# Our Daily Life Dependency Driven by Renewable and Nonrenewable Source of Energy

Bahman Zohuri[1] and Farhang Mossavar Rahmani[2]

1. Golden Gate University, Ageno School of Business, Data Analytic, San Francisco, CA 94105, USA

2. College of Professional Study, National University, San Diego, CA 92037, USA

**Abstract:** Our dependency on energy is so vital that it makes it difficult to imagine how humans can live on our planet earth without it. The demand for electricity, for example, is directly related to the growth of the population worldwide, and presently, to meet this demand, we need both renewable and nonrenewable energy. While nonrenewable energy has its shortcomings (negative impact on climate change, for example), renewable energy is not enough to address the ever-changing demand for energy. One way to address this need is to become more innovative, use technology more effectively, and be aware of the costs associated with different sources of renewable energy. In the case of nuclear power plants, new innovative centered around small modular reactors (SMRs) of generation 4th of these plants make them safer and less costly to own them as well as to protect them via means of cyber-security against any attack by smart malware. Of course, understanding the risks and how to address them is an integral part of the study. Natural sources of energy, such as wind and solar, are suggesting other innovating technical approaches. In this article, we are studying these factors holistically, and details have been laid out in a book by the authors' second volume of series title as *Knowledge Is Power in Four Dimensions* under Energy subtitle.

**Key words:** Renewable and non-renewable source of energy, electricity on demand, population growth, forecasting demand on energy, cyber-security and smart malware.

## 1. Introduction

The significant growth in the electricity production industry in the last 30 years has centered on the expansion of natural gas power plants based on gas turbine cycles. The most popular extension of the simple Brayton gas turbine has been the combined cycle power plant with the Air-Brayton cycle serving as the topping cycle and the Steam-Rankine cycle serving as the bottoming cycle for a new generation of nuclear power plants that are known as GEN-IV. The Air-Brayton cycle is an open-air cycle, and the Steam-Rankine cycle is closed. The air-Brayton cycle for a natural gas-driven power plant must be an open cycle, where the air is drawn in from the environment and exhausted with the products of combustion to the environment. This technique is suggested as an innovative approach to GEN-IV nuclear power plants

in the form and type of small modular reactors (SMRs). The hot exhaust from the Air-Brayton cycle passes through a heat recovery steam generator (HRSG) before exhausting to the environment in a combined cycle. The HRSG serves the same purpose as a boiler for the conventional Steam-Rankine cycle [1].

The flow of electricity generated via renewable and non-renewable energy as a continuous stream is a blood that is needed for today's technological society and the world of digital gadgets that we are living on. The personal data assistant (PDA), is the mini-computer that lets us keep track of your schedule, keep your contacts with you and look at documents on the go, including other means of a business that you conduct on your computer as the daily routine of your modern technology all of us face. These electronical and digital gadgets are tools that we cannot live without no matter where we are and what we do in our daily routine life.

Demand for electricity on these digital devices and our needs for communication through means of

**Corresponding author:** Bahman Zohuri, adjunct professor, research field: business and data analytics.

Internet of Things (IoT) is an essential asset that needs to protect against any smart malware attack by utilizing the best cyber-security available to us.

The smart cyber security also allows us to keep track of any smart malware and be aware of their footprint. Knowing that will enable us to trace them at the level of a smart grid that is getting integrated into our national or international electrical network and be able to protect power plant control rooms that are part of producing electricity into the grid for our daily consumptions.

Again, this electricity is an essential asset of our daily life and technical blood that we need to be in continuous flow.

In Section 4 of this article, we refer to a need for such smart cyber-security in a holistic format.

## 2. What Is Energy?

It is impossible to overstate the importance of energy. Just think where humanity would be without it may be enough to demonstrate this point. Like the past, energy will play a vital role in shaping future industries, cities, nations, and the world. As a result, energy is a critical factor that shapes future paradigms in any target entity or world. To have a better understanding of the role that energy plays in the world today and in the future, in this chapter, we first look at the definition of energy and its different forms. And second, we review the data related to energy consumptions both in the world and in the United States [2].

