

Article

The Impact of COVID-19 on Energy Start-Up Companies: The Use of Global Financial Crisis (GFC) as a Lesson for Future Recovery

Martina Pilloni ^{1,*} , József Kádár ^{2,3,4,*}  and Tareq Abu Hamed ^{2,4}¹ Chemical and Geological Science Department, University of Cagliari, SS 554 Bivio Sestu, 09042 Cagliari, Italy² The Arava Institute for Environmental Studies, Kibbutz Ketura, D.N. Hevel Eilot 8884000, Israel;

tareq@arava.org

³ Haifa Center for German and European Studies, University of Haifa, Abba Khoushy Ave 199,

Haifa 3498838, Israel

⁴ Dead Sea and Arava Science Center, Tamar Regional Council 86910, Israel

* Correspondence: martina.pilloni@gmail.com (M.P.); jozsef.kadar@arava.org (J.K.)

Abstract: *Purpose:* The study discusses COVID-19's short-term impact on Israel's renewable energy start-up sector from March to July 2020. *Results and contributions:* The interviewed companies were experiencing supply chain disruption, logistical issues, and restrictions in work access, all of which negatively impacted business operations. Moreover, companies reported revenue losses and difficulty in securing funding, interpreted here as financial distress. In some cases, companies cut back on staff. Insights from the literature on the global financial crisis (GFC) were used here to discuss patterns discerned from the interviews. Policy recommendations are presented at the end based on both the interpretation of data and a literature review. *Methodology:* This paper combined the qualitative research analysis of COVID-19's impacts on energy start-up companies assessed by a questionnaire during interviews with a literature analysis on the previous GFC. *Gap:* This study aimed to clarify the issues experienced by the start-up companies in the renewable energy sector in Israel during the first months of the pandemic and contributes to the COVID-19 narrative in the energy sector, focusing on a topic that has not been thoroughly discussed at present. *Relevance:* The paper contains unique primary data on the short-term financial impact of COVID-19 on renewable energy start-up companies, and recommends policies to assist these companies and effectively respond to their financial needs in times of crisis. The paper points out that the absence of such a financial policy for start-up companies might pose risks to the companies' growth and innovation, and have harmful consequences for the renewable energy sector, energy transition, and climate goals. The attention currently given to initial short-term measures should shift toward a more structural and long-term approach. *Impact:* The paper wants to capture the attention of policymakers and the research community in evaluating and adequately addressing the financial needs of the start-up sector, which is a crucial segment of the economy, and is indispensable for achieving long-term goals such as energy transition.

Keywords: renewable energies (RE); COVID-19; start-up sector; policy; green recovery; financial innovation; cleantech



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1. Introduction

The World Health Organization (WHO) declared coronavirus disease 2019 (COVID-19) a public health emergency and a global pandemic on 11 March 2020. COVID-19 is a severe acute respiratory syndrome caused by coronavirus 2 (SARS-CoV-2), first reported in China. Governments worldwide put in place emergency policy interventions that demanded people enter nationwide lockdowns, with extensive restrictions of movement and travel, border closures, and self-isolation (indicated as *quarantine*). Between March–May 2020, the measures that prevented the virus from spreading harshly impacted the economic

system's flow, leading to a general recession. Within a few weeks, the first wave of the COVID-19 pandemic shocked civil society and resulted in a crisis in all sectors of the global economy [1].

Due to COVID-19, the entire supply chain faced severe problems such as supply disruption, reduced production capacity, logistical difficulties, and demand changes. The supply chain disruption due to the pandemic originating in China in December 2019 and then spreading elsewhere led to a ripple effect [2]. The large-scale disruption of the supply chain seriously impacted industries in different sectors such as automotive, medical, electronics, and more; large companies suffered from a reduction in production and supply of raw materials and manufacturing components starting early in the pandemic [3].

Almost immediately, the COVID-19 pandemic caused severe repercussions for businesses, both on the supply and the demand side [4]. The pandemic caused a shock of exceptional magnitude for micro-, small-, and medium-sized enterprises (MSMEs) worldwide [5]. According to survey data in the UK in May 2020, 80% of surveyed small- and medium-sized enterprises (SMEs) witnessed a decline in revenues, with nearly 20% believing they would be out of business by August 2020, and more than 50% worried about being out of business within 12 months [6]. Among the European countries, in March 2020, one-third of German SMEs expected a more than 10% decline in revenues. In the same period, a survey in Italy revealed that more than 70% of surveyed SMEs had been directly affected by the pandemic [7].

