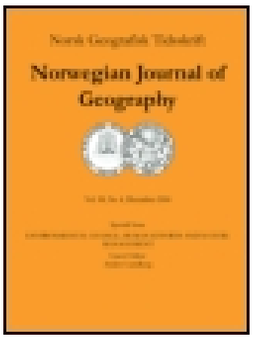

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Determinants of responsible innovation for sustainability transition in a developing country: Contested narratives for transition in the Sri Lankan power sector

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ABSTRACT

Global efforts towards sustainable energy transition remain uneven. Developing countries are embedded in a vulnerable setting requiring rapid but responsible action to meet increasing energy demands due to their specific projected economic and population growth. Consequently, such countries have addressed the challenges of achieving sustainable energy transition differently compared with developed countries with regard to renewable energy development and its governance. Theories of sustainability transition and responsible innovation (RI) have their origin in developed countries, and the application of this Western-centric version has been found incompatible with the contexts of developing countries. The aim of the paper is to explore how contextual understandings of RI are discursively constructed and how such understandings enable or constrain sustainable energy pathways in developing countries. The author draws on empirical evidence relating to the power sector in Sri Lanka and analyses three narratives in play revealed by a qualitative case study. The findings indicate that developing countries must place greater emphasis on aligning technological innovation systems with RI in efforts to achieve sustainability transitions by being vigilant with regard to contextual narratives on RI. The author concludes that prevalent narratives should be regarded as a bridge for linking sustainability transitions to RI.

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Introduction

Research, innovation, and investments are vital for our efforts to respond to climate changes. The efforts have to be global, too, to bring about rapid radical structural transformation by employing low-carbon technologies (Gül 2020). In this global effort, developing countries have shown slower progress in their transition process as a result of them being embedded in more vulnerable settings with economic constraints, survival priorities, and inadequate and restrictive governance mechanisms (Walsh & Hallegate 2019; Saculsan & Mori 2020). However, they need rapid production of energy to meet their increasing energy demands arising from projected economic and population growths and priorities (OECD & International Energy Agency 2011).

The literature on sustainability transition, with its roots in the Western context, presents analytical frameworks that conceptualise sustainability transition as major structural changes. Authors advocate a shift to a new system requiring systematic long-term co-evolutionary processes with the involvement of many actors and sectors, leading to fundamental restructuring of production and consumption in societies (Farla et al. 2012). Two examples of such analytical frameworks are the multilevel perspective (MLP) (Geels 2002) and the technological innovation system (TIS) (Hekkert et al. 2007; Bergek et al. 2008). Scholars have also emphasised the need to expand the geographical scope of sustainability transition research to gain a richer understanding of how transitions unfold across different geographical contexts and the reasons

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why transition successes and failures are context-dependent (Lachman 2013; Herman 2021; Wang & Lo 2021) by calling for more sophisticated empirical research and appropriate analytical frameworks for developing countries (Sovacool 2014; Wang & Lo 2021).

Responsible innovation (RI) is a Western-centric construct. RI emphasises the ethical and societal benefits of making innovation more responsible (Macnaghten et al. 2014). In RI, the public, political processes, and institutions are routinely and systematically attentive to and responsible for political and social aspects, while also addressing institutionally defined priorities, values, and concerns (Owen & Pansera 2019; Owen et al. 2021). The effectiveness of directly transposing such a Western-centric approach to the Global South cannot and should not be taken for granted (Macnaghten et al. 2014). Countries in the Global South have different sets of debates centred on their own needs and priorities, their contexts differ from those in the Western world, and they rely on external support for technologies, innovations, and investments to enable transitions (Theiventhran 2022), thus making innovations in sustainability transition new to their place rather than radical innovations (Edsand 2019). Furthermore, countries in the Global South differ from those in the Global North with regard to their institutional architecture, energy trajectories, sociotechnical order, governance, and approaches to sustainability transitions (Macnaghten et al. 2014). Given the focus on sustainability transition in this paper, the word 'responsible' is applied to include a collective duty to give consideration to potential impacts when introducing renewable technology, such as for the supply and distribution elements comprising accessible, affordable, and reliable energy.

When introducing and expanding new technologies to a country, engaged stakeholders significantly influence the decision-making process, which means their views, perceptions, and actions regarding innovation and energy trajectories are decisive for policy decisions (Reusswig et al. 2018; Komendantova 2021). It is therefore necessary to understand existing tensions between different narratives within the energy sector that influence the energy trajectory. The term 'narratives in play', which was introduced by Fløysand & Jakobsen (2017), is used in this paper because it relates to existing and emerging discourses that influence stakeholders' behaviours, actions, decision-making processes, investment decisions by firms, and ultimately innovation and the energy trajectory of a country.

This paper focuses on developing countries or, more broadly, the Global South (the non-Western nations). I question the current dominant Western-centric discourse and its global approach to addressing climate change and facilitating sustainability transitions. Greater emphasis should be placed on aligning a TIS with RI in efforts to achieve sustainability transition that befits the specific context of developing nations. The empirical evidence required to substantiate this link is drawn from an investigation of the power sector in Sri Lanka.

