United Nations Industrial Development Organization (UNIDO)

Clean Tech Tracking Framework and Assessment Report

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Mind the Bridge

EY

Building a better working world

Table of Contents

1. Abbreviations and Acronyms

AJP	American Jobs Plan
ARPA-C	Advanced Research Projects Agency-Climate
ARPA-E	Advanced Research Projects Agency-Energy
BAU	Business As Usual
BBB	Build Back Better
BIM	Building information modeling
BLOOM	The Cleantech Cluster Barbados
CARICOM	Caribbean Community
CCS	Carbon capture and storage
CSA	Corporate Sustainability Assessment
DJSI	Dow Jones Sustainability Indices
EGDIP	European Green Deal Investment Plan
ESG	Environmental, Social, and Governance
EU	European Union
EV	Electric Vehicles
EY	EY Caribbean and EY Costa Rica
FCA	Future Cleantech Architects
FDI	Foreign direct investment
GDP	Gross Domestic Product
GHG	Greenhouse gas
GMA	Greater Metropolitan Area
GMO	Genetically modified organism
IIA	Israel Innovation Authority
ICO	Initial Coin Offering
IDB	Inter-American Development Bank
IFI	International financing institution
IMF	International Monetary Fund
IoT	Internet of things
IPO	Initial Public Offering
MTB	Mind the Bridge
MSA	Media and Stakeholder Analysis
NDC	Nationally Determined Contribution
OECD	Organisation for Economic Co-operation and Development
OEM	Original equipment manufacturer
PPP	Purchasing power parity
R&D	Research and development
R&I	Research and innovation
SASB	Sustainability Accounting Standards Board
SDGs	Sustainable Development Goals
SEIP	Sustainable Europe Investment Plan
SMEs	Small and medium-sized enterprises
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
VC	Venture Capital

2. Literature Review

2.1 Introduction and Research Scope

In the existing literature, “Clean Tech” appears to be used as a broad term whose definition scope changed over time depending on several factors including technological advancements, mutating socio-economic contexts, and international agreements. With the ultimate goal of providing a synthetic definition of “Clean Tech” and an up-to-date classification framework (*taxonomy*), we aim at tracking the evolution of the term by assessing the historical expansion of its scope in several industry areas - also including so-called “*enabling technologies”* in the analysis.

To provide a broader overview of the current and future status of Clean Tech at a global level, the analysis will take into consideration the ongoing development of a sustainable investments’ taxonomy at European level, also in relation to the UN Sustainable Development Goals (“SDGs”) and other international agreements.

2.2 Brief History of the Term

To shed light on the evolution of the scope of Clean Tech innovation, we aim at addressing the issue from the perspective of a particular financial sector - the Venture Capital (“VC”) industry, which can prove particularly useful to identify past, current, and future trends in the field.

Following a similar model to the one used to track Silicon Valley’s waves of innovation (Blank, 2009), it is possible to identify a pattern in the evolution of the scope of innovation in the “Clean Tech” field.

The use of the term can be traced back to about 30 years ago in the VC community (O’Rourke, 2009). From a VC perspective, about a decade later, the term was used to assess the interest in early energy transition efforts commonly defined as “Green Energy and Technology” by the then emerging phenomenon of *green VC* or *environment-related VC* (Randjelovic et al., 2003). In that period, the term gained popularity in the media but quickly became a *buzzword* (Shakeel, 2021) encompassing different technologies in several sectors rather than evolving into a new sector per se (Caprotti, 2012), including those technologies commonly referred to as “*sustainability tech*”.

Most recently, the emerging political and socio-economic debate regarding a tech-based approach to environmental challenges - including climate change, with the reduction of greenhouse gas (“GHG”) emissions and net-zero targets - suggest that the emergence and growth of Clean Tech depends on both incremental innovation and groundbreaking technologies in the field (Caprotti, 2012). More specifically, government backing appears to be effective and necessary in supporting the spur of innovation, especially tackling climate change-related issues and challenges (EU, 2020) and high-risk, long-term “deep technology” investments (Gaddy et al., 2017). Emerging technologies in the specific field of Climate Tech must be therefore considered as part of the Clean Tech sector (Clean Tech Group, 2021).

Moreover, it is necessary to take into account the ongoing debate and recent efforts in the definition of a complete taxonomy of sustainable investments including enabling technologies that are key to the development of groundbreaking innovations in the Clean Tech sector (EU, 2021).

2.3 Clean Tech Definition Framework

The Organisation for Economic Co-operation and Development ("OECD"), in its Glossary of Statistical Terms, includes the following definition of Clean Technology: "the installation or a part of an installation that has been adapted in order to generate less or no pollution" (OECD, 1997), which sets the environmental control element as key differentiator. The definition has been used for clustering exercises that encompass major sectors including Renewable Energy, Water, Environment, Materials, and Agro Technology (OECD, 2012).

According to a comprehensive expert survey on the future needs of Clean Tech R&D conducted by Future Clean Tech Architects ("FCA"), future trends to be added to the previously mentioned industrial applications include for the next decade those related to decarbonization and carbon capture/storage, industrial conversion, and nuclear energy including storage (Schniering, 2021). Notably, the same survey by FCA indicates that technology drivers for the long-term future (2030 and beyond) will include digital deep technologies (so-called "enabling technologies") e.g., IoT, Artificial Intelligence, Blockchain and Carbon Finance, Sensors and Monitoring, Asset Management and Digitization, etc.

Hybrid technologies are supposed also to take over in the future (e.g., farming photovoltaics) (Schniering, 2021), as deep technologies increase their applicability to a wide range of sectors (Mind the Bridge, 2021, own elaboration on proprietary data).

Specific sectors, for example, energy - require further attention, as - from the VC investment point of view - they tend to be capital intensive, affected by regulation, and unevenly distributed in terms of relative growth rates of individual technology verticals (Kivity, 2020). This fact points to further attention in devising a taxonomy framework that takes into consideration those key differences.

From the point of view of regulatory bodies, as made clear by the efforts of the *Clean Tech Group* in the context of the *Global Clean Tech Innovation Index* analysis and report, Clean Tech may refer to "any process, product, or service that can help to reduce negative environmental impacts through methods such as significant energy efficiency improvements, the sustainable use of resources, or environmental protection activities" (Hasan, 2021). More specifically, international agreements and policy orientation at global level, such as the desired achievement of SDGs is expected to take significant and well-targeted investment actions (Tilbury, 2020).

Evidence-based reports (Government of Canada, 2020) remark the necessity of taking into account global targets - such as a qualified selection of environment-related challenges indicated by the SGDs - to build proper taxonomies of Clean Tech from an investment perspective, which is key for fostering sustainable innovation ecosystems.

The necessity of a broader, general approach to defining “Clean Tech” therefore appears to be the most reasonable provided the current state of the art, in order also to provide a framework of reference that can take into account future developments and trends of the industry. Therefore, we apply to the scope of this research the synthetic definition of “Clean Tech” hereby indicated:

Clean Tech represents the technologies and business model innovations that enable the transformation to a more resource efficient and low carbon economy.

2.4 Taxonomy Framework

2.4.1 Introduction to the Proposed Taxonomy Framework

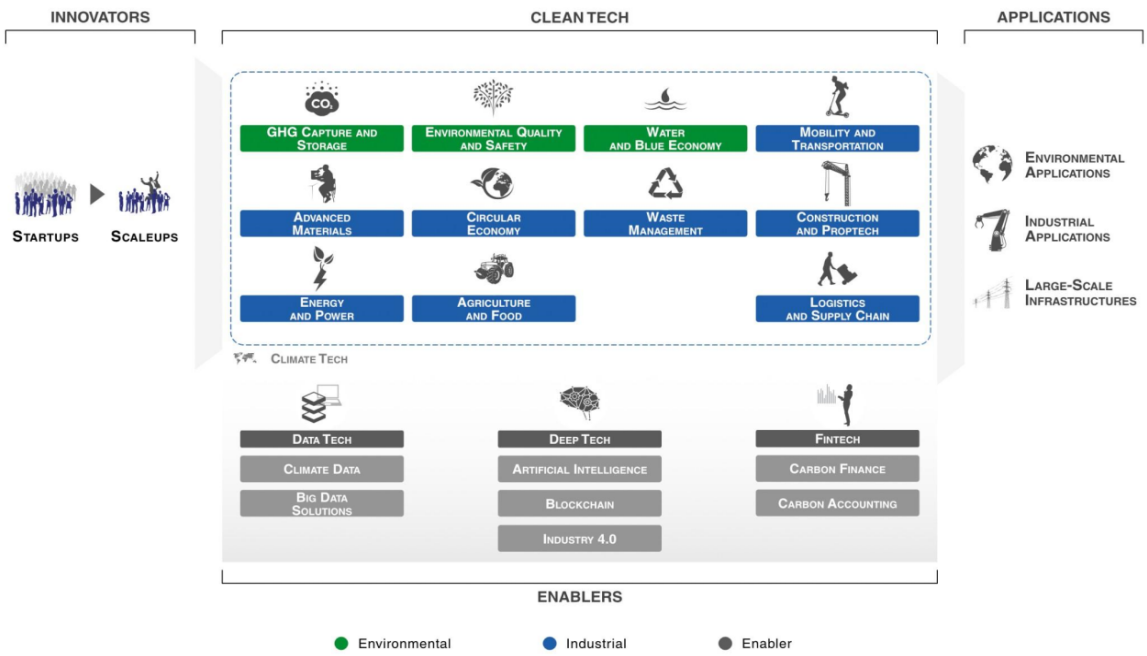

Figure 1: Proposed Taxonomy of Clean Tech Innovations

According to the previously discussed existing literature, we propose the following taxonomy of Clean Tech innovations generated by startup and scaleup ecosystems at global scale, for effective analysis, comparison, and identification of industry trends.
The proposed taxonomy distinguishes between:

- Clean Technologies
- Enabling Technologies

The former aim to include and distinguish between environmental-related technologies (including Sustainability Technologies) and industrial technologies that fit the aforementioned Clean Tech definition.

Enabler Technologies, on the other hand, include products and services that, though not directly accountable as “Clean Tech”, “enable”, “facilitate”, or support the creation of entirely new product-markets in the field of Clean Tech.

All Clean Technologies indicated in the taxonomy may have multiple applications:

- Environmental applications
- Industrial applications
- Large-scale Infrastructure applications

Enabler Technologies may support all applications by contributing to any Clean Technology indicated in the taxonomy.

It is worth noting that any startup or scaleup analyzed within the context of the Clean Tech Tracking Framework can develop and market products or services that apply to more than one technology or application, a global trend identified by recent reports especially in relation to deep technologies (Mind the Bridge & Crunchbase, 2021).

2.4.2 Environmental Technologies

Taking into account existing approaches (Clean Tech Group, 2017 - EY, 2013), we include and distinguish (by associating - where relevant - the main related sub-technologies/sub-verticals) in the proposed taxonomy the following Environmental Technologies:

- **GHG Capture and Storage (CCS)**
  GHG Removal, GHG Storage, Carbon Footprint Monitoring, Carbon Capture, CCUS, Carbon Sequestration

- **Environmental Quality and Safety**
  Environmental Management Systems, Environmental and Natural Resource Management, Environment, Health and Safety (EHS), Reforestation, Afforestation, Land Resource Management, Deforestation Prevention

- **Water and Blue Economy**
  Desalination, Water Purification, Water Distribution, Wastewater Treatment, Leak Prevention, Water Management Systems, and Ocean technologies

Notably, Carbon Capture and Storage (“CSS”) is a thriving industry whose investments more than doubled at global scale in 2020 (BloombergNEF, 2020), fueled also by government research funding. For this field, 2021 was clearly identified as a potential pivoting year due to the momentum of net-zero emissions targets. Then, CCS could grow significantly in the next decade.

2.4.3 Industrial Technologies

Similarly taking into account existing approaches (Clean Tech Group, 2017) and tracking existing reported trends (appropriately referenced below), we include and distinguish (by associating - where relevant - the main related sub-technologies/sub-verticals) in the proposed taxonomy the following Industrial Technologies:

- **Mobility and Transportation** (Crist, 2021)
  Engine Efficiency, Engine Design, Engine Materials, Electric Vehicles, Micro Mobility, e-Mobility Infrastructure, Ride Sharing, Charging Points, Transport Efficiency, Autonomous Vehicles, Sensor Technologies, Predictive Maintenance and Repair, Low GHG Heavy Duty Road Transport

- **Advanced Materials**
  Biofuels, Biochemicals, Bio-based Polymers, Materials and Chemicals Discovery, Composites

- **Circular Economy** (WBCSD, 2021)
  Circular Design, Reuse, Secondary Material Markets, Biomass Supply, Waste-to-energy

- **Waste Management**
  Recycling, e-Waste, Wastewater

- **Construction and Proptech**
  Urban Planning, Urban Design, Smart Building, Building Management, Thermal Storage, Innovative Construction Methods, Lighting, Fixtures, Fittings, Heating, Cooling, Energy Consumption, Smart Metering, Efficient Construction, Modular Construction, 3D Printing, Additive Manufacturing, Imagery Computing, BIM

- **Energy and Power**
  Alternative Fuels, Renewable Energy, Energy Storage, Supply-demand Balancing Mechanisms, Energy Efficiency, Oil and Gas Efficiency, Fossil Fuel Energy Generation Efficiency, Wind Energy, Solar Energy, Nuclear Generation, Battery Technology

- **Agriculture and Food**
  Food Production Methods, Carbon Intensive Food Production Replacement, Synthetic Proteins, Insect Proteins, Low GHG Farming, Precision Farming, Vertical Farming, Aeroponics,, Soil Carbon Emission Reduction, Food Supply Chain Management, Fertilisers, Agritech Robotics, Agricultural Genomics, Aquaculture

- **Logistics and Supply Chain**
  Delivery Tech, Safe Transport and Circular Supply Chains

Notably, Climate Tech is considered as a cross-cutting technology, thus surpassing the so-called “Clean Tech 1.0” trend that was visible in the first decade of the new millennium. That trend focused primarily on the energy sector (European Patent Office, 2021) and, as such, was substantially ill-fated (Pitchbook, 2021), and as previously mentioned has been of relatively small significance in terms of providing a clear definition of Clean Tech, as new trends in the energy sector appear to be more closely aligned with other industry verticals (World Economic Forum, 2021).

As defined by Pitchbook, Climate Tech may refer to “*solutions across various industries that seek to help countries and businesses reduce carbon emissions”* (Pitchbook, 2021). Other authoritative sources (Streimelweger, 2021) also report Climate Tech innovation to be targeting a broad range of industry verticals while seeking to decarbonize the economy.

2.5 Other Approaches

In the last two decades, investors have been increasingly considering non-financial factors as part of their due diligence and analysis processes to identify and track financial and material risks and opportunities for investment and growth. As a reference, Environmental, Social, and Governance (“ESG”) investing gained extensive popularity in just about 20 years, to the point that in 2020 an estimated 25% of all new investments are in ESG funds, with a global total of $23 trillion (Hill, 2020).

As part of this trend, we identified the following two approaches to the evaluation of corporate sustainability to be reviewed in order to assess the eventuality of the existence of

comparable KPIs and/or processes that can be appropriately applied to the evaluation of a Clean Tech ecosystem at national level.

2.5.1 Dow Jones Sustainability Index

The Dow Jones Sustainability Indices ("DJSI") are float-adjusted market capitalization weighted indices that measure the performance of companies selected with ESG criteria using a best-in-class approach (S&P Global, 2021).

Launched in 1999, the DJSI provides an integrated assessment of each company according to a series of governance & economic, environmental and social criteria, with a strong focus on long-term shareholder value.

Social Dimension **Criteria Topics**	**Environmental Dimension** **Criteria Topics**	**Governance & Economic** **Criteria Topics**
Addressing Cost Burden	Biodiversity	Anti-crime Policy & Measures
Asset Closure Management	Building Materials	Brand Management
Corporate Citizenship and Philanthropy	Climate Strategy	Codes of Business Conduct
Financial Inclusion	Co-Processing	Compliance with Applicable Export Control Regimes
Health Outcome Contribution	Electricity Generation	Corporate Governance
Human Capital Development	Environmental Policy & Management Systems	Customer Relationship Management
Human Rights	Environmental Reporting	Efficiency
Labor Practice Indicators	Fuel Efficiency	Energy Mix
Local Impact of Business Operations	Genetically Modified Organisms	Financial Stability and Systemic Risk
Occupational Health and Safety	Low Carbon Strategy	Fleet Management
Partnerships Towards Sustainable Healthcare	Mineral Waste Management	Health & Nutrition
Passenger Safety	Operational Eco-Efficiency	Information Security / Cybersecurity & System Availability
Responsibility of Content	Packaging	Innovation Management
Social Impacts on Communities	Product Stewardship	Market Opportunities
Social Integration & Regeneration	Raw Material Sourcing	Marketing Practices
Social Reporting	Recycling Strategy	Materiality
Stakeholder Engagement	Resource Conservation and Resource Efficiency	Network Reliability
Strategy to Improve Access to Drugs or Products	Sustainable Forestry Practices	Policy Influence
Talent Attraction & Retention	Transmission & Distribution	Principles for Sustainable Insurance
	Water Operations	Privacy Protection
	Water Related Risks	Product Quality and Recall Management

Social Dimension Criteria Topics	Environmental Dimension Criteria Topics	Governance & Economic Criteria Topics
		Reliability
		Risk & Crisis Management
		Strategy for Emerging Markets
		Supply Chain Management
		Sustainable Construction
		Sustainable Finance
		Water Related Risks

Table 1: DSJI Assessment Criteria

To assess any company, a specific set of criteria is defined (see Table 1). Information sources include a Corporate Sustainability Assessment questionnaire (“CSA”), company documentations, a Media and Stakeholder Analysis (“MSA"), and direct contact with companies (S&P Global, 2021a).

On the one hand, particularly effective is the layered approach that includes primary and secondary information including media and stakeholder perspectives, while on the other hand the individual criteria are appropriate for corporate investment analyses.

By assessing the results of the *Sustainability Yearbook* (S&P Global, 2021b) based on the DSJI Assessment Criteria in Table 1, it is possible to compile Table 2 below which includes the main Clean Tech-related sustainability issues that are of significant relevance to the DSJI industry areas that can be associated with the technology distinctions that we included in the Clean Tech taxonomy.

Technology Application/DSJI Industry Area	DSJI Key Clean Tech-related Sustainability Issues
Environmental Technologies - Paper and Forest Products	- Biodiversity - Operational Eco-Efficiency - Product Stewardship - Sustainable Forestry Practices - Water Related Risks
Industrial Technologies - Automobiles - Biotechnology - Building Products - Chemicals - Construction & Engineering - Construction Materials - Electric Utilities - Food Products - Gas Utilities - Homebuilding - Multi and Water Utilities - Real Estate - Transportation and Transportation Infrastructure	- Biodiversity - Building Materials - Climate Strategy - Electricity Generation - Fuel Efficiency - Low Carbon Strategy - Operational Eco-Efficiency - Packaging - Product Stewardship - Raw Material Sourcing - Resource Conservation and Resource Efficiency - Transmission and Distribution - Water Related Risks
Enabler Technologies - Banks - Insurance - Software	- Climate Strategy - Environmental Policy & Management Systems - Operational Eco-Efficiency

Table 2: DSJI Key Clean Tech-related Sustainability Issues

2.5.2 Sustainability Accounting Standards Board

The Sustainability Accounting Standards Board ("SASB") was founded as a nonprofit organization in 2011 to help businesses and investors develop a common language about the financial impact of sustainability. SASB Standards guide the disclosure of financially material sustainability information by companies to their investors. Available for 77 industries, the Standards identify the subset of ESG issues most relevant to financial performance in each industry (SASB, 2021).

Sustainability Accounting serves the purpose of "identifying the impacts that environmental, social and human capital issues have on business models, financial performance, and long-term enterprise value, and how businesses adapt corporate strategy, risk management, and governance in response". The SASB standards are organized into five broad sustainability dimensions: *Environment, Social Capital, Human Capital, Business Model and Innovation, Leadership and Governance*. The Standards also identify industry-specific measures (SASB, 2020).

Each dimension is assessed to evaluate the capability of the company of achieving "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Report, *Our Common Future*).
The sustainability dimensions as defined by SASB appear to be applicable to Clean Tech innovation ecosystems and country approaches by evaluating:

- Environmental impact of activities
- Social impact on the ecosystem's stakeholders, including human rights, protection of vulnerable groups, etc.
- Long-term management of the workforce (more broadly - the human capital of the ecosystem), including culture, workers' rights, labor practices, etc.
- Business model resilience and integration of sustainability in innovation processes and product and service design of the ecosystem's stakeholders
- Governance, regulations, ethical approaches, professional integrity and liability.

By assessing individual SASB standards related to SASB industry areas connected with the technological applications that we included in the Clean Tech taxonomy presented here, it is possible to compile Table 3 below that includes all the main Clean Tech-related "sustainability disclosure topics & accounting metrics" that are of significant relevance and may support the identification of specific key sustainability issues that Clean Tech solutions may address.

