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Literature Survey: Future Energy Resources to Mitigate Climate Change

Lu Yangxiameng

Xi'an Medical University, Xi'an Shanxi, China

ABSTRACT. *This present survey looks at two peer reviewed articles on the topic of future energy resources. Both articles examine a sustainable solution to increasingly severe climate change and energy security. One (Jacobson and Delucchi, 2011) explores the feasibility of energy produced by wind, water, and sunlight (WWS) including characteristics of WWS energy, future energy demand, availability of WWS resources, numbers of WWS infrastructure needed, and area and materials. The other article describes status quo and potential problems of global nuclear energy worldwide (Mez,2012). The author details current statistics of nuclear plants under construction and cancelled, length of time to build and operate nuclear infrastructure, and costs.*

KEYWORDS: *Renewable energy; Nuclear energy; Climate change; Energy security*

1. Introduction

A growing increase in extreme weather and natural disasters have led to more concerns on climate change and energy security than ever. One possible solution to tackle climate crisis and ensure public safety is to explore the possibilities of future energy resources. Energy with wind, water and solar power is proposed by Jacobson & Delucchi (2011) as a promising environmentally-friendly, low-cost, and safe alternative energy. Nuclear power is also explored as a solution to the problems of climate change and energy security. A noticeable amount of research has been done to analyse these areas. This literature survey examines these two future energies. The first paper of Jacobson & Delucchi's "Providing all global energy with wind, water, and solar power, Part I: Technologies, energy resources, quantities and areas of infrastructure, and materials "(2011) details the feasibility of WWS energy, while second Mez's "Nuclear energy-Any solution for sustainability and climate protection" (2012) describes current situation and problems in nuclear industry so as to reconsider the use of nuclear power. Both articles would serve as reliable reference to carry out research on future energy issue.

2. Paper One

The overall objective of Jacbson & Delucchi is to analyse the feasibility of

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energy produced by wind, water, and sunlight (WWS) so as to offer a mitigation to climate change and energy security worldwide. They discuss features of WWS energy, energy demand in the future, and availability of WWS energy, numbers of WWS infrastructure required, and area and building materials. They conclude by stating technical findings to show the possibility of achieving global WWS.

To begin, they give a review of previous literature studies about various energy plans. This is followed by a conclusion that application of WWS power would reduce or even eliminate a variety of environmental and medical problems.

Moving on to the reasons for choosing WWS, Jacobson & Delucchi list three points: the absense of greenhouse gases emissions and air pollutants, low impacts on wildlife and renewable or recyclable resources. They also state four reasons not to consider nuclear energy: risk of a nuclear war or terrorism catastrophe, more carbon emissions than WWS, a limited amount of uranium, and radioactivity it produces.

Turning to characteristics of WWS, they describe wind technology including wind and wave, three water technologies such as geothermal, hydroelectricity and tidal, and two solar technologies such as solar PV and CSP.

Concerning the use of WWS power for transportation, Jacobson & Delucchi cite the example of battery-electric vehicles (BEVs) and hybrid BEV-HFCVs as electric vehicles with power that can be provided by WWS. They also give examples of air heaters and air conditioning to illustrate the use of electricity that comes from WWS.

The article next moves to global energy demand and availability of WWS. Jacobson & Delucchi give figures of the power required today by WWS and requirements by 2030, 12.5 trillion watts (TW) and 17 TW, respectively. They also argue that global energy requirements can be satisfied by solar and wind power. And then the processes of wind and solar power extraction are explained by Jacobson & Delucchi and they finally suggest geothermal and tidal or hydropower to provide a sustainable energy supply in those areas lacking adequate wind and sun.

As for numbers of WWS plants and devices needed, Jacobson & Delucchi provide an estimated quantity for 2030 by showing exact figures in a table. They also contend that only ~0.74% of global land area is needed for the footprint, and 1.18% for spacing are required to build this infrastructure.

Material requirements are Jacobson & Delucchi‘s next issue related to WWS. They first list materials needed for wind power such as steel and pre-stressed concrete and for solar infrastructure such as amorphous silicon. These materials are readily available. However, rare earth elements (REEs) like neodymium (Nd) for wind energy, are tight resources, and reserves of silver for solar power could be reduced in the future. For example, they propose alternative generators to solve the REE problem in wind turbines.

Finally, Jacobson & Delucchi conclude that WWS energy plants and devices can reduce power demand by 30% worldwide by 2030. Moreover, they present technical findings of availability infrastructure, area and materials of WWS energy required. In addition, costs and policies needed to employ WWS all over the world are

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mentioned by authors as issues what they are going to examine in Part II of their paper.

3. Paper Two

Mez's aim was to examine status quo and potential risks of nuclear energy worldwide so as to reconsider the rebirth of global nuclear programmes. He discusses the history of nuclear energy's renaissance, current global situation of nuclear projects, costs and duration of building nuclear infrastructure and problems in nuclear industry. Eventually, he concludes by mentioning Fukushima accident to show the tendency toward closuring nuclear plants in most European countries.

Mez introduces the topic by a common understanding that nuclear energy could be environmentally-friendly, safe and low-cost choice to tackle energy problems. This is followed by a President Obama's statement advocating employing nuclear power. However, Mez questions this support by addressing sustainability and cost of nuclear energy.

Moving on to so-called nuclear renaissance, Mez cites the example of Reagan's plans to revive nuclear in 1980s and 233 reactors under construction in 1979. Yet he also provides statistics, for example, no new nuclear power was used to transmit electricity in 2008, the first time this had occurred since 1956. This adds to his argument to show non-renaissance.

