Technology, Policy and Management

Towards more sustainable development of offshore wind power (OWP) by looking from institutional economics point of view

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Abstract

Sustainable development of large-scale offshore wind parks is a complex issue and applies extensive investigation. Social aspect of sustainable development of OWPs is recognized as one of weak pillars of sustainable development. Paradigm shifting could be one way to resolve this issue. Shifting to institutional economics, in place of neo-classical economics, is suggested by this study. This approach encompasses social aspects as much as possible. This research consists of literature review and case study of OWPs development in the Netherlands. This study unfolds that social justice, in term of fair distribution of ills and benefits, is one crucial social issue which will be a matter by designing and choosing of an institution. Unfair distribution of ills and benefits is a conflict caused by variation of values and interests. Consideration of social justice helps to result in a more sustainable development of OWPs. Further researches are needed to develop frameworks for resolving conflicts over values and interest regarding sustainable development of large-scale OWP systems.

Key words: *Institutional economics; Offshore wind power; Sustainable development; Social aspects; Social justice*

1. Introduction

Shifting to renewable energies aids at overcoming challenges derived from the power generation from conventional energy sources (ellabban et al., 2014). Offshore wind power (OWP) is one of the suggested options for electricity generation from renewable energy sources. As a relatively novel renewable energy (RES-E) technology, power generation by OWP technology is not enough economic in compare with some other RES-E technologies (bio-fuels) and conventional fossil fuels (Kaldellis et al., 2013). This is considered as one of main reasons for low diffusion of large-scale OWPs in the Netherlands and also in other EU countries (Negro et al., 2012).

Governments use policy instruments to support OWP projects for overcoming of relevant market barriers in the most economic way (Haas et al., 2011). In order to design and imply policy instruments, usually governments refer to neo-classical economic approach wherein the choice of a given support system is a matter of efficiency. For instance, in the Netherlands, the

Dutch government provided several regulations (e.g. MEP, SDE, SDE+) to stimulate developers to invest in new OWP projects. In all of these three plans, policy-makers focus on effectiveness and efficiency. The Dutch government tried to develop OWPs in efficient way. They started with price based policy (Feed-in Tariff) under MEP and SDE. They stopped them due to they said they are not efficient. Therefore they diverted to quantity based policy, SDE+, to develop RES-E technologies in the most efficient way. On the other side, the Dutch utilities, as main developers, did not invest in development of new OWPs. They argue that they have access to more efficient ways (Natural gas and coal) for power generation. And the Dutch electricity consumers, even young generation, perceive that power generation from OWPs is expensive (Wieczorek et al., 2013). These all result in, only 376 MW OWP (2016) is developed while they have planned to develop 6400 MW up to 2023. This demonstrates that looking at this issue from neo-classical point of view does not lead to meet relevant objectives.

Therefore it is important to change point of view. New institutional economics (NIE) is one of options. Looking at RES-E from new institutional economics (NIE) gives a new perceive about successful development of RES-E. From this point of view (NEI), not only economic oriented aspects (efficiency and effectiveness), but also environmental and social aspects are important and determinant aspects for successful development of RES-E.

Power generation from offshore wind is a sustainable way for power generation, but sustainable development of one offshore wind site is another issue. Therefore beside the changing (improving) current economic perspective for looking at development of OWPs, sustainable development of OWPs is a crucial subject for consideration.

This paper will be started by clarifying of aim and objectives of the paper. Also research method will be discussed. Some key terms would be described at the third part of this paper. To the extent that literature is available, this study will investigate sustainable development of OWPS, sustainability in new institutional economics (NIE) approach, and more sustainable development of OWPs by NIE approach. The next part includes the case study. And discussion of results and conclusion compose the two last part of this study.