Sri Lanka, with its commitment to becoming carbon-neutral by 2050, is yet to achieve its distribution elements. Among other reasons, there is dissonance between the country's acceptance of the necessity to invite private investment for clean energy transition and the offer of a suitable environment for rapid and successful investment through investor-friendly pathways, processes, and governance (World Bank 2019), which could expedite the process. I answer the following research question: *How is RI understood in processes of sustainable energy transition in Sri Lanka, and how does this understanding inform sustainability transition theory?*

I first describe the theoretical underpinnings of the study on which this paper is based by elaborating how sustainability transition and RI can be made more context-sensitive by aligning them with narratives in play. Thereafter, I outline the methodological choices and considerations. In the empirical section, the narratives in play are evinced through three different contested narratives that emerged from interviews with groups of key stakeholders. Following a discussion of the findings from the qualitative case study, I present my main conclusions.

Theoretical framework

Sustainability transition

Global effort is required to expand research geographically in order to capture the different microlevel nuances involved in shaping energy transitions. The literature on sustainability transitions, which has its roots in the Western context, presents theoretical frameworks conceptualising long-term energy transition governed through radical transformation in existing carbon-intense systems. The most widely used analytical frameworks are the multilevel perspective (MLP) (Geels 2002) and the technological innovation system (TIS) (Hekkert et al. 2007; Bergek et al. 2008).

Innovation, whether heralding radical change to the world or bringing existing technology or practices to new locations, is held to be the cornerstone of sustainable change (Markard & Truffer 2008). Furthermore, sustainability transition studies consider that mature

and stable old technologies have been at the centre of analyses, even though novel technologies capture the focus of sustainability transitions (Markard & Truffer 2008). The TIS framework, which is centred on technology, has been used to study long-term technological change and is often applicable across geographical boundaries (Hekkert et al. 2007). It also focuses on the following: the interaction between actors, institutions and networks; the interplay between seven key functions of an innovation system described in detail by Hekkert et al. (2007) and Bergek et al. (2008); and the diffusion and use of established technologies (Markard & Truffer 2008), which is the case in developing countries. Importantly, a TIS also involves framing, lobbying, and legitimising technology, both attracting support for it by states with conducive policies and enabling engaged stakeholders to succeed in attracting further investment (Njøs et al. 2020). Despite being criticised as being too inward-looking and paying less attention to contexts (Markard & Truffer 2008, 610), I nevertheless consider the TIS framework appropriate for this study of a developing country in light of the above-mentioned attributes.

Technology for sustainability transition needs to be developed within the appropriate context in order to bring about discernible and beneficial changes that are acceptable to society. However, Hekkert et al. (2007) note that the focus on innovation systems is primarily on analysing the speed and direction in bringing about technological change, and the activities that foster or hamper innovation. Thus, such an approach neglects the contextual distinction and inadequately prioritises a responsible two-way communicating process between the technology and the context.

In this paper, I regard context as a 'setting' moulded by political, economic, social, cultural, and environmental structures; hence, the context is embedded within these contextual complexities. Decision-makers and implementors respond and give credence to such complexities by being responsible and accountable, ensuring that the complexities are taken into account, while also being conscious of not triggering new inequalities and injustices (Wang & Lo 2021) when employing either new or relatively new technologies. Thus, to be responsible, innovations and technologies are developed by taking into consideration that the individual country context is important, but they also need to inspire the trust of private, public, academic, and society actors through appropriate dialogue, negotiations, and expositions. Furthermore, technological development means that the new technologies must be sustainably built in a responsible manner and resilient for the long-term.

Carlsson & Stankiewicz (1991, 111, original emphasis) define a technological system 'as a network of agents interacting in a *specific economic/industrial area* under a particular *institutional infrastructure* or set of infrastructures and involved in the generation, diffusion, and utilisation of technology'. The functionality and effectiveness of technological change involving a TIS can be measured through the seven functions of an innovation system that consists of both individual and collective actions (Hekkert et al. 2007; Bergek et al. 2008). As TISs in developing countries has focused on the formative stage of innovation and been mainly influenced by the exogenous contextual factors affecting the absorption, growth, and diffusion of those TISs, wider contextual analysis is required than has hitherto been done (Edsand 2019). For developing countries that leapfrog with imported technology, functionality is about understanding the capability of the country to receive the technology successfully (Edsand 2019). Additionally, they need to attract entrepreneurs and investors to bring in and legitimise the technology in order for the technology to grow and diffuse. Two among the seven TIS functions described by Hekkert et al. (2007) and Bergek et al. (2008), *entrepreneurial activities* and *legitimisation* play key roles in the absorption and growth of a technology in a developing country. *Entrepreneurial activities* involve the crucial role entrepreneurs play in developing an innovation system by bringing in technology though market opportunities. Through societal support, *legitimisation* helps to achieve broad acceptance and compliance with relevant institutions (formal and informal rules), government, research, and industry actors. Therefore, it is vital to conceptualise how a technology is absorbed and placed within the context of a developing country characterised by its intricate social, economic, political, and cultural factors, while also giving consideration to the mechanisms that hinder its progress. The relationship between both technology and innovation and the contextual environment can be challenging. Consequently, the innovation process has to be an interactive, reflexive, and transparent operation with a conciliation mechanism. Njøs et al. (2020) highlights the existing gap in TIS literature as the failure to engage sufficiently with narratives to understand the dynamic interplay between the different functions of TISs. The aim of this paper is to fill this gap by engaging with the narratives in order to gain a better understanding of the context of responsible absorption of technology.

