ENABLING ENVIRONMENT FOR INNOVATION IN CLEANTECH

ENERGY

RESEARCH REPORT

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Executive Summary

A major concern nowadays is the depletion of nonrenewable energy resources, how to improve energy efficiency, and how to achieve sustainable development by utilizing and managing resources and energies. Due to the growing interest in transition to low carbon technologies, many countries tend to adopt clean technology in different sectors (Y.-C. Yang et al., 2020). Technology today is at the center of human development and, moving forward, plays a vital role in tackling climate change. Technology is an essential component of a comprehensive climate change strategy that includes global efforts to limit and reduce greenhouse gas (GHG) emissions through mitigation measures and decrease the adverse impacts resulting from climate change through adaptation (UNDESA, 2009). In order to meet the climate change challenge, two things should be considered: (a) the direction of technological innovation (in terms of effective policies, measures, and clean technologies that integrate development and sustainability), and (b) the pace of technological innovation (Tan, 2010).

"Cleantech" is the term used to refer to various companies and technologies that aim to improve and enhance environmental sustainability, such as renewable energy sources, new approaches for recycling, and other environmentally friendly methods and practices (Clift & Longley, 1995).

Different definitions explain the meaning of Cleantech. Getzner defined clean technologies as "fairly sophisticated production systems, developed and adopted for the primary purpose of environmental performance," while another, Fukaso (2008), described it as "clean technologies as the technological solutions that are most likely to sustain environmental preservation over the long run." Cleantech also refers to various companies and technologies that aim to improve and enhance environmental sustainability (Koltuniewicz & Drioli, 2008; Ozusaglam, 2012).

The aim of "cleantech" is to explore/develop technologies that protect the environment, repair the damage done, and conserve and preserve earth's natural resources. The three main goals of Cleantech include:

- Providing a higher performance at lower costs.
- Reducing negative implications on the environment by eliminating harmful waste.
- Using natural resources efficiently.

Companies in the Cleantech industry directly enable the efficient use of natural resources and produce less ecological impact, achieved through shifting current practices in industrial production and consumption from the current pattern, incompatible with growing scarcity of natural resources. Consequently, there is a need to transform the current path towards sustainable energy solutions and clean technologies (UNIDO, 2018). Cleantech spans many industry sectors and includes the following segments: energy generation, energy storage, energy infrastructure, energy efficiency, transportation, water and wastewater, air and environment, materials, manufacturing/ industrial, agriculture, and recycling and waste (Dikeman, 2015). **Figure 1** represents the different sectors included in the Cleantech industry.

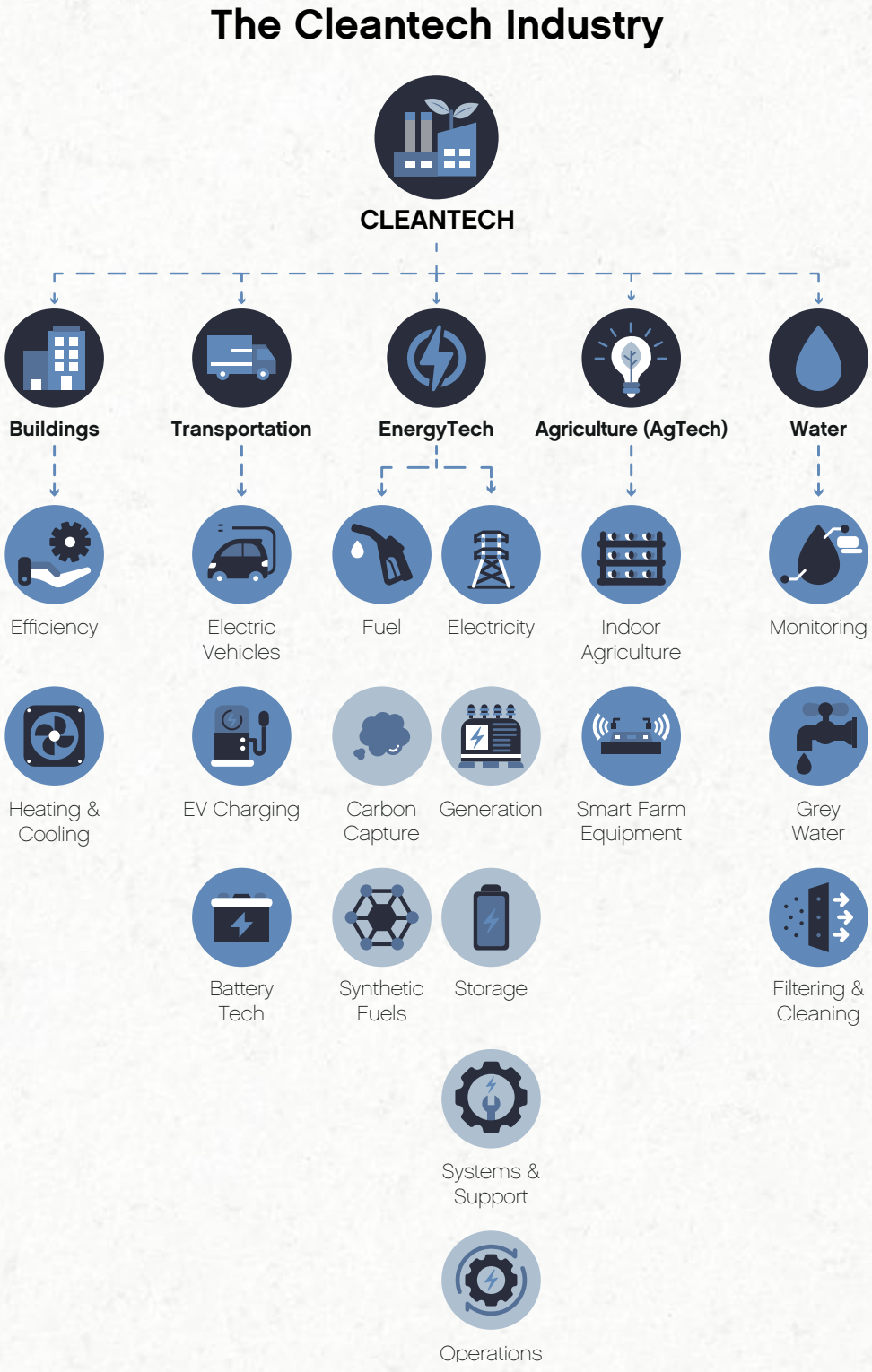

Figure 1: Categories in the Cleantech industry (Nussey, 2019)

Cleantech increases jobs **Figure 2**, and some important contributors to this increase are solar panel installers, civil and process engineers, technicians, and manufacturing personnel. Reports show that this shift towards Cleantech is cited as a fast-growing area of employment, nearly 20 percent higher than the national average (IRENA, 2020). An example of this is reflected **Figure 2** where cleantech SMEs in Canada tend to have more employees and have been in operation longer than other SMEs working in domains other than Cleantech (Huang, 2020).

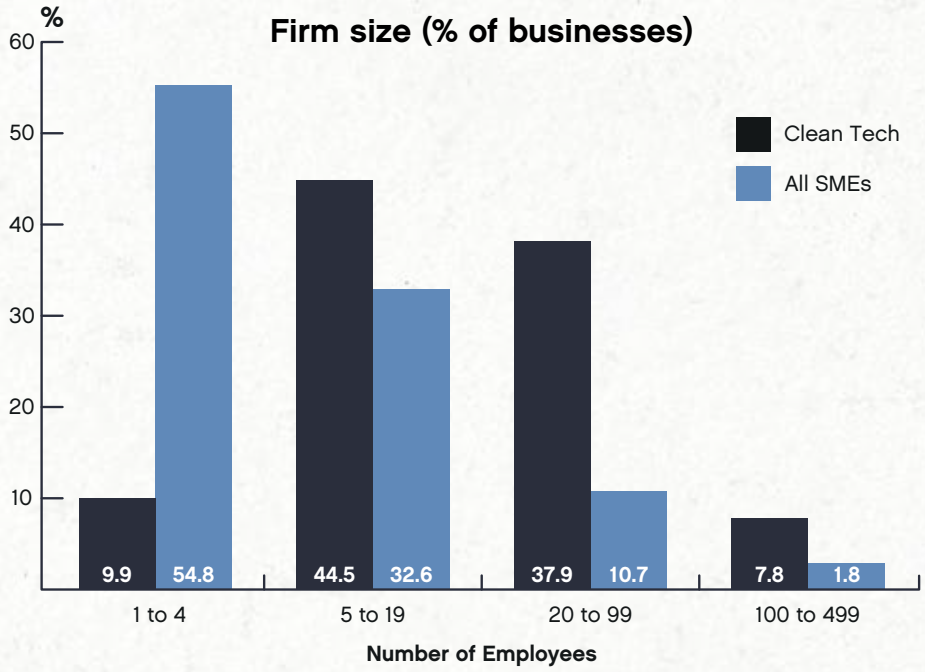

Figure 2: Comparison of Number of Employees in Cleantech SMEs vs All SMEs

The market for Cleantech is relatively young; however, it has garnered a significant number of investors interested in this sector due to the increasing awareness of the impact of climate change and the depletion of natural resources. Understanding "cleantech" means exploring products and services that improve operational performance while reducing costs, energy consumption, waste, and negative effects on the environment (Svenfelt, 2021).