In physics, energy is the quantitative property that must be transferred to an object to perform work on, or to heat, the object. Energy is a conserved quantity; the law of conservation of energy states that energy can be converted in form, but not created or destroyed. The SI unit of energy is the joule. Joule is the energy transferred to an object by the work of moving it a distance of 1 meter against a force of 1 newton.

Typical forms of energy include the kinetic energy of a moving object, the potential energy stored by an object's position in a force field (gravitational, electric or magnetic), the elastic energy stored by stretching solid objects, the chemical energy released when a fuel burns, the radiant energy carried by light, and the thermal energy due to an object's temperature.

Mass and energy are closely related. Due to mass-energy equivalence, any object that has mass when stationary (called rest mass) also has an equivalent amount of energy whose form is called rest energy. Any additional energy (of any form) acquired by the object above that resting energy will increase the object's total mass just as it increases its total energy. For example, after heating an object, its increase in energy could be measured as a small increase in mass, with a sensitive enough scale [2].

Living organisms require energy to stay alive, such as the energy humans get from food. Human civilization requires energy to function, which it gets from energy resources such as fossil fuels, nuclear fuel, or renewable energy. The processes of Earth's climate and ecosystem are driven by the radiant energy Earth receives from the sun and the geothermal energy contained within the Earth [2].

## 3. Is Nuclear Energy Renewable Source of Energy?

Assuming, for the time being, we are taking fission reaction as the foundation for present (GEN-III) and future (GEN-IV) nuclear power reactors, as source nuclear energy source to somewhat degree; we can argue it is a clean source of energy.

Although nuclear energy is considered clean energy, its inclusion in the renewable energy list is a subject of significant debate. To understand the debate, we need to understand the definition of renewable energy and nuclear energy first. However, until we manage through future technology of these fission reactors to manage to bring down the price electricity per kilowatt hours driven by fusion energy down to the point of those by gas or fossil fuels, there is no chance to push these reactors beyond GEN-III [2].

Renewable energy is defined as an energy source/fuel type that can regenerate and can replenish itself indefinitely. The five major renewable sources used most often are biomass, wind, solar, hydro, and geothermal.

Nuclear energy, on the other hand, is a result of heat generated through the fission process of atoms. All power plants convert heat into electricity using steam. At nuclear power plants, the heat to make the steam is created when atoms split apart—called fission. The fission releases energy in the form of heat and neutrons. The released neutrons then go on to hit other neutrons and repeat the process, hence generating more heat. In most cases, the fuel used for nuclear fission is uranium.

One question we can raise here in order, to further understand whether, or not, we need to present nuclear technology as a source of energy is that: What is the difference between clean energy and renewable energy? In other words, why is nuclear power in the doghouse when it comes to revamping the nation's energy mix?

The issue has come during the debate over the Waxman-Markey energy and climate bill and its provisions for a national renewable-energy mandate.

Many environmental groups are fundamentally opposed to the notion that nuclear power is a renewable form of energy—because it produces harmful waste byproducts and relies on extractive industries to procure fuel like uranium.

Even so, the nuclear industry and pro-nuclear officials from countries, including France, have been trying to brand the technology as renewable because it produces little or no greenhouse gases. Branding nuclear as renewable could also enable nuclear operators to benefit from some of the same subsidies and friendly policies offered to clean energies like wind, solar, and biomass.

So far, however, efforts to categorize nuclear as a renewable source of power are making little headway.

The latest setback came in around August of 2009 when the head of the International Renewable Energy Agency (IRENA)—an intergovernmental group known as IRENA that advises about 140 member countries on making the transition to clean energy—dismissed the notion of including nuclear power among its favored technologies.

