

12-3-2015

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### Recommended Citation

Sutrisno, Aziiz; Vennix, Jac A. M.; and Syaifudin, Noor (2015) "Improving Renewable Energy Transition Acceptance: A Simulation Gaming Approach on a Multi Actor Setting in the Netherlands," *Makara Journal of Technology*: Vol. 19: Iss. 3, Article 2.

DOI: 10.7454/mst.v19i3.3041

Available at: <https://scholarhub.ui.ac.id/mjt/vol19/iss3/2>

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## Improving Renewable Energy Transition Acceptance: A Simulation Gaming Approach on a Multi Actor Setting in the Netherlands

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### Abstract

The Netherlands have tried very hard to increase their renewable energy sources (RES) shares to fulfill the European Union target in 2050. However, RES performance did not show the expected result as the performance declined in 2009 producing even wider gap compare to the target. The Dutch government's tried to incorporate all interested stakeholders by forming the Dutch energy transition task force. Nevertheless, the task force's result is also not showing a desirable trend. Key reasons behind the Dutch low RES performance are the lack of shared understanding and positive attitude toward RES development among interested actors. This research uses a role-playing game to increase shared understanding and positive attitude within the actors. The game set players in a competing role as the government, an energy company and the end user. Players were given the ability to make decisions on their respective area. A pilot study was then conducted to measure the effectiveness of the game. The pilot study showed the game increased actor's individual understanding and shared understanding. Moreover, it also showed that the game increases actor's positive attitude toward RES development in the Netherlands.

### Abstrak

**Meningkatkan Penerimaan Transisi Energi Terbaru: Pendekatan Simulasi Permainan pada Situasi Multi-Aktor di Belanda.** Belanda telah berusaha sangat keras untuk meningkatkan sumber energi terbarukan (RES) untuk memenuhi target Uni Eropa pada tahun 2050. Namun, kinerja RES tidak menunjukkan hasil yang diharapkan karena kinerja menurun pada tahun 2009, yang kemudian memperlebar jarak dari target. Pemerintah Belanda telah mencoba untuk menggabungkan semua pemangku kepentingan dengan membentuk gugus tugas transisi energi Belanda. Namun demikian, hasil satuan tugas juga tidak menunjukkan tren yang diinginkan. Alasan utama di balik kinerja RES yang rendah di Belanda adalah kurangnya pemahaman bersama dan sikap positif terhadap pengembangan RES di antara para pemangku kepentingan. Penelitian ini menggunakan permainan *role-playing* untuk meningkatkan pemahaman bersama dan sikap positif pada aktor. Permainan ini menjadikan para pemain bersaing dengan satu sama lain sebagai pemerintah, perusahaan energi, dan pengguna akhir. Pemain dapat membuat keputusan pada daerah masing-masing. Sebuah studi percontohan kemudian dilakukan untuk mengukur efektivitas permainan. Studi percontohan memperlihatkan bahwa pemahaman individual dan pemahaman bersama para aktor meningkat. Selain itu, studi ini juga memperlihatkan bahwa permainan meningkatkan sikap positif aktor terhadap pengembangan RES di Belanda.

*Keywords: attitude, energy transition, shared understanding, simulation gaming*

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### 1. Introduction

The growing concern in extensive energy use has become a popular topic both in the academia and policy makers' area. Policy makers believe that the increasing rate of energy usage might harm the national budget and reduce the national performance on environment conservation, and current energy regime is too unstable

to support future economic growth. Therefore, they consider shifting the current energy regime to more reliable alternatives, namely using renewable energy sources (RES). RES provide economic, environmental and energy independence incentives for adopting countries [1,2]. Additionally, the acceleration of increasing interest on moving from conventional energy sources to RES is also coming from fear factors on geopolitical

changes in big oil producer nations and environmental challenges derived from consequences in physical and chemical usage of current energy options [3].

The 1997 Kyoto Protocol produced in the United Nations Framework Convention on Climate Change was considered as the kickoff point in the promotion of RES. Since then, the European Union (EU) has been working towards a RES supply equivalent to 12% of the total EU's final energy consumption by 2010 [4]. Additionally, European countries within the EU areas today produce 111% more energy coming from renewable energy than in 1990, making the EU the leader of RES development [5]. This fact proves that the EU is applying effective regulations to support renewable energy initiatives [3].