2. Aim and objectives

The aim of this paper is to integrate studies on the concept of sustainable development of large-scale offshore wind parks (OWPs) with the concept of sustainability in institutional economics approach, and, as the final aim, to illustrate the sustainable development of OWPs from institutional economics point of view. This is achieved through addressing three objectives: (1) creating a set of definitions; (2) conducting a literature review and also a case study on sustainable development of OWPs and sustainability in institutional economics approach; (3) addressing the importance of social dimension in sustainable development of OWPs. This helps to shifting our perspective from neoclassical economics to institutional economics. This study will be one step in stimulating the debate on integrating social aspects and economic aspects in decision-making regarding development of OWPs, as one of RES-E technologies.

3. Research method

This paper is a study with two main interweaved sub-subjects: sustainable development of offshore wind farms in the Netherlands, and social governance in new institutional economics (NIE) approach. These two topics have two absolutely different features: once, sustainable development of OWPs is almost a well-known and mature field, and another one is not so rich.

Issues related to sustainable development of OWPs have been extensively studied for decades, therefore this topic has a rich body of literature. Those available literature have been studied for not only to get an insight into this subject but also to review what has been done up to now in this field. On the other side, due to the lack of rich literature on sustainability in new institutional economics (NIE) approach, I decided to investigate sustainability in NIE with analogy (comparative study). In other words, social governance in NIE approach is compared with environmental governance in the NEI approach and in the neo-classical economics approach.

This systematic literature review includes three domains. Review on every domain is triggered by one leading reference: paper "review of the European offshore wind innovation system" (by Wieczorek et al., 2013), paper "Assessment of sustainability indicators for renewable energy technologies" (by Evans et al., 2009), and scientific article "Institutions and environmental governance: A reconceptualization" (Paavola, 2007). Authors of the article "review of the European offshore wind innovation system" try to provide an insight into the overall European offshore wind innovation systems. Moreover this article compares OWP projects development in the Netherlands, the UK, Denmark, and Germany. Authors of the article "Assessment of sustainability indicators for renewable energy technologies" try to assess and rank some RES-E technologies based on several important sustainability criteria. In "Institutions and environmental governance: A reconceptualization", Paavola (2007) argues that sustainable governance is best understood as the establishment, reaffirmation or change of institutions to resolve conflicts over unlimited values and interests, and limited resources.

"Google scholar" and "Scopus" are used as two search engines for finding relevant literature. Combination of some key words is used to detect desirable literature. Key words such as institutional economics, renewable energy, offshore wind power, sustainability. This led us not only to some useful articles or books, but also to find some professional and academic journals such as "Ecological Economics", "Renewable and Sustainable Energy Reviews", and "Energy Policy".

4. Definitions

The large-scale of *offshore wind parks* (OWPs) is a socio-technological system. Offshore wind power technology is relatively in the early stage of technological development (Wieczorek et al., 2013). This means it is a commercial immature technology. From technological point of view, development of OWP systems is characterized by high capital costs, relatively low variable costs, long lead-time, extensiveness of scale, and relatively less availability.

The concept of *sustainable development* has been developed to upgrade human welfare by combination of environmental issues with socio-economic issues (Hopwood et al., 2005). The Commission of the European communities defines the sustainable development as the long-term consideration of economic growth, social cohesion and environmental protection (communities, 2001). This implies that the economic, social, and environmental dimensions are three main pillars of sustainable development.

The concept of *new institutional economics* (NIE) is an approach to look at economics from an institutional point of view by incorporation of theory of institutions into economics (North, 1995). This incorporation determines the rules of the game for economic exchange (Feige, 1990). New institutional economics focuses on social norms, and rules.

5. Methodological knowledge

5.1. Literature review

5.1.1. Sustainable development of offshore wind parks (OWPs)

By sustainable development of large-scale offshore wind systems, developers concern not only generation electricity in the most economic way but also (negative) social and environmental impacts. Some indicators should be identified for evaluating sustainability of energy generation from OWP technology.

Scientific articles have been reviewed, and several criteria are listed. Researchers used those criteria to assess sustainable development of OWPs and other RES-E technologies (Table 1). This literature study starts by article (Evans et al., 2009). This article establishes the structure of this part of the research, and also leads to some other relevant scientific papers. The keywords used in the literature search were: sustainable development, evaluation, offshore wind power, social impacts, environmental impacts, economic aspects. Some of those evaluation criteria are listed in Table 1, and would be discussed in the next paragraphs.