"IRENA will not support nuclear energy programs because it's a long, complicated process, it produces waste and is relatively risky," Hélène Pelosse said, "its interim director-general, told in general."

"Energy sources like solar power," Ms. Pelosse said, "are better alternatives—and less expensive ones, especially with countries blessed with so much sun for solar plants," she said it in 2009.

## 4. Related Cyber Security Impacts on Energy

DOE is continuing to work on cost-effectively preventing, detecting, and mitigating modern cyber threats to nuclear energy systems, which is the subject of this article. Understanding the risks associated with each design decision is fundamental to cyber protection. With the increasing application of digital instrumentation, control, and communication systems and the constant evolution of cyber security threats and technologies, there is a need for a comprehensive analytical capability to model and simulate industrial control systems (ICSs) and their vulnerabilities that come from IoT and inter-connectivity of machine-to-machine (M2M). Applications are sought for modeling and simulation capabilities that can inform researchers, designers, and operators when assessing cyber security risks. Research of most interest will address the characteristics and behaviors of components within embedded instrumentation and control (I&C) systems that are used within the nuclear enterprise.

Another area of interest includes the integration of cyber research enabling platforms that would couple high fidelity of nuclear plant simulators with emulation, hardware-in-the-loop, or human-in-the-loop instances of control and communication. Models shall capture the behavior of an I&C system to:

(1) Simulate characteristics of an I&C system under cyber-attack;

(2) Study the cyber risk impacts of upgrades and maintenance on such systems;

(3) Enable future nuclear energy cyber security research, and;

(4) Facilitate nuclear facility operation education and training.

The above issues also apply to any other power plant that generates electricity into the grid no matter what.

Dealing with energy and being able to predict or forecast [3] its future existence requires its guarantee of safe operation in particular with coming to nuclear power plants within the grid either on-line or off-line. As has been indicated here in this section, cyber security plays a significant role when it comes to operating these reactors safely, whether they presently are operational or will go into operation shortly as a form of Generation IV (GEN IV) or Generation V (GEN V). Such an issue is the huge driven factor within the nuclear power industry production of such a plant as a means of a source of energy to produce electricity as demands growth increases exponentially per population growth.

In summary, cyber security plays a significant role in the protection of such assets at our disposal. With help from artificial intelligence (AI) integrated into the IoT, we can build a resilience system (RS) that will protect our grid system nation-wide and will be able to predict any malicious attach in the form of energy blocks malware before it attacks. Attacks are evolving, so should your security. Security does not need more tools; it just needs more rules simply because fighting new threats with more tools only adds complexity with more degree freedoms as these new tools bring on board. It is time to rethink your approach to cyber security.

"What makes cyber threats so dangerous is that they often go unnoticed for a while, until the real damage is clear, from stolen data over power outages to destruction of physical assets and great financial loss.

Over the coming years, we expect cyber risks to increase further and change the way we think about integrated infrastructure and supply chain management."

This definition is coming as a result of "Cyber threats a top priority at 2017 Munich Security Conference". There were more than 500 decision-makers from across the globe gathered in Munich to discuss significant international security challenges. Among them were over 25 heads of state and government, 80 foreign and defense ministers, international organizations, members of parliament, high-ranking representatives of armed forces, civil society, and business.

The energy sector is of particular concern where an attack on an operating system could cause infrastructure to shut down, triggering economic or financial disruptions or even loss of life and massive environmental damage. The potential for physical damage makes this industry a prime target for cyber-criminals, state-sanctioned cyber-attacks, terrorists, hacktivists, and others looking to make a statement.

In the face of this rapidly evolving cyber threat landscape, the question of the bond between the US, under the administration of Donald Trump, and its European NATO allies was high on the agenda during the conference. Strong partnerships play a role in effectively addressing cyber challenges today, and in recent events, cyber-attacks have been an increasing part of hybrid warfare.

