del Pacto Verde: Liderazgo de la industria europea con cero emisiones netas*. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/green-deal-industrial-plan_es

Comisión Europea. (s. f.-d). *REPowerEU*. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_es

Comisión Europea. (2023a). *Ayudas estatales: La Comisión adopta un marco temporal de crisis y transición para seguir apoyando la transición hacia una economía con cero emisiones netas*. https://ec.europa.eu/commission/presscorner/detail/es/ip_23_1563

Comisión Europea. (2023b). *Ayudas estatales: La Comisión modifica las normas generales de exención por categorías para facilitar y agilizar las transiciones ecológica y digital*. https://ec.europa.eu/commission/presscorner/detail/es/IP_23_1523

Comisión Europea. (2024). *Comunicación de la Comisión al Parlamento Europeo, ald Consejo, al Comité Económico y Social Europeo y al Comité de las Regiones. Hacia una gestión industrial ambiciosa del carbono en la UE* (COM(2024) 62 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2024%3A62%3AFIN&qid=1707312980822

Comittee for a Responsible Federal Budget. (2022). *CBO Scores IRA with $238 Billion of Deficit Reduction*. https://www.crfb.org/blogs/cbo-scores-ira-238-billion-deficit-reduction

Cooling Post. (2023). *£1.5bn boost for UK heat pumps*. https://www.coolingpost.com/uk-news/1-5bn-boost-for-uk-heat-pumps/

Cox, S. (2016). *Financial Incentives to Enable Clean Energy Deployment: Policy Overview and Good Practices* (NREL/TP--6A20-65541, 1239887; p. NREL/TP--6A20-65541, 1239887). https://doi.org/10.2172/1239887

Crerar, P., Harvey, F., & Stacey, K. (2023). *Rishi Sunak announces U-turn on key green targets*. The Guardian. https://www.theguardian.com/environment/2023/sep/20/rishi-sunak-confirms-rollback-of-key-green-targets

Criscuolo, C., & Menon, C. (2012, noviembre 29). *Feeding Green Ideas: Risk Finance in the Cleantech Sector*. Science, Technology, and Industry Directorate, OECD, Paris.

Criscuolo, C., & Menon, C. (2014). *Environmental policies and risk finance in the green sector: Cross-country evidence*. OECD Science, Technology and Industry Working Papers. https://linkinghub.elsevier.com/retrieve/pii/S0301421515001299

Curtin, J., McInerney, C., & Ó Gallachóir, B. (2017a). Financial incentives to mobilise local citizens as investors in low-carbon technologies: A systematic literature review. *Renewable and Sustainable Energy Reviews*, *75*, 534-547. https://doi.org/10.1016/j.rser.2016.11.020

Curtin, J., McInerney, C., & Ó Gallachóir, B. (2017b). Financial incentives to mobilise local citizens as investors in low-carbon technologies: A systematic literature review. *Renewable and Sustainable Energy Reviews*, *75*, 534-547. https://doi.org/10.1016/j.rser.2016.11.020

Cyrill, M. (2018). *What is Made in China 2025 and Why Has it Made the World So Nervous?* China Briefing. https://www.china-briefing.com/news/made-in-china-2025-explained/

Daly, M. (2024, diciembre 1). *EPA proposes 'methane fee' for waste generated by oil and natural gas companies*. PBS. https://www.pbs.org/newshour/politics/epa-proposes-methane-fee-for-waste-generated-by-oil-and-natural-gas-companies#:~:text=The%20oil%20and%20natural%20gas,%241%2C500%20per%20ton%20by%202026

Davenport, C. (2024). *Biden Administration Announces Rule Aimed at Expanding Electric Vehicles*. The New York Times. https://www.nytimes.com/2024/03/20/climate/biden-phase-out-gas-cars.html?campaign_id=60&emc=edit_na_20240320&instance_id=0&nl=breaking-news&ref=headline&regi_id=97901552&segment_id=161303&user_id=33c5bf0298434f467478b9b13722ef76

Department for Transport, Office for Zero Emission Vehicles, & Browne, A. (2024). *Pathway for zero emission vehicle transition by 2035 becomes law*. https://www.gov.uk/government/news/pathway-for-zero-emission-vehicle-transition-by-2035-becomes-law

Díaz Zúñiga, E. (n.d.). *¿Qué son los instrumentos financieros y cuántos tipos hay?* IG. https://www.ig.com/es/estrategias-de-trading/-que-son-los-instrumentos-financieros-y-cuantos-tipos-hay--210525

Doran, K. (2024). *Investment Tax Credit Vs. Production Tax Credit*. https://smallbusiness.chron.com/investment-tax-credit-vs-production-tax-credit-67549.html

Drahokoupil, J. (2023). *Investment incentive*. Encyclopedia Britannica. https://www.britannica.com/topic/investment-incentive

EIB. (s. f.-a). *Recovery and Resilience Facility and financial instruments*. European Investment Bank. https://www.eib.org/en/products/mandates-partnerships/rrf/index

EIB. (s. f.-b). *The Europe 2020 Project Bond Initiative—Innovative infrastructure financing*. European Investment Bank. https://trad.eib.org/products/blending/project-bonds/index.htm

EIC. (s. f.). *About the European Innovation Council*. European Innovation Council. https://eic.ec.europa.eu/about-european-innovation-council_en

EIF. (s. f.). *InvestEU. A new information point for Financial Intermediaries*. European Investment Fund. https://engage.eif.org/investeu/

EPA. (2023). *Climate Change and Human Health: Who's Most at Risk?* United States Environmental Protection Agency. https://www.epa.gov/climateimpacts/climate-change-and-human-health-whos-most-risk#:~:text=For%20example%2C%20people%20living%20on,impacts%20from%20climate%2Drelated%20hazards.

Ernst and Young. (2021). *Japan's 2021 Tax Reform introduces tax incentives for carbon neutrality and digital transformation*. https://www.ey.com/en_gl/tax-alerts/japan-s-2021-tax-reform-introduces-tax-incentives-for-carbon-neutrality-and-digital-transformation

Ernst and Young. (2023). *Canada | Legislative update for the CCUS investment tax credit*. Tax alert. https://www.ey.com/en_gl/tax-alerts/canada---legislative-update-for-the-ccus-investment-tax-credit

Erzurumlu, S. S., & Erzurumlu, Y. O. (2013). Development and deployment drivers of clean technology innovations. *The Journal of High Technology Management Research*, *24*(2), 100-108. https://doi.org/10.1016/j.hitech.2013.09.001

Esteller, R. (2024). *La UE invertirá 10.000 millones en captura de CO2 hasta 2030*. El Economista. https://www.eleconomista.es/energia/noticias/12637830/01/24/la-ue-invertira-10000-millones-en-captura-de-co2-hasta-2030.html?utm_source=claves_manana&utm_medium=email_periodico

European Commission. (s. f.-a). *Competitive bidding. A new tool for funding innovative low-carbon technologies under the Innovation Fund*. https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/competitive-bidding_en

European Commission. (s. f.-b). *EU Taxonomy Navigator*. https://ec.europa.eu/sustainable-finance-taxonomy/

European Commission. (s. f.-c). *European Defence Fund*. Defence Industry and Space. https://defence-industry-space.ec.europa.eu/eu-defence-industry/european-defence-fund-edf_en

European Commission. (s. f.-d). *LIFE Programme*. https://cinea.ec.europa.eu/programmes/life_en

European Commission. (s. f.-e). *Renewable Energy Directive*. Energy. https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en

European Commission. (s. f.-f). *Strategic Technologies for Europe Platform (STEP)*. https://commission.europa.eu/strategy-and-policy/eu-budget/strategic-technologies-europe-platform_en

European Commission. (s. f.-g). *The Digital Europe Programme*. Shaping Europe's digital future. https://digital-strategy.ec.europa.eu/en/activities/digital-programme

European Commission. (s. f.-h). *What is the Innovation Fund?* https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/what-innovation-fund_en#what-is-being-funded-and-how

European Commission. (2023). *European Chips Act: The Chips for Europe Initiative*. Shaping Europe's digital future. https://digital-strategy.ec.europa.eu/en/factpages/european-chips-act-chips-europe-initiative

European Council. (s. f.). *Fit for 55*. https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/

European Council. (2024). *Net-Zero Industry Act: Council and Parliament strike a deal to boost EU's green industry*. https://www.consilium.europa.eu/en/press/press-releases/2024/02/06/net-zero-industry-act-council-and-parliament-strike-a-deal-to-boost-eu-s-green-industry/

European Scientific Advisory Board on Climate Change. (2024). *Towards EU climate neutrality Progress, policy gaps and opportunities. Assessment Report 2024*. Copenhagen K. https://climate-advisory-board.europa.eu/reports-and-publications/towards-eu-climate-neutrality-progress-policy-gaps-and-opportunities

European Union. (s. f.-a). *About the InvestEU Fund*. https://investeu.europa.eu/investeu-programme/investeu-fund/about-investeu-fund_en?prefLang=es

European Union. (s. f.-b). *Europe. The clean tech powerhouse. What do a strong economy and a bull market have in common? Clean Tech.* Recuperado 13 de diciembre de 2023, de https://next-generation-eu.europa.eu/cleantech_en

European Union. (s. f.-c). *InvestEU Advisory Hub*. https://investeu.europa.eu/investeu-programme/investeu-advisory-hub_en?prefLang=es

European Union. (s. f.-d). *InvestEU Portal*. https://investeu.europa.eu/investeu-programme/investeu-portal_en?prefLang=es

European Union. (s. f.-e). *NextGenerationEU*. https://next-generation-eu.europa.eu/index_en

Evans, S., & Viisainen, V. (2024). *Analysis: Trump election win could add 4bn tonnes to US emissions by 2030*. Carbon Brief. https://www.carbonbrief.org/analysis-trump-election-win-could-add-4bn-tonnes-to-us-emissions-by-2030/

Evergreen Action. (2023a). *Here's How Two IRA Programs Can Improve Access to Clean Power in Rural Communities*. https://www.evergreenaction.com/blog/ira-can-improve-access-to-clean-power-in-rural-communities?utm_source=pillar&utm_medium=website&utm_campaign=ira&utm_content=pillar-iraimpl

Evergreen Action. (2023b). *What Are Clean Energy Tax Credits and How Do They Work?* https://evergreenaction.com/blog/what-are-clean-energy-tax-credits?utm_source=pillar&utm_medium=website&utm_campaign=ira&utm_content=pillar-iraimp&_gl=1*vzn8oo*_ga*MTg1OTQzNzEwMC4xNjk4NzYyNzIy*_ga_7BCSSJJF34*MTcwMTM0MzM2My40LjAuMTcwMTM0MzM2My42MC4wLjA.*_gcl_au*MTU3NjUwODYyNC4xNjk4NzYyNzIy

Evergreen Action. (2023c). *What Are Environmental and Climate Justice Block Grants?* https://www.evergreenaction.com/blog/environmental-climate-justice-block-grants?utm_source=pillar&utm_medium=website&utm_campaign=ira&utm_content=pillar-iraimp

Evergreen Action. (2023d). *What Is the Climate Pollution Reduction Grants Program?* https://evergreenaction.com/blog/what-is-the-climate-pollution-reduction-grants-program?utm_source=pillar&utm_medium=website&utm_campaign=ira&utm_content=pillar-iraimpl&_gl=1*1bl3bfh*_ga*NzIxNTMxNDMxLjE3MDEwMjUzMzY.*_ga_7BCSSJJF34*MTcwMTM3NjE5OC4xMS4xLjE3MDEzNzYyMTcuNDEuMC4w*_gcl_au*MTMxNzEyNjcxMS4xNzAxMDI1MzM2

Evergreen Action. (2023e). *What is the Greenhouse Gas Reduction Fund?* https://www.evergreenaction.com/blog/what-is-the-greenhouse-gas-reduction-fund?utm_source=pillar&utm_medium=website&utm_campaign=ira&utm_content=pillar-iraimpl

Fanjul Fernandez, G. (2022). *El mercado de la energía solar en India*. ICEX España Exportación e Inversiones.

Fernández Gómez, J. (2024). *Esquemas innovadores de financiación de proyectos y actividades sostenibles*. Instituto Vasco de Competitividad-Fundación Deusto.

Fernández Gómez, J., & Larrea Basterra, M. (2021). Fomento de la financiación verde en el ámbito subnacional. El caso del País Vasco. *Ekonomiaz*, *99, 1 semestre*.

https://www.euskadi.eus/web01-a2reveko/es/k86aEkonomiazWar/ekonomiaz/abrirArticulo?idpubl=96&registro=15

Fernández Gómez, J., & Larrea Basterra, M. (2022a). El papel de los Gobiernos en el desarrollo de ecosistemas eficientes de financiación de inversiones. *Ikerketak*, *I*. https://www.euskadi.eus/contenidos/informacion/ikerketak_ekonomiaz/es_publica/adjuntos/IKERKETAK-2022-I-El-papel-de-los-Gobiernos-en-la-financiacion-de-inversiones.pdf

Fernández Gómez, J., & Larrea Basterra, M. (2022b). *Empleo y capacidades verdes en la CAPV* (01/2022; Cuadernos Orkestra). Instituto Vasco de Competitividad-Fundación Deusto. https://www.orkestra.deusto.es/es/investigacion/publicaciones/informes/cuadernos-orkestra/2333-220008-empleo-capacidades-verdes-capv

Fong, F. (2023). *A Sober Second Look. Taking Stock of the Competitiveness of Canada's Climate Policy Framework Relative to the U.S.* TD Economics. https://economics.td.com/domains/economics.td.com/documents/reports/ff/A_Sober_Second_Look.pdf

Gabbatiss, J., & Lempriere, M. (2023). *Autumn statement 2023: Key climate and energy announcements*. https://www.carbonbrief.org/autumn-statement-2023-key-climate-and-energy-announcements/

Gatzert, N., & Kosub, T. (2016). Risks and risk management of renewable energy projects: The case of onshore and offshore wind parks. *Renewable and Sustainable Energy Reviews*, *60*, 982-998. https://doi.org/10.1016/j.rser.2016.01.103

Geslin, L., Messad, P., Bourgery-Gonse, T., & Hartmann, T. (2024). *Macron pitches 'made in Europe' to guarantee prosperity in 'Sorbonne II' speech*. Euractiv. https://www.euractiv.com/section/economy-jobs/news/macron-pitches-made-in-europe-to-guarantee-prosperity-in-sorbonne-ii-speech/

Gobierno de España. (2022). *Incentivos regionales*. https://www.fondoseuropeos.hacienda.gob.es/sitios/dgfc/es-es/ipr/ir/paginas/inicio.aspx

Gobierno Vasco, Spri, EVE, & Ihobe. (2016). *Listado vasco de tecnologías limpias 2016*. https://www.ihobe.eus/publicaciones/listado-vasco-tecnologias-limpias-2016-2

Gouardères, F. (2023). *Fondo de Transición Justa*. https://www.europarl.europa.eu/factsheets/es/sheet/214/fondo-de-transicion-justa