Technology Application/SASB Industry Area	**SASB Sustainability Disclosure Topics & Accounting Metrics - Sustainability Issues**
Environmental Technologies	
Forestry Management	- Ecosystem Services & Impacts - Rights of Indigenous People - Climate Change Adaptation
Water Utilities	- Energy Management - Distribution Network Efficiency - Effluent Quality Management - Water Affordability & Access - Drinking Water Quality - End-Use Efficiency - Water Supply Resilience - Network Resilience & Impacts of Climate Change
Wind Technology & Project Developers	- Workforce Health and Safety - Ecological Impacts of Project Development - Materials Sourcing - Materials Efficiency

Technology Application/SASB Industry Area	SASB Sustainability Disclosure Topics & Accounting Metrics - Sustainability Issues
Industrial Technologies	
Agricultural Products	- Greenhouse Gas Emissions - Energy Management - Water Management - Food Safety - Workforce Health and Safety - Environmental & Social Impacts of Ingredient Supply Chain - GMO Management - Ingredient Sourcing
Automobiles	- Product Safety - Labor Practices - Fuel Economy & Use-Phase Emissions - Materials Sourcing - Materials Efficiency & Recycling
Biofuels	- Air Quality - Water Management in Manufacturing - Lifecycle Emissions Balance - Sourcing & Environmental Impacts of Feedstock Production - Management of the Legal & Regulatory Environment - Operational Safety, Emergency Preparedness & Response
Building Products	- Energy Management in Manufacturing - Management of Chemicals in Products - Product Life Cycle Environmental Impacts - Wood Supply Chain Management
Chemicals	- GHG Emissions - Air Quality - Energy Management - Water Management - Hazardous Waste Management - Community Relations - Workforce Health & Safety - Product Design for Use-phase Efficiency - Safety & Environmental Stewardship of Chemicals - Genetically Modified Organisms - Management of the Legal & Regulatory Environment - Operational Safety, Emergency Preparedness & Response

Technology Application/SASB Industry Area	SASB Sustainability Disclosure Topics & Accounting Metrics - Sustainability Issues
Construction Materials	- GHG Emissions - Air Quality - Energy Management - Water Management - Waste Management - Biodiversity Impacts - Workforce Health & Safety - Product Innovation - Pricing Integrity & Transparency
Electric Utilities	- GHG Emissions - Energy Resource Planning - Air Quality - Water Management - Coal Ash Management - Energy Affordability - Workforce Health & Safety - End-Use Efficiency & Demand - Nuclear Safety & Emergency Management - Grid Resiliency
Food (Retailers, Processing)	- Fleet Fuel Management - Air Emissions from Refrigeration - Energy Management - Food Waste Management - Data Security - Food Safety - Product Health & Nutrition - Product Labeling - Labor Practices - Management of Environmental & Social Impacts in the Supply Chain - Packaging Lifecycle Management - Ingredient Sourcing
Fuel Cells and Industrial Batteries	- Energy Management - Workforce Health & Safety - Product Efficiency - Product End-of-life Management - Materials Sourcing
Home Builders	- Land Use & Ecological Impacts - Workforce Health & Safety - Design for Resource Efficiency - Community Impacts of New Developments - Climate Change Adaptation

Technology Application/SASB Industry Area	SASB Sustainability Disclosure Topics & Accounting Metrics - Sustainability Issues
Marine and Road Transportation	- GHG Emissions - Air Quality - Ecological Impacts - Employee Health & Safety - Business Ethics - Accident & Safety Management - Driver Working Conditions
Oil & Gas (Exploration, Midstream, Refining)	- GHG Emissions - Air Quality - Water Management - Biodiversity Impacts - Competitive Behaviour - Operational Safety, Emergency Preparedness & Response - Hazardous Materials Management - Workforce Health & Safety - Product Specifications & Clean Fuel Blends - Pricing Integrity & Transparency - Management of the Legal & Regulatory Environment - Critical Incident Risk Management
Real Estate (including Services)	- Energy Management - Water Management - Management of Tenant Sustainability Impacts - Climate Change Adaptation - GHG Emissions - Air Quality - Driver Working Conditions - Accident & Safety Management
Solar Technology & Project Developers	- Energy Management in Manufacturing - Water Management in Manufacturing - Hazardous Waste Management - Ecological Impacts of Project Development - Management of Energy Infrastructure Integration & Related Regulations - Product End-of-life Management - Materials Sourcing
Waste Management	- GHG Emissions - Air Quality - Fleet Fuel Management - Management of Leachate & Hazardous Waste - Labor Practices - Workforce Health & Safety - Recycling & Resource Recovery

Technology Application/SASB Industry Area	SASB Sustainability Disclosure Topics & Accounting Metrics - Sustainability Issues
Enabler Technologies	
Consumer Finance	- Customer Privacy - Data Security - Selling Practices
Insurance	- Fair Advice - Transparent Information - Incorporation of ESG Factors in Investment Management - Responsible Behaviour Incentives - Environmental Risk Exposure
Internet Services	- Hardware Environmental Footprint - Data Privacy - Advertising Standards - Freedom of Expression - Data Security - Employee Recruitment, Inclusion & Performance - IP Protection & Competitive Behaviour

Table 3: SASB Sustainability Disclosure Topics & Accounting Metrics

2.6 Conclusions and Future Research Developments

The proposed definition and taxonomy of Clean Tech serve the main purpose of providing a methodology for tracking startup and scaleup Clean Tech innovation ecosystems in the context of the Clean Tech Tracking Framework of Barbados.

Far from being exhaustive and definitive, the definition and taxonomy allow for an appropriate mapping and tracking of the performance of startups and scaleups in the field, by providing a structured yet comparable framework to extract, archive, and analyse data from existing open data sets, to identify the main technology trends, taking into account also so-called “enabling technologies”.

Future research may also take into further consideration the results of the ongoing debate on the EU Taxonomy of sustainable investments and recent evolutions in the legislative processes related to Clean Tech and widespread adoption of renewable energy sources in the United States.

3. Clean Tech Strategies and Innovation Policies Overview in Leading Country Areas

In the following sections, we provide an overview of the dedicated Clean Tech Strategies and Innovation Policies of a selected subset of countries and innovation ecosystems worldwide and in the Caribbean. The ecosystems of EU27, US, and Israel have been considered for their prominent, benchmarking positioning among global innovation ecosystems[1.]

To provide a more comprehensive picture of the Caribbean ecosystem, and identify regional benchmarks and comparables, we also provide an overview of the policies and strategies related to Clean Tech innovation of Costa Rica and the Dominican Republic, selected according to the relevance of their energy transition policies and for their proximity to Barbados.

For each country/area we provide an individual synthetic scoring used to produce the public policy assessment in the context of the Clean Tech Tracking Framework (see Section “Two-Axes Tracking Framework” and Methodology for a detailed description of scores and evaluations).

3.1 European Union

3.1.1 Dedicated Strategy

In 2019, the European Union (EU) launched the EU Green Deal, a three-decade policy effort to make the Union climate neutral by 2050[2]. The policy is aimed at meeting the goals of the

[1] Mind the Bridge, *Evolve or Be Extinct - Current and Future Models of Open Innovation from the 2021 World’s Corporate Startup Stars*, Paris, December 2021

[2] European Commission, *The European Green Deal sets out how to make Europe the first climate-neutral continent by 2050, boosting the economy, improving people's health and quality of life, caring*

Paris Climate Agreement, an international treaty on climate change introduced in 2015 with the long-term aim of keeping the rise in global temperatures below 2°C (3.6°F), reducing the impact of climate change[3].

The EU recognizes that climate change and environmental degradation are an existential threat to Europe and to the world. To overcome these challenges, the EU Green Deal is bound to transform the EU into a modern, resource-efficient and competitive economy, ensuring:

- No net emissions of greenhouse gasses by 2050 (green transition)
- Economic growth decoupled from resource use (sustainable economic growth)
- No person and no place left behind (societal challenges)

The EU Green Deal is a complex set of policy initiatives in the following areas[4]:

- Clean Energy
- Sustainable Industry
- Building and Renovation
- Farm to Fork
- Eliminating Pollution
- Sustainable Mobility
- Biodiversity
- Sustainable Finance

Action areas include:

- Climate
- Energy
- Agriculture
- Industry
- Environment and Oceans
- Transport
- Finance and regional development
- Research and innovation

Synthetic Assessment: ✦✦✦✦✦ (5 out of 5)
The EU Green Deal is a global benchmarking initiative due to its long-term scope, ambitious nature, and complexity. Tailored to tackle the existential challenges posed by climate change, including societal issues, the strategy seems appropriate to support Clean Tech innovation and entrepreneurship through dedicated and budgeted actions.

for nature, and leaving no one behind, December 11, 2019, Brussels, retrieved from: https://ec.europa.eu/commission/presscorner/detail/en/ip_19_6691

[3] European Commission, *Delivering the European Green Deal*, retrieved from: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en

[4] European Commission, *A European Green Deal*, retrieved from: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

3.1.2 Dedicated Incentives

To finance the policies envisioned in the EU Green Deal, the EU plans to leverage the "InvestEU" investment plan, forecasting at least €1 trillion in investment. Furthermore, approximately €260 billion per year should be required by 2030 in investments to reach the aforementioned goals[5].

Currently, one third of the €1.8 trillion investments from the NextGenerationEU Recovery Plan from the COVID-19 pandemic has been allocated to finance the EU Green Deal[6]. EU countries must devote at least 37% of the financing they receive under the €672.5 billion Recovery and Resilience Facility to investments and reforms that support climate objectives[7].

Moreover, the EU Commission has put in place the European Green Deal Investment Plan (EGDIP), also referred to as Sustainable Europe Investment Plan (SEIP), as part of the Green Deal. This includes the Just Transition Mechanism, which focuses on ensuring a fair and just transition to a green economy. It will mobilise significant investments over the period 2021-2027 to support citizens of the regions most impacted by the transition[8].

In addition to these, sustainable finance measures, including the Taxonomy Regulation for classifying green investments to avoid "greenwashing" and increase investment focus, will contribute to the European Green Deal by boosting private sector investment in green and sustainable projects including Clean Tech solutions[9].

De-incentives are also envisioned to foster the decarbonization of the EU economy, including a carbon pricing for the aviation sector[10].

Synthetic Assessment: ✦✦✦✦✦ (5 out of 5)
The budget appears to be appropriately sized. Its co-investment strategy, including public-private partnerships, seems to be adequate to foster further investments and reach the desired targets. De-incentives (preliminary efforts towards "carbon taxation") complement a complex and well-structured incentive plan. Since individual actions are delegated to individual member states, they may be susceptible to political debate.

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[5] European Commission, *The European Green Deal Investment Plan and Just Transition Mechanism explained*, January 14, 2020, Brussels, retrieved from: https://ec.europa.eu/commission/presscorner/detail/en/qanda_20_24

[6] Pellegrini, V., *Europe on the Moon, the Green Deal: generativity or old economy make-up operation?*, 89Initiative, July 30, 2021retrieved from: https://89initiative.com/europe-on-the-moon-the-green-deal-generativity-or-old-economy-make-up-operation/

[7] European Commission, *NextGenerationEU: Questions and answers on the Recovery and Resilience Facility*, June 16, 2021, Brussels, retrieved from: https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_3014

[8] European Commission, *Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions Sustainable Europe Investment Plan European Green Deal Investment Plan*, January 14, 2020, Brussels, retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2020:21:FIN

[9] European Commission, *EU taxonomy for sustainable activities - What the EU is doing to create an EU-wide classification system for sustainable activities*, retrieved from: https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en

[10] European Commission, *Reducing emissions from aviation*, retrieved from: https://ec.europa.eu/clima/eu-action/transport-emissions/reducing-emissions-aviation_en

3.1.3 Research Investments

According to the EU, research and innovation (R&I) will play a determining role in accelerating and navigating the necessary transitions to support Europe in becoming the world's first climate-neutral continent by 2050. R&I can also contribute to the deployment, demonstration, and de-risking of specific solutions, and support in the engagement of citizens in social innovation[11].

The core R&I programme of the EU is Horizon Europe (2021-2027). Horizon Europe works in synergy with other investment programmes and national public and private investment vehicles to help foster sustainable solutions and disruptive innovation.

The EU allocates 35% of the total Horizon Europe budget to address climate change and support clean technologies[12]. Specific actions include the following:

- *EU Green Partnerships*
  Horizon Europe is set to include a new wave of R&I partnerships in critical areas such as transport - including batteries - clean hydrogen, low-carbon steel, circular bio-based sectors, the built environment and biodiversity. By bringing private and public partners together, European Partnerships help avoid the duplication of investments and contribute to reducing the fragmentation of the EU R&I landscape. With €8B in budget, Green Partnerships are set to run from 2021 to 2030[13].
- *EU Green Missions*[14]
  EU Missions are a new way to bring concrete solutions to large-scale challenges. They have ambitious goals and will deliver concrete results by 2030, moving research and innovation into a new role, combined with new forms of governance and collaboration, as well as by engaging citizens. Examples of such missions include eg. supporting 150 regions to become climate resilient by 2030, make 100 climate neutral and smart cities, restore oceans and water.

Through a pilot call, "Green Deal Call", the last one under the EU's previous R&I programme "Horizon 2020", the EU Commission made available €1 billion to support 73 projects directly contributing with Clean Tech solutions to the EU's response to the climate crisis and help

[11] European Commission, *Research and innovation for the European Green Deal - The role of research and innovation in the European Green Deal, Horizon Europe and its green missions and partnerships, EU-funded projects news and related content*, retrieved from: https://ec.europa.eu/info/research-and-innovation/strategy/strategy-2020-2024/environment-and-climate/european-green-deal_en

[12] European Commission, *Supporting climate action through the EU budget*, retrieved from: https://ec.europa.eu/clima/eu-action/funding-climate-action/supporting-climate-action-through-eu-budget_en

[13] European Commission, *Commission and industry invest €22 billion in new European Partnerships to deliver solutions to major societal challenges*, June 14, 2021, Brussels, retrieved from: https://ec.europa.eu/commission/presscorner/detail/en/IP_21_2943

[14] European Commission, *EU Missions in Horizon Europe*, retrieved from: https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe_en#:~:text=EU%20Missions%20will%20support%20Europe's,their%20design%2C%20implementation%20and%20monitoring.

protect Europe's unique ecosystems and biodiversity. The call attracted 1,500+ proposals from a pool of 25,000+ partners[15]*.*

Synthetic Assessment: ✦✦✦✦✦ (5 out of 5)
EU R&I for Clean Tech and climate change programmes are structured and a significant budget has been already allocated and partially deployed. The broad scope of the programme may partially reduce the focus on clean technologies, though at the same time it would help tackle several societal challenges. Access to funding is still relatively hindered by structural bureaucratic challenges and not uniform between member states.

3.2 United States

3.2.1 Dedicated Strategy

The 2020 Biden-Harris presidential electoral campaign outlined a clear plan - based on the Green New Deal public policy proposal - to make the United States (US) economy 100% based on clean energy and to support the country in reaching a net-zero emissions goal by 2050.

The plan envisioned a $1.7 trillion federal investment over 10 years in clean energy and environmental justice, along with unique policy goals of rallying the world to meet the threat of climate change by leveraging a strong diplomatic effort.
In February 2021, the Biden administration made its first step in that direction by rejoining the Paris accords, which the US had officially exited in the previous year by the orders of then President Donald Trump.

In November 2021, the Biden Administration published the *"The Long-Term Strategy of the United States, Pathways to Net-Zero Greenhouse Gas Emissions by 2050"* document which presents the overall vision of the United States and areas of development to be prioritized to achieve its goal of net-zero emissions by 2050[2]. To solidify its approach, the United States led the creation of the *Global Methane Pledge*[3], an initiative together with over 100 countries to reduce global methane emissions to keep the goal of limiting global warming to 1.5 degrees Celsius, within reach. It is expected that more concrete efforts will be made public through the publishing of the *The U.S. National Climate Strategy*[2] in the next few months.

During 2021, the Biden administration structured a legislative framework - the "Build Back Better agenda" (BBB) - to include funding for COVID-19 relief, social services, welfare, infrastructure, including addressing climate change-related challenges and issues.
By restricting the focus on the relative impact of clean technologies on the overall budget, the most recent revision of the bill allocates $555 million for clean energy and climate change provisions[1]:

[15] European Commission, *Horizon 2020 European Green Deal call: results and ambitions for the future*, October 27, 2021, Brussels, retrieved from: https://ec.europa.eu/info/events/horizon-2020-european-green-deal-call-results-and-ambitions-future-2021-oct-27_en

- Infrastructure development (focusing also on railway and public transport)
- Automotive industry (especially supporting clean vehicles production and procurement)
- Achieving a carbon pollution-free power sector by 2035
- Energy efficiency of building through retrofits and new affordable buildings construction
- Accelerating R&D investments focused on strategic research areas like clean energy, clean transportation, clean industrial processes, and clean materials
- Sustainable agriculture and conservation

Although the bill is still in the legislative process of the country, there is firm interest in the bill being adopted[4,5,6]. It is noticeable that the United States has adopted such a firm new direction towards these initiatives considering that just a few years ago the country had no clear strategy regarding clean technologies and carbon reductions.

Synthetic Assessment: ✦✦✦✧✧ (3 out of 5)

The ambitious plan set out by the Biden administration, in terms of focus on climate-related issues and support to the development of clean technologies, appears to be unprecedented in size and scope. Several independent analysts, including Moody's, evaluated the proposed bill and agreed that it should be effective in reaching the goal of cutting emissions by 50% by 2030, while highlighting its financial viability and limited impact on long-term inflation[7]. Several external and internal factors, including the COVID-19 pandemic impact and opposition within Congress, may have a substantial impact on the final content of the bill and its desired effects. Further evaluation is then required.

3.2.2 Dedicated Incentives

Due to the federal government structure of the United States, there are multiple government levels to the support provided to clean technologies companies. At a state level there are over 2,500 policies and incentives in place throughout the United States, including several tax credits that promote the adoption of Electric Vehicles (EV), more accessibility to solar and wind technologies, etc[7]. Nonetheless, there is a marked disparity between the amount of legislation present in some states versus others in which for example, the two most populous states, California and Texas have between them over 292 policies and incentives while the following two most populous, New York and Florida, only 184 policies.

With the policies expected to be applied through the Build Back Better Act framework of spending dedicated to climate change, a national benchmark of support to the Clean Tech space through incentives and funding support. Currently, the bill is set to include "a 10-year expansion of tax credits for utility-scale and residential clean energy, transmission, storage, electric vehicles and clean energy manufacturing"[16].

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[16] P. Stevens, *Biden's new spending framework has $555 billion for clean energy, focused on incentives, not punishments*, CNBC, October 28, 2021, retrieved from: https://www.cnbc.com/2021/10/28/biden-spending-framework-includes-555-billion-in-climate-incentives.html

[2] White House. (11,2021). *The long-term strategy of the United States,* retrieved from: https://www.whitehouse.gov/wp-content/uploads/2021/10/US-Long-Term-Strategy.pdf

[3] U.S. Department of State. (2021, November 2). United States, European Union, and partners formally launch Global Methane Pledge to keep 1.5C within reach - United States Department of State. U.S. Department of State. Retrieved from: https://www.state.gov/united-states-european-union-and-partners-formally-launch-global-methane-pledge-to-keep-1-5c-within-

[8] Moody's. (2021, November 4). *Macroeconomic Consequences of the Infrastructure Investment and Jobs Act & Build Back Better Framework*. Retrieved from: https://www.moodysanalytics.com/-/media/article/2021/macroeconomic-consequences-of-the-infrastructure-investment-and-jobs-act-and-build-back-better-framework.pdf

According to the White House BBB Framework[8], the framework allocates the following budget areas:

- $320 billion: Clean energy tax credits
- $105 billion: Resilience investments (to address climate change-related adverse events including floods, wildfires, etc.)
- $110 billion: Investments and incentives for clean energy technology, manufacturing and supply chains
- $20 billion: Clean energy procurement

These steps show a promising direction of the industry inside the country. Nonetheless, it is yet to be demonstrated that they will be adopted for a long-term and that more concrete steps will be done to achieve the government's ambitious goals by 2050.

Synthetic Assessment: ✦✦✦✧✧ (3 out of 5)

As mentioned, the current status of ongoing negotiations may impact on the final structure of the bill. This score represents the current initiatives in place in the United States, taking into consideration its recent efforts towards more Clean Tech focused programs.

3.2.3 Research Investments

In February 2021, to support the Biden administration's climate agenda, the US Department of Energy announced $100 million in funding for transformative clean energy technologies[10].

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[4] Joselow, M., & Ellerbeck, A. (2022, January 18). *Analysis | climate advocates argue against breaking up BBB, call it a 'mistake' for Democrats and the planet*. The Washington Post. Retrieved from: https://www.washingtonpost.com/politics/2022/01/18/climate-advocates-argue-against-breaking-up-bbb-call-it-mistake-democrats-planet/

[5] Macwilkes. (2021, December 17). *Americans like what's in the build back better act. they're lukewarm on the bill itself.* FiveThirtyEight. Retrieved from https://fivethirtyeight.com/features/americans-like-whats-in-the-build-back-better-act-theyre-lukewarm-on-the-bill-itself/

[6] Milman, O. (2018, August 21). *How the Trump administration is rolling back plans for Clean Power*. The Guardian. Retrieved from: https://www.theguardian.com/environment/2018/aug/21/epa-clean-power-plan-rollback-affordable-energy-rule

[7] North Carolina State University. (2021, December 17). Database of state incentives for renewables & efficiency®. DSIRE. Retrieved January 20, 2022, from https://www.dsireusa.org/

[9] White House. (2021, October 28). *Build Back Better Framework*. The White House. Retrieved February 7, 2022, from https://www.whitehouse.gov/briefing-room/statements-releases/2021/10/28/build-back-better-framework/

[10] Department of Energy. (2021, February 11). *Doe announces $100 million for Transformative Clean Energy Solutions*. Energy.gov. Retrieved February 7, 2022, from https://www.energy.gov/articles/doe-announces-100-million-transformative-clean-energy-solutions

[11] The Clean Tech Group, *The Global Clean Tech Innovation Index 2017*, Third Edition, 2017

Funding will be made available via its Advanced Research Projects Agency-Energy's ("ARPA-E") OPEN 2021 funding opportunity.