Responsible innovation as a topic of discourse

The responsible innovation (RI) policy discourse emphasises the importance of aligning research and innovation to the values, needs, and expectations of

society and ensuring sensitivity to societal values in innovation process (Owen et al. 2021; Stahl et al. 2021; Rödl et al. 2022). The discourse also underlines the need to anticipate both positive and negative societal impacts of innovation and to take actions to mitigate the latter in an ethically acceptable and socially desirable way (von Schomberg 2013; Macnaghten et al. 2014; Fløysand et al. 2021). The purpose of RI is to create spaces for discussions of aspects of innovation that are of public interest or concern, with the aim of 'taking care of the future through collective stewardship of science and innovation in the present' (Stilgoe et al. 2013, 1570). Therefore, by advocating 'forward-looking approaches, methods and frames of reference for reflecting on the societal impact of research and innovation' (Fløysand et al. 2021, 3), RI can be considered a topic of discourse. For example, the governance of emerging technologies has been placed at the core of RI, thereby emphasising the inclusion and participation of all affected stakeholders (government, academia, industry, civil society) of innovation and having a collective responsibility to reflect more appropriately on the values and interests of the wider group of actors instead of only promoting the technology per se (Vasen 2017). The RI discourse also highlights that the dissemination and social appropriateness of emerging and mature technologies are not solely about the economic dimension; importantly, they include the appropriate placement of the technologies within all sectors of society (Vasen 2017). Therefore, RI not only attempts to understand the complexities of the contexts in which innovation occurs, but also acts as a 'double feedback loop' to inform those responsible for innovation and technology about the most responsible way to proceed, given the fact that societal aspects always exist in the context and that those contextual underpinnings need to be explored and absorbed.

Scholars have cautioned that RI frameworks focus mainly on emerging technologies, based on a European set of institutionally defined priorities, values, and concerns (Macnaghten et al. 2014; Vasen 2017). Notably, the risks, uncertainties, unintended consequences, and challenges of aligning technology with societal expectations are not limited to emerging technologies. They also exist for proven and mature technologies that are new in a place. These barriers are more conspicuous in the context of developing countries, where technologies are imported from elsewhere and allied investors and developers are typically uninformed about such barriers to the successful absorption, maintenance, and adoption of technology change, as well as societal expectations concerning acceptance. These requisite factors remain relatively unexplored. The RI discourse and its functionality as a double feedback loop help understand real world complexities and to inform and negotiate societal expectations with the technology developers and stakeholders as to how well the technology can be absorbed and placed within a given society.

Thus, the RI discourse needs to be translated beyond the Global North by engaging with the Global South to achieve suitable, bespoke frameworks that befit the nuances of the geographical context in question (Macnaghten et al. 2014; Vasen 2017). Such an outcome depends on dialogue between the Western-centric approaches and the sustainability transition agenda of developing countries, especially to align with United Nations Sustainable Development Goal 7: 'Ensure access to affordable, reliable, sustainable and modern energy for all' (United Nations n.d). Through such dialogue and outcomes, the differentiated needs and the significant heterogeneity of such countries could be addressed.

Narratives in play

There has been limited research to date to achieve a link between TIS and RI frameworks. Also, the way that innovation systems' structures and functions can be reconfigured remains unexplored (Owen & Pansera 2019). In this paper I attempt to show that fusion between the TIS and RI frameworks is important and that narratives in play can be the link to achieve such fusion (Fig. 1).

Enriching TIS through RI necessarily involves engaging and acknowledging the narratives that inform an understanding of the existing tensions among stakeholders in moving towards a sustainable energy pathway. However, RI norms and values are not explicitly visible in the actions of key stakeholders but are often reflected or implied through their claims and statements related to what they perceive as the right energy pathway for their country. Thus. it is important to understand the narratives used by key stakeholders and the established deep-rooted practices that influence innovation processes in countries. Such prevalent narratives, rules, and practices may influence and even undermine and/or dominate innovation and technology development, in turn leading to a particular energy technology to be absorbed and accepted, while overriding stakeholders with other

Fig. 1. Centrality of narratives in the link between sustainability transition and responsible innovation.

justified and legitimate but conflicting and contesting details and facts.

Analysing narrative in play and absorbing their meanings through engagement in discourse can help us to understand how contextual factors impact RI for sustainability transition, as shown in Fig. 1. Discourse is seen as a structure for producing shared meaning related to a phenomenon that shapes the perceptions and practices of people, whereas narratives are specific perceptions or modes of explanation promoted by an actor or group of actors within a particular discourse (Fløysand et al. 2021, 4). Thus, a discourse is built on the back of many narratives. The use of narratives in energy transition to achieve a low-carbon future is expanding (Veland et al. 2018). However, competing multiple narratives within debates create tension, leading to narratives by powerful stakeholders dominating, influencing, and/or reinforcing a nation's energy pathway and precipitating path-dependency.

