The Effect of Technopreneurial Orientation on Co-Creation and Sustainability Value

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Abstract

Supporting the energy transition toward sustainability, which is increasingly necessary to accelerate, requires research to improve the engineering atmosphere with a technology-based entrepreneurial orientation. The situation is aimed at the engineers who are playing an important role in the electricity sector due to the potential of stranded assets and paradigms of intermittency and new patterns of energy flow. Using a quantitative method with structural equation modeling analysis and a partial least square approach, this study explains the importance of the co-creation process as a mediator to be able to utilize the technopreneurial orientation among engineers to support sustainability in the electricity sector. By empowering engineers to be technologically-based entrepreneurs, they can form a co-creation by prioritizing dialogue, which allows shared access and transparency in taking risks, a major aspect that boosts the co-creation effect in the energy transition to sustainability.

Keywords

Sustainability, Value Co-Creation, Technopreneurship, Engineering Management, Energy Transition and electricity.

1. Introduction

Restrictions on social mobility caused by the Covid-19 pandemic have reduced greenhouse gas emissions (GHGs) (Naderipour *et al.*, 2020). Limited mobility has reduced carbon emissions from the transportation sector significantly. The changing pattern of electricity consumption is the next consideration, due to the shifting load flow of electricity to the residential sector. As is well known, the characteristics of household electricity consumption vary greatly depending on the activities and behavior of the occupants (Zohar *et al.*, 2020). Additionally, the characteristics of the

load (consumption) are not fully following the characteristics (production) that supply it, namely the majority of types of coal-fired power plants with a population of approximately 63.9 percent in Indonesia (Mulyana and Rahmawati, 2020).

Indonesia is participating in the energy transition, having pledged to reduce global CO2 emissions as part of the Paris Agreement. Indonesia aims to achieve a 23 percent new and renewable energy (NRE) utilization rate in its national energy mix by 2025. That must be taken into account due to the characteristics of renewable energy plants, which are highly dependent on natural conditions. As a result, natural activities impact the operation of renewable energy power plants (Harjanne and Korhonen, 2019). Furthermore, Indonesia, located in a tropical climate, is experiencing unpredictable natural conditions due to global climate change (Sugiawan and Managi, 2016).

Another factor to be considered is the growing use of micro-scale power plants in residential. Roof-top Solar power generation can aid in the energy transition to renewable energy. However, the intermittency due to reliance on nature, its dispersed location, unique consumption patterns, and the emergence of micro-household-based industries are all important considerations. Those are led to microgrid expansion, where system stability is required to address the potential for cross-directional energy flows that could change the power grid architecture (Petit, 2017). All those technical complexities, however, are being solved by the engineers with their reliance on high-end technology. While, the true complexity lies in the involvement of nature as well as the human and social aspects since sustainability in triple-bottom-line is the true ultimate aim of the energy transition (Komendantova and Neumueller, 2020; Tainter, 2011).

Realizing sustainability which includes people, profit, planet, requires harmonization so that other parties also take an active role as a whole, through the energy transition in the electricity sector (Buana *et al.*, 2021). Therefore, the various complexities above become the starting point for research on the management of engineering in the electricity sector towards new horizons.

2. Literature Review

2.1. The Value of Sustainability

The triple bottom line approach to sustainability has become a widely accepted viewpoint on sustainability performance (Lacy *et al.*, 2019). The measurement of sustainability performance has become the foundation for business control processes, one of which is used to measure organizational performance, whether or not it is sustainability-oriented, using three indicators, namely economic, social, and environmental (Hourneaux Jr *et al.*, 2018). Towards that, electricity is the final form of energy that is most prepared to realize the energy transition to sustainability (Henbest, 2020). As a result, the sustainability of electricity is inextricably linked to the overall sustainability of energy (Goldrath *et al.*, 2015).

According to the World Energy Council, sustainability in the energy context can be assessed using a broader sustainability index (WEC, 2018). The World Energy Council defines energy sustainability as the Energy Trilemma Index, which includes three dimensions at the national level: energy security, energy equity, and environmental sustainability (WEC, 2017). The Energy Trilemma Index is an official indicator used to assess a country's ability to provide a sustainable energy system across three balanced dimensions: energy security, energy equity (accessibility and affordability), and environmental sustainability (Song *et al.*, 2017).