Profound variations due to the pandemic also emerged in the energy sector; direct impacts were observed on the demand side and consumption, while indirect impacts affected the power generation and energy market [8]. The containment measures against the coronavirus completely changed people's lifestyles and altered society's daily demand for energy. The reduction in business activities and manufacturing, the travel restrictions, and the limitation on international trading affected the demand for all energy sectors (petroleum, natural gas, and electricity) and services [9]. In Italy, a decrease of 15% in energy demand was observed in March 2020 compared to 2019, including demand for oil, gas, and electricity [10]. The first lockdown reduced demand by 15.6% for electricity and 12.0% for commercial gas in the UK [11]. In Canada, electricity declined by 14% [12]. Since the government mandates required a large part of the population to stay at and work from home, the energy demand profile significantly changed. It meant household electricity use was directly affected by COVID-19 and lockdown measures [13]. The fall in energy consumption was correlated to the strictness of the lockdown; it was about 25% in Italy, 20% in France, and 12% in the UK. A significant reduction in electricity consumption across all markets was registered in the US, ranging from 6.36% to 10.24% in April 2020, and from 4.44% to 10.71% in May 2020 [14].

An abrupt fall in the fuel demand was observed in several countries worldwide; in the first quarter of 2020, a 6% reduction was recorded in oil demand [15]. This was related to commercial flight operations, which fell dramatically, with over two-thirds fewer flights worldwide between March and April 2020. A decrease in public transportation was also observed, although with some variability across cities, about 90% in Italy and France, 85% in Spain, 75% in the UK, and 70% in Germany [16]. The decline in demand and the macroeconomic variables saw crude oil reaching negative prices in April 2020, for the first time in history [17].

The COVID-19 crisis also changed the electricity generation mix and energy market prices. The decrease in electricity demand resulted in a reduction in the traditional power supplies with an increment in the share of renewable energy (RE) sources. The increase in RE generation led to increased demand and prices for ancillary services in the operational systems [10]. Since March 2020, the reduced electricity demand and the falling oil and natural gas prices have produced dramatic price drops in most electricity markets. The most severe drop was observed in the European electricity markets. For most European countries, these declines exceeded 50% compared to April 2019. Electricity prices also fell

in the US; in February and March 2020, 7–25% declines were reported. In India, electricity prices dropped by 24% in April 2020 [18].

Considering the turmoil in the energy sector brought on by the pandemic since March 2020 and seeing the uncertainty brought by the rise of a second wave [19] this study was designed to answer the following questions:

What is the short-term impact of COVID-19 on start-up companies working in the renewable energy sector? Are those companies suffering from business operation discontinuity and cash flow stress?

The significance of approaching such an evaluation on start-up companies relies on the fact that a crisis or deflection of the energy start-up sector might have complex implications for economics, innovation, and sustainable development, undermining the positive role that green entrepreneurship [20] has on energy transition.

This study focused on the Israel start-up ecosystem since Israel represents one of the densest and most active technological innovation ecosystems, with a high number of innovative companies, expenditure on R&D, and venture capital investment per capita. According to the Startup Nation Center, between 2018 and 2020, there was a significant increase in trading investment and the number of start-up companies in Israel. In 2018, the trending investment was \$65.92 million with 198 companies, while in 2020, the investment was \$157.6 million, and the number of start-up companies increased [21]. There are more than 200 energy tech companies in 5 different segments of the energy sectors: (1) generation, (2) transmission and distribution, (3) consumers, (4) storage, and (5) off-grid technologies [22]. Most of the start-up companies are in the transmission or distribution segment. The energy start-up sector is export-oriented, and 90% of investments come from abroad [23].

The research represents unique primary data that allows for the description of the COVID-19 pandemic's impact on renewable energy start-up companies, since the literature offers studies on start-up ecosystems [24] but not specifically regarding the energy sector. Moreover, the data raise inquiries about the resilience of start-up enterprises during times of crisis and the government's role in mitigating and relieving such economic emergencies.

Since governments have already started to plan the pandemic "exit strategy", the idea of how to turn the economic recovery into a model for promoting sustainability, RE development and green innovation [25,26] are at the core of the debate.

