Bring Joy to Gamers: Adding Renewable Energy Alternative through Sustainable Development Indicators

Shoeib Faraji Abdolmaleki(✉), Yesodharan Vaisakh, and Pastora Maria Bello Bugallo

TECH-NASE Research Group, School of Engineering (ETSE), Universidade de Santiago de Compostela Avda. Lope Gomez de Marzoa s/n 15782, Santiago de Compostela, Spain
shoeib.faraji@rai.usc.es

Abstract. This study aims to identify the indicators with the potential to be used in video games by using the concept of sustainable development through Renewable Energy (RE) sustainability assessment. A systematic review performs to gather the key indicators. Also, this study seeks to increase players' awareness about the role of RE in real life and expands the game appealing to sustainability. In this study, the game named TOWNSHIP™ is employed to evaluate if we can include RE and sustainability assessment concepts to use as a tool for sustainable development consciousness to the public. The work evaluates the availability of environmental, economic, social, technical, and governmental indicators in the game (capacity, aptitudes, and attractive options). First, from an existing inventory of sustainable indicators, more compatible ones for RE are selected. Second, with the help of expert viewpoints, potential indicators are picked for the game. Finally, from the analysis of the game structure, some scenarios were constructed, and the game run in an assumption atmosphere. The study concludes the video game's potential for sustainable development indicators in RE and advances recommendations for improving the game's attractiveness through updated options.

Keywords: Video game · Renewable energy · Sustainable development · Sustainability indicators · Gaming

1 Introduction

Today, to develop a video game in addition to the graphic quality that requires a high level of distinctive processor systems and platforms, creating content in games is also of particular importance. In the world of video games, developers try to measure the players' interest by using polls in the databases and platforms (e.g., Play Store which makes these games available for everyone), so they can make positive changes in these games by reviewing different feedbacks. A quick look at the participation of players and gamers in the polls can show how much the audience cares about the quality of the products they receive.

U. Dhar et al. (Eds.): ISAGA 2021, LNCS 13219, pp. 3–14, 2022.
https://doi.org/10.1007/978-3-031-09959-5_1

The necessity to create a game could be fueled by a variety of backgrounds. For example, a game can be developed for the sole purpose of entertainment, education (e.g., [1, 2]), understanding a process (e.g., [3, 4]), motivational issues, or considering all of these parameters (e.g., [5]). Meanwhile, games that have been produced for educational purposes to raise the awareness of the audience with concepts that are substantial such as energy transition, climate change, engineering process, etc., are in the stage of growth and development [6–10] (e.g., using RE as a game concept). A review of the existing literature shows that despite many efforts, the amount of games produced in this field is growing and the use of basic concepts, frameworks, and ultimately the target audience is in its infancy.

RE considers a solution and a concept for sustainable development [11], and its role has rarely been seen in video games. In addition to a small number of video games (based on Scopus and Web of Science platforms investigation) in which RE is part of the overall game process (e.g., [1, 8], and [12]), there are several simulations game (e.g., [6]) and serious games (e.g., [13]). Therefore, it needs to investigate the role of RE in a video game by designing a valid route, considering diverse terms and options. Then, we can expect that involving this notion in games will assist in boosting not only people's understanding but also the enjoyment of the game.

Therefore, this study examines the potential of sustainable development indicators (as options and terms) in RE in the form of video games. Also, it considers a type of video game that has a high quality, which gives some suggestions on creating game attractiveness based on enhanced options.

2 Indicators and Frameworks

Since RE is perceived as a crucial pathway to Sustainable Development (SD), its assessment is critical for SD Goals (SDGs). Some SDGs have an excellent connection with RE. For instance, SDG-7 (refer to ensuring access to affordable, reliable, sustainable, and modern energy for all) and SDG-13 (refer to taking urgent action to combat climate change and its impacts) are some examples [14]. As a result, successful implementation of a RE system can affect these SDGs outlines. In achieving SDGs, more effort than current policies and approaches is required. It is especially true in the energy sector, as energy is a necessary component of all development operations.

Many efforts have done to shape this idea to analyze the long-term development of a system. Sustainability assessments are conducted by SD frameworks, which is one of the essential factors. It is a logical design on which the indicators are based [15]. A framework is a high-level, direct reference to SD principles [16]. Many national and international legal frameworks have been created around the idea of designating energy sources such as renewable or non-renewable, and RE has become a dominating concept in energy policies. RE is designed to be firmly associated with the sustainability and successful mitigation of climate change in public discourse [17].