Energy

The ACT SMART (Agri-food and Cleantech) innovation hub represents a new approach for strengthening business advancement and job creation in the Agri-food and Cleantech sectors in Lebanon. This concept applies a sector-wide approach for economic growth by stimulating innovators and entrepreneurs to put their creativity and energy at the service of these two sectors, encouraging them to develop local solutions. Under this umbrella, our research component aims to strengthen business advancement and job creation in the Agri-food and Cleantech sectors in Lebanon. Specifically, this paper constitutes a by-product of an established working group and expert consultations in the energy sector that formed a platform for dialogue and policy discussions for a better Cleantech-enabling environment. The participating SMEs were part of a mapping exercise conducted to identify potential members and to discuss the industry's urgent needs and priorities for improved entrepreneurship.

Lebanese SMEs have shown the need to stimulate a clear, organized demand in a small market like Lebanon. To this end, strengthening and simplifying regulations could help stimulate the sector, as could rationalizing the matter of cumbersome administrative procedures. In addition, bridging the coordination gap between emerging Cleantech SMEs and policymakers needed for better outcomes. The white paper exhibits two categories of recommendations: the first calls on the various levels of government to implement the recommendations to help make Lebanon a breeding ground for developing the Cleantech sector, and the second category calls on stakeholders in the ecosystem as well as entrepreneurs to better support the effort to expand into global markets.

Overview of the Cleantech Sector

Cleantech in the energy sector covers a wide range of technologies that fall under the umbrella of three main pillars: Clean Energy, Energy Efficiency, and Energy Storage. Each pillar gathers a set of sub-categories that constitute the SMEs' potential areas of expertise as follows (Kachan & Co, 2013):

- Clean Energy: Solar, wind, renewable fuels, biomass, geothermal, fuel cells, etc.;
- Energy Efficiency: Smart grid, green building, building automation, LED lighting, data centers and devices, smart appliances, infrastructure, etc.; and
- Energy Storage: Batteries, thermal storage, hydrogen storage, mechanical storage, capacitors, etc.

Current Situation

Two aspects limit Cleantech in Lebanon: (a) the introduction of clean/renewable energy sources (mainly solar and wind), which have shown notable growth over the past decade (2010-20), and (b) energy efficiency initiatives in existing and new buildings. A series of projects have been implemented, and the Lebanese Government has been active in setting goals for improving the country's energy efficiency and renewable energy capacity through the National Energy Efficiency Action Plan (NEEAP) and the National Renewable Energy Action Plan (NREAP) 2016-20, respectively; the latter is currently being updated to cope with the 2021-25 period (LCEC, 2016). These national targets came as a result of Lebanon's announcement at the 2009 Copenhagen Climate Summit to reach 12 percent of the total primary energy consumed (electricity and heating) from renewable energy sources by 2020.

At the Paris Conference in 2015 and through the Nationally Determined Contributions (NDC), the Lebanese Government also pledged to commit to unconditionally generate 18 percent of its power demand (electricity demand) and 11 percent of its heat demand from renewable energy sources by 2030, compared to the combined 15 percent back in 2015 (MoE, 2020); Lebanon ratified the Paris Agreement in parliament under law 115 in March 2019.

Despite not being able to reach the 2020 target due to political instabilities and several institutional and financial barriers in 2018, Lebanon announced a new goal aiming to meet 30 percent of the electricity consumed from renewable energy sources by 2030, which means doubling the share of renewable energy expected from existing plans and policies, and achieving a ten-fold increase on the current 3-4 percent share in the country's energy mix (IRENA, 2020). This also formed the basis of the first update to the electricity reform paper in March 2019. The latter included plans to add around 1.1 GW of renewable energies by 2030 (480 MW of solar and 620 MW of wind). In addition, the IRENA Renewable Energy Outlook for Lebanon released in June 2020 sets up a clear and well-designed roadmap, providing an in-depth analysis to identify additional renewable energy potential and quantify other factors, such as cost, investment needs, and effects on externalities related to air pollution and the environment.

Energy

To date, the total installed renewable energy power capacity accounts for around 350 MW, including 286 MW from hydropower sources, 7 MW from landfill in Naameh, and a cumulative installed solar PV capacity (mostly from distributed installations) of 78.65 MW at the end of 2019 (LCEC, 2021). In addition, as of December 2017, the total installed surface area of Solar Water Heaters (SWH) in Lebanon exceeds 608,000 m2.

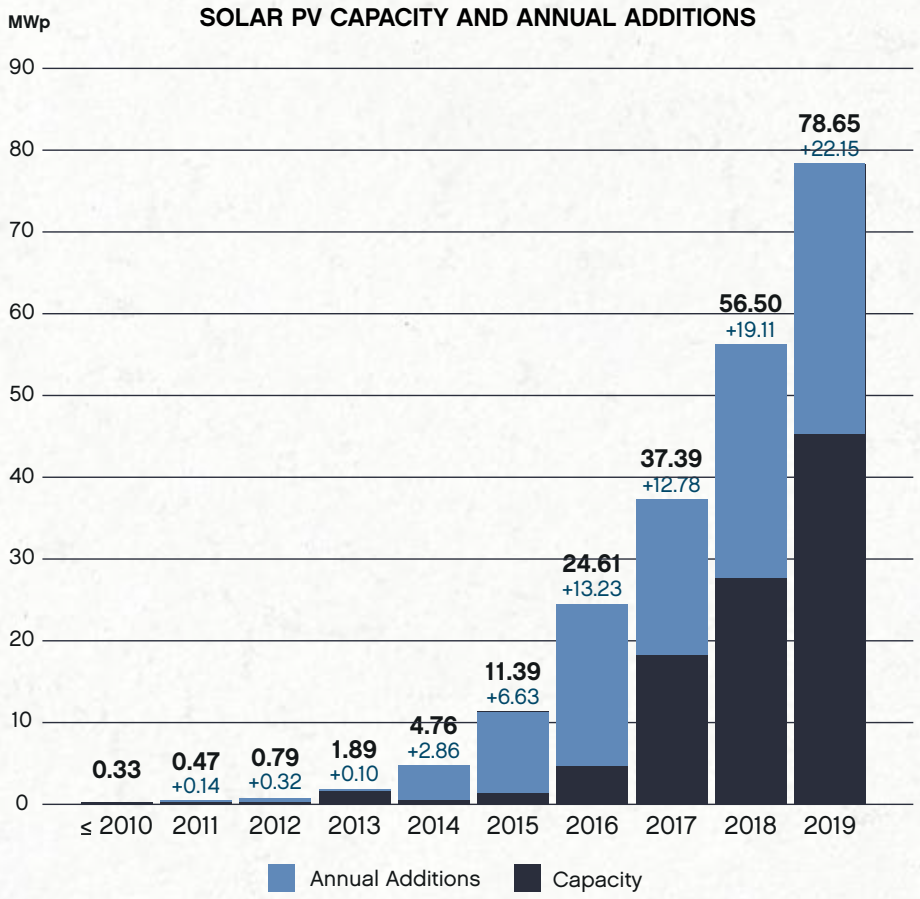

Figure 3: Installed Capacity of Distributed PV Solar Systems (LCEC, 2021)

Regulatory and Institutional Framework in the Lebanon Context

Characterized as a monopoly, the Lebanese electricity sector is managed by Electricity of Lebanon (EDL), which is the public authority in charge of generating, transmitting, and distributing power in Lebanon, under the Ministry of Energy and Water (MoEW). However, the Ministry of Finance (MoF) also exercises control over EDL, particularly through the assessment of investment viability over all types of projects that may have financial implications, and over the need for state financial contributions. In parallel, auditing institutions exercise control on prudent accounting and financial operation (EBRD, 2019).