Gould, T., Fischer, D., Frankl, P., & Bahar, H. (2023). *Financial headwinds for renewables investors: What's the way forward?* IEA at COP 28. https://www.iea.org/commentaries/financial-headwinds-for-renewables-investors-what-s-the-way-forward?utm_campaign=IEA+newsletters&utm_medium=Email&utm_source=SendGrid

Gouvernement du Canada. (2023). *Un plan canadien: Une classe moyenne forte, une économie abordable, un avenir prospère*. https://www.budget.canada.ca/2023/home-accueil-fr.html

Government of Canada. (2022). *Canada Growth Fund. Technical Backgrounder:* https://www.budget.canada.ca/fes-eea/2022/doc/gf-fc-en.html

Government of Canada. (2023). *Net Zero Accelerator Initiative*. https://ised-isde.canada.ca/site/strategic-innovation-fund/en/net-zero-accelerator-initiative

Government of Canada. (2024a). *Launching the second phase of consultations on the Scientific Research and Experimental Development Tax Incentive Program*. https://www.canada.ca/en/department-finance/programs/consultations/2024/launching-the-second-phase-of-consultations-on-the-scientific-research-and-experimental-development-tax-incentive-program.html

Government of Canada. (2024b). *Regional Energy and Resource Tables*. https://natural-resources.canada.ca/climate-change/regional-energy-and-resource-tables/24356

GOV.UK. (2023). *Powering Up Britain*. https://www.gov.uk/government/publications/powering-up-britain/powering-up-britain

Graham, K., & Knittel, C. R. (2024). Assessing the distribution of employment vulnerability to the energy transition using employment carbon footprints. *Proceedings of the National Academy of Sciences*, *121*(7), e2314773121. https://doi.org/10.1073/pnas.2314773121

Hafner, S., James, O., & Jones, A. (2019). A Scoping Review of Barriers to Investment in Climate Change Solutions. *Sustainability*, *11(11)*(3201). https://doi.org/10.3390/su11113201

Hafner, S., Jones, A., Anger-Kraavi, A., & Pohl, J. (2020). Closing the green finance gap – A systems perspective. *Environmental Innovation and Societal Transitions*, *34*, 26-60. https://doi.org/10.1016/j.eist.2019.11.007

Han, B., & Dong, L. (2021). *China's new renewable consumption targets: An enabler to fulfill 2030 climate commitment*. S&P Global Commodity Insights. https://www.spglobal.com/commodityinsights/en/ci/research-analysis/chinas-new-renewable-consumption-targets-an-enabler-to-fulfill.html

Helm, T. (2024). *Can Trump ruin Biden's Inflation Reduction Act?* Net Zero Investor. https://www.netzeroinvestor.net/news-and-views/can-trump-ruin-bidens-inflation-reduction-act

Hemmadi, M. (2024). *Unable to meet startup procurement commitment, National Defence looks to reduce it*. The Logic. https://thelogic.co/news/unable-to-meet-startup-procurement-commitment-national-defence-looks-to-reduce-it/

HM Government. (2009). *The UK Low Carbon Transition Plan. National strategy for climate and energy*. TSO. https://assets.publishing.service.gov.uk/media/5a74b4b1e5274a3cb2866852/9780108508394.pdf

HM Government. (2023a). *Powering Up Britain*. https://assets.publishing.service.gov.uk/media/642468ff2fa8480013ec0f39/powering-up-britain-joint-overview.pdf

HM Government. (2023b). *Powering up Britain. Energy Security Plan*. https://assets.publishing.service.gov.uk/media/642708eafbe620000f17daa2/powering-up-britain-energy-security-plan.pdf

HM Government. (2023c). *Powering up Britain. The Net Zero Growth Plan*. https://assets.publishing.service.gov.uk/media/642556c560a35e000c0cb167/powering-up-britain-net-zero-growth-plan.pdf

Hodgson. (2023). *Game On: The Implications of the US Inflation Reduction Act for Canadian Competitiveness*. https://www.cdhowe.org/sites/default/files/2023-04/E-Brief_339_0.pdf

IEA. (2021a). *An Energy Sector Roadmap to Carbon Neutrality in China*. International Energy Agency. https://www.iea.org/reports/an-energy-sector-roadmap-to-carbon-neutrality-in-china

IEA. (2021b). *Fund management guidelines for industrial transformation and upgrade (made in China 2025)*. https://www.iea.org/policies/2627-fund-management-guidelines-for-industrial-transformation-and-upgrade-made-in-china-2025

IEA. (2021c). *Korean New Deal—Digital New Deal, Green New Deal and Stronger Safety Net*. https://www.iea.org/policies/11514-korean-new-deal-digital-new-deal-green-new-deal-and-stronger-safety-net

IEA. (2021d). *Notice on Matters Concerning the New Energy Feed-in Tariff Policy*. https://www.iea.org/policies/14119-notice-on-matters-concerning-the-new-energy-feed-in-tariff-policy

IEA. (2021e). *Renewable Energy Green Certificate and Trading Mechanism*. https://www.iea.org/policies/6474-renewable-energy-green-certificate-and-trading-mechanism

IEA. (2021f). *Renewable Energy Law of the People's Republic of China*. https://www.iea.org/policies/3080-renewable-energy-law-of-the-peoples-republic-of-china

IEA. (2021g). *Top 1000 Industrial Energy Conservation Programme*. https://www.iea.org/policies/2325-top-1000-industrial-energy-conservation-programme

IEA. (2022a). *14th FYP for Raw Material Industry Development*. https://www.iea.org/policies/14702-14th-fyp-for-raw-material-industry-development

IEA. (2022b). *Canada 2022. Energy policy review*. IEA. https://iea.blob.core.windows.net/assets/7ec2467c-78b4-4c0c-a966-a42b8861ec5a/Canada2022.pdf

IEA. (2022c). *Carbon Peaking, carbon neutral energy sector plan*. https://www.iea.org/policies/14307-carbon-peaking-carbon-neutral-energy-sector-plan

IEA. (2022d). *Launching of the National Green Development Fund*. https://www.iea.org/policies/12360-launching-of-the-national-green-development-fund

IEA. (2022e). *Special refinancing loan to support the clean and efficient use of coal to promote green and low-carbon development*. https://www.iea.org/policies/14460-special-refinancing-loan-to-support-the-clean-and-efficient-use-of-coal-to-promote-green-and-low-carbon-development

IEA. (2022f). *Tracking clean energy innovation. Focus on China*. International Energy Agency. https://www.iea.org/reports/tracking-clean-energy-innovation-focus-on-china

IEA. (2023a). *Adjustments and improvements to Subsidy Policies for New Energy Vehicles*. https://www.iea.org/policies/12936-adjustments-and-improvements-to-subsidy-policies-for-new-energy-vehicles

IEA. (2023b). *Energy efficiency 2023*. https://www.iea.org/reports/energy-efficiency-2023

IEA. (2023c). *Energy Technology Perspectives 2023*. International Energy Agency.

IEA. (2023d). *Energy Technology RD&D Budgets Data Explorer*. https://www.iea.org/data-and-statistics/data-tools/energy-technology-rdd-budgets-data-explorer

IEA. (2023e). *ETP Clean Energy Technology Guide* (International Energy Agency) [dataset]. https://www.iea.org/data-and-statistics/data-tools/etp-clean-energy-technology-guide

IEA. (2023f). *Hydrogen Industry Development Plan (2021-2035)*. https://www.iea.org/policies/16977-hydrogen-industry-development-plan-2021-2035

IEA. (2023g). *New Energy Automobile Industry Development Plan (2021-2035)*. https://www.iea.org/policies/13099-new-energy-automobile-industry-development-plan-2021-2035

IEA. (2023h). *Notice on supporting electric buses deployment*. https://www.iea.org/policies/16902-notice-on-supporting-electric-buses-deployment

IEA. (2023i). *Subsidy on New Energy Vehicle 2023*. https://www.iea.org/policies/17536-subsidy-on-new-energy-vehicle-2023

IEA. (2023j). *The State of Clean Technology Manufacturing: An Energy Technology Perspectives Special Briefing*.

IEA. (2023k). *World Energy Outlook 2023*. International Energy Agency. https://www.iea.org/reports/world-energy-outlook-2023

Ihobe. (2022). *El Listado Vasco de Tecnologías Limpias incluirá ocho nuevas tecnologías para apoyar el despliegue de la planificación ambiental*. https://www.ihobe.eus/actualidad/listado-vasco-tecnologias-limpias-incluira-ocho-nuevas-tecnologias-para-apoyar-despliegue-planificacion-ambiental

IMF. (2023a). *Canada: 2023 Article IV Consultation-Press release and staff report* (IMF Country Report No. 23/286). https://www.imf.org/en/Publications/CR/Issues/2023/07/27/Canada-2023-Article-IV-Consultation-Press-Release-and-Staff-Report-537072

IMF. (2023b). *Fiscal monitor. On the Path to Policy Normalization*. https://www.imf.org/en/Publications/FM/Issues/2023/04/03/fiscal-monitor-april-2023

IMF. (2023c). *Fiscal monitor. Climate Crossroads: Fiscal Policies in a Warming World*. https://www.imf.org/en/Publications/FM/Issues/2023/04/03/fiscal-monitor-april-2023

Invest India. (s. f.). *Production Linked Incentive (PLI) Schemes in Indi*. https://www.investindia.gov.in/production-linked-incentives-schemes-india

IPCC. (2023). *AR6 Synthesis Report. Climate Change 2023*. https://www.ipcc.ch/report/ar6/syr/

IRENA. (2023). *Renewable Power Generation Costs in 2022*. International Renewable Energy Agency.

Jones, R., Baker, T., Huet, K., Murphy, L., & Lewis, N. (2020). Treating ecological deficit with debt: The practical and political concerns with green bonds. *Geoforum*, *114, 49-58.* https://doi.org/10.1016/j.geoforum.2020.05.014

Karaboytcheva, M. K. (2021). *El Fondo Europeo de Defensa 2021-2027*. Servicio de Estudios del Parlamento Europeo.

Kenton, W. (2023). *Financial Instruments Explained: Types and Asset Classes.* https://www.investopedia.com/terms/f/financialinstrument.asp

Kerry, J., & McCarthy, G. (2021). *The Long-Term Strategy of the United States, Pathways to Net-Zero Greenhouse Gas Emissions by 2050*. United States Department of State and the United States Executive Office of the President.

Kleimann, D., Poitiers, N., Sapir, A., Véron, N., Veugelers, R., & Zettelmeyer, J. (2023). *How Europe should answer the US Inflation Reduction Act* (04/23; Policy Contribution). Bruegel.

Kleimann, D., Tagliapietra, S., Zettelmeyer, J., Poitiers, N., Sapir, A., Véron, Ni., & Veugelers, R. (2023). *How Europe should answer the US Inflation Reduction Act* (Policy Contribution Issue n˚04/23, February 2023). https://www.bruegel.org/sites/default/files/2023-02/PB%2004%202023_0.pdf

Korea Energy Agency. (s. f.). *NRE Home Subsidy*. Recuperado 31 de enero de 2024, de https://dco.energy.or.kr/renew_eng/new/subsidy.aspx

Kumar, S. (2024). *Viability Gap Funding—Indian Economy Notes*. https://prepp.in/news/e-492-viability-gap-funding-indian-economy-notes

Larrea Basterra, M., & Bilbao Ozamiz, M. (2020). *La transición energética en el Reino Unido* (67/2020; Cuadernos Orkestra). Instituto Vasco de Competitividad-Fundación Deusto. https://www.orkestra.deusto.es/images/investigacion/publicaciones/informes/cuadernos-orkestra/200019-la-transicion-energetica-en-el-Reino-Unido.pdf

Leblanc, D. (2023). *Ottawa suspends $1B green fund after receiving whistleblower complaint*. https://www.cbc.ca/news/politics/sustainable-development-technologies-canada-champagne-1.6985847

Lee, S., McBride, P., Kim, B., & Jieyu, G. (2023). *Navigating the net zero transition. Chapter 5: The Republic of Korea*. https://www.kwm.com/sg/en/insights/latest-thinking/navigating-the-net-zero-transition-chapter-5-the-republic-of-korea.html

Lee, Y. J., Lee, J. Y., & Lee, B. (2023). *Announcement of National Basic Plan for Carbon Neutrality and Green Growth*. https://www.kimchang.com/en/insights/detail.kc?sch_section=4&idx=27488

Leiserowitz, A., Maibach, E., Rosenthal, S., Kotcher, J., Goddard, E., Carman, J., Verner, M., Ballew, M., Marlon, J., Lee, S., Myers, T., Goldberg, M., Badullovich, N., & Thier, K. (2023). *Climate Change in the American Mind: Politics & Policy, Fall 2023* [Yale Program on Climate Change Communication]. ale University and George Mason University. https://climatecommunication.yale.edu/publications/climate-change-in-the-american-mind-politics-policy-fall-2023/toc/7/

Leussink, D. (2023). *Japan to give up to $1.8 billion in subsidies for storage battery, chip projects*. Reuters. https://www.reuters.com/markets/asia/japan-give-up-18-bln-subsidies-storage-battery-chip-projects-2023-04-28/

Levinson, A., Werner, K. D., Ashenfarb, M., & Britten, A. (2024). *The Inflation Reduction Act's Benefits and Costs*. U.S. Department of the Treasury. https://home.treasury.gov/news/featured-stories/the-inflation-reduction-acts-benefits-and-costs

Lowey, M. (2024). *Canada Growth Fund Investment total $340 Million: What´s the Value for Taxpayers´Money?* Research Money. https://researchmoneyinc.com/article/canada-growth-fund-investments-total-340-million-what-s-the-value-for-taxpayers-money-

Manzoor, R., & Ramay, S. A. (2013). Technological Innovations and Size of Economy. In Green Growth and Technological Innovation: A case for South Asian countries. En *Green Growth and Technological Innovation: A case for South Asian countries* (pp. 9-11). Sustainable Development Policy Institute. http://www.jstor.org/stable/resrep00613.12

Mcgowan, F. (2023). *Powering up Britain: Analysing the government's energy security and net zero strategy*. https://ukandeu.ac.uk/analysing-the-governments-energy-security-and-net-zero-strategy/

McKinsey & Company. (2022). *The Inflation Reduction Act: Here's what's in it*.