Sustainability, as the primary goal of the energy transition, entails the complexities of various parties' interests. Better orchestral harmonization between parties can help with this (Tian *et al.*, 2021). The co-creation process has the potential to improve sustainability performance by emphasizing togetherness (Kijima and Arai, 2016). Togetherness in value creation shapes social, economic, and environmental harmony as the foundation for collectively shaping the future (Ma *et al.*, 2019). The increase in sustainability caused by increased co-creation behavior begins with a harmonious balance between provider and beneficiary components (Kuenkel and Gruen, 2018). Greater collaboration is required for the energy transition's sustainability performance to be jointly directed to renewable energy (Jenkins, 2019). The statement that value co-creation affects high mutual success supports the increase in co-creation behavior, which will be followed by an increase in sustainability (Kruger *et al.*, 2018). Based on that sustainability is a value that is embodied in the balance of the triple bottom line of social, economic, and environmental that can be co-created jointly interested parties, then the proposed hypothesis is:

H1: Achievement of sustainability is affected significantly by value co-creation among parties.

2.2. Interplaying Co-creation of Value

Harmonization of diverse roles in creating sustainability requires a manifested process (Tommasetti *et al.*, 2020). For this reason, it is also necessary to harmonize diverse complexities in a well-orchestrated activity (Aquilani *et al.*, 2016). Based on the context of the energy transition towards electricity sustainability, the complexity of collaboration between various interests is emerging along with the development of the energy transition. Departing from that, there are previous studies that say that the complexity in the energy transition to sustainability, actually comes from economic, social, and environmental factors (Grubb *et al.*, 2017). There is a statement about the complexities of the energy transition that comes from a non-technical origin (Tainter, 2011). Until it is discovered that the complexity of the energy transition is actually due to the difficulty of participating and effectively cooperating between the involved engineers (Johnson, 2007). Then this study employs a value-co-creation approach where a cooperation process that is more than an interaction between stakeholders can create a strategic function together.

The conceptual journey of value co-creation has taken many twists and turns. One is used to reduce information asymmetry between parties with mutual interests (Prahalad and Ramaswamy, 2001). As a result, indicators based on the concepts of dialogue, accessibility, risk, and transparency have emerged as a method of assessing its success (Taghizadeh *et al.*, 2016). Dialogue flow necessitates information based on both parties' desire to act on the information received. The right to use facilities for dialogue in the value creation process is defined as accessibility. Risk means being dependent between parties who want to create value honorably and trustworthy. Transparency is defined as the availability to empower the creation of quality value (Albinsson *et al.*, 2016).

Engineering activities in the Indonesian electricity sector are critical to overcoming the complexities brought by asymmetric electricity activities. As a consequence, it is critical to understand the behavior of the engineer in the asymmetrical interaction overcoming mutually beneficial cooperation (Karami and Read, 2021). Engineers who are also technology savvy, according to this argument, must be able to play an entrepreneurial role (Misiak-Kwit *et al.*, 2021). Furthermore, because the electricity sector is so technologically sophisticated, the required entrepreneurial orientation must be technology-based as well (Yordanova *et al.*, 2020). Based on the idea that sustainability is the value created by the expertise of engineers in aligning social, economic, and environmental aspects, which are also influenced by technopreneurial orientation, this study proposes the following hypothesis:

H2a: The value co-creation is affected significantly by the technopreneurial orientation.
H2b: The value co-creation significantly mediates technopreneurial orientation toward the achievement of sustainability.

2.3. Technopreneurial Orientation

The research uses the combination of technology-based expertise and entrepreneurial use of engineers as interviewees. The word technopreneurship is therefore used since this phrase is still latent and not condensed (Fowosire *et al.*, 2017). This phrase implies the presence of creative technological mastery abilities, individual scientific insight, and technical knowledge, followed by the capacity to build and run enterprises, as well as take financial risks, to accomplish their objectives and views (Dolatabadi and Meigounpoory, 2013). As a consequence, it is thought to be coherent with the study's discovery of a correlation on entrepreneurial orientation.