Analyzing the 2008–2009 GFC helps to comprehend the business risks and needs of the entrepreneurial and start-up ecosystem during the COVID-19 crisis, and therefore it can inspire support for appropriate policy initiatives. How governments spend the recovery money directly influences climate goals and future sustainability. Past economic crises and consequent recovery strategies may offer valuable insights for future economic, taxation, and regulatory policies [27]. For this reason, this paper offers a review of the GFC literature and uses the insights to discuss the data. In addition, the literature review revealed policy recommendations.

External shocks affect all SMEs to some extent; however, it is essential to consider how different types of businesses may be affected by a crisis, including the case of start-up companies during the COVID-19 crisis. The paper contributes to this topic and highlights the need for data and assessment of the entrepreneurial ecosystem under the recession induced by the coronavirus health crisis [28].

Lockdown also affected the low-carbon energy sector, which is particularly worrying due to the consequent delay in tackling climate change [29]. In this sense, the present research points out the challenges and risks that energy start-up companies face due to the COVID-19 crisis.

Already, the GFC opened the debate about policy interventions in times of crisis, calling for "*laissez-faire*" policies that would allow innovative small and young businesses to bring a new equilibrium to the economy. However, as small and young companies are more fragile during a recession, active policies are more desirable to re-establish economic stability and help entrepreneurial businesses to move from survival toward growth and

prosperity [30]. The great demand for innovative products and services provided by start-up companies in the global markets [31] should be kept in mind.

The paper is organized as follows. First, we review the literature on the 2008 financial crisis focused on the energy sector, SMEs, and start-up ecosystems. Then, results from the interviews are presented and qualitatively discussed using the insights from the literature review on GFC. Policy recommendations are outlined following the discussion of the results. Finally, this paper concludes with suggestions for further research.

2. Literature Review

2.1. Energy Sector during GFC

The GFC has been recorded as the worst financial crisis after the Great Depression of the 1930s; its severity and magnitude affected financial and macroeconomic conditions worldwide [32]. Studies showed that no country and economic sector were immune to the crisis, while different sectors were affected differently [33]. During the financial crisis, the credit shocks determined the spillover effect into global stock markets [34]. It had strong implications on global investment diversification. A financial contagion effect occurred with the transmission of the crisis across financial and non-financial sectors. Investors sold their assets and moved into cash or safer assets (for example, government bonds), reducing their risk exposure to the real economy and markets. Among the sectors, energy was the most affected in all regions [35]. GFC significantly impacted the crude oil market with enormous price fluctuations. In 2008, oil prices fell from US \$147 to US \$31/barrel in only five months. Price shocks were due to the concomitance of aggregate demand and precautionary demand that influenced both oil-importing and oil-exporting countries [36]. As the total world demand declined, the imbalance between oil supply and demand aggravated and increased market instability [37].

The financial crisis also affected the crude oil market in terms of efficiency and investors' collective events. A decline in oil market efficiency was observed following the GFC since the Organization of the Petroleum Exporting Countries (OPEC) reduced oil production [38]. Oil supply and demand shocks were the main drivers of macroeconomic uncertainty and were contingent on investor attitudes regarding financial market volatility [39]. The prolonged oil price shocks, along with the economic and policy uncertainty, intensified the volatility transmissions from oil to other energy and non-energy commodities [40,41], inducing systemic risks [42]. Empirical results showed strong cross-section herding spillovers and risk spillovers from the fossil fuel markets to the renewable energy stock market in the US during the GFC [43]. Between 2008 and 2009, the financial investment in global sustainable energy was slowed down. In 2009, research and development (R&D) spending and financial investments in the global sustainable energy market were 7% lower than before the financial crisis [44].

However, green economic recovery programs seemed to perform well during the GFC, with the opportunity to create jobs and reduce annual energy costs through green stimulus [45].

2.2. SME and Start-Up Companies under GFC

The GFC had serious effects across all economic sectors; however, the micro- and small-sized companies were the most vulnerable [46]. SMEs were affected overall by the shrinking of the national and international market, but more specifically by the reduced demand, the postponed payments from the clients, and decreased credit with suppliers and investors, who became more conservative in their investments [47]. The reduced credit supply induced a continued investment decline from July 2008 to March 2009, when the demand side effects considerably strengthened the crisis [48]. The credit supply shock restricted the SMEs' ability to invest due to limited external finance [49]. During the GFC, the impact on finance access was statistically and economically significant, and it was disproportionate between the companies [50]. The magnitude and conditions of available bank credits represented a real challenge for the European MSMEs, while the failure of

the banking systems had a crucial role in crisis intensification [51]. The GFC increased the probability of businesses failing; however, the companies with high human capital and R&D levels were the most likely to survive [52].