To pursue its energy innovation R&D strategy, ARPA-E was established in 2009 as a United States government agency tasked with promoting and funding research and development of advanced energy technologies. ARPA-E has since spurred 1000+ projects with $2.6B invested in R&D by the US government, complemented with $4.9 billion in private investment.

The central relevance of private investment in the US is also mentioned by the Clean Tech Group in their latest *Global Clean Tech Innovation Index* report of 2017, where it is referred that "the US shows strengths in start-up access to private finance and scores top for renewable energy investment attractiveness but has potential to improve in providing a Clean Tech-supportive policy environment and R&D expenditure on Clean Tech relative to its GDP"[11].
Within the context of the aforementioned BBB act, the Biden administration incorporated part of the vision of the American Jobs Plan (AJP) where the President called on Congress to invest $35 billion in a full range of solutions to achieve technological breakthroughs to address climate change and positions the US as a global leader in clean tech. This included:

- The launch of ARPA-C (modeled on the previously mentioned ARPA-E) to expand funding for climate research
- Increase funding for climate-focused research by $5B
- Invest $15 billion in demonstration projects for climate R&D priorities
- Invest $50 billion in the National Science Foundation (NSF)
- Invest $40 billion in a nation-wide operation of research infrastructure upgrade

Synthetic Assessment: ✦✦✦✦✧ (4 out of 5)

In the US, research investments in the field of Clean Tech are mainly driven by private actors, as authoritative sources report that government funding in relation to the country's GDP may be substantially increased. The US shows strengths in terms of access to private funding for startups and academic spin-offs, but the country's research facilities require upgrade and pioneering government programs such as ARPA-E could act as a model for the future, Clean Tech and climate-related R&D endeavors. As previously mentioned, bills enforcing the currently envisioned strategy is still under debate.

3.3 Israel

3.3.1 Dedicated Strategy

Since the Paris Agreement, Israel has undertaken steps to increase its ambition towards a cleaner future. In July 2021, a government decision called "Transition to a Low Carbon Economy" was passed, including GHG emissions reduction goals of 27% (for 2030) and of 85% (for 2050)[17].

To reach these ambitious goals, the government has put in place several recommendations for implementation, in areas such as transport, waste management, electricity generation,

[17] Sussman, N., Aviram-Nitzman, D., Shoef Kollwitz, H., *A Just Transition to a Low Carbon Economy*, The Israel Democracy Institute, October 28, 2021, retrieved from: https://en.idi.org.il/articles/36475

energy intensity, industry, climate impact of goods and services. The recommendations include implementation review processes and monitoring.

Israel intends to draw upon the broad talent pool, ecosystem attractiveness, and structural advantages to foster Clean Tech innovation to tackle the challenge areas outlined.
As a matter of fact, the advanced status of the Israeli innovation ecosystem is widely acknowledged[18] and substantially validated by key indicators tracked by several authoritative sources, such as:

- According to the Global Clean Tech Innovation Index 2017[19,] which draws upon 15 indicators to explore where entrepreneurial clean technology companies are most likely to emerge, Israel is ranked 6th among the 40 countries indexed;
- According to the Israel Innovation Authority (IIA) - by normalizing by 'GDP spending on R&D' - Israel ranks as one of the top countries in the world in respect to R&D investments, which may point to the beneficial results of Israel's high level of investment in R&D for its Climate Tech industry[20;]
- Israel is widely recognized as a trailblazer and global leader in Water Tech, Precision Agriculture, Climate and Weather Imaging, Agri Tech, Cultured Meat21.

Synthetic Assessment: ✦✦✦✧✧ (3 out of 5)

Israel has set ambitious goals for transitioning to a low carbon economy in accordance with the Paris Agreement, and can leverage a historical leadership in several innovation areas. Though lacking a comprehensive, dedicated strategy regarding Clean Tech, the Israeli ecosystem appears to be well-suited to becoming a haven for innovation in the field, mainly thanks to benchmarking policies that increased the attractiveness of the country in terms of startup activity and internationally recognized R&D.

3.3.2 Dedicated Incentives

The State of Israel offers a broad scope investment incentive program (Industrial R&D - R&D Fund) dedicated to support commercial companies currently developing new products or upgrading an existing technology. It provides financial support to cover R&D expenditure between 20-50% of its costs (with additional support for companies headquartered in specific development zones[)22.]

Dedicated, Clean Tech-related support programs in selected fields are managed by the Israel Innovation Authority (IIA) jointly with various government departments, including the following:

- Environmental Technologies
- Reducing Greenhouse Emissions
- Agriculture (Agri-Tech)

[18] Mind the Bridge, *Corporate Innovation in Israel - Report 2020*, Tel Aviv, June 2020
[19] Cleantech Group, *The Global Cleantech Innovation Index*, 2017
[20] Israel Innovation Authority, *Israel's State of Climate Tech 2021*, 2021, retrieved from: https://innovationisrael.org.il/en/report/israels-state-climate-tech-2021
[21] Analyses performed by IIA and Sparkbeyond based on measured scientific knowledge and implementations.
[22] Israel Innovation Authority, *R&D Fund*, retrieved from: https://innovationisrael.org.il/en/program/rd-fund

Local stakeholders (including start-ups, corporates, investment companies, consulting companies, civil society organizations, and government bodies) generally appear to be advocating for "a mix of further innovation incentives and environmental regulatory policies (eg. investment-driven tax reductions or cash grants) to potentially accelerate market demand for Clean Tech"[23].

Synthetic Assessment: ✦✦✦✧✧ (4 out of 5)
The State of Israel provides tailored and dedicated incentives and cost subsidization programs for the development of groundbreaking innovation and pilot R&D projects. Several sources indicate that further incentives - including tax reductions, grants, etc. - may support the acceleration of market demand and entrepreneurial activity in the field of Clean Tech.

3.3.3 Research Investments

In the 2018-2020 period, the Israeli government invested more than $280 million to promote R&D in climate tech startups. More specifically, as reported in the Israel's State of Climate Tech 2021 report, the Israel Innovation Authority ("IIA") - an independent statutory entity responsible for advancing innovation - has since supported 300+ ventures with a total budget of $250 million (16% of total budget), contributed to the ideation phase via 7 incubators and innovation labs, and financed later-phase R&D testing and implementation by providing $60 million to climate tech startups[24].

As indicated in the July 2021 Update of Israel's Nationally Determined Contribution Under the Paris Agreement submitted to the UNFCCC[25], the Israeli government acknowledged the country's leadership in R&D investment per capita among OECD countries, and restates that a portion of that spending goes to clean tech and climate technologies, specifically in areas where Israel has a relative advantage, eg. water use, agritech, and climate adaptation (specifically to arid/semi-arid conditions).

The IIA recommends the creation of an "overall vision for a carbon-neutral Israel as part of an ambitious, holistic, and integrated climate action plan" within the context of a broad national plan that goes beyond the revised and improved NDC[26].

Regarding academia, Israel is ranked fourth in the world for research personnel, with the highest number of PhDs per capita anywhere else globally. The extensive talent pool poses as a fertile ground for research and innovation, not surprisingly hosting 350+ R&D centers established by international multinational leading corporations[27].

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[23] D. Süsser, *Israel: Green innovation could power economic recovery*, IASS Potsdam, August, 3, 2020, retrieved from: https://www.iass-potsdam.de/en/blog/2020/08/israel-green-innovation-could-power-economic-recovery
[24] Israel Innovation Authority, *Israel's State of Climate Tech 2021*, 2021, retrieved from: https://innovationisrael.org.il/en/report/israels-state-climate-tech-2021
[25] Government of Israel, *Update of Israel's Nationally Determined Contribution Under the Paris Agreement*, July 2021, retrieved from: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Israel%20First/NDC%20update%20as%20submitted%20to%20the%20UNFCCC.docx
[26] Nationally Determined Contribution submitted to the UN Framework Convention on Climate Change, August 2021
[27] Israel Innovation Authority, *Innovation in Israel*, retrieved from: https://innovationisrael.org.il/en/contentpage/innovation-

Synthetic Assessment: ✦✦✦✦✧ (4 out of 5)
In relation to the GDP, Israel is one of the most advanced countries in terms of R&D investments, talent pool, and quality of R&D centers. The IIA calls out for further support to the field of Climate and Clean Tech by establishing an overall strategic vision within the context of a broad national plan beyond the targets set in the NDC.

3.4 Costa Rica

3.4.1 Dedicated Strategy

Costa Rica is already a world leader in terms of environmental sustainability, sporting benchmarking figures in terms of renewable energy (95%+ share in the country's electricity matrix) and deforestation prevention (50%+ of the national territory is covered in forests).

More specifically, since 2019, more than 99% of the energy generated in the country has come from renewable energy sources. According to the country's National Center for Energy Control, Costa Rica has been running on more than 98% renewable energy since 2014.
In 2006, the Costarican government put climate change at the top of its agenda, including it as a strategic priority in its national development plan.

In 2018, Costa Rica adopted a plan to achieve a net-zero emissions economy by 2050. The plan takes a holistic approach through citizen participation, technology changes, innovation, research, and knowledge, by including significant measures in basic infrastructure and economic sectors such as the public and private transport, energy, industry, agriculture, waste management and soil and forest management. In addition, the plan establishes a roadmap for modernizing the economy, generating jobs and boosting sustainable growth.

In synergy with the goals of the sustainability plan of Costa Rica, and in collaboration with the country's Export Agency (PROCOMER), Costarican entrepreneurs and startups in the field of Clean Tech will benefit from dedicated funds and support actions.

Synthetic Assessment: ✦✦✦✦✦ (5 out of 5)
Costa Rica acts as a benchmark of environmental sustainability in the region and worldwide. Their strategy and implementation process has been evaluated by third parties as appropriate to reach the goals of the Paris Agreement.
Nevertheless, the country lacks a relatively developed innovation ecosystem. Preliminary efforts have been made to tackle this challenge.

3.4.2 Dedicated Incentives

Costa Rica offers a wide range of tax incentives for entrepreneurial activity that are established in particular areas of the country, i.e., the local Free Trade Zone and the Greater Metropolitan Area (GMA) where entities enjoy even greater benefits.

Within the Free Trade Zone, entities may benefit from tax incentives on income, imports and exports of goods. Among others, companies that may apply to the Free Trade Zone include

israel#:~:text=We%20have%20enjoyed%20consecutive%20years,per%20capita%20anywhere%20else%20globally.

scientific research firms and companies operating in strategic sectors, in line with the general governmental strategy.

Inside the GMA, companies may benefit from extensive tax exemptions up to 100%. Such incentives are generic in nature, i.e., they are standardized and may be applied to any and all companies according to their operation.

Synthetic Assessment: ✦✦✦✧✧ (3 out of 5)

Costa Rica employs a wide range of incentives, tax exemption programs, and trade facilitation actions including FDI attraction. Support actions are mostly industry-agnostic but are available also to Clean Tech-related companies.

3.4.3 Research Investments

Recent reports[28] and data (Trading Economics, 2018) indicate that Costa Rica is relatively underperforming in terms of R&D spending in relation to the country's GDP.

In 2016, R&D investments accounted for 0.57% of the country's GDP, decreasing to 0.38% in 2018 (World Bank, 2018[29]). Those findings hint to the relative lack of a culture of innovation in Costa Rica (IDB, 2016), which appears to be explaining the country's low number of researchers in per capita terms, as well as its low levels of investment in R&D.

An important challenge Costa Rica faces in becoming an innovation-based economy is the lack of a sufficient stock of human capital (a shortage of scientists, engineers, and technicians) due to limits in coverage and quality of the educational system (IDB, 2016).

Private-sector commitment to R&D remains weak. For economic development and innovation, also related to the ambitious targets regarding environmental sustainability and clean technology, Costa Rica relies more on the contribution of FDIs. (OECD, 2012[30]).

Since then, the Costarican Government has strived to improve higher education enrollment and graduate outcomes in the country with support from the World Bank (a $200M loan). Early results include a 20% increase in the number of students enrolled in the top 4 universities of Costa Rica in 5 years (World Bank, 2021[31]).

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[28] R. Monge-González, *Innovation, Productivity, and Growth in Costa Rica - Challenges and Opportunities*, IDB - Inter-American Development Bank - Institutions for Development Sector Competitiveness and Innovation Division, Technical Note n° IDB-TN-920, January 2016. Available from: https://www.researchgate.net/publication/289672224_Innovation_Productivity_and_Growth_in_Costa_Rica_Challenges_and_Opportunities [accessed Jan 11 2022].

[29] World Bank, *Research and development expenditure (% of GDP) - Costa Rica*, retrieved from: https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?locations=CR

[30] OECD Development Center, *Attracting Knowledge-Intensive FDI to Costa Rica - Challenges and Policy Options*, *Making Development Happen Series No. 1*, OECD Publishing, Paris, 2012.

[31] World Bank, *Improving Higher Education Enrollment and Graduate Outcomes in Costa Rica*, Results Briefs, April 21, 2014, retrieved from: https://www.worldbank.org/en/results/2021/04/14/improving-higher-education-enrollment-and-graduate-outcomes-in-costa-rica#:~:text=Total%20enrollment%20of%20undergraduate%20and,6%2C885%20to%207%2C117%2C%20respectively).

Most recently, the Government of Costa Rica has established several strategies to support and develop innovation and research in the country. We record the following:

- (2018-2022) Estrategia de Transformación Digital hacia la Costa Rica del Bicentenario 4.0 (Digital Transformation Strategy towards Costa Rica's Bicentennial 4.0), focused on education, health, social development, security, transportation, digital government, environment and land management
- (2020-2030) Estrategia Nacional de Bioeconomía Costa Rica (National Strategy of Bio-economy of Costa Rica), focused on sustainable development

Moreover, in 2021 the National Council of Scientific and Technological Research (Consejo Nacional para Investigaciones Cientificas y Tecnologicas) has been transformed into the Costarican Agency of Promotion of Innovation and Research (Procii - Promotora Costarricense de Innovacion e Investigacion), established to promote scientific and technological development and innovation[32].

Synthetic Assessment: ✦✦✧✧✧ (2 out of 5)

The Costarican ecosystem still lacks the necessary R&D investment structure to foster a healthy innovation ecosystem, including attracting and nurturing high-skilled talent. Multiple actions have been taken to improve the situation, bearing initial encouraging results including the increase of graduate enrolled students (talent pool) and the deployment of national strategies dedicated to research and innovation, some focused on sustainable development - thus potentially effective in supporting Clean Tech innovation.

3.5 Dominican Republic

3.5.1 Dedicated Strategy

The Dominican Republic is a nation that is still in the developing stage of deploying national, long-term strategies in the Clean Tech space. The country generates ~17.54% of its energy from renewable sources, which are mainly generated through Hydro, Eolic, Solar, and Biomass sources[1].

The country has been considerably pro-active in the generation of clean energy, including the creation of its first hydroelectric plant in 1945[2]. The most relevant legislation regarding the Clean Tech and clean energy space is the law number 57-07, passed in the year 2007, in which the government of then-president Leonel Fernandez made the commitment of promoting the national adoption of renewable energy through multiple incentive instruments[3]. One of the main goals of the legislation is to reach a 25% of electric generation nationwide from renewable sources by the year 2025 and based on the projections under the most recent analysis of the Dominican government on renewable energetic production in its territory, they are in a promising position to achieve that milestone[4].

Other highlights of the law 57-07 include a 100% tax exemption for the import of all machinery, equipment, and accessories needed to produce clean and renewable energy. Also, a tax credit on up to 75% of the cost of machinery and equipment for home-owners,

[32] Consejo Nacional de Rectores Costa Rica, *Estado de la Nación 2021.*

commercial, and industrial businesses that shift to clean energy producing equipment on their properties[3]. This law has stood as the benchmark of support to the clean energy industry since its inception.

A significant step towards carbon neutrality and further support of clean technologies is the Dominican Government's recently launched (December,2021) *National Energetic Plan (2022-2036)*[5]. Even though the plan is still in the "*observation, recommendations, and suggestions"* stage, it aims to lay out the national plan for the upcoming 15 years of the country which would potentially update the incentives that have been in place since 2007. The plan prioritises continuing the reduction of tariffs in the import and acquisitions of clean energy technologies to encourage its widespread adoption, including citizen participation and the shift to more renewable sources by industrial entities. It is notable to mention that the *Ministry of Environment* has taken a central role in the preparation of communication strategies in favor of promoting the widespread use of cleaner solutions in which for example, in the year 2021, 78,565 citizens received training and participated in educational programs regarding clean methods[6]. This collaboration between ministries, which also includes the Ministry of Energy and Mines, is notable and represents an effort to decentralize the efforts to cleaner national initiatives.

Synthetic Assessment: ✦✦✦✦✧ (3 out of 5)

Even though the support to the clean energy industry is quite significant in the Dominican Republic, multiple calls have been made within the government to implement updated, and more extensive incentives and instruments in favor of entrepreneurs[7]. These actions would be relevant to diversify the Clean Tech space as the country has focused significantly more on the generation of clean energy over other clean technologies (e.g., circular economy, waste treatment).

3.5.2 Dedicated Incentives

As mentioned, the most important piece of legislation in place related to the clean industry is the law 57-07 which also includes several incentives, specially for the implementation of clean energy generation for individual homeowners. Even though the support is quite extensive, it is limited to the clean energy sector.

Separately, the country has accelerated its support to local entrepreneurs, mainly through the *Ministerio de Industria y Comercio y Mipymes (MICM)*, which regulates the industrial, exporting, internal & external commerce, micro, small and medium sized enterprises, among others. The law number 688-16, passed in the year 2016, is focused on developing incentive and support structures for local entrepreneurs[8]. A relevant presidential decree by then-president Danilo Medina, decreed 160-18, indicated the creation of an investment fund, named - *Fondo de Contrapartida Financiera para el Desarrollo del Emprendimiento* (CONFIE)[9].

In October 2020, the *Fiduciaria Reservas* and the MICM launched the CONFIE fund that includes RD$75 million to be deployed for local entrepreneurs[10]. The criteria of support includes 4 years for the repayment of the investments, in which the first 18 months will be free of payments and an annual rate of 9%.

Even though the country has been implementing incentives in support of the clean energy space since dozens of years ago, the focus of support has been almost exclusively in that space rather than expanding it to include other Clean Tech technologies and solutions. The country is still in need of stronger legislation that provides incentives and instruments of support to entrepreneurs, with that support in place, hopefully it will translate in further support to other relevant Clean Tech startups to develop locally.

Synthetic Assessment: ✦✦✧✧✧ (2 out of 5)

The Dominican Republic employs a wide range of incentives, tax exemption programs, and trade facilitation actions including FDI attraction for the renewable energy space. Support actions are mostly focused on that space but are still in need of more concrete incentives specifically focused on general Clean Tech-related companies.

3.5.3 Research Investments

Data indicates that the Dominican Republic is underperforming in investment amounts in the Research & Development (R&D) space[11]. The most recent calculations indicate that the Dominican Republic invests between 0.01 and 0.03% [11,12] of its GDP on R&D, which is less than half the average of Latin America & the Caribbean[13]. In 2005, the Dominican Republic launched the *Fondo Nacional de Innovación y Desarrollo Científico y Tecnológico* (Fondocyt) which is a fund to finance R&D projects led by academic institutions, research centers, etc. in which in its first cycle (2005), it invested RD$16.7 million in R&D, in contrast, 10 years later in 2015, the investment went up to RD$689.8 million [13, 14]. Even though the support is still increasing, it is well below the regional and international trends.

Synthetic Assessment: ✦✧✧✧✧ (1 out of 5)

The Dominican Republic is underperforming in the R&D space, especially the one focused on the creation of Clean Tech solutions. A comprehensive plan that prioritizes the funding of R&D projects nationwide could lead to them strengthening their internal innovation ecosystem.

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[10] Banco Banreservas. (2020, September 10). *Fiduciaria Reservas y MICM firman acuerdo para administrar Fondo CONFIE*. Banreservas. Retrieved from https://www.banreservas.com/articulos/fiduciaria-reservas-y-micm-firman-acuerdo-para-administrar-fondo-confie

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3.6 Barbados

3.6.1 Dedicated Strategy

In September 2015, Barbados communicated its Intended Nationally Determined Contribution (“INDC”) to the United Nations Framework Convention for Climate Change (“UNFCCC”) Secretariat. Following its April 2016, signing and ratification of the Paris Climate Agreement, the INDC became the first Nationally Determined Contribution where Barbados committed to taking steps decarbonize the electric grid, improve energy efficiency and reduce emissions across all sectors[33] Their mainstream approach to climate change resulted in the Barbados government incorporating climate change adaptation across a number of national sectoral plans (agriculture, water, health, coastal zone, etc.). The mitigation measures are expected to achieve a GHG reduction of 44% compared to its Business-As-Usual (“BAU”) scenario by 2030 with an interim target of 37% reduction by 2025.