The argument for including the technopreneur ship variable is based on the idea that not all engineers are equipped to manage opportunities and entrepreneurial thinking. The emphasis is on the fact that there are engineers with strong technical abilities but a lack of a commercial and entrepreneurial mindset (Prodan, 2007). Therefore, this study proposes the concept of technopreneurial orientation, which is a combination of entrepreneurial and tech-savvy orientation. There are three aspects, namely innovativeness, proactiveness, and the courage to take constructive risks (Miller, 2011), two aspects, namely independence and competitive aggressiveness (Lumpkin *et al.*, 2010), and additional tech-savvy aspects, namely understanding modern technology and using their expertise to take advantage of it (Fowosire *et al.*, 2017).

Technology-based entrepreneurship has a positive relationship with sustainability in the presence of innovation and high technology (Youssef *et al.*, 2018). Technology-enabled entrepreneurship has the potential to play a larger role in promoting long-term development (George *et al.*, 2020). As a result, when issues concerning sustainable development

arise, technology-based entrepreneurship becomes critical (Nilsson *et al.*, 2018). Themes that emerge from an entrepreneurial approach to sustainability are closely related to great uncertainty and ignorance (Soo Sung and Park, 2018). This has an impact on actors' ability to effectively predict the future to avoid the consequences of its degradation (Dorion *et al.*, 2018). Establishing that sustainability represents a manifestation of the harmony of the triple-bottom-line, which is influenced by technopreneurial orientation, this research proposes the following hypothesis:
H3: Technopreneurial orientation has a significant effect on the achievement of sustainability.

3. Methodology

This quantitative exploratory research data resulted from distributing online questionnaires (cross-sectional). A total of 319 responses were received from electrical engineers in Indonesia, reflecting 14 indicators of the variables of technopreneurial orientation, value co-creation, and sustainability. The indicator employs a 7-point Likert scale response, with a score of 1 – 7 indicating strong disagreement to strong agreement. Seven Likert scales ensure higher quality information (Tarka, 2017). As well as provides a more accurate measurement of electronically distributed and unsupervised questionnaires (Finstad, 2010) and is better suited for higher cognitive respondents (Weijters *et al.*, 2010).

The structural equation modeling (SEM) analysis with the partial least-squares (PLS) approach is used in this study, utilizing the Adanco software. The objective is to investigate the relationship between variables. The confirmatory factor analysis determines the validity and reliability of the constructs and their indicators. The structural model employs the coefficient of determination (R^2) to predict the influence of the exogenous latent variable on the endogenous latent variable. The path coefficient (β) is then used to determine the pattern of the exogenous on the endogenous. Sustainability is defined as an endogenous latent variable, value co-creation as an intervening latent variable, and technopreneurial orientation as an exogenous latent variable.

4. Result

All indicators for measuring this variable are valid and reliable, as shown in Table 1. Further, the loading factor value of each indicator, shown in Figure 1, according to the software output results.