Methodology

This article is based on a qualitative study in which a case study approach was adopted, with an exploratory and descriptive research design focusing on the Sri Lankan power sector. Data collection was done using semi-structured interviews, document reviews, and participant observation. Interviews were held with stakeholders engaged in the Sri Lankan power sector in the following categories: public sector, private sector, and academics and experts specialising in energy.

Initially, potential Sri Lankan key informants for the interviews were identified via local media channels, and one potential interviewee was identified at an international conference on renewable energy held in Sri Lanka, which I attended in February 2019. Thereafter, I used snowball sampling to find more stakeholders to interview. A total of 41 interviews were held: 14 with public sector stakeholders, 15 with private sector stakeholders, and 12 with academics and energy experts. Of the 41 interviews, 29 were face-to-face interviews conducted during the fieldwork in Sri Lanka from November 2019 to February 2020 (i.e. four months in total). Due to travel restrictions relating to the COVID-19 pandemic, 10 interviews were conducted online via Zoom meetings and 2 through email exchanges from Norway during the period August 2020 and March 2021. I am a member of a research collaboration project between Norway and Sri Lanka, which consists of Norwegian academic and industrial partners: Capacity Building and Establishment of a Research Consortium (CBERC). The project is run jointly by the Western Norway University of Applied Sciences and the University of Jaffna, Sri Lanka, and is funded by the Royal Norwegian Embassy in Colombo, Sri Lanka; the project period is 2017–2022. A total of 10 Norwegian stakeholders were identified through both the collaboration and networking. Interviews were held with Norwegian stakeholders in only two of the three categories, namely the private sector, and academics and energy experts.

Each interview lasted 15–120 minutes and covered questions relating to the study objectives, as well as to the energy sector, governance, commitments towards renewables, opportunities, barriers, and the way forward in Sri Lanka. All interviews except three were voice recorded and then simultaneously transcribed and translated from the local languages into English. Document reviews were conducted of strategic documents from the Asian Development Bank, the World Bank, and the United Nations, as well as annual and evaluation reports, plans, newspaper articles, government institution reports, and websites that all related to Sri Lanka. Additionally, during the fieldwork, participant observation during three site visits (coal power plant, floating solar launch, and off-grid hybrid power plant), as well as participation in two conferences and one talk, all of which related to renewable energy development in the country, provided insights into the complexities of implementing different energy technologies in Sri Lanka. The fieldwork in Sri Lanka was stopped when no new data or no new themes emerged, meaning data saturation had been reached (Fusch & Ness 2015).

As the study focused on narrative analysis, the stakeholder's commonalities in arguments and claims were built into three different narratives for analysis and discussion. The document sources were initially used to understand the energy sector and the related challenges and subsequently to validate the interviews. When going through the interview recordings and transcripts and between documents and interviews, the process was iterative. However, in the absence of sufficient or updated information in existing documents, the analysis relied on interviewees' claims and observations.

Narratives in play in the power sector in Sri Lanka

The Sri Lankan power sector

Sri Lanka is a signatory to the Paris Agreement (United Nations Framework Convention on Climate Change n.d.) with a commitment to achieve carbon neutrality by 2050 (Presidential Expert Committee 2019). Compared with other South Asian countries, Sri Lanka remains relatively better off in terms of electric energy access. In 2016, 99.3% of the Sri Lankan population

had access to electricity from the national grid, with a per capita electricity consumption of 651.8 kWh per annum (Central Bank of Sri Lanka 2020). In 2019, the country's population was 21.8 million, and as the country covered 65,610 km^2, its population density was 350 per km^2 (Central Bank of Sri Lanka 2020). The island has a tropical climate, which is influenced by monsoon winds.

As an island nation, Sri Lanka has a small isolated electric grid, a night peak load, and a localised energy system to manage its domestic power production and consumption. The geo-climatic setting of the island is particularly conducive to harnessing its indigenous energy sources of biomass, hydro, solar, and wind power, yet the country remains totally dependent on imported coal and oil for power generation, which strains the country's foreign exchange reserves. The electricity generation mix consists of 36.6% coal, 26.6% oil, 24.9% hydro, and 11.9% from non-conventional renewable sources (Central Bank of Sri Lanka 2020, 80). Electricity demand is projected to increase by 4.9% annually (Ceylon Electricity Board 2019).