With energy consumption and emissions from waste accounting for 72% (67% to energy generation and 33% to transport) and 16% of GHG, there is significant attention given to these sectors.

[33] Barbados Intended Nationally Determined Contribution: Communicated to the UNFCCC on September 28, 2015

To demonstrate its commitment, Barbados has implemented a number of initiatives resulting in positive results which include[34]

- Decentralized solar PV installations with over 2,000 independent power producers generating 45MW of power
- Deployment of electric passenger vehicles public buses
- Retrofitting of 100 public buildings financed IDB loan and EU-CIF grant funding
- Establishment of feed-in-tariffs to renewable energy up to 10MW
- Elimination of duties on imported systems and equipment linked to renewable energy

In 2019, the Government introduced a national energy policy which is aimed at transforming Barbados' petroleum-based economy to be a fully renewable energy and carbon neutral state in the world[35]. The policy was prepared using a multi-criteria approach which cuts across multiple environmental and industrial clean tech applications (renewable energy, mobility and transport, waste management, etc.). Built on 10 visionary goals linked to core values, established via the multi-criteria approach, from diversity (of sustainable energy options) through environment (minimizing impacts contributing to climate change) to regulation (through clear legal regulatory frameworks); it has a number of clearly defined objectives and policy measures relating to renewable energy, energy efficiency, transportation, waste management, water protection all geared towards Barbados achieving 100% renewable energy status and making a tangible contribution climate mitigation.

Synthetic Assessment: ✦✦✦✧✧ (3 out of 5)
Barbados has a clear agenda and policies which spread across various areas of clean tech and they have implemented a number of initiatives to generate some momentum in these areas. Funding for some of the initiatives were provided by multilateral banks. However, the strategies do not fully address all areas of clean tech and there is no economy wide budget dedicated to clean tech innovation and entrepreneurship.

3.6.2 Dedicated Incentives

To encourage the adoption and promotion of sustainable actions at the individual and corporate level, Barbados offers a range of tax incentives granted by the Customs and Excise Department which include:

- Import duty exemptions on renewable energy systems & energy conservation apparatus/machinery
- VAT exemptions on building materials dedicated to renewable energy generation
- Zero rating of VAT on renewable energy systems and products produced in Barbados[36]

Additionally, there are a number of incentives granted by the Barbados Revenue Authority which include:

[34] Barbados 2021 Update of the First Nationally Determined Contribution (Submitted in Fulfillment of Obligations under the Paris Agreement on Climate Change by the Government of Barbados
[35] Barbados National Energy Policy 2019-2030, retrieved from: Barbados National Energy Policy (BNEP) 2019 – 2030 – Energy.gov.bb
[36] Renewable Energy and Energy Efficiency Incentives Booklet for Individuals and Companies, retrieved from https://energy.gov.bb/download/fiscal-incentive-booklet/?wpdmdl=3168&refresh=624f18af810491649350831

- Personal tax deductions against income for the purchase of environmentally preferred products, electrical retrofitting
- Deductions against assessable income for companies equal to 150% of amount expended in achieving internationally recognized environmental certification
- Ten-year income tax holiday for developers, manufacturers and installers of renewable energy products
- Along with a range of other fiscal incentives related to staff training, marketing, R&D, dividends for shareholders of companies solely engaged in installation and supply of renewable energy systems of energy efficiency products[36]

Through funding (SMART Fund 1) from the Inter-America Bank ("IDB"), Barbados through the Enterprise Growth Fund Limited, BDS$24 million offered a mix of concessional loans and grants for financial and technical support (pre-investment and viability studies, etc.) to renewable energy and energy efficiency projects.[37][38] SMART Fund 2 is about to commence which will be funded by BDS$60 million loan from IDB and a €13 million grant from the European Union ("EU") to build on SMART Fund 1[39].

These initiatives, though on the surface appear to be extensively limited to the clean energy sector, is impacting on other sectors such as waste management which is expected to see green energy park (30MW energy from waste and biomass facility) by 2025.

In 2018, when the Mottley led administration was elected to Government among their first "mini-budget" that same year, the Government eliminated the Road Tax fee which is due annually for all registered vehicles and replaced it with a fuel tax which was incorporated into the cost of the fuel. While this was intent on primarily capturing tax revenue from those who avoided paying the Road Tax, it also served as an indirective incentive for to move towards electric vehicles. In the recently held March 2022 budgetary proposal by the Mottley administration which regained the Government in the January 2022 general elections, more direct incentives were announced as part of greening transport and to meet the 2030 decarbonization commitments; these included:

- Doubling of the interest free loans (up to BDS$100,000) available to public officers for the purchase of electric or hybrid vehicles
- Reduction in the customs tariff from 45% to 10% for new and used electric vehicles, hybrids, fuel cell and solar powered vehicles
- Two-year excise tax and VAT holiday on the purchase of electric vehicles

Beyond greening transport, the government has started to pave the way for Barbadian homeowners to own and install photo-voltaic systems (up to 10kW) on their rooftops bypassing the application and permit process which saw 625 domestic applications to 879 combined domestic and corporate application awaiting approval as at 31 January 2022. Though the logistics and speed of interconnections to the privately owned electricity grid will need to be laid out.

Synthetic Assessment: ✦✦✦✦✧ (4 out of 5)

[37] Renewable Energy – EGFL Website
[38] Sustainable Energy Investment Programme (Energy Smart Fund 1) – Energy.gov.bb
[39] Sustainable Energy Investment Programme (Energy Smart Fund 2) – Energy.gov.bb

The dedicated incentives provide a range of incentives and exemptions to support sustainability and Barbados' drive toward its goal of being a carbon neutral state. Given the highest contributors to GHG is in energy generation and transport, the incentives are targeted on delivering the greatest impact on GHG reductions.

The recent additional incentives offered for the transport sector are expected to help accelerate the development of the infrastructural charging network and other small and micro businesses involved in the testing and maintenance of electric vehicles. However, to account for the loss in fuel tax revenue, an alternate fuel levy was introduced for those who own electric vehicles. While there are significant incentives for the energy sector and increasing incentives to transport, there may be room for specific incentives to other clean-tech areas.

3.6.3 Research Investments

BARBADOS is the home of one of the Universities of the West Indies which ranked in the top 1.5% (25) of universities in the world by the Times Higher Education ranking system which ranked 1,668 elite universities in the study[40]. The University offers and continues to expand and coordinate its research, innovation and commercialization on its campus through collaboration with public and private institutes.

Synthetic Assessment: ✦✧✧✧✧ (1 out of 5)

Though loans and grants advanced by the IDB and the EU via SMART Fund 2 is intended to, inter alia, support the pre-investment studies over the next six years, the studies will be focused on RE, there is no allocation for other clean tech areas and there is no national budget dedicated to research in clean tech areas.

4. Summary Table of Country Strategies and Innovation Policies

United States	**EU27**	**Israel**	**Costa Rica**	**Dominican Republic**	**Barbados**
Dedicated Strategy					
BBB (Build Back Better) agenda ($555M dedicated to clean energy and climate change provisions). Ongoing debate.	Existence of dedicated and budgeted strategy: EU Green Deal - long-term initiative tailored to support solutions	Set of recommendations and government initiatives initially put in place. Lack of a dedicated, comprehensive strategy. Advanced ecosystem and structural advantages.	World leader in environmental sustainability (RE: 99% of energy mix). Holistic plan to achieve net-zero emissions by 2050. Limited size of the local innovation ecosystem.	Preliminary strategies and laws in place to incentivize green transition, including tax exemptions on import of equipment to produce clean energy. Existing strategies limited to the energy sector.	Climate change adaptation and energy policies in place, including initiatives that generated momentum. Limited clean tech-related scope of policies and lack of economy-wide budget dedicated to clean tech innovation and entrepreneurship.

[40] Building and Entrepreneurial UWI: Special Report; retrieved from Building an Entrepreneurial UWI (flippingbook.com)

Summary Table of Country Strategies and Innovation Policies (cont'd)

Dedicated Incentives					
2,500 policies and incentives in place at federal state level. More dedicated initiatives in some of the most populous states (e.g. California and Texas) $320B allocated in the BBB plan for tax incentives (ongoing discussion).	InvestEU plan (€1T) to finance EU Green Deal. Part of NGEU (€0.6B) to finance investments and reforms supporting climate objectives. EGDIP to finance transition to a green economy. De-incentives (carbon taxation) Regulatory efforts (sustainable investments taxonomy)	Dedicated R&D support programs for Israeli companies. Dedicated support programs for Clean Tech companies, managed by the IIA. Expressed need for further incentives (e.g. tax credit, grants…)	Wide range of incentives, tax exemption programs, and trade facilitation actions including FDI attraction. Entities HQed in the local Free Trade Zone and the Greater Metropolitan Area (GMA) enjoy even greater benefits.	Wide range of incentives, tax exemption programs, and trade facilitation actions including FDI attraction for the renewable energy space. Dedicated Clean Tech incentives are still required.	Significant range of incentives in the energy and transportation sector, including fiscal incentives and duty exemptions. Room for further incentives in other clean tech areas.
Research Investments					
R&D managed by the ARPA-E agency (historically about $3B invested). Significant role of private sector investments. Exploratory discussions for the establishment of a dedicated climate-related agency (ARPA-C) in the context of BBB plan (ongoing debate).	35% of Horizon Europe dedicated to address climate change and support clean technologies through EU Green Partnerships and EU Green Missions.	Leading position at global level in terms of R&D investments per capita. $280M+ invested to promote R&D in climate tech. The IIA recommends an integrated action plan for further actions.	Relatively limited R&D investments (0.57% of GDP in 2016, decreasing to 0.38% in 2018). Recent developments in the establishment of strategies to develop RDI in the country.	Low RDI investments: 0.01-0.03% of GDP. Underperforming in relation to regional and global benchmarks. Lack of dedicated Clean Tech RDIs.	Loans and grants advanced by the IDB and the EU to support pre-investments studies focused on RE. No allocation for other clean tech areas and no national budget for R&D in clean tech innovation.

Table 4: Summary Table of Country Strategies and Innovation Policies

4.1 RE Capacity and Generation Overview

To provide a more comprehensive picture of the current status of each ecosystem's Clean Tech public policy and strategy, we also report data related to RE capacity (including Y-o-Y Growth rates), and RE Generation shares. These figures highlight the potential connection with Clean Tech investments (Innovation Outcomes, as indicated in Section 6.2 "Two-Axes Tracking Framework") and provide a preliminary picture of the status of each ecosystem's efforts in transitioning to a clean economy.

	RE Capacity RE Capacity (MW) 2020	RE Capacity Avg. Y-o-Y Growth (last 5 yrs)	RE Generation Share (%)
EU27	479917	5.3%	22.1
USA	292065	8.4%	19.8
Israel	1501	13.5%	5.8
Dominican Rep.	1413	14.0%	9
Costa Rica	3124	6.1%	99.8
Barbados	50	46.8%	4.6

Table 5: RE Capacity and RE Generation shares

As reported by the statistics produced by the International Renewable Energy Agency (IRENA)[41], Barbados is experiencing the fastest year-over-year increase in RE capacity in the last 5 years (46.8%). Nevertheless, its RE generation share is still relatively low (4.6%)[42], especially when compared to neighboring countries such as Costa Rica (close to 100%)[43], about half of Dominican Republic (9%)[44], and more advanced countries such as the US (19.8%)[45] and the EU (22.1%)[46]. Israel - relatively underperforming - reports figures more in line with Barbados[47].

5. Clean Tech Mapping of Private Sector (Tech Scaleup) Funding Trends

5.1 Key Figures

The 2022 Global Innovation 100 index reports about 11K companies - including startups - in the Clean Tech field of technology headquartered in 94 global countries.

[41] IRENA (2021), *Renewable capacity statistics 2021*, International Renewable Energy Agency (IRENA), Abu Dhabi, ISBN: 978-92-9260-342-7

[42] U.S. Department of Energy, *Barbados Energy Snapshot*, National Renewable Energy Laboratory, June 2020

[43] Zúñiga, A., *Costa Rica's electric grid powered by 98% renewable energy for 6th straight year*, The Tico Times, December 18, 2020, retrieved from: https://ticotimes.net/2020/12/18/costa-ricas-electric-grid-powered-by-98-renewable-energy-for-6th-straight-year#:~:text=In%202020%2C%20Costa%20Rica%20has,from%20biomass%20and%20solar%20panels.

[44] IRENA, *Renewable Energy Prospects: Dominican Republic*, July 2016, retrieved from: https://www.irena.org/publications/2016/Jul/Renewable-Energy-Prospects-Dominican-Republic#:~:text=A%20REmap%20country%20study%20from,PV)%2C%20wind%20and%20bioenergy.

[45] U.S. Energy Information Administration, 2020, retrieved from: https://www.eia.gov/tools/faqs/faq.php?id=92&t=4#:~:text=In%202020%2C%20renewable%20energy%20sources,about%2019.8%25%20of%20electricity%20generation

[46] Eurostat, 2020, retrieved from: https://ec.europa.eu/eurostat/web/energy/data/shares

[47] Fisher, I., *Israel Misses 2020 Renewable Energy Goal, by a Very Long Way*, Haaretz, March 16, 2021, retrieved from: https://www.haaretz.com/israel-news/.premium-israel-misses-2020-renewable-energy-goal-by-a-very-long-way-1.9625618

To provide a more accurate picture of the Clean Tech industry trends in the countries analyzed (US, EU27, Israel, Costa Rica, Dominican Republic, Barbados) we restricted our mapping exercise to scaleups (ie. tech startups founded after 2000 that raised >$1M since inception, see Methodology). Based on preliminary profile data obtained for the companies operating in the Clean Tech industry in Barbados, a definitive conclusion could not be drawn on the number of scaleups in Barbados at this time. However, and notwithstanding our restrictions on the mapping exercise mentioned above, to present a view on the characteristics of the local industry, irrespective of the classification of the companies (i.e. startup, scaleup, etc.) certain statistics and commentary are provided below on the industry as a whole. Data obtained from primary surveys on the profiles of the Barbados Clean Tech companies are provided in section 8.3 below and will be provided in the Industry Report together with any additional profile data obtained.

In the above-mentioned countries - according to our broad definition of “Clean Tech” - we record 3,166 scaleups in the field that collectively raised $301.6B in capital (as defined in the Inception Report methodology) since their inception.

In the following table, we provide an overview of each country area analyzed.

Country	# Clean Tech Scaleups	Capital Raised (USD$B)
United States	2,089	$243.8B
EU27	943	$53.3B
Israel	132	$4.5B
Costa Rica	1	-
Barbados**	1**	-

***Public information for this metric is not available therefore, what is presented here is based on primary preliminary data provided by survey participants who responded to the survey question.*

Table 6: Country Overview

Currently we do not record any startup able to cross the scaleup barrier in the Dominican Republic. In the Bloom cluster we record 10 startup companies.

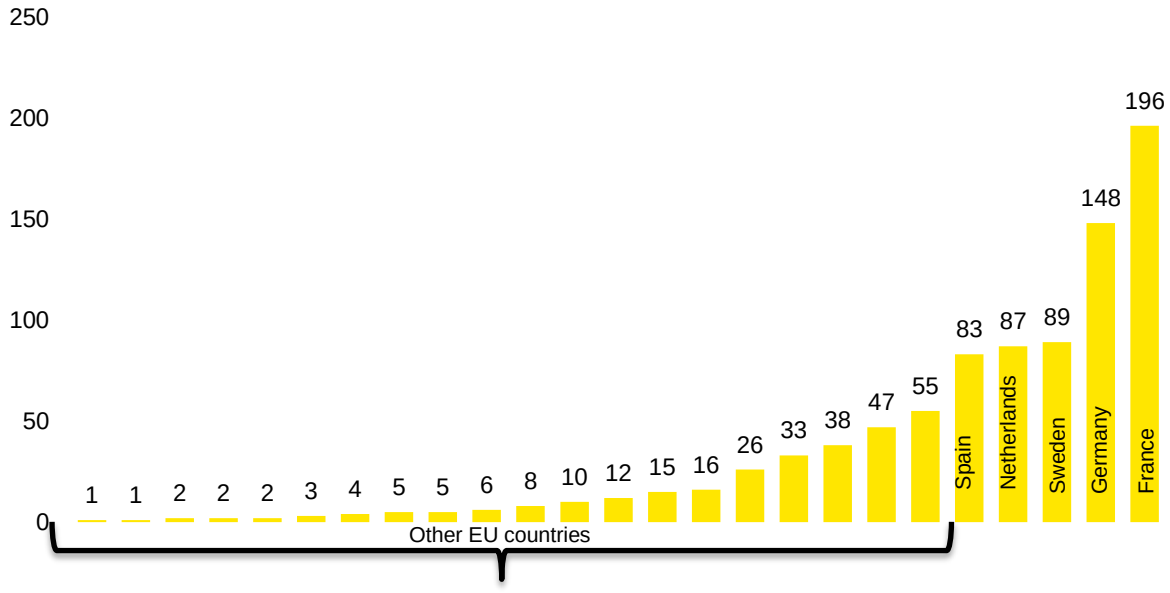

Figure 2: Clean Tech Scaleup Number Distribution (EU27)

In Europe, in terms of scaleups, we record a more significant concentration of companies in France (196), Germany (148), Sweden (89), the Netherlands (87), and Spain (83).

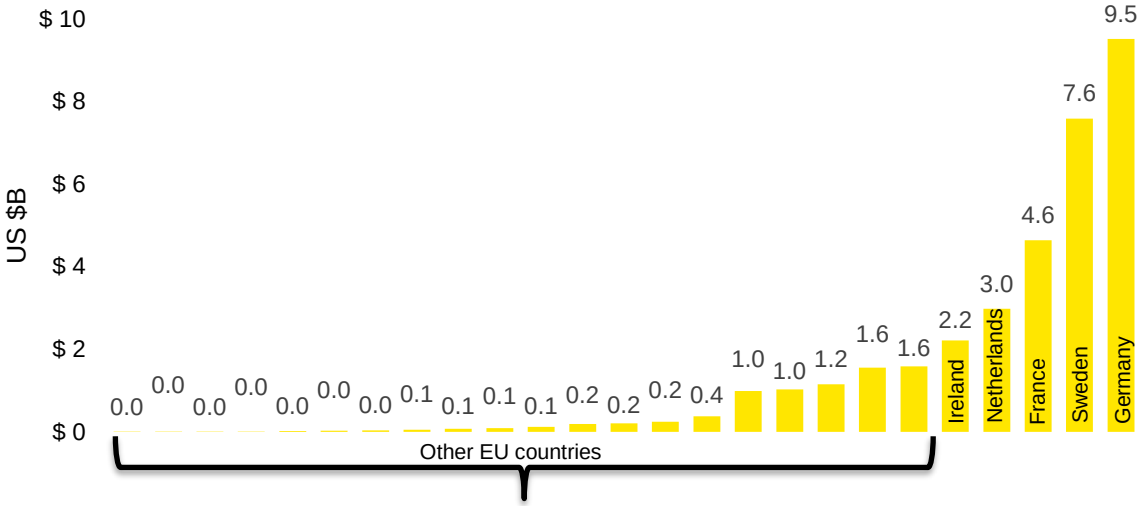

Figure 3: Clean Tech Capital Raised Distribution (EU27)

In terms of funding, Germany and Sweden take the lead, respectively with $9.5B and $7.6B in capital attracted, followed by France ($4.6B), the Netherlands ($3B), and Ireland ($2.2B).

5.2 Year-over-year Investments

According to our data, Clean Tech scaleup investments in the countries under scrutiny are booming.

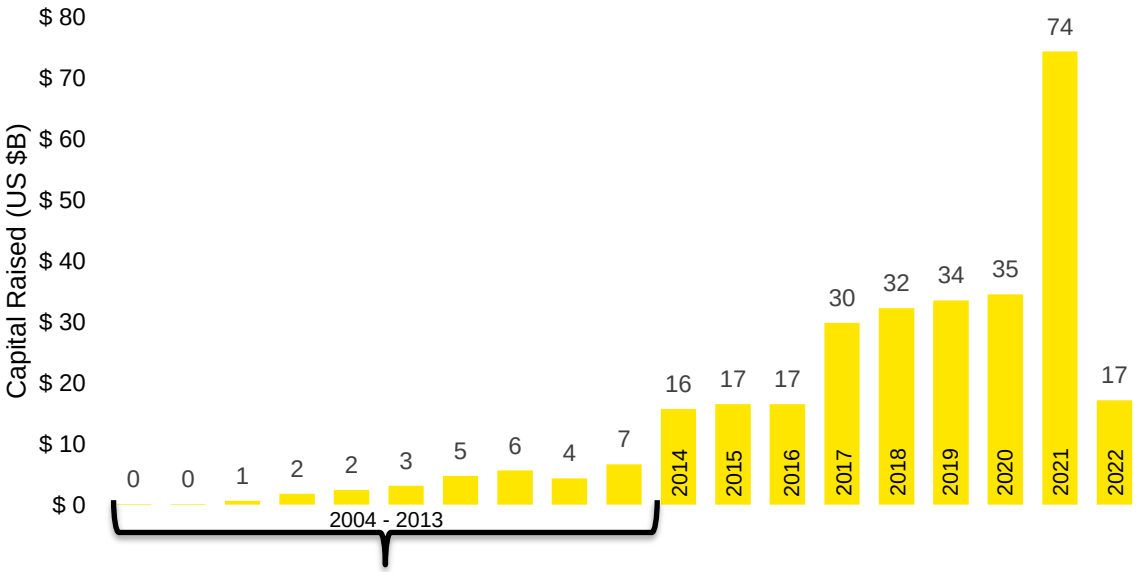

Figure 4: Clean Tech Capital Investments Y-o-Y (All Countries)

Our analysis identified three pivotal years. According to our records, before 2006, Clean Tech scaleup investments were very limited and never surpassed a total of $1B in the countries under scrutiny. Between 2006 and 2013, we recorded average investments around $4B per year. In the 2014 - 2016 timeframe, investments substantially quadrupled up to about $16B per year. Between 2015 and 2020, Clean Tech scaleup investments constantly

grew from about $30B in 2015 to $35B in 2020. Notably, it appears that the Covid-19 pandemic did not impact at all the growing interest in Clean Tech at global scale.