Besides, analysts and decision-makers at the local, national, and international levels can use indicators to gain a deeper understanding of the SD circumstances and trends, the effects of policies, as well as the long-term consequences of policy changes [18]. Indicators can provide a numerical value for the sustainability level and highlight all

dimensions so that the users can compare the sustainability of different systems and select the most appropriate one with the lowest costs. The users also must determine if the benefit of a RE system exceeds its costs if it is more attractive than other systems, and a numerical value helps simplify their assessment and decision-making [19]. Furthermore, it provides a broad picture of whether governments have made sufficient progress toward SD plans and goals [20].

Indicator selection is vital to recognizing SD dimensions. In addition to the three main pillars of SD (environment, economic, and social), this study investigates the government's role and technical properties (i.e. by considering governmental and technical indicators in the RE sector). The study of ref [21] was followed to collect SD indicators for RE's evaluation, in which environmental, economic, social, governmental, and technological indicators were found by comprehensive literature analysis. The authors in ref [21] used the high-frequency indicators found in the RE and SD literature to choose the most important indicators in each dimension. Table 1 gathered up a list of indicators in each dimension.

Table 1. The most important indicators for RE sustainability assessment [21]

Dimension	Indicators
Environmental	CO_2 emission, land use, impact on ecosystem, NO_x, and SO_x emission, GHG emission reduction, particle emission, noise, need for waste disposal, and emission generally.
Economic	Investment cost, operation and maintenance cost, energy cost, fuel cost, payback period, net present value, service life, cost of capital, generation cost per unit, GDP, and employment rate
Social	social acceptability, job creation, social benefit, impact on health, compatibility with political and legislative situation international obligation, public awareness and willingness, availability, R&D, government support
Technical	Efficiency, reliability, resource availability, maturity, safety, primary energy ratio, feasibility, continuity and predictability of performance, capacity factor, and innovativeness
Governmental	Legal regulation of activity, government support, political stability, absence of violence/terrorism, control of corruption, the efficiency of subsidy for the feed-in tariff, compliance with international obligations, and influence on sustainable development of energy

3 Material and Methods

3.1 Introducing a Capable Video Game

This study uses a game as an example to better comprehend the use of indicators. TOWNSHIP™ is a free-to-play city-building game developed by "Playrix" that is accessible on various platforms. In this game, players can design their fantasy city according to their

preferences using the game's choices. Building infrastructure, harvesting crops, mining, and trading are some of the game's most well-known elements. This game gives a core natural environment that players can personalize to their liking. The game's architecture allows players to develop cause-and-effect links with basic life ideas such as environmental awareness, economic relations, and social understanding, all while having fun with the game's options.

3.2 Hypothesizing and Assumptions

Using an existing video game provides the necessary foundations (e.g., a huge animation base, a high-performance technical staff to support new game options, a large fan number, etc.) to add new concepts and to realize whether players can get satisfied with the new features through online polls. However, this is an intellectual test to expand the concept of SD and the use of RE. Also to use a video game, this study follows the results of some scientific works. For two decades, scholars find out that video games bring happiness to players. For example, Przybylski et al. (2010) investigated that "video games have the potential to enhance intrinsic motivation and short-term well-being insofar as they provide players with experiences that satisfy universal psychological needs" [22]. Johnson et al. (2013) reviewed the role of video games and well-being. Their findings indicate a variety of advantages to playing video games, regardless of their substance. Then, playing video games can lead to improvements in mood, stress reduction, and emotions of competence and autonomy, among other things [23].

To engage the RE with this game, if we apply the concept of energy (energy transition) and sustainable development to the structure of this game, then we can use the capacity of indicators in this game as smart options. This study also omits the various perspectives on sustainable development (such as the triple button line) because it simply wants to discuss the role of indicators as in-game options.

Moreover, it is assumed that Table 1 provides a sufficient number of appropriate indicators for this study. This study assumes that all indicators are on an equal footing in the game to make it easy to use them.

Furthermore, like other features of this game, the RE has equal wealth. For example, just as a dairy factory, poultry, and other industries are essential for a city and a community, RE is also required. By following this supposition, the game forces players to follow sustainable development solutions for the energy supply of the city as well as utilizing RE.