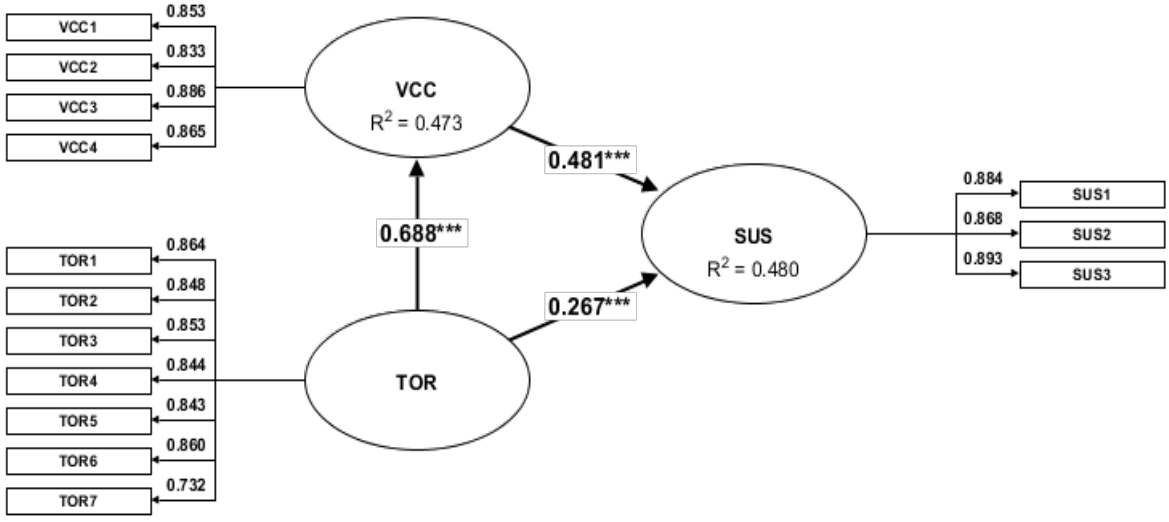

Figure 1. Research Model and Overall Indicator's Value

Table 1. Construct Validity & Reliability

Construct	AVE (>0.5)	ρA (>0.7)	Cronbach-α (>0.7)
Technoprenurial Orientation (TOR)	0.6987	0.9315	0.9277
Value Co-creation (VCC)	0.7384	0.8860	0.8820

Sustainability (SUS)	0.7776	0.8706	0.8580

AVE : Average variance extracted
ρA : Dijkstra-Henseler's coefficient

According to Table 2, the coefficient of determination (R^2) of value co-creation (VCC) variable is 0.4735, which indicates that 47.35 percent of the variance is explained by the technopreneurial orientation (TOR). While the (R^2) of the sustainability (SUS) variable is 0.4802, it indicates that 48.02 percent of the variance is explained by the value co-creation (VCC) variable and technopreneurial orientation (TOR). The path coefficient (β) test results value is 0.6881 on the path between technopreneurial orientation (TOR) and value co-creation (VCC), indicating technopreneurial orientation will increase value co-creation by 68.81 percent. Similarly, the path coefficient value of 0.4812 on the relationship between value co-creation (VCC) and sustainability (SUS) suggests that co-creation among engineers will increase sustainability by 48.12 percent. Meanwhile, the path coefficient value of 0.2674 on the direct relationship of technopreneurial orientation (TOR) to sustainability (SUS), only increase 26.74 percent. The path coefficient demonstrating that the value co-creation activities mediates technopreneurship orientation among engineers to achieve sustainability. Remain on Table 2, the value of Cohen's (f^2) in this study indicates the magnitude of the influence of variables. The relationship between entrepreneurial orientation (TOR) and value co-creation (VCC) has a value of 0.8992, while value co-creation (VCC) and sustainability (SUS) has a value of 0.2346, demonstrating the magnitude of the influence between each. Meanwhile, the value of 0.0725 ignores the direct relationship between technopreneurial orientation (TOR) and sustainability (SUS) (Hair *et al.*, 2017).

Table 2. Output of Structural Model Path

R^2	Path	β	Cohen (f^2)
VCC : 0.4735	TOR – VCC	0.6881	0.8992
SUS : 0.4802	VCC – SUS	0.4812	0.2346
-	TOR – SUS	0.2674	0.0725

R^2 : Coefficient of determination
Cohen (f^2) : Effect size

Reconfirming the value of the path coefficient (β), the Adanco software bootstrap 2999 samples, and 5% significance level. The result shows in Table 3.

Table 3. Bootstrap Output of Path Modelling

Path	Direct effect	Indirect effect	Total effect	t-value (t >1.96)	p-value (p < 0.05)
TOR – VCC	0.6881	-	0.6881	21.0073	0.0000
VCC – SUS	0.4812	-	0.4812	6.6831	0.0000
TOR – SUS	0.2674	-	0.2674	4.4326	0.0000
TOR – VCC – SUS	-	0.3311	0.5986	15.0947	0.0000

According to Table 3, the significance of the relationship between technopreneurial orientation (TOR) and value co-creation (VCC) obtained a t-value of 21.0073 and a p-value of 0.0000, and this proves the significance of the influence between them. In the relationship between value co-creation (VCC) and sustainability (SUS), the t-value is 6.6831 and the p-value is 0.0000, so there is also a significant effect on the relationship. On the direct influence between technopreneurship orientation (TOR) and sustainability (SUS), there is also a significant relationship, as indicated by the t-value of 4.4326 and the p-value of 0.0000 (Hair *et al.*, 2017). The significance test result of the total effect (direct and indirect) which obtained a t-value of 15.0947 and a p-value of 0.0000, on the relationship between technopreneurial orientation (TOR) through the value co-creation (VCC) process toward sustainability (SUS) proved to be greater than the direct relationship between technopreneurship orientation (TOR) and sustainability (SUS) with the t-value of 4.4326 and p-value of 0.0000 and by the very low Cohen (f^2) value (0.0725). As a result, although all hypotheses were accepted, the Cohen (f^2) and the significance test result proves the important role of value co-creation in mediating the influence of technopreneurship orientation on sustainability.