Table 1: List of indicators regarding assessment of sustainable development of RES- E technologies

Sustainable development aspects	Sustainable development indicators
Economic	Availability of resources, Efficiency, Effectiveness, Technical availability, Contribution to job creation
Environmental	Greenhouse gas emissions, Qualitative environmental impacts, Ecosystem
Social	Qualitative social impacts, Equity

- **Availability of resources**

In general, offshore wind energy has great resource potential, which generally increases with distance from the shore (Kaldellis & Kapsali, 2013). High availability of wind energy sources is derived from the high magnitude, speed and duration of wind blowing in sea. This means that there is a sustainable availability of wind resources in sea. The European Commission expected 5800 GW is the technical potential of OWP in Europe, that 150 GW of OWP capacity could be realized up to 2030 (Wieczorek et al., 2013). Also the European Wind Energy Association (EWEA) anticipated that around 6000 MW of offshore wind capacity to be realized by 2030 in the Netherlands (EWEA, 2011).

- **Effectiveness**

Effectiveness is the extent to which objectives are met (Mitchell et al., 2011). In case of OWP, the actual increase in the amount of electricity generated by OWPs in total electricity supply within a specific time period. Effectiveness or productivity could be measured by capacity factor or utilization factor of the local wind potential. Capacity factor of offshore wind (20% - 40%) is more than onshore wind (20% - 30%) due to stronger and steadier wind blowing in sea compare to in land (Kaldellis & Kapsali, 2013). Effectiveness of OWP depends on availability of wind resources (magnitude, speed, direction and duration) and commercial maturity of OWP technology. The OWP technology is at pre-commercial mature step that leads to relatively low performance (effectiveness). Some environmental and social restrictions decrease that effectiveness. For instance regulations determine that only 4% of the offshore area within 10 km from the coast could be used for construction of OWPs (EuropeanEnvironmentAgency, 2009). Also there are some restrictions imposed due to existence of other sectors and actors

(e.g. gas and oil sites, shipping lane, etc.) who work at that area. These all of environmental, social and technological restrictions cause that although the Netherlands has almost 2700 TW unrestricted technical potential for offshore wind energy in 2030 (EuropeanEnvironmentAgency, 2009), but only 6000 MW of OWP capacity could be realized up to 2030.

- **Efficiency**

Efficiency, in general, is defined as the ratio of outcomes to inputs (Mitchell et al., 2011). For instance, referring OWP it could be defined as the ratio of OWP targets achieved to economic resources spent (Mitchell et al., 2011). Although current power generation is not efficient, due to commercial immaturity of OWP technology, but studies (Hobohm et al., 2013; Ederer 2015) show it is expected that relevant technological innovation leads to cost reduction by up to 39% through 2020. This results in a levelized cost of power of 9 ct/kWh (Ederer, 2015). The same as effectiveness, efficiency depends on availability of wind resources (magnitude, speed, direction and duration) and commercial maturity of OWP technology. High installation, connection, and maintenance costs lead to low efficiency of power generation from OWPs.

- **Technical availability**

The technical availability implies "the hours of operation of a given wind turbine or wind farm by considering the time period that the machine is kept out of operation due to e.g. scheduled maintenance, unforeseeable events (e.g. lightning, sudden fault of a machine) etc." (Kaldellis & Kapsali, 2013). The technical availability of offshore wind turbine depends on the technological status of the installation at the time it went inline, the technical availability changes, and the accessibility difficulties of the wind farm under investigation (Kaldellis & Kapsali, 2013). These imply that the technical availability of OWPs varies due to some factors such as the distance from the coast, local climate change (determines the accessibility to offshore wind site) etc. Therefore the technical availability of OWPs varies between 67% (Barrow site – UK, online-2006) and 98.3% (Tunø Knob – Denmark, online 1995) (Kaldellis & Kapsali, 2013).