The EU translates energy principle consensus into an energy roadmap which assigns legally binding targets to individual member states. The objectives of EU-Energy roadmap 2050, as it is called, are to reach 80% reduction in greenhouse gasses (GHG) below 1990 levels by 2050 across the EU members and to create an energy system that delivers the same service level today. That means, the EU members must conduct a full transition to a new energy system in the way energy is used and in the way it is produced [6]. This requires a transformation across all energy related emitting sectors, moving capital into new more sustainable sectors. However, one of the RES development obstacles lies in the cost of its initial installation. The EU member governments have tried to stimulate RES development investment by providing several schemes such as feed-in tariffs and many more in order to make it more financially attractive than conventional energy. Such measures might increase pressures on the national budget and creates a governmental dependency on RES. Especially during the European financial crisis, governmental financial support to RES might have to be reviewed.

As one of the EU members and aligned with the national interest, the Netherlands also participates in supporting the EU directive on renewable energy. The Dutch government also ratified these EU-directives in the form of a National Renewable Energy Action Plan (NREAP) [7]. NREAP opens new opportunities for the Dutch RES performance as it integrates RES development in the EU area. The updates serve as a highly important addition since the nature of the Dutch energy market itself will be changing due to market size expansion and other new socioeconomic implications [8,9]. The Dutch energy agency predicts that if the NREAP policy on accelerating renewable energy usage is carried out, the share of renewable energy will increase from 4% currently to 8% in 2020. Although this is a strong increase, it is not enough to achieve the European target of 14% by 2020 [3].

The Dutch government has experimented with different approaches both in terms of policy instruments and in terms of the focus of the policy (demand vs. supply). Despite all the good effort from the Dutch government, the Dutch RES shares is still lagging behind expected rates. The result of the policy measure does not show the expected result. Figure 1 shows the RES development over time in. The green line visualizes how the system will develop after the introduction of NREAP.

The discourse and debate on the RES energy market also bring out some notable remarks on how the Dutch energy transition plan toward RES meets the concept of triple bottom line, in which transition to RES should benefit Dutch economic, environmental, and social performance. In this case, the government is well aware that there are three main groups attracted to RES transition based on their own values and interests.

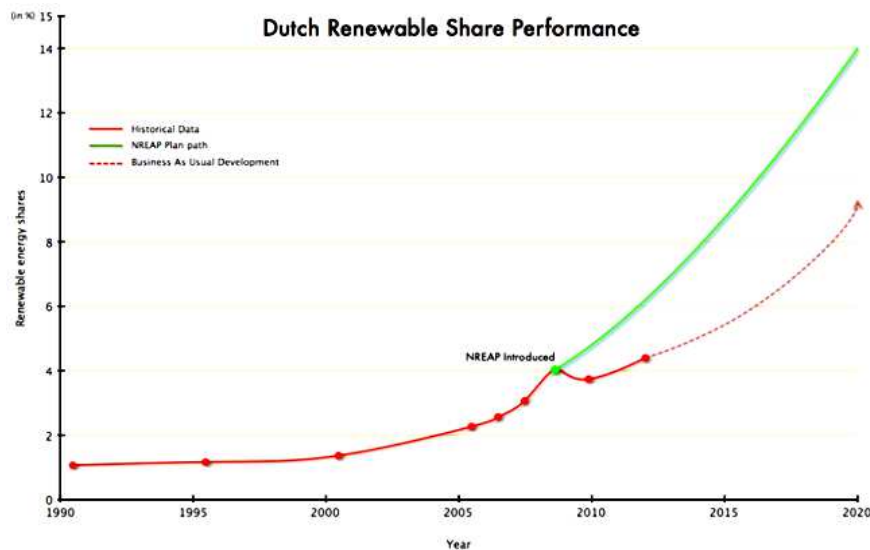


Figure 1. Dutch Renewable Share Performance (BAU Scenario Developed from CBS Data)

Three big interest groups on the Dutch energy transition plan are the Dutch government, the Dutch energy companies, and the citizen as the end user for any energy products. These interest groups are the main actors on the Dutch energy transition issue.

Having their own interest, these actors resemble a unique interaction on the energy roadmap issue. The end user mostly will affect the demand side of the whole energy system, mostly based on the attractiveness of energy price compared to their income, while the energy company affects the supply side mainly based on financial profitability. Therefore, the energy companies prefer to have a high energy price to maximize their profitability. On the other hand, the end user desires a minimum energy price. Such interaction creates a competing interest between two parties. The Dutch government has tried to bridge differences between all actors by forming a task force. This task force is a form of an acknowledgment that such shared understanding between actors is important. However, the RES task force failed to deliver the expected result. One particular reason behind that result is the inability of the task force in creating shared understanding that the government is a reliable and committed partner on the RES development policy to all other interested stakeholders.