Post pandemic, in 2021, we recorded a substantial boom in Clean Tech investments, up to $75B. At the time of writing, in the first month of 2022 we already recorded $17B in capital raised, suggesting that Clean Tech scaleup investments are definitely experiencing momentum.

5.3 Clean Tech Industry Area Concentration

Following our Clean Tech definition and taxonomy, not surprisingly, due to the long-standing history of green tech - as mentioned in the literature review - we record that the vast majority of Clean Tech scaleups in the countries under scrutiny operate in the Energy and Power industry vertical (1,012 - about one out of three).

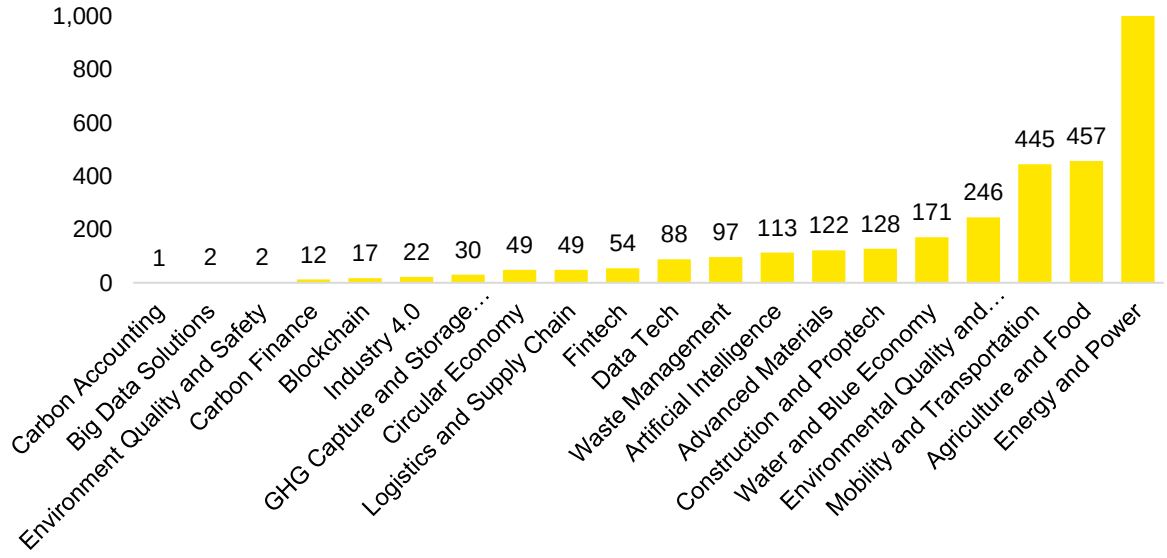

Figure 5: Clean Tech Scaleup Concentration by Industry Area

Other thriving industries include Agriculture and Food (457 scaleups) and Mobility and Transportation (445). Climate-related industries such as Environmental Quality and Safety are increasingly becoming relevant (246 scaleups). We also record more than 100 scaleups operating in the areas of Construction and Proptech (128) and Advanced Materials (122). Among enabling technologies, the most relevant appear to be Artificial Intelligence (113), Data Tech (88), and Clean-related Fintech (54).

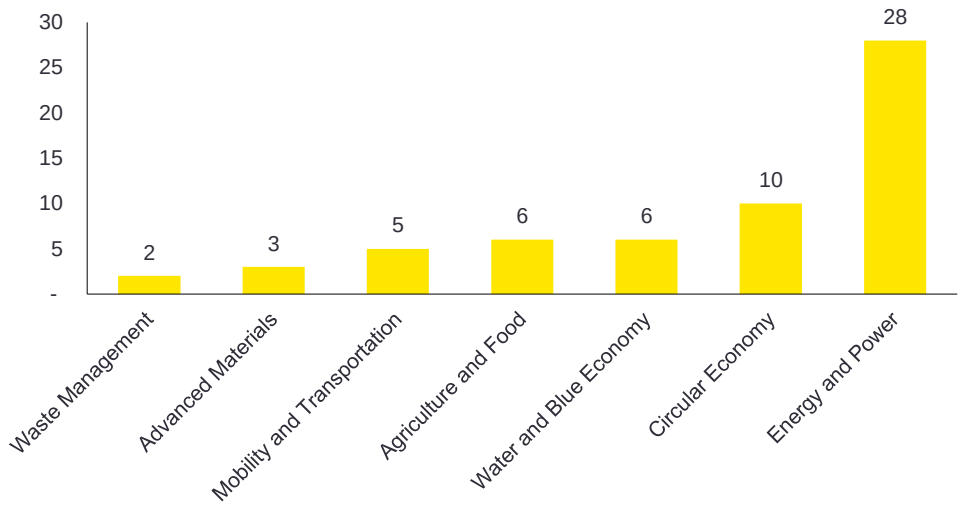

Figure 6: Clean Tech Scaleup Concentration by Industry Area in Barbados

Quite similar to the concentration profile of scaleups in the selected global and regional benchmark countries, the bulk of Clean Tech companies within Barbados (almost one out of two or 50%) also operate with the Energy and Power industry vertical. Together with Circular Economy, Water and Blue Economy and Agriculture and Food, they constitute the 80% of the Clean Tech Industry in Barbados.

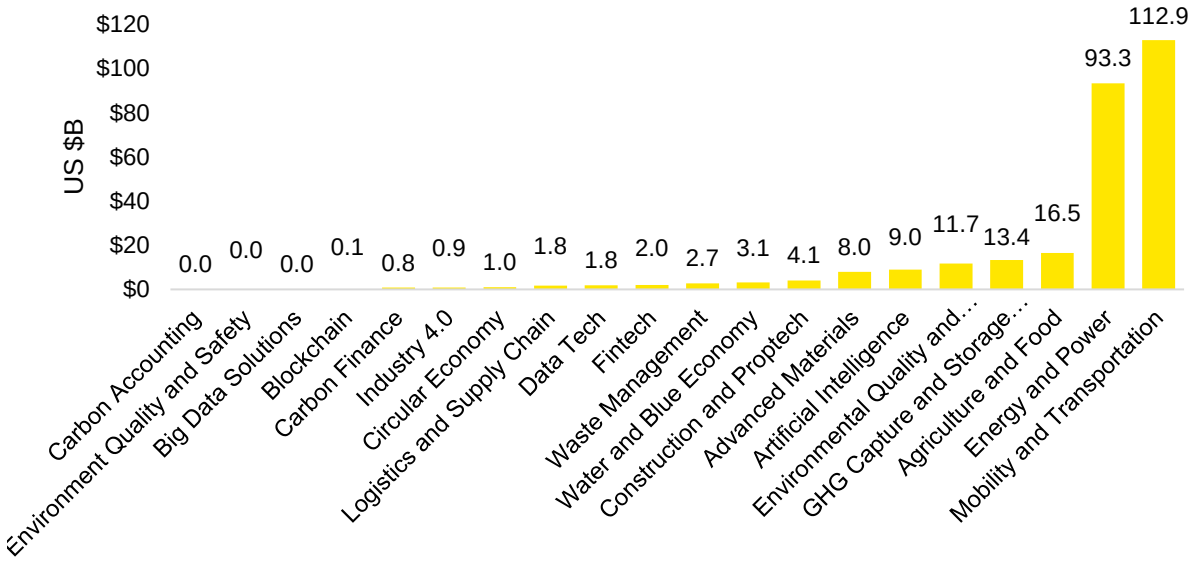

Figure 7: Clean Tech Scaleup Capital Investment Concentration by Industry Area

In terms of capital, Mobility and Transportation scaleups attract substantially more funding than their counterparts operating in other industries[48]. Globally, they attracted more than $100B, precisely $112.9B. By comparison, Energy and Power scaleups attracted $93.3B in funding. No other industry can match these two in terms of capital concentration.
The third place in the ranking is held by Agriculture and Food scaleups ($16.5B in capital raised). In accordance with our literature assessment, we observe that climate-related

[48] Notably, this Industry Area Vertical includes tech giants eg. Uber that have been referenced in leading industry reports (eg. Pitchbook - see Literature Review) as positively affecting climate, thus worth being considered both individually and as a specific industry sector as part of the Clean field of technology.

industries (Environmental Quality and Safety and GHG Capture and Storage) are becoming increasingly relevant and attract significant amounts of capital, respectively $13.4B and $11.7B. Other industries appear to be relatively more marginal, but still capable of concentrating billions of dollars in funding.

5.4 Cleantech Industry Jobs

By assessing the employee range data of Clean Tech scaleups in the countries and areas under analysis, using class averages, it is possible to estimate the following workforce employed in advanced Clean Tech scaleups.

Cleantech Scaleups Jobs					
		Number of Cleantech Scaleups per Employee Range			
Employee Range	**Class Average**	**US**	**EU27**	**Israel**	**Costa Rica**
1-10	5	565	250	39	1
11-50	30	927	447	66	0
51-100	75	252	80	13	0
101-250	175	165	59	10	0
251-500	375	56	28	1	0
501-1000	750	47	14	0	0
1001-5000	3,000	25	6	1	0
5001-10000	7,500	10	2	0	0
10000+	10,000	9	0	0	0
Total Cleantech Scaleup Jobs (est.)		374,660	84,985	8,275	35
Total Cleantech Scaleup Jobs (rounded est.)		375,000	85,000	8,300	35
		Total Country's Workforce			
		US	**EU27**	**Israel**	**Costa Rica**
		149,629,000	195,752,000	3,910,000	2,100,000
		Source: Fred, St.Louis Fed, 2022	*Source: Eurostat, 2022*	*Source: Statista, 2022*	*Source: Instituto Nacional de Estadistica y Censos de Costa Rica, 2022*
		Cleantech Scaleup Jobs vs. Total Country's Workforce			
		US	**EU27**	**Israel**	**Costa Rica**
		0.25%	0.04%	0.21%	0.00%

Table 7: Clean Tech Scaleup Jobs

The US acts as a benchmark, adding up to 0.25% of the entire country's workforce directly employed in Clean Tech scaleups. Israel and the EU follow respectively with 0.21%, and 0.05%. Data regarding Costa Rica appears to be of relatively limited significance due to the small size of the local Clean Tech scaleup ecosystem. The Dominican Republic is not included due to the absence of a local Clean Tech scaleup ecosystem. The Dominican Republic and Barbados are not included due to the absence of a local Clean Tech scaleup ecosystem.

6. Clean Tech Tracking Framework

6.1 Introduction

Existing reports[49] have highlighted the importance of the following stakeholders for the sustainable growth of tech innovation ecosystems, especially emerging ones:

- Entrepreneurs (startups)
- Corporates
- Capital[50]
- Research and Talent
- Government agencies

These should be supported by a favorable, enabling government policy framework that provides adequate incentives and guarantees stability, thus attracting and fostering entrepreneurial activity. This is particularly relevant for energy transitions, as they usually require a mix of public and private forces[51.]

Separately, research points out that focusing on scaleups over startups as innovation and economic catalysts is the most effective way of measuring an ecosystem's innovation enablement[11,12,13]. Scaleups, defined in the Methodology section below, have also proved to be a significant benchmarking indicator as it provides a concrete view of the proven capacities of an ecosystem to generate scalable, successful ventures[14,15,16]. For reference, scaleups generate almost half of all new jobs in the US, and 50% of the turnover of SMEs in the United Kingdom, demonstrating their sublime importance[13,17,18]. As a result, this framework focuses its analysis of tech-solutions on this group.

Therefore, we propose a Clean Tech Tracking Framework that highlights the relationship between dedicated public policy for Clean Tech Innovation (including an assessment of the presence of talent and public support to R&D) and the Innovation Outcome (scaleups and scaleup financing, in absolute and relative terms) that is a significant proxy of the positive results (both in terms of entrepreneurial growth path and investments) of the enabling conditions that adequate policies introduce to the ecosystems under analysis. Leveraging

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[49] Mind the Bridge, *StartupCity Hubs in Europe - 2018 Report*, Brussels, November 2018

[50] Hereby including in the definition the following (but not limited to): private investors, banks and international financing institutions (IFIs) including IDB, EU, UN etc. grant, loan and private equity e.g. all risk financing instruments that are available for SMEs and startups.

[11] Isenberg, D. (2021, September 17). *Focus Entrepreneurship policy on scale-up, not start-up*. Harvard Business Review. Retrieved from https://hbr.org/2012/11/focus-entrepreneurship-policy

[12] Insight Partners (https://www.insightpartners.com/), I. P. (2021, February.). *The scaleup revolution: A force multiplier of economic growth*. Insight Partners. Retrieved from https://www2.insightpartners.com/scale-up-report

[13] Moules, J. (2021, February 10). *How 'scale-up' business became the engine of job creation*. Financial Times. Retrieved from https://www.ft.com/content/fee31b91-e023-48a2-ba3a-137fe56cce5b

[14] Mind the Bridge Research database: https://research.mindthebridge.com/reports

[15] "Growth Entrepreneurship in Developing Countries: A Preliminary Literature Review." 2016. Washington, DC: The World Bank Group. License: Creative Commons Attribution CC BY 3.0

[16] Berger-de León, Dreischmeier, Konigsfeld, Libarikian. (2021, November 16). *How good are you at business building? A new way to score your ability to scale new ventures*. McKinsey & Company.

[17] Decker, R., Haltiwanger, J., Jarmin, R., & Miranda, J. (2014). The role of entrepreneurship in US job creation and economic dynamism. *Journal of Economic Perspectives*, *28*(3), 3–24. https://doi.org/10.1257/jep.28.3.3

[18] Scaleup Institute. (2020, December 11). *SCALEUP indicators from a national and local perspective*. ScaleUp Institute. Retrieved from https://www.scaleupinstitute.org.uk/scaleup-review-2020/scaleup-indicators-from-a-national-and-local-perspective-2-2/

[51] Zhi Yang, Heng Chen, Lei Du, Chaoran Lin, Wei Lu, *How does alliance-based government-university-industry foster cleantech innovation in a green innovation ecosystem?*,
Journal of Cleaner Production, Volume 283, 2021, 124559, ISSN 0959-6526, https://doi.org/10.1016/j.jclepro.2020.124559.

Mind the Bridge's proven methodology in analyzing and tracking the advancements of innovation ecosystems at global scale and the enabling conditions that foster growth[52], we produce a scalable and flexible framework, designed to be continuously updated to effectively track progress over time of individual ecosystems. The following sections present in detail the structure of the framework, the scoring systems used, and preliminary results of applying the framework to the selected subset of countries and areas under analysis.

6.2 2-Axes Tracking Framework

The proposed framework is based on a mix of qualitative and quantitative data.
The Framework is based on the following 2 main axes:

- **Clean Tech Innovation Public Policy** - Government strategies, policies, and enabling conditions (quali-quantitative data)

- **Clean Tech Innovation Outcome** - Clean Tech investments, startups/scaleups, density, etc. (quantitative data)

The tracking framework is designed to provide an internationally comparable synthetic scoring mechanism of the ecosystem which considers all the proposed specific indicators.

The scoring mechanism - for each analyzed ecosystem - combines the enabling conditions (eg. qualitative data, stakeholder's perspective, etc.) versus a quantitative picture of the relative size of the local Clean Tech innovation ecosystem on a matrix. whose axes represent the ecosystem's performance in the two above-mentioned areas.

This relationship between public policy and innovation financing has been made particularly evident in existing literature[53].

We adopt a synthetic visual representation of the scoring mechanism in the form of a matrix.

[52] Mind the Bridge, European Innovation Economy in Silicon Valley, San Francisco, September 2018

[53] Mazzucato M., Semieniuk G., Financing renewable energy: Who is financing what and why it matters. Technological Forecasting and Social Change, Volume 127, 2018, Pages 8-22, ISSN 0040-1625, https://doi.org/10.1016/j.techfore.2017.05.021.

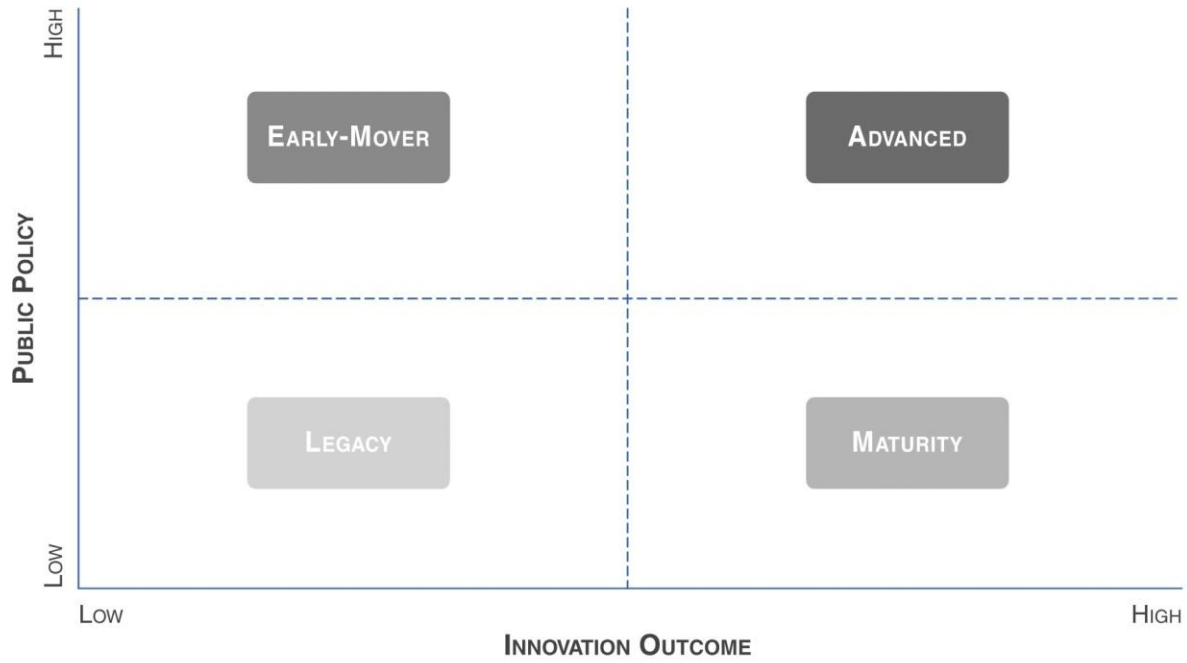

Figure 8: Clean Tech Tracking Framework Matrix

By positioning each ecosystem on the matrix, four profiles emerge, from early mover to advanced ecosystems, each with unique average characteristics.

- **Legacy Ecosystems**
  Legacy ecosystems have yet to evaluate and structure a Clean Tech-related strategy and policy orientation, while their private sector ecosystem of SMEs, startups, and scaleups has yet to form. Depending on the size of the early-stage tech ecosystem and ongoing policy debate, legacy ecosystems can be positioned closer to other quadrants.

- **Early-Mover Ecosystems**
  Early-Movers have already put in place structured strategies and policies, thus having set favourable conditions for the growth of a sustainable Clean Tech ecosystem of thriving SMEs, startups and scaleups.

- **Maturity Ecosystems**
  Mature ecosystems host an already thriving Clean Tech SME, startup and scaleup ecosystem, without the necessary backing of public institutions and policies, ie. mostly driven by the effort of private institutions, entrepreneurs, funds, etc. By leveraging the existing advantages while defining a public policy strategy, these ecosystems can move to the upper-right quadrant.

- **Advanced Ecosystems**
  Advanced ecosystems present the most favourable combination of factors for the sustainable development of a Clean Tech ecosystem, including a mix of public institutional efforts in the form of adequately structured strategies and policies and a thriving entrepreneurial innovation ecosystem. The two factors reinforce themselves and can fuel further growth, acting as global benchmarks.

The framework acts as a tool for ecosystem benchmarking and identification of effective actions for status improvement over time, leveraging clear metrics to measure results.

Outlined below is a comprehensive list of indicators used to track and assess the status and trends in the framework, to produce the synthetic scoring previously described.