Turning to current situation of nuclear programmes all over the world, the author gives statistics of 61 reactors under construction and 156 reactors planned worldwide. On the other hand, there were over 100 cancellations. Then Mez offers a decline in the number of reactors in European Union from 177 in 1989 to 134 in 2012. He also states that three countries in EU have closed nuclear energy plants in which two of them decides to phase out after Fukushima. After that, Mez compares the percentage of nuclear energy worldwide (13.4% of global production, 5.8 % of primary energy supply) with the percentage of renewables (19.5% of global production, 12 % of primary energy supply). He then cites examples such as Watts Bar-2's 40 year construction to mention length of time it takes to build nuclear infrastructure. Mez also contends that nuclear programs in China, India, Russia and Argentina show a downward trend. For instance, China decided to carry on a small proportion of nuclear plans from 2011 due to State Council' s policy after the Fukushima accident. As a result of these facts, including shortage of finance, complicated situation of licensing procedure, and potential hazard in most countries, speaking of a "renaissance" is a wrong assertion.

The next issue is about age and power produced by nuclear devices, showing that if an operating lifetime is 40 years, 287 reactors will be taken off the grid by 2025. As for power produced by nuclear plant, there is a very modest proportion of 2.3% worldwide.

In terms of plans and forecasts, Mez points out that US and other western industrialized countries call for a peaceful use of unclear energy. However, he lists

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four reasons why this optimistic version is unlikely to happen: overuse of uranium, financial problems, and deficient production capacity and technicians. With a rough estimate of costs of 5,333 $/KW for a night, Mez argues that the costs of nuclear energy plants are more expansive than fossil fuel stations, onshore wind, solar PV and hydro costs.

The article next moves to two problems faced by nuclear industry. One is the shortage of production capacity, which is illustrated by examples like no single manufacturing plants for producing components in USA. The other is the lack of skilled personnel such as engineers, nuclear experts.

With respect to environmental protection by nuclear power stations, Mez cites the example of manager of a German-based energy company RWE to state the belief that nuclear energy plants are CO2 free. Nonetheless, he also offers data indicating that nuclear stations do produce CO2 emissions. For example, they cause 1/3 more greenhouse gases than gas power plants. In addition, uranium is highly in demand because of its limitation.

The final concern for Mez is that civil use of nuclear energy could lead to military nuclear-proliferation. For example, several countries such as Israel, India, Pakistan and North Korea have created nuclear weapon even though their original attention is the civil use of nuclear power.

In conclusion, Mez summarizes his mentioned points such as problems like lack of production capacity and potential danger of nuclear problems faced by nuclear industry and listing countries who have closed or are phasing out nuclear power stations due to the Fukushima accident.

4. Comparison

The main similarity between the two papers is exploring sustainable energy solutions to address climate change and energy security. The difference involves two different choices: energy produced by wind, water, and sunlight (WWS), and nuclear energy. Jacobson & Delucchi's aim was to examine the feasibility of WWS energy such as characteristics of WWS energy and availability of WWS resources, whereas Mez's purpose was to analyse the current situation and potential risks of global nuclear energy.

Both articles state that addressing climate crisis, pollution, and energy insecurity needs changes in energy infrastructure, but while the Jacobson & Delucchi paper gives a review of previous studies about various plans followed by advocating WWS as a future solution to reduce environmental and health problems, Mez questions whether the use of nuclear power will increase. Similarly, both Jacobson & Delucchi and Mez mention the potential risks of nuclear energy, there are effect of CO2 emissions, a limitation of uranium and military use of nuclear power.

A major difference of their papers lies in authors' conclusion about these two kinds of energy. Jacobson & Delucchi conclude that WWS plants can reduce energy demand by 30% worldwide by 2030, which is an optimistic forecast. On the other

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hand, Mez summarizes problems of nuclear power and lists countries who have closed or are phasing out nuclear power plants after the Fukushima accident, which indicates his negative view on nuclear energy. Another basic difference is that while Jacobson & Delucchi probes into some practical applying issues about how to make good use of WWS energy, Mez provides history and current situation of nuclear power development.

Given both authors' concern about examine a sustainable solution to climate crisis and energy insecurity, their different areas of focus provide a comprehensive and complimentary overview of this topic.

5. Evaluation

With regard to accuracy, the main criteria is that two papers appear in international peer reviewed journals. The Jacobson & Delucchi article was published in *Energy Policy*, an authoritative research publication specialized in the academic fields of energy supply. Similarly, Mez article was presented in the same journal, *Energy Policy.* Yet it should be noticed that the dates of publication (2011 and 2012, respectively), could be too old to keep in pace with this ever-changing topic.

The second reliability factor is the acknowledged expertise of the authors. Jacobson is associated with the Department of Civil and Environmental Engineering, Stanford University in America. Delucchi is connected with Institute of Transportation Studies, University of California at Davis in USA, while Mez comes from Department of Political and Social Science, Freie University Berlin at Berlin in Germany. They are all in a world-class research universities.

Thirdly, there are extensive reference lists of research in these two papers to show validity. Both articles would be authentic and trustworthy sources for further study on the issues regarding climate change and energy insecurity.

References

[1] Jacobson, M., Delucchi, M (2011). Providing all global energy with wind, water, and solar power, Part I: Technologies, energy resources, quantities and areas of infrastructure, and materials. Energy Policy, vol.39, no.3, pp.1154-1169.

[2] Mez, L (2012). Nuclear energy–Any solution for sustainability and climate protection? Energy Policy, pp.48