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Removing barriers for sustainability: A qualitative cross-country analysis of entrepreneurial ecosystem attributes in Israel and Germany

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Abstract

There is a growing scholarly and political consensus about the potential of entrepreneurial ecosystems (EEs) to further sustainability by fostering sustainable start-ups. However, little is known about how the constituents of EEs as institutional framework for entrepreneurship affect the success of sustainable start-ups. Based on institutional theory, this paper develops and tests a conceptual framework to assess how the configuration of EE components affect mature EEs in their ability to support sustainable start-ups. Based on semi-structured interviews with EE stakeholders from Tel Aviv and Berlin, along with site visits and participatory observations, this cross-country analysis demonstrates that the attributes represent a promising explanatory approach for the sustainability alignment of an EE. The empirical results are threefold: (1) sustainable start-ups have special needs regarding their institutional environment and (2) require a more distinctive support structure surpassing the level of an EE. Hence, (3) each institutional component has to be tackled according to its spatial relevance to further sustainability. This translates into differentiated policy implications for fostering sustainability and theoretical advancements in EE research regarding spatial integration of sustainable start-up support. We contribute to institutional and entrepreneurship literature by implementing the idiosyncrasies of an EE's ability to further sustainability through their attributes.

JEL: O31; O38; Q01; R11

Keywords: entrepreneurial ecosystem; sustainable start-ups; case study; institutional theory

SDG keywords: SDG 11 Sustainable cities and communities

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1. Introduction

Scholars and policymakers show mutual consent concerning the high relevance of entrepreneurship for sustainability that characterizes the ‘fourth wave’ of entrepreneurship research (Volkmann et al. 2021, 1047). Recent publications emphasize the importance of sustainable start-ups as a conduit for sustainability (Belz and Binder 2017; Bischoff and Volkmann 2018; Hall, Matos, and Bachor 2019; Parrish and Foxon 2006)¹ and entrepreneurial ecosystems (EEs) as the institutional setting for entrepreneurship (Audretsch et al. 2023; Tiba, van Rijnsoever, and Hekkert 2020). Following Spigel (2017), an EE consists of a region’s cultural, social and material attributes that “support the development and growth of innovative start-ups and encourage nascent ventures and other actors to take the risks of starting, funding, and otherwise assisting high-risk ventures” (p. 50). Recent publications have started to use this understanding to assess how EEs can purposefully target sustainability (Audretsch and Fiedler 2023; Theodoraki, Dana, and Caputo 2022).

Despite this growing interest, it remains unresolved how an EE’s configurational components individually and interdependently affect its capability to support sustainable start-ups. To the best of our knowledge, what is pending is a nuanced empirical analysis of the institutional environment, such as infrastructure and resource provision, and its role as a driver or impediment to this objective (Hoogendoorn, van der Zwan, and Thurik 2019; Spigel 2017; Steinz, van Rijnsoever, and Nauta 2016).

We pick up Chaudhary et al. (2023)’s question of “how [...] the configuration of ecosystem elements result[s] in sustainability” (p. 7) by combining institutional theory and the conceptual basics of EEs and their attributes (Spigel 2017). We start with the assumption that the insufficient provision and configuration of EE attributes function as institutional impediments to sustainable start-ups in an EE. We address the following research question (RQ):

RQ *How does the institutional environment equip entrepreneurial ecosystems to further sustainability?*

Conducting a binational cross-country analysis of the mature EEs of Tel Aviv, Israel, and Berlin, Germany, we use the concept of EE attributes (Spigel 2017) as an ‘institutional environment’ to assess the premises for fostering sustainable start-ups.²

We show that some attributes are of the utmost importance for sustainable start-ups, while others play a subordinate role compared to other non-sustainable start-ups. We make a twofold contribution to current discussions: First, we relate the peculiarities of sustainable start-ups to an established EE framework and show how different EE attributes enable sustainable start-ups and, hence, sustainability. Second, we reveal the diverse relevancies of attributes and combine different levels of spatial aggregation on which they unfold their effects. The results of our study imply that analysing and implementing measures for the purposive support of sustainable start-ups requires the incorporation of multiple spatial levels. Focusing the analysis on the effects of different EE attributes fuels recent calls for broadened approaches that stick neither to local nor regional nor to national perspectives.

2. Entrepreneurial ecosystems as instruments for fostering sustainability

We base our idea of the institutional environment as crucial for fostering sustainable start-ups on two current discussions in entrepreneurship research. First, induced by the increasing societal relevance of wicked problems such as climate change, waste management and decarbonization, scholars have started to develop new concepts that perceive entrepreneurship as a catalyst for societal change and sustainability (Bischoff and Volkmann 2018; Kuckertz and Wagner 2010; Rennings 2000). Second, recent research on entrepreneurship has been dominated by systemic approaches that perceive entrepreneurial success as the

¹ Considering several definition approaches (Belz and Binder 2017), we stick to Schaltegger and Wagner (2011), who argue that sustainable start-ups “generate new products, services, techniques and organizational modes that substantially reduce environmental impacts and increase the quality of life” (p. 223).

² The data of this study were collected between May and October 2021 and one supplementary interview in May 2023. This study does not include recent developments occurring after this period.

result of reciprocal interaction processes among various stakeholders and show a strong emphasis on functioning spatially confined institutional structures (Acs et al. 2017; 2017)] and Cavallo et al. (2019)] for comprehensive reviews).

EEs provide a conceptual approach in which the institutional environment, as a combination of resources, networks and infrastructure, determines a location's ability to create and support successful new ventures (Davidsson et al. 2023; Spigel 2017; Stam and van de Ven 2021) and acts as a barrier if it is underdeveloped (Spigel 2017; Steinz, van Rijnsoever, and Nauta 2016). This relates to institutional theory as a suitable conceptual framework for describing barriers evolving from new ventures' surroundings (DiMaggio and Powell 1983; Steinz, van Rijnsoever, and Nauta 2016). The argument posits that in the absence of a functioning institutional environment, start-ups cannot scale up and prosper (Hoogendoorn, van der Zwan, and Thurik 2019). We combine this theoretical argument and the EE concept by perceiving Spigel's (2017) EE attributes as components of the institutional environment that may act as barriers if configured in a suboptimal way.

Compared to non-sustainable start-ups, the creation of sustainable start-ups poses different demands of resources, yields higher risks and needs to be addressed accordingly (Keskin, Diehl, and Molenaar 2013; Paech 2007; Parrish and Foxon 2006). Ongoing EE research alongside the intensified interest in sustainability led to a burgeoning scholarly discussion about the premises of fostering the needs by designing the resources accordingly (Bertello et al. 2022; Cohen 2006; Pankov, Velamuri, and Schneckenberg 2021; Simatupang, Schwab, and Lantu 2015; Volkmann et al. 2021). Three methodological and thematic approaches dominate the recent nascent scholarly discourse on sustainable entrepreneurial ecosystems (SEEs). **Table 1** provides a brief overview.

