Social Constraints of Implementing New Energy System

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Xiangwen Guo

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor

Richard D. Jacques, Ph.D., Department of Engineering and Society

Introduction

According to the National Academy of Engineering, there are 14 Grand Challenges for Engineering in the 21st century and two of them (make solar energy economical & provide energy from fusion) are directly related to energy.

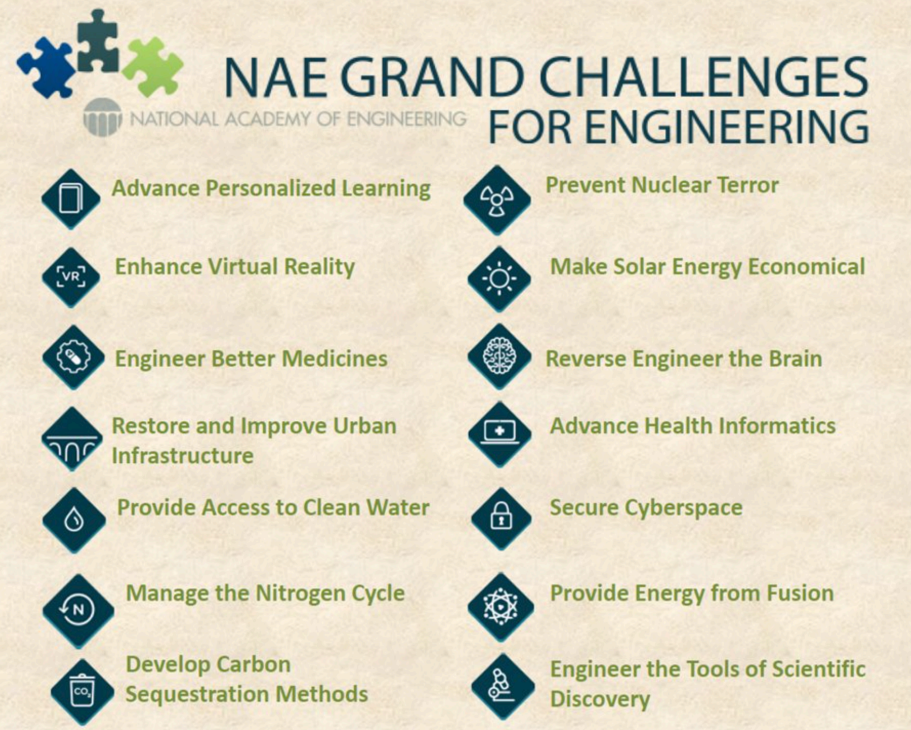

Figure 1- 14 Grand Challenges For Engineering

From global warming to heating up frozen dinner, energy is related to everyone's life. An efficient energy system could provide safe and reliable power to fulfill our needs. An outdated and poorly designed one could cause safety issues like fire hazard and also could lead to power outages. Therefore it is important for us to implement more efficient power system. Also we need to keep in mind that new power system does not only relate to the power companies but also influence our lives significantly.

Energy, as the power source drives the living engine of the world, it is an essential task to generate energy efficiently and substantially. However, technology could not be separated from human activity. Besides technological issues, there are many other social constraints needed to be considered. Throughout this paper, I will first present the existence of social constraints of implementation new energy system and in the later sections, these social constraints will be discussed and analyzed under the social construction of technology framework. In the end, methods to incorporate these social constraints when designing and implementing new energy system will be discussed.

The Existence and Importance of Social Constraints to Implement New Energy System