5. Discussions

The study confirms the importance of successful sustainability in the electricity sector by co-creation activities which, according to survey results for engineers, are preceded by a technopreneurial orientation. Various organizations and companies in the electricity sector and other energy industries that focus on the three pillars of global and regional sustainability often encounter difficulties in carrying out activities involving the active role of all parties, despite being held together (Grubb *et al.*, 2017). This occurred as a result of the engineers' lack of entrepreneurial orientation. As is well known, the energy sector always employs cutting-edge technology to achieve maximum efficiency (Johnson, 2007). As a consequence, it is necessary to ensure the success of each stage of its activities with parameters that can be interpreted from complicated to simply convenient. The role of the engineer who truly understands technological aspects must be improved in their entrepreneurial orientation from the start of his program of activities so that it becomes the key to long-term success.

The success of incorporating sustainability aspects from the energy trilemma index could be applied to the investigation of engineers' sustainability behavior. Therefore, the operational implications of these aspects must refer to the engineers' perception of how to plan activities with an entrepreneurial mindset to co-create with interested parties in the electricity sector to achieve sustainability goals. The efforts to achieve significant electrification targets demonstrate the behavior of co-creation in achieving energy security goals. Efforts are also being made to make electricity more affordable and equitable in remote areas. The coheren consistency with all parties, are reflected in the strong relationship with all levels of the local community. The shared objective of achieving those fulfillment of electricity needs, in the future, appears to imply the engineers' strong efforts to continue co-create value for electricity sustainability.

The evidence of a positive paradigm that co-creation can achieve sustainability theoretically supports previous research that states that the balance of social, economic, and environmental as the foundation for forming a collective future is shaped by collaboration in value creation (Ma *et al.*, 2019). The increase in sustainability caused by increased co-creation behavior is shaped by a harmonious balance between the provider and beneficiary components (Kuenkel and Gruen, 2018). Similarly, the statement that the energy transition's sustainability performance can be co-creatively directed to renewable energy, requiring greater co-creation to make it happen (Jenkins, 2019). The increase in co-creation behavior which will be followed by an increase in sustainability is also supported by the statement that the co-creation of value affects the success in achieving sustainability (Kruger *et al.*, 2018).

It became apparent in confirming the key informants' desire to dedicate some time to creating co-creation that engineers always took the time to satisfy their curiosity about the advancement and development of up-to-date electricity technology that was brought about earlier on due to co-creation (Barile *et al.*, 2020). The strong desire of the engineer to develop scientific progress was also responded to the explanations for the strong curiosity in co-creation with technology activists (Tian *et al.*, 2021). They are also very proactive and productive in initiating entrepreneurship from a value co-creation perspective. The research also demonstrates that technopreneurship can generate a new value that sustains economic growth (Dorion *et al.*, 2018). That since technology is capable of leading the market to a network that enables shared value to be created (Breidbach and Maglio, 2016). This research will lead, in entrepreneurial attitudes that have their characteristics that can be involved in every social and cultural structure, to the mutually benefiting creation of sustainability in the electricity sector.

The technopreneurial orientation of engineers is evidence that the co-creation process supports the achievement of electricity sustainability. Nevertheless, several factors require more in-depth research to improve the energy sector's sustainability performance. First, as a recommendation for engineering management in the electricity sector, the need for management action to improve the situation of unity in the dialog that provides mutual access to openness in order to minimize risk perceptions. The second suggestion for management is to focus on the issues that are used in this research as indicators of the co-creation model for sustainable development, especially those dealing with the strategic electricity industry. Thirdly, stakeholders should consider making it possible for engineers in their respective fields to contribute through dialogue, with transparent access to and knowledge of the risks to each side, to the three pillars of sustainability.