Ratified prior to the Paris II conference, the sector has yet to implement law 462/2002. This law calls for the establishment of an Electricity Regulatory Authority (ERA), unbundling of Lebanon's power sector, and creating a more competitive market for electricity with independent power producers (IPP). ERA would pave the way for setting streamlined procedures for the licensing of new power production projects, including renewable energy ones. The main challenges facing the deployment of renewable energy in Lebanon, and thus Cleantech, are related to the country's institutional and regulatory frameworks, the availability of financing, and the state of resources, technology, and infrastructure. In addition, the sector suffers from complex administrative procedures, high subsidies, and low tariffs, along with high technical and non-technical losses (34 percent, combined); all of which reduce the appetite in shifting to renewables and hindering innovation in the sector.

Therefore, there is a dire need to set in place a consistent legal framework for the renewable energy sector that tackles both utility-scale and decentralized energy projects as well as energy efficiency measures, and legalizes all forms of power swap between the utility and the end-users (Net-Metering, Power Wheeling, Feed-in-Tariff, private to private, etc.). Renewable energy generation, which played a secondary role in the sector so far, needs significant mainstreaming and scaling up to reduce dependency on costly imported fuels. Sectoral renewable energy targets (solar, wind, biofuel, etc.) should be at the heart of the energy mix and not just as a policy add-on. On the other hand, tariff structure and subsidy removal should allow for the proliferation of renewables through small- and medium-scale deployment. Transmission grid reinforcements are needed across the country to accommodate the planned additional generation capacity, especially from renewable energy sources, to ensure reliable supply. At the financial level, reinforcing the existing financing mechanisms, incentives, and grants are essential.

Innovation in the Cleantech Sector and Current Business Landscape

Innovation in energy Cleantech is used to describe a variety of technologies and practices, ranging from solar and wind energy production to processing improvements that can enhance efficiencies in supply chains and production lines (Elia et al., 2021).

Innovation in Cleantech generally refers to the rising financial industry, which represents new technology and related business models offering competitive returns for investors and customers while providing solutions to global challenges. The investment's primary focus includes renewable energy, along with green technology, eco-efficient production techniques, and sustainable business. Hence, the most important goal is to achieve environmental sustainability and prevent air/water/land pollution in order to ensure a healthy living environment and reduce the negative impacts of burning fossil fuels (coal, oil, and natural gas) on the environment (Dikeman, 2015).

Cleantech manufacturing industries use new, innovative technologies to create these products and services that compete favorably on price and performance while reducing the influence on the environment (Kachan & Co, 2013). **Figure 4** shows what falls under clean energy technology, and the different practices that can be adapted in this domain. The three major titles include clean energy, which reflects on wind, solar, and renewable fuels; energy efficiency with an emphasis on green building, smart grids, and LED lighting; and energy storage, which mainly consists of sustainable battery storage, thermal storage, and mechanical storage.

To achieve the best of this transition to clean technology, more financial incentives, especially subsidies, should provide the initial stage to boost this transition and encourage firms to invest in clean technology innovation (J. Yang et al., 2020; Y.-C. Yang et al., 2020)

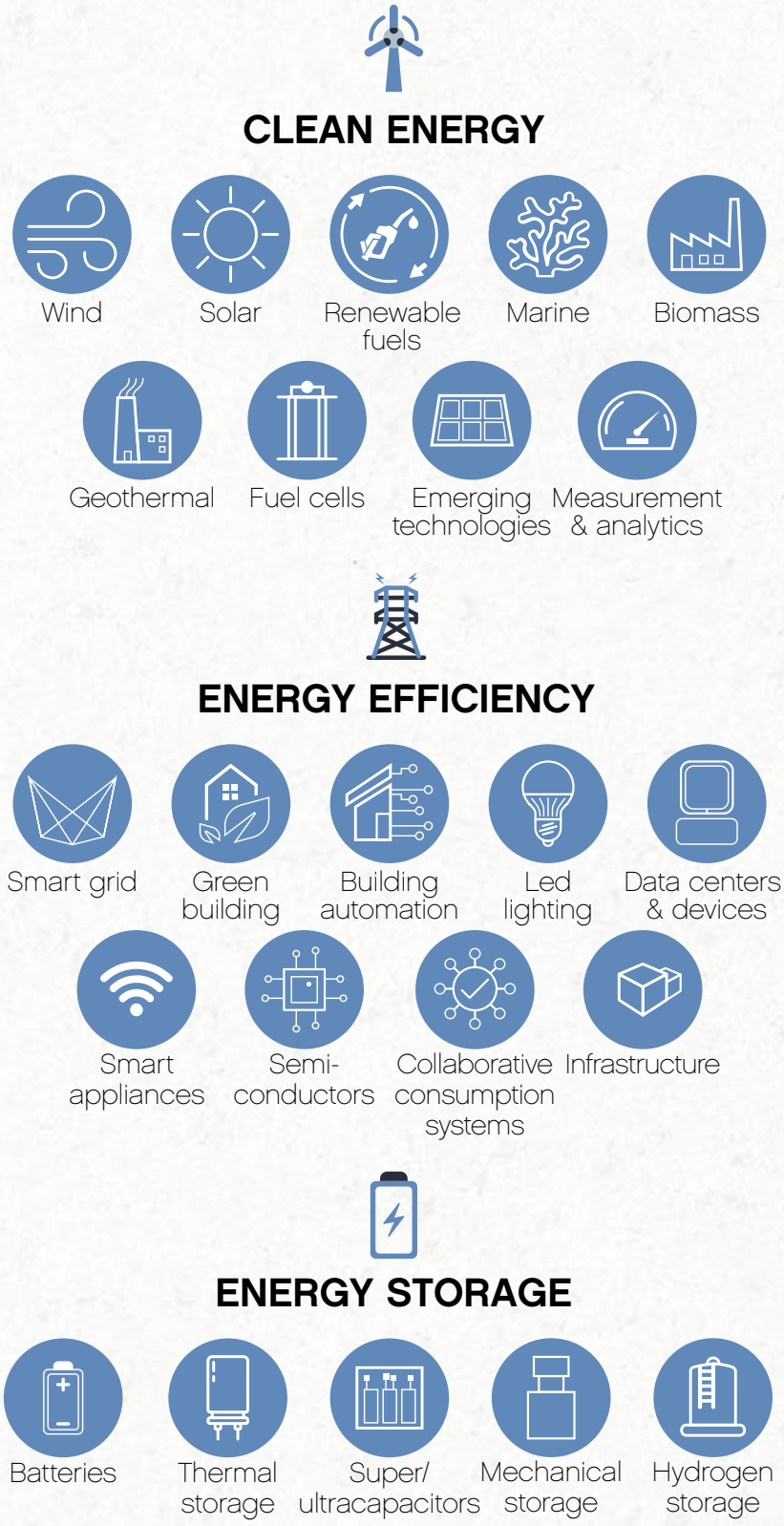

Figure 4: Categories that Fall Under Clean Energy Technology (Kachan & Co, 2013)

Energy

Figure 5 represents the life cycle in innovation and R&D regarding clean technologies in emerging and developing countries. The cycle is divided into four stages: Stage 1 introduces clean technology, where a certain selection criterion is considered to assess the country's capacity to adapt to the transition; Stage 2 reflects on the adaptation to reverse engineering, which suggests that the more a group repeats a task, the more adept that group becomes at that task; Stage 3 moves to manufacture the handling of all work components from materials to producers and system designers; and finally Stage 4 includes exporting "cleantech" to other countries (Tan, 2010).