Credit availability played a critical part in SMEs business survival during the GFC; the bank debt was also a critical source of funding for the start-up companies, as shown by the Belgian start-up companies. However, start-ups that were strongly dependent on banks or founded by financially constrained entrepreneurs had a higher probability of bankruptcy during the crisis [53]. Before 2008, the survival of start-up companies in the US was associated with a high number of small banks; however, after the GFC, these benefits disappeared, possibly because small banks had fewer government guarantees than large banks during the GFC [54].

As banks and private equity investors withdrew from entrepreneurial activities during the crisis, considerable changes rose in entrepreneurial finance with new forms of investments [55]. In the UK, venture capital (VC) schemes, Enterprise Capital Funds (ECFs), and the Angel Co-Investment Fund (ACF) held an essential role for new and innovative SMEs, promoting equity finance in the post-GFC era [56].

Japanese banks responded to the global financial crisis by establishing different support programs for SMEs to prevent the financial shock of the crisis after 2008; the measures taken included a public fund scheme and revision of capital adequacy [57]. In the same way, the Australian government provided financial assistance to SMEs during the global financial crisis, using different forms of direct and indirect aid, including tax benefits [58].

The capital markets also adapted during the GFC to respond to the increasing investor demand for innovative clean technology companies (cleantech) with their higher need for external capital [59]. Examples of cleantech are energy efficiency and energy storage companies. In Japan, investments into the home energy management systems (HEMS) sector and a stricter program on household energy efficiency norms reduced residential electricity needs. Such technological innovations allowed Japan to reduce electricity consumption and address the energy security issue after the Fukushima nuclear disaster in 2011 [60]. The HEMS market developed under the GFC. Following an increasing global trend, the HEMS start-up companies hit the market in 2008 and 2009. The HEMS global market revenue was estimated to be USD 4.2 billion in 2017 [61].

Financial innovation in entrepreneurial finance during the GFC increased financial inclusion and allowed entrepreneurs access to finance. The financial development and the financial diversification denoted a successful strategy for the GFC recovery era. It was the answer to the contraction in private debt and equity markets as observed during the global financial crisis. The large increase in the use of non-traditional sources of finance in the real economy has been assessed as revolutionary and transformative, considering how they relieve the adversative effects of the pro-cyclical provision of entrepreneurial finance. Over a decade later, new financing options, such as blockchain, peer-to-peer (P2P) lending, and equity-based crowdfunding, are still used, indicating that they were not just a trend of GFC but a real need for innovation in finance provision and diversification from bank debts [62].

Supply chain finance (SCF) is evaluated as a mitigation strategy that can help meet the new challenges as those posed by the GFC. SCF aims to improve funding access and control the financial flow within the whole supply chain. Such financial evolution allows for a response to chain disruptions and rapid adjustments to the unpredictability of supply chain flows. SCF especially involves buyers and suppliers, and financial suppliers have a crucial role; large and creditworthy buyers agree with financial institutions on purchases in advance from their suppliers. It allows suppliers to deliver and have invoices paid, avoiding the risk of going out of business [63].

The difficulties in raising external finance for young innovative SMEs and long-horizon innovative sectors, such as cleantech, have induced the proliferation of government interventions in the post-GFC era. However, the challenges still reside in balancing and adequately addressing the financial needs (in accordance with the development stage and the long- or short-horizon of business innovation); thus, an innovative mechanism such as a

financial escalator is required. As the financial gap is often due to information asymmetries, finance finding services also have a crucial role, as demonstrated by the UK experience [64]. Additionally, in the start-up sector, policymakers are required to pay attention to the capital owners' low participation and consider the lack of effective channels between the two sides (investor and start-up company). New policy mechanisms, rules, or supports should guide capital and reduce the problematic information asymmetry between the two sides [65].