6. Conclusions

Overall, this research reveals that engineers who undertake out national strategic planning could achieve good performance as an advantage of the outcomes of co-creation to achieve sustainability. This research has empirically

proved that sustainability is a benchmark for its achievement, according to the strategic management model. It cannot be dismissed from the complexity and dynamics in realizing such a requirements engineering in achieving electricity sustainability in Indonesia. It, therefore, requires a good technopreneurial orientation from engineers to co-create to achieve sustainability.

In order for the noble goal of sustainability to be realized, the management needs to provide supporting facilities and infrastructure. First, by considering that the engineers already have a good technopreneurial orientation, the management needs to maintain the direction so that this orientation becomes a behavior to achieve sustainability. Second, by providing access that facilitates dialogue behavior in order to create transparency with a common perception of risk between the parties. Third, by prioritizing harmonization of sustainability in the triple bottom line, it has always been the main goal of every activity.

This study has limitations that need to be taken into consideration before the results are generalized. The respondents in this study were only 30 years old and above, so the millennials was not included. While data gathering is anonymous, self-reporting behavioral measurements can result in social desirability bias as individuals tend to react inadequately.

References

Albinsson, P.A., Perera, B.Y. and Sautter, P.T., DART scale development: Diagnosing a firms readiness for strategic value co-creation, *Journal of Marketing Theory and Practice*, Vol. 24 No. 1, pp. 42–58, 2016.

Aquilani, B., Silvestri, C. and Ruggieri, A. , Sustainability, TQM and value co-creation processes: The role of critical success factors, *Sustainability (Switzerland)*, Vol. 8 No. 10, p. 995, 2016.

Barile, S., Grimaldi, M., Loia, F. and Sirianni, C.A. , Technology, value co-creation and innovation in service ecosystems: Toward sustainable co-innovation, *Sustainability (Switzerland)*, MDPI AG, Vol. 12 No. 7, , 2020.

Breidbach, C.F. and Maglio, P.P. (2016), Technology-enabled value co-creation: An empirical analysis of actors, resources, and practices, *Industrial Marketing Management*, Elsevier, Vol. 56, pp. 73–85, 2016.

Buana, Y., Mursitama, T.N., Abdinagoro, S.B. and Pradipto, Y.D. (2021), Conceptualization value co-creation towards sustainability in national electricity, *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, Vol. 729 No. 1, p. 012041., 2021.

Dolatabadi, R.V. and Meigounpoory, M.R. (2013), Effective Determinants of Corporate Nano-Technopreneurship Process in Active Technological Knowledge Base Firms, *International Journal of Academic Research in Business and Social Sciences*, Vol. 3 No. 11,2013.

Dorion, E.C.H., Olea, P.M., Coallier, F., Prodanov, C.C., Severo, E.A., Guimarães, J.C.F., Nodari, C.H., *et al.* (2018), Entrepreneurship and Sustainability as Key Elements for Innovation: A Brazilian Dilemma, *Entrepreneurship - Development Tendencies and Empirical Approach*, InTech, 2018.

Finstad, K., Response interpolation and scale sensitivity: evidence against 5-point scales, *Journal of Usability Studies*, Vol. 5 No. 3, pp. 104–110, 2010.

Fowosire, R.A., Idris, O.Y. and Elijah, O., Technopreneurship: A View of Technology, Innovations and Entrepreneurship, *The Global Journal of Researches in Engineering*, Vol. 17, 2017.

George, G., Merrill, R.K. and Schillebeeckx, S.J.D., Digital Sustainability and Entrepreneurship: How Digital Innovations Are Helping Tackle Climate Change and Sustainable Development, *Entrepreneurship: Theory and Practice*, SAGE Publications Ltd, 2020.

Goldrath, T., Ayalon, O. and Shechter, M., A combined sustainability index for electricity efficiency measures, *Energy Policy*, Elsevier, Vol. 86, pp. 574–584, 2015.

Grubb, M., McDowall, W. and Drummond, P.,On order and complexity in innovations systems: Conceptual frameworks for policy mixes in sustainability transitions, *Energy Research and Social Science*, Elsevier Ltd, Vol. 33, pp. 21–34, 2017.