The Dutch Energy agency reports argued that the reason behind low RES performance was the side effect of having a low energy price. As the energy price decreased compared to preceding years, and the household income remained at the same level, the energy consumption rose to a level where short term measures of adding conventional energy needed to fill in the gap of energy supply and demand. However, Shell report implied that the government lack of incentives forced the energy company to return conventional energy development (Shell, 2012). Additionally, recent consumer satisfaction survey shows that 83% of the Dutch people feel that the government must do more to achieve the RES target.

Clearly, all of the different opinions and positions of the actors shown above make the RES development plan harder to execute. Such disputes might play a big role behind the Dutch low RES performance. Several studies also back up this hypothesis by underlining the lack of shared understanding within the actors, which is the key problem of many RES development in the Netherlands or all over the world [10].

Having every actor interact in a social setting using an engaging platform might also improve opinion cohesion in the society. This notion follows Ajzen's theory of planned behavior (TPB), which states that having a supportive social norm will alter actor's behavior into the expected direction [11]. Furthermore, a gaming environment is a proven method to increase actor's individual understanding [11]. An expansion of a

traditional individual computer based game to a socially interactive role-play game has also been proven to have effect on converging player's understanding. This becomes the research objective for this study, which is to determine the effect of a knowledge exchange platform, particularly in the form of role-play simulation game, to increase actor's shared understanding and positive attitude toward RES development in the Netherlands. Academically, this study helps increasing the understanding of the effectiveness of a social role-playing simulation game for converging shared understanding and improving a positive attitude toward an issue. The present research bridges some of the gaps in the society shared understanding regarding the government RES plan by proposing a knowledge exchange platform that may lead to the converging of actor's understanding and attitude. It also might increase understanding of the dynamics within the competing actors. This study, currently, is the first to integrate learning platform effectiveness and attitude measurement.

## 2. Methods

The Dutch energy transition issue is a tricky and wicked situation. It is not a situation where the government could act as a single entity to force all interested actors to adopt the government initiatives. More than that, all actors develop their own course of action, which might decrease the overall RES system performance. It leads to a conception that the Dutch energy transition issues are difficult topics to discuss for all interested stakeholders.

A System Dynamics (SD) Model was developed to visualize and untangle the current Dutch energy system. SD is an approach to elaborate policy analysis discussion in a complex system which enables visual interactions between variables in the system. Moreover, many SD studies have been used in similar energy dynamics discussion thus making SD a compelling approach to be used on the energy policy discussion [12]. Next, a discussion on actor's perspectives and the notion of sociotechnical transition was included using insights coming from the system dynamics model and the literature. In the Netherlands, some of the studies focused on technological aspects of energy transition. Moreover, detailed discussion with transition management perspectives [13] and sociotechnical multi-dimension analysis [10] are part of the vast interest of the Dutch energy transition policy studies.

As the number of RES studies increases, the number of methods and tools being used in the area also increases. Many scholars have also tried to visualize and predict the trend developing in the area, which have made variety of tools appear at the scene. Nevertheless, the focus of this research is actor interaction as game players; therefore, the modeling method used in this research should be simple enough yet able to visualize

the system with its interactions and feedbacks. By visualizing policy feedbacks and creating a platform for the stakeholders to interact, it would be able to start a deeper and more fruitful policy discussion.

SD has been proven to give a better understanding of complex interactions among various factors [14] while at the same time also providing the ability to link observable patterns of behavior of a system in a multi-scale point of views, both the systemic pattern and in the more detailed performance indicators. The methodology of SD builds on a feedback view of the world, meaning that our decisions under certain goals alter the world and subsequently lead to new decisions [12].

One of the very early SD studies about energy transition was conducted by Sterman, and it showed the important notion of ‘competing resources’ between energy options. More importantly, the study also underlined the important interaction of the energy sector with the economic sector. We set out the simulations of energy transitions from a complex socio-technical systems perspective – for which the traditional approaches may be problematic. SD interprets the systems in a microworld setting that contains feedback mechanism, time delays, and non-linearity relevant in the system of interest. These tools and simulation paradigms are useful for policy interventions; nonetheless, the robustness of simulations needs to be expanded for two reasons. First, the tools are limited in their ability to capture long-term dynamics in infrastructures. Second, interventions in complex systems may change the structure of the system, causing the dynamics to change as well [15]. Those are the reasons for the difficulty to analyze long-term effects of interventions in complex systems.