McKinsey Sustainability. (2023). *COP28: Energy*. https://www.mckinsey.com/capabilities/sustainability/our-insights/sustainability-blog/cop28-energy?stcr=BCEF1C2F9D754208AEB5B1486CF0C04E&cid=other-eml-alt-mip-mck&hlkid=aa8e34424b96452b9b581b0976857180&hctky=10303809&hdpid=c445aa34-4399-4dfe-9d1c-785ae3c3628f

Ministerio para la Transición Ecológica y el Reto Demográfico. (s. f.). *La Unión Europea en la lucha contra el cambio climático*. https://www.miteco.gob.es/es/cambio-climatico/temas/el-proceso-internacional-de-lucha-contra-el-cambio-climatico/la-union-

europea.html#:~:text=La%20Ley%20Europea%20del%20Clima%2C%20aprobada%20en%20junio%20de%202021,marcha%20estrategias%20y%20planes%20de

Ministry of Heavy Industries. (2023). *Fame India Scheme*. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1942506

Ministry of Power. (s. f.). *Energy Efficiency*. https://powermin.gov.in/en/content/energy-efficiency

Ministry of Power. (2022). *Ministry of Power notifies Green Hydrogen/ Green Ammonia Policy*. https://pib.gov.in/PressReleasePage.aspx?PRID=1799067

Ministry of Power. (2023a). *Cabinet approves the Scheme titled Viability Gap Funding for development of Battery Energy Storage Systems (BESS)*. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1955113

Ministry of Power. (2023b). *National Framework For Promoting Energy Storage Systems*. Government of India.

MNRE. (s. f.-a). *PM JANMAN*. Ministry of New and Renewable Energy. https://mnre.gov.in/pm-janman/

MNRE. (s. f.-b). *Production Linked Incentive (PLI) Scheme: National Programme on High Efficiency Solar PV Modules*. Ministry of New and Renewable Energy. https://mnre.gov.in/production-linked-incentive-pli/

MNRE. (s. f.-c). *Solar Overview* [Ministry of New and Renewable Energy]. https://mnre.gov.in/solar-overview/

MNRE. (s. f.-d). *Solarisation of Sun Temple Town of Modhera in Mehsana District, Gujarat* [Ministry of New and Renewable Energy]. https://mnre.gov.in/solarisation-of-sun-temple-town-of-modhera-in-mehsana-district-gujarat/

MNRE. (2022). *Annual Report 2021-22*. Ministry of New and Renewable Energy. https://mnre.gov.in/annual-reports-2021-22/

MNRE. (2023). *Annual Report 2022-23*. Ministry of New and Renewable Energy. https://mnre.gov.in/annual-reports-2022-23/

Modernisation Fund. (s. f.). *What can be financed*. https://modernisationfund.eu/investments/

MoEF. (2021). *National Action Plan on Climate Change (NAPCC)*. Ministry of Environment, Forest and Climate Change.

Mosquera López, S., & Fernández Gómez, J. (2023). *Aceptación social de proyectos de energía renovable locales* (08/2023; Cuadernos Orkestra). Instituto Vasco de Competitividad-Fundación Deusto. https://www.orkestra.deusto.es/es/investigacion/publicaciones/informes/cuadernos-orkestra/2670-230063-aceptacion-social-proyectos-energia-renovable-locales

Muralikrishna, I. V., & Manickam, V. (2017). Chapter Thirteen—Industrial Wastewater Treatment Technologies, Recycling, and Reuse. En I. V. Muralikrishna & V. Manickam

(Eds.), *Environmental Management* (pp. 295-336). Butterworth-Heinemann. https://doi.org/10.1016/B978-0-12-811989-1.00013-0

NCSC. (2021). *Xie Zhenhua explica en detalle la formulación del sistema de políticas 1+N como cronograma y hoja de ruta para lograr objetivos duales de carbono*. National Center for Climate Change Strategy Research and International Cooperation. http://www.ncsc.org.cn/xwdt/gnxw/202107/t20210727_851433.shtml

NDRC. (2021a). *Action Plan for Carbon Dioxide Peaking Before 2030*. National Development and Reform Commission. https://en.ndrc.gov.cn/policies/202110/t20211027_1301020.html

NDRC. (2021b). *Aviso de la Comisión Nacional de Desarrollo y Reforma sobre Asuntos Relacionados con la Política de Precios de la Nueva Energía Conectada a la Red en 2021*. https://www.gov.cn/zhengce/zhengceku/2021-06/11/content_5617297.htm

Ngcamu, B. S. (2023). Climate change effects on vulnerable populations in the Global South: A systematic review. *Natural Hazards*, *118*(2), 977-991. https://doi.org/10.1007/s11069-023-06070-2

NHS England. (s.f.). *Suppliers*. https://www.england.nhs.uk/greenernhs/get-involved/suppliers/

Noh, H. J. (2019). Financial Strategies to Accelerate Green Growth. En *Handbook on green finance. Sustainable Development* (Sachs, J., Woo, W., Yoshino, N., Taghizadeh-Hesary, F. (eds)). Springer, Singapore. https://doi.org/10.1007/978-981-13-0227-5_16

OECD. (2003). *Checklist for Foreign Direct Investment Incentive Policies*. https://www.oecd.org/daf/inv/investment-policy/2506900.pdf

Owen, R., Brennan, G., & Lyon, F. (2018). Enabling investment for the transition to a low carbon economy: Government policy to finance early stage green innovation. *Current Opinion in Environmental Sustainability*, *Volume 31*(April 2018), Pages 137-145. https://doi.org/10.1016/j.cosust.2018.03.004

Packroff, J. (2024). *EU Single Market report: Letta wants to mimic US tax credits*. Euractiv. https://www.euractiv.com/section/economy-jobs/news/eu-single-market-report-letta-wants-to-mimic-us-tax-credits/

Packroff, J., & Messad, P. (2024). *EU agrees law to boost green industry at home* [Euractiv]. https://www.euractiv.com/section/politics/news/eu-readies-law-to-boost-green-industry-at-home/?utm_source=Euractiv&utm_campaign=9e1faa623b-EMAIL_CAMPAIGN_2024_02_02_10_48_COPY_01&utm_medium=email&utm_term=0_-e9bac4001f-%5BLIST_EMAIL_ID%5D

Pickerel, K. (2022). *The basics of ITC vs. PTC for the solar industry*. Solar Power World. https://www.solarpowerworldonline.com/2022/10/the-basics-of-itc-vs-ptc-for-the-solar-industry/

Pinge, D., Reddy, V., Saini, E., Kashyap, Pal, U., & Kalra, A. (2023). *Green Investment Opportunities in India*. Impact Investors Council & Climate Policy Iniciative. (https://powermin.gov.

in/sites/default/files/National_Framework_for_promoting_Energy_Storage_Systems_August_2023.pdf)

Plumer, B. (2024). *Here's Where Biden's Climate Law Is Working, and Where It's Falling Short*. The New York Times. https://www.nytimes.com/2024/02/21/climate/inflation-reduction-act-progress-climate.html

Polzin, F. (2017). Mobilizing private finance for low-carbon innovation – A systematic review of barriers and solutions. *Renewable and Sustainable Energy Reviews*, *77*, 525-535. https://doi.org/10.1016/j.rser.2017.04.007

Polzin, F., & Sanders, M. (2020). How to finance the transition to low-carbon energy in Europe? *Energy Policy*, *147*, 111863. https://doi.org/10.1016/j.enpol.2020.111863

Qadir, S. A., Al-Motairi, H., Tahir, F., & Al-Fagih, L. (2021a). Incentives and strategies for financing the renewable energy transition: A review. *Energy Reports*, *7*, 3590-3606. https://doi.org/10.1016/j.egyr.2021.06.041

Qadir, S. A., Al-Motairi, H., Tahir, F., & Al-Fagih, L. (2021b). Incentives and strategies for financing the renewable energy transition: A review. *Energy Reports*, *7*, 3590-3606. https://doi.org/10.1016/j.egyr.2021.06.041

RBC. (2022). *Financing Greener Growth: Canada's Need to Accelerate Investment*. https://www.rbccm.com/en/insights/story.page?dcr=templatedata/article/insights/data/2022/11/financing_greener_growth

Sachs, J. D., Woo, W. T., Yoshino, N., & Taghizadeh-Hesary, F. (2019). Importance of green finance for achieving Sustainable Development Goals and Energy Security. En *Handbook of Green Finance. Sustainable Development* (Sachs, J., Woo, W., Yoshino, N., Taghizadeh-Hesary, F.). Springer, Singapore. https://doi.org/10.1007/978-981-13-0227-5_13

Sage. (2023). *Hecho imponible*. https://www.sage.com/es-es/blog/diccionario-empresarial/hecho-imponible/

Scarpaleggia, F. (2023). *Support for clean technologies in Canada to reduce domestic and international greenhouse gas emissions. Report of the Standing Committee on Environment and Sustainable Development*. https://www.ourcommons.ca/Content/Committee/441/ENVI/Reports/RP12656899/envirp10/envirp10-e.pdf

Scheinert, C. (2023). *EU's response to the US Inflation Reduction Act (IRA)* (PE 740.087; In-Depth Analysis). Policy Department for Economic, Scientific and Quality of Life Policies.

Shaw, V. (2021). *China set to mandate solar on at least 20% of residential roofs in pilot counties*. pv magazine. https://www.pv-magazine.com/2021/07/01/china-set-to-mandate-solar-on-at-least-20-of-residential-roofs-in-pilot-counties/

Sino German Cooperation on Climate Change - Climate Partnership. (2022). *China Released Its 14th Five-Year Plan for Renewable Energy with Quantitative Targets For 2025*. https://climatecooperation.cn/climate/china-released-its-14th-five-year-plan-for-

renewable-energy-with-quantitative-targets-for-2025/#:~:text=The%20plan%20sets%20a%202025,%25%20for%20non%2Dhydro).

Soo-Yeon, K. (2022). *S. Korea to expand tax incentives for R&D on carbon neutrality technology*. https://en.yna.co.kr/view/AEN20220106002500320

Stöckl, B. (2023). *Dutch grant more fossil fuel subsidies than previously thought*. Euractiv. https://www.euractiv.com/section/politics/news/dutch-grant-more-fossil-fuel-subsidies-than-previously-thought/?utm_source=EURACTIV&utm_campaign=4f1adee836-EMAIL_CAMPAIGN_2023_08_31_08_05&utm_medium=email&utm_term=0_-4f1adee836-%5BLIST_EMAIL_ID%5D

Stokes, B. (2024). *EU-US relations after the Inflation Reduction Act, and the challenges ahead* (PE 759.588). European Parliamentary Research Service. https://data.europa.eu/doi/10.2861/385275

Tagliapietra, S., Veugelers, R., & Zettelmeyer, J. (2023). *Rebooting the European Union's Net Zero Industry Act* (Issue N˚15/23) [Policy Brief]. Bruegel. https://www.bruegel.org/policy-brief/rebooting-european-unions-net-zero-industry-act

Tavares-Lehman, A. T., & Lundan, S. M. (2016). Part I: Invesment Incentives: An Introduction. En *Rethinking investment incentives* (Ana Teresa Tavares-Lehmann, Perrine Toledano, Lise Johnson, and Lisa Sachs, p. 368). Columbia University Press.

The White House. (s. f.). *What is Direct Pay (Elective Pay)?* https://www.whitehouse.gov/cleanenergy/directpay/

The White House. (2021). *Fact Sheet: The Bipartisan Infrastructure Deal*. https://www.whitehouse.gov/briefing-room/statements-releases/2021/11/06/fact-sheet-the-bipartisan-infrastructure-deal/

The White House. (2022). *Fact Sheet: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China*. https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs-create-jobs-strengthen-supply-chains-and-counter-china/

The White House. (2023a). *Building a Clean Energy Economy: A Guidebook to the Inflation Reduction Act's Investments in Clean Energy and Climate Action*.

The White House. (2023b). *Fact Sheet: One Year In, President Biden's Inflation Reduction Act is Driving Historic Climate Action and Investing in America to Create Good Paying Jobs and Reduce Costs*. https://www.whitehouse.gov/briefing-room/statements-releases/2023/08/16/fact-sheet-one-year-in-president-bidens-inflation-reduction-act-is-driving-historic-climate-action-and-investing-in-america-to-create-good-paying-jobs-and-reduce-costs/

Thomas, K. P. (2007). *Investment incentives: Growing use, uncertain benefits, uneven controls*. Global Subsidies Initiative.; Geneva.

Thurton, D. (2023). *Liberals «dawdle» on billions in net-zero investment tax credits: NDP critic*. CBC. https://www.cbc.ca/news/politics/net-zero-tax-credits-climate-1.7009126

Tsurumaki, Y., Deszcz, A., Shum, J., & Kishi, C. (2023, noviembre 24). *Navigating the new zero transition. Chapter 6: Japan*. https://www.kwm.com/sg/en/insights/latest-thinking/navigating-the-net-zero-transition-chapter-6-japan.html

UNCTAD. (2000). *Tax Incentives and Foreign Direct Investment A Global Survey* (ASIT Advisory Studies No. 16). United Nations Conference on Trade and Development. https://unctad.org/system/files/official-document/iteipcmisc3_en.pdf

UNCTAD. (2024). *Investment Policy Hub*. https://investmentpolicy.unctad.org/investment-laws

UNDP. (2021). *China's 14th five-year plan* (9; Issue Brief). United Nations Development Programme China.

Unión Europea. (2023). *Directiva (UE) 2023/2413 del Parlamento Europeo y del Consejo, de 18 de octubre de 2023, por la que se modifican la Directiva (UE) 2018/2001, el Reglamento (UE) 2018/1999 y la Directiva 98/70/CE en lo que respecta a la promoción de la energía procedente de fuentes renovables y se deroga la Directiva (UE) 2015/652 del Consejo*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023L2413&qid=1699364355105

U.S. Department of Energy's Wind Energy Technologies Office. (2023). *Production Tax Credit and Investment Tax Credit for Wind Energy*. https://windexchange.energy.gov/projects/tax-credits#spanish

Vitello, C. (2023). *Net Zero Incentives: What you need to know about the new tax credits for Canadian cleantech*. Environment Journal. https://environmentjournal.ca/net-zero-incentives-are-you-familiar-with-the-new-investment-tax-credits-for-canadian-cleantech/

Wells, L. T., Allen, N. J., Morriset, J., & Prinia, N. (2001). *Using tax incentives to compete for foreign investment. Are they worth the costs?* (Vol. 15). Foreign Investment Advisory Service.

WHY project. (2024). *Directory of articles and reports related to work packages*. https://www.why-h2020.eu/materials/articles-and-reports

Wong, D. (2020). *How Can Foreign Technology Investors Benefit from China's New Infrastructure Plan?* China Briefing. https://www.china-briefing.com/news/how-foreign-technology-investors-benefit-from-chinas-new-infrastructure-plan/

World Bank. (2019). *China to Scale Up Distributed Renewables with GEF Support*. https://www.worldbank.org/en/news/press-release/2019/05/03/china-to-scale-up-distributed-renewables-with-gef-support

WSJ. (2023). *The Real Cost of the Inflation Reduction Act Subsidies: $1.2 Trillion*. Wall Street Journal. https://www.wsj.com/articles/inflation-reduction-act-subsidies-cost-goldman-sachs-report-5623cd29

Xi, J. (2017). *Xi Jinping's report at 19th National Congress of the Communist Party of China*. http://www.xinhuanet.com/english/special/2017-11/03/c_136725942.htm

Xinhua News Agency. (2021). *Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035*.