3.3 Framework of the Study

This study presents a direction regarding the indicators selection and implementation through a game with excellent graphical quality and basic potential to add RE and SD definitions to utilize indicators in this game and evaluate the game's enjoyment.

Five experts were invited to create the game's key performance indicators, ensuring that they were well-versed in RE, SD, and sustainability indicators. They are also the ones who have played the game and are familiar with the gam's atmosphere. As a result, a questionnaire was created based on the data in Table 1 and the question of which indicators may be used in the game was posed. They then answered by evaluating two

conditions: 1) what are the most essential indications, and 2) which indicators can be more consistent with the game's framework.

The essential information for the initial selection of indicators was acquired based on the opinions of five specialists (Fig. 1).

Fig. 1. Considering expert viewpoints regarding selecting indicators for the game (top and down)

According to this, they determined that 43 of the 48 accessible indicators possessed the necessary capacities. The next stage was to construct a condition so that a more appropriate set of indicators could be selected for use in the game with higher confidence in all opinions to achieve common ground amongst expert perspectives. As a

result, indicators were chosen on which at least 60% of experts agreed. In other words, at least three of them must agree on a particular indicator. Finally, a total of 26 indicators were discovered. A hierarchical diagram of the selected indicators is shown in Fig. 2. Regarding this, nine environmental indicators, six economic indicators, four social indicators, four technical indicators, and three government indicators were finalized to use in the game.

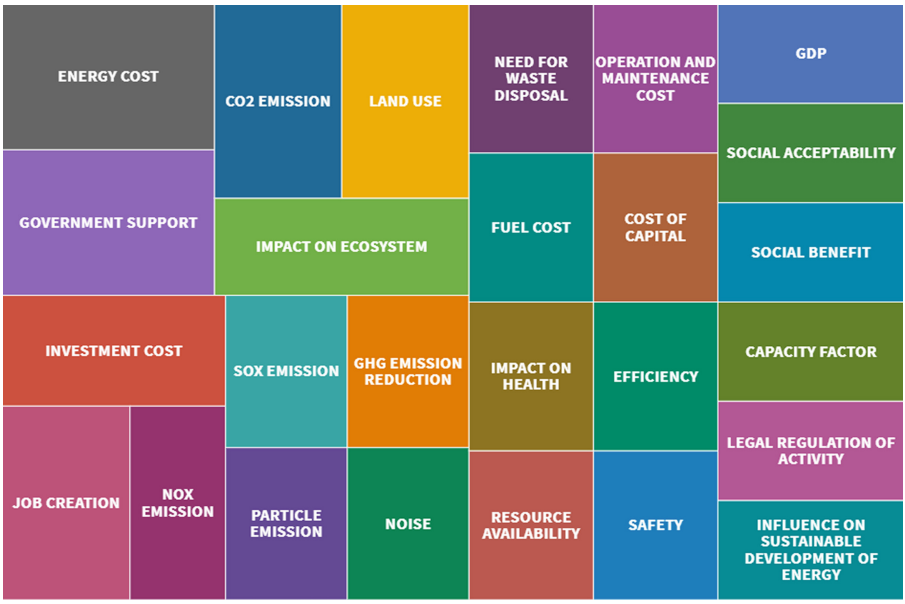

Fig. 2. Potentiated indicators selected to employ in the game

"CO_2 emission," "land use," and "impact on the ecosystem" are among the most important environmental indicators. Also, within economic indicators, "energy cost" and "investment cost" received more votes. Experts, on the other hand, ranked "job creation" as the most considerable social indicator. Technical indicators are on par in terms of weight, but "government support" is the most significant governmental indicator. "Energy costs" and "government support" were the indicators that drew the attention of all specialists (5 out of 5).

To apply the indicators in the game ventricle this study introduces a flowchart (Fig. 3). It shows how indicators can be used to feed the game and how they'll be used as options in the game. First, this study proposes a game with the possibility of selecting environmental variables (e.g., this city would be located on which continent) to demonstrate how a city's sustainability differs from one location to another. The level of sustainability for this hypothetical city gauges all the time in step 2 using the various terms and conditions that this game can add to its framework. For example, the game can assess the city's sustainability using SD criteria (environmental, social, economic, and so on) and approaches based on Multi-Criteria-Decision-Making (MCDM) to measure the sustainability level. The game then proposes a form of RE as a solution to the sustainability

challenge in the issue of energy generation (wind, solar, bioenergy, hydropower, etc.). There is a range of terms that it is possible to employ to demonstrate how the game can provide some form of RE (step 3). For example, the amount of money (a player has earned while playing the game), the levels of the game, etc. The game will begin the RE sustainability evaluation after a player selected RE type(s) in step 4 (with the conditions in step 2). The game will check again if there is non-compliance with the utilization of RE and SD. If it was not sustainable at that time, the game refers to step 2 for further investigation. If the condition was sustainable, the game considers more indicators in each dimension to offer more RE options during the time-play and game stages.