As the alliance is faced with an evolving complex threat environment, state and non-state actors can increasingly utilize cyber-attacks in the context of military operations. NATO and its allies in Europe rely on strong and resilient cyber defenses to fulfill the alliance's core tasks of collective defense, crisis management, and cooperative security. In the face of the threat of emerging cyber-attacks, NATO needs to be prepared to defend its networks and operations against the growing sophistication of such risks.

When it comes to the stolen data and data at the volume of Big Data, as we have stated, integration of AI becomes a necessity as part of preventing hacking and dealing with cyber security-related issues. Also, as we have seen when AI is involved, then the other two sub-sets of it such as machine leering (ML) and deep learning (DL) are involved, and combination of these provides a good understanding of RS [4] within cyber surety element of the energy sector to prevent any unwanted cyber attacks. The RS gets built with DL involved in data mining and data analytics of historical data and incoming new data to discriminate a new threat when comparing these data at real-time or near-real-time data. Passing up this information to its upper set system is known as ML according to the IoT via M2M and finally to AI to inform its human operator, which is a process between Machine-to-Human (M2H).

All these system integrations can be achieved with possibly new innovative technologies utilizing techniques such as Feed Forward Neural Network or Back Forward Algorithm, which involves a family of methods used to efficiently train Artificial Neural Networks (ANNs) as part of overall integrated systems. See Chapter Eight of this book for more information on subjects of Feed Forward Neural Network or Back Forward Algorithm [5].

As we stated previously, one of the benefits of augmenting IoT as part of industrial applications is in energy that electricity providers deliver reliable, fair-priced services and products to their end-users, namely the consumers.

While the energy sector has been evolving in terms of generation and distribution, the IoT has the potential to be the most transformational if challenges related to reliability, integration, system complexity, and security can be overcome. While reliable connectivity is an ongoing problem, many companies are struggling to integrate IoT technology with existing platforms, which tend to be overly complicated. They may need to rethink their approach to data security to deploy IoT

projects safely and securely.

Usage of IoT within the energy sector of the industry, enables organizations in the energy sector, including oil and gas companies and utilities, to capture and analyze increasing volumes and varieties of data streams flowing from numerous systems and connected devices, as well as shift analytics from traditional data centers toward devices at the edge. Implementation of IoT solutions along with AI integrates streaming data with analytics and visualization so you as the owner of the electricity-producing company can:

(1) Get the most value from your smart grid investments. Stop intentionally dropping valuable data because of bandwidth constraints. With IoT solutions in place, you can use more new data sources without clogging operational systems by filtering and analyzing IoT data in motion, whether it is from a data center, edge device or cloud.

(2) Optimize electric vehicle (EV) and distributed energy resource (DER) integration. Forecast specific needs of EVs and availability of DERs to meet demand, ensure grid stability and control costs.

(3) Extend your analytics infrastructure. Take algorithms to the data, reduce data movement and automate processes across your IoT infrastructure to reap incremental and long-term business gains.

(4) Develop new business opportunities. The right IoT platform enables innovation in both customer and grid applications, so you can get creative as you unlock new potential in DERs, advanced energy forecasting and smart city applications.

With current demand and a need for a proper IoT innovative technology augmenting with an appropriate AI in place, electricity production owners and organization can deliver the cutting-edge IoT/AI solutions to their consumers and customers for energy in the way that works best for their business, which includes:

(1) Advanced predictive modeling. Make better predictions of energy demand with more accurate forecasting models based on more data from more

sources, including smart meters and weather stations. Automatically track model accuracy and easily update models to reflect changes.

(2) Smart meter analytics. Optimize smart meter deployment and manage timely customer communications to get the most value from your investments in smart meters and advanced metering infrastructure.

(3) Comprehensive asset data. Integrate structured and unstructured data from all sources to get an enterprise view of asset performance and drive improved grid reliability.

(4) Advanced early-warning analytics. Identify potential issues early, even before they occur, so you can proactively take corrective action to improve outcomes.