Both axes are evaluated using a scoring mechanism that employs a 1-5 Likert-type scale. Qualitative analyses and evaluations on the scale are based on available information, stakeholders' perspectives (if applicable), and the researcher's own perspective. The individual scores of each indicator are averaged to produce a synthetic score ranging from 1 to 5, to precisely position each ecosystem on the matrix.

Policy Indicators

- Government strategies, policies, and enabling conditions
    - Strategy: Existence of a dedicated, coherent national Clean Tech strategy (if any, or generalist approaches)
        - Score scale: 1-5
            - 1: Preliminary or exploratory strategic approaches (eg. agendas, ongoing policy discussions, studies)
            - 2: Progressing or advanced generalist innovation support strategy
            - 3: Existence of a generalist innovation support strategy. Progressing discussions about a dedicated Clean Tech strategy in place (eg. approved agendas, establishment of think tanks)
            - 4: Existence of a dedicated Clean Tech strategy, currently without a dedicated budget
            - 5: Existence of a dedicated Clean Tech strategy, with allocated budget
    - Incentives: Existence of explicitly dedicated Clean Tech-related incentives including tax benefits
        - Score: 1-5
            - 1: Limited presence of generalist industrial incentive programs, lack of a structured approach
            - 2: Presence of progressing or advanced generalist industrial incentive programs
            - 3: Presence of generalist industrial incentive programs, and preliminary discussions about dedicated Clean Tech incentives
            - 4: Presence of generalist industrial incentive programs and some dedicated incentive programs for Clean Tech
            - 5: Presence of multiple dedicated incentive programs for Clean Tech
    - Research: Existence of Clean Tech investments in research infrastructure, grants, loans, and subsidies and the presence of Top Academic Institutions based on the QS World University Rankings 2021
        - Score: 1-5
          1: Limited presence of generalist industry RDIs, low average score of ecosystem's higher education institutions (1000-2000 QS World Ranking)

- 2: Adequate presence of generalist industry RDIs, medium average score of ecosystem's higher education institutions (500-1000 QS World Ranking)
- 3: Adequate presence of generalist industry RDIs and preliminary discussions or strategies related to dedicated Clean Tech RDIs, medium average score of ecosystem's higher education institutions (500-1000 QS World Ranking)
- 4: Adequate presence of generalist industry RDIs and minimal or limited dedicated Clean Tech RDIs, medium-high average score of ecosystem's higher education institutions (100-1000 QS World Ranking)
- 5: Adequate presence of generalist industry RDIs and significant dedicated Clean Tech RDIs, high average score of ecosystem's higher education institutions (1-500 QS World Ranking)

Innovation Outcome Indicators

- Clean Tech (Innovation Ecosystem)
  - Absolute number of Clean Tech scaleups in each ecosystem
    Scoring:
    - 5: current benchmark[54]
    - 4: 50-90% of the current benchmark
    - 3: 30-50% of the current benchmark
    - 2: 10-30% of the current benchmark
    - 1: >0-10% of the current benchmark
  - Number of Clean Tech scalers and superscalers in each ecosystem (Score: 0-1 where 1 is the current benchmark)
    Scoring:
    - 5: current benchmark
    - 4: 50-90% of the current benchmark
    - 3: 30-50% of the current benchmark
    - 2: 10-30% of the current benchmark
    - 1: >0-10% of the current benchmark
  - Capital Raised by Clean Tech scaleups, scalers, and superscalers in each ecosystem (Score: 1-5 where 5 is the current benchmark)
    Scoring:
    - 5: current benchmark
    - 4: 50-90% of the current benchmark
    - 3: 30-50% of the current benchmark
    - 2: 10-30% of the current benchmark
    - 1: >0-10% of the current benchmark
  - Clean Tech Scaleup Density Ratio (i.e. total number of scaleups, scalers, and superscalers in each ecosystem compared with its population) (Score: 1-5 where 5 is the current benchmark)

[54] The Clean Tech Tracking Framework is purposefully designed to be updatable (recurringly) and flexible, i.e. it can be applied to different subsets of ecosystems to be analyzed, and can be re-assessed over time to track progress. Therefore, for the "Innovation Outcome" axis, we employ a flexible model that scores each indicator in relation to the currently benchmarking ecosystem's results, instead of applying fixed, nominal values that would undermine significance in case the ecosystems under analysis would present relatively less heterogeneous figures than those provided in the context of this report. By applying a relative scale, it is also possible to more consistently track progress over time, by better showcasing relative performance changes, thus identifying "fast movers" and ecosystems characterized by a more linear growth path.

Scoring:

- 5: current benchmark
- 4: 50-90% of the current benchmark
- 3: 30-50% of the current benchmark
- 2: 10-30% of the current benchmark
- 1: >0-10% of the current benchmark

- Clean Tech Investing Ratio (i.e. total capital raised by scaleups, scalers, and superscalers in each ecosystem compared to the national GDP, PPP) (Score: 1-5 where 5 is the current benchmark)

  Scoring:

  - 5: current benchmark
  - 4: 50-90% of the current benchmark
  - 3: 30-50% of the current benchmark
  - 2: 10-30% of the current benchmark
  - 1: >0-10% of the current benchmark

- Cleantech Scaleup Jobs (i.e., estimated amount of employees of Cleantech scaleups, compared to the total country workforce) (Score: 1-5 where 5 is the current benchmark)

  Scoring:

  - 5: current benchmark
  - 4: 50-90% of the current benchmark
  - 3: 30-50% of the current benchmark
  - 2: 10-30% of the current benchmark
  - 1: >0-10% of the current benchmark

6.3 Policy Indicators Comparison

Country Area	**Strategy Score**	**Incentives Score**	**Research Score**	**Average**
Barbados	3/5	4/5	1/5	**2.7**
Dominican Republic	3/5	2/5	1/5	**2.0**
Costa Rica	5/5	3/5	2/5	**3.3**
Israel	3/5	4/5	4/5	**3.7**
EU27	5/5	5/5	5/5	**5.0**
United States	3/5	3/5	4/5	**3.3**

Table 8: Policy Indicators Comparison

6.4 Innovation Outcome Indicators

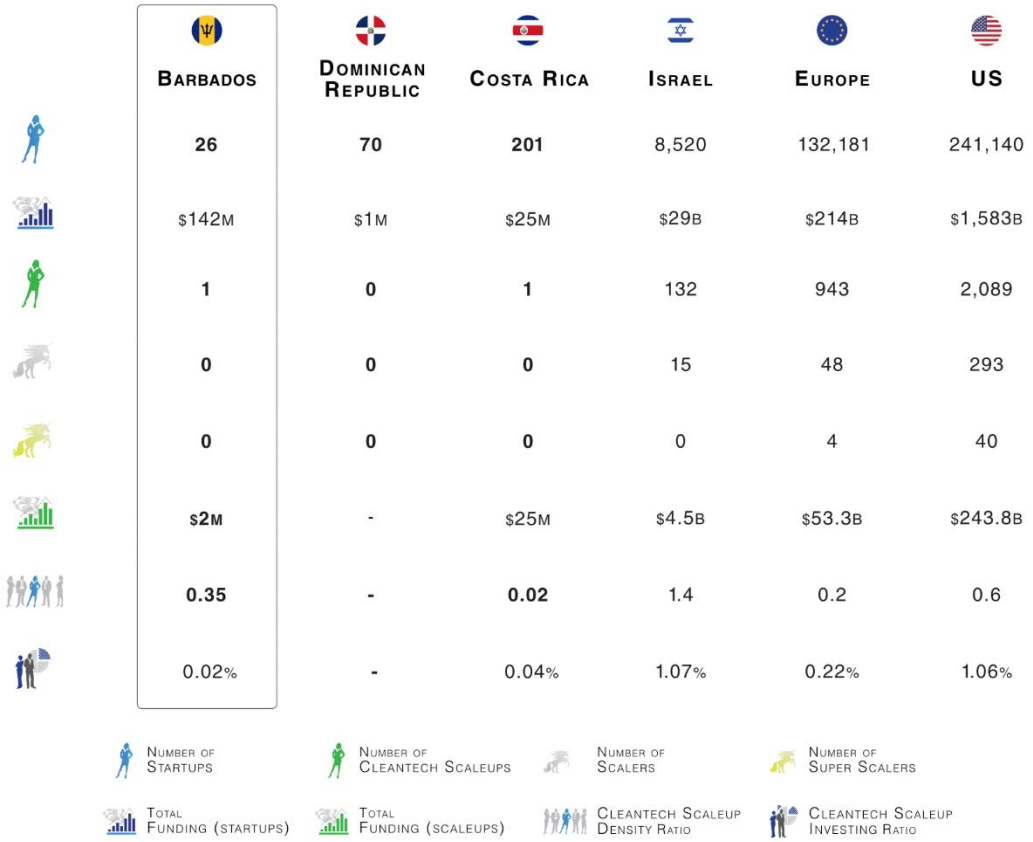

Figure 9: Overview of Innovation Outcome Indicators of the Selected Country Areas

Country Area	Scaleups Score	Scalers Score	Capital Raised Score	Density Ratio	Investing Ratio	Cleantech Jobs	Average
Barbados	0/5	0/1	0/5	2/5	1/5	1/5	**0.7**
Dominican Republic	0/5	0/1	0/5	0/5	0/5	0/5	**0**
Costa Rica	0/5	0/1	1/5	1/5	1/5	1/5	**0.7**
Israel	1/5	1/5	1/5	5/5	5/5	4/5	**2.8**
EU27	4/5	2/5	2/5	2/5	2/5	2/5	**2.3**
United States	5/5	5/5	5/5	3/5	4/5	5/5	**4.5**

Table 9: Country Comparison

6.5 Tracking Framework Current Preliminary Positioning Analysis

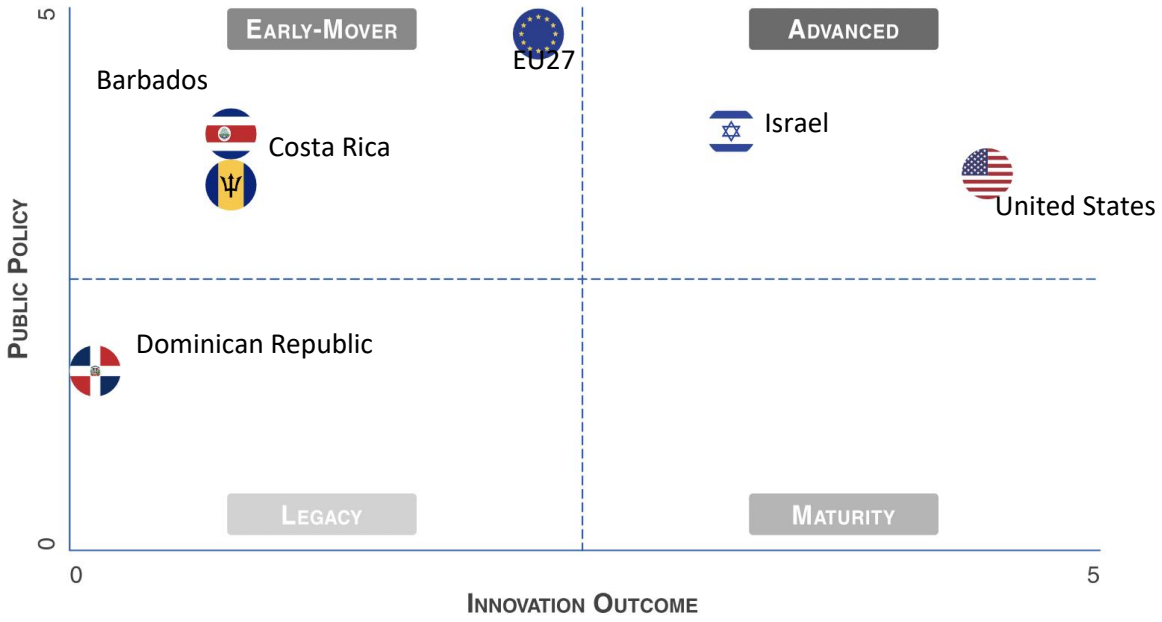

Figure 10: Positioning Analysis

According to our analysis illustrated in Figure 10 derived by the preliminary research effort produced in the context of the assessment report, we position Barbados in the “early-mover” quadrant of the matrix, close to another ecosystem of the Caribbean - Costa Rica. Both the areas have made significant policy orientation efforts whose potential - taking into consideration the size of their economy - can set the basis for the nurturing of a sustainable Clean Tech startup ecosystem.

As a matter of fact, Innovation Outcomes represent the actual, action-oriented KPIs that will demonstrate in the future the effectiveness of policies that the countries have put in place, whether or not they’ve been sufficient to attract funding and to foster innovation and the spawn of a sustainable scaleup ecosystem. This analysis must be considered as preliminary.

Further research and detailed information about local companies, stakeholder perspectives, as well as the evolution of policy measures in each area can impact the absolute positioning of each ecosystem by providing more accurate results.

The same framework can be used to assess the relative performance of a country in comparison with other regions and/or ecosystems, maintaining the two-axis paradigm to visually and logically connect policy orientation efforts with measurable effects and results on the ecosystem population of tech companies.

The Clean Tech Tracking Framework serves also the purpose of tracking each ecosystem’s progress over time, by periodically measuring and updating the provided indicators to continuously evaluate their policy orientation.

6.6 Assessment and Tracking Framework Key Indicators Summary

As a reference, Table 10 below includes a summary of the key indicators to be continuously assessed and reviewed periodically to produce the synthetic score and positioning mentioned in the previous section.

As a complementary tool to be further explored, the indicators can be put in a SWOT Matrix to produce individual assessments and benchmark ecosystems to selected comparables.

The summary table indicates how each key indicator refers to the appropriate SWOT quadrant.

SWOT Matrix	
Strengths	**Weaknesses**
► Government and monetary stability ► The Barbados Government offers National Development Scholarships for postgraduate studies in some clean tech areas (eg. Waste Management, Agriculture & Food and water and blue economy)[55] ► Scholarships also available to students in the green economy sector which is a short-term exchange opportunity in Canada for CARICOM students to pursue degrees in disciplines related to climate change and resilience building[56].	► Availability of incentives to develop clean tech applications beyond RE and mobility are not as prevalent ► Large RE projects are stalled by slow permit approval process ► Challenges to the implementation of some policies ► National budget for research and development ► Insufficient R&D infrastructure to facilitate transition from idea generation to commercialization ► Insufficient focus on other clean tech areas (eg. waste management - given the small size of the island, water management - given the island's water scarcity) ► Despite being a water scare country, the low water rates do not create an incentive for the development of clean tech innovations in this space ► Absence of robust regulations with emissions limits and corresponding non-compliance penalties

[55] National Development Scholarships 2018 / Announcements / What's New / Ministry of Education, Technological and Vocational Training (mes.gov.bb)
[56] Canada–CARICOM Skills Training for the Green Economy Scholarships / Latest News / What's New / Ministry of Education, Technological and Vocational Training (mes.gov.bb)

SWOT Matrix	
Opportunities ► Dedicated strategy to support the development of some clean tech areas (RE, EE, Mobility and Transport, etc.) ► Dedicated incentives and the establishment of feed-in-tariffs for RE has created strong inducement for companies to enter and operate in the sector hence its rapid year-over-year increase in RE capacity ► Tax holidays and credits on individual and corporate levels assists in adoption and promotion of sustainable actions and serve to strengthen both demand and supply sides ► Increased exemptions from duties for EVs should lead to increased uptake as Barbados moves towards decarbonization ► Availability of grants and loan financing at concessionary rates from developmental banks to support, inter alia, feasibility studies at both the private and public levels and capacity building ► World rated universities offering graduate and under-graduate programs across multiple clean tech areas with tuition for under-graduate programs fully funded by Barbados Government and access to (low interest rate loans) available via the Student Revolving Loan Fund.	**Threats** ► Based on its high per capita income there is a limitation on development finance available beyond IDB and IFC and foreign commercial lenders are conservative in their lending approach given Barbados' sovereign credit rating

Table 10: SWOT Matrix

6.6.1 Key Indicators Summary Table

Key Indicator	Type	Source(s)	2-Axes Assessment Tracking Framework	SWOT Complementary Framework Quadrant
Sustainability Issues - ESG *List of Clean Tech-related issues based on the DJSI Assessment Criteria provided for industry areas where Clean Technology may refer to or be applied (including Enabler Technologies)*	Qualitative	DSJI	n/a	Strengths Weaknesses *(depending on assessment capabilities, measurement, and addressing)*

Sustainability Issues - Disclosure Topics & Accounting Metrics *List of Clean Tech-related issues based on the SASB Accounting Standards provided for industry areas where Clean Technology may refer to or be applied (including Enabler Technologies)*	Quali-quantitative	SASB	n/a	Strengths Weaknesses *(depending on assessment capabilities, measurement, and addressing)*
Existence of a Dedicated Strategy for Clean Tech Innovation *Generalist strategies to support innovation may be included but produce lower scores*	Qualitative	Official Government Documentation	Public Policy Axis	Opportunities
Dedicated Clean Tech Innovation Budget *The adequacy of the size of the budget can be benchmarked in relation to the country's GDP*	Quantitative	Official Government Documentation	Public Policy Axis	Strengths
Socio-Economic and Political Environment *Including an assessment of the country's stability, GDP growth rates, debt/GDP ratio, monetary stability, and other macro-economic variables*	Qualitative	International Institutions e.g. World Bank, IMF, etc.	Public Policy Axis	Strengths Threats

Key Indicators Summary Table (cont'd)

Dedicated Clean Tech Incentives - Tax Incentives - Tax Credit - Exemptions on Custom Duties - Employment Incentives - Red Tape Removal - Investment Incentives - M&A Incentives - R&D Incentives - Company Restructuring Incentives - Sustainability-related Incentives - Risk Financing Instruments - Fiscal Instruments including Feed-in Tariffs - Micro-economic Instruments including subsidies, concession loans and credits - De-incentives (Carbon Tax) - Presence of Public-Private Dedicated Clean Tech Incubators/Accelerators - Others	Quali-quantitative	Official Government Documentation	Public Policy Axis	Opportunities Weaknesses *(for the lack thereof)*
Dedicated Clean Tech RDI - RDI Public Budget - Participation to International Programs/Projects and Partnerships	Quali-quantitative	Official Government Documentation	Public Policy Axis	Opportunities Weaknesses *(for the lack thereof)*
Research Potential - Number of Top-Notch Universities - Talent Pool (estimated number of high-degree graduates/year)	Quantitative	QS World University Rankings	Public Policy Axis	Opportunities Threats *(for the lack thereof)*
Success Cases *Presence of top companies in the Clean Tech field that could produce significant spillover effects - selected according to funding amount since inception*	Quantitative	Open Datasets (e.g. Crunchbase, Pitchbook) *based on proposed Clean Tech Assessment and Tracking Framework Taxonomy*	n/a	Strengths

Key Indicators Summary Table (cont'd)

Innovation Outcomes **- Scaleup Density Ratio** **- Scaleup Investing Ratio** *We define "Scaleup Density Ratio" as the number of scaleups per 100K inhabitants - i.e. a measure of density of scaleups in a given ecosystem, and "Scaleup Investing Ratio" as capital raised by scaleups as a percentage of GDP - i.e. a measure meant to measure the capital invested in scaleups in a given ecosystem, compared to the size of the overall economy of that country.*	Quantitative	Open Datasets (e.g. Crunchbase, Pitchbook) *based on proposed Clean Tech Assessment and Tracking Framework Taxonomy* International Institutions e.g. World Bank, IMF, etc. GDP to be used in $,PPP	Innovation Outcome	Strengths Weaknesses *(for the lack thereof)*
Number of Clean Tech Startups *Startups defined as tech companies founded after 2000 that raised <$1M since inception*	Quantitative	Open Datasets (e.g. Pitchbook) *based on proposed Clean Tech Assessment and Tracking Framework Taxonomy*	n/a	Opportunities Weaknesses *(for the lack thereof)*
Innovation Outcomes **- Number of Scaleups, Scalers, Super Scalers** *Scaleups, Scalers, and Super Scalers defined as tech companies founded after 2000 that respectively raised >$1M, >$100M, >$1B*	Quantitative	Open Datasets (e.g. Crunchbase, Pitchbook) *based on proposed Clean Tech Assessment and Tracking Framework Taxonomy*	Innovation Outcome	Opportunities Weaknesses *(for the lack thereof)*
Innovation Outcomes **- Capital Raised by Scaleups** *Capital raised including private investors, banks and international financing institutions (IFIs) including IDB, EU, UN etc. grant, loan and private equity e.g. all risk financing instruments*	Quantitative	Open Datasets (e.g. Crunchbase, Pitchbook) *based on proposed Clean Tech Assessment and Tracking Framework Taxonomy*	Innovation Outcome	Strengths Weaknesses *(for the lack thereof)*

Key Indicators Summary Table (cont'd)

Stakeholders' Views Collected through qualified interviews with high-profile stakeholders of the local Clean Tech ecosystem, standard surveys, workshops.	Qualitative	Primary Sources	Public Policy Innovation Outcome	Strengths Weaknesses Opportunities Threats
Tech Innovation and Clean Tech Industry Trends *To produce comparisons, industry definitions, taxonomies, and identify and update benchmarks.*	Qualitative	Academic and Industry Sources	n/a	n/a

Table 11: Key Indicators Summary Table

7. Annexes

7.1 Annex 1 - Online Data Repository

Access to the Online Data Repository is view-only.
It includes access to a relational database including data about 3,000+ Clean Tech scaleups in the area considered, including historical data about their funding.