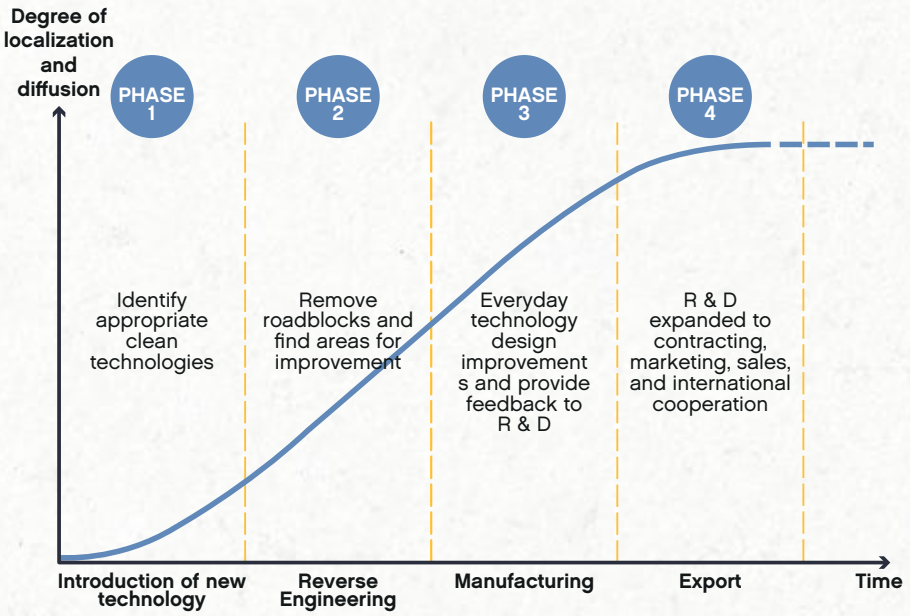

Figure 5: Life Cycle of Innovation and R&D in Emerging and Developing Countries (Tan, 2010)

With the variety of sectors that fall under Cleantech, this domain opens up different opportunities to take place under its faction, and holds a lot of prospects for innovation and exploration of new clean technologies.

A favorable business environment can facilitate the emergence of high-quality companies that are open to growth and can become more conducive to the rise of innovation in the Cleantech sector, which increases the demand of this technology among the public at a local and international level.

Leveraging public procurement is a measure that would generally stimulate demand in the Cleantech sector, in addition to lending Lebanon's SMEs credibility by providing them with opportunities to put their innovations into practice, enabling them to reach critical mass, and enhancing their capacity for regional and, possibly, international expansion.

Energy

To further study the number of SMEs working in the Cleantech sector, a mapping exercise of the existing landscape included different categories, such as the type of SME, service market geography, annual turnover, and several other aspects that play a crucial role in innovation. The mapping tackled around 352 SMEs working in the energy sector in Lebanon; the data collected was from different sources, such as public/private institutions, governmental data base, and publicly available information. Of those, 79 SMEs had answered the survey and thus considered in the assessment phase.

The majority of the energy SMEs are based in Beirut area (33 percent), followed by Matn area (20 percent), Zahle and Saida (9 percent each), and the rest in other regions **Figure 6**.

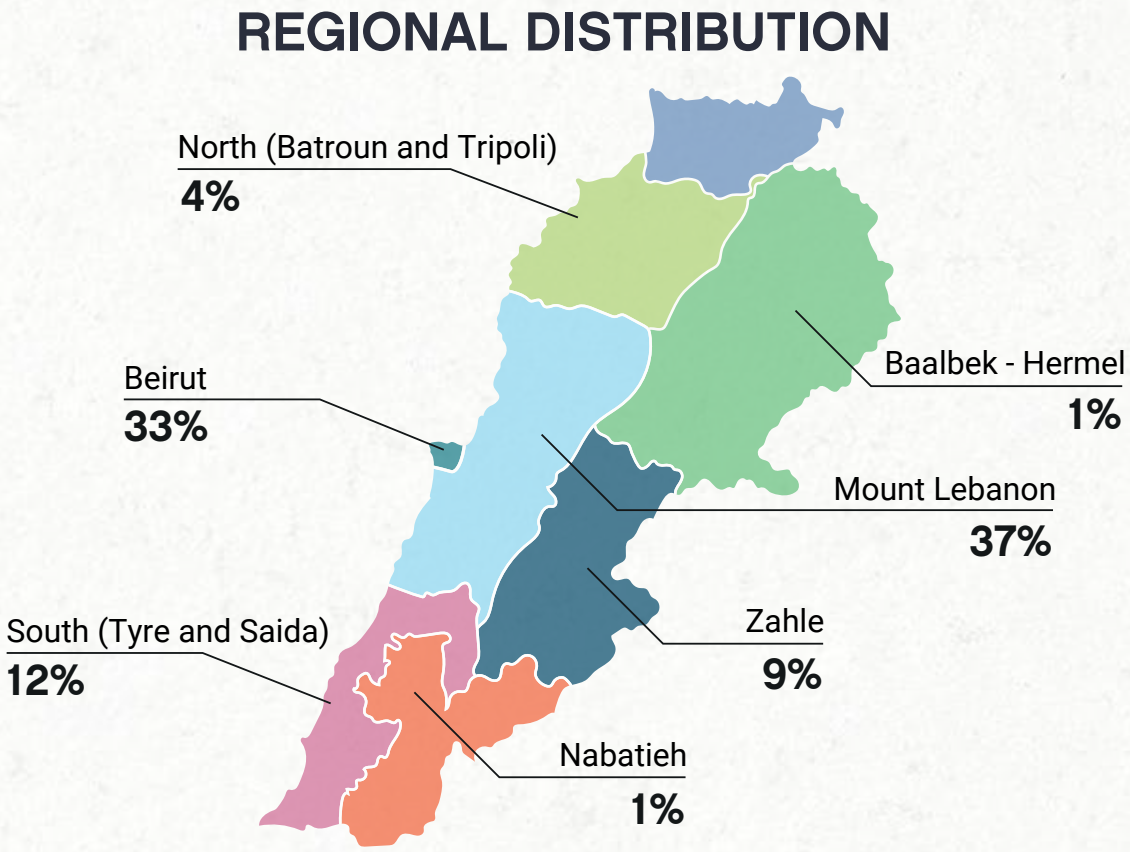

Figure 6: SME Distribution Across Lebanon

The mapped SMEs were mostly oriented towards renewable energy (60), and solar water heaters (28), followed by service providers, smart metering, smart grids, and private diesel generators **Figure 7**.