Model development. In the past decades, the notion of price competition between the energy options has remained as the number one issue of the RES policy debate. Many beliefs on the power of market dynamics would eventually make RES as the primary energy

option as the conventional energy price keeps on rising and the RES price keeps on decreasing over the year. Unfortunately, the conventional energy price is not steadily rising as predicted. Especially since the crisis hit the United States and the EU, the price of conventional energy is declining due to the effect of lower energy demands from both regions. Particularly, there are concerns that the economic crisis will lower the conventional energy price further (IEA, 2011) resulting in a bigger gap of RES price. With the financial benefit and cost leaning even more toward conventional energy, the RES development needs stronger policy measures to push RES development harder beyond the energy lock-in. Figure 2 shows the importance of available capital which affected both RES and the conventional energy.

Socio-technical process as a part of the RES development has been abandoned in the earlier Dutch RES initiatives. The preliminary surveys on the public acceptance of RES revealed very high levels of support for the technology. Hence, it suggested smooth policy implementation. However, the RES development turned out not to produce the expected result. This fact implies the awareness of all actors on the ends of RES, but then it left out the details on consequences of implementing such a plan. One of the key characteristics of transitional change processes is their multi-actor nature. However, there is more in this multi-actor nature than just multiple agents interacting.

These interacting actors are not identical, but they possess very different properties, such as their preferences, objectives, and resources. The acceptance by key stakeholders and policy actors of effective policies on the social side, social actors (e.g. individuals, groups, organizations, firms) are the main motor of change in the socio-technical systems. In that respect, explicit recognition of these actors and of variety among them with respect to transition-related behaviors is important. Therefore, one of the building blocks on analyzing

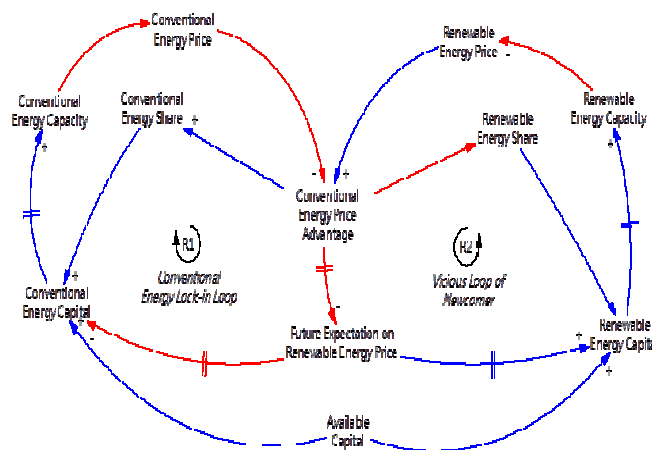


Figure 2. Conceptual Model on Energy Investment Lock-in where the Structure Shows a Success-to-successful Archetype

complex socio-technical issues is recognizing the actors which represent the social elements in the system. Actors and options are still aggregate concepts, but they represent relatively homogenous entities in nature, whose behaviors are easier to analyze empirically [16].

The shared actor's comprehension of the systems mechanism and opportunities is needed to put Dutch RES development back on the expected track. Shared understanding is a collective way of organizing relevant knowledge. Without shared understanding on each other's positions the Dutch RES plan will only be a good paper plan without effective implementation. In order to help them build cognitive bridges to the shared understanding, the research will focus on eliciting the actor's individual understanding of the Dutch energy system.

Studies show that more comprehensive and shared mental models between actors' seem to be at the foundation for improved policies and decisions [17]. It also has been asserted that learning in small groups relies a great deal on the group's patterns of interaction in guiding the coordination of the group [18,19]. Games and simulations provide such an engaging learning mechanism in terms of creating a socially cordial environment to share ideas. Moreover, it also enables organizations to envision alternative futures within a condensed time frame, and help them get a holistic view of the change journey and its results [20]. A gaming environment also brings out a positive friendly environment for actors to collaborate and share their ideas. Additionally, games and simulations help organizations create memories of the future; enable shared experiences and building of shared intelligence and develop their participants' motivation and confidence to act. Based on these findings, this shared experience will also increase a social subjective norm which eventually affects actor's intention toward renewable energy. These facts put simulation gaming as a potential candidate to improve shared understanding between actors.

