

# Systems Thinking for Sustainable Energy in the Philippines: Insights for Policymaking

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## Systems Thinking for Sustainable Energy in the Philippines: Insights for Policymaking

Energy production and consumption can be a complex area of governance and management, thus the utilization of the systems thinking approach offers a holistic perspective, examining the full lifecycle of energy—from resource extraction through to generation, distribution, and end use. Through the application of systems thinking to electricity in the Philippines, both immediate and long-term challenges can be addressed to promote sustainable practices that align with the principles of a circular economy. This approach supports the goal of providing adequate, affordable, and reliable energy to the population (Berardy et al., 2021).

### Current Situation in Energy Production and Consumption

Energy resources in the Philippines are a mix of coal, imported oil, renewable energy sources (such as hydro, geothermal, wind, and solar), and natural gas, with coal still as the dominant source (Department of Energy Philippines, 2022). There is, however, a host of significant challenges being faced by the energy sector. Such hurdles hinder sustainable development which, in turn, endangers the energy efficiency and supply in the country. In recent times, electrification issues have been experienced, alongside frequent power outages in several parts of the country, particularly in the Visayas region. Heavy dependence on coal and other imported fossil fuels raises issues on environmental and economic concerns, given the finite nature of these resources and their damaging effect on greenhouse gas emissions (Quirapas & Tongco, 2022).

Shortage in energy resources is caused by increasing demand driven by economic progress and rising population (Asuncion & Cruz, 2020). Oftentimes, these shortages are apparent in underserved rural areas where access to other energy resources is difficult; moreover, the Philippines, being an archipelago, worsens grid vulnerabilities, thereby creating wide gaps in energy access and all the more complicating the efforts to employ a unified energy network (Alzona et al., 2018). The challenges faced by the Philippine energy sector has crucial implications that need policy revisions and urgent reforms in energy sourcing mechanisms. These also underscore the imperative for a transition that considers sustainable energy solutions to address environmental impacts, improve energy equity, and uphold long-term economic resilience.

### Adapting Systems Thinking to Energy Sustainability

**Systems thinking** is an analytical approach that emphasizes the understanding that for a system to deliver efficient products and services and achieve its objectives, it has to ensure that all components interact with one another within the context of the whole (Senge, 1990). Its emphasis is on the interconnectedness of parts and components; the existence of feedback loops as integral to ensuring check and balance and eventual adjustments; and the dynamic behavior of systems over time. Using systems thinking, complex problems can be given solutions through the consideration of the system's structure and relationships, rather than looking at symptoms and components in isolation.

The systems thinking perspective has varied applications across different disciplines, including environmental management, healthcare, education, and policymaking, to identify root causes of issues and develop holistic and long-term solutions. As a case in point, in sustainable energy, systems thinking can be utilized to analyze

the complex interplay of elements in energy production and consumption patterns, including environmental impact and societal needs.

In the Philippine energy system, systems thinking may be used in analyzing the entire sector as a network of interconnected components - from resource extraction to consumption. The move to transition to renewable energy sources, such as solar and wind, will make way for reduced dependency on imported fossil fuels, which are subject to price volatility and contribute significantly to greenhouse gas emissions, thereby aligning the system with sustainability goals (Asuncion & Cruz, 2020). Meanwhile, challenges in energy distribution, which are rampant in rural areas, can be properly addressed through equitable distribution generation solutions like microgrids which enhance system resilience and eventually, reduce transmission losses (Alzona et al., 2018). Furthermore, on the consumption side, systems thinking underscores the value of promoting energy efficiency and optimizing consumer