Energy

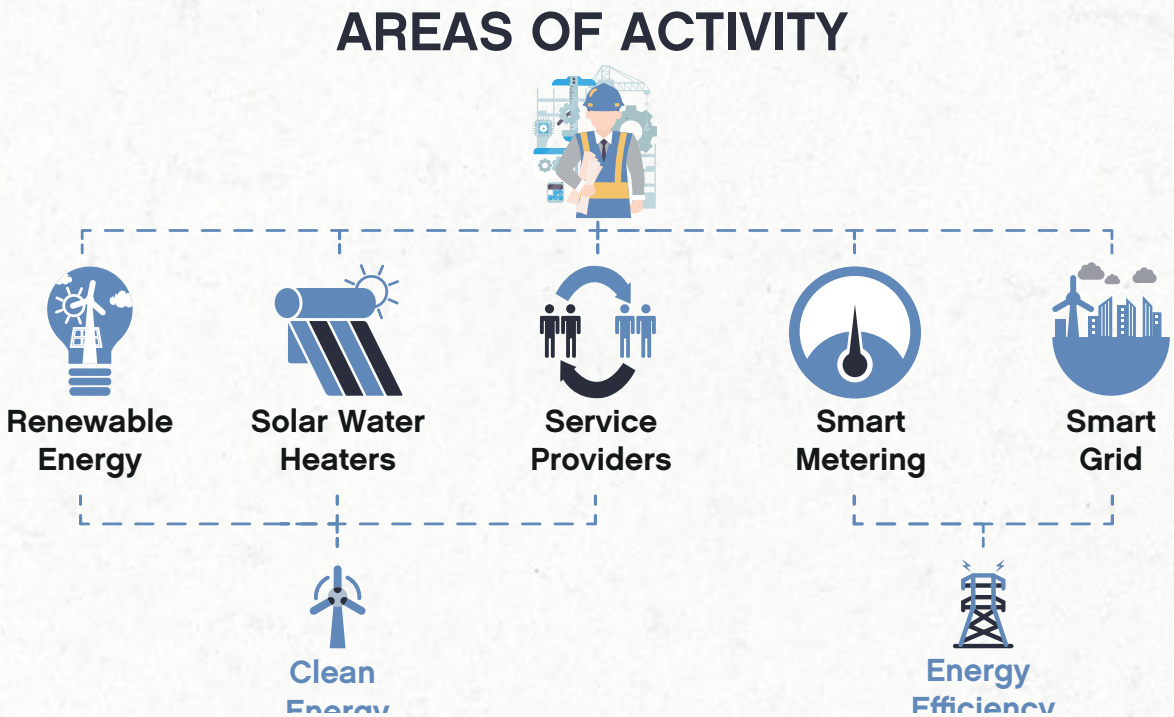

Figure 7: Main Focus of SMEs in the Energy Sector

The majority of SMEs were contractors (21 percent), followed closely by suppliers (20 percent), designers (15 percent), consultants (14 percent), operation and management (11 percent), industrial (7 percent), trainers (6 percent), and the smallest number working as operators (4 percent), illustrated in **Figure 8**.

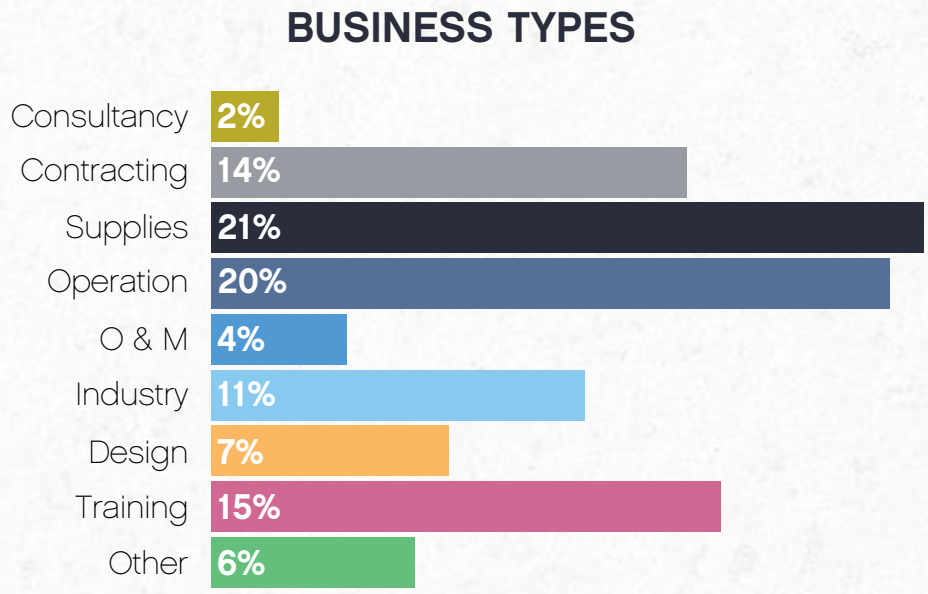

Figure 8: Business Type Adapted by SMEs in the Energy Sector

Energy

It is important to highlight that most of the SMEs participating in the survey have confirmed that they are involved in innovation in the Cleantech sector, and shed light on a set of challenges they face that sometimes hinder their work. These challenges range from economic, social, and to the political status of the country. Nevertheless, it is worth mentioning that despite these challenges, the SMEs do see opportunities in the sector, and, with the right coordination and implementation, this sector is open for innovation in Cleantech.

According to the Investment Development and Authority of Lebanon (IDAL), energy demand for the MENA region is increasing at an alarming rate, with expectations of 114 percent increase by 2050. Such an issue requires a new approach in a joint effort from the public and private sectors in Lebanon, which has a well-developed entrepreneurial scene, where a good percentage of the adult population is either running an established business or starting a new one; this is where innovation in the Cleantech sector should be encouraged and promoted.

In terms of innovation in technology, Lebanon adopted solar water heaters (SWH) for installation in different parts of the country. This incentive contributed to some extent in enhancing the renewable energy targets and national commitments for reduction of greenhouse gas emissions. SWH technology rather than conventional water heating (diesel, gas, biomass boilers, and electric resistance elements) leads to a reduction of more than 80 percent in fossil fuel use, offsetting the yearly emission by 156 kilotons of carbon dioxide (MoEW & LCEC, 2019).

In addition, another innovative, sustainable initiative worth mentioning is energy storage, despite still being in the early stages of development. Energy24, a local company working in the field, has developed an energy storage solution that allows for large amounts of electrical storage into a specific type of battery to power residential, commercial, and industrial loads during long power outages in the region of Bchaaleh, North Lebanon. Matrix Energy in Jabboule, Bekaa, also developed a similar solution. Such initiatives allow consumers to bypass power outages, all the while saving between 50 percent and 70 percent on their annual electricity bills.

Bioenergy has also come to the Lebanese government's attention for its potential to generate low-energy output from sludge in small or medium wastewater treatment plants (WWTP). In 2013, a CEDRO study reflected the generation of biogas, achieved in two wastewater plants in Lebanon (Sour and Tripoli), produced electricity from anaerobic digestion of sludge. The system is still non-operational in both facilities. Although seen as a pilot study for Lebanon, this technology exhibits potential to increase energy production and decrease greenhouse emissions. The increase in energy production will permit the WWTPs to be self-sufficient in terms of electricity and can even supply excess power to surrounding villages (UNDP & CEDRO, 2015).

Energy

Hydropower is a known technology that has been producing power for over a century at the known rivers in the country (namely Litani, Nahr Ibrahim, Kadisha, Bared, and Richmaya), and has proven implementational potential in Lebanon. Currently, Lebanon produces a total of 286 MW from hydropower, and with the upgrade and improvement in existing hydropower plants, a study by UNDP-CEDRO and MoEW suggests an increase of energy production by 95 percent compared to current rates, along with increasing the share of renewables and increasing Lebanon's energy supply security (CEDRO, 2013). Pumped hydro storage is another area for exploration in the country, when renewable power could store water during the day and used when the sun is not shining.

Innovators have been working hard to find solutions to some of the biggest environmental issues through alternative technologies, renewable energy, and sustainable tools, such as the adoption of pollution prevention methods, the initiation of cross-statutory initiatives that aspire to manage tradeoffs to maximize environmental protection and economic efficiency, etc. (EPA, 2007). It is very promising to see the amount of creativity and innovation in the energy Cleantech sector, however, innovation is still very limited in the sector and is open for rehabilitation and change, where most of the proposals are still at pilot-scale.

Integrating Innovation in the Energy Sector with Entrepreneurship

One more concern to put Cleantech energy innovation in action is the unclear environment that SMEs face in Lebanon. It is essential to understand the Lebanese custom environment before starting innovation in the Cleantech sector.

In 2004, the World Bank Group conducted a first of its kind report, Ease of Doing Business, shifting attention to support small to medium enterprises (SMEs) (World Bank, 2020). Since then, the investment sector redirected its focus to SMEs and entrepreneurship; sectors that are, supposedly, not affected by any political turmoil.

The Lebanese government took critical steps with the chambers of commerce to launch Improving the Business Environment in Lebanon (IBEL), South Business Innovation Center (SouthBIC), and Business Incubation Association in Tripoli (BIAT). The Ministry of Economy and Trade (MoET) supported by UNDP created an SME Unit-Enterprise Team. This unit spearheaded the implementation of a new program, Integrated Small and Medium Enterprise Support Program (ISSP), aimed at supporting SMEs from a technical perspective, and offering policymakers the needed information to enhance existing policies or draft new ones. SME-related policies need to be part of an entire reform process for them to be effective, entailing the enhancement of the business and regulatory framework by Lebanese policymakers (Malaeb, 2018).

In Lebanon, SMEs represent 90 percent of registered firms, engaging 50 percent of the working population. However, these SMEs contribute only 27 percent of total revenues. In fact, SMEs face several challenges that hinder their development, growth, and long-term sustainability. The obstacles stem from different factors, such as culture, capabilities, capital, market structure, legal and regulatory framework, and research and innovation (MoET, 2014). Based on a survey conducted by Malaeb (2018) encompassing 110 responding firms out of 150, results presented **Figure 9** reflects the most prominent obstacle faced by SMEs is the political and economic situation (14%), and the least is in acquiring finance (7%).