Link to the "Scaleups" base: https://airtable.com/shrMfgPehTgKsEh3X
Link to the "Investments" base: https://airtable.com/shrAerGbufuY0Qdfb

7.2 Annex 2 - .csv Data Export

Two .csv files including all the information stored in the Online Data Repository (Annex 1) are shared in editable, machine-readable form, to perform further analyses and to update data over time.

8. Top 25 Clean Tech Scaleup Profiles

8.1 Introduction

To provide a comprehensive picture of the current status of the Clean Tech global ecosystem, the selection of the top 25 Clean Tech Scaleup Profiles/Case Studies has been performed by taking into account: funding, y-o-y growth, representation of technologies, geographical distribution (proportionate to the data in this report).

Profile data has also been provided, in section 8.3 below, on each of the Clean Tech companies in Barbados, which provided such data in response to surveys.

8.2 Top 25 Clean Tech Scaleup Profiles

8.21 Rivian

http://www.rivian.com

HQ: USA, Plymouth
Founded: 2009
Status: Public
Funding: $10.7B
Main Lead Investors: Ford Motor, D1 Capital Partners, T. Rowe Price, Climate Pledge Fund
Employees: 5001-10000
Clean Tech Vertical Assessment: Mobility and Transportation
Partners: Ford (until November 2021, see article)

Description

Rivian is an automotive technology company that develops products and services to advance the shift to sustainable mobility. The company manufactures category-defining electric vehicles and accessories intended to offer a comfortable and eco-friendly drive experience. Rivian's battery packs are designed to be easily removed from vehicles and either recycled or used in "second life" applications such as stationary storage. The interiors of vehicles are made from 100% animal-free materials with mid-life repairability and end-of-life recyclability planned into the design. Dunnage containers at Rivian's plant are reusable and made from plastics harvested from the ocean.

8.22 Vivint Solar

http://www.vivintsolar.com

HQ: USA, Lehi
Founded: 2011
Status: Public, acquired by Sunrun
Funding: $3.5B
Main Lead Investors: Investec, Brookfield Asset Management
Employees: 1001-5000
Clean Tech Vertical Assessment: Energy and Power
Partners: Energy Hub (see article), Freedom Forever (see article)

Description

Vivint Solar provides a diverse range of products to power homes through solar power. Products range from: rooftop solar energy systems, solar energy storage and at-home EV chargers. Together, Vivint Solar and Sunrun serve 495,000+ homeowners nationwide.

8.23 Intersect Power

https://www.intersectpower.com/

HQ: USA, Beaverton
Founded: 2016
Status: Active
Funding: $3.4B
Main Lead Investors: HPS Investment Partners, CarVal Investors, Generate Capital, Macquarie Infrastructure and Real Asset
Employees: 11-50
Clean Tech Vertical Assessment: Circular Economy
Partners: SB energy (see article)

Description

Intersect Power is an infrastructure development company bringing utility-scale power to wholesale customers and markets, with the goal of delivering value and viability to both energy buyers and project investors. Founded in 2016, Intersect Power focuses on innovative and scalable low-carbon solutions in retail and wholesale energy markets. The company is vertically integrated: it develops and owns some of the world's largest clean energy resources providing low-carbon electricity, fuels, and related products to customers across North America.

8.24 Amyris

http://amyris.com/

HQ: USA, Emeryville
Founded: 2003
Status: Public
Funding: $1.8B
Main Lead Investors: Khosla Ventures, DAG Ventures, Temasek Holdings, Total, DSM, Vivo Capital, National Institutes of Health, Foris Ventures
Employees: 501-1000
Clean Tech Vertical Assessment: Environmental Quality and Safety
Partners: Inscripta (see article), Minerva Foods (see article), Total (see article), Ingredion (see article), ImmunityBio (see article), Biomillenia (see article)

Description

Amyris is a science and technology leader in the research, development and production of sustainable ingredients for the Clean Health & Beauty and Flavors & Fragrances markets. Amyris creates renewable products made with clean chemistry. Their products use an impressive array of exclusive technologies, including state-of-the-art machine learning, robotics and artificial intelligence. It uses an industrial synthetic biology platform that applies its innovative bioscience solutions to convert plant sugars into hydrocarbon molecules and produces specialty ingredients and consumer products. Its technology creates products that support biopharmaceutical drug discovery and production, from cosmetic emollients and fragrances to fuels, solvents, lubricants, and nutraceuticals.

8.25 Joby Aviation

http://www.jobyaviation.com

HQ: USA, Santa Cruz
Founded: 2009
Status: Public
Funding: $1.6B
Main Lead Investors: Uber, Toyota, Intel Capital,
Employees: 501-1000
Clean Tech Vertical Assessment: aerospace
Partners: Uber (see article), Toyota (see article)

Description

Joby Aviation, Inc. is a transportation company developing an all-electric vertical take-off and landing aircraft which it intends to operate as part of a fast, quiet, and convenient air taxi service beginning in 2024. They have spent more than a decade (and 1000+ test flights) developing and testing the zero-emissions aircraft that will travel 150+ miles on a single charge, enabling a pilot and four passengers to leapfrog over the congestion below at speeds of up to 200 mph.

The aircraft is quiet when it takes off and is nearly silent in flight, opening up unprecedented opportunities for traveling in both congested cities and under-served rural communities. Long term vision is to build a global passenger service that saves a billion people an hour every day, while helping to protect the planet.

8.26 Evoqua Water Technologies

http://www.evoqua.com/en

HQ: USA, Warrendale
Status: Acquired by AEA Investors
Funding: 2013
Main Lead Investors: -
Employees: 5001-10000
Clean Tech Vertical Assessment: Water and Blue Economy
Partners: Ostara Nutrient Recovery Technologies Inc. (see article), Filtec (see article)

Description

Evoqua Water Technologies provides products, solutions, and services to help municipalities and industrial customers to protect and improve water safety, quality, reliability and availability, now and for future generations. Its cost-effective and reliable treatment systems and services ensure uninterrupted quantity and quality of water, enable regulatory and environmental compliance, increase efficiency through water reuse, and prepare customers for next-generation demands.

8.27 QuantumScape

http://www.quantumscape.com/

HQ: USA, San Jose
Founded: 2010
Status: Public, acquired by Kensington Capital Acquisition Corp
Funding: $2B
Main Lead Investors:Volkswagen Group, Bill Gates, Qatar Investment Authority
Employees: 251-500
Clean Tech Vertical Assessment: Autotech
Partners: Fluence Energy (see article)

Description

QuantumScape is a renewable energy company that develops solid-state battery technology to increase the range of electric cars. The company works to revolutionize the battery industry by producing a solid-state battery that will provide a substantially higher level of battery storage than other batteries currently on the market. It manufactures lithium batteries aimed to accelerate the commercialization of solid-state batteries. The groundbreaking technology is designed to overcome the major shortfalls of legacy batteries and brings us into a new era of energy storage with two major innovations — an anodeless architecture and proprietary solid ceramic separator — that improve energy density, charging speeds and safety.

Lately QuantumScape is expanding its market introducing its solid-state lithium-based rechargeable batteries into the stationary power applications

8.28 Apeel Sciences

http://apeel.com

HQ: USA, Goleta
Founded: 2012
Status: Active
Funding: $0.64B
Main Lead Investors: GIC, Temasek Holdings, Kate Perry, Viking Global Investors, The Bill & Melinda Gates Foundation, The Rockefeller Foundation
Employees: 501-1000
Clean Tech Vertical Assessment: Foodtech
Partners: International Finance Corporation (see article)

Description

Apeel Sciences' plant-derived solution for fresh food providers doubles the lifespan of harvested fruits and vegetables even without refrigeration. It develops low-cost, natural technologies to help to eliminate food spoilage, reduce water and energy use, and preserve natural ecosystems.

Apeel uses materials that exist in the peels, seeds, and pulp of all fruits and vegetables to create a protective extra peel that seals moisture in and keeps oxygen out. That means the produce stays fresh, nutritious, and delicious twice as long. It also means less produce goes to waste throughout the supply chain—from grower to retailer to consumers at home.

8.29 PureCycle Technologies

https://purecycle.com

HQ: USA, Ironton
Founded: 2015
Status: Public
Funding: 0.54B
Main Lead Investors: Closed Loop Fund, Sylebra Capital
Employees: 11-50
Clean Tech Vertical Assessment: Waste Management
Partners: Milliken and Nestlé (see article), Total (see article), Gulfspan Industrial (see article)

Description

PureCycle Technologies' process offers the only recycled polypropylene with properties equal to virgin polymer. The proprietary process removes color, odor, and other contaminants resulting in 100% virgin-like polypropylene from recycled feedstock with potentially unlimited markets.

8.210 Helion Energy

http://www.helionenergy.com

HQ: USA, Everett
Founded: 2013
Status: Active
Funding: 0.58B
Main Lead Investors: Mithril Capital Management, Sam Altman, Capricorn Investment Group
Employees: 11-50
Clean Tech Vertical Assessment: Energy & Clean Tech
Partners: -

Description

Helion is a fusion power company based in Everett, WA, with the mission to enable a future with unlimited clean energy.
Just like regenerative braking in an electric car, their system is built to recover all unused and new electromagnetic energy efficiently.
They use deuterium and helium-3 (D-^{3}He), a cleaner, higher octane fuel. This helps keep the system small and efficient.
Currently, they are scaling up their latest plasma accelerator prototype.

8.211 Adionics

http://www.adionics.com/en/

HQ: France, Thiais
Founded: 2012
Status: active
Funding: $7M
Main Lead Investors: Bpifrance
Employees: 11-50
Clean Tech Vertical Assessment: Water and Blue Economy
Partners: Suez, Masdar, EDF, Total. Engie (see presentation)

Description

Adionics provides advanced ionic solutions such as lithium and iodide extraction, and salts separation. Thanks to the patented technology, AquaOmnes®, Adionics can tackle the needs of a wide variety of industries and cities, including those whose demands are currently unmet. Adionics created a revolutionary family of solvents that is able to extract salts from sea water or brine. While other desalination solutions extract water from the salt, Adionics does the contrary, which allows the process to be more efficient, sustainable and customizable.

8.212 The Ocean Cleanup

http://www.theoceancleanup.com

HQ: Netherlands, Rotterdam
Founded: 2013
Status: active
Funding: $35.4M
Main Lead Investors: Marc Benioff, Lynne Benioff
Employees: 51-100
Clean Tech Vertical Assessment: Water and Blue Economy
Partners: Maersk, CocaCola, Latham & Watkins, Deloitte, De Brauw Blackstone Westbroek, Government of Netherlands, Macquarie, AkzoNobel, Safilo, Salesforce, Iridium, Seiche Auto Naut, Data Iku, Microsoft, brabantia, CFF Communications, DSM, Solid Works, The Bennink Foundation, Gard, Globus, We Ship Yachts, The Ilsababy Foundation, Tito's Handmade (see website)

Description

The Ocean Cleanup is a non-profit organization developing and scaling technologies to rid the oceans of plastic. The company develops technologies to extract, prevent, and intercept plastic pollution. Their aim is to remove 90 % of floating ocean plastic. With the help and support of individuals, corporations and governments all over the world, The Ocean Cleanup aims to realize the mission and work towards a future where plastic no longer pollutes our oceans.

8.213 Biotalys

https://biotalys.com/

HQ: Belgium, Ghent
Founded: 2012
Status: Active
Funding: $77.6M
Main Lead Investors: Sofinnova Partners, Bill & Melinda Gates Foundation, Flanders Innovation and Entrepreneurship (VLAIO), Novalis LifeSciences, Gimv
Employees: 11-50
Clean Tech Vertical Assessment: Agriculture and Food
Partners: Olon (see article)

Description

Biotalys is a food and crop protection company developing a new generation of protein-based biocontrol solutions, shaping the future of sustainable and safe food supply. Based on a ground-breaking technology platform, the company is developing a broad pipeline of effective and safe products with novel modes of action, addressing key crop pests and diseases across the whole value chain, from soil to plate.

8.214 Wallbox

https://www.wallbox.com/

HQ: Spain, Barcelona
Founded: 2015
Status: Public
Funding: $167.5M
Main Lead Investors: Cathay Innovation, WIND Ventures, Seaya Ventures, Iberdrola, Desafía
Employees: 501-1000
Clean Tech Vertical Assessment: Mobility and Transportation
Partners: Hyundai Motor Deutschland (see article), Uber (see article), Replenish (see article), Sun Power (see article)

Description

Wallbox is a global company, dedicated to changing the way the world uses energy in the electric vehicle industry. Wallbox creates smart charging systems that combine innovative technology with outstanding design and manage the communication between vehicle, grid, building and charger. Wallbox offers a complete portfolio of charging and energy management solutions for residential and semi-public use in more than 60 countries, and soon will begin commercializing public charging solutions as well. Wallbox's mission is to facilitate the adoption of electric vehicles today to make more sustainable use of energy tomorrow. The company employs over 500 people in Europe, Asia, and the Americas.

8.215 Rimac Automobili

https://www.rimac-automobili.com

HQ: Europe, Croatia
Founded: 2009
Status: active
Funding: $0.2B
Main Lead Investors: Porsche Ventures, Hyundai Motor Company, Kia Motors
Employees: 1001-5000
Clean Tech Vertical Assessment: Autotech
Partners:
Koenigsegg (see article), Automobili Pininfarina (see article), Porsche AG (see article)

Description

Rimac is a technology powerhouse, manufacturing electric hypercars and providing full technology solutions to global automotive manufacturers. Founded in 2009 with headquarters in Croatia, Rimac started as a garage project and grew into a globally recognized technology leader.

The company's flagship, the Concept_One, was entirely designed, developed and manufactured in-house. In 2018 Rimac introduced the next generation hypercar, the C_Two, a car alive with technology. Today, the company numbers over 1200 people and has grown into a leader within a highly competitive industry with the ambition to become a full electrification partner for many OEMs. Rimac Automobili has challenged the status-quo with the vision to revolutionise and reinvent the sports car with its technology thus successfully tackling the electrification challenge set upon the automotive industry.

8.216 Beta Renewables

http://www.betarenewables.com/

HQ: Italy, Tortona
Founded: 2011
Status: Active
Funding: $344M
Main Investors: TPG, Chemtex International
Employees: 1-10
Clean Tech Vertical Assessment: Advanced Materials
Partners: Novozymes (see article)

Description

Beta Renewables is a leader in the field of advanced biofuels and biochemical compounds at competitive costs. Beta Renewables is a unique joint venture between Biochemtex, a company of the Mossi Ghisolfi Group and the U.S. fund TPG (Texas Pacific Group)

8.217 Ynsect

http://www.ynsect.com/

HQ: Europe, France
Founded: 2011
Status: Active
Funding:$0.4B
Main Investors: Astanor Ventures, BPI France, Idinvest Partners
Employees: 101-250
Clean Tech Vertical Assessment: Foodtech
Partners: ipiff, Proteines France, FAO, IAR, Genopole, Innovia, Snia, Vitagora, AgroParisTech, cnrs, Pure Simple True LLC (see article)

Description

Ÿnsect transforms insects into premium, high-value ingredients for pets, fish, plants, and human beings. From its purpose-built state of the art farms, the company offers an organic, long-term sustainable solution to accelerate consumption of protein and plants.

Due to its negative carbon activity and meeting the highest standards of verified social and environmental performance, Ÿnsect uses pioneering proprietary technology protected globally by c.300 patents to produce Molitor and Buffalo mealworms in vertical farms.
It is currently building its third production unit, the largest vertical farm in the world, in Amiens, France and operates two sites in France (since 2016) and the Netherlands (since 2017)

8.218 Infarm

https://infarm.com

HQ: Europe, Germany
Founded: 2013
Status: Active
Funding: $0.6B
Main Investors: Atomico, Lightrock, Qatar Investment Authority, LGT Lightstone
Employees: 1001-5000
Clean Tech Vertical Assessment: Agritech, Foodtech
Partners: Sobeys (see article)

Description
Infarm builds and distributes efficient vertical farms throughout cities. Infarm combines efficient vertical farms with IoT technologies and Machine Learning, to offer an alternative food system that is resilient, transparent, and affordable. The company distributes its smart modular farms throughout the urban environment to grow fresh produce for the city's inhabitants.

Its latest-generation farming units consume 95% less water and 99% less land compared to open farming, with zero chemical pesticides, and zero chemical fertilizers.

8.219 TIER Mobility

http://www.tier.app

HQ: Europe, Germany
Founded: 2018
Status: Active
Funding: $0.65B
Main Investors: Softbank Vision Fund, Speedinvest, Goodwater Capital, Mubadala Capital, Northzone, Axa Germany, Nico Rosberg
Employees: 501-1000
Clean Tech Vertical Assessment: Mobility
Partners: Busby (see article), Safe & the City (see article), Moovit (see article), Nunam (see article), Northvolt (see article), Google (see article)

Description
TIER Mobility is Europe's leading shared micro-mobility provider, with a mission to Change Mobility for Good. By providing people with a range of shared, light electric vehicles, from e-scooters to e-bikes and e-mopeds, powered by a proprietary energy network, TIER helps cities reduce their dependence on cars.

With a focus on providing the safest, most equitable and most sustainable mobility solution, TIER has been climate neutral since January 2020

8.220 Northvolt

http://www.northvolt.com

HQ: Europe, Sweden
Founded: 2016
Status: Active
Funding: $6B
Main Lead Investors: Goldman Sachs Asset Management, Volkswagen Group, Swedish pension funds (AP1, AP2, AP3, AP4), InnoEnergy, BMW Group
Employees: 1001-5000
Clean Tech Vertical Assessment: Energy & Clean Tech, Autotech
Partners: Tier Mobility (see article), BMW Group (see article), Epiroc (see article), Scania (see article), Vattenfall (see article), Volkswagen Group (see article), Volvo Car Group (see article), Galp (see article)

Description
Northvolt develops sustainable lithium-ion batteries in conjunction with R&D, industrialization, and recycling to support clean energy. It provides electrification and renewable energy storage designed for lithium-ion battery plant to produce batteries for electric vehicles. The mission is to deliver environment-friendly batteries with an 80% lower carbon footprint compared to those made using coal energy and with recycling technology without compromising with important ecosystems, enabling the auto industry to replace fossil fuels with electricity in an efficient manner.

The company aims to establish a supply of sustainable battery cells and systems.

8.221 Aleph Farms

https://www.aleph-farms.com/

HQ: Israel, Rehovot
Founded: 2017
Status: Active
Funding: $131.4M
Main Lead Investors: Leonardo DiCaprio, L Catterton, DisruptAD, VisVires New Protein
Employees: 11-50
Clean Tech Vertical Assessment: Agriculture and Food
Partners: BRF (see article), Wacker (see article), Thai Union and CJ CheilJedang (see article)

Description

Aleph Farms grows beef steaks, from non-genetically engineered and non-immortalized cells isolated from a living cow, without slaughtering the animal and with a significantly reduced impact to the environment. Aleph Farms released the world's first cultivated steak in December 2018 and the world's first cultivated ribeye steak in 2021. The company's vision is to provide unconditional nutrition for anyone, anytime, anywhere.

8.222 StoreDot

http://www.store-dot.com

HQ: Israel, Herzliya
Founded: 2012
Status: Active (on SPAC merger, see article)
Funding: $190.5M
Main Lead Investors: Vinfast, Raison Asset Management, BP, Daimler, Singulariteam, Samsung Ventures
Employees: 101-250
Clean Tech Vertical Assessment: Advanced Materials
Partners: Group14 (see article), VinFast (see article), Molecules (see article)

Description

StoreDot is the leader in the innovation of materials and their device applications, developing ground-breaking technologies based on a unique methodology for the design, synthesis and tuning of new organic compounds. These proprietary compounds dramatically improve the performance of a range of devices, including batteries, displays, sensors and digital memory.

Designed to replace known technologies by means of enhanced physical, chemical, electrical and optical properties, StoreDot's technology, inspired by nature, can be optimized for multiple industries, including fast-charging batteries for mobile devices and electric vehicles. Additionally, it has the potential to disrupt such industries as energy, displays, semiconductors, image sensors, and digital memory.
With a strong technological team of noted scientists and device engineering experts, StoreDot is positioned to reinvent the world of materials and devices as we know it.

8.223 Phinergy

http://www.phinergy.com/

HQ: Israel, Lod
Founded: 2010
Status: Public
Funding: $50M
Main Lead Investors: Indian Oil Corporation, Alcoa
Employees: 11-50
Clean Tech Vertical Assessment: Energy and Power
Partners: IndianOil Corporation (IOC) (see article)

Description

Phinergy develops metal–air technology, turning metals (namely aluminum and zinc) into a new way to store, transport, and generate clean and safe energy. Phinergy's aluminum-air technology releases the abundant energy contained in aluminum, resulting in a clean, safe, cost-efficient, and fully recyclable energy source. Phinergy's aluminum-air technology provides on-demand, clean energy for a variety of applications including energy backup for critical sites, on-demand distributed generation for microgrids, and range extenders for electric vehicles.

Phinergy's zinc-air technology provides a high-capacity, low-cost, grid-scale energy storage solution for renewable sources such as wind and solar.

Phinergy has established strategic partnerships with leading companies worldwide.