- **Contribution to job creation**

Employment creation is not only an economic benefit but also a social advantage of OWP development. Over the five years (2006 – 2011), 60,000 new jobs have been created in the wind energy sector in the EU (Bilgili et al., 2011). In the Netherlands, over 2150 people works full time in the offshore wind sector by 2014.[1]

- **Greenhouse gas emissions**

Greenhouse gas emissions measured in "grams of CO_2 are emitted according to the full operational life cycle of each renewable energy technology including CO2_e emissions from manufacturing of the plant to full operation of the technology" (Evans et al., 2009). It is noteworthy that the greenhouse gas emissions are not constant within each technology. Figure 1 illustrates that the emissions differ widely within technology.

[1]/http://www.offshorewind.biz/2014/10/17/the-netherlands-offshore-wind-creates-2150-full-time-jobs [1]

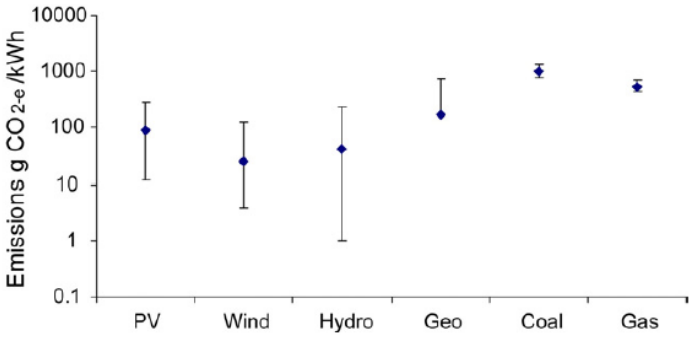

Figure 1: CO2 emissions by different technologies during power generation (Evans et al., 2009)

As Figure 1 shows power generation from wind technology leads to low greenhouse gas emissions compare to other technologies.

- **Qualitative environmental impacts**

Although power generation from OWP is considered as an environmental option to replace electricity production from conventional fossil fuels resources but construction of large-scale OWP sites leads to some potential negative environmental impacts. There are some negative impacts regarding electricity generation from OWPs such as bird strike, (short-term and long-term) negative impacts on marine life, aesthetics, fishing negative impacts, boating and yachting safety (Musial et al., 2006). In more detail, construction of OWPs causes marine mammals dispersed away due to high level of noise.

- **Qualitative social impacts**

Power generation from OWP or other (RES-E) technologies results in a wide range of positive and negative social impacts. Positive impacts include less dependency to import of fossil fuels from some uncertain geopolitical areas, price fluctuation etc. On the other side, deployment of OWPs causes some protests by local communities such as residents at the shore, fisheries, the oil and gas industry (Eggink E., 2013).

- **Equity**

Equity regarding development of large-scale offshore wind farms refers to unfairness of distribution of ills and benefits. Development of large-scale OWPs requires huge investment. This leads to two main challanges; small power companies could not enter to this field. Only giant power (energy) companies have potential ability to invest in development of large-scale OWPs. To cover those huge capital costs, power companies need governmental financial support for investment in this field or they impose it on (paid by) end-consumers. This extra payment has more negative impacts on low income households. This is unequal distribution of associated ills and benefits and threatens equity in society.

For illustration of a more clear insight into sustainable development of OWPs, the multi-criteria analysis (MCA) is used. Although usually the MCA is applied for comparative evaluation of some alternatives on some identified criteria, but in this study this method will be used to show that by developing of large-scale OWP projects which aspects of sustainability is considered less than other aspects.

Table 2: Structure of the performance matrix regarding the case of sustainable development of OWPs (Adapted from (Lotfi et al., 2011)

Sustainable aspects	Sustainable development indicators					SUM
Economic	Resources availability	Efficiency	Effectiveness	Technical availability	job creation	-
	+++	--	--	-	+	
Environmental	Greenhouse gas emissions		Qualitative environmental impacts			++
	+++		-			
Social	Qualitative social impacts		Equity			++
	++		0			

Among three aspects of sustainability, environmental and social aspects of sustainability are more considered by the development of large-scale OWPs. In other words, although the development of OWP is not relatively economic, but it considers relevant social and environmental concerns.