Table 1. Prevalent research strands in SEE research

	Micro-level	Meso-level	Macro-level
Objects of analysis	Individual projects, innovation forms, ventures, programs or regional ecosystems with sustainability-oriented stakeholders	Stakeholder and network dynamics within EEs, SEE development	Supra-regional or national EEs
Data analysis	Qualitative (single or multiple) case studies	Systematic literature review, bibliometric analysis	Econometric panel data or cross-sectional analysis, fuzzy set qualitative analysis
Main subject	Strategic and managerial challenges emanating from SE focus; ecosystem configuration and development	Pathway and development from traditional EE to SEE	General socioeconomic factors relevant for formation of sustainable ventures, interaction between stakeholders and (S)EE performance
Sustainability Orientation	Sector- or dimension-focused (triple bottom line)	Undefined, SEE as a natural development of EEs by time	No further definition, triple bottom line or remains fuzzy
Exemplary literature	DiVito and Ingen-Housz (2021); Pankov, Velamuri, and Schneckenberg (2021); O'Shea, Farny, and Hakala (2021); Wagner et al. (2021) Polzin, Flotow, and Klerkx (2016); Cohen (2006)	Chaudhary et al. (2023); Bertello et al. (2022); Bischoff and Volkmann (2018); Theodoraki, Messegghem, and Rice (2018)	Huang et al. (2023); Khatami et al. (2022); Bischoff (2021); Tiba, van Rijnsoever, and Hekkert (2021); Volkmann et al. (2021); Hoogendoorn, van der Zwan, and Thurik (2019); Neumeyer and Santos (2018)

Abbreviations:

EE	Entrepreneurial ecosystem
SEE	Sustainable entrepreneurial ecosystem

The ‘micro-level strand’ focuses on particular elements or stakeholders by outlining various strategic and managerial challenges emanating from their sustainability orientation. Based primarily on qualitative in-depth analyses of individual cases, these studies evaluate the impact of enabling sustainability-oriented actors within an EE and emphasize the particularities resulting from sustainable ventures (Cohen 2006; DiVito and Ingen-Housz 2021). For instance, O’Shea, Farny, and Hakala (2021) shed light on the lengthy and phase-dependent development of the sustainability alignment of EEs through actor dynamics that focus on new venture creation. More scholars follow similar approaches by qualitatively analysing either particular sustainable start-ups or national EEs and their premises for sustainable entrepreneurship (Forrest, Wiek, and Keeler 2023; Wagner et al. 2021).

The ‘meso-level strand’ covers literature reviews aiming to delineate EEs’ pathways towards more sustainability, focusing on the interorganizational level and associated resource streams. Chaudhary et al. (2023), for instance, explained the upsurge of interest in SEE configuration through the alignment of EEs towards sustainable entrepreneurial activities, its actors and the focal role of institutional settings as well as outputs of SEEs. Following a similar approach, Theodoraki, Messeghem, and Rice (2018) argued for a ‘holistic approach’ for SEEs by emphasizing the interconnectedness of the entirety of ecosystem members. Thus, relationships can bridge the lack of crucial resources for ventures.

The ‘macro-level strand’ contains approaches that use data on national or supranational levels to identify particularly relevant socioeconomic factors for enabling sustainable start-up formation. Khatami et al. (2022) confronted the results of extant qualitative approaches by subordinating a supportive culture for sustainable start-ups and emphasizing infrastructural factors and resource provision. In contrast, Bischoff (2021) found regional entrepreneurial culture and tailored promotion measures to be of utmost importance. Huang et al. (2023) showed how generally defined socioeconomic dimensions affect EEs’ ability to foster sustainable start-ups. Tiba, van Rijnsoever, and Hekkert (2021) identified the causal drivers of sustainable venture formation by assessing mature EEs and their share of sustainable start-ups in relation to their given resources and infrastructural settings.

These strands form our understanding of how the institutional environment of sustainable start-ups affects their prospects of success but neither assesses the role of individual EE components nor the interdependencies between them. This, however, would enrich the nascent conceptual discourse and provide practical implications for policymaking and strategic EE development. This potential has been recognized and initially harnessed by Tiba, van Rijnsoever, and Hekkert (2020), who conducted a comparative in-depth analysis to evaluate the factors that support sustainable venture creation. They compared the EEs of Berlin and Lagos to show the high relevance of role-modelling projects for the attraction of sustainable start-ups and their required resources (Tiba, van Rijnsoever, and Hekkert 2020). We aim to engross this thought by harnessing the conceptual overlaps between institutional theory and EEs to systemically assess various EE components.

3. Towards a holistic, attribute-based institutional approach

Emphasizing the interdependencies between different configurations regarding resource provision and infrastructure, Spigel (2017) defines 10 interwoven attributes of cultural, social and material dimensions that reinforce each other and determine the ability of an EE to foster start-ups. Alongside the rising interest in sustainable start-ups, scholars have recently started to assess the relevance of these attributes to sustainability. We apply the framework to analyse the suggested attributes as institutional drivers and barriers for sustainable start-ups (**Table 2**).

Table 2. EE attributes identified by Spigel (2017) and their implications for fostering sustainable start-ups