8.224 Homebiogas

http://www.homebiogas.com/

HQ: Israel
Founded: 2010
Status: Public
Funding: $35.5M
Main Lead Investors:
Employees: 51-200
Clean Tech Vertical Assessment: Circular Economy, Energy & Clean Tech
Partners: DAI (see article), Qnergy Inc (see article)

Description

HomeBiogas is a world leader in developing groundbreaking and simple to use biogas systems, enabling people and businesses around the globe to turn their own organic waste into self-made clean energy. HomeBiogas is serving thousands of households, farmers, businesses and underserved communities in over 100 countries around the world. Its fully off-grid, patent-based systems offer modular options to suit each customer's needs, empowering them with a sustainable way of living and a healthier life.

8.225 BildTEK

https://bildtek.com/?

HQ: Costa Rica
Founded: 2013
Status: Active
Funding: $1.6M
Employees: 1-10
Clean Tech Vertical Assessment: Construction
Main Investors: Carao Ventures
Partners: -

Description

BîldTEK increases productivity and construction quality by integrating design and production technology to build efficient structures with light-gauge steel framing. They believe in integrated computer automated design and manufacturing as enabling elements to revolutionize traditional building systems in quality, time and cost. BîldTEK is smart building: there is a better way to build using a simplified process that reduces the environmental impact and ensures structural precision . Use of building information modeling (BIM) and a controlled manufacturing process to produce structures of cold-formed steel for residential and commercial construction.

8.3 Clean Tech (Barbados) Company Profiles

8.31 Sun Power

www.sunpowr.com

HQ: Factory Yard, Christ Church, Barbados
Founded: 1978
Status: Active, Private
Funding: No Data
Employees: 11-50
Gender Distribution: 70% male; 30% female
Clean Tech Vertical Assessment: Energy and Power
Annual Turnover (US$): 500,000-2.5M
Main Investors:
Partners: -

Description

Manufacture and sell solar water heating systems, tanks, panels, water storage systems and pressure release valves. All products, with the exception of modular tanks, are produced locally.

8.32 Solar Genesis

www.solargenesis.com

HQ: Barbados
Founded: 2013
Status: Active, Private
Funding: No Data
Employees: 1-10
Gender Distribution: 100% male
Clean Tech Vertical Assessment: Energy and Power
Annual Turnover (US$): 50,000-250,000
Main Investors:
Partners: -

Description

Renewable energy company providing consulting, project management and solar development services for the Caribbean solar photovoltaic (PV) market.

8.33 Sol Ecolution

https://solpetroleum.com/sol-ecolution-barbados/

HQ: Cayman Islands
Founded: 2021
Status: Active, Private
Funding: No Data
Employees: 1-10
Gender Distribution: No Data
Clean Tech Vertical Assessment: Energy and Power
Annual Turnover (US$): No Data
Main Investors:
Partners: - Sol Caribbean Limited

Description

Provides high quality, reliable and safe energy solutions with Solar energy being a key pillar of Sol Ecolution’s renewable energy offering. The full-service offering includes: project financing, site selection and assessment, project scoping and design, pre-feasibility and feasibility studies, contract negotiation, engineering procurement and construction services – provided through local partnerships.

8.34 Sustainable Barbados Recycling Centre (SBRC)

www.sbrcinc.com

HQ: Vaucluse, St. Thomas, Barbados
Founded: 2009
Status: Active
Funding: No Data
Employees: 11-50
Gender Distribution: 75% male; 25% female
Clean Tech Vertical Assessment: Circular Economy
Annual Turnover (US$): No Data
Main Investors:
Partners: - Sanitation Service Authority, Government, Williams Industries

Description

Divert waste to develop products from the organic solid waste stream as it seeks to maximize diversion of recyclable waste from the Sanitary Landfill, reduce the disposal load, conserve the Island's resources, increase the organic content of local soils and contribute to the effort of reducing global warming. Among products produced are bagged organic mulch, animal bedding, compost, top-soil, soil amendment, wood chip and coconut fibre.

8.35 S.I.R Water Management Limited

www.sirwatermgmt.com

HQ: Bloomsbury, St. Thomas, Barbados
Founded: 1998
Status: Active, Private
Funding: No Data
Employees: 1-10
Gender Distribution: 67% male; 33% female
Clean Tech Vertical Assessment: Water and Blue Economy
Annual Turnover (US$): 0.5M-2.5M
Main Investors:
Partners: -

Description

Hydra jetting, leak detection, grease removal systems, wastewater treatment, water disinfection systems, pumps, water conditioning & storage, water saving devices, micro bacterial aids and water storage tanks.

8.36 Rum and Sargassum Inc

https://rumandsargassum.com/

HQ: 28 Dairy Meadows, Holders Hill, St. James, Barbados
Founded: 2021
Status: Active, Private
Funding: No Data
Employees: No Data
Gender Distribution: 25% male; 75% female
Clean Tech Vertical Assessment: Renewable Energy
Annual Turnover (US$): 0.5M-2.5M
Main Investors:
Partners: - University of the West Indies, Cave Hill Campus

Description

Renewable fuel for all cars via rum distillery wastewater and sargassum seaweed biogas CNG kit.

8.37 Red Diamond Compost

https://reddiamondcompost.com

HQ: Weston, St. James, Barbados
Founded: 2017
Status: Active, Private
Funding: No Data
Employees: 1-10
Gender Distribution: 50% male; 50% female
Clean Tech Vertical Assessment: Agriculture and Food
Annual Turnover (US$): No Data
Main Investors:
Partners: - Bloom Cleantech Cluster, Export Barbados, CoESL (Caribbean Centre of Excellence for Sustainable Livelihoods), GEN Caribbean, Organic Growers and Consumers Association, Radicle Global, Barbados Manufacturers Association, Barbados Chamber of Commerce and Industry

Description

Create fertilizers and bio-stimulants designed to support the fragile microbes responsible for building soil structure, storing organic soil carbon, cycling nutrients to plants, and are safe for wildlife.

8.38 ProSolar 246

www.prosolar246.com

HQ: Chapel Place, Culloden Road St. Michael, Barbados
Founded: 2019
Status: Active, Private
Funding: No Data
Employees: 1-10
Gender Distribution: 50% male; 50% female
Clean Tech Vertical Assessment: Energy and Power
Annual Turnover (US$): No Data
Main Investors:
Partners: - Bloom Cleantech Cluster (Export Barbados & UNIDO)

Description

Renewable energy – Project management and project development (solar and wind projects), roof and ground mounted panel installation, hybrid grid-tie battery storage systems, off-grid renewable energy solution, solar panel cleaning and replacement of modules/inverters and troubleshooting services for system faults.

8.39 National Petroleum Corporation

www.npc.bb

HQ: Wildey Main Road, St. Michael, Barbados
Founded: 1982 however Natural Gas Vehicles first started in 2008 in conjunction with Courtesy Garage, and NPC had commissioned its first fast-fill natural gas station in 2011. Concentrated research and activities around biomethane started in 2018 with BoD approval on a pilot project in 2019
Status: Active, Private
Funding: US$37,000,000 – IADB, Deployment of Cleaner Fuels and Renewable Energies in Barbados
Employees: 101-250
Gender Distribution: 72% male; 28% female
Clean Tech Vertical Assessment: Renewable Energy & Biofuels
Annual Turnover (US$): No Data
Main Investors:
Partners: - Ministry of Energy and Business and IADB

Description

Refueling of CNG Vehicles and distribution of natural gas supply.

8.310 MegaPower Ltd.

www.megapower365.com

HQ: Wildey Business Park, Wildey, St. Michael, Barbados
Founded: 2013
Status: Active, Private
Funding: No Data
Employees: 11-50
Gender Distribution: 58% male; 42% female
Clean Tech Vertical Assessment: Mobility and Transportation
Annual Turnover (US$): 2.5M-5.0M
Main Investors:
Partners: - BL&P, Partner sites at various locations across Barbados where the use of the charging stations requires a MegaPower RFID card – locations/partners are Little Good Harbour Hotel and Fish Pot Restaurant, LimeGrove Lifestyle Center, The Walk in Welches, Caribbean LED Lighting, BICO Ice Cream, Southern Palms Beach Hotel, Atlantis Hotel

Description

Sale of EVs, reuse and upcycle old EV batteries for new projects (from golf carts to streetlights); design solar carports, charging networks

8.311 Innogen Technologies Inc.

https://www.innogenonline.com

HQ: Harold Hoyte and Fred Gollop Media Complex, Fontabelle, St. Michael, Barbados
Founded: 2016
Status: Active, Private
Funding: No Data
Employees: 1-10
Gender Distribution: 84% male; 16% female
Clean Tech Vertical Assessment: Energy and Power
Annual Turnover (US$): No Data
Main Investors:
Partners: - Acceleron Pharma (parent company)

Description

Commercial and residential off grid and grid connected services including energy storage.

8.312 Healing Grove Container Farm

www.healinggrove.com

HQ: Barbados
Founded: 2022
Status: Active, Private
Funding: No Data
Employees: 1-10
Gender Distribution: 25% male; 75% female
Clean Tech Vertical Assessment: Agriculture and Food
Annual Turnover (US$): No Data
Main Investors:
Partners: -

Description

Solar PV powered Greenhouse, Shade house, Freight Container Farming, Water recycling, hydroponics, aquaponics.

8.313 Emera Caribbean Renewables Inc.

https://www.emeracaribbeanrenewablesltd.com

HQ: Garrison Hill, St. Michael, Barbados
Founded: 2012
Status: Active, Private
Funding: No Data
Employees: 11-50
Gender Distribution: 75% male; 25% female
Clean Tech Vertical Assessment: Energy and Power
Annual Turnover (US$): No Data
Main Investors:
Partners: - Emera Inc. (parent company)

Description

Provides custom engineering design, procurement, construction, project management, and after sales operations and maintenance support of renewable solutions inclusive of photovoltaic, wind, energy storage, as well as energy management services for commercial and industrial scale applications.

8.314 Ecohesion Inc.

https://ecohesion.bb/

HQ: Building 1, Town Centre, Villages at Coverley, Christ Church, Barbados
Founded: 2013
Status: Active, Private
Funding: US$20,000
Employees: 11-50
Gender Distribution: 70% male; 30% female
Clean Tech Vertical Assessment: Water and Blue Economy
Annual Turnover (US$): 500,000-2.5M
Main Investors: UNDP
Partners: - Huber, Suez, New Terra

Description

Design and build water and wastewater treatment assets. Remote control and monitoring wastewater treatment assets as well as maintenance.

8.315 Caribbean Environmental Management Bureau (CEMBI)

www.cembi.org

HQ: “Simbar", Lodge Hill, St. Michael, Barbados
Founded: 2008
Status: Active, Private
Funding: No Data
Employees: 1-10
Gender Distribution: 50% male; 50% female
Clean Tech Vertical Assessment: Circular Economy
Annual Turnover (US$): No Data
Main Investors:
Partners: - GEF-SGP UNDP, Bloom Cleantech Cluster (Export Barbados & UNIDO)

Description

BitEgreen Market: web platform & app. BitEgreen Market is an innovative environmental initiative that uses technology to assign monetary value to reusable and recyclable material for all citizens and corporations, making it.

8.316 Caribbean LED Lighting Inc.

www.caribbeanledlighting.com

HQ: Unit 1, Dega Complex, Lower Estate, St. Michael, Barbados
Founded: 2011
Status: Active, Private
Funding: US$2.0M
Employees: 11-50
Gender Distribution: 53% male; 47% female
Clean Tech Vertical Assessment: Energy and Power
Annual Turnover (US$): 2.5M-5.0M
Main Investors:
Partners: - Hadco Group of Companies & LED Roadway Lighting

Description

Bulb disposal, energy lighting audits, lighting level measurements, payback analysis, energy efficient lighting products.

8.317 Caribbean E-Waste Management Inc.

http://cewmi.com/

HQ: Herberts Land, Codrington Hill, St. Michael, Barbados
Founded: 2008
Status: Active, Private
Funding: US$250,000-US$500,000
Employees: 1-10
Gender Distribution: 67% male; 33% female
Clean Tech Vertical Assessment: Circular Economy
Annual Turnover (US$): 50,000-250,000
Main Investors:
Partners: - SBRC

Description

Disassemble and recover recyclable materials from electronic equipment that cannot be repaired, refurbished or upgraded which are then shipped to e-Stewards or R2 certified international recyclers to undergo further processing.

8.318 BIM EV Services

https://bimev.business.site

HQ: Shop Hill, St. Thomas, Barbados
Founded: 2019
Status: Active, Private
Funding: No Data
Employees: 1-10
Gender Distribution: 50% male; 50% female
Clean Tech Vertical Assessment: Mobility and Transportation
Annual Turnover (US$): No Data
Main Investors:
Partners: - Bloom Cleantech Cluster (Export Barbados & UNIDO)

Description

Fully electric vehicle rental company.

8.319 Barbados National Oil Company Limited

https://bnocl.com

HQ: Woodbourne, St. Philip, Barbados
Founded: 1982; Renewable Energy Department established in 2010
Status: Active
Funding: No Data
Employees: 101-250
Gender Distribution: 50% male; 50% female
Clean Tech Vertical Assessment: Energy and Power
Annual Turnover (US$): 500,000-2.5M
Main Investors:
Partners: - Bloom Cleantech Cluster (Export Barbados & UNIDO)

Description

Solar PV systems (residential, commercial and utility scale), sell battery-based solutions.

9. Methodology

9.1 Process

By leveraging:

- The Clean Tech definition and sub-technologies list included in the Literature review
- The Policy Framework (divided into the following core elements: Strategies, Incentive, and Research)

It is possible to produce updates to the current, provided assessment and/or to perform further analyses by researching and comparing different ecosystems and regions.
The process requires the following steps:

- Data gathering including updates to the existing sources (indicated throughout the document)
- Data check and reclassification of existing open data taxonomies and hierarchies to be aligned with the Clean Tech definition and Framework indicated
- Re-assessment of indicators (scaleup ecosystem metrics existence of policies, incentives, R&D investments, etc.)
- Quali-quantitative scoring of each indicator
- Positioning on the Matrix Framework and evaluation of progress (if any)

All data included in this assessment is to be considered as preliminary and suitable for updates, revisions, and changes according to stakeholders' views, additions from new sources (including primary information), and the impact of externalities or unforeseen events. Data is provided *as is* and the accuracy of all information in each source used within this assessment report is of the sole responsibility of the author(s).

9.2 Definitions

9.2.1 Definition of Clean Tech and Taxonomy

We define **"Clean Tech"** as:
Clean Tech represents the technologies and business model innovations that enable the transformation to a more resource efficient and low carbon economy.

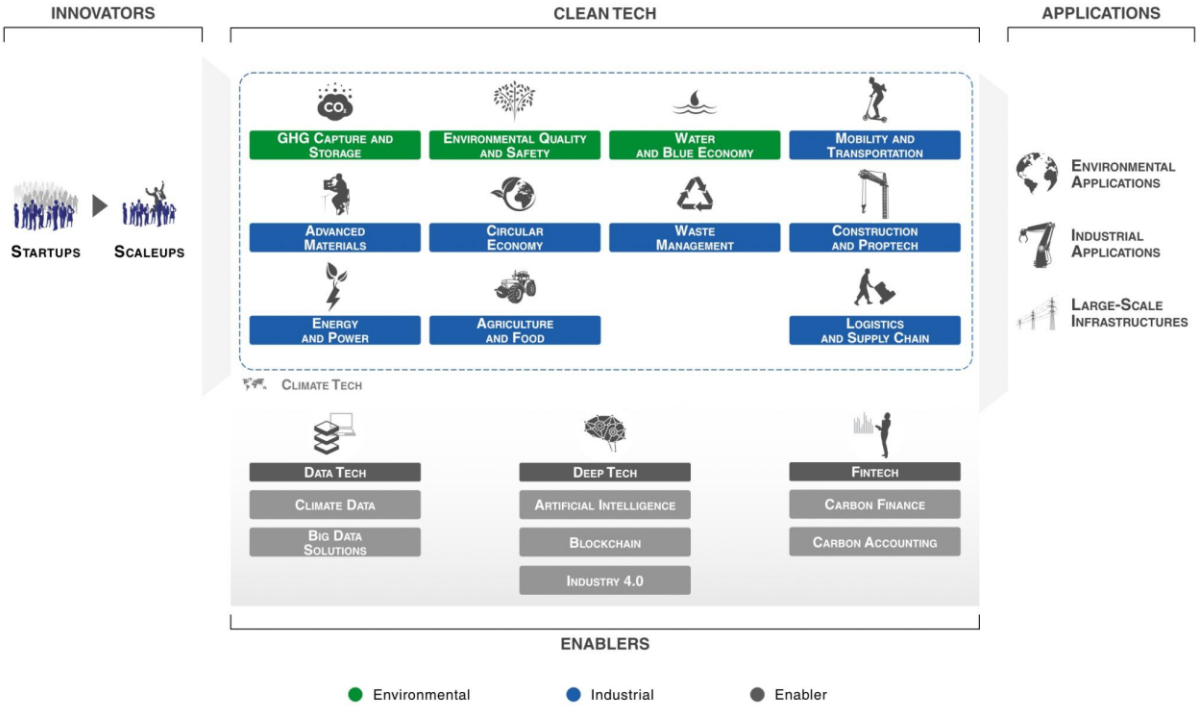

Figure 10: Clean Tech and Taxonomy

9.2.2 Definition of Tech Companies and Tech Scaleup Ecosystems

"Startups"
Innovative tech companies founded after 2000 that raised <$1M in funding (equity) since inception.

"Scaleups"
Innovative tech companies founded after 2000 that raised >$1M in funding (equity) since inception.

"Scalers"
Innovative tech companies founded after 2000 that raised >$100M in funding (equity) since inception.

"Super-Scalers"
Innovative tech companies founded after 2000 that raised >$1B in funding (equity) since inception.

“Equity Funding”

- *All private equity funding rounds (including angel investments, seed capital, series A, B, C, etc.), either coming from VCs or CVCs; funding raised on equity crowdfunding platforms; convertible notes and other equity-based financial instruments.*
- *Public funding provided in exchange for equity (e.g. specific investments vehicles from the EIB).*
- *IPO proceeds, at closing price, including over-subscribed shares.*
- *Capital raised through ICO (exchange rate of cryptos at the day of ICO).*
- *Operations with no new cash entering the company's balance sheet as a number of existing shareholders sell all or a portion of their holding are not considered. This includes secondary funding rounds, buyouts and buy-ins.*

We also propose the utilization of several indicators to comparatively monitor the relative performance of regional or national Clean Tech ecosystems, defined as follows:

“Scaleup Density Ratio”
The number of scaleups per 100K inhabitants. A measure of density of scaleups in a given ecosystem.

“Scaleup Investing Ratio”
Capital raised by scaleups as a percentage of GDP. A measure meant to measure the capital invested in scaleups in a given ecosystem, compared to the size of the overall economy of that country.

“Scaleup Country Index”
Country ranking built upon the Scaleup Density Ratio and Scaleup Investing Ratio. A measure of the overall innovation commitment of a given ecosystem and its ability to produce significant tech players.

“Scaleup (City) Hub Index”
Hub ranking built upon Scaleup Density Ratio and Scaleup Investing Ratio. A measure of the overall innovation commitment of a given city/tech hub and its ability to produce significant tech players.

“Scaleup Matrix”
The matrix visually compares ecosystems by factoring the Scaleup Density Ratio and Scaleup Investing Ratios.

9.2.3 Geographies

“MENA (including Israel)”
This is based on the World Bank definition, excluding Malta (included in Continental Europe due to its participation in the Eurozone) and Turkey (analyzed separately). Included countries are listed below.
Middle East: United Arab Emirates, Kingdom of Saudi Arabia (KSA), Kuwait, Qatar, Bahrain, Sultanate of Oman, Yemen, Kingdom of Jordan, Iraq, Islamic Republic of Iran, Syria, Lebanon, West Bank and Gaza, Djibouti, Israel
North Africa: Egypt, Morocco, Algeria, Tunisia, Libya

“Europe”
We categorize European sub-regions and list the associated countries below:
British Isles: United Kingdom (including Gibraltar, Guernsey and Jersey), Ireland
Central Europe: France, Germany, Switzerland, Austria, Principate of Monaco, Liechtenstein.
Nordics: Denmark, Iceland, Finland, Sweden, Norway
Southern Europe: Spain, Italy, Portugal, Greece, Malta, Cyprus, Andorra, San Marino, Vatican City
Benelux: The Netherlands, Belgium, Luxembourg.
Eastern Europe: Poland, Czech Republic, Slovakia, Slovenia, Croatia, Serbia, Bosnia and Herzegovina, Montenegro, Macedonia, Kosovo, Albania, Romania, Bulgaria, Hungary, Moldova, Ukraine, Belarus.
Baltics: Estonia, Lithuania, Latvia.

“North America and Caribbean”
We include in the definition:
United States: all 50 US states (Overseas territories such as Guam are not included).
Canada
The Caribbean (based on the World Bank definition): Aruba, Bahamas, Barbados, Belize, Cayman Islands (U.K.), Curaçao (Netherlands), Dominican Republic, Guyana, Haiti, Jamaica, Organisation of Eastern Caribbean States (OECS) (ie. Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines), Sint Maarten, Suriname, Trinidad and Tobago, Turks and Caicos

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