5.1.2. Sustainability in new institutional economics approach

Referring to definition of sustainability, it is essential to consider economic, environmental, and social aspects in time of choosing of economic approaches. Neo-classical economics and institutional economics are two of main classes of thought in economics.

Neo-classical economics is defined as "an approach which (1) assumes rational, maximizing behavior by agents with given and stable preference functions, (2) focuses on attained, or movements toward, equilibrium states, and (3) excludes chronic information problems" (Hodgson, 1998). This economic approach concerns only pure economic issues such as GNP growth, employment, balance of payments, indices of inflation (Soderbaum, 1992). This implies that this approach was developed to deal with pure economic problems and was not elaborated to concern social and environmental issues. In other words, developers of this economic approach did not think to develop a method to deal with social and environmental issues. From sustainability point of view, the neo-classical economics is not a proper approach to result in sustainable development.

In contrast, the Institutional Economics (IE) is an option suggested addressing social and environmental issues by focusing on actors, their perspectives, interests, and also by concentration on institutional arrangements (Soderbaum, 1992). The institutional arrangements "refers to organization, rules of the game, power relationships, entitlements and other types of control over resources" (Soderbaum, 1992). Since people have their own interests and roles, and they are taking part in activities, those activities could be well-managed by incorporation of institutions (rules of the game) into economy.

Environmental issues in IE

Under conventional economic schools, such as neo-classical economics, economists assume that everything can be traded against everything else in monetary terms (Soderbaum, 1992). This sort reasoning is not suitable way to discuss environmental impacts (issues) which are almost irreversible and cause infinite costs. For instance, negative environmental impacts (e.g. jungles depletion or oil resources depletion) on next generation not only are irreversible but also they could not be traded in monetary terms. Then institutional economics is suggested to deal with those environmental problems by providing of (new) regulations and also by consideration of variation of interests, ethical matters (intergenerational

justice) etc. By consideration of institutions, the relevant uncertainties would be decreased. Institutions, as the roles of the game, also lead to resolve conflicts over environmental resources (Paavola, 2007).

Social issues in IE

In contrast to neo-classical economics, institutional economics does not focus only on market (economic) efficiency. Beside economic efficiency, the institutional economics approach focuses on a wide range of social issues such as social responsibility, equity, social exclusion etc. Human beings are involved in interactions while they have interdependency and follow their own (conflictive) expected and unexpected interests. Institutions could minimize conflicts and uncertainties by creation of social framework governing those interactions or by providing relevant regulations, as the rule of the game. In other words, institutional economics is an approach to look at economics from an interdisciplinary point of view by focusing on social-ethical aspects (Soderbaum, 1992). Interdependency implies that a decision by one of involved actors influences that of another (Paavola et al., 2005). This social influence shapes the decision-making. It is different with neo-classical economics wherein optimal solutions based on calculations on monetary shapes the decision-making (Soderbaum, 1992).

The traditional institutional economics is improved and replaced by the New Institutional Economics (NIE). The NIE is "an attempt to extend the range of neo-classical theory by explaining the institutional factors traditionally taken as givens, such as property rights and governance structures, and, unlike the old institutionalism, not as an attempt to replace the standard theory" (Rutherford, 2001). The concept of interdependency is one of the main cornerstones of the NIE. Agents are independent in consumption of private goods with attributes such as rival consumption and excludability (Paavola, 2007). In this situation (consuming private goods), private priority rights are established in order to govern it (Paavola, 2007). This interdependency creates conflicts due to limitation of resources and variation of interests (Paavola, 2007). It is needed to get insight into social norms and shared values for overcoming those created conflicts. Then this is not an issue of efficiency (economic effectiveness), but that of social justice.