Yoshino, N., & Taghizadeh-Hesary, F. (2018). Alternatives to Private Finance: Role of Fiscal Policy Reforms and Energy Taxation in Development of Renewable Energy Projects. En *Financing for Low-carbon Energy Transition* (Anbumozhi, V., Kalirajan, K. & Kimura, F. (eds.)). Springer, Singapore.

Zhao, A., Wang, J., Sun, Z., & Guan, H. (2022). Environmental taxes, technology innovation quality and firm performance in China—A test of effects based on the Porter hypothesis. *Economic Analysis and Policy*, *74*, 309-325. https://doi.org/10.1016/j.eap.2022.02.009

Zhou, F., Peng, L., & Li, J. (2022). *China's 14th Five-Year Plans on Renewable Energy Development and Modern Energy System*. Energy Foundation. https://www.efchina.org/Blog-en/blog-20220905-en

ANNEX 1. Examples of different incentives

Table 10 Examples of financial incentives

Incentive	Example
Subsidies	USA: Home efficiency rebates Under this programme, grants are provided for state energy offices to offer price reductions for energy efficiency and energy-saving improvements in single-family and multi-family buildings. This programme, along with the home electrification programme and appliance rebates, is part of the home energy rebate programmes authorised by the Inflation Reduction Act.
Wage subsidies	Canada: Science Horizons Youth Internship (SHI) | ECO Canada The Science Horizons Youth Internship is a programme whereby the host company receives 80% funding and up to 25,000 Canadian dollars (C$) to cover a participant's salary. The host will provide a new permanent full-time job related to the STEM and environmental field. This programme is open to companies of all sizes.
Rebates on Social Security contributions	Spain: BOE-A-2014-6276 Royal Decree 475/2014 of 13 June on rebates on Social Security contributions for research personnel. This Royal Decree aims to establish a 40% rebate on employer contributions to social security contributions for common contingencies concerning research personnel. For these purposes, research personnel are considered to be workers included in groups 1, 2, 3 and 4 of the General Social Security Scheme who, on an exclusive basis and for the whole of their working time in the company, engaged in research and development and technological innovation activities, are dedicated to carrying out the aforementioned activities, whether their contract is of indefinite duration, on an internship basis or for a specific project or service. Vizcaya (Spain): DECRETO FORAL de la Diputación Foral de Bizkaia 203/2013, de 23 de diciembre, por el que se aprueba el Reglamento del Impuesto sobre Sociedades (BOB 31 Diciembre) Rebates on social security contributions for research personnel.
Infrastructure grants	Germany: Germany invests 500 million euros to increase public charging points for electric cars (motorpasion.com) The German Federal Ministry of Transport and Infrastructure will invest 500 million euros by the end of 2025 to promote public electric charging infrastructure and encourage the penetration of electric vehicles in the country. Africa: Unlocking Africa's Potential: The Imperative of Infrastructure Investment - APCO Worldwide The African Development Bank Group (AfDB) invests in infrastructure in Africa, such as roads, airports, and seaports, to promote regional trade.

Source: own elaboration.

Table 11 Examples of financial incentives

Incentive	Example
Loans (soft)	Norway: Funding for innovation projects | Innovation Norway (innovasjonnorge.no) Norsk Solar is granted a loan of NOK 20 million from Innovation Norway. - Norsk Solar Innovation Norway, the Government's instrument for innovation and development of Norwegian business and industry, has granted Norsk Solar a loan of NOK 20 million for ten years.
Guarantees, sureties, other risk mitigation instruments	France: 2023-M-007-06_Rapport_Aides_transition_ecologique.pdf (finances.gouv.fr) The French public sector investment bank (*Banque Publique d'Investissement*, Bpifrance) granted loan guarantee funds in 2022 for EUR 265 million. In addition, it offers loan guarantees. EU: EIB approves 5 billion to support European wind energy manufacturers - SMARTGRIDSINFO The EIB will provide €5bn to reinforce commercial banks' provision of guarantees for investment by companies in the wind sector. The plan is expected to support up to €80bn in new wind investment and increase wind capacity by 32 GW. Colombia: a2census *Crowdlending* and *crowdfunding* platforms finance different projects of Colombian companies, including the development of clean technologies. The National Guarantee Fund partially covers the investment, between 50% and 70%, in case of default by the SME.
Government equity participation [77]	Germany: 2022-03-05-PR-Moving-forward-with-new-shareholder-structure_ENG_final.pdf (germanlng.com) The floating storage and regasification unit (FSRU) Brunsbüttel (2023) belongs to RWE (10%), Gasunie (40%), and the governmental development bank *Kreditanstalt für Wiederaufbau* (50%).
Activation of R&D expenditure [78]	Spain: Research and development expenditure. Accounting treatment and tax aspects. - DNV If there are sound reasons for technical success and economic profitability, in addition to the obligation to provide individualised information by project and costs in the report, R&D expenses are capitalised. Amortisation begins, the year following their activation, with a maximum period of five years. However, less time is allowed if the useful life is shorter, as may occur in the new technologies sector.

Source: own elaboration.

[77] Financing on more attractive terms than the market, it is important to ensure a justification from an economic and social point of view, avoiding crowding out private investment and ensuring that tenders are competitive processes. This public investment should encourage more private companies to invest or close a potential financing gap.

[78] This is an accounting (financial) measure, but has important fiscal implications.

Table 12 Examples of fiscal incentives (environmental taxes)

Incentive	Example
Excise (energy) taxes: electricity tax, hydrocarbon tax, coal tax, etc.	Poland: Poland - Corporate - Other taxes (pwc.com) Coal is subject to an excise tax depending on the product. The tax rates are PLN 32.84 per 1,000 kilograms (kg) of coal, PLN 11.87 per 1,000 kg of lignite and PLN 37.95 per 1,000 kg of coke. In practice, there is a wide range of exemptions.
Carbon taxes[79]	Sweden: Sweden's carbon tax - Government.se The carbon tax was introduced in 1991 at a rate of SEK 250 ('25) per tonne of CO_2 emitted and gradually increased to SEK 1330 ('122) in 2023[80].
Carbon border adjustment mechanism	EU: Carbon Border Adjustment Mechanism - European Commission (europa.eu) Instrument for the import of goods from outside the EU, which addresses the risk of carbon leakage. It sets a price on carbon emitted while producing carbon-intensive goods and encourages cleaner industrial production in non-EU countries.
Tax on means of transport[81]**: road tax, registration tax, etc.**	Slovenia: Motor vehicle tax in Slovenia - what is the new calculation? - Data d.o.o. In January 2021, the new Motor Vehicle Tax, which applies only to vehicles registered in Slovenia, entered into force, reducing the burden of the luxury tax or engine size tax by 65% on average. The new tax will no longer be based on engine power but on (i) CO_2 emissions, (ii) the EURO standard of the engine and (iii) the age of the vehicle.
Natural resource taxes	British Columbia (Canada): Natural resource taxes - Province of British Columbia (gov.bc.ca) The extraction of natural resources, timber and mining is subject to the payment of taxes, fees and charges. The activities concerned are mining oil, natural gas extraction, and forestry.
Taxation of pollutants	Switzerland: 814,018 (admin.ch) The VOC tax is intended to incentivise reducing VOC emissions by substituting or recycling organic solvents and giving a price signal in favour of VOC-free or low-VOC products. The tax rate is CHF 3 per kilogram of VOCs. Producers who generate VOC emissions are subject to the tax.
Taxation of waste	Spain[82]: Agencia Tributaria: Excise tax on non-reusable plastic packaging Excise duty on non-reusable plastic packaging. The tax base is constituted by the quantity of non-recycled plastic, in kilograms, contained in the products subject to the tax.

Source: own elaboration.

[79] They can take different forms and different taxable events. In Spain, the carbon tax is levied on emissions of fluorinated greenhouse gases.

[80] Currency conversion based on an exchange rate of SEK 10.87 per euro.

[81] In Spain, there are specific vehicle taxes such as the Special Tax on Certain Means of Transport (mainly for passenger cars) and the Tax on Mechanical Traction Vehicles (a municipal tax, commonly known as "road tax").

[82] In Spain there are other taxes on waste such as those on nuclear waste, on the storage of nuclear fuel and on the deposit of waste in landfills. For more details see (Tax Agency, 2024).

Table 13 Examples of tax incentives (tax benefits)

Incentive	Example
Accelerated depreciation	Philippines: 20081216-RA-09513-GMA.pdf (officialgazette.gov.ph) Since the 2008 Act, accelerated depreciation has been allowed for plants, machinery, and equipment that are reasonably necessary and actually used for the exploration, development, and utilisation of renewable resources. They may be depreciated using a rate not exceeding twice the rate that would otherwise have been used.
Deductions in the quota (tax credit)	France: LUX_LIB1\56965\1 (en-notifications.com) The *Crédit d'impôt "Investissement Industries Vertes*" or C3IV aims to restore France's industrial base and reduce its carbon footprint. It is available to companies established in France making tangible and intangible investments for the manufacture of certain green products: (i) new generation batteries and key battery components, solar panels, wind turbines and heat pumps; (ii) tangible investments, including land, buildings, installations, equipment and machinery; (iii) intangible investments (patent rights, licences, know-how or other intellectual property rights). Depending on the investment location, the amount will be between 20% and 60% of the investments made and may not exceed EUR 150-350 million. It will be attributable to the corporate tax due by the company for the tax year during which the investments are made. Any excess would be refunded. Spain: Tax Agency: Deductions to encourage the performance of certain activities - R&D&I deduction The basis for the deduction is made up of the amount of R&D expenditure and, where applicable, investments in tangible and intangible fixed assets, excluding buildings and land. Expenditure incurred by the taxpayer, including depreciation of assets assigned to the aforementioned activities, shall be deemed to be R&D expenditure as it is directly related to those activities and, is actually applied to the performance of those activities, and is identified explicitly by the project. The deduction may not be applied to indirect expenses (such as those of the general structure of the company or financial expenses) or to all expenses which, despite being directly related to the aforementioned activity, cannot be individualised, i.e. allocated between the various projects benefiting from the deduction and the company's other activities, or if such allocation has not been made.
Receipt of a tax credit as payment	USA: Fact sheet: How the Inflation Reduction Act´s tax incentives. USA: FACT SHEET: How the Inflation Reduction Act's Tax Incentives Are Ensuring All Americans Benefit from the Growth of the Clean Energy Economy | U.S. Department of the Treasury The Inflation Reduction Act allows state, local and Indian community governments, as well as non-profit organisations and other tax-exempt entities, to receive certain tax credits as direct payments from the Internal Revenue Service (IRS), streamlining these entities' access to key incentives and supporting their investments in local communities. Among others, the tax credit is allowed as payments for production or investment, for qualified clean commercial vehicles, for alternative fuel refuelling property, for advanced energy projects, for clean fuel production, and for carbon oxide sequestration.
Tax credit rebate programme	USA: Low-income communities bonus credit program | Department of Energy. USA: Low-Income Communities Bonus Credit Program | Department of Energy The credit bonus programme provides a 10 or 20 percentage point increase in the investment tax credit for qualified solar and wind energy installations with a maximum net capacity of less than 5 MW. A 10 percentage point increase is available for eligible solar and wind installations installed in low-income communities or on Indian lands, and a 20 percentage point increase is available for eligible solar and wind installations as part of a low-income residential building or low-income economic benefit project.

Tax reductions (on the tax base), additional or increased reductions	Malaysia: Budget 2023: More funds, incentives for green tech to meet net zero target and sustainability agenda - Malaysian Green Technology And Climate Change Corporation (mgtc.gov.my) Through Budget 2023, it proposes to extend the deadline for claiming the Green Investment Tax Allowance (GITA) from three to five years. Companies wishing to acquire green technology assets listed in the ad-hoc directory (MyHIJAU) or those undertaking green technology projects for their business or own consumption can apply for GITA.
Tax exemptions or tax holidays	Malaysia: Budget 2023: More funds, incentives for green tech to meet net zero target and sustainability agenda - Malaysian Green Technology And Climate Change Corporation (mgtc.gov.my) The 2023 Budget proposed to extend the *Green income tax exemption* (GITE) until 31 December 2025. It was also proposed to extend the exemptions from three to five years. It is available to green technology service providers that meet a number of requirements. Eligible companies can obtain 70% corporate tax exemptions.
Tax rate reduction	Spain: When should you apply the reduced VAT rate of 10% (agremia.com)? The 10% tax rate may be applied to replacing boilers with more efficient ones if it is part of an overall renovation of the building whose cost exceeds 25% of the purchase price or market value of the building before the renovation, excluding the value of the land.
Rebate, exemption	City Council of Cúllar Vega (Granada, Spain): Reduction of IBI for three years for houses that install photovoltaic systems in Cúllar Vega - SOLARINFO Property Tax (IBI) will be subsidised for three consecutive years for residents who install solar panels on their homes, provided that the homes are not newly built. The rebate amounts to 50% of the IBI bill, and it will be applied the year following the installation of the panels.
Tax refunds	Canada: Minister Guilbeault highlights the big five new Clean Investment Tax Credits in Budget 2023 to support sustainable made-in-Canada clean economy - Canada.ca In the 2023 budgets, a tax deduction is included in the refundable share of 15% for investments in clean electricity. This share is earmarked for investments in technologies necessary for the generation and storage of clean electricity and its transmission between provinces and territories, for which taxable and tax-exempt entities are eligible.
Offsetting of tax losses from previous years	New Zealand: New tax loss carry-forward rules: The business continuity test - Bell Gully In 2021, the continuity test came into force, which applies to a company subject to a shareholder change affecting more than 51% ownership. This test allows the company to carry forward tax losses generated from the 2013/14 financial year onwards, provided that certain conditions are met, including that there is no significant change in business activities during the period of business continuity, except in certain circumstances (e.g. companies with significant deductions for bad debts that cannot benefit from the different offsetting periods).
Offsetting of losses against taxable profits from previous years	Australia: Temporary loss carry-back rules - What you need to know (pwc.com.au) The loss carry forward scheme operates as a refundable tax offset, providing a loss-making company with a cash refund for the tax that was paid in a previous year(s). The rules are flexible in the sense that a company may elect to set off or carry forward any available tax loss earned in the financial years 2019-20, 2020-21, 2021-22 and/or 2022-23 against tax paid in respect of the financial year 2018-19 or later. No loss is required to be applied as a *carryback* instead of utilising it in future years, and no ordering rules require it to be applied to the earliest tax year.
Monetisation and/or transmission	USA; IRA-Guidebook.PDF. Whitehouse.gov. US; Inflation-Reduction-Act-Guidebook.pdf (whitehouse.gov) All deductions included in the IRA, except 168(e)(3)(B), are eligible for direct payment and portability. The Act extends many tax incentives to entities that do not generally benefit from

of tax credits [83]	deductions, such as state, local, and Indian governments and other tax-exempt entities. Specifically, these entities may elect to receive some of the IRA deductions through direct payments. Taxpayers must first make an investment or production activity to obtain the tax deduction or reduction that qualifies for the direct payment or pass-through election. To do so, they must complete and submit a pre-filing registration application no earlier than the beginning of the tax year, during which the taxpayer will obtain the deduction they wish to monetise with an elective payment election or rollover election.