Game usage on the learning environment is not new. Games have been applied in a broad spectrum of application areas, such as military, government, educational, corporate, and healthcare. Games are competitive interactions bound by rules to achieve specific goals that depend on skill and often involve chance and an imaginary setting. The nature of the simulation gaming method affects learning and performance. First, the extent to which users perceive the simulation as reflective of real life situations is positively associated with learning. Second, the ease of use of the simulation positively affects learning. Simulation gaming has also been proven to be an effective learning process in an iterative and flexible manner. It addresses three iterative stages of effective learning: mapping mental models, explicating and

structuring assumptions via systems models and challenging mental models. There is also evidence reported that a computer-assisted intervention is successful to facilitate behavior change, such as smoking, weight, exercise, and drinking problem [21]. These computer simulations give people first-hand insight into how inputs affect the outcome. Users are able to explore and learn how the system works by finding causes and effects of situations through computer simulations.

Social interaction in the role-play simulation game appears to influence understanding on the individual level as well as group shared understanding. The framework is based upon the notion that learning activities are the central construct of learning interactively with games and that these activities need to be considered in relation to experiential or exploratory models of learning, whereby the learner becomes an active participant in the learning processes [22]. As a bottom-line, simulation and gaming is able to address four important things on increasing shared understanding. First, it proves as an effective learning method which is building an understanding of the big picture. Second, it effectively builds a visceral understanding of possible futures that a system might find. Third, it also addresses the learning notion. It is becoming a part of our common sense understanding that groups are learning more effectively than individuals as the collective intelligent in a group will more likely to perform learning task better than individual intelligence [23]. Fourth, it also develops one's ability and confidence to make judgment calls and act in ever-changing circumstances.

Attitude is defined as actors' favor toward the Dutch RES plan and influenced by beliefs, including social influences, flow experience, perceived usefulness, and perceived ease-of-use. As a general rule, the more favorable the attitude and subjective norm, and the greater the perceived control, the stronger the person's intention to perform the behavior in question. Finally, given a sufficient degree of actual control over the behavior, people are expected to carry out their intentions when the opportunity arises. Ajzen and Fishbein encompassed this theory as TPB.

The Dutch energy transition SD model was built based on 4 well tested system dynamics models on the energy transition issue [24-28]. Those models were translated and modified to fit in to the objectives of the research. As a result, the Dutch energy transition model also employed the same basic structure of energy investment structures. The model's equations were developed based on different combinations of input variables for various sub-models on economic. These equations employed real-world data relevant to various internal linkages among socioeconomic factors. The model data sources mainly came from secondary source of publically accessible data.

The model was designed to draw feedback mechanisms between the socio-economic and energy sector in the Netherlands. However, due to its nature of being a game engine, the model itself did not need to have technical detail. The model was simple enough to provide a basic notion of feedbacks in the energy sector. In addition, the model was composed of widely accepted theories and empirical data. Furthermore, the Dutch energy transition model consisted of several sectors in order to make it clearer and easier to be developed. These sectors were then grouped into modules based on the broader functions. It goes without saying that the development of the energy system model required highly interrelated sociotechnical components. Figure 8 shows how the sectors interact inside the model.

Figure 3 illustrates the complexity of the interaction within the socio-technical components of the Dutch energy system. It shows us that the energy system itself is more than just an energy transformation process from the primary energies to the final energy consumption.

Because not all energy sources are the same in terms of cost structure and availability, the module was built by using the array function. Each array element represents one energy source. In this model the energy sources were Oil, Gas, Coal, Nuclear, Solar, Wind, Hydro and Biobased energy. This model used input from playing actors to determine the number of the investment portion of per options. In order to simplify the actors' calculation, their options were only divided into Conventional or Renewable Energy and distributed evenly based on the capital efficiency rank on each energy production sources. The model incorporated

capital delay function to show different financial perspectives over each energy options. For example, a big investment of Hydro energy takes more than 5 years to secure its funding while the other energy options might just need 1 year.

The model was validated and verified to have consistent behavior to be used as the engine of the game. However, it also needs to be underlined that the model objective itself was to elicit the Dutch RES system for different actors. Therefore, a lot of simplification was made in order to meet the objectives. In that case, the model should not be seen as a prediction tool or the whole representation on the Dutch energy system.

**Game mechanics.** To improve the user experience over the game, the role playing was supported by a computer simulation. This computer simulation helped all actors to review their policy decisions. In addition to providing social support. By giving users the change to actively engage in discussions and policy feedback, users would find a hands-on experience on attending a real policy making process. In this case, a hands-on experience would be a major attitude driver for users. Because users learned directly through first-hand experience and indirectly through observation, it would eventually improve the attitude toward the issue.