5.1.3. More sustainable development of OWPs by NEI approach

As discussed earlier, by evolutionary development of institutional economics, it is aimed at not only gaining economic efficiency but also considering environmental and social concerns. Also it is addressed that economic growth beside the consideration of relevant environmental impacts and social concerns will lead to sustainable development. This shows the similarity of addressed points by sustainable development and the NEI approach.

Development of a large-scale offshore wind park, as a socio-technical system, is a technological and economic project that brings up social and environmental impacts. Since "the social dimension has commonly been recognized as the weakest pillar of sustainable development" (Lehtonen, 2004), therefore in this study, social impacts of the development of OWPs will be discussed. Development of a large-scale OWP leads to some social conflicts caused by variation of values and interests of involved actors.

In the Netherlands, several actors with their own values, interests, resources, and goals are involved for development of an OWP project (Table 3). They share their own resources and pursue their objectives.

Table 3: The list of main involve actors for development of one OWP projects in the Netherlands

Actors	Values	Interests	Resources	Objectives
Dutch government	Sustainable social democratic development	More electricity generation from RESs	Policy instruments	More power generation from OWP
Developers	More share of market	More reputation via power generation from RESs	Economic and technological resources/facilities	Efficient electricity generation from OWP
Financial agencies	More profit		Financial funds	Safe financing projects
Fishery industry	More profit	Maximum access to fishes	Economic and political negotiations/lobby	Access to fishes
Military		Maximum access to sea	Political negotiations	Minimum disruption for access to sea
Shipping	More profit	Maximum access to sea	Economic and political negotiations/lobby	Access to sea
Environmental NGOs	Protect environment	Less negative environmental impacts	Social pressure, political negotiations	Minimize negative environmental impacts
Electricity consumers	Depend on consumers (cheap/green electricity)	Cheap electricity	Tax payment, electricity payment, national vote for new parliament	Cheap (reasonable) electricity

The OWP technology has some distinctive features such as high capital costs, relatively low variable costs, long lead-time, extensiveness of scale, and relatively less availability. These distinctive features result in market failures. Hence governmental intervention is needed to overcome those barriers. Usually governments use public resources such as economic policy instruments (e.g. Feed-in Tariff, Tradable Green Certificates) for that intervention.

Also those distinctive features cause that investors (developers) do not have motivation to invest in those projects. Developers need economic supports during deployment of OWP projects and also they want to be supported during operation phase by guaranteed electricity purchase (tariff) by someone, preferably by government. In the Netherlands, energy companies invest, build, own and operate OWP projects (Negro et al., 2012). The support systems also could persuade financial agency to support investors.

Usually OWPs are located at sites which other actors (industries), such as fishery, military, shipping, etc. are there.

Environmental NGOs are another actor that tries to protect sea against negative impacts caused by deployment of OWPs. They encourage social pressure and do political negotiations to influence deployment process in order to minimize the relevant negative impacts on sea environment.

As the last but not the least actor, end users of electricity are involved by development of an OWP. Electricity consumers pay for deployment of an OWP projects through several ways. Sometimes they pay it via electricity bill directly. In some cases, electricity end-users support OWP projects through tax paying. Tax paid by consumers is used as policy instruments to

support OWP projects. In every case they must pay for development of OWPs in a social democratic country such as the Netherlands.

These all demonstrate that development of a large-scale offshore wind farm brings up some costs (ills) and benefits. Therefore fair distribution of those ills and profits is a crucial social issue. Social governance implies that all relevant institutional solutions are needed to overcome those conflicts over distribution of ills and benefits caused by variation of values and interests. Thus for conceptualization of this social issue, the choice of institutions is a matter of social justice rather than of economic effectiveness.

Since almost all of those recognized actors are interdependent on each other, usually those actors could not realize their objectives in the subject of conflicts simultaneously (Paavola, 2007). As Paavola (2007) suggests, those conflicts over interests could be resolved by defining whose interests are to prevail, and to what degree (Paavola, 2007). This study focuses on conflicts over distribution of costs and benefits imposed/rewarded on consumers and developers, and overlooks the other conflicts between other involved actors.