In comparison to soft infrastructures, hard infrastructures like energy production, distribution and consumption play important roles in the smart city imaginary and production. A transition to a fossil fuel free future is a goal but for it to be actually achieved and there are resiliencies from the citizens and public that could not be ignored. The domain of sustainable energy system involves the resistances from the aspects of legal and political boundaries. There is a distance existed between sociotechnical imaginaries of smart city in the research domain and in local community initiatives. A turning participation process from consultation to engagement is needed in order to achieve energy system transition. However in many researches, the commitment and engagement of citizens in the energy production, distribution and use are neglected. Thus, Corsini's paper used bibliometric mapping of multiple scientific literature to capture the "publicly performed visions of desirable futures" of the relationship between energy and the city. Bibliometric methods are driven by the demand to assess scientific production,

making the results available to a wide range of stakeholders such as scientists, policymakers, practitioners, etc. (Ellegaard and Wallin, 2015). The results are term maps that have different color, fonts and distant representing different relationships, co-occurrence and areas of studies, constructed from 74,932 publications on the topics related to energy. From analyzing these map, the authors have come up with the conclusion that most scientific researches on energy mainly focus on energy performance, efficiency and infrastructures and lack of attention on socio-political issues. More efforts are needed on taking in consideration the citizen's role in energy system.

Also as the information technology becomes more accessible, many activities related to energy consumption could be monitored (Moran, 2001) . However, Nyberg has performed case study on 'smart grid' development in Japan and came to the conclusion that extensive tailoring of in- formation is required in order to engage users to develop an active relationship with infrastructure.

Thus, when implementing a new power system to an area, social factors must be considered and reflected onto the design since human activity and the design itself is interrelated and shape each other constantly. For example, digitalization as a technology that could inform us more about any given circumstance and process however, the increase of quantitative information does not have significant qualitative change in the society because of its lack of the involvement of human behaviors.(Roy A. Nyberg, 2018) Besides technical difficulties, there are also social constraints involved in the process of implementing new power system. It is important to identify these social constraints and analyze them and then reflect them onto the

design of power system in order to achieve the desired engineering goal of providing clean and substantial energy in an efficient and safe way.

Social Constraints Analysis under SCOT Framework

The main idea of SCOT (Social Construction of Technology) is that human activity and technology should be considered inseparably. The way of how people use technology actually changes the technology itself. When develop technologies, relevant social groups and interpretive flexibility should be considered in designs. (Sismondo, SCOT and Construction of Technology from Introduction to STS,P98).

Relevant social group is one of the factors in the SCOT framework. In the case of implementing new energy system, users, electricity power providers and government are the main social group that related to the change.

Stakeholder	Roles
Dominion	maintain power; provide power to new neighborhoods; maintain energy production efficiently
Citizens	have lights, computers, phones; become eco-conscientious
Power-line workers	deal with repairs, upkeep; track wire scheme, grid effects
Engineers	improve technologies; reduce cost or improve efficiency
Solar panel companies	observe market trend; increase efficiency; provide know-how and products
Environment	lora and fauna; emissions; land management
Local Government	define standards and administration of public works initiatives