(5) Automated monitoring and predictive alerts. Reduce downtimes, avoid major defects and address potential performance issues before they escalate, and use built-in workflows and case management capabilities for faster problem resolution.

With all the above privileges utilizing IoT and AI as combined innovative technology of Device-to-Machine (D2M) and M2M, they harness the sensor data to boost uptime, performance and productivity while lowering maintenance costs and reducing your risk of revenue loss.

## 5. Conclusion

As the population grows, so does the demand for energy. Energy has been classified under two categories of renewable and nonrenewable. It seems like at the heart of the debate about renewable energy lies the confusion over the exact definition of renewable energy and the requirements that need to be met to be one. Recently Helene Pelosi, the interim Director General of IRENA, stated that IRENA would not support nuclear energy programs anymore. Among the reasons, she highlighted that it is not only a long and complicated process, but also, it produces waste and is relatively risky. Her argument proves that her

decision has nothing to do with having a sustainable supply of fuel [6]. And if that is the case, then nuclear proponents would have to figure out a way to deal with the nuclear waste management issue and other political implications of atomic power before they can ask IRENA to reconsider including nuclear energy in the renewable energy list [7].

Another argument against fission nuclear power plants as a source of renewable energy comes from Dr. James Singmaster. On August 3, 2009, he stated: "The basic problem of the climate crisis is the ever-expanding overload of heat energy in the closed biosphere of earth. Temperatures are going up to indicate the increasing heat energy overload. Everyone reading this should check out Dr. E. Chaisson's article titled 'Long-Term Global Warming from Energy Usage' in EOS (Trans. Amer. Geophys. Union, V. 89, No. 28, Pgs. 253-4 (2008)) to learn that nuclear energy, be it fission or fusion, being developed should drop with money being put to developing renewable energy supplies using the sun, wind, and hydrogen."

The hydrogen needs to be generated from splitting water using sunlight with the best one or two of seven catalysts reported in the last two years, or with excess solar or wind collection generating electricity that could be used to generate hydrogen by electrolysis of water.

There is no way that nuclear power can avoid releasing trapped energy to increase the energy overload, so it should be forgotten.

To remove some of the energy as well as some of the carbon overloads in the biosphere, we need to turn to the pyrolysis of massive ever-expanding organic waste streams to remake charcoal that will be removing some of both overloads. It will require using renewable energy, and the pyrolysis process expels about 50% of the carbon as small organic chemicals that can be collected, refined, and used for fuel that is a renewable one. For more about using pyrolysis, search my name on GreenInc blog or google it for other blog comments on pyrolysis.

## References

[1]  Zohuri, B. 2015. *Combined Cycle Driven Efficiency for Next Generation Nuclear Power Plants: An Innovative Design Approach* (1st ed.). New York: Springer Publication Company.

[2]  Zohuri, B., and Mossavar-Rahmani, F. 2020. *A Model to Forecast Future Paradigm, Energy.* Apple Academic Press, a CRC Press, Taylor & Francis Group.

[3]  Zohuri, B., and Mossavar-Rahmani, F. 2019. *A Model to Forecast Future Paradigm, Knowledge Is Power in Four Dimensions.* Apple Academic Press, a CRC Press, Taylor & Francis Group.

[4]  Zohuri, B., and Moghaddam, M. 2017. *Business Resilience System (BRS): Driven through Boolean, Fuzzy Logics and Cloud Computation: Real and Near Real Time Analysis and Decision-Making System* (1st ed.). New York: Springer Publication Company.

[5]  Zohuri, B., and Moghaddam, M. 2017. *Neural Network Driven Artificial Intelligence: Decision Making Based on Fuzzy Logic (Computer Science, Technology and Applications: Mathematics Research Developments.* Nova Science Publishers, Inc.

[6]  Chowdhury, D. 2012. *Is Nuclear Energy Renewable Energy.* Stanford Physics Department.

[7]  Kanter, J. 2009. "Is Nuclear Power Renewable?" *New York Times.*