3. Methodology

The study is based on a mixed methodology that combines qualitative research carried out by interviews and an analysis of the GFC literature. The research design began by identifying a focus group of renewable energy start-up companies located in Israel, listed by the Start-up Nation Central (Tel Aviv-Yafo, Israel) and representative of the five start-up sectors including generation, transmission and distribution, off-grid technology, storage, and consumer, in accordance with the energy-tech map developed in 2020 by the Start-up Nation Central, Ignite The Spark: The Israeli Energy Tech Community (Tel Aviv-Yafo, Israel), and the Israel Export Institute (Tel Aviv-Yafo, Israel). In August 2020, the focus group, including seven start-up companies, was contacted, and the CEO of each company was interviewed with a questionnaire of 33 questions. The questionnaire was in English. A first trial was made with a few companies that met the criteria in order to assess and adjust the questionnaire before meeting the participants. The interviewed persons were not personally involved in the study. The involvement was kept anonymous and without any reward for participation. The data were collected five months after the declaration of the global pandemic and when the second wave was hitting Israel. The timeframe seemed appropriate to conduct a first assessment of the short-term impact of the ongoing pandemic.

The first part of the questionnaire was prepared to assess what the companies experienced during the first and second pandemic wave, which was during the period March–July 2020. In the second part, the questions were aimed at assessing their views about the future of their company and asking their opinion about the measures put in place by the government and other potential financial measures.

The questions were designed around three main themes; continuity of business operation, cash flow, and future perceptions, which vary as a function of externalities generated under COVID-19. The responses were labeled under those themes during the data analysis. Qualitative analysis was used to portray the ongoing circumstances and disclose the patterns of the short-term impact of the COVID-19 crisis on energy start-up companies involved in the study.

Secondary sources were used to discuss such patterns and to understand the main direction of the phenomena represented by the questionnaire answers. The secondary resources used in this study were literature resources centered on GFC, which specifically discussed the energy sector and entrepreneurial ecosystem, SMEs, and start-up companies.

Policy recommendations were outlined by combining the literature findings and qualitative analysis based on interviews.

Research Limitations

The present research was constrained by time, size, and geographical space.

It is essential to highlight that the data revealed only the circumstances in August 2020; the study only collected data on the extremely short-term impact (March–July 2020) and was carried out during the second pandemic wave.

The sample size was small, and it did not allow a statistical analysis of the replies. However, generating a statistical analysis was not the goal of this research.

The interviews involved only start-up companies with headquarters located in Israel. However, the choice to focus on Israel was justified because it is known as “the start-up nation” with a highly developed ecosystem of start-up companies.

4. Results

4.1. Description of Interviewed Companies

The seven companies were founded between 2008 and 2015 with headquarters in Israel. All were involved in the renewable energy field; five companies operated in a single energy sector, while two were active in multiple sectors. Table 1 summarizes the companies' characteristics, including the type of business (production, R&D, service), RE domain, and form of business (B2B, business to business; B2G, business to government; and B2C, business to consumer) [66]. The start-up companies were categorized according to the number of employees [67] five micro-enterprises, one small-enterprise, and one medium enterprise.

Table 1. Characteristics of the start-up enterprises involved in this study.

Size	Number of Employees	Business Form	Business Type	RE Domain
Micro	5	B2B B2G	Production and manufacturing (P&M)	Solar PV
	5	B2B	R&D	Energy efficiency
	6	B2B	R&D	Energy storage
	15	B2B	Services	Solar PV. Wind Energy storage Energy efficiency
	18	B2B	Services	Solar PV
Small	50	B2B B2G	Production and manufacturing Service R&D	Solar PV. Biomass Solar thermal Energy storage Energy efficiency
Medium	150	B2B	Services	Solar PV.

4.2. Questionnaire Results

The companies were asked to express openly if the first wave of COVID-19 affected their companies and how. The companies that claimed to be affected mentioned how sales had dropped, projects were frozen, new projects were minor in number, replies from clients were slower than before, and the international projects were blocked. During the period March–May 2020, the companies stated that they had experienced restrictions on work access, logistical issues in delivering the products and services, and supply chain disruptions. Such issues were related directly to the lockdown measures and indicated a pattern in which business activities were disrupted and the day-to-day operations were negatively affected. The companies experienced a decline in sales, decreased investments, and revenue losses in the same period. The micro-companies seemed to be experiencing more such issues related to the cash flow impact and interpreted here as financial distress induced by liquidity constraint.