Figure 2- Stakeholder Analysis

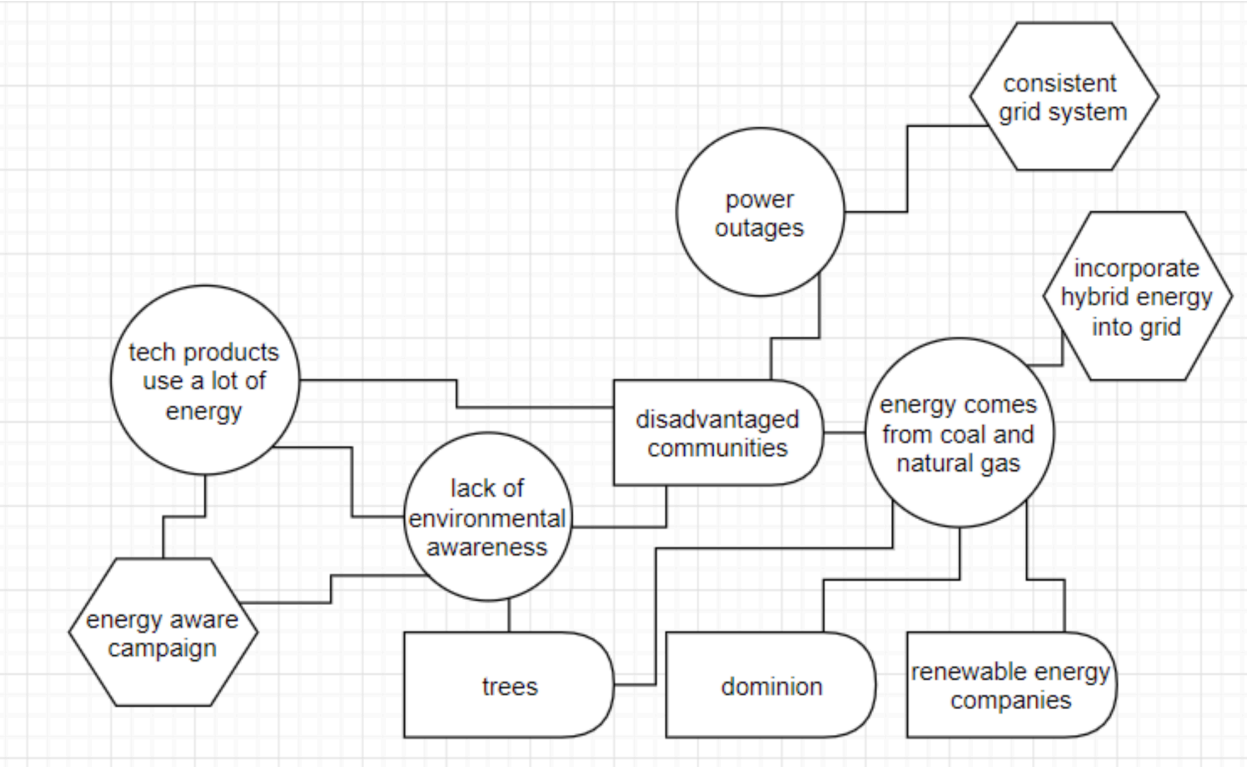

Figure 3- SCOT Diagram

Figure 3 shows the SCOT Diagram created for the social constraints to implement new energy system. It has major problems being the shape of circle, solutions being the shape of hexagon and stakeholders as half-round rectangles. Lines between them show the connection. For example, the problem of power outages has two lines connecting the stakeholder of disadvantaged communities and the solution for that problem is a consistent grid system. The purpose of this SCOT diagram is to show the interrelationship of stakeholders, problems and solutions. New energy system might cause the users to worry about higher cost and other uncertainties. In Charlottesville, there are 46,487 registered residence with the poverty rate being 24.5%. This means around 11,389 residence are below the poverty line. Thus it is essential to minimize extra cost to user or provide long term benefit to users. Also, for any technology to be

implemented successfully, make users to have a better understanding of how the technology works is important to remove many concerns that they might have. Another aspect is the interpretative flexibility in the SCOT framework. Different consumer and financial group might have different opinions on the same product. Families with low income might have negative opinions on extra costs or work to have a better power system since they might already minimize their power consumption. On the other hand, people with high income tend to like the idea of sustainability and environmental friendly. They might want to invest money into adopting new energy system that have a long term benefit. To the energy companies, generating benefit might be an essential goal for them. Upgrade to new system adds to the sunk cost and would not generate enough money to cover that investment in a short term. Permission from the local government is also needed if were to change the location of power generators. Also, many states have energy plans that need to be followed.

Methods to Incorporate Social Constraints

With the existence and importance of social constraints in mind, I advocate two methods to incorporate them when it comes to implement new energy system. The first one is to hold energy awareness campaign to inform and educate citizens of energy usage. This will help to reduce the use of coal and natural gas power and help to implement clean energy solutions. Also, with a group of informed citizens, they could also become a leverage to large energy companies like Dominion to influence their power grid plan and to pursue a better energy system. Figure 4 shows the values that could be included in the energy awareness campaign.