The game flow tried to capture the actors' diverse opinions on the issue. Every actor had its unique policy options. Some of the policy options were to be confirmed by other actors or even in some cases one policy option of an actor might have an interest conflict on another actor. Such impressions would then provoke

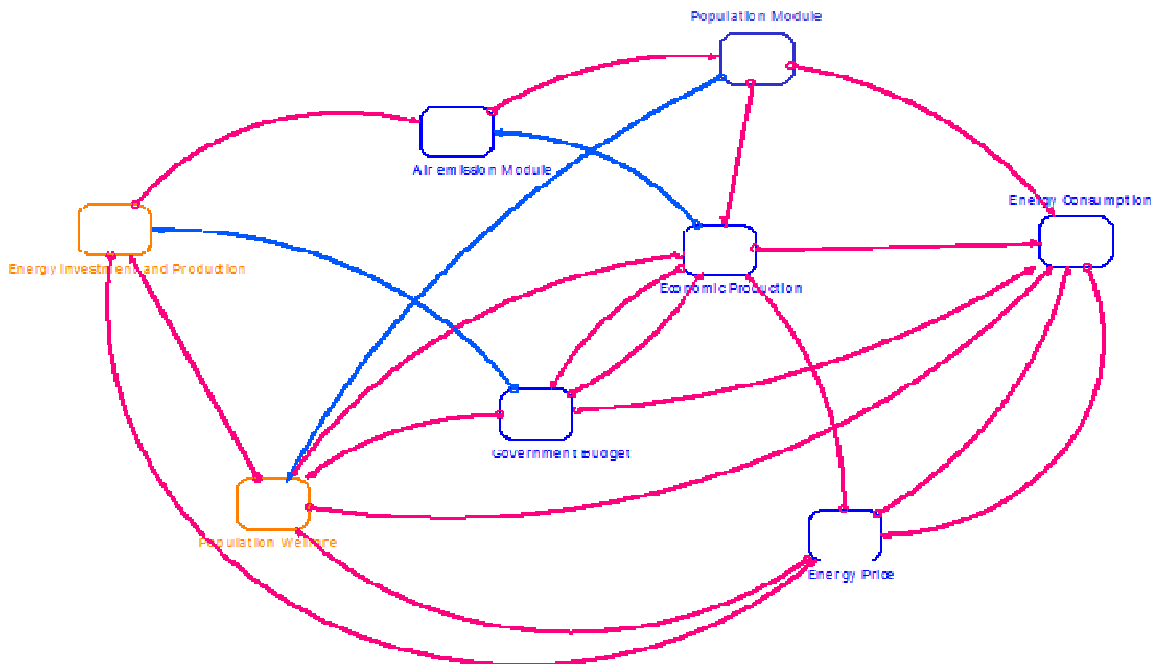


Figure 3. Model Sectors Interaction

more engaging social interactions between all actors which can be described as engineered social play. What is meant here by social play is active engagement with a game (through use of its controls or through observation and attention to ongoing game play) by more than one person at once. The game social play happens when actors are bargaining with each other on their policy options in order to protect their own interests.

Measurement of actors' understanding can be a tricky process since an actor's understanding is formed by a long term process over the actors' life. Often an actor's understanding on one issue reflects more than his idea, and it also reflects his embedded values and experiences over somewhat related issues. However, the research did not try to distinguish exactly actor's understanding or mental model on the concept of the integrated energy system as a whole. The research main purposes were to show the actor's mental model regarding on the development of the Dutch RES performance.

The proposed understanding measurement tool employed a measurement method proposed by Schaffernicht and Grösser on comparing individual mental models. The measurement tool analyzes the empirical material for dynamic components of a mental model in the form of a causal loop diagram which were operationalized by the number of feedback loops and the conceptual similarity underlining it [17]. It divided the number of feedback loops by the average loop length to control for the fact that longer feedback loops could more likely be parts of additional feedback loops. The method was claimed as a robust method on comparing individual mental models, because it addresses the selection of the feedback loops measured and the selection weights for the individual parts of the distance ratios used for the computation.

Addressing and measuring actor's attitude was also a complex topic. Attitudes are usually dormant and are expressed in speech or behavior only when the object of the attitude is perceived. This notion brings out several important factors that should be addressed on such a measurement. Argumentative issues of such measurement will invoke discussion on types of scale used and its linearity. In order to obtain the required information about individual attitudes, TPB surveys are generally used that address specific questions within a particular field of study [29]. An overlapping understanding might be derived from similar patterns of answers in the questionnaires. The measures developed on the basis of the pilot data assess attitudes, subjective norm, perceived behavioral control, and intentions. In addition, the questionnaire will usually also include a measure of past behavior before participants play the game.