<i>Dimension</i>	<i>Attribute</i>	<i>Description by Spigel (2017)</i>	<i>References to sustainable start-ups in literature</i>
Cultural	Supportive Culture	Cultural attitudes that support and normalize entrepreneurial activities, risk taking and innovation.	Need to push and incentivize ‘environmental awareness’ of society and firms (Giudici et al., 2019); entrepreneurial culture as precondition for sustainable start-ups (Bischoff, 2021); actors’ sustainability orientation as main driver for sustainable innovation opportunities (DiVito and Ingen-Housz 2021); sustainability-oriented community values as a prerequisite for sustainable start-ups (Aliabadi et al. 2022)
Cultural	Histories of entrepreneurship	Prominent local examples of successful entrepreneurial ventures	Existing sustainable ventures required to show feasibility (Hall et al., 2019); the presence of constrained start-ups mitigates EE development, especially in the case of technological constraints (van Rijnsoever 2022)
Social	Worker talent	Presence of skilled workers who are willing to work for start-ups	Well-educated and sustainability-oriented workforce required for development and growth of sustainable ventures (Cohen 2006)
Social	Investment capital	Availability of investment capital from family and friends, angel investors and venture capitalists	Need for specialized funding programs addressing sustainable start-ups due to their idiosyncratic needs (Polzin, Flotow, and Klerkx 2016)
Social	Networks	Presence of social networks that connect entrepreneurs, advisors and investors	Enhancing social capital in EE enhances resource access, strengthens relationships, and increases trust (Theodoraki, Meseghem, and Rice 2018); shared sustainability intention as fundamental enabler of sustainable ventures (O’Shea, Farny, and Hakala 2021)
Social	Mentors and role models	Local successful entrepreneurs and business people who provide advice for younger entrepreneurs	Including entrepreneurs in policy design can reduce concerns about costs for technology and help develop guidelines (Hall, Matos, and Bachor 2019)
Material	Policy and governance	State-run programs or regulations that either support entrepreneurship through direct funding or remove barriers to new venture creation	Policy awareness of sustainability issues is a main driver of sustainable entrepreneurial opportunities (Giudici, Guerini, and Rossi-Lamastra 2019); sustainability needs to be addressed directly in support programs (Fichter and Tiemann 2020); governmental support of sustainability orientation as main success factor on macro level (Kuckertz, Berger, and Brändle 2020)
Material	Universities	Universities and other HEIs which both train new entrepreneurs and produce new knowledge spillovers	Creation and diffusion of scientific and technological knowledge as requirement for sustainable start-ups (Giudici, Guerini, and Rossi-Lamastra 2019); university-linked programs support emergence of those ventures by specialized education and transfer programs (Wagner et al. 2021); academia-driven intermediaries as pro-active supporters of sustainability knowledge diffusion (Bäumle, Hirschmann, and Feser 2023)
Material	Support services	Firms and organizations that provide ancillary services to new ventures, for example, patent lawyers, incubators or accountancies	Need to address broad range of newly emerging sustainable business models (Neumeyer and Santos 2018); collaborative support services required to foster sustainable entrepreneurial opportunities (Bischoff, 2021; Bischoff and Volkmann, 2018); need for coherent support system for sustainable innovation (Kanda et al. 2022); intermediaries lobbying for interests of sustainable start-ups (Alwakid, Aparicio, and Urbano 2021)

facilitate business ideas and development (Audretsch and Fiedler 2023; Theodoraki and Messeghem 2017). To build networks, regional actors require sufficient levels of structural, cognitive and relational social capital to the sustainable start-up that helps them gain mutual trust and ease resource access (Theodoraki, Messeghem, and Rice 2018).

Similar to the histories of entrepreneurship, *mentors and role models* can have a lighthouse effect for upcoming entrepreneurs: the exchange with peers and prominent entrepreneurs provides guidance. In addition to mentoring schemes, successful sustainability-oriented business actors can participate in designing policies, thereby mitigating constraints and developing guidelines tailored to sustainable start-ups (Hall, Matos, and Bachor 2019).

3.3. *Material attributes*

Policy and governance can enhance entrepreneurial activities by facilitating regulations and programs (Spigel 2017). The awareness of policymakers is the main premise for a focus on sustainability (Giudici, Guerini, and Rossi-Lamastra 2019). Policy programs targeted at promoting sustainable start-ups foster sustainability (Fichter and Tiemann 2020) by anchoring sustainability issues in central strategies (Kuckertz, Berger, and Brändle 2020). In this regard, EEs can be perceived as the implementation layer of mushrooming sustainability-oriented approaches and instruments in entrepreneurship policy (Khatami et al. 2022).

Universities provide knowledge and training for entrepreneurs (Spigel 2017) and fulfil two main functions in fostering sustainable start-ups: first, the provision of scientific and technological knowledge as a prerequisite for new start-ups (Giudici, Guerini, and Rossi-Lamastra 2019), and second, specialized knowledge transfer and teaching programs connected to universities as a promising conduit for sustainable knowledge spillovers (Wagner et al. 2021). Universities have the potential to be an important source of sustainable start-ups but require incentives by policymakers to shift their focus to sustainability (Giudici, Guerini, and Rossi-Lamastra 2019).

Academia-driven, public and semi-public *support services* play an important role in this process (Bäumle, Hirschmann, and Feser 2023). These services can foster social capital by providing entrepreneurs with opportunities for knowledge exchange (Kenney and Patton 2005; Theodoraki, Messeghem, and Rice 2018) by crossing the gap between entrepreneurship education and applied experiential knowledge (Lamine et al. 2018). Policymakers need support services to help them connect with entrepreneurs and learn about their concerns and ideas (Hall, Matos, and Bachor 2019). A sustainability alignment across support services raises awareness and engagement within society and facilitates sustainable start-ups. Therefore, entrepreneurial support programs need to directly address and foster these ventures (DiVito and Ingen-Housz 2021).

Physical infrastructure relates to material resources and facilities such as plants, office space, transportation and communication (Spigel 2017). This is particularly relevant for technology-based sustainable start-ups, which require extensive space for research and development (R&D) and production processes. The extant infrastructure of incumbent enterprises supplies a low-cost opportunity for budget-restricted, early-stage sustainable ventures (Polzin et al. 2016). Foxon and Pearson (2008) argued for the public provision of sustainability-tailed infrastructure and resources since private provision is often insufficiently scaled.

Open markets determine the demand for start-ups' products and technologies (Spigel 2017). The creation of open markets requires special attention to overcome market failures impeding the adoption of sustainable start-ups (Ball and Kittler 2019).

4. Data and methodology

4.1. Case characteristics

Our qualitative cross-country approach to analysing two vibrant and thriving EEs addresses the call for more explorative, comprehensive approaches (Maroufkhani, Wagner, and Wan Ismail 2018; Theodoraki and Messeghem 2017).

To ensure the applicability of conceptual ecosystem basics, a critical mass of sustainable ventures and specialized support infrastructure, we analyse two comparably mature EEs. Both locations are considered to be well performing in terms of traditional entrepreneurship, ranked within the global top 15 (Startup Genome 2022). See **Table 3** for an overview of the basic characteristics.

Table 3. EE characteristics of Tel Aviv and Berlin

<i>Indicator</i>	<i>Tel Aviv</i>	<i>Berlin</i>
Share of sustainable Start-ups [%] ¹	5.0	6.2
Share Women Founders [%] ¹	8.0	13.0
Environmental Performance Index ¹	78.14	84.26
Share of population religious [%] ¹	95	37
Early-Stage funding per Start-up [k\$] ¹	509	483
GDP/capita [k\$] ¹	41.4	26.3
Social Expenditure (share of GDP) [%] ¹	16.1	25.3
Rank in Global Start-up Ecosystem Report 2022 ²	7	16
Sector strengths ²	AI, Big Data and Analytics; Cybersecurity	Fintech; AI, Big Data and Analytics

Source: ¹Tiba et al. (2021), ²Startup Genome (2022).