Regarding the second wave, the companies were still alleging fewer new projects and the halt of international projects due to the travel restrictions. Moreover, the companies complained about the halt in sales and highlighted how people were worried and preferred to work at home. In the period June–July 2020, according to the interview replies, the companies continued experiencing supply chain disruptions, logistical issues, and work access restrictions, which still adversely impacted the regular business operations. The companies that had already experienced a decline in sales in March–May 2020 were still

experiencing this in June–July 2020. Moreover, companies were experiencing revenue losses during the second wave; if compared to the first wave, one additional company was experiencing such a loss. It may indicate how the continuation of restrictions increased the occurrence of financial distress among the companies. In the time frame of four months, two micro-companies reduced their workforce in response to the pandemic externalities.

Since March 2020, the companies had been following the legislation, adopting sanitation rules, using masks, and continuing social distancing in the workplace. Moreover, companies used remote working and changed their work shifts in order to respect the restrictions and avoid overcrowded workplaces.

During the interviews, the companies were asked to assess the government's strategy and the measures implemented in response to the economic consequences of COVID-19. Specifically, they were asked to rate the tax and employment measures and the economic stimulus package. Only two companies replied to this question, describing dissatisfaction. However, the "I would rather not say" response might reflect a sort of discontent.

The companies were asked to rank specific potential financial measures useful to address the economic crisis induced by COVID-19; they showed differing opinions about the usefulness of tax credits, tax relief, and non-refundable loans, while they agreed on ranking positively dedicated finance programs.

Then, the companies were asked to forecast the next six months (counting from August 2020). Gaining new contracts and clients seemed to be the most common worry, followed by networking and supply chain issues. Moreover, they expressed concern about a decline in sales in the future. The companies expressed different opinions regarding future investments, and some had no idea what to expect from investors. Such a lack of prediction about future investments was associated with a high level of uncertainty due to the ongoing circumstances. Further evidence of that uncertainty was represented by the fact that some companies re-evaluated their overall business plans, specifically their business strategies, investors, and stakeholders.

5. Discussion

The COVID-19 crisis and GFC are marked by significant negative features such as price shocks [68] supply disruptions [63] financial markets risks [69] and stock market value deterioration [70]. Despite the different aspects [71], the two crises share common severity and socio-economic consequences of a global financial contraction.

According to interview results, the energy start-up companies in Israel experienced supply chain disruptions during the COVID-19 crisis, and they complained about ongoing projects being "frozen", while the new projects were fewer than before, and international projects were blocked. Those were the effects of the lockdown measures and the travel restrictions. Such a situation experienced by the companies reflected the fact that worldwide, the chain disruption prompted a stall of projects [72] and slowed down RE deployment; technological sectors of wind turbines, solar panels, and electric vehicles were all negatively impacted [29].

The questionnaire answers gave an indication of cash flow issues for the start-up companies from March 2020 to July 2020; as documented by their replies, some start-up companies experienced a decline in sales, decreased investments or delays in receiving them, and revenue losses. The pandemic externalities, financial turmoil, and future uncertainty resulted in two companies out of the seven reducing their workforces. Such evidence is significant among a small group. Microenterprises suffered the most, experiencing economic losses and significant disruption to business continuity in the short term.

As already observed during the GFC, the economic impacts of a recession are not equally distributed across business firms. The smaller companies were more affected than larger companies [73]. Usually, the smaller businesses are already financially unstable and highly dependent on routine business transactions and day-to-day operations. They were more directly and indirectly vulnerable to the COVID-19 economic disruptions. They were under severe risk of running out of money as the economic lockdown persisted longer than

expected. In 2020, a survey found that 61% of businesses in the UK were challenged with cash balances under COVID-19 externalities, with 8.6% of businesses that either had no reserved earnings or were micro-firms, especially at risk [74]. As an analogy, the economic recession starting in 2008 produced credit restrictions for SMEs, which aggravated their liquidity constraints and caused capital problems [75]. As observed during the GFC, the liquidity constraints and business insolvency were directly correlated to firm survival and job losses [76]; in the same manner, the implications of the COVID-19 crisis on SMEs negatively affected economic development and job creation. It was expected that business failures for SMEs would double in 2020 [77]. Not surprisingly, in July 2020, the SMEs in Spain were responsible for two-thirds of the national fall in employment during the COVID-19 pandemic [78]. During COVID-19, the SMEs tended to be willing to reduce negative cash flow and costs rather than increase their debts and move the financial problem to the future [79]. The cut in the workforce during a recession is a way to reduce costs and restore cash flow.