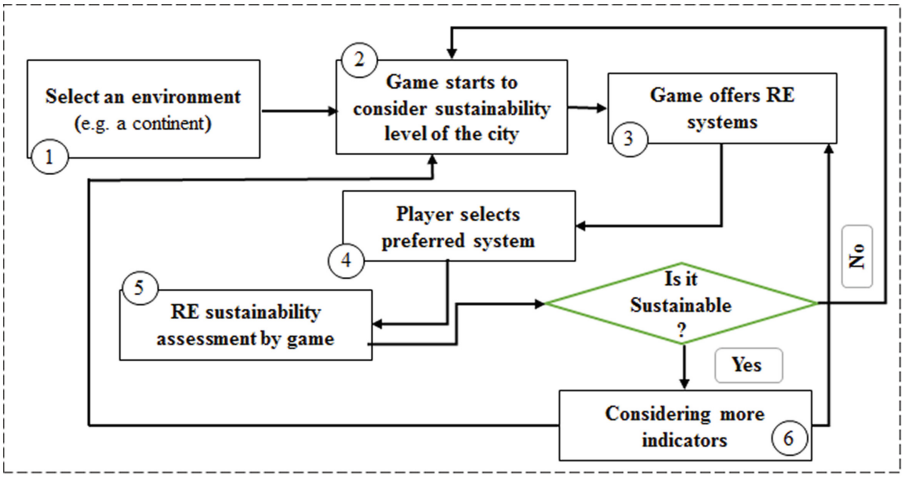

Fig. 3. SD indicators selection and implementation for the video game

3.4 Scenarios for Indicator Selection Within the Game

While renewables are very environmentally sound, the use of land (onshore or off-shore) for establishing a renewable structure can be a negative factor. Players can choose the RE option to secure the city's energy if the game offers several RE types to supply energy for manufacturing, housing, transportation, and other sectors related to the game's environment. However, players need to be careful about their budget, the size of RE (i.e., land use for renewable system implementation), and CO_2 emissions. Besides, the measure of power plant effect on surroundings, visual impact, manufacturing waste recycling, and primary greenhouse gas emission can represent other beneficial environmental indicators (Fig. 4).

Instead of sending messages to show players what they need and what the condition is, the government in this game (which is defined to control the game as an intelligent element) can support the idea of RE implementation and examine whether players are eligible to apply a type of RE. Therefore, the indicators introduced in Fig. 4 (government role) can be used in this game.

In this game, the criteria that affect the city's energy supply, such as the efficiency of a RE system, capacity, resource availability, and feasibility, can be realized as technical indicator possibilities. Technical indicators provide gamers with alternatives for determining which RE system is best to use throughout game stages. Players will be considered as decision-makers in RE system selection because this game has a dynamic concept.

People in each community affect government and vice versa. Therefore, society can ask about what they want. Then, they should be satisfied whit the RE type installed while it brings them benefits like job creation. The social indicators in Fig. 4 can aid in the decision of appropriate RE by taking into consideration the social aspects that concern RE. It can be happening by exposing some messages from citizens in this game because citizens respond to the changes that players apply during the game.

Fig. 4. Implementing selected indicators for the video game[1]

Finally, the economic situation of the game (i.e., the amount of money that players earn through each economic activity like selling products and mining) can control most of the activities that are happening in the game. Investment cost, as an economic indicator, includes all types of expenses. Hence, players can choose the appropriate RE type for their budget over time based on their financial resources. In the same way, for other economic indicators, we can make different scenarios to consider the sustainability of RE while gaming.

[1] In this study, a few snapshots were taken of the game (from Playrix-TOWNSHIP™: https://www.playrix.com/games/township) so that to present the game space and deal with some options in the form of indicators.