Source: own elaboration.

Table 14 Examples of market incentives

Incentive	Example
Premiums, regulated prices, guaranteed tariff *(FIT)*	Victoria (Australia): Minimum feed-in tariff review 2023-24 | Engage Victoria The Essential Services Commission fixed feed-in tariffs for energy exported to the grid from small-scale renewable sources, such as rooftop solar, for 2023-24.
Premiums, regulated prices, guaranteed tariff *(FIP)*	Japan: InfluenceMap Japan Feed-in-tariff (FIT) / Feed-in-premium (FIP); Renewable energy in Asia: investment incentives in six key markets | TMF Group (tmf-group.com) A FIP was introduced in April 2022 to incentivise investment in renewables and encourage their integration into the electricity market. Under the FIP, a premium is added to the market price instead of buying electricity at a fixed price, as in the FIT. Only power plants with a capacity of 50 kW or more (high voltage and special high voltage) are eligible for the FIP system.
Net measure (virtual, aggregated, etc.)	Brazil: Brazil introduces new rules for distributed generation, net metering - pv magazine International (pv-magazine.com) Net metering regime from 2023. Network tariffs will continue to ensure reasonable profitability for Brazilian prosumers and will gradually increase over the years.
Net turnover (wholesale or retail)	Arizona: DSIRE (dsireusa.org) Customer generators will be paid an avoided-cost tariff for energy exported to the grid. For residential customers, the monthly net excess generation is carried forward indefinitely, and the utility pays the customer the remaining credits at the end of the annual period if the amount of credits exceeds a certain balance. For non-residential customers eligible for the retail rate, the net excess generation is carried forward and paid to the customer at the utility's avoided cost rate at the end of the annual period.
Contracts for Difference	United Kingdom: Contracts for Difference Scheme - House of Commons Library (parliament.uk) It is the government's main mechanism for supporting new energy infrastructure with low GHG emissions. CfDs work by guaranteeing a fixed price for electricity, which generators receive per unit of energy production. When the wholesale price of electricity fluctuates, the

[83] It is common to apply monetisation when a company does not have sufficient tax liability to benefit from the full amount of a deduction to which it is entitled. Through monetisation, it can assign it and in return obtain financing from a third party (Doran, 2024). In Spain it can only be applied with the tax administration and for R&D deductions, for an amount of 20% of the deduction generated.

	generator receives a subsidy up to the fixed price or returns any surplus above the fixed price to the system, so it is sure always to receive the value of the strike price.
Electricity purchase contracts	France: Typical PPA terms and risk allocation in France - DLA Piper Corporate PPAs (dlapiperintelligence.com) In France, PPAs for companies can be physical or financial. Their duration can vary between approximately 5 years (*brownfield* projects) and 25 years (*greenfield* projects), depending on the maturity of the installation.
Renewable quotas or portfolio	Massachusetts (USA): Program Summaries | Mass.gov The programme requires retail electricity suppliers (regulated distribution companies and competitive suppliers) to source a percentage of the electricity they supply to their customers from qualified renewable energy installations.
Certificates of origin, guarantees of origin (renewable)	EU: Renewable Energy Guarantees of Origin | AIB (aib-net.org) An instrument of EU environmental policy, which aims to disclose and certify to the final consumer that a certain amount of electricity supplied to the distribution grid or transmission grid has been generated from renewable energy sources or in the process of high-efficiency cogeneration (CHP, i.e., combined heat and power).
Renewable auctions	Chile: CNE issued preliminary bidding rules for the 2023 supply tender for regulated customers with important innovations regarding the treatment of market risks and incentives for storage and non-variable renewable energies - Comisión Nacional de Energía The National Energy Commission issued the Preliminary Bases of the National and International Public Tender for the Supply of Energy and Electrical Power 2023/01 (5,400 GWh, divided into 2 Supply Blocks of 1,800 GWh and 3,600 GWh each, starting in 2027 and 2028 respectively).
Emissions trading scheme (permits)	Indonesia: Indonesia | International Carbon Action Partnership (icapcarbonaction.com) Launched in early 2023, it covers power generation from facilities larger than 100 MW and smaller coal and fossil fuel plants. The government sets intensity targets, which determine the number of allowances each installation receives for each MWh of electricity generated.

Source: own elaboration.

Table 15 Examples of regulatory incentives

Incentive	Example
Stable, fair and predictable regulatory framework	Uzbekistan and Chad (World Bank): GERI 2022: Global Electricity Regulatory Index - ESMAP Report (worldbank.org) According to the Global Electricity Regulatory Index (GERI), these are the two lowest-ranked countries in terms of "regulatory substance", which assesses the content of technical regulation applied in the electricity sector. It analyses the elements of tariff setting (level, structure, cost transfer rules, automatic tariff adjustment mechanisms and review schedules), quality of service standards, licensing frameworks, guidelines and procedures, and the human resource capacity of the regulator to carry out its functions.

Investment laws[84]	USA: Fact sheet: How the IEA Act´**s** tax incentives. USA: FACT SHEET: How the Inflation Reduction Act's Tax Incentives Are Ensuring All Americans Benefit from the Growth of the Clean Energy Economy | U.S. Department of the Treasury The IRA is legislation developed to combat climate change and promote investments in decarbonising the US economy. The goal is to increase investment and manufacturing in clean and decarbonised technologies.
International treaties, international investment agreements[85]	Energy Charter Treaty: Energy Charter Treaty - Energy Charter The Energy Charter Treaty provides a multilateral framework for energy cooperation in international law. It aims to promote energy security by operating more open and competitive energy markets while respecting the principles of sustainable development and sovereignty over energy resources. Paris Agreement: The Paris Agreement | UNFCCC It addresses technology development and transfer to improve resilience to climate change and reduce GHG emissions. It establishes a Technology Mechanism to accelerate the development and transfer of decarbonisation technologies.
Energy efficiency obligations	France: White Certificate Scheme & Obligation - Policies - IEA White certificates system and obligation. Under the French White Certificates Trading Scheme, energy suppliers (electricity, gas, heating oil, LPG, heating, cooling) must meet the government's energy savings targets through residential and tertiary customers. Suppliers are free to select actions to meet their targets, such as informing customers on how to reduce energy consumption, launching promotional programmes, offering incentives to customers, etc.
Energy saving certificate, energy efficiency certificate	New South Wales (Australia): Energy Savings Certificates | IPART (nsw.gov.au) An ESC is a tradable energy savings certificate created under Division 7 of Part 9 of the Electricity Supply Act 1995. Each ESC represents one notional MWh of energy.
Specific regulatory frameworks	Netherlands: Experimenten Elektriciteitswet 2015-2018 (rvo.nl) The Electricity Experiments Act 2015-2018 (*Experimenten Elektriciteitswet 2015-2018*) made it possible for cooperatives and owners' associations to deviate from the Electricity Act 1998. Under this scheme, the following were analysed: (i) the application of renewable energy or cogeneration in local initiatives, (ii) the efficiency of energy infrastructures and (iii) cooperation with end-users in energy supply.
Clean special economic zones	OECD: OECD Certification Scheme for Clean Free Trade Zones - OECD The Recommendation calls on Members and acceding non-Members to adopt and implement a voluntary Clean FTZ Code of Conduct.

Source: own elaboration.

[84] For more details on investment law, see UNCTAD (2024).

[85] For more details on international investment treaties, see UNCTAD (2024).

Table 16 Examples of knowledge and collaboration incentives

Incentive	Example
Information and technical services (consultancy, guidance, advisory, advisory, accounting or legal services; organisation of missions, partner search services - contact platforms between actors, lobbying activities, reduction of bureaucracy or simplification of procedures, reduction of administrative burden, one-stop-shop, etc.).	ELENA - European Local ENergy Assistance: ELENA - European Local ENergy Assistance (eib.org) ELENA provides technical assistance for investments in energy efficiency and renewable energy in buildings and sustainable mobility.
Training	Florida (USA): incentive-clean-energy-incentives.pdf (selectflorida.org) The *Quick Response Training Program* (QRT) provides grant funding for customised training that new or expanding companies need. The aim is to effectively retain and attract companies that create new quality jobs and clean technologies. The programme is structured to be flexible and "responsive" to companies' training objectives. The company can use its own customised training programme with its own trainer, provide training from an external provider or use a college, technical centre or university to provide customised training. Reimbursable training expenses include trainer/trainer salaries, curriculum development, textbooks/manuals and materials/supplies.
Public-private partnership agreements, Public-private partnerships	Turkey: Turkey: In Position || Site Selection Online It was one of the first countries to implement its own PPP legislation. 1994 Law 3996 was enacted for various areas such as transport, energy and water supply and treatment. An example of an investment made under a PPP is the Trans-Anatolian Natural Gas Pipeline (TANAP), which became operational in 2018.
Green Innovation Awards	Green product award: Login | Green Product Award (gp-award.com) This international award distinguishes products based on design, impact and sustainability criteria. Once a year, companies and *start-ups* can receive feedback on their products and services, and for nominees and winners, the award offers numerous advantages to distinguish themselves from their competitors in the market.
Green public procurement and contracting	Basque Country (Spain): Ihobe - News - 75% of Basque government purchases will be made on the basis of sustainable criteria within ten years The ACBC Green Purchasing and Contracting Programme 2030 identifies five areas of action from which 10 lines of action derive: (i) consolidating green purchasing and contracting as an essential tool for the deployment of policies, (ii) advancing commitment to both public and private green purchasing and contracting, (iii) turning

	green purchasing and contracting into a structural and innovative element in organisations, providing resources for a systemic and strategic implementation, (iv) to have an adequate, quality market, preparing supplier companies, especially SMEs, to meet the environmental demands of contractors, and (v) to make visible the progress, achievements and benefits of green purchasing and contracting, measuring implementation and its results, as well as communicating and promoting them.
International, global partnerships	USA - Canada: Cleantech Alliance - We help build the Cleantech Economy. US-Canada: CleanTech Alliance - We help build the CleanTech economy. The CleanTech Alliance represents over 1,100 organisations from 17 US states and four Canadian provinces. Founded in 2007 by clean technology and business leaders, the Alliance facilitates the creation and growth of clean technology businesses and jobs through various educational programmes, research, products, and services.
Green taxonomy, list of green technologies, identification of (common) interest projects	EU: EU taxonomy for sustainable activities - European Commission (europa.eu) The green taxonomy is a key element of the EU's sustainable financing framework and an important tool for market transparency. It helps direct investments towards the economic activities most needed for the transition, which are in line with the objectives of the European Green Deal. The taxonomy is a classification system that defines criteria for economic activities aligned with a net zero trajectory by 2050 and with broader environmental objectives other than climate.

Source: own elaboration.

ANNEX 2. Additional information on incentive programmes in the United States

Below are the projects that are eligible for production or investment tax credits.

Table 17 Projects eligible for IRA CTP or JTIs

Type of tax credit	Type of projects
PTC or ITC	Solar, wind, and geothermal electricity generation.
PTC	Electricity generation comes from biomass, landfills, waste, hydroelectric, marine, hydrokinetic sources, and zero-emission nuclear power: green hydrogen production, clean fuels, and carbon capture and storage.
ITC	Energy storage, microgrid controllers, fuel cells, geothermal (heat pump and direct use), cogeneration, biogas, microturbines, and interconnection costs. Industrial or manufacturing installation of clean energy equipment, emissions reduction, and critical materials.

Source: based on U.S. Environmental Protection Agency (EPA) and The White House (2023a).

Table 18 summarises the main support the IRA provides by type of technology and sector, following the clean technology classification presented in Table 2.

Table 18 Main IRA subsidies by technology and sector

Sector	Subsector
Agriculture and food chain	• Grants for financing and technical assistance to agricultural and forestry producers adopting conservation measures (US$ 3.25 billion). • Grants for technical assistance on the food chain, agriculture, finance and rural development issues (US$ 125 million).
Energy efficiency	• Tax credits for energy efficiency improvements in housing, purchasing energy storage systems and constructing new energy-efficient housing. • Tax deduction for improving the energy efficiency of commercial buildings. • Grants to state and local governments for developing and implementing efficient housing rebate programmes (US$ 4.5 billion). • Grants to state and local governments to adopt energy efficiency codes for buildings (US$ billion).
Energy generation and storage, environment and air quality	• Tax credits for electricity production from renewable sources and investment in renewable energy projects. • Tax credits for small-scale solar and wind projects in vulnerable or low-income communities.

	• Tax credits for nuclear power generation. • Tax credits for developing and transporting sustainable biofuels and aviation fuels. • Tax credits for green hydrogen production (the size of the tax credit depends on the emissions rate, i.e., the kilograms of carbon emitted per kilogram of H_2 produced). • Carbon capture and storage tax credits. • GHG reduction fund that provides grants for clean energy and climate projects, mainly focused on vulnerable communities (US$ 27 billion). • Loan guarantee programme for developing innovative clean technologies for energy generation, consumption, transport or distribution or that support decarbonisation, processing of critical materials or recycling (US$ 3.6 billion). • The EPA administered the Methane Emissions Reduction Programme to provide technical and financial assistance to accelerate the reduction of methane and other GHG emissions from natural gas and oil systems by developing new equipment, technological innovation and well closures (US$ 1.55 billion). In addition, the programme imposes a fee for methane waste emissions above a certain threshold[86]. • A loan and guarantee programme to finance farmers' investments in renewable energy systems or efficiency improvements (US$1.7 billion). • Energy Research Fund (US$ 2 billion). • Environmental and climate justice grants to empower vulnerable communities to design and implement clean energy and pollution reduction projects (US$ 3 billion).
Energy infrastructures	• A loan guarantee programme for investment in energy infrastructure, including infrastructure for carbon capture, utilisation, and storage (US$5 billion). • Loans and grants for constructing or modifying transport networks (US$ 2.8 billion). • Plan to model and analyse the electricity transport generated by offshore wind technology (US$ 100 million).
Materials and manufacturing processes	• Tax credits for investment in advanced energy projects such as establishing or expanding infrastructure for producing clean energy machinery, clean vehicles and emission reduction equipment. • Tax credits for producing wind and solar energy components, batteries, inverters and critical materials. • Subsidies for domestic heat pump production (US$ 250 million). • Subsidies for decarbonisation of energy-intensive industries (US$ 5.8 billion).
Transport and logistics	• Tax incentives for purchasing clean vehicles, subject to household income requirements. The Act provides a US$3,750 tax credit for vehicles that meet requirements for extraction or processing of critical materials in the US or countries with free trade agreements and an additional US$3,750 for vehicles that meet a threshold of US-manufactured battery components and domestic assembly requirements. • Tax credits for the purchase of clean second-hand vehicles of US$ 4,000 or 30% of the sales price, including the purchase of commercial vehicles. • Tax credits for households and businesses using alternative fuels such as bioethanol, biodiesel, and electric charging.