Hair, Hult, G.T.M., Ringle, C.M. and Sarstedt, M. , *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, 2nd ed., SAGE Publications Inc., Los Angeles, 2017.

Harjanne, A. and Korhonen, J.M., Abandoning the concept of renewable energy, *Energy Policy*, Elsevier Ltd, Vol. 127, pp. 330–340, 2019.

Henbest, S., Perspective on Energy Transition, *Papeles de Energia*, Vol. 8 No. Jan-2020, pp. 41–51, 2020.

Hourneaux Jr, F., Gabriel, M.L. da S. and Gallardo-Vázquez, D.A.,Triple bottom line and sustainable performance measurement in industrial companies, *Revista de Gestão*, Vol. 25 No. 4, pp. 2177–8736, 2018.

Jenkins, K.E.H., Energy justice, energy democracy, and sustainability: Normative approaches to the consumer

ownership of renewables, *Energy Transition: Financing Consumer Co-Ownership in Renewables*, pp. 79–97, 2019.

Johnson, W.H.A.,Managing Collaborations of Engineering Management With Academia and Government in Triple Helix Technology Development Projects: A Case Example of Precarn From the Intelligent Systems Sector, *Engineering Management Journal*, Vol. 19 No. 2, pp. 12–22, 2007.

Karami, M. and Read, S, Co-creative entrepreneurship, *Journal of Business Venturing*, Elsevier, Vol. 36 No. 4, p. 106125, 2021.

Kijima, K. and Arai, Y.,Value Co-creation Process and Value Orchestration Platform, *Global Perspectives on Service Science: Japan*, Springer, New York, NY, pp. 137–154, 2016.

Komendantova, N. and Neumueller, S.,Discourses about energy transition in Austrian climate and energy model regions: Turning awareness into action:, *Energy & Environment*, SAGE PublicationsSage UK: London, England, Vol. 31 No. 8, pp. 1473–1497, 2020.

Kruger, C., Caiado, R.G.G., França, S.L.B. and Quelhas, O.L.G.,A holistic model integrating value co-creation methodologies towards the sustainable development, *Journal of Cleaner Production*, Elsevier Ltd, Vol. 191, pp. 400–416, 2018.

Kuenkel, P. and Gruen, A. , Co-creation for Sustainability as a Societal Learning Journey, *World Sustainability Series*, pp. 377–393, 2018.

Lacy, P., Gupta, P. and Hayward, R., From Incrementalism to Transformation: Reflections on Corporate Sustainability from the UN Global Compact-Accenture CEO Study, *Managing Sustainable Business*, Springer Netherlands, pp. 505–518., 2019.

Lumpkin, G.T., Brigham, K.H. and Moss, T.W., Long-term orientation: Implications for the entrepreneurial orientation and performance of family businesses, *Entrepreneurship and Regional Development*, Vol. 22 No. 3–4, pp. 241–264, 2010.

Ma, Y., Rong, K., Luo, Y., Wang, Y., Mangalagiu, D. and Thornton, T.F., Value Co-creation for sustainable consumption and production in the sharing economy in China, *Journal of Cleaner Production*, Elsevier, Vol. 208, pp. 1148–1158, 2019.

Miller, D., Miller (1983) Revisited: A Reflection on EO Research and Some Suggestions for the Future, *Entrepreneurship Theory and Practice*, SAGE PublicationsSage CA: Los Angeles, CA, Vol. 35 No. 5, pp. 873–894, 2011.

Misiak-Kwit, S., Wiścicka-Fernando, M. and Fernando, K.S.D., The Symbiotic Mutualism between Co-Creation and Entrepreneurship, *Sustainability*, Multidisciplinary Digital Publishing Institute, Vol. 13 No. 11, p. 6285, 2021..

Mulyana, R.N. and Rahmawati, W.T.,Hingga Mei 2020, bauran energi untuk produksi listrik masih dikuasai batubara, *Investasi.Kontan.Co.Id/News*, 2 August, available at: https://investasi.kontan.co.id/news/hingga-mei-2020-bauran-energi-untuk-produksi-listrik-masih-dikuasai-batubara (accessed 30 March 2021), 2020.