4 Results and Discussion

One of the goals of any game development company can be to create popular and enjoyable games. This study introduces how the scientific definition of RE can contribute to a video game. Therefore, a game is selected to see which interconnections exist between sustainability indicators and game options. After identifying the indicators of sustainable development in RE, the structure of the game will be assessed for SD and RE with available sustainable indicators.

Video games have the potential to be an extremely effective tool for telling stories. Furthermore, gamers have a pivotal role in the video game storyline as they are required to make decisions that affect the game route and atmosphere [22]. In this study, gamers are encouraged to not only have fun while playing, but also to learn about the game's possibilities through trial and error, paying fees, and completing RE tasks freely. Also, they serve as a process designer by providing crucial concepts (i.e., SD and RE).

Nowadays, a significant shift toward more sustainable energy systems is required. So, it needs both the utilization of renewable energy sources and comprehensive approaches that take into account cost reductions, energy efficiency, and institutional innovation [24]. This game is assumed to provide a geographical area for the game world and use environmental, economic, social, technical, and governmental indicators to select a renewable power plant. In this way, after playing a few times, the player realizes the importance of the indicators and can try to make the fitting choice, which is done in the real world using complex mathematical algorithms and methods such as MCDM. Citizens who have a minimum awareness of RE sources are more effective partners in increasingly complicated power economies and political decisions in general [1].

Developing various scientific strategies and scenarios can boost the attraction option of the game and player awareness. In this regard, Magnussen et al. in 2013 studied scientific discovery games for authentic science education. This study aimed to investigate how a scientific game concept can strengthen authentic experimental practice and create new science, education, and the elements that play a central role in such a game. They discovered that by collaborating with academics and participants in the research (where both are highly motivating features), games are commonly utilized in education to drive students to engage in instructional activities [25]. For instance, by increasing the level of knowledge (by designing a school and a university in TOWNSHIP™) and boosting the research level and development (R&D) as an indicator (Table 1), it is possible to create updates in renewable power plants while playing. It requires incorporating a component within the game, such as a university, which will display messages on the screen to assist players in determining whether or not to play the game depending on RE choices and energy conditions. Therefore, they can expect the amount of energy produced to increase the financial benefit of gameplay. Also, players are highly motivated by scientific discovery games and the fact that they allow them to participate in scientific investigations [25]. The video gaming industry is expanding at a breakneck pace, attracting the attention of gamers of all ages. Thanks to advanced graphics processors and innovations in software programming and computing platforms, modern games provide appealing and often odd worlds to explore, escape from, and enjoy. As a result, the majority of individuals spend a good deal of time engrossed in the gaming world. Furthermore, many people will devote

a significant amount of time to perfecting their gaming abilities, learning the gaming environment, and inventing tools to aid them in their game success ([26] and [27]).

There is a vast literature to argue about the enjoyment of a video game. Some of the critical enjoyment attributes, this research concludes game world, storyline, characters, music, quality assurance, challenge, competition, art design, and graphics (e.g., [28–32]). Hence, if we add a new definition to an existing game, we can anticipate that new challenges added to the game. Therefore, players will face circumstances to solve the requirement by their decisions. So that is true if we apply SD and RE to the structure of a high-quality game. The concept of SD and RE should be a concern for the people while they are living in an era in which problems like climate change, natural security, energy production-transition, and economy are human being significant affairs. As a result, subjoining SD indicators to RE can convey some of the enjoyment features of video games. The game environment, for example, must provide space, or at least a perception of space, that encourages the player to explore. Therefore, including such a unique idea can enjoy the game and acquaint the audience with vital concepts. Also, each game must target a range of abilities, so the combination of experiences required to solve a game problem must progress incrementally [33]. It is envisaged that players get involved with the new idea deeply. Besides, incentives must be adequate for the mix of abilities and skill levels required to complete a gaming problem or challenge, which TOWNSHIP™ already uses this system of rewarding.

Thus, as can be seen from the examples, this study aims to increase the excitement by considering new ideas and capabilities of a game. However, it remains a profound investigation of other enjoyment factors; the emotion of joy, for instance, is out of this study's scope.

This study believes that the collaboration between academic and game companies can bring new ideas for games features. Also, it suggests that the conceptual frameworks in sustainability assessments should examine to create different scenarios. Therefore, various updates, different versions, and more attractive options can be provided for the future of this type of game.