According to another study [80] the COVID-19 breakdown greatly impacted the Israeli start-up companies that depended on foreign markets. Selling products and services to customers became harder during the first months of the pandemic. Moreover, start-up companies were impacted by lockdown restrictions and travel bans, making communication difficult and impeding them from securing funding. As a result of pandemic externalities, start-up companies stopped hiring. Some of them fired workers or put workers on unpaid leave. In addition, companies lacked information on investors' interests and behavior, which made future business perspectives less predictable. The interview findings are in line with such results.

As the interviewed start-up companies expressed, there was little confidence in predictions of the forthcoming months with negative expectations for new sales, new contracts, and networking. Moreover, the majority had no idea about future investments. It was shown that a higher level of uncertainty generally arises in innovative technology start-up companies than in other types as a result of the extremely high competition [31].

Concerning the government measures in response to COVID-19, the interviewed start-up companies negatively ranked the measures or avoided replying to that question as an indication of discontent. Sentiments of dissatisfaction were also chronicled from German start-up companies during the first two months of the pandemic. Many were excluded from government support services because they were not bankable, or ineligible due to other bureaucratic obstacles [81]. In line with this, the start-up companies during the interviews indicated that dedicated financial programs are the most desirable. On the contrary, the lack of government intervention for COVID-19 would increase the percentage of business failures and unemployment [77]. It should not be ignored that COVID-19 challenges induced the CEOs to rethink their business plans in terms of strategy, investors, and stakeholders.

6. Policy Recommendations

The uncertainty brought by the COVID-19 pandemic represents challenges for future planning in every sector of the economy and society. However, the pandemic that created a global collective human experience might drive sustainable transitions and a more resilient economic system. Governments in the pandemic period focused on green fiscal stimulus packages to tackle financial and climate-environmental crises together, as already happened in the GFC [82]. As the GFC has aided countries in committing to the Kyoto Protocol and Copenhagen Accord with the promise to reduce emissions on a territorial basis [83], the COVID-19 crisis seems to have prompted the commitment to the European Green deal that some authors already defined as "*the social vaccine*" [84].

European Green Deal (EGD) demonstrates the EU's commitment to fighting climate change and supporting Sustainable Development Goals. The EGD provides targets and directions for politicians and policymakers to achieve climate neutrality by 2050. Despite the opinion that the COVID-19 crisis represents a critical moment for EGD [85], the pan-

demographic world embodies a fertile ground to implement EGD. Besides the European case, the global commitment to the COP Glasgow Pact can drive the COVID-19 economic recovery worldwide and simultaneously reduce CO₂ emissions, opening new opportunities for green technologies [86].

COVID-19 impacted the renewable energy sector due to several factors such as lower demand, shortage of investment, and disruption of supply chains. The renewable energy markets are still considered vulnerable to shocks in the fossil fuel market [43]; the collapse of fossil fuel prices may cause renewable energy projects to lose competitiveness [87]. It might negatively influence private investments. The international flows of low-carbon energy technologies have to re-emerge quickly from COVID-19, and policy must support such a recovery [29]. During the economic recession after 2008, only legislation and incentives were significant investment drivers in renewable energy projects [88]. The incentives tried to balance the fall in the investment trend observed between 2008 and 2009. In a recession, the renewable energy sector has interesting short- and long-term characteristics; for example, clean energy infrastructure is particularly labor-intensive. In the short run, it may create twice as many jobs per dollar as fossil fuel investments [89].

Nowadays, protecting the renewable energy industry can contribute to the energy sector's resilience and increase energy access, which is still an urgent priority in the Global South, and even more so when facing a pandemic [90].

The increase in renewable energy production over the total power production, as has happened since March 2020, requires innovation and flexible options within the electricity system to guarantee secure and reliable electricity supplies as required for industrial development and economic growth. Active participation of industry in the low-carbon economy, developed by innovation and renewable energy sources, can encourage green industrial development and boost inclusive industrial development and growth to deliver a just transition [91]. According to some authors, environmental investments may offer a refuge for investors during crisis periods due to their relatively safer stance [92].

An increase in renewable power generation amplifies the energy system's operational challenges and requires continued innovation [8]. A greater chance is thus opened for the start-up energy sector. However, finance access is one of the critical determinants for business during a recession [50], with smaller enterprises most constrained in their capability [93]. The start-up ecosystem does not represent an exception.