Abbreviations:

AI	Artificial Intelligence
GDP	Gross Domestic Product

Tel Aviv is also referred to as ‘Silicon Wadi’ (Senor and Singer 2009), implying strengths in artificial intelligence, big data, analytics and cybersecurity. Due to Israel’s extreme weather and geopolitical conditions, federal innovation and entrepreneurship strategies are aligned to deal with scarce resources and resource efficiency (Alatout 2008; Harel et al. 2017). This translates into the second highest R&D rate after Silicon Valley and status as one of the leading innovation and tech centres in the world (Gauthier et al. 2022). Israel is home to approximately 850 sustainable start-ups, about 220 of which are located in the metropolitan area of Tel Aviv (Start-up Nation Central 2023).

Germany is home to the second largest share of sustainable start-ups in Europe as of November 2022 (Gauthier et al. 2022). According to a survey by Fichter et al. (2023), Berlin is home to 17% of all sustainable start-ups in Germany. Similar to Tel Aviv, Berlin hosts many international start-ups and attracts over 60% of all German deal flows in capital investments. Support mechanisms for sustainable ventures, such as finance and programs, are part of the legal framework (Gauthier et al. 2022).

4.2. Data collection and analysis

Our primary data source is 19 semi-structured interviews with start-up representatives, researchers and intermediaries from Berlin (6) and Tel Aviv (7), as well as intermediaries working on the intersection between both EEs (6). Our selection criteria resulted in a balanced sample representing the perspectives of policymakers, investors, entrepreneurs, scientists and intermediaries. We conducted the interviews between May and October 2021 (complemented by one additional interview in May 2023). Considering the different

organizational backgrounds and fields of expertise, we tailored the interview guidelines in accordance with the interviewed actor groups (see **Appendix A1 Interview guideline**). The interviewees were informed prior to the interview that the interview will be audiotaped, transcribed and analysed. They had to sign a declaration of consent beforehand. See **Table 4** for a comprehensive overview of all interviewees.

Table 4. Overview of the interviewees

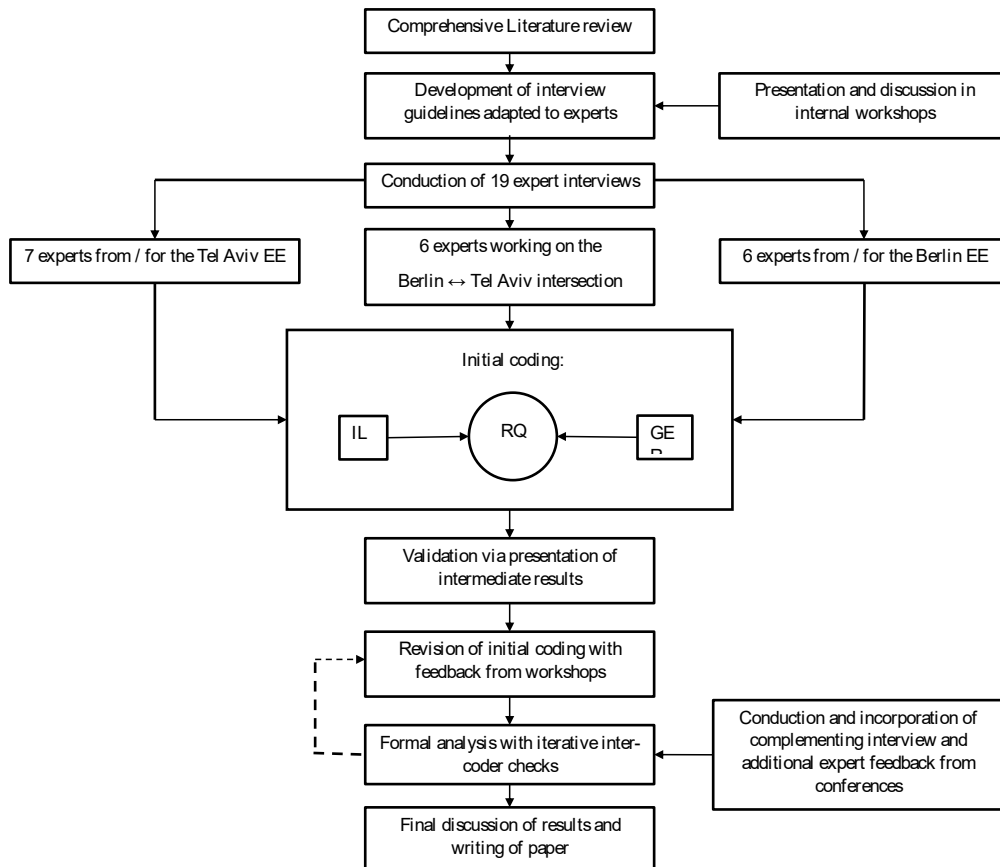
<i>No.</i>	<i>Abbreviation</i>	<i>Region</i>	<i>Organization type</i>	<i>Role in Organization</i>
1	I	Berlin	Start-up	Data Scientist
2	I	Jerusalem	LLC/ Profit/ Accelerator	Founder
3	G-I	Tel Aviv	Non-Profit Institution in Germany-Israel Exchange	Senior Executive
4	I	Frankfurt am Main	Profit	Managing Partner
5	G-I	Berlin	State-Company and LLC/ Profit	Head of
6	U	Berlin	Research/ Policy Consultancy in Germany-Israel Exchange	Research Associate
7	I	Tel Aviv	INC	Marketing Manager
8	I	Tel Aviv	LP	General Partner
9	I	Munster	PLC	Managing Partner
10	G	Jerusalem	Non-Profit Governmental Institution	Head of
11	G-I-U	Tel Aviv	Non-Profit Organization	Director
12	G	Berlin	Non-Profit Governmental Institution	Director
13	I-U	Tel Aviv	HEI	Vice Dean/ Professor
14	I-U	Munich	HEI Incubator	Consultant
15	G-I-U	Tel Aviv	Accelerator	Managing Director
16	G-I	Berlin	Registered Association in Germany-Israel Exchange	Project Lead
17	G-I-U	Eschborn	Registered Association	Project Lead
18	G-I	Tel Aviv	Non-Profit Organization	Partnerships Manager
19	G-I	Berlin	Public-private partnership	Area manager

Abbreviations:

G	Governmental actor
I	Industrial actor
U	University actor
Combination of G, I, U	Intermediary between the respective domains
HEI	Higher educational institution
INC	Incorporated business
LLC	Limited liability company
LP	Limited partnership
PLC	Public limited company

We recorded all interviews via online conferencing tools and transcribed them for analysis. We complemented our primary interview data by desk research of background information on each EE, a participatory observation during an on-site event that focused on valuable learnings from the Israeli EE for the German EE and experiences from temporary research stays in Tel Aviv and Berlin. See **Fig. 1** for an overview of the research process.

Fig. 1. Research flowchart (own compilation).



We followed Mayring's (2010) qualitative content analysis approach to code and triangulate the data in accordance with our research question (see **Appendix A2 Code system**). We began by analysing how each of the EE attributes defined by Spigel (2017) was discussed during the interviews. We focused on the special characteristics of sustainable start-ups leading to a higher or lower relevance of each particular attribute for fostering sustainability in comparison to other forms of innovative ventures (e.g., digital business models). After the initial round of coding, we presented and discussed the intermediate results in internal and external workshops with German and international scholars.

5. Results

This paper builds upon the EE attributes defined by Spigel (2017) to analyse their role in fostering sustainable start-ups. We present the empirical results in accordance with these attributes. **Table 5** provides an overview of the main results and representative quotes for each attribute.

Table 5. Relevance of EE attributes for fostering sustainable start-ups (own compilation)

<i>Attribute</i>	<i>Relevance for sustainable start-ups</i>	<i>Spatial aggregation</i>	<i>Representative quote</i>
Supportive culture	Supportive culture needs to incorporate the superordinate mission of sustainable start-ups to build legitimacy for sustainable solutions that are less attractive for entrepreneurs in regards of scaling up and for customers in regards of prices	National	‘You have to incorporate also the impact. You do not just need a business model but also an impact and that might restrain entrepreneurs because they want to scale up and develop something big quickly. And I think, the whole mindset is a very different approach.’ (17-G-I-U)
Histories of entrepreneurship	Failed support policies for similar industries in the past can lead to a lack of investment capital and entrepreneurs	National	‘After the failure of the solar industry in Germany, there was a long phase of crisis because there was a lack of investment capital because of the capital that many investors had lost. Many investors had reservations against cleantech because they learned from the solar industry that the Business Cases only worked with if they got funded. And many entrepreneurs left the field because they said due to the lack of capital and flagship projects, this is not attractive for me.’ (9-I)
Worker talent	Well-educated and SE-oriented workforce required for growth of SE ventures	Local	‘And Human resources. As soon as you have some money you can hire additional people – depending on what kind of start-up you are.’ (6-U)
Investment capital	Developing sustainable products is comparably expensive and time consuming and therefore needs specialized funding programs that support commercialization	National	‘So, the characteristic of one of the features of the cleantech sector is that you spend a lot of time with fundraising and trying to solve problems that are not related to the technology. The second thing is that there is a big hole from the proof of concept to commercialization, what is called the valley of death.’ (8-I)
Networks	Multiple mushrooming networks with similar topics that impede the development of higher impact by each network	Regional	‘And you have also new communities now managed by the Ministry of Economy dealing with Energy and Water resources. Sometimes I think there are more communities than technological initiatives. But they are very important because they initiate conferences and webinars and help people to get to know each other.’ (10-G)
Mentors and role models	Lighthouse SE ventures nudge an upsurge in interest and incentivize for further SE ventures	National	‘Meanwhile, there are successful flagship projects. One of them being the firm [start-up]. Luckily, we invested in them. They do battery banks for photovoltaic systems. They have been sold to [energy MNE] successfully and managed to become a world market leader in that segment. It was a great success story, at which many entrepreneurs look and say: ‘Okay that worked. Someone managed to build a big enterprise and the flagship shows that this sector works.’ (9-I)
Policy and governance	Nations in need to prioritize climate action as first mover to enable citizens towards sustainability orientation	National	‘Speaking a bit more in general, you need a stronger ‘Climate Leadership’. But if the countries do not commit to certain goals that are ambitious there can be no market drive, which says: ‘We really do have a vision for Israel. We will be climate neutral in 2050 and we have strong goals for 2030 regarding renewable and circular economy.’ If we had this, this would send a signal to the industry that certain solutions are required. And it is a shortcoming that Israel does not do that.’ (6-U)

Universities	Recursive technology transfer between universities and sustainability-oriented actors is time and resource intensive and requires special incentives that are not established yet	Regional	‘And we still have not really figured out how and in which governmental channels we can support these initiatives and encourage more research students to be involved in researching and developing their applied research. And this is still a challenge. We do that. We have a program that support younger start-ups. It is called [XY] and it is starting to work. But on this specific stage, which is the technology transfer from academia to industry, I think we still have some work to do there.’ (10-G)
Support services	Support services focusing on sustainable start-ups need to measure and report their contribution to sustainability which is difficult because there are no standardized methods	Regional	‘It is not only about measuring, but also reducing negative impacts on the environment. And it slowly arrives on the portfolio level but this is just the beginning. And if you do it, of course, you want to measure it, prove it, be able to illustrate it. Of course, that is the goal, but for today, if you ask me, it is basically zero.’ (12-G)
Physical infrastructure	In comparison to other (especially IT) start-ups, sustainable start-ups require access to high quality infrastructure to develop and test technologies	Local	‘But if you are not just a software start-up, you need huge plants. Maybe you need universities that have capacities or you need firms that are willing to invest in order to be able to experiment. And that takes time.’ (6-U)
Open markets	No particular relevance; Venture formation in general is way more challenging in smaller countries with negligible domestic markets	International	‘So, you in Germany have the luxury of a large domestic market so start-ups can choose whether they focus on the domestic market or they want to aim for America. They do not necessarily need to deploy to the US. But in Israel, it is different because we have a small domestic market and the expectation for start-ups, from investors and everybody they need to convince from day one, that they have a solution that fits the challenges of other markets.’ (8-I)

Abbreviations:

G	Governmental actor
I	Industrial actor
Combination of G, I, U	Intermediary between the respective domains
MNE	Multinational enterprise
U	University actor
US	United States of America

5.1. Cultural attributes: encourage entrepreneurs, customers and investors

Supportive culture

According to the interviewees, a *supportive culture* for sustainable start-ups seems relevant since the majority of investors and entrepreneurs strive for fast and high financial revenues without focusing on sustainability. Public awareness of sustainability combined with appreciating and encouraging entrepreneurial activities is beneficial in developing market frameworks, mobilizing venture capital (VC) and allowing sustainable start-ups to prosper.

‘Firms understand: if the customers demand and incorporate it [sustainability] in their buying decisions [...]. And that, in addition to the general urgency of the climate problem, which in our view has rather led to it becoming relevant for the consumer and the consumer passing on the pressure to the firms.’ (09-I)

Cultural change among consumers is needed to improve the acceptance of sustainable technologies. This is particularly important since early-stage technologies often lack attractiveness and certain prospective revenues for investors and consumers.

‘And also, that it is reasonably fast and that [...] the opportunity in the market or the window that opens up that does not then close again because there are often different speeds with which you have to deal. The large company can wait another two or three years and the start-up will already be bankrupt or the founders will then have to do something else.’ (17-G-I-U)

Notably, for Tel Aviv, the interviewees did not only address this topic in terms of one holistic *supportive culture* that supports all sustainability-related activities but also in particular cultures, namely a ‘solar culture’ or an ‘energy culture’.

Histories of entrepreneurship

Concerning *histories of entrepreneurship*, the interviewees emphasized the relevance of success stories of sustainable ventures to create dynamics that attract specialized national and international VC and skilled labour via increasing the popularity of sustainability-related topics. This process takes time, and sustainable start-ups have only recently gained public and political interest. In addition, it appears tough to build a momentum of change as long as other business models remain commercially successful.

‘Israeli start-ups in Tel Aviv are doing extremely well these days, breaking any record for fund raising. However, it is not the deal with environmental start-ups.’ (10-G)

Moreover, a repositioning of the Tel Aviv EE directed towards sustainability is discussed by the interviewees in the context of an international competition for VC attention. Interviewees discussed the need for a catch-up phase that is necessary because there are not ‘a thousand companies that went public from Israel’ (08-I). *Histories of entrepreneurship* are used to foster the ex-post construction of sustainability-focused rebranding to enable and accelerate this catching-up process.

‘[The] investors will invest only if there are enough things to show here and success stories [in Israel]. So, we need to generate success stories as well [...].’ (11-G-I-U)

In contrast, interviewees described the relevance of histories of entrepreneurship in Berlin by shifting the focus from past to future activities since failed support policies for renewable energy around 2010 caused withdrawals by both entrepreneurs and investors and led to negative connotations with sustainable technologies. This required time and funding programs to regain the motivation for resuming entrepreneurial activities and investments in sustainability.

5.2. Social attributes: Immature support measures

Worker talent

Interviewees discussed *worker talent* with regard to the degree of novelty of many sustainable technologies. A sustainability orientation leads to the necessity of retraining and recruiting personnel with updated qualifications, prompting a demand for customized curricula and educational initiatives. However, considering the global mobility of highly educated labour and the comparable demands of start-ups in other fields, interviewees from both EEs discussed this attribute subordinately.

‘[T]his means that the capacities and competencies are still being created at the moment. It is currently forward-looking because it is still developing.’ (14-I-U)

Investment capital

A prominent topic in the interviews was *investment capital* for sustainable ventures. Interviewees from both EEs emphasized the relevance of VC for sustainable start-ups, noting that focal technologies are often expensive. According to the interviewees, current investment decisions are based solely on key financial performance indicators and growth predictions. Interviewees suggested developing a ‘mapping with regard to the UN Sustainable Development Goals (SDGs) or certain environmental standards’ (06-U). Several interviewees criticized the restricted access to investment capital for sustainable ventures. This is not only limited to the existing evaluation routines but also to their complexity and uncertainty, which leads to a situation with ‘[...] only a small minority of impact-driven investors’ (1-I).

This results in a shared negative assessment of access to investment capital for sustainable start-ups in both EEs, albeit with distinct contextual differences. In Berlin, access to investment capital represents a primary challenge, reflected in the interviews through metaphors such as ‘the drought in the desert’ (04-I), but insufficient access to funding was not considered only for sustainable start-ups. Notwithstanding the

lack of particular programs for sustainable start-ups, the overall situation in Tel Aviv EE was described more positively.

‘And it looks like it is much easier to make money with an application to fund a restaurant in Tel Aviv or in Berlin than investing in a new solar technology [...]’ (08-I)

Public funding as a replacement for lacking investment capital offering tailored support for sustainable start-ups is important for both EEs. However, it is not perceived as a sufficient complement to private capital due to the prevalent regulatory framework. Specialized public programs are scarce and entail significant bureaucratic burdens for application and handling processes. Sustainable start-ups have to compete in general funding programs at the federal or European Union (EU) level.

‘For a start-up to get funded by Horizon Europe they need to hire someone, pay them a lot of money, so, they figure out what the hell can they do inside the programs.’ (11-G-I-U)

Networks

According to the interviewees, sustainability-oriented *networks* are required for sustainable start-ups to thrive. To establish such networks, it is important to build on existing start-up support structures. Several entrepreneurship networks are currently adopting or intensifying a focus on sustainability. As this adoption process is rapid, such networks are currently mushrooming in both EEs, leading to a confusing landscape, with many networks risking cannibalizing each other. In Berlin, interviewees held the federal structure responsible for this dispersed network landscape. To benefit from these networks, the orchestration of different actors is perceived as crucial to gathering sustainability communities.

‘In the Energy industry for example there is a network called [X], an energy network, but now I heard there will be a new one called [Y] or something like that, and I think: ‘Erm, are you creating competition among each other?’ I don’t understand that.’ (6-U)

Role models

The existence of *role models* was considered a pivotal determinant of fostering sustainable start-ups. Notwithstanding the high relevance that interviewees from both EEs ascribed to actors who are able and willing to support others, they remain scarce. So far, this support has relied on a few actors rather than comprehensive mentoring support. Experts from both EEs value the respective support systems as underdeveloped compared to other ones.

5.3. Material attributes: Intensified demand for support

Policy and governance

The provision of comprehensive *policy and governance* support for sustainable start-ups was a topic of intense discussion during the interviews. Experts from both EEs criticize current strategies for showing too little commitment. One interviewee articulated that ‘[...] cleantech is not sexy enough, strictly said. And the government has to get involved with funding programmes.’ (5-I)

Interviewees see the need for impulses from governmental actors to overcome barriers in terms of resources and infrastructure. In Berlin, interviewees attest to a focus on start-ups in the e-commerce sector, which they believe is stifling entrepreneurship and encouraging imitation. It would require more steering to foster alternative topics.

The policy and governance discussion in Tel Aviv focused on a broader political context. Ongoing conflicts hinder the development of support-intensive sustainability sectors. For instance, budgets for sustainability projects had been suspended before upcoming re-elections. Further, the Israeli EE is steered by successful incumbent actors with particular interests in fossil fuels and ‘[...] no strong environmental voice. There are always other topics that have priority.’ (06-U)

Interviewees highlighted the need for policy guidelines and regulatory frameworks to boost ‘entrepreneurial leadership’ (06-U) for sustainability. In this context, policies supporting sustainable start-

ups require incentives for science, firms, investors and entrepreneurs. Moreover, policy actors have a pioneering task by acting as role models, incentivizing sustainable start-ups and addressing local and regional challenges.

Universities

Universities represent an important factor in fostering sustainability by providing and organizing sustainability-focused technology transfer and spin-off programmes. Interviewees emphasized their ‘role in solving the big problems of humankind’ (08-I).

Israel sticks to academic freedom and limits its support to financial aid.

‘Did I mention that in our main programs that are ongoing and are successful today, unfortunately, academia is not a big part of that [in Israel]. [...] Their approach is that it is not right to earmark specific research areas through these very early stages of innovation. [...] We see that academia should be completely free. And you know, we should not channel research to a specific area. So, this is why unfortunately today, they are not much involved.’ (10-G)

In Tel Aviv, universities tend to play a less active role in chasing sustainability-related topics (10-G). In the opinion of the interviewees, universities in Berlin follow a more proactive approach to promoting sustainability.

‘Of course, [universities] play [...] a very central role, especially in the CleanTech area, because [it] requires a lot of preparatory technological work. A large proportion of cases can only happen at universities or research institutions. Sometimes it can also be done outside, but really fundamental innovations can only happen there because it simply takes a long time, a certain infrastructure et cetera. And that is only possible to a very limited extent in the private sector and, as a founder, I would say often, in many cases, not at all.’ (09-I)

Support services

Support services mainly provide information to enhance the connectivity between entrepreneurs, VCs and knowledge providers. The interviewees emphasized two challenges in working with support services. First, the diverse scopes and needs of sustainable start-ups complicate the provision of tailored support. Growing interest in the topic has led to a multifaceted support landscape that overstrains entrepreneurs searching for support.

‘[W]e [in Germany] have a tangled mass of hubs and accelerators. In one federal state, we have a national, a federal and a private hub and it is very confusing for external actors.’ (3-G-I)

One interviewee suggested establishing a ‘grand challenges centre’ (05-I) to address topics across industries and superordinate challenges. Second, robust indicators capable of monitoring and evaluating the effects of support services are missing. Many programs still use indicators, such as the number or commercial success of new ventures, without measuring their sustainability impact. Some programs use the SDGs for evaluation, but interviewees argue that innovative firms and technologies can meet the ‘Black and White’ (12-G) criteria even without focusing on sustainability.

Physical infrastructure

Interviewees in both EEs discussed *physical infrastructure* mainly regarding the costs of plants and testing facilities and emphasized the need to access incumbent-owned infrastructure or universities because the required equipment is expensive compared to e-commerce and digital ventures succeeding through business model innovation. The free or low-cost provision of space and machinery by industrial and scientific intermediaries is considered a crucial offer and is perceived to decide over the survival of sustainable start-ups.

‘[If] you are not a software start-up, you need huge facilities. Then you need universities that have the space or the firms that provide money to experiment.’ (06-U)

Open markets

Interviewees pointed out different contexts in Tel Aviv and Berlin. In Berlin, the discussion is shaped by participation in domestic and EU markets, while Tel Aviv is in a small country relying on foreign capital and knowledge resources. For instance, one interviewee in the Israeli EE explained: '[...] it is tough to be in Israel [...] to scale up a company. So, this is the reason why I am eager to find big European leaders and partners' (8-I). Moreover, cooperation with direct neighbours is difficult in Tel Aviv due to political isolation. However, open markets develop at the current stage similarly in comparison to other start-up domains.

6. Discussion

6.1. EE attributes determining the success of fostering sustainable start-ups

Our results corroborate the explanatory value of cultural, social and material attributes as central constituents of EEs for promoting sustainable start-ups (Cohen 2006; Tiba, van Rijnsoever, and Hekkert 2020) and functioning as institutional guardrails (Hoogendoorn, van der Zwan, and Thurik 2019; Steinz, van Rijnsoever, and Nauta 2016). The coherent investigation of individual attributes implies several extensions to the current understanding of how EEs can foster sustainable start-ups.

Cultural attributes are essential to stimulating a mutual understanding of sustainability. They help overcome reservations among investors and customers. Their relevance stems from the specific characteristics of sustainable start-ups and the perceived lack of commercial attractiveness compared to other types of ventures. Fostering sustainable start-ups requires the intrinsic motivation of entrepreneurs, investors and customers building upon positive examples.

Social attributes build upon the cultural alignment towards sustainability and target the acceptance and profitability of sustainable ventures. This requires the education and attraction of a suitable workforce and the mobilization of investors, mentors and functioning networks.

Material attributes are required to meet the comparably high resource demands of sustainable start-ups. This requires policy support in terms of public funding and connectivity to academic providers of knowledge and infrastructure. In particular, earlier sustainable start-ups depend on partners that support technology and business model development. Proposition 1 reflects these specific needs emanating from the particularities of sustainable start-ups.

Proposition 1. *Sustainable start-ups differ from other types of entrepreneurial ventures in terms of their need for EE configuration. Being perceived as less commercially attractive, sustainable ventures require special support instruments and structures that consider the effects of previous policies and events and address the development of a sustainability-oriented entrepreneurial culture.*

6.2. Spatial integration of EE attributes

During the interviews, it became apparent that despite their relevance for sustainable start-ups, some attributes can hardly be steered on a regional level and necessitate a more nuanced spatial perspective. Opportunities to configure *cultural attributes* on a regional level are limited. Cultural attributes are path-dependent and reflect stakeholders' prior political and societal experiences. To compete with other entrepreneurial subsystems, a nascent SEE requires a coherent and positive story to tell, including particular cases, as well as general sustainability-aligned practices from the recent past. The topics discussed imply that these cultural premises cannot be steered on the regional level but represent the result of societal processes. This connects, for instance, to Fukuyo (2015), who highlighted a growing interest in renewables and the importance of end consumers in the Japanese energy market after the 2011 nuclear disaster. Bischoff (2021) highlighted the force of entrepreneurial and sustainability culture for sustainable ventures to thrive within an EE by including different spatial levels that match the demands of specific cultural attributes.

Social attributes require a detailed strategy that surpasses the boundaries of an EE. For instance, *worker talent* depends on the specific needs of a sustainable venture and thus has local relevance. *Networks* are mainly driven by regional initiatives, enabling sustainability-oriented actors to create momentum. By combining different locations and networks, a larger support structure for sustainability initiatives can be established. This supports the findings of DiVito and Ingen-Housz (2021), who observed the power of cooperative activities leveraging sustainability orientation within an EE.

Likewise, *material attributes* require integration into the sustainability support landscape on different spatial levels. A certain strategic sustainability alignment in policy and governance is needed. *Universities* act as knowledge sources and initiators for sustainable start-ups. The orchestration between policy support and academic programs for sustainability has to be tackled on a regional level in order to be effective. The recent upsurge in interest in sustainable start-ups has slowly translated into a higher demand for sustainable technologies. This supports the findings of Ball and Kittler (2019), who investigated support structures for sustainable start-ups and showed that policy and governance help overcome “environmental market failure [...] [and] entry barriers” (p. 840).

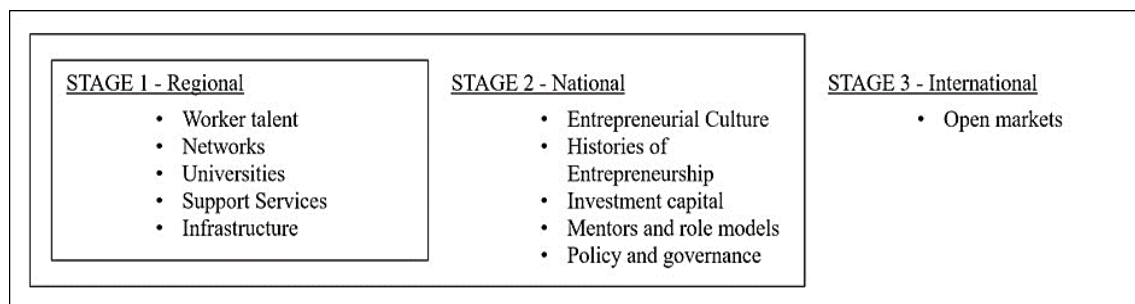
Scholars have recently started to assess the explanatory power of incorporating several spatial levels of analysis. Building upon a qualitative single case study of an incubator and its embeddedness in the surrounding EE, Theodoraki and Messeghem (2017) distilled three functional, overlapping subsystems and noted that different factors affect different subsystems. Accordingly, an EE can be divided into one micro-level that describes a single incubator, one industry-based meso-level and a rather conceptual macro-level. Responding to Cavallo, Ghezzi, and Balocco’s (2019) call for research on identifying the optimal level of EE analysis, our results corroborate the suggested differentiation between subsystems and enrich it with an in-depth analysis of individual attributes forming the institutional environment. Moreover, our results support Theodoraki and Messeghem’s (2017) call for an integrated approach that takes into account several spatial and organizational levels and neither abandons nor exalts the prevalent local perspective. Proposition 2 reflects this need for spatial differentiation.

Proposition 2. *Analysing an EE’s conduciveness to sustainable start-ups requires the comprehensive incorporation of different spatial levels. Several relevant attributes (e.g., supportive culture) cannot be steered on a regional level and need to be investigated and designed accordingly.*

7. Conclusion

We address the question of how well a region’s institutional framework is equipped to foster sustainability by assessing the specific needs of sustainable start-ups. By perceiving Spigel’s (2017) EE attributes as the institutional environment, we provide a conceptual framework for the different capabilities of EEs to foster sustainable start-ups. By testing it, we provide an empirical starting shot for the assessment of EE attributes as sustainability drivers.

Fig. 2. Tentative suggestion of analysis stages for EE attributes (own compilation).



From a policy perspective, these contributions imply a need for policymakers to create holistic approaches that consider the multifaceted institutional constituents and success determinants of sustainable start-ups. In this regard, EE attributes can provide helpful guidance in designing new instruments. For instance, extensive investments in physical infrastructure and financial incentives might fail if comparable recent policies fail. EE attributes can function as an empirical toolbox to understand the status quo on different spatial levels and to identify prospective transition pathways.

From a scholarly perspective, our mix of deductive and inductive steps of analysis yields two main implications for further investigation of this toolbox. On the one hand, the indicated applicability of EE attributes to sustainable start-ups calls for more in-depth analyses of EE attributes and their effects on the institutional support of sustainable start-ups. On the other hand, the emphasis of different spatial aggregations on which EE attributes unfold their relevance questions approaches that analyse EEs as monolithic, regional entities. In contrast, our results imply the need for novel approaches that distinguish between different spatial levels. **Fig. 2** illustrates a tentative suggestion for spatial levels of analysis for different EE attributes. Based on the results of an exploratory qualitative study, these suggestions are the first hint for more in-depth studies on the role of particular EE attributes.

Speaking of shortcomings, we focus on two mature metropolitan EEs. Working towards generalizable results requires approaches that incorporate EEs of different stages and types of regions. In particular, the attributes unfolding their relevance on a regional level may demonstrate varying levels of relevance or manifest in unique ways. Furthermore, our analysis focuses on one well-adopted selection of EE attributes by Spigel (2017). Notwithstanding the proven reliability of this framework, we acknowledge that other frameworks (e.g., Stam and van de Ven 2021) suggest different attributes that might be applicable to questions regarding the promotion of sustainable start-ups as well. Identifying the most pertinent and significant attributes to analyse EEs' conduciveness to sustainable start-ups requires testing and comparing more and other attributes.

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Declaration of interest

The authors report there are no competing interests to declare.

Data Availability

The data that support the findings of this study are available from the corresponding author, LJ, upon reasonable request.

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Appendix

A1. Interview guideline

Section	Questions
<i>Section 0: Introductory questions</i>	(1) Please briefly describe your function in [X]. (2) What is your and your X's understanding of cleantech?
<i>Section 1: Organizational structures and characteristics</i>	(1) Please describe the main business of [X]. <ul style="list-style-type: none"> (a) Which goals regarding start-up activities have you already been able to realize in [X]. (b) How are business partners selected? (c) Which target group are your activities aimed at? (d) How many start-ups do you support? <ul style="list-style-type: none"> • How many of them belong to the cleantech sector? • How do you support the start-ups? • How do you decide on the resources you provide the start-ups? • Which programs do you have to support start-ups?
<i>Section 2: sustainability</i>	(1) What role does sustainable development play for [X]? <ul style="list-style-type: none"> (a) Has the role of sustainable development changed over the years? (2) Which contributions to sustainable development do you see through your activities and the resulting start-ups? <ul style="list-style-type: none"> (a) Are there any conflicting goals between your activity and other actors in the cleantech entrepreneurial ecosystem?
<i>Section 3: process and network description</i>	(1) Please describe with an example how start-up support takes place in [X]. <ul style="list-style-type: none"> (a) [Process description] (2) Which role do [other EE constituents] play? <ul style="list-style-type: none"> (a) To what extent are there any collaborations? (3) What role do communication skills and networks play?
<i>Section 4: the entrepreneurial ecosystem</i>	(1) Please describe particular features of the entrepreneurial ecosystem in [X's region]. <ul style="list-style-type: none"> (a) Which differences exist in the opposite country (IL or GER)? (2) Please describe what needs to be in place in an entrepreneurial ecosystem to support a start-up like it is in [X's region]. <ul style="list-style-type: none"> (a) [Characteristics of the region, actors, university/government related organizations/industry as a particular actor, same experiences, same goals/values, proximity] (b) Outside of [X], who else in the region is active in start-up activities besides you? (3) What are the barriers to start-up support in Tel Aviv? <ul style="list-style-type: none"> (a) What barriers do your activities address? (b) What would be conducive? (c) What barriers can be removed over time? (4) What are the barriers to start-up support in Tel Aviv? <ul style="list-style-type: none"> (a) Regarding: networks, government support of start-ups, science in cleantech sector.

A2. Code system

Created with Microsoft PowerPoint.