5 Conclusion

This study provides a quick assessment of the potentiated sustainability indicators toward RE to investigate the hypothetic options that increase video game attraction. Considering environmental, economic, social, technical, and government drivers, this study came up with attractive proposals that create the right atmosphere for players. The relationship between the indicators and RE has examined as well as the creation of appropriate items to increase the status of the game. The results demonstrate that including a new impression in the game with sustainability ideas can level up the novel challenges. In this regard, some assumptions include assessing the ability of the game to adopt the innovative implication. Enjoyment factors consider both the game's structure (e.g., high graphic base) and new concept's capacity (e.g., bringing new challenges). Hence, it supposes that the pleasure of playing will increase due to these prospects, and players will be more associated with the concepts of sustainable development and RE after repeating this game. Despite the lack of high-quality video games focusing on RE, this

study recommends using games that can combine this content. Also, to find the best scenarios in this game and better influence the game structure, it is necessary to evaluate sustainability frameworks.

References

1. Cohen, M.A., Niemeyer, G.O., Callaway, D.S.: Griddle: video gaming for power system education. IEEE Trans. Power Syst. **32**(4), 3069–3077 (2017). https://doi.org/10.1109/TPWRS.2016.2618887
2. Li, H., Chabay, I., Renn, O., Weber, A., Mbungu, G.: Exploring smart grids with simulations in a mobile science exhibition. Energy, Sustainability and Society **5**(1), 1–8 (2015). https://doi.org/10.1186/s13705-015-0066-4
3. Robledo, J., Leloux, J., Lorenzo, E., Gueymard, C.A.: From video games to solar energy: 3D shading simulation for PV using GPU. Sol. Energy **193**(March), 962–980 (2019). https://doi.org/10.1016/j.solener.2019.09.041
4. Schauppenlehner, T., Graf, C., Latosinska, B., Roth, M.: Entwicklung einer neuen Schnittstelle für Mensch- Maschinen-Interaktion im Kontext raumbezogener partizipativer Prozesse, pp. 13–22 (2020). https://doi.org/10.14627/537698002.Dieser
5. Prilenska, V.: Serious game for modelling neighbourhood energy supply scenarios. IOP Conf. Ser. Earth Environ. Sci. **410**(1) (2020). https://doi.org/10.1088/1755-1315/410/1/012091
6. Ouariachi, T., Elving, W.: Accelerating the energy transition through serious gaming: testing effects on awareness, knowledge and efficacy beliefs. Electron. J. e-Learning **18**(5), 410–420 (2020). https://doi.org/10.34190/JEL.18.5.004
7. Dresner, M.: Changing energy end-use patterns as a means of reducing global-warming trends. J. Environ. Educ. **21**(2), 41–46 (1990). https://doi.org/10.1080/00958964.1990.9941930
8. Ouariachi, T., Elving, W., Pierie, F.: Playing for a Sustainable Future: The Case of We Energy Game as an Educational Practice. Sustainability **10**(10), 3639 (2018). https://doi.org/10.3390/su10103639. Oct.
9. Street, G.: Serious Games for Eco-Effective Transformations. In: Thirty Eighth International Conference on Information Systems. South Korea (2017). no. December
10. Gerber, A., Ulrich, M., Wäger, P.: Review of Haptic and Computerized (Simulation) Games on Climate Change. In: Wardaszko, Marcin, Meijer, Sebastiaan, Lukosch, Heide, Kanegae, Hidehiko, Kriz, Willy Christian, Grzybowska-Brzezińska, Mariola (eds.) ISAGA 2019. LNCS, vol. 11988, pp. 275–289. Springer, Cham (2021). https://doi.org/10.1007/978-3-030-72132-9_24
11. Wang, Y., Zhang, D., Ji, Q., Shi, X.: Regional renewable energy development in China: A multidimensional assessment. Renew. Sustain. Energy Rev. **124** (May 2020). https://doi.org/10.1016/j.rser.2020.109797
12. Khatib, T., et al.: Development of DAYSAM: An educational smartphone game for preschoolers to increase awareness of renewable energy. Sustain. **13**(1), 1–23 (2021). https://doi.org/10.3390/su13010433
13. Ouariachi, T.: Understanding the urgency and complexities of the energy transition through serious gaming. In: 18th European Conference on e-Learning, pp. 461–466 (2019). https://doi.org/10.34190/EEL.19.002
14. European Commission: Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions, Next steps for a sustainable European future, European action for sustainability (2016). [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52012DC0673