5.2. Case study (OWP development in the Netherlands)

Up to 2016 in the Netherlands, only 357 MW OWP is installed and is connected to national grid. This amount is too far from the objective (6400 MW up to 2023). As mentioned earlier, due to some distinctive technological features of large-scale OWPs, the development of OWPs supported by governments. In the Netherlands, the Dutch governments supported these projects since early 1990s. They tried several economic policy instruments to promote power generation by OWPs. They implemented policies such as Ecotax, Feed-in Tariff, and Tradable Green Certificates etc.

Up to now, the economic oriented criteria (efficiency and effectiveness) were two major criteria for evaluation of policy instruments implementation (Kuhn, 1999; Menanteau et al., 2003; Haas et al., 2004; Regwitz et al. 2006; Bergek et al. 2010; Haas et al 2011; Mitchell et al. 2011; Del Rio 2014;). The Dutch governments, especially the right wings, assess those policy instruments from neo-classical economic point of view. Therefore increasingly they have diverted to more economic effective policies, quantity driven policies (e.g. TGCs). By these support systems, they aimed at stimulating investors to invest in new OWP projects. Usually they finance those policy instruments by state budget. In some cases, developers impose associated costs on consumers through electricity bills that led to some unequal extra ills for low income households compare to high income households.

Despite these support systems, diffusion of OWP is slowly in the Netherlands. Studies show there is no supportive perception by the Dutch people (Negro et al., 2012). They presume electricity generation by OWPs is expensive (Negro et al., 2012). Investors hesitate to invest in it due to commercial immaturity of OWP technology. They invest in it only in case of guaranteed support system. They prefer price based policy instruments (FiT) which are considered inefficient from policy-makers' point of view.

All of these above mentioned efforts demonstrated that looking to this issue (development of OWPs) from neo-classical economic point of view does not lead to huge development of OWPs in the Netherlands. In neo-classical approach, efficiency and effectiveness are two focal points, and everything will be evaluated on these two economic oriented criteria. In this approach social and environmental issues are not matter. Positive and negative externalities are

overlooked. Social justice (distribution of ills and benefits) is not a concern. Interdependency between involved actors is not considered.

6. Discussion

In the context of pluralism, for governing sustainable development of OWPs, the Dutch government should design and establish some new institutions or modify existed institutions to overcome conflicts over distribution of costs and benefits while protect private property rights.

Before deployment of OWPs, optimistic public perception about electricity generation by OWPs is needed for promotion of public acceptance. Optimistic public perception of OWPs could be categorized under informal institutions. It is categorized under the first Level of Williamson, informal institutions (Williamson, 1998). Optimistic point of view to this issue is a sort of soft institution to influence the incentive structure, as Jacobsson and Johnson (2000) categorize institutions to soft and hard institutions (Jacobsson et al., 2000). Optimistic public perception of OWPs could be generated and fostered by public campaigns. Public acceptance generates a massive social pressure needed to stimulate governments to support OWP projects.

In the Netherlands, some economic policy instruments (e.g. FiT, TGCs, etc.) have been already provided to stimulate investment in developing of new OWPs. From institutional point of view, policy instruments are formal regulations (the second level of Williamson). They provide needed capital for deployment of an OWP and also guaranteed electricity purchase. According to Jacobson and Johnson (2000) categorization, policy instruments, as legislations, are hard institutions that shape the specific path that OWP technology would be developed (Jacobsson & Johnson, 2000).