[86] The EPA announced that this rate would be US$ 900 per tonne, with increases to US$ 1,500 per tonne in 2026 (Daly, 2024).

	• Subsidies for producing clean vehicles, including hybrid, electric, and hydrogen fuel cell electric vehicles (US$ 2 billion). • Procurement programme for purchasing clean vehicles for the US Postal Service (US$ 3 billion).
Water and wastewater	• Grants for technical assistance for natural resource conservation projects that improve water and air quality, groundwater and surface water conservation, soil health improvement, wildlife habitat creation, and climate change mitigation (US$ 8.45 billion).

Source: own elaboration based on Boehm & Scalamandrè (2023) and The White House (2023a).

ANNEX 3. Additional information on incentive schemes in the European Union

Table 19 summarises the main aid programmes that can promote the development of clean technologies at the EU level.

Table 19 Aid programmes in Europe for the development of clean technologies

Programme/ Tool	Description	Types of incentives
Resilience and Recovery Facility (RRF)	The main instrument of the NextGenerationEU package with a budget of €723.8 billion. Member States can invest funds from the RRM in eligible projects through different financial instruments, which the EIB can implement (EIB, n.d.-a).	Loans, guarantees, quasi-equity, equity.
Cohesion Fund	This fund finances environmental and trans-European network projects in Member States with gross incomes below 90% of the EU average. Its budget is €392 billion from 2021 to 2027.	Loans, grants, equity or quasi-equity investments, and guarantees.
Horizon Europe Programme	A funding programme for research and innovation to mitigate the effects of climate change, achieve sustainable development goals, and increase EU competitiveness. It has a budget of €95.5 billion from 2021 to 2027.	Subsidies, grants, loans, guarantees, equity or quasi-equity investments, and guarantees.
Modernisation Fun	This fund finances 10 Member States for their transition to climate neutrality (Modernisation Fund, n. d.). It has a budget of €57 billion from 2021 to 2030, assuming a carbon price of €75/tCO_2.	Member States can choose the incentive form between subsidies, grants, guarantees, loans, and equity investments.
Innovation Fund	It is a fund financed by the EU ETS to finance the development of technology and net zero industries. Its budget is around €40 billion for 2020 to 2030 (European Commission, n.d.-h). It is key to financing programmes such as REPowerEU, the Hydrogen Bank, the Green Deal Industrial Plan, and the Net Zero Emissions Industry Act (see Subsection 4.2.2).	Regular grants or *subsidies* of up to 60% of the calculated costs (capital and operational costs minus profits in the first 10 years of operation). Up to 40% of the grant is awarded during the project preparation phase, the remainder during the project's operational phase, and subject to verification of

	It focuses on financing clean technology projects, processes in energy-intensive industries, carbon capture, storage and use, renewable energy generation, and storage.	abatement/avoidance of certain emission levels. It grants up to 100% of the calculated costs in competitive auctions and is granted during the project's operational phase, also subject to emission verifications. Competitive auctions for an activity or product, where the bidders requiring the least funds will win the support[87]. The fund offers three competitive auction mechanisms: fixed premium contracts, CfDs and carbon contracts for difference (CCfDs). The EIB is responsible for providing Project Development Support (PDA), where the maturity of projects is increased through technical and financial assistance.
Connecting Europe Facility	Instrument for financing trans-European networks for transport, energy, and digital services. It has a budget of €33.71 billion from 2021 to 2027. It identifies the European level of infrastructure needs for energy network projects and selects the IPCEI (Important Projects of Common European Interest) most likely to contribute to achieving the climate goals.	Grants, risk guarantees, and project bonds. Initiative of the European Commission and the EIB. Project bonds seek to create public-private partnerships for project financing through institutional investors. The initiative works by improving the promoters' credit quality and dividing the debt into two tranches: senior and subordinated. Subordinated debt or project bond credit enhancement can be a loan or credit line with the EIB. This enhances the credit quality of senior debt, which is then placed on the capital market through the issuance of bonds (EIB, n.d.-b).

[87] In the pilot of the competitive auctions under the Hydrogen Bank, open from November 2023, the Innovation Fund will hold an auction to finance green hydrogen generation projects. Each participant bids a fixed premium of euros/kilogram (€/kg) produced, bids are ranked from lowest to highest, and funds are allocated until the budget is exhausted (European Commission, n. f.-a).

InvestEU	Programme focused on supporting sustainable investment, innovation, and job creation in the EU. It also supports the REPowerEU scheme. It has a budget of €26.2 billion to support national and international financial institutions (such as the EIB and the European Investment Fund) to mobilise more than €372 billion of private investment (EIF, n. d.). It consists of three programmes: the InvestEU fund (European Union, n.d.-a), the European Advisory Centre (European Union, n.d.-c), and the InvestEU Portal (European Union, n.d.-d).	The InvestEU fund offers four products for financial intermediaries: (i) Guarantees: Financial intermediaries can apply to obtain guarantees for their lending of up to 80% of the amount. The percentage depends on whether it is a capped guarantee, the risk level of the debt portfolio, and its destination (in the case of funds for just transition or cohesion of regions, the maximum rate applies). The EIB is responsible for about 75% of the guarantees offered in the programme (Kleimann, Poitiers, et al., 2023). (ii) Equity: equity investments in or alongside funds in venture capital, private equity, and private credit. (iii) Climate and infrastructure funds: fund for investments in strategic climate action and environmental sustainability issues. (iv) Capacity-building instrument: advice to intermediaries focused on microfinance, social entrepreneurship, and financing the education and skills ecosystem. The InvestEU Advisory Centre provides technical assistance to projects seeking funding. Access to the InvestEU Portal database brings together investors and project promoters.
Just Transition Fund	A fund within the cohesion policy that seeks to support territories with socio-economic challenges arising from the green transition, it has a budget of €17.5 billion from 2021 to 2027 (Gouardères, 2023).	It mainly provides grants or subsidies. It attracts private investment through InvestEU and provides loans to the public sector through the EIB.
European Innovation Council Fund (EIC)	Main innovation programme of the Horizon Europe initiative. It seeks to support innovation by identifying, developing, and	Grants and equity investment for start-ups and SMEs.

	deploying technologies. It has a budget of €10.1 billion (EIC, n. d.)	
European Defence Fund	The fund promotes cooperation between companies and research actors to develop technologies and equipment for EU defence. It has a budget of €8 billion from 2021 to 2027 (European Commission, n.d.-c). It seeks to foster competitiveness and innovation in European defence value chains and to contribute to their strategic autonomy (Karaboytcheva, 2021).	It finances up to 100% of research costs through grants and between 20% and 80% of capacity-building activities (prototyping, testing, certification, etc.).
Digital Europe Programme	A funding programme to develop digital technologies for businesses, citizens and public administrations (PAs) (European Commission, n.d.-g). It has a budget of €7.5 billion from 2021 to 2027.	Grants or subsidies of up to 50% of the eligible costs incurred during the implementation of the project.
LIFE Programme	Programme for the financing of environment and climate action projects. It has four sub-programmes: (i) nature and biodiversity, (ii) circular economy and quality of life, (iii) climate change mitigation and adaptation, and (iv) clean energy transition (European Commission, n.d.-d). It has a budget of €5.4 billion from 2021 to 2027.	Subsidies or grants
Major Projects of Common European Interest (IPCEI)	A tool for coordinating the private and public sectors to finance innovation and infrastructure projects that are transnational or of high strategic importance to the EU. Projects are designed to correct market failures in the value chain and, therefore, require public incentives for their development. IPCEIs subsidise costs for validation studies, patenting, materials, purchasing or building or construction of buildings, infrastructure and land, personnel costs, and R&D&I activities. The maximum amount of aid may not exceed the minimum necessary to make the project profitable.	They provide grants or non-repayable grants, provided private promoters make significant contributions. Depending on the project's needs, they can also provide guarantees, collateral, or loans to solve problems with access to finance. If risk sharing is required, they can also make repayable advances to the promoter.
Chips for Europe Initiative - Chips Fund	Programme to support the development of technological and innovation capabilities in semiconductors in the EU.	Loans and equity investments for start-ups, scale-ups, SMEs, and mid-caps. An open and free design platform for simulating cooperation between users and key ecosystem

	actors to strengthen the industry's design capabilities (European Commission, 2023).

Source: own elaboration.

In addition, at the national and regional levels, Member States also have investment incentive programmes where they offer loans, guarantees, and endorsements, national support schemes for renewable energy generation (such as feed-in-tariffs and feed-in-premiums, which accounted for 80% of these schemes by 2020) and subsidies for the purchase of electric vehicles (subsidies were €6,000 on average). They also have public procurement rules and clean energy standards. At the regional level, there are Smart Specialisation Strategies, regional investment budgets, and the implementation of EU cohesion policies (Kleimann, Poitiers et al., 2023).

ANNEX 4. Additional information on incentive programmes in China

Energy and climate policy before the 14th Five-Year Plan

The Renewable Energy Act of 2005 was one of the first laws to promote renewable energy, including wind, solar, hydro, biomass, geothermal, and ocean energy. The Act is a comprehensive framework for energy source policies and prioritises renewable energy for the country's energy and high-tech industrial development (IEA, 2021f).

The Act introduced regulations requiring grid operators to purchase renewable energy quotas, preferential electricity tariffs for renewable energy, and financial incentives such as loan discounts and tax incentives. In 2006, FITs for renewables were introduced and strengthened in 2009-2011, incentives that succeeded in boosting the installed capacity of renewable energy sources, particularly wind and solar PV, and the development of the domestic turbine and solar panel manufacturing industry (BTI, 2023; IEA, 2021a).

As part of the incentive scheme for developing the wind industry, 2005 the NDRC imposed a local content requirement on wind power plants, requiring 70% of wind turbine components to be local. Subsequently, in 2009, the NDRC repealed the requirement but continued to consider local content a relevant factor in awarding wind farm concessions and imposing technical and procedural conditions on foreign developers (BTI, 2023).

Regarding energy intensity, the 11th Five-Year Plan (2006-2010) was the first to introduce an energy intensity reduction target (20% reduction over the five years of the plan). Since this plan, all of them have had targets for reducing the country's energy intensity (IEA, 2021a). In 2006, the Energy Saving Programme was also launched in the top 1,000 industries, where participating companies were required to formulate and implement energy-saving plans with the provinces' management, supervision, and fiscal incentives (IEA, 2021g).

In 2015, electricity market reforms were initiated to liberalise electricity pricing mechanisms, lower electricity prices, increase industrial productivity, and boost economic growth. In addition, in the 13th Five-Year Plan (2016-2020), a cap on coal use was introduced, providing greater certainty for the transition to renewable energy sources (IEA, 2021a).

2015 also saw the launch of the Made in China 2025 initiative, with the government seeking to exploit the synergies between the country's economic development and decarbonisation goals. The initiative aimed to boost manufacturing by strengthening technological innovation, product quality, and the transition to green production. The strategy included energy and material efficiency targets and controlling pollution levels. The target sectors of the strategy were electrical equipment, agricultural machinery, new materials, fuel-efficient and new energy vehicles, numerical control tools and robotics, information technologies, aerospace equipment, railway equipment, ocean engineering equipment, and high-end ships and medical devices (Cyrill, 2018; IEA, 2021a).

The China 2035 Standards Plan, launched in 2018, sought to accompany the Made in China 2025 Plan, with ambitions on standards for emerging technologies such as 5G internet, internet of things (IoT), and artificial intelligence, for use, among other applications, across the energy supply chain. The two plans are part of the strategy to make the country a leader in technological innovation (Chipman Koty, 2020). In the same vein, the National Energy Administration (NEA) published in 2018 its Action Plan for the Development of the Smart Photovoltaic Industry to promote the development of the industry with the implementation of intelligent automation and other technologies (BTI, 2023).

In 2018, the second phase of the Air Pollution Prevention and Control Action Plan (2018-2020) was adopted to address the deteriorating public health effects of increasing particulate pollution. The plan established targets for reducing emissions of major air pollutants and priority actions, such as promoting cleaner manufacturing processes, using clean energy and energy efficiency, developing clean transport systems, and promoting regional coordination in pollution prevention and control (IEA, 2021a).

As part of the recovery plan from the COVID-19 pandemic, the government pushed forward its New Infrastructure initiative, which included investments in the country's digital infrastructure, such as the construction of 5G networks, digitisation of energy infrastructure (ultra-high voltage transmission networks) and transport infrastructure (urban and inter-city high-speed rail networks and electric vehicle charging facilities); as well as investment in R&D and government support for private sector participation, by issuing special bonds, encouraging PPP and expanding credit support (Wong, 2020).

The National Emissions Trading Scheme (ETS) became operational in 2021. Together with the provincial schemes operating since previous years, it constitutes the market pricing mechanism and is expected to be an important market-based instrument to help the country meet its climate targets (IEA, 2021e).

Table 20 details the main energy and environmental targets of the 14th Five-Year Plan.

Table 20 Main energy and environmental objectives of the 14th Five-Year Plan

Target	*Description / Incentives*
Strengthening the national science and technology strategy (Part 2, Article IV)	• Establish national laboratories focusing on quantum information, photonics and micro- and nanoelectronics, networked communications, artificial intelligence (AI), biotechnology and pharmaceuticals, modern energy systems, and other significant fields of innovation. • Reorganise state laboratories and establish research and innovation centres, universities, and R&D institutions. • Promote resource sharing and cooperation between research institutes and companies. • Invest in basic research, optimise the cost structure, implement tax incentives for companies, and promote citizen investment through donations and fund creation.

	• Support the creation of international innovation centres in different cities. Develop independent innovation zones and invest in infrastructure. Create big data centres. • Create banks to provide resources for R&D.
Enhancing the technological innovation capacity of enterprises (Part 2, Article V)	• Implement tax deduction policies and tax incentives for investment in R&D for high-tech companies. • Optimise insurance compensation and incentive policies for developing and purchasing technological equipment. • Use public procurement policies to support the development of products and services. • Improve systems for evaluating R&D investment by state-owned enterprises and establish an independent accounting system. • Improve preferential tax rates to encourage innovation by small and medium-sized enterprises in the science and technology sector. • Create technology platforms to support the construction of innovation centres by companies, universities, research centres, etc. • Promote the integration of large, medium, and small enterprises to foster innovation and growth. • Make research platforms, reports, and data available to companies so that they can apply scientific results in the real sector. • Promote the licensing of S&T research results through fiscal funding to small and medium-sized enterprises. • Creation of institutions specialised in the transfer of technologies to the market. • Develop S&T financial products, such as the financing of intellectual property pledges and S&T insurance. • Deploy technology pilots to offset risk at this stage of project development. • Opening of national IPO funding channels for science and technology companies. • Encourage the development of venture capital investment.
Deepening the strategy to strengthen the manufacturing sector (Part 3, Article VIII)	• Strengthen international cooperation on industrial safety and promote production and supply chain diversification. • Enhancing the competitiveness of production chains in high-speed rail, energy equipment, new energies, maritime transport, and other fields. • Promote the development of innovative and green manufacturing, where clusters and innovation initiatives are developed in integrated circuit technologies, aerospace, marine and maritime engineering equipment, robotics, advanced rail transit equipment, advanced energy equipment, engineering machinery, high-end computer numerical control (CNC) machines, and medical and healthcare equipment. • Consolidate tax and fee reductions, reduce enterprises' production and operating costs, and enhance the manufacturing industry's competitiveness. • Expand the scale of medium and long-term lending to the manufacturing industry, increase lending for technological transformation, and promote equity investment and bond financing for the sector.
Developing and expanding the emerging industries strategy (Part 3, Article IX)	• Focus on developing strategic emerging industries such as next-generation information technology, biotechnology, new energies, new materials, high-end equipment, electric and hybrid vehicles, green products, aerospace, and marine equipment.