The internal-consistency method rests firmly on classical scaling theory. If the scale is expected to measure a single underlying continuum, then the items should have

strong relationships both with that continuum and with each other. In principle, validity indicates the degree to which an instrument measures what it is supposed or intended to measure which seeks to establish that the items or questions are a well-balanced sample of the content domain to be measured. The TPB questionnaire development is straightforward and well-documented [30].

### 3. Results and Discussion

The experiment conducted in this study was a pilot test of the proposed method. It tried to seek out the potential effects of the proposed method on the players. Intriguingly, although it was only played in a relatively small sample size, it still produced many interesting results to develop the proposed method further. The experiments were conducted in three different sessions. Each of these sessions was designed as a "ex-ante and ex-post with control-group"-design. The experiment gathered actors understanding by having them fill out the questionnaire asking their opinion on the topic with a causal loop diagram. Those diagrams represented each actor's understanding before and after the experiment. Based on this finding, there is supporting evidence that the RPSG might be a useful tool to improve participant understanding just as recommended by Garris *et al* [31].

Table 1 comprises the elements of the analysis by comparing the total number of variables, causal links, and loops drawn in the first and second question of the questionnaire of each individual.

To investigate potential attitude differences between pre-test and post-test, the questionnaire data was based on TPB. The questionnaire was validated with Wilcoxon signed-rank test and the Cronbach test to see the internal reliability of the test. Statistically, the test proved that the developed questionnaire was reliable. The questionnaire scored 0.86 in the pre-test and 0.87 in the post-test which indicated the internal reliability of the questionnaire is sufficient. Then, these data were treated by the same t-test analysis to determine the effect on the experiment to the actor's attitude. Table 2 displays the summary of the statistical test results on the actor's attitude toward RES development in the Netherlands.

The test showed that the attitude towards the RES development was positively increasing after the experiment. Moreover, the test result ruled out the possibility of having maturity effect on the attitude by showing that the control groups test result did not show significant improvement on their attitude. In Figure 4, it can be seen that players playing the government roles had relatively small variance compared to other players.

Figure 4 might represent the phenomenon that happened in the society over the RES development issue. Public perceptions of a range of renewable energy sources



were mostly positive; however, the public attitude regarding the renewable energy still show diverse opinions depend on the payoff to access the RES based energy. Such a condition created a ‘Not In My Backyard’ (NIMBY) Syndrome in the society, where public perception of the RES was high as long as the RES development did not affect people’s daily life [32].

Therefore, it was not enough to just rely on the public perception on the RES while at the same time public participation on the RES development itself was still low. Wustenhagen *et al.* [33] suggest three dimensions of social acceptance, namely socio-political, community, and market acceptance.

Increasing participation and empowering community on the RES development will reduce the variance on the public attitude toward the RES development. Nevertheless,

attitudes and behaviors are complex topics. Regulation, economic instruments, and provision of information is not enough to shape a solid positive attitude on the RES development in the society.

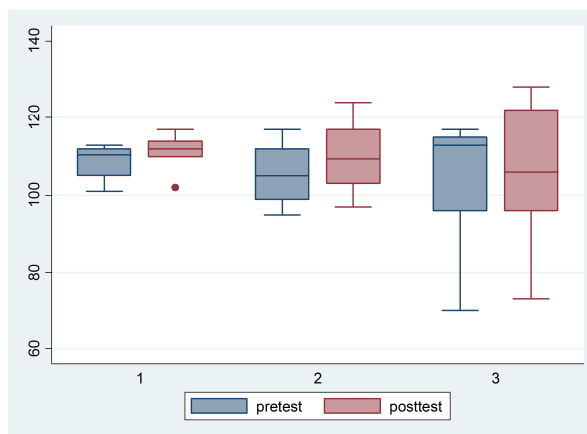
The study tested the influence a game had on the actor understanding based on their roles. In this particular matter the test results showed that there were significant differences on the improving test results between roles in one group. It showed the government role scored significantly lower improving individual understanding than the other roles. This result might come from the initial notion of different interest. This happened due to the fact that the government role as regulator on the energy system required a certain level of understanding on overall energy system as well as adequate understanding level on both the energy company and the end user interest. However, this position also tended to makes the

**Table 1. Individual Understanding Measurement**

Indicator Mean Values	Experimental Group					
	Before			After		
	The Gov	Ener Com	End User	The Gov	Ener Com	End User
Number of variables	2	2.33	2.33	⇒ 2	↓ 2	↓ 2
Causal Links	2.33	2.33	2.33	↓ 2	↓ 2	↓ 2
Loops	1	0.67	0.67	↑ 1	↑ 1	↑ 1