The history of Sri Lanka's power generation dates back to the British colonial period when mini hydropower fulfilled the energy requirement for motive power and in-house lighting for the large-scale tea factories. Hydropower, which was then the only indigenous energy source, accounted for the largest share of electricity generation through major hydropower projects until 1996, when the electricity sector switched from a predominately hydropower system to a mixed hydro-thermal power system. The accelerated electricity demand, in tandem with rapid economic growth and severe droughts, led to capacity additions with thermal power plants as the potential of nation's hydropower resource diminished. Initially, the then state-owned Ceylon[1] Electricity Board (CEB) was the sole entity engaged in power generation, transmission, and distribution until 1996, when private sector investors were commissioned to build, own, and operate small power plants to generate renewable energy and sell it to the sole buyer (CEB) with a feed-in-tariff. Portfolio diversification in energy supplies provided opportunities for local and global investors and developers to promote renewable energy technologies, particularly solar and wind. Faced with capacity shortage, the country has recently commissioned new technology power plants (Asian Development Bank 2019).

Historically, public financing paid the CEB for the purchase of power plants. By contrast, non-conventional renewable sources, including wind and solar power, are typically financed through either private sector participation or international financing (World Bank 2019).

The narratives on sustainability transition

The Sri Lankan power sector trajectory towards sustainability transition is a contested phenomenon. Based on the interviewees' statements, these contestations can be interpreted as three different narratives in play:

1. The *policymaker-centric sustainable energy development narrative*, which highlights that Sri Lanka's sustainable energy development is about providing affordable and reliable power supply, and requiring fossil fuel to play a key role in the power sector trajectory.
2. The *professional-centric sustainable energy development narrative*, which calls for a timely shift to exploit the island's abundant sources of solar and wind power with the assistance of foreign and local capacities and resources, but which identifies the vital need for knowledge incorporation.
3. The *investor-centric sustainable technology development narrative*, which emanates from investors and developers.

The energy sector's conundrum is related to the direction of movement (trajectory) towards renewables. This is unveiled by the first two well-established narratives (i.e. policymaker-centric and professional-centric), which fundamentally influence meanings and understandings of the concepts 'responsible' and 'sustainable' in the minds of interested parties. The policymaker-centric narrative has a narrower and simpler understanding of 'responsible' and 'sustainable' as providing affordable access and uninterrupted power supply to power the nation and its economic growth, continuing with the major contribution from fossil fuel in the energy mix. The professional-centric narrative, which interlinks with global scientific knowledge and community, places greater emphasis on the concepts of 'responsible' and 'sustainable' by including long-term accountability. It sets out to achieve the same outcome as asserted by the policymaker-centric narrative, but advocates achieving it by also legitimising and earnestly exploiting available ample domestic resources that promote environmentally friendly renewables and the building of local capacities through a policy of 'investing now for future dividends'.

The views of the different stakeholders were not limited to a committed narrative but were interlaced with the acknowledged need for interim steps for immediate access:

[1]In 1972, Ceylon became the Republic of Sri Lanka.

> As a citizen of the country, I believe people should be first given access to electricity, whether it be from coal or otherwise. When we reach that level, we can think of renewables. (Energy expert, 2019)

The policymaker-centric and professional-centric narratives continue to exist without much conciliation between them, and therefore progress to establish a working power sector trajectory has been held back.

The investor-centric narrative emanates from Norwegian private firms with technological know-how and expertise. They had responded to calls to exploit abundantly available opportunities for renewable alternatives aimed at investment dividends and firm development. Thus, their narratives are centred on energy governance, policy pathways to investments, and resources.

Sustainability transition and the RI discourse

While the three narratives influence and affect the trajectory of the power sector in Sri Lanka, the interviewees' statements also helped identify contextual issues affecting the sustainability transition process and RI practices within it. The empirical evidence provided by the interviewees were categorised as follows: (1) access to and limitations of low-carbon technology; (2) resources to absorb low-carbon technologies; (3) power sector governance; and (4) investment for low-carbon solutions. However, there was considerable overlap between the four categories.

Access to and limitations of low-carbon technology

While many of the interviewees' adverse reactions to renewables generally related to technical limitations (e.g. seasonally related fluctuations in power generation, with wind and solar power limiting reliability and dependability), they also disclosed specific contextual limitations. Sri Lanka currently receives one-third of its power from fluctuating generation sources, including hydropower and other renewables. This context confers the sense of a barrier, due to the need to additional reliance on renewable technologies that are affected by seasonal changes in the weather. One interviewee explained the issue as follows:

> Being a small country, the small power sector can create certain instability in the network. Because of that, there is reluctance to connect more renewables as they are intermittent. The storage options are there, but expensive and again the financial constraint. (Public sector employee, 2019)

For a financially constrained country, which opts for least-cost options even in its long-term planning (Ceylon Electricity Board 2021), the capacity for taking costly mitigating steps to secure grid stability such as storage was considered unrealistic and impractical:

> We are government-owned and going with breakeven without profit. We can't run at a loss. Therefore, we are going with the least-cost options. When you are promoting renewables, these technical barriers have additional cost. (Public sector employee, 2020)

An energy expert with long engagement in the Sri Lankan power sector said that 'renewables mean trouble because of reliability' and recounted his experience:

> Before 1995, we had 100% hydropower except one oil plant, and this even now gives blackouts. If rains don't come, then no option. With a growing economy, you can't have that sort of uncertainty. (Energy expert, 2020)