	• Encourage technological innovation, mergers, and company restructurings. Emphasise the industry's investment funds' guiding role and increase investment guarantees and risk compensation. • Organise and implement incubation and acceleration schemes for the future industry in neural intelligence, quantum computing, gene technology, future networks, seabed and aerospace development, hydrogen energy, energy storage, and other cutting-edge technologies. • Deploy national research institutes for future industrial technologies and strengthen the exploration of cutting-edge and disruptive technologies.
Building a modern infrastructure system (Part 3, Article XI)	• Strengthen support for digital transformations, smart upgrades, integration, and innovation. • Deploy new infrastructures, such as information, integration, and innovation. • Accelerate the digital transformation of traditional infrastructures such as transport, energy, and municipal administration and strengthen the construction of smart grids and innovative dispatch systems. • Giving the market a leading role, opening up diversified investment channels, and building new types of standard infrastructure systems. • Promote energy transition and build a clean, low-carbon, secure, and efficient energy system. • Accelerate the development of non-fossil energy by increasing the scale of wind and photovoltaic power generation and accelerating the development of distributed energy. Boost the construction of coastal nuclear power. Increase the share of non-fossil energy in total energy consumption to around 20%. • Encourage the concentration of coal production in resource-rich areas, reasonably control the scale and pace of development of coal-fired power plant construction, and promote the substitution of coal for electricity. • Accelerate the smart transformation of the electricity grid and smart microgrids construction. • Strengthen the connection between sources, grids, and loads to improve the electricity system's complementarity and smart adjustment capability. • Increase clean energy consumption and storage capacity and improve transmission and distribution capacity for remote areas. • Promote the flexible refurbishment of coal-fired power plants and accelerate the construction of pumped storage plants and the large-scale application of new energy storage technologies.
Facilitating domestic movement (Part 4, Article XII)	• Improve tax and fee reduction policies and build a tax system that helps businesses expand investment, increase investment in R&D, regulate income distribution, and reduce consumer burden.
Promoting domestic-international movement (Part 4, Article XIII)	• Optimise foreign investment services and strengthen foreign investment promotion and protection. • Support increased foreign capital investment in manufacturing technology, transformations, and traditional manufacturing and services modernisation. • Support the creation of R&D centres and participation in implementing national science and technology projects by foreign-funded companies. • Encourage reinvestment of profits by companies financed from abroad.
Improving ecosystem quality and stability (Part 11, Article XXXVII)	• Increase transfer payments for key ecological function areas, source areas of important water systems, and nature reserves.

	• Improve ecological compensation in the market and encourage the participation of various types of social capital[88] in ecological protection and restoration.
Accelerating the green transformation of the development model (Part 11, Article XXXIX)	• Prioritise energy efficiency in industry, construction, transport, and public bodies. • Promote increased energy efficiency in emerging fields such as 5G and large data centres. • Strengthen the energy efficiency of energy-consuming units, implement key projects such as energy system optimisation, and accelerate the formulation and revision of mandatory national standards on energy consumption and efficiency quotas for products and equipment. • Strengthen conservation and intensive land use. Improve the development and protection of mineral resources and develop a green mining industry. • Build a market-oriented green technology innovation system, with green technology innovation research and benchmarking initiatives, and improved resource efficiency of key industries and products. • Establish a unified system of standards, certification, and labelling of green products and improve promotion mechanisms for energy-efficient appliances, high-efficiency lighting products, and water-saving appliances. • Strengthen legal and political guarantees for green development. Implement fiscal policies that favour energy efficiency, environmental protection, and integrated resource use. • Develop green finance, improve the remunerative use of natural resources, and innovate and improve pricing mechanisms for natural resources, wastewater and waste treatment, and water and energy use.
Implementing priority strategies for employment (Part 14, Article XLVII)	• Coordinate vocational training funds at all levels and types, develop innovative utilisation methods, and open channels for training subsidies to reach enterprises and trainers. • Improve pre-tax deduction policies for training expenses and encourage companies to train and improve labour skills.

Source: own elaboration based on Xinhua News Agency (2021).

[88] The term social capital is used synonymously with social finance, social investment and social capital to refer to any investment outside the government budget. It includes private investment and investment by state-owned enterprises (Daly, 2024).

ANNEX 5. Additional Information on Incentive Programmes in Canada

Main policy developments and instruments before 2020

Canada has a long history of developing investment incentives. For example, for more than 70 years, it has had the Industrial Research Assistance Programme, which supports SMEs in developing innovation capacity and bringing ideas to market (Scarpaleggia, 2023). Since 2002, it has also had Sustainable Development Technology Canada's Seed Funding[89], Start-up Funding and Scale-up Funding to accelerate the progress of SMEs in the development and commercialisation of clean technologies.

More recently, since 2015, the Government of Canada has been taking numerous steps to develop a clean economy: (i) €4.2 billion for the Low Carbon Economy Fund to install emission-reducing technologies in provinces and territories, businesses, Aboriginal communities and other organisations; (ii) 3.3.8 billion for the Canadian Key Minerals Strategy to make Canada a global supplier of key minerals; (iii) 3.9 billion in funding to make zero emission vehicles more affordable and build new charging stations; (iv) 1.5 billion for the Clean Fuels Fund including clean hydrogen and biofuels; (v) 4.4.7 billion for the National Trade Corridors Fund (ports, roads, railways and airports); (vi) 33.5 billion for the public transport infrastructure programme, green infrastructure and community, cultural and recreational infrastructure, as well as in rural and northern communities; (vii) 35.35 billion for the Canada Infrastructure Bank to attract private capital to significant infrastructure projects; (viii) 75 million from the Clean Technology stream of the Impact Canada Initiative; (ix) 1 billion from the Zero Emission Vehicle Infrastructure Programme; and (x) 2.6 billion for the new Canada Innovation Corporation, which will help Canadian companies invest in research and development.

The country has the Canada Cleantech Alliance, a Canadian coalition of 22 cleantech associations and accelerators representing more than 2,000 manufacturers, innovators, investors, developers and researchers from across the country. It is led by Clean Energy Canada, Écotech Québec, Energia Ventures, Foresight, the Ontario Cleantech Industry Association (OCTIA) and the Smart Prosperity Institute.

Canada's Clean Economy Plan, as outlined in section 4.4, is organised around four pillars: (i) targeted programmes, (ii) strategic financing, (iii) investment tax credits[90] and (iv) pollutant emissions pricing and regulatory framework. In addition, it proposes to strengthen trade by (i) establishing a National Supply Chain Strategy through strategic investments in trade corridors, (ii) maintaining preferential duty-free access across the G7 and to two-thirds of the world's consumers through the Canada-US-Mexico Agreement, the Canada-US-Mexico Agreement, the

[89] In 2023, Sustainable Development Technology Canada (SDTC) suspended all funding due to some irregularities (Leblanc, 2023), and by spring 2024, it had still not resumed. This could have jeopardised small cleantech companies hoping to receive funding under the programme.

[90] Generally, the term tax credit is understood in international cases as a deduction from the tax liability.

Canada-US-Mexico Agreement, the Canada-US-Mexico Agreement, the Canada-US-Mexico Agreement and the Canada-US-Mexico Agreement. The Canada-US-Mexico Agreement, the Canada-European Union Comprehensive Economic and Trade Agreement and the progressive and comprehensive Trans-Pacific Partnership Agreement, while strengthening Canada's share of global investment; and (iii) ensuring Canada's inclusion in electric vehicle incentives under the US IRA and activities related to key minerals used in the production of electric vehicle batteries.

This requires boosting innovation and productivity by (i) stimulating business R&D through the creation of the Canada Innovation Corporation for both new and established industries; (ii) supporting invention and innovation through global innovation clusters, intellectual property and funding for cutting-edge research and artificial intelligence, quantum computing, genomics and life sciences; (iii) modernising Canada's world-class research infrastructure through investments in National Research Council facilities and university campuses across the country; (iv) maintaining a highly competitive corporate tax rate; and (v) building infrastructure through the Invest in Canada infrastructure programme[91], the Canada Infrastructure Bank[92] and other programmes.

As a result, there is a need to invest in people: (i) fund health care, child benefits, early learning and child care; (ii) ensure that Canadian workers benefit from investment tax credits; (iii) address labour shortages; (iv) provide targeted tax assistance to Canadian professionals through a labour mobility deduction and a doubling of the deduction for tooling expenses; (v) prepare the Canadian workforce for quality jobs through skills development, such as the Sectoral Workforce Solutions Programme, Skills for Success, the Union Training and Innovation Programme and the Apprenticeship Service; and (vi) support Canada's students and youth through scholarship and student loan programmes.

Budget 2022

The Growth Plan for Canada (GFC) was created in 2022 as a subsidiary of the Canada Development Investment Corporation (CDEV). Based on sound investment principles, the government sets the priorities and responsibilities of this operationally independent entity.

The CGF will make investments that catalyse private sector investments (in private projects and companies) that help transform and grow Canada's economy (Government of Canada, 2022).

CGF investments will help achieve climate targets for emission reductions, accelerate the deployment of key technologies (e.g., low-carbon hydrogen and CCUS), generate employment, boost productivity and clean growth in new and traditional sectors, foster intellectual property retention, capitalise on the country's natural resources, and strengthen critical supply chains.

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[91] A programme that is part of the Invest in Canada Plan and provides stable, long-term financing to reduce air and water pollution, provide clean water, increase resilience to climate change and build a clean growth economy, create strong, vibrant and inclusive communities, and ensure access to modern, reliable services for Canada's families. More than 33 billion in funding will be delivered through bilateral agreements.

[92] Catalyst for private investment in projects that support economic growth, for key sectors such as green infrastructure, clean energy, public transport, trade and transport and broadband infrastructure.

In 2022, Canada's Critical Minerals Strategy Discussion Paper was released. It is a draft strategic plan outlining Canada's approach to becoming a leader in the responsible, inclusive, and sustainable production of critical minerals, from mining to manufacturing. The draft was launched before a new Canada's Critical Minerals Strategy was developed.

Budget 2023

In parallel to the US IRA, the Canadian government has developed a major ("unprecedented") incentive package for the country's clean technology industry. The first chapter is about affordable living and sustaining the middle class; the second is about investing in care, public health and accessible services; the third is about affordable energy, good jobs and a growing clean economy; the fourth is about advancing reconciliation and building a Canada that works for all; the fifth is about Canada's global leadership; and the sixth chapter is about effective government and a fair tax regime.

According to Vitello (2023), although the climate and industrial policy presented in Canada's 2023 federal budget does not match the coverage provided by the IRA, the Canadian approach allows a level playing field between the two countries for certain types of clean investment and financing. In addition, the Canadian government itself envisages benefiting from some of the conditions set out in the IRA as "buy North American", which ensures that the supply of key minerals processed and batteries manufactured in Canada is supported by an automotive manufacturing partnership (Gouvernement du Canada, 2023).

The budget for investment in human capacity building is also included.

The budget includes more than $80 billion over 10 years in new measures to combat climate change and accelerate the deployment of clean technologies in Canada, bringing the total amount to $200 billion. Below is an excerpt from the budget.

Table 21 The Canadian Plan: Affordable Energy, Good Jobs and a Growing Clean Economy (thousands of Canadian dollars)

	2022-2023	2023-2024	2024-2025	2025-2026	2026-2027	2027-2028	***Total***
3.1. Investing in clean electricity	**0**	**8**	**1 081**	**1 683**	**2 146**	**2 443**	***7 361***
Introduce a tax credit for clean electricity investment	0	0	800	1 400	1 900	2 200	*6 300*
Supporting clean electricity projects	0	10	288	289	252	249	*1 088*
Funds from other existing departmental resources	*0*	*-3*	*-7*	*-6*	*-6*	*-6*	*-27*
3.2. A growing clean economy	**0**	**173**	**1 464**	**2 331**	**3 499**	**3 632**	***11 099***
Introducing an investment tax credit for clean technology manufacturing	0	35	1 015	1 020	1 170	1 270	*4 510*
Introducing a tax credit for clean hydrogen investment	0	90	330	1 150	2 050	1 940	*5 560*
Improving reduced tax rates for manufacturers of zero-emission technologies	0	0	5	5	5	5	*20*
Supporting clean technology projects	0	0	8	42	94	151	*294*
Extend eligibility for tax relief to investment in clean technologies and geothermal energy, among others.	0	0	20	25	45	95	*185*
Updated guidelines on federal obligation to consult	0	3	6	3	0	0	*11*
Improving the carbon capture, use and storage investment tax credit	0	45	80	86	135	170	*516*
Administrative costs	0	1	1	1	1	1	*5*