Pandemic-control actions also needed measures for supporting the most exposed firms and households first-aid measures such as liquidity support were evaluated as crucial in alleviating the cash flow constraints of start-up companies and SMEs during the COVID-19 pandemic [79]. However, currently, governments are asked to identify policies with a long-term and strong positive impact. In this sense, clean energy R&D spending and clean energy infrastructure have positive multiplier effects on economic growth and climate change resilience. As observed during the GFC, government intervention is needed to coordinate business finance policy thus creating a suitable finance ecosystem for green business and tackling climate change. The role of the government in fostering and supporting entrepreneurship has been recognized as central in the development of the PV market after 2008, which determined a subsequent decline in the prices of solar modules [94]. The government-assisted policy created an environment where testing and investigation are legitimate. It makes access to critical resources easier, where entrepreneurs and new enterprises can exploit their potential in a competitive and productive system [95]. The investment into R&D for PV has efficiently decreased the cost of PV modules and positively supported the development of markets for PV modules [96].

The role of policy is also acknowledged for developing the HEMS [97] and energy efficiency cleantech [98], which was prompted by the rise in electricity prices [99]. The policy support for such innovations reduced energy consumption and allowed many large and small companies to flourish [61].

The cleantech sector is still a sector with limited profitability that depends on government incentives [100,101]. There is still an enormous and highly challenging funding

gap (often skewing) for innovative green companies [102]; from an investor's perspective, the cleantech companies often represent a long-horizon innovation with high risk and considerable uncertainty. This generally drives investment toward digital technologies that offer faster returns [103].

The financial gap is accentuated in the case of start-up companies, and dedicated financial schemes represent a necessity as policy responses did not match the entrepreneurial needs during the first months of the pandemic [81]. Uncertainty prevents entrepreneurs from taking on additional loans [79]. Although start-up creativity and business flexibility companies might handle their risk management and face adversity [104], they are cash-constrained.

Government co-finance programs demonstrated after GFC have catalytic value for highly innovative firms and can rescue and safeguard them from the shadow of the financial crisis induced by COVID-19. Dedicated programs for the start-up ecosystem are the most effective as long as they address the specific financial needs of start-up companies. Governments should focus on strategically supporting start-up companies in the renewable energy sector. Limiting their failures may also sustain the RE technological innovation and learning curve [105], economic growth, and energy transitions in the post-pandemic era. In the specific case of Israel, if the energy start-up financial distress induced by the COVID-19 crisis is not adequately addressed, Israel risks losing the energy transition momentum and missing the worldwide economic opportunity to contribute with technological innovation to the RE sector. It might decrease the prominent position of the "the Start-up Nation" within the international market.

Further Research

The research can benefit from follow-up, which helps to evaluate the longer-term implications of COVID-19 over time, particularly concerning the different RE sectors, and as a means to compare with other geographical areas.

7. Conclusions

The COVID-19 health crisis led governments to take drastic measures, which had immediate negative impacts on economic life and businesses.

The research first illustrates how Israel's renewable start-up companies were challenged in March–July 2020 by the consequences of the crisis. Two microenterprises reduced their workforce after March 2020, which indicates that the smaller start-up companies were affected the most. The pandemic affected the companies differently; however, the most common issues were supply chain disruptions, logistical problems, and work access restrictions that affected their operations. In the first and second pandemic wave in Israel, the companies faced cash flow problems due to sales decline, revenue losses, and investment decreases.

Second, the research reviewed the GFC literature, specifically looking at the financial crisis that impacted the energy sector, the SMEs and start-up companies, and the government's role in dealing with the financial disruption after 2008. Innovation in financial systems to enable entrepreneurship support was central to protecting the smaller enterprises from cash flow problems and investment interruption during and after the GFC. Likewise, policy intervention assisted in maintaining investments in the renewable energy sector after 2008, and aided the development of PV and energy efficiency technologies.

Finally, policy recommendations should encourage policymakers to follow the lessons from the GFC to assist the entrepreneurial ecosystems experiencing COVID-19 related financial challenges. The recovery plans should not neglect start-up companies' specific economic needs but rather use dedicated financial programs to provide first aid and long-term support for the most innovative firms.

We sought to raise awareness and explain the financial impact of COVID-19 on start-up companies involved in the RE sector. It requires that policymakers and practitioners reflect

on energy start-up companies' many failures and how this represents a risk for innovation and energy transition in the near future.

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