The expert highlighted that coal and thermal plants were needed as backup power plants due to frequent and prolonged drought conditions, which affected hydropower generation (i.e. green energy). The cost of solutions, including hiring diesel power plants during such periods, are levied from customers (Presidential Expert Committee 2019), and the energy expert feared that additional costs to consumers would continue with renewable energy generating technologies. However, those with a professional-centric narrative countered such arguments by pointing to the high potential for achieving grid stability through an integration process with wind and solar power:

> The Northern Province has a capacity to harness 3000 MW of wind power. Also, solar power has a good potential in this province and if we integrate and have a hybrid unit with wind and solar power, our reliability will be high. Both have their disadvantages and advantages but if we integrate them, we have good potential. (Academic, 2019)

The academic's view was supported by another interviewee:

> Our total peak demand is 2400 MW. In Poonakary and Mannar[2] we have huge potential to generate from renewable sources. We will be able to meet today's demand and the demand of the future through solar power, wind power, and traditional hydropower, and the option is cheap. (Public sector employee, 2019)

Resources to absorb low-carbon technologies

Human and financial resources, or the lack of them, were major issues concerning sustainability transitions in which unfamiliar technologies were used:

[2]Poonakary village and Mannar town are both in the Northern Province in Sri Lanka.

> Renewable energy technology integration is a new subject to us. So, the engineers in the planning branch have to develop their capacities in the use of new technology. That is not happening. There is no policy for training. (Public sector employee, 2020)

Despite the fact that technologies have been evolving over many years, and that both the literature about them and the outcomes achieved by other countries using such technologies are readily accessible, such resources have not been accessed and used by the energy sector in Sri Lanka, thus indicating inadequacy in the prevailing system:

> In terms of talent, Sri Lanka has that, but using it and creating a value addition is what we need. (Public sector employee, 2020)

A large number of engineers graduate annually, yet their skills and knowledge, as well as those of academics and researchers, have been inadequately exploited to bring about a positive outcome through integration, consultation, and incorporation within policy development, planning, research and implementation of nationally agreed projects to help achieve sustainable energy transition in a responsible manner. In reflecting on immature governance, institutional limitations, and system flaws, one interviewed opined as follows:

> Academics can do a lot, but academics are not consulted by the policymakers. They undermine the skills of academia. I don't think academics can do much in the country. In Sri Lanka, decisions by policymakers are made based on their own views or the views of the people around them. (Academic, 2019)

The resultant loss of talent, in particular high-end human resources, to other countries was not only highlighted by Sri Lankan stakeholders but also pointed out by foreign experts in the energy sector as a major barrier to industry development:

> I see a lot of brain capacity leaving the country. So, then I ask them [scholars], why are you leaving? There is no future. Because you need to be politically connected to move up in the system. This is, of course, extremely discouraging and it is difficult to build something that can last, that is sustainable. (Norwegian private investor, 2020)

Some public sector interviewees also pointed to the non-applicable nature of reports submitted by foreign consultants on integration plans to take forward sustainable energy transition:

> When we did the integration plan, since we didn't know the subject, we engaged some [foreign] consultants. They did the studies and gave some recommendations. What they proposed was not practical for Sri Lanka. (Public sector employee, 2020)

The quotation further illustrates that the resources, which include technical expertise, cannot simply be transferred: they need to be modified according to the context.

Power-sector governance

The power-sector governance factor pervaded through and was identified within all the contextual categories in the empirical evidence. Stakeholders promoting *the professional-centric* and the *investor-centric* narratives in particular regarded the power-sector governance in Sri Lanka as immature and as impeding entrepreneurial activities and the legitimisation process. Despite having large potential for renewable energy, as supported by the interviewees' responses, Sri Lanka's efforts to take and use available opportunities and incentives have been very limited. Lack of leadership within energy governance was described as follows:

> Sri Lanka's national policies are generally dormant documents. These policies are generally used by the researchers and the presenters to say that this is what it is, and we hardly see the policies being met or implemented. There are certain principles, strategies, and milestones. These are not seriously followed. (Energy expert, 2019)

Other mentioned barriers that the power sector needed to reflect upon and reform in order to build a responsible framework for sustainability were scant progress in workstreams requiring serious action, lack of or disconnection between policy, planning, and implementation, and mismatches between declarations and practice. A perceived need for a responsible policy framework was shared by the interviewees:

> If the government is declaring a [renewable energy] policy, then there is a policy target [and] there is a policy cost, and that policy cost should be given to the utility that is implementing that [policy]. That is not happening here. (Public sector employee, 2020)

Above all, the interviewees revealed system flaws, such as the non-existence of a structure or the energy governance system being manipulative and politicised for individual gains rather than for national gains, which one academic termed 'mandatory sponsorship', meaning that practice was systematised. The system and governance flaws have huge impacts on renewables in terms of them gaining a foothold in the country, particularly when that is dependant on foreign investment. This was evident from the perception of one interviewee:

> There is no system and systematic approach to doing projects. There is so much corruption. There should be [a] strong political will. Imagine a foreign investor. It is difficult. (Public sector employee, 2020)