Funds from other existing departmental resources	*0*	*0*	*0*	*0*	*0*	*0*	*-2*
3.3. Investing in the Canadian Workforce	**1**	**566**	**84**	**-132**	**-204**	**-208**	***107***
Doubling the deduction for tools for traders	1	2	2	2	2	2	*11*
Supporting employee collective trusts	0	0	2	3	5	10	*20*
Investing in Canada's labour market transfer agreements	0	625	0	0	0	0	*625*
Continuing to support seasonal employment insurance claimants	0	5	77	65	0	0	*147*
Protecting jobs through timely access to job-sharing arrangements	0	2	2	2	0	0	*5*
Provide ongoing support to the Student Internship Programme.	0	0	198	0	0	0	*198*
Employment Insurance premium income for measures included in the 2023 budget	0	-68	-197	-203	-211	-220	*-899*
3.4. Reliable transport and resilient infrastructure	**-16**	**195**	**157**	**153**	**209**	**224**	***921***
Strengthening Canada's trade corridors	0	5	12	13	13	9	*52*
Funds from other existing departmental resources	*0*	*-3*	*-9*	*-8*	*-8*	*-8*	*-35*
Investing in VIA Rail trains and services	0	117	5	10	39	39	*210*
Investing in the Canadian Coast Guard	0	23	26	23	23	24	*120*
Funds from other existing departmental resources	*0*	*-6*	*-6*	*-5*	*-5*	*-5*	*-28*
Ensuring the safety and reliability of ferry services in eastern Canada	0	15	15	0	0	0	*30*
Redeveloping the Bonaventure Expressway and supporting transport infrastructure in Montreal	0	42	114	120	146	164	*587*
Carry-over of funds from one year to the next	*-16*	*0*	*0*	*0*	*1*	*1*	*-15*
3.5. Investing in tomorrow's technology	**-24**	**53**	**129**	**196**	**210**	**196**	***759***
Using university research to help companies grow	0	39	36	33	0	0	*109*
Supporting Canadian leadership in space	0	17	53	119	174	146	*508*
Funds from other departmental resources	0	0	-1	-40	-49	-48	*-138*
3.6. Investing in Canada's forest economy	**0**	**85**	**130**	**153**	**0**	**0**	***368***
Funds from other departmental resources	*0*	*-10*	*-10*	*-10*	*0*	*0*	*-30*
Establishing the Dairy Innovation and Investment Fund	0	0	1	21	81	94	*196*
Funds previously earmarked in the fiscal framework	*-24*	*-100*	*-100*	*-100*	*0*	*0*	*-324*
Helping farmers to move away from Russian fertilisers	0	5	14	14	0	0	*34*
Funds from other existing departmental resources	*0*	*-7*	*-7*	*-7*	*-7*	*-7*	*-34*
Lowering interest rates for agricultural producers	0	13	0	0	0	0	*13*
Maintaining livestock exports with a foot-and-mouth disease vaccine bank	0	12	12	12	12	12	*58*
Additional investments - A Canadian plan: strong middle class, affordable economy, prosperous future	**0**	**218**	**200**	**184**	**50**	**35**	***686***
Extend flow-through share deductions and tax relief for critical mineral exploration to lithium brine mining activities.	0	3	3	3	3	2	*14*
Support for advanced transport technologies	0	37	49	53	0	0	*138*
Support the accessibility and safety of the Canadian transport system.	0	84	85	86	0	0	*255*
Less: Costs to be recovered	*0*	*-1*	*-2*	*-2*	*0*	*0*	*-5*
Funds from other existing departmental resources	*0*	*-1*	*-1*	*-1*	*0*	*0*	*-3*
Enhancing the capacity of the Canadian Transportation Safety Board	0	5	4	4	4	4	*20*
Funding for the Explosive Detection Dogs Programme and the handler team	0	4	6	6	7	7	*30*
Renewal of funding for Regional Economic Growth through Innovation programme	0	50	0	0	0	0	*50*
Renewal of funding for the Diverse Inclusion and Economic Change programme in the North	0	0	15	15	15	0	*44*
CFIA market access and food security programme	0	38	38	16	16	16	*126*
Renewing the assets of the AAC laboratory	0	0	1	3	4	5	*13*
Funds from other existing departmental resources	*0*	*0*	*0*	*0*	*0*	*0*	*-1*
Future Arctic oil and gas exploitation	0	1	2	2	1	1	*7*
Funds from other existing departmental resources	*0*	*0*	*0*	*0*	*0*	*0*	*-2*
Chapter 3 - Net budgetary impact	**-39**	**1 213**	**3 114**	**4 415**	**5 910**	**6 322**	***20 934***
Clean air and water	**0**	**168**	**231**	**237**	**106**	**62**	804

Protecting freshwater resources	0	82	92	91	84	84	433
Funds from other existing departmental resources	0	-42	-42	-42	-34	-34	-194
Protection of Canada's whales	0	37	53	53	0	0	144
Cleanliness and greening of port facilities	0	5	39	60	51	7	162
Funds from other existing departmental resources	0	-1	-1	-1	-1	-1	-3
Protecting endangered species	0	61	61	61	0	0	184
Improving catastrophe insurance	0	14	14	3	0	0	32
Raising awareness of flood risks	0	4	6	6	0	0	15
Funds from other existing departmental resources	0	-1	-1	-1	0	0	-4
Modernising federal disaster aid	0	11	13	8	8	8	48
Funds from other existing departmental resources	0	-3	-3	-2	-2	-2	-12

Note: The figures in this table should be treated cautiously, as they are mostly projections or aspirational targets and may not lead to the expected disbursements.
Source: translated from Gouvernement du Canada (2023) Chapter 3 and Chapter 4.3.

ANNEX 6. Additional information on incentive programmes in India

Other policies or measures to promote technologies in India include those related to energy efficiency, bioenergy, smart agriculture, labour market, and training and R&D, which are detailed below.

Energy efficiency

In 2011, the National Mission for Enhanced Energy Efficiency (NMEEE) was launched under the NAPCC, which sought to create a regulatory and policy regime to promote energy efficiency. The mission has four initiatives to improve energy efficiency in energy-intensive industries (Ministry of Power, n. d.):

- Perform Achieve and Trade Program: a market-based mechanism to increase the cost-effectiveness of energy efficiency improvements in energy-intensive industries with mandatory energy reduction targets. The programme works by certifying energy savings above the required target, which can be traded,
- Market Transformation for Energy Efficiency: to accelerate the switch to energy-efficient equipment through innovative measures to make products more affordable (e.g., providing incentives for producers of efficient equipment and products to sell at discounted prices),
- Energy Efficiency Finance Platform: for the creation of mechanisms to help finance demand-side management programmes in all sectors,
- Economic Framework for Energy Efficiency Development for financial and other incentives. There are programmes such as (i) the Energy Efficiency Partial Risk Guarantee Fund, which operates through project risk guarantees to provide commercial banks with partial coverage of project development risk; (ii) the Energy Efficiency Venture Capital Fund, which is a fund aimed at financing projects through venture capital; and (iii) the National Energy Conservation Awards to industry and other establishments, granted by the Ministry of Energy.

Bioenergy

MNRE launched the National Bioenergy Programme for 2021-2026 in 2018, with an outlay of Rs. 858 crores in Phase I. The programme is divided into the following three programmes: (i) Waste to Energy Programme, which seeks to incentivise power generation from municipal, industrial, and agricultural waste; (ii) Biomass Programme, which seeks to support briquette and pellet manufacturing and promotion of cogeneration from biomass in industries, and (iii) Biogas Programme for promotion of small biogas plants. The programmes operate through CFA to finance capital costs or per unit produced (MNRE, 2023).

Intelligent agriculture

India aims for agricultural value chains to adopt green and climate change impact mitigation practices while increasing productivity and security in the sector. This Climate Smart Agriculture

(CSA) approach features data analytics practices, innovative technologies, and accompaniment, especially for smallholder farmers. In addition, it offers subsidies and grants to lower the costs of adopting green practices and guaranteeing farmers' incomes during the transition process.

Labour market and training

Through scholarships to students and research scholars in R&D and academic institutions in renewable energy, the MNRE's Human Resource Development (HRD) Scheme supports workforce training at all levels, including promoting higher studies and research courses. The programme has initiatives such as: (i) short-term training and skills development in renewable energy; (ii) scholarships for higher studies and research in renewable energy; (iii) improvement of education and training infrastructure in renewable energy; (iv) renewable energy chair; and (v) the national renewable energy internship programme (MNRE, 2023).

Research and development

The MNRE, through the Renewable Energy Research and Technology Development Programme (RE-RTD), provides up to 100% financial support to government, non-profit research organisations, and NGOs, and 50-70% to industry. The programme provides project identification, formulation, monitoring, evaluation, approval, and financial support guidelines (MNRE, 2023).

ANNEX 7. Additional information on incentive schemes in the United Kingdom

Main policy developments and instruments pre-2020

In order to achieve the decarbonisation target, firstly, carbon budgets were established, which are currently defined until 2037, and which restrict the volume of emissions that can legally be emitted for five-year periods by all sectors of the economy. Secondly, in 2013 the Energy Act was passed (updated again in October 2023), a regulatory document of great importance which, among others, developed a series of mechanisms that accompanied the reform of the electricity market in the UK. These include the capacity market, the regulatory scheme for electricity distribution activity (RIIO) to incentivise investment and innovation in distribution networks, contracts for difference and the reduction of electricity demand through energy efficiency measures.

The government implemented a Carbon Price Floor (CPF) for electricity generation, in order to promote the necessary investment in low-carbon energy that the EU ETS had failed to achieve. To advance decarbonisation, renewable energy sources are promoted, for which *renewable obligations* (ROs) were used between 2002 and 2017[93]. More recently, contracts for difference[94], with *feed-in-tariffs,* have been reintroduced. These contracts incentivise investment in renewables by allowing project developers, with high upfront costs and long lifetimes, direct protection against volatile wholesale market prices. In addition, the allocation by technology auctions allows the cost of projects to be contained (Larrea Basterra & Bilbao Ozamiz, 2020).

In 2017, The UK Clean Growth Strategy was approved, accompanied by an investment of over £2.5 billion for low-carbon technology innovation. This strategy set out 50 policies to drive progress on decarbonisation across all areas of the economy and society, which also maintained synergies with the Industrial Strategy.

For its part, the Industrial Strategy, also of 2017, set out four major challenges for the country, two of them related to energy (clean growth and mobility of the future) and a third one with a broad spectrum, but also with an impact on the energy sector, referring to artificial intelligence and the data revolution. The fourth challenge relates to the ageing population. In this way, the United Kingdom closely linked energy policy to industrial policy for decarbonisation and, to this end, sought to rely on innovation, on its ability to attract talent and investment, as well as on funding.

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[93] This scheme established the obligation for electricity suppliers to guarantee an increasing amount of electricity from renewable sources. Thus, each MW of renewable electricity received a certificate of origin.

[94] These contracts were key to providing certainty to the *offshore* wind sector and incentivising continued cost reductions. However, as cost reductions do not guarantee a maximum level of costs, an annual cap on the total costs of support measures for negative emission technologies was introduced, controlled by the Treasury. For this process, the Climate Change Act established the Climate Change Committee (CCC), an independent public body that advises the UK, the Government and Parliament on how to address and prepare for climate change.

In 2019, the Green Finance Strategy, updated in 2022, and the Clean Air Strategy were published. The Clean Air Strategy complements the Clean Growth Strategy (2017), the 25-year Environment Plan (2018) and the Industrial Strategy (2017). It sets out a range of measures needed to improve air quality.

Main elements of PoB and PoB's Net Zero Growth Plan

The PoB is organised around three main themes the set of objectives, approaches and incentives it offers (HM Government, 2023a) as can be seen in Table 22.

Table 22 Main elements of the Powering Up Britain programme

Scope of action	Incentive
Clean and secure energy supply	
Nuclear programme	Future Nuclear Enabling Fund: GBP 120 million
Floating offshore wind	Floating Offshore Wind Manufacturing Investment Scheme: £160 million
Solar	-
CCUS	20 billion fund
H_2	Net Zero Hydrogen Fund: £240 million
Networks	Developing a Connections Plan
Planning	Development of clear and orderly planning
Electricity market	Electricity market review
RCDE-UK	Development of a long-term pathway
Responding to a growing demand for efficiency in homes and businesses	
Energy efficiency	Energy Company Obligation Scheme: GBP 1 billion
Heat networks	Heat Network Transformation Programme: 220 million euros
Clean heat	Heat Pump Investment Accelerator: £30 million[95]
Fuel price rebalancing	-
Support for the rest of the economy	
Industry	Industrial Energy Transformation Fund: £185 million
Carbon leakage	Consultation on a border carbon adjustment mechanism and product standards
Zero-emission vehicles	-
Sustainable aviation fuels	Advanced Fuels Fund: £165 million Subsidies to Airbus

[95] *Grants* for boilers to double to £7,500 (Crerar et al., 2023).

Natural resources, waste and fluorinated gases	Environmental Land Management Schemes, Agricultural Investment Fund and Agricultural Innovation Programme
Green Finance Strategy 2023	Taxation, regulation, planning reform, targeted spending and international collaboration.
Supporting green capacities	Net Zero Action Plan and Nature Workforce by 2024

Source: own elaboration based on HM Government (2023a).

The Table 23 lists some of the areas in which work has been carried out in the framework of this plan in recent years.

Table 23 Main elements of The Net Zero Growth Plan - Powering Up Britain

Area	Detail of developments
Increased ambition for renewables and record capacity secured	CfD (offshore wind, onshore wind, solar, tidal, geothermal, floating offshore wind) Floating Offshore Wind Manufacturing Investment Scheme: £160 million VAT exemption on solar panels installed on houses until 2027 Measures to reduce the time needed to build renewable energy installations Improving the resilience of supply chains by making funds available to support key port and manufacturing infrastructure through the Offshore Wind Manufacturing Investment Plan and strengthening the CfD Supply Chain Plan process. Offshore Wind Roadmap
Deliver up to 24 GW of nuclear capacity by 2050	1.7 billion in direct government funding for one nuclear project to reach the Final Investment Decision in Parliament and for two projects to reach the Final Investment Decision in the next. Launch of Great British Nuclear which will deliver the government's long-term nuclear programme and support the government's ambition to deliver up to 24 GW of nuclear power in the UK by 2050. Supporting SMRs and advanced modular reactors (AMRs) by investing up to 210 million and providing up to 55 million in funding to develop two new AMRs. R&D in the Reactor Design Demonstration and Regulatory Support programme.
Delivery of at least one CCUS by the mid-2020s	Negotiations with Net Zero Teesside Power. Approval of legislation for the Dispatchable Power Agreement (DPA), which will provide the basis for negotiations. Consultation on business models for energy, bioenergy with carbon capture and storage (Power BECCS). Evaluation of the presentation of the BECCS energy project.
Strategically designed network infrastructure	Strategic Framework for Electricity Networks in August 2022. Accelerate connections for the new generation and demand, with an action plan. Holistic Network Design published by the National Grid System Operator (ESO). Changes to Ofgem regulation to allow network infrastructure to be built ahead of requirements. This includes £20 billion in transmission projects. Response to the consultation on the decision to establish the Future System Operator (FSO). In 2021, Ofgem recommended to the Government that additional responsibilities should be assigned to the system operator, that the system operator should be independent from the transmission system owner among others. 100 million Marine Coordination Support Scheme to support interconnection and offshore wind projects. Consultation on the Strategy and Policy Statement for Energy Policy, and a consultation on community benefits.

	Consultation on changes to the National Energy Policy Statements, to reflect the strategic importance and need for network infrastructure and a strategic and coordinated approach.
Intelligent Systems and Flexibility Plan and Energy Digitisation Strategy	Consultation for a new policy framework for energy smart appliances and demand response services. Deployment of more than 30 million smart and advanced meters in homes and businesses across Britain. New Demand Flexibility Service, as an additional tool to manage the electricity system in winter. Up to £65 million through the Flexibility Innovation Programme together with up to £68 million through the Energy Storage programme. Smart charging action plan for electric vehicles in January 2023. At least 18 GW of interconnector capacity by 2030 and pilot multi-purpose interconnectors. The UK Infrastructure Bank (UKIB) will appoint capital fund managers covering electricity storage. UKIB will invest by attracting wider sources of funding. In the future, UKIB expects to make direct investments in the electricity storage sector.

Note: some of these elements are repeated from the table on PoB.
Source: own elaboration based on HM Government (2023c).

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