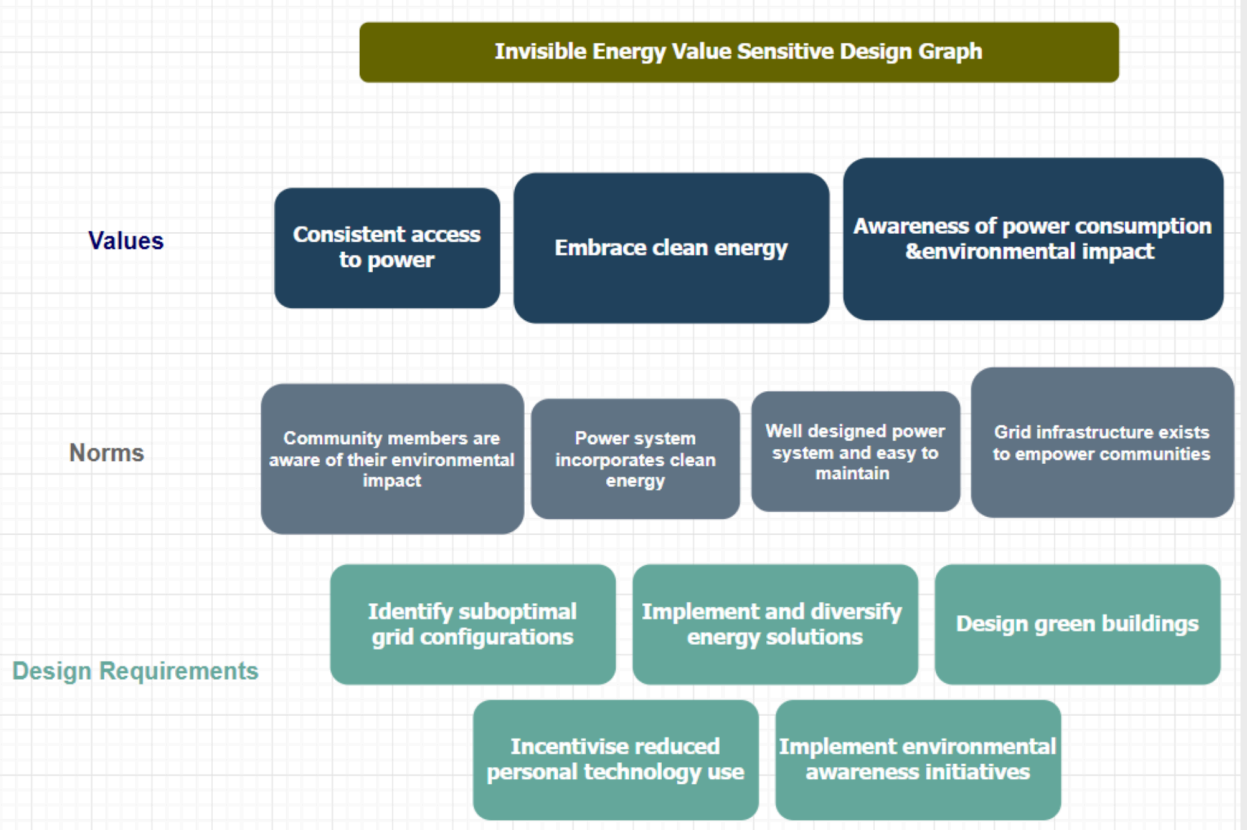

Figure 4- Values for Energy Awareness Campaign

The second method is for the energy companies to do more social research and collect more data from the citizens before implementing new energy system. As for the collection of data, many local organizations could be reached out like 350.org Charlottesville (organization uses online campaigns, grassroots organizing, and mass public actions to oppose new coal, oil and gas projects) and AHIP (home repair nonprofit organization working to ensure safe, affordable homes for our neighbors in need). Data could be collected by interviews and documents. Interviews could be conducted in the fashion of face-to-face or through designed questionnaire. All data collected from the field would be kept confidential, no participant, individual or organization, will be identified in the results. More field research could be done on the users' willingness to adapt to a new energy system and their concerns and Also, model could

be built to analyze the financial situation for a company to actually upgrade their energy generating system.

Conclusion

The goal of a more sustainable energy source and efficient power system has always been pursued by engineers. However, like stated in the beginning, technology could not be separated from human activity. There is social resilience when adapting new technology. Without people and technology working closely towards the same goal together, the technology may not have the same effect as designed. Methods mentioned in this paper like energy awareness campaign and social field research for companies could bring people and technology closer and have each party to take each other's benefits into account to create a more efficient solution.

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