Study by Kaldellis and Kapsali (2013) shows developers (power companies) have not enough motivation to invest in new OWP projects (Kaldellis & Kapsali, 2013). Especially by implementation of recent quantity based support system (TGCs) which a commercial immature RES-E technology, such as OWP, has not chance to receive support subsidy compare to more mature economic RES-E technologies. This demonstrates that policy-makers care only for their own interests (efficient implementation of policy instruments) and they do not concern developers' interests while successful implementation of policy instruments depends on developers' acceptance (Haas et al., 2011). From the NIE point of view, by consideration of interdependency between involved actors, policy-makers must not only consider their own interests while they depend on developers. This consists with Paavola (2007) argumentation that it is very difficult that involved actors realize their objectives in the subject of conflicts simultaneously (Paavola, 2007). Moreover from social justice point of view, extra unequal costs should not be imposed on one given actor (OWPs' developers). This results in unfair distribution of costs and benefits that threatens social equity (Pascula et al., 2014). Even there is an unfair distribution of benefits for developers of cheap RES-E technologies by implementation of TGCs. In addition, in some cases implementation of TGCs results in over compensation for some developers of cheap RES-E technologies, and it is considered as unfair distribution of benefits. Also implementation of policy instruments leads to exclusion of small power companies those could not compete with big power utilities.

In case of financing of policy instruments through cost imposition on electricity bills, there is the risk of unfair imposition of extra associated costs on low income households. This is another matter of social justice. This risk is more at policy-making by right wing governments. They

argue this is more compatible with market principles. This decreases public acceptance. Low public acceptance is a main barrier for successful implementation of the given policy. Again this consists with Paavola (2007) that argues there is a big challenge that involved actors achieve their objectives in the subject of conflicts simultaneously (Paavola, 2007).

The above discussion leads us to conclude that sustainable development of large-scale offshore wind farms is not realized successfully by only caring economic (efficiency) aspects, as it is suggested in the neo-classical economics. New institutional economics (NIE) is proper approach for sustainable development of large-scale OWPs. This approach addresses interdependency as focal point for consideration in order to solve conflicts over values and interests. Also this discussion illuminates that the improving or designing (new) institutions is a matter of social justice rather than of economic effectiveness.

7. Conclusion

As a contribution to get more sustainable development of offshore wind parks (OWPs) through applying new institutional economics (NIE) approach, a literature study has been conducted in order to get an insight in three main relevant concepts. The first part of literature study focuses on understanding the sustainable development of OWPs. For this, development of OWPs is evaluated on some criteria. These criteria consists of indicators from all of three dimensions of sustainability; social, environmental and economic dimensions. This literature study unfolds that although development of OWP brings up social and environmental advantages but it is not economic at this time. In the second part of review, sustainability in new institutional economics (NIE) approach has been investigated. The NEI approach has been suggested as a more sustainable approach to replace the neo-classical economic approach. Neo-classical approach is understood as a pure economic oriented approach, while the NEI is suggested for gaining social and environmental objectives beside economic goals. The study unfolds that interdependency is a core issue in the NIE. By consideration of interdependency the conflicts over variation of values and interests will be solved. This is a social matter rather than economic matter. The last part of literature review devoted on investigation of applying the NEI approach for looking at the development of offshore wind projects. This review shows that for sustainable development of socio-technical systems (e.g. large-scale OWPs), social aspects must be considered as much as possible. Among those relevant social issues, the social justice is one of important issues. This study also shows that a more sustainable development of OWPs will be achieved by consideration of social justice (fair distribution of costs and benefits).

The case study was the second part of this study. In this part, development of OWPs in the Netherlands has been investigated. Over the last twenty five years, development of OWPs in the Netherlands has not led to meet objectives. Investigation demonstrates that looking at this issue (development of OWPs) from neo-classical economics point of view is one of reasons for this failure. Efficiency is the main core under neo-classical economics approach. This approach is not proper approach to handle issues about different conflicts over values and interests.

The last part of this paper includes discussion of results achieved in literature study and case study. The discussion illuminates that the NIE is a proper approach to resolve those conflicts over values and interests. The interdependent involved actors solve their conflicts in order to achieve their more valuable objectives.

As the conclusion, it is noteworthy to mention that by improvement of existed institutions or designing new institutions a more sustainable development of large-scale offshore wind farms will be realized successfully. Institutions care interdependency as focal point for consideration in order to solve conflicts over values and interests.

This study will be continued by investigation of designing and development of normative frameworks to confront and solve conflicts over values and interest regarding sustainable development of socio-technical systems.

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