15. Kristle Nathan, H.S., Sudhakara Reddy, B.: A conceptual framework for development of sustainable development indicators. Mumbai (2008). [Online]. Available: http://www.igidr.ac.in/pdf/publication/WP-2008-003.pdf
16. Pintér, L., Hardi, P., Bartelmus, P.: Sustainable development indicators: proposals for the way forward. Int. Inst. Sustain. Dev. New York, USA, pp. 1–35 (2005). [Online]. Available: https://www.iisd.org/system/files/publications/measure_indicators_sd_way_forward.pd
17. Harjanne, A., Korhonen, J.M.: Abandoning the concept of renewable energy. Energy Policy **127**, 330–340 (2019). https://doi.org/10.1016/j.enpol.2018.12.029. Apr.
18. Anna, B.: Classification of the European Union member states according to the relative level of sustainable development. Qual. Quant. **50**(6), 2591–2605 (2016). https://doi.org/10.1007/s11135-015-0278-x. Nov.
19. Liu, G.: Development of a general sustainability indicator for renewable energy systems: A review. Renewable and Sustainable Energy Reviews. Elsevier Ltd. **31**, 611–621 (2014). https://doi.org/10.1016/j.rser.2013.12.038
20. Unander, F.: Energy indicators and sustainable development: the international energy agency approach. Nat. Resour. Forum **29**(4), 377–391 (2005). https://doi.org/10.1111/j.1477-8947.2005.00148.x
21. Abdolmaleki, S.F., Bello Bugallo, P.M.: Evaluation of renewable energy system for sustainable development. presented in World Renewable Energy Congress (2021)
22. Przybylski, A.K., Rigby, C.S., Ryan, R.M.: A motivational model of video game engagement. Rev. Gen. Psychol. **14**(2), 154–166 (2010). https://doi.org/10.1037/a0019440
23. Johnson, D., Scholes, L., Carras, M.C.: Videogames and wellbeing: a comprehensive review. CRC Young and Well and PAX Australia (2013)
24. Duke, R., Geurts, J.L.: Policy Games for Strategic Management: Pathways into the Unknown. Dutch University Press, Amsterdam, p. 54 (2004)
25. Magnussen, R., Sidse Damgaard, H., Planke, T.: Scientific Discovery Games for Authentic Science Education. In: 7th European Conference on Games Based Learning, pp. 344–351 (2013)
26. Arrasmith, W.W.: Video game knowledge modules for higher education and technology learning, assessment, and certification. In: 5th international technology, education and development conference, pp. 4195–4204 (2011)
27. Wells, D., Fotaris, P.: Game-based learning in schools: trainee teacher perceptions in implementing gamified approaches. In: European conference on games based learning (ECGBL), pp. 754–762 (2017)
28. Wirth, W., Ryffel, F., von Pape, T., Karnowski, V.: The development of video game enjoyment in a role playing game, Cyberpsychology. Behav. Soc. Netw. **16**(4), 260–264 (2013). https://doi.org/10.1089/cyber.2012.0159. Apr.
29. Halbrook, Y.J., O'Donnell, A.T., Msetfi, R.M.: When and how video games can be good: a review of the positive effects of video games on well-being. Perspect. Psychol. Sci. **14**(6), 1096–1104 (2019). https://doi.org/10.1177/1745691619863807. Nov.
30. Klimmt, C., Blake, C., Hefner, D., Vorderer, P., Roth, C.: Player Performance, Satisfaction, and Video Game Enjoyment. In: Natkin, Stéphane., Dupire, Jérôme. (eds.) ICEC 2009. LNCS, vol. 5709, pp. 1–12. Springer, Heidelberg (2009). https://doi.org/10.1007/978-3-642-04052-8_1
31. Vorderer, P., Hartmann, T., Klimmt, C.: Explaining the enjoyment of playing video games: the role of competition. In: second international conference on Entertainment computing, pp. 1–9 (2003)
32. Klimmen, C.: Dimensions and determinants of the enjoyment of playing digital games: A three-level model. Faculty of Arts, Utrecht University, Utrecht, p. 257 (2003)
33. Kadle, A.: 9 Essential Elements for Fun in Games. UPSID learning (2011). https://www.upsidelearning.com/blog/2011/01/31/9-essential-elements-for-fun-in-games/