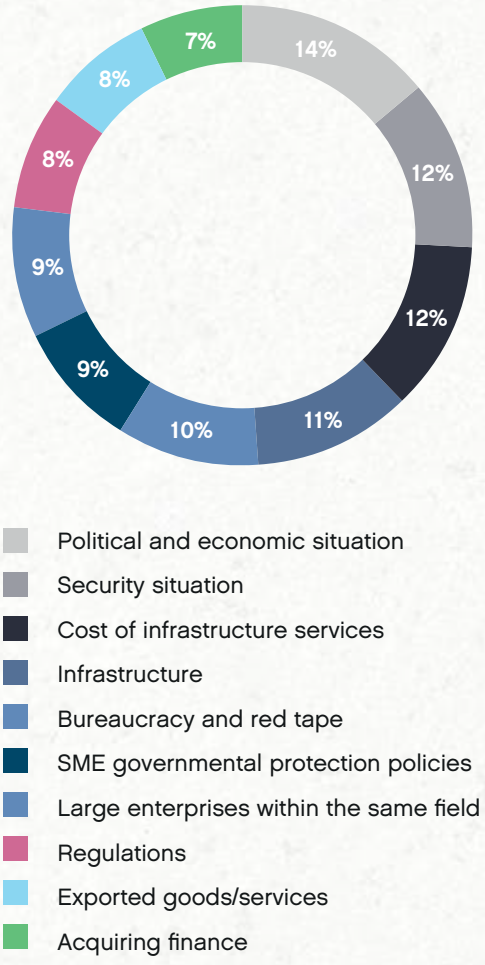

Figure 9: Most common obstacles faced by SMEs

To enhance SME development, prosperity, and long-term sustainability an appropriate enabling environment is a must. To encourage creation and allow for the growth of enterprises in a sustainable manner, a conducive environment must have four important pillars, considered as "interdependent and mutually reinforcing": political, economic, social, and environmental (ILO, 2019).

Political Elements

Several indicators fall under the political element umbrella and are critical in determining the vulnerability of the political aspect towards the development of sustainable enterprises. Peace and political stability determine the stability of the government involved and are considered a critical condition for the development of SMEs in attracting foreign investment (ILO, 2019; OECD, 2004).

Good governance highlights the importance of controlling the extent of corruption exercised for public gain, the government effectiveness in providing good public services, policy formulation and implementation, and its trustworthiness to commit to such policies (ILO, 2019; Stepanyan et al., 2019). In addition, International Labor Organization (ILO) emphasizes enhancing social dialogue and relations, or cooperation between the labor force and the employer, while respecting universal human rights and international labor standards (ILO, 2019).

Economic Elements

Several papers define enabling the business environment for SMEs as having acknowledged the importance of the economic aspect in enhancing their work environment. Economic aspect indicators include enabling policy and regulatory environment as a major and important factor for SMEs' conducive environment (ILO, 2019; Stepanyan et al., 2019; OECD, 2004; UN-ESCAP, 2011). The enforcement of a transparent policy and regulatory environment guarantees the simplification of operation, promulgation, access to resources and markets, and exit. Governments should also address the different failures and obstacles SMEs face, dampening their activity, and limiting their innovative capabilities. SME strategies should be cross-cutting, targeting several areas like sound macroeconomic policies and good management of the economy (ILO, 2019; OECD, 2004). These policies are set to ensure a stable and predictable economic situation.

Another major factor easing the development and sustainability of SMEs is access to finance (ILO, 2019; Stepanyan et al., 2019; OECD, 2004; UN-ESCAP, 2011). In fact, SMEs' growing and strengthening potential relies heavily on their capability to invest in reorganization, innovation, enhancement, and diversification. Financial services should be improved giving more availability and accessibility to SMEs and entrepreneurs (UN-ESCAP, 2011). Infrastructure plays an important role for SME competitiveness and development (ILO, 2019; OECD, 2004; UN-ESCAP, 2011). Enhancing transportation, telecommunication, energy, water, and sanitation can provide SMEs with needed activity and accessibility to local, regional, and global markets (ILO, 2019) The quality of infrastructure smooths services and goods production and can lead to an improved competitive business environment. One final indicator is technology or technological capability, which can greatly affect the competitiveness of enterprises (UN-ESCAP, 2011). Nowadays, everything is shifting towards information and communication technologies (ICT), considered a fundamental element for the sustainability of enterprises (ILO, 2019). Its affordability and accessibility provide a better competitive and innovative environment for SMEs.

Social Elements

From a social perspective, the most important factor is the development of an entrepreneurial culture (ILO, 2019; UN-ESCAP, 2011). Entrepreneurs contribute significantly to the enhancement of GDP in several countries, considered the main engine for global economic development. SMEs are in fact the engine of economic growth, categorized as key to development. Local production and innovation opportunities should always be grasped whenever possible (ILO, 2019). Government policies should help and support entrepreneurs, which entails developing their technical skills, given that entrepreneurs are vital and essential to the economy. Policy measures should include entrepreneurship training and education, youth entrepreneurial programs, new business incubation, and women entrepreneurship development. Developing these measures stimulates an entrepreneurial culture, inclusive of all genders and ages. External funding plays a significant role in developing the entrepreneurial culture in needed areas (UN-ESCAP, 2011).

To fulfill and enhance an entrepreneurial culture, human capabilities should develop high-quality systems of education, training, and lifelong learning (ILO, 2019; Stepanyan et al., 2019; OECD, 2004). The lack of well-educated and skilled-labor force is one of the most significant challenges faced by developing countries (OECD, 2004).

Another factor hindering the development and growth of sustainable enterprises is social justice and inclusion (ILO, 2019). Inequality and discrimination are impeding the growth of SMEs. Policies should target and aim for the provision of social justice and the inclusion and equality of employment opportunities needed to enhance SME-enabling environments.

Adequate social protection provides citizens with access to vital services needed to improve productivity, such as health care, unemployment benefits, maternity protection, and basic pension (ILO, 2019); factors essential for SME development and productivity.

Stressing this subject, a World Bank (2019) case study of the regulatory performance of a country across different indicators showed that Lebanon scored almost always lower than the MENA average, which reflects the gap in Lebanon's economy. The case study results reflect a score out of 100 **Table 1**, comparing Lebanon to regional and MENA country averages. Additionally, of the 190 countries reviewed, the study revealed Lebanon ranked 142 in ease of doing business, 146 in starting a business, 140 in protecting minority investors, 113 in paying taxes, and 151 in resolving insolvency.

Energy

Table 1: Lebanon's Score in Different Business Indicators with Respect to Other Countries and the Regional MENA average

Pillar vs. Country (%)						Regional Average
Ease of doing business	**54.04**	60.98	58.56	41.57	63.5	58.3
Starting a business	**78.63**	84.43	84.11	80.99	80.07	82
Protecting minority investors	**41.67**	46.67	58.33	53.33	80.0	51.83
Paying taxes	**67.94**	71.48	52.73	73.97	75.0	74.52
Resolving insolvency	**29.55**	30.31	42.27	21.10	0	32.69

Moving forward, starting a Cleantech business in the energy sector from professional and practical perspectives puts SMEs in the face of varying challenges. Some of the challenges discussed in the sections below shed light on the most pressing needs to create an enabling environment in Lebanon's energy sector.

With this in mind, and following the mapping exercise conducted among energy SMEs, a group of 15 of 79 respondent SMEs took part in consecutive working groups (WG) held between August and December 2020, in parallel with ongoing one-to-one meetings and discussions with industry experts, international organizations, NGOs, and public representatives at the concerned ministries and governmental bodies (identified as non-SMEs). The selection process followed a methodological approach aiming to represent all categorized business types **Figure 8**, SME sizes (number of employees), and years of experience.