Foreign and established investment firms are used to functioning within an integrated framework involving government, researchers, and private sector stakeholders with defined policies, regulations, and directionality. However, when looking for investment opportunities and expecting a similar investment milieu in Sri Lanka, they have found that the situation is more complex, conflicting, and incompatible with RI because it is less inclusive and less transparent, there is a lack of firm policies; the returns on investments are dismal, and there are manipulative and unproductive practices:

> There is a lack of transparency and actual knowledge sharing. We have to know that the money will be paid back and [we] cannot risk that[it will not be paid back], but if those things are in place, it will be of huge interest for developers. Make very sure that there is no sort of corruption in the system. (Norwegian private investor, 2021)

The overall impact of the adverse governance factors is on credibility:

> The government needs to make changes in regulations, policies and so forth. Only action will give evidence that they do as they say, and not say and do something different. It is about credibility. (Norwegian private investor, 2020)

Investment in low-carbon solutions

Norway has a long-standing legacy of economic and technology cooperation with Sri Lanka. Thus, the empirical evidence related to influencing factors in renewable investment was drawn from Norwegian private investors. Norwegian firms see huge openings in the renewable resources markets in Sri Lanka, especially solar power, but have found the existing policy framework less conducive for market entry:

> The sunshine in Sri Lanka is one of the best in Asia and it [the sunshine] is perfect, everything is there, but it is a matter of opening up from the political side. I think the private industry is fully capable and the market is large. Also, they would like to go for bigger projects, but that is not happening. So, involving the private industry on a larger scale, and giving them a more relaxed framework to work under will be very positive. It would be a lot easier to involve academia and research in the development [of renewable energy]. (Norwegian private investor, 2020)

Investors' expectations for profitable investment in renewable energy were not being met, partly due to restrictive offers:

> We are not only looking to be an equipment supplier, but also to own and operate power plants, selling power. To attract investment, to make things happen, is to have a transparent system of doing the bids. (Norwegian private investor, 2021)

Norwegian investors found engagement with policymakers and the energy governance system in Sri Lanka unpleasant and convoluted:

> We tried, through various angles, to get into Sri Lankan renewable markets, but it all made it impossible due to their [Sri Lankan's] view on letting renewables compete into the market, [which] made it extremely difficult and [they] more or less sabotaged foreign private initiatives to get in. (Norwegian private investor, 2020)

A high-level barrier experienced by the Norwegian investors was the lack of policies, processes, and skill sets in the energy sector, which hindered and discouraged a business environment for private investors, and revealed governance and institutional limitations:

> From the investor's viewpoint, we look at the process, and skill set. They don't have a policy in place, don't have regulations in place, [and] don't have standardisation. (Norwegian private investor, 2020)

Foreign investors were further discouraged by the lack of set tariffs and returns on investments, due to the high-risk, widely fluctuating local currency:

> In terms of foreign investments, we don't have a set tariff. If someone secure a [piece of] land to do a 10 MW project, there is no published area. Foreign investors have to realise that they are going to have it in Rupees and cents, and not many are going to be excited by that. (Private sector representative, 2019)

To summarise, the three narratives and the interconnected contextual aspects characterise and highlight the barriers, tensions, and the immature energy governance pertaining to RI for sustainability transition in Sri Lanka.

Discussion

The aim of this paper is to explore the narratives related to sustainable energy transition in the Sri Lankan power sector and to discuss how this case can inform the broader literature on RI and sustainability transition in the context of a developing country. Furthermore, this paper offers a framework (Fig. 1) to comprehend sustainability transition and RI through narratives in play related to the absorption of low-carbon technology into the Sri Lankan power grid. Although stakeholders in the country's sustainable energy transition have a collective vision to move towards a sustainable pathway, their claims and perceptions of a responsible pathway towards achieving it are contested. This is expressed through two co-existing narratives: the *policymaker-centric narrative*, in which it is argued that assurance

of distribution needs to be the responsible way towards achieving sustainability, and the *professional-centric narrative* in which it is argued that there is a need for a more inclusive approach that integrates knowledge and the existing abundant natural and human resources to achieve it. Whereas the two narratives are contested and give rise to a muddled trajectory, the *investor-centric narrative* informs about the shortfalls and adverse elements in Sri Lanka's current sustainability transition process.

While the three narratives inform, influence, and affect the trajectory of the power-sector in Sri Lanka, the interviewees' statements also helped to identify contextual issues affecting the sustainability transition process and RI practices within it. The tensions between the narratives, which were evident from the claims and statements made by the interviewees, reiterated that, as concepts 'responsible' and 'sustainable' are context-related. The empirical evidence relating to Sri Lanka, which was sourced from the interviewees, reflected that the sustainability transition in the country has fallen short of acknowledged and promoted RI practices. In particular, immature energy governance and ineffective transition-management leadership were prominent factors affecting the energy transition. Also, the lack of agreement between the contested narratives and the absence of a reconciled policy trajectory with a planned step change towards sustainable energy transition reflected poor leadership in energy governance.