**Table 2. Attitude toward RES (MW= Mann-Whitney Test, KW= Kruskal-Wallis Test)**

Text	Test Result
Pre- vs Post-test in experimental group	t-test, paired (p≈ 0.008; Pr (Post>Pre) = 0.99; MW, P=0.01
Improving test result (experimental vs control group)	t-test, paired (p≈ 0.01; Pr (Exp>Con) = 0.99; KW, P=0.01
Pre- and post-test on the roles	Nested Anova, p value = 0.59 in population and 0.41 within exp group; KW, p=0.649



**Figure 4. Box Plot Graph of the Attitude Test Scores (1) The Government Role (2) The Energy Company Role (3) The End User**

government as an inert actor in the discussion process. A different rendition of government perspectives is needed because it has been proven that the government actions in the past by imposing both fiscal and monetary policies were not enough to foster the RES development in the Netherlands.

The second important result of the analysis addressed the possible effect on the actors shared understanding after playing the game. Statistical tests conducted in the research analysis did not show a significant effect on converging shared understanding between the actors. This result does not reflect the expected result from the proposed method. However, there are some possible explanations over the reason behind the unexpected result. One possible explanation involves the source of the participants in the game.

The game itself provided shared experience, open communication, and an information sharing platform for converging the shared understanding. Additionally, it also provided an environment to build team spirit within the groups following the Hinds and Weisband theory to converge shared understanding. One might argue that a one-and-a-half-hour role play game would not immediately replace the actor's individual understanding which accumulated from years of experience and education. Another possible explanation involved increasing conflict within the group because of heated discussion between the actors in the same group. With such conflict escalation inside the group, it would be unlikely to cause a converging shared understanding. The participants in the game exhibited the 'group cohesion effect' when the competition between the groups became less decisive, the players devoted fewer resources to the intra-group conflict, in which on this case some of the participants thought the intra-group competition was more important than achieving the big target [34]. Another interesting finding came from the polarization of actors understanding. Through some qualitative observation, the end user actors tended either to be more like the government or the energy companies. Furthermore, the group which comes out with a "virtual" leader or an alpha figure would most likely have better shared understanding compared to the group with a lot of strong figures or no strong figure at all. This fact brings out the interesting notion of group cohesion in the course of the game.

Connecting transition management body of knowledge in a computer simulation model was challenging, if not impossible. It brought notions from various fields which were so different that they were hard to link conceptually, let alone to be formalized into a computerized simulation model [35]. In any case, the research presented here was a first step in contributing to evaluating the effectiveness of a role playing simulation game to increase individual and shared understanding as well as changing attitude

toward an issue. The potential of using this RPSG to improve the actor individual understanding, shared understanding, and attitude is big because the game provides a motivating environment and the ability to present complex environments with repeatable and insightful display [31]. In particular, the proposed game also provides a basis for organized communication about a complex topic. Moreover, the proposed game also provides the quality on motivating stakeholders and presenting the scenario result might help to increase the actor's individual and shared understanding as well as increasing a positive attitude toward the issue [32,36,37].

#### 4. Conclusions

This paper is an exploration of the effort to improve the Dutch renewable energy sources performance by introducing a role play simulation game (RPSG). This research mainly focused on the study of the effectiveness of the RPSG to improve actor individual and shared understanding as well as increasing positive attitude toward renewable energy sources development in the Netherlands. The research found that there were significant evidence supporting the effectiveness of the proposed method on improving the actor individual understanding and the actor attitude toward the RES development in the Netherlands. It might be worth to note that despite some of the mock-up statistical tests on the proposed method did not show expected result, there were still some results showing improving shared understanding answers. Therefore, the paper conclusion would be to recommend the potential of RPSG in the discussion process of the RES development in the Netherlands because it shows the potentials of increasing the actor individual and shared understanding as well as improving positive attitude toward the RES development in the Netherlands.

Despite all of the findings mentioned, it does not assume to be universally received solution for improving the RES performance in the Netherlands, but as a first step in the right direction over the effort to improve the condition. The future research will benefit from more samples than suggested and conducted in this research. Furthermore, by having more samples and actual actors playing the RPSG it will open much more interesting research findings. Since the development of virtual meeting space in the world is also allowing actors to play the game in an online setting.

#### Acknowledgements

The author gratefully acknowledges support from Erling Moxnes, Ettiene Rouwette, and Isti Surjandari for their valuable inputs. The authors also acknowledge financial support from the European Commission for this research. A great gratitude also acknowledged to the reviewer/s for their tireless endeavor.

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