The first WG consisted of separate meetings for the SMEs selected and non-SMEs, where an open discussion tackled financial, legal, and policy aspects of the sector, and conducted a SWOT analysis (identifying Strengths, Weaknesses, Opportunities, and Threats), not only within the current economic crisis but also overcoming the current pressing conditions and thinking of medium- to long-term solutions. In the second WG, SMEs and non-SMEs shared their concerns, prioritized identified challenges, and discussed potential opportunities moving forward with the aim of enabling a Cleantech environment in the energy sector. The discussion highlighted a series of regional and international case studies that constitute potential solutions to some of the challenges raised, detailed in this section.

Challenges' Prioritization Setting

The first working group's discussions helped to set the scene and prepare the groundwork for participating SMEs in sharing the obstacles they face in these challenging times, hindering any reform plans or trials, enabling an innovative business environment. These challenges mainly revolved around policy, fiscal, and technical aspects **Table 2**.

Table 2: Summarized SMEs Challenges from First Working Group

Challenges	Description
Lack of trainings and certificates in the energy sector	In order to keep their credibility, competitiveness, and customer satisfaction, SMEs offer high quality products and services that require continuous training and certification in the field, which is not easily accessible.
Absence of classification criteria	SMEs suffer from a lack of market censorship and control, and the potential for irregular service providers to set services and products without having the necessary know-how, track record and/or expertise in the field, and without standard training or qualifications to present such services.
Lack to access to finance	Under current dire conditions, SMEs find it difficult to secure investors to finance a project that will take time to achieve revenues in the long run, and thus prevent various project implementations serving underprivileged areas.
Challenging patency rights' procedure	Lack of government support to facilitate the patents—currently taking up a lot of time and effort for the administrative and legal papers—which sometimes cost more money than what the products net. Conversely, other service providers are able to imitate the same patents for product of concern without much efforts.
Absence of governmental laws and policies	Lack of regulations/policies for renewable energy implementation and adaptation, especially at the distributed (residential/municipal) level.
Difficulty when working with the government	Municipalities and private sector willingness to be involved in the installation of these solutions, finding it difficult to operate under several legal governmental restrictions.
Absence of essential primary material	SMEs are disincentivized or discouraged to try and manufacture their own primary material through financial and policy grants.

During the second working group, SMEs and non-SMEs prioritized those challenges based on their importance to improve an enabling environment for innovation, the urgency of the action, the impact they would have on the business as well as their potential to create a ripple effect on the overall business landscape.

As a result, the most pressing issue for SMEs was the lack of access to finance—identified as the first priority—followed by bureaucratic governmental procedures and difficulties working with public institutions (second priority), and then by the absence of a classification criteria that would categorize SMEs (third priority), based on track-record and expertise. To a lesser extent, the absence of essential primary material came in fourth priority, followed by the challenging patency rights' procedures, the lack of renewable energy laws and policies, and finally the lack of training and certification in the energy sector.

Regional and International Case Studies

Parallel work has aimed to look at the regulatory framework, policies, and/or mechanisms adopted by countries in the MENA region and around the world when it comes to creating a suitable business environment for innovation and clean technologies in the energy sector, to try to explore the lessons learned, and the similarities that could apply to the Lebanese context.

Among the GCC countries, Qatar has, for example, inaugurated the TASMU Innovation lab to be its hub for professional training and certification, helping nurture business research, development, and innovation for SMEs. The lab aims to discuss the challenges faced within the innovation ecosystem and proposes solutions to overcome them. At the fiscal level, several countries (such as UAE, Jordan, KSA, etc.) have initiated energy support programs and green environmental funds (KSA and Jordan) and introduced tax breaks (KSA) with the aim to incentivize Cleantech companies to innovate, grow and develop their businesses, and drive technological and process improvements across different sectors.

On the other hand, other countries have focused on spurring new business ideas to encourage Cleantech investment through clear government laws and regulations, related to renewable energies. These aim to protect the SME business environment, ensure that companies structure their businesses well, and create "rules of the game" for any clean technology or innovative product/service. Also, they clearly worked to set clear renewable energy (RE) targets and competitive bidding or tendering to pave the way for SMEs to innovate and grow. California's Renewable Portfolio Standards are a perfect example, and on the government's commitment to deploying clear targets in renewables.

Identified Leads and Policy Recommendations

Having a set of prioritized challenges in hand, expert consultations conducted pathways for potential solutions and opportunities to change the existing business landscape.

Consecutive discussions with SMEs and non-SMEs considered potential leads that could pave the way not only to overcome the current consecutive crises but also to enable business innovation in the energy sector.

Concerned ministries, public institutions, and governmental bodies considered discussing their applicability and taking the necessary steps towards implementing those leads revolving around much needed reforms and policy actions.

In a trial to narrow down these measures and rank them with regards to priority actions, participating SMEs and non-SMEs assessed each lead based on the following scoring criteria: ease of implementation (easy, medium, or hard), relevance to Lebanon (very relevant, medium relevance, or no relevance), timeframe (short-term, medium-term, or long-term), cost (high cost, medium cost, low cost, or no cost), and institutions involved. Each criterion followed a systematic scoring scheme, graded from zero to three (with three having the highest implementational possibility, while zero had the lowest possibility), and then summing all the individual scores out of a total score of 12; the details for this scoring scheme methodology are in Appendix A.

Thirteen respondents of the participating SMEs and non-SMEs have participated in the evaluation process, with the resultant ranking and scoring **Table 3**; each identified lead also has an estimated timeframe for execution.

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Table 3: Ranking, Score, and Timeframe of the Identified Leads

Rank	Proposed Low-Cost Action	Average Score (Out of 12)	Institutions Involved	Timeframe
1	Create joint committees between all academic teams involved in innovation at universities, and then between academia and the SMEs.	**8.8**	Academia (universities) with IRI, LIBNOR, and SMEs	Short-term
1	Establish clear classification criteria for SMEs in the energy sector to enhance credibility and to ensure good quality services, especially when it comes to ToRs/Calls launched by the MoEW/LCEC.	**8.8**	LCEC, IRI, LIBNOR	Medium-term
2	Identify areas for business improvement through dedicated training and certification programs for SMEs. Example: TASMU Innovation Lab in Doha, Qatar, that enhances business research, development, and innovation through events, training, and certificates.	**8.5**	LCEC, MoE	Medium-term
2	Find alternative solutions and shortcuts to avoid governmental/institutional bureaucratic delays that hinder the implementation of any decision/decree.	**8.5**	LCEC, MoE, IRI, LIBNOR	Medium-term
3	Identify and implement alternative financial schemes to fund innovation for SMEs in the Cleantech sectors. Example: Re-allocate some of the Oxygen fund's money raised by the ALI and BDL for Cleantech and innovation.	**8.4**	MoF, LCEC, MoI, BDL	Medium-term
4	Issuance of exclusive permits on some primary equipment, such as: the issuance of decisions/decrees or "licenses for import" by the Ministry of Industry on some specific equipment used in the energy value chain.	**8.2**	MoI, MoF, LCEC, IRI, LIBNOR	Short-term
5	Coordinated tax incentives issued by the MoF, MoET, and the MoI on primary material and key elements of the manufacturing value chain.	**7.8**	MoF, MoI, MoET, LCEC	Short-term
6	Identify and use areas of innovation for Cleantech in the energy sector to guide the donors' community agenda to attract fresh grants and funds.	**7.6**	LCEC, MoF, MoE, MoI	Short-term
7	Removal of social barriers to the implementation of industrial zones that are part of the MoI's national strategy. **Example:** Variable social acceptability among demographics to establish industrial zones.	**7.3**	MoI, LCEC, IRI, MoE	Long-term
8	Solicit local universities to design, study, and test innovative material and solutions in the Cleantech industry. Laboratories used in testing must be qualified and certified	**6.2**	MoI, MoE	Medium-term

As for institutional involvement, results have revealed a remarkable role the LCEC can play in all aspects: policy, governance, technical, and, to some extent, fiscal. SMEs' answers have shown a great reliance on the center in enabling the business environment moving forward.

Alternatively, Ministry of Industry (MoI) can play a key role in almost all of the identified leads, more heavily where there is a strong correlation with tax incentives and issuing permits for the manufacturing value chain; mentioned in areas of academic and social inclination. Also, several leads and business opportunities found the Ministry of Environment (MoE) to be an important player.