Naderipour, A., Abdul-Malek, Z., Ahmad, N.A., Kamyab, H., Ashokkumar, V., Ngamcharussrivichai, C. and Chelliapan, S., Effect of COVID-19 virus on reducing GHG emission and increasing energy generated by renewable energy sources: A brief study in Malaysian context, *Environmental Technology & Innovation*, Elsevier, Vol. 20, p. 101151, 2020.

Nilsson, J., Jansson, J., Vall, G.H. and Modig, F.,The importance of market and entrepreneurial strategic orientations among companies committed to sustainability values and practices, *Business Strategies for Sustainability*, Routledge, pp. 131–143, 2018.

Petit, V.,, *The Energy Transition: An Overview of the True Challenge of the 21st Century*, *The Energy Collective*, Springer International Publishing., 2017.

Prahalad, C.K. and Ramaswamy, V., The value creation dilemma: New building blocks for co- creating experience, *Harvard Business Review*, 2001.

Prodan, I., A model of technological entrepreneurship, *Handbook of Research on Techno-Entrepreneurship*, Elgar Publishing, pp. 26–38, 2007.

Song, L., Fu, Y., Zhou, P. and Lai, K.K., Measuring national energy performance via Energy Trilemma Index: A Stochastic Multicriteria Acceptability Analysis, *Energy Economics*, North-Holland, Vol. 66, pp. 313–319, 2017.

Soo Sung, C. and Park, J.Y., Sustainability orientation and entrepreneurship orientation: Is there a tradeoff relationship between them?, *Sustainability (Switzerland)*, MDPI AG, Vol. 10 No. 2, 2018.

Sugiawan, Y. and Managi, S.,The environmental Kuznets curve in Indonesia: Exploring the potential of renewable energy, *Energy Policy*, Elsevier Ltd, Vol. 98, pp. 187–198, 2016.

Taghizadeh, S.K., Jayaraman, K., Ismail, I. and Rahman, S.A. , Scale development and validation for DART model of value co-creation process on innovation strategy, *Journal of Business and Industrial Marketing*, Vol. 31 No. 1, p. 20, 2016.

Tainter, J.A. ,Energy, complexity, and sustainability: A historical perspective, *Environmental Innovation and Societal Transitions*, Vol. 1 No. 1, pp. 89–95, 2011.

Tarka, P. ,The comparison of estimation methods on the parameter estimates and fit indices in SEM model under 7-point Likert scale, *Archives of Data Science*, Vol. 2 No. 1, 2017.

Tian, J., Vanderstraeten, J., Matthyssens, P. and Shen, L., Developing and leveraging platforms in a traditional industry: An orchestration and co-creation perspective, *Industrial Marketing Management*, Elsevier, Vol. 92, pp. 14–33, 2021.

Tommasetti, A., Mussari, R., Maione, G. and Sorrentino, D., Sustainability Accounting and Reporting in the Public Sector: Towards Public Value Co-Creation?, *Sustainability 2020, Vol. 12, Page 1909*, Multidisciplinary Digital Publishing Institute, Vol. 12 No. 5, p. 1909,2020.

WEC, *World Energy Trilemma Index 2017*, London, 2017.

WEC., *World Energy Trilemma Index 2018*, London, UK, 2018.

Weijters, B., Cabooter, E. and Schillewaert, N.,The effect of rating scale format on response styles: The number of response categories and response category labels, *International Journal of Research in Marketing*, North-Holland, Vol. 27 No. 3, pp. 236–247, 2010.

Yordanova, D., Filipe, J.A. and Coelho, M.P. ,Technopreneurial Intentions among Bulgarian STEM Students: The Role of University, *Sustainability*, Multidisciplinary Digital Publishing Institute, Vol. 12 No. 16, p. 6455, 2020.

Youssef, B.A., Boubaker, S. and Omri, A. , Entrepreneurship and sustainability: The need for innovative and institutional solutions, *Technological Forecasting and Social Change*, Elsevier Inc., Vol. 129, pp. 232–241, 2018.

Zohar, T., Parag, Y. and Ayalon, O. , Strategizing demand management from the middle out: Harnessing middle actors to reduce peak electricity consumption, *Energy Research and Social Science*, Elsevier Ltd, Vol. 61, p. 101360, 2020.

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