Sri Lanka's shift towards renewables is currently dependent on the engagement of and investments by foreign private sectors, which requires a facilitative framework for such involvement. An entrepreneurial activity in a well-functioning TIS will take advantage of business opportunities, not only to turn knowledge, networks, and market into concrete actions but also to diversify business for the firm's development (Hekkert et al. 2007). Thus, the presence and engagement of active entrepreneurs is a key indicator of the performance of a TIS and lack of such presence and engagement will influence the remaining functions of a TIS (Kooijman et al. 2017), in turn affecting the ability to create legitimacy for a newer technology trajectory. The investor-centric narratives revealed that there was a desire to invest and a motive for business development, and that there was ample opportunity for such investment in the field of sustainable energy development. However, there were concerns about the lack of a responsible framework for the absorption of investments and technology. Sri Lanka needs to change course and overcome the not-so-insurmountable issues of the existing manipulative practices, resistance to change from the existing technology regime, and the non-conducive investor environment that hinders firms from entry and investors from engagement in the energy sector. Sri Lanka also needs to heed feedback from the *investor-centric narrative*, which highlighted the absence of an integrated approach and mechanisms for initiating entrepreneurial activities, and that the prevalent and established practices were institutionalised and resulted in unyielding barriers and vulnerabilities to the absorption of innovations and technologies.

Scholars have echoed the need for the integrated role of multiple actors in mobilising low-carbon transition strategies (Wang & Lo 2021). Knowledge exchange, integration, and development are fundamental for innovation, absorption, and development, not only for reducing uncertainty and ensuring sustainability, but also for progressive and appropriate decision-making, especially in a context in which technology absorption requires interaction between government, academics, international institutions, competitors, and the market. Policy decisions need to be consistent with national commitments, and to take account of the changing norms, values, and practices. In the studied Sri Lankan case, the empirical evidence highlighted the absence of these considerations in the planning and decision-making processes, as well as the underutilisation of resources, including academics and technocrats in the energy transition process, and the fact that the country is leaning towards more ad-hoc decision-making with prevalent manipulative practices. The Sri Lankan case also highlights the importance of effective energy governance, which will help to fuse a TIS and RI and thus achieve a resilient sustainable energy transition.

Legitimisation of innovations and technologies (a responsibility of the state), which strongly deviates from established institutional practices will be challenging. These technologies need to overcome resistance by gradually becoming part of the incumbent regime and creating an environment to legitimise a TIS through a RI process, thus making the established practices redundant and paving the way for alternative institutional practices to penetrate institutional traditions. Actors with vested interests and powers often oppose such changes (Kooijman et al. 2017), as exemplified by the dominant *policymaker-centric narrative*, which supports reinforcement and/or continuation of fossil fuel technologies, deviating from the narrative holder's own climate commitment, and marginalising the knowledge, perceptions, and views of *professional-centric* and *investor-centric* stakeholders. It was noticeable that new investments in renewable technologies, which are crucial for technological change, were being held back by supporters of the dominant *policymaker-centric* narrative. Therefore, it falls on stakeholders

who promote renewable technologies, both local and foreign, to find progressive and innovative ways to challenge and/or deinstitutionalise this dominant narrative with a framework that is aligned both with the United Nations Sustainable Development Goal 7 (United Nations n.d.) and with RI principles. In doing so, the insistence on 'reliable, affordable energy access to all' by supporters of the dominant narrative needs to be accommodated before manoeuvring for a technological shift.

The Sri Lankan case informs that giving serious attention to the many critical appraisals within the three narratives and taking a corrective course could be the first step to interlocking RI with the sustainable energy transition.

Conclusions

Responsible innovation (RI) in sustainability transition is about responsible interplay between the functional elements of a TIS, together with the acknowledgement that operationalising RI can be challenging, as the framework cannot capture all of its elements tangibly. The innovation has to be 'responsible' by also being context-sensitive in order for transition to be appropriate and sustainable. While RI may be considered by scholars as a 'luxury argument' for developing countries (Vasen 2017), its positive impacts can still be realised if they are applied in tandem with a TIS by engaging in the energy discourse flowing from different responsible stakeholders' narratives regarding the way forward.

This study of the Sri Lankan power sector highlights that, as concepts, 'sustainable' and 'responsible' have different meanings in resource-poor settings. For Sri Lanka, RI in sustainability transition is first and foremost about affordable and reliable energy access for all. Thus, 'sustainability' has to be conceptualised in a more generic form, as well as in term of context, which means that the social aspect of distribution needs to be initiated in tandem with sustainable technological change for it to be accepted without dissent. For this to take place, Sri Lanka will need to have an integrated approach by incorporating knowledge with policy and investments.

There is a dearth of empirical studies of RI and sustainability transitions across different geographical contexts in the literature. The findings of the qualitative empirical research presented in this paper inform that aligning RI with sustainability transition is also about being cognisant of the discourse arising from prevalent narratives. In view of this, this paper proffers a methodological contribution by placing prevalent narratives in context as a necessary bridge to link sustainability transition with RI in order to be able to take forward the energy transition process effectively (Fig. 1). The findings from the data analysis suggest that sustainability transitions in developing countries can be better understood by being vigilant with regard to contextual narratives on RI. Further research in different geographical contexts will be needed to enhance the conclusions presented here.

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