The role of academia (universities), IRI, and LIBNOR have also highlighted setting clear classification criteria for SMEs in the sector, issuing certifications and training as well as identifying areas for business improvement and innovation for Cleantech in the energy sector.

At the fiscal level, the role of the Ministry of Finance is inevitable, especially in setting and implementing alternative financial schemes to fund innovation for SMEs in the Cleantech sectors, as well as in issues related to tax incentives, issuing permits, and prioritizing donors' community grants; IDAL and Kafalat should be playing a complimentary role as well in this regard.

Way Forward

SMEs currently face a major financing challenge where a significant number cannot access financial resources to undergo any innovative approaches. For a country like Lebanon, SMEs usually rely on external financial flows, such as foreign direct investment, donors as well as foreign aids. This entails some governmental regulations should be set to ease the process between SME and foreign donors to sustain green businesses and industries.

New, out-of-the-box financial schemes should encourage SMEs to invest in clean technologies, especially within the current economic crisis and the impact this can have on their businesses. In addition, policymakers can promote Cleantech by allowing coordinated tax incentives for SMEs to import primary materials needed across their value chain.

Another major issue is the lack of targeted regulations for clean technology and innovation. The presence of regulations is a key factor in incentivizing and supporting SMEs and enabling the business environment for innovation in Lebanon. This will necessitate the removal of barriers that still hinder SMEs from moving forward in their innovative approach, such as lack of a stringent regulatory framework and a bureaucratic process at all levels. Therefore, government needs to intervene in alternative mechanisms and mitigating measures to reduce the burden of these barriers, in terms of policies, laws, and regulations.

Moreover, SMEs also consider certification schemes a crucial topic for assessment. They boost technical credibility by acquiring relevant know-how and skills from accredited international institutions thus tapping into consumer demand for clean technologies, tools, and products. Once certified, accredited SMEs gain credibility in local and international markets, which increases their income and encourages the business.

Academia and research institutions also provide mitigation measures where a joint committee between academic institutions and SMEs present a great opportunity for SMEs to enable their skill growth and innovate through knowledge, involving universities and students in R&D related to their innovative ideas and products.

In conclusion, policy frameworks are key contributors that enable SME environments and ensure innovative green growth. The question remains: how and who should administer these policies? The SMEs **Table 3** partially answer this question. This reflects the different institutional and policy contexts at the government level that suggests who is responsible, and who can ease the gap in different SME burdens. That said, a vital component in enabling SME environments is the need to collaborate and coordinate across different government bodies as well as non-government actors in playing a major role as policymakers. A collaborative network buildup across different policy areas (business development and environmental protection), government level (ministries), and type of actors (non-governmental policymakers and universities) with SMEs can maximize the SME clean technology business benefits, encourages a shift towards greener approaches, and supports clean technology and business model integration.

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Appendix A

The Scoring Scheme Methodology

	Examples of Solutions (Second Working Group)	Imple-mentation Ease	Relevance to Lebanon	Cost	Time Frame	Key Institutions Involved	Average Toral score /12
1	Coordinated tax incentives issued by the MoF, MoET, and the MoI on primary material and key elements of the manufacturing value chain.	Easy (=3) Medium (=2) Hard (=1)	Very (=3) Medium (=2) Not (=0)	No (=3) Low (=2) Medium (=1) High (=0)	Short-term (=3) Medium-term (=2) Long-term (=1) Doesn't Apply (=0)	LCEC, MoF, MoE, MoA, MoET, MoI, LIBNOR, KAFALAT, IDAL, and IRI	7.8
2	Issuance of Exclusive Permits on some primary equipment, such as: the issuance of decisions/ decrees or "licenses for import" by the Ministry of Industry on some specific equipment used in the energy value chain.	Easy (=3) Medium (=2) Hard (=1)	Very (=3) Medium (=2) Not (=0)	No (=3) Low (=2) Medium (=1) High (=0)	Short-term (=3) Medium-term (=2) Long-term (=1) Doesn't Apply (=0)	LCEC, MoF, MoE, MoA, MoET, MoI, LIBNOR, KAFALAT, IDAL, and IRI	8.2
3	Identify and implement alternative financial schemes to fund innovation for SMEs in the Cleantech sectors.	Easy (=3) Medium (=2) Hard (=1)	Very (=3) Medium (=2) Not (=0)	No (=3) Low (=2) Medium (=1) High cost (=0)	Short-term (=3) Medium-term (=2) Long-term (=1) Doesn't Apply (=0)	LCEC, MoF, MoE, MoA, MoET, MoI, LIBNOR, KAFALAT, IDAL, and IRI	8.4
4	Identify and use areas of innovation for Cleantech in the Energy sector to guide the donor community agenda and attract fresh grants and funds.	Easy (=3) Medium (=2) Hard (=1)	Very (=3) Medium (=2) Not (=0)	No (=3) Low (=2) Medium (=1) High (=0)	Short-term (=3) Medium-term (=2) Long-term (=1) Doesn't Apply (=0)	LCEC, MoF, MoE, MoA, MoET, MoI, LIBNOR, KAFALAT, IDAL, and IRI	7.6
5	Identify areas for business improvement through dedicated trainings and certification programs for SMEs.	Easy (=3) Medium (=2) Hard (=1)	Very (=3) Medium (=2) Not (=0)	No (=3) Low (=2) Medium (=1) High (=0)	Short-term (=3) Medium-term (=2) Long-term (=1) Doesn't Apply (=0)	LCEC, MoF, MoE, MoA, MoET, MoI, LIBNOR, KAFALAT, IDAL, and IRI	8.5
6	Establish clear classification criteria for SMEs in the energy sector to enhance credibility and ensure good quality services, especially when it comes to ToR/Calls launched by the MoEW/ LCEC.	Easy (=3) Medium (=2) Hard (=1)	Very (=3) Medium (=2) Not (=0)	No (=3) Low (=2) Medium (=1) High (=0)	Short-term (=3) Medium-term (=2) Long-term (=1) Doesn't Apply (=0)	LCEC, MoF, MoE, MoA, MoET, MoI, LIBNOR, KAFALAT, IDAL, and IRI	8.8
7	Removal of social barriers to the implementation of industrial zones that are part of the MoI's national strategy.	Easy (=3) Medium (=2) Hard (=1)	Very (=3) Medium (=2) Not (=0)	No (=3) Low (=2) Medium (=1) High (=0)	Short-term (=3) Medium-term (=2) Long-term (=1) Doesn't Apply (=0)	LCEC, MoF, MoE, MoA, MoET, MoI, LIBNOR, KAFALAT, IDAL, and IRI	6.2

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	Examples of Solutions (Second Working Group)	Imple-mentation Ease	Relevance to Lebanon	Cost	Time Frame	Key Institutions Involved	Average Toral score /12
8	Find alternative solutions and shortcuts to avoid governmental/institutional bureaucratic delays that hinder the implementation of any decision/decree.	Easy (=3) Medium (=2) Hard (=1)	Very (=3) Medium (=2) Not (=0)	No (=3) Low (=2) Medium (=1) High (=0)	Short-term (=3) Medium-term (=2) Long-term (=1) Doesn't Apply (=0)	LCEC, MoF, MoE, MoA, MoET, MoI, LIBNOR, KAFALAT, IDAL, and IRI	8.5
9	Solicit the local universities to design, study, and test innovative material and solutions to the Cleantech industry. Laboratories used in testing must be qualified and certified.	Easy (=3) Medium (=2) Hard (=1)	Very (=3) Medium (=2) Not (=0)	No (=3) Low (=2) Medium (=1) High (=0)	Short-term (=3) Medium-term (=2) Long-term (=1) Doesn't Apply (=0)	LCEC, MoF, MoE, MoA, MoET, MoI,– LIBNOR, KAFALAT, IDAL, and IRI	7.3
10	Create joint committees between all academic teams involved in innovation at universities and between academia and SMEs.	Easy (=3) Medium (=2) Hard (=1)	Very (=3) Medium (=2) Not (=0)	No (=3) Low (=2) Medium (=1) High (=0)	Short-term (=3) Medium-term (=2) Long-term (=1) Doesn't Apply (=0)	LCEC, MoF, MoE, MoA, MoET, MoI, LIBNOR, KAFALAT, IDAL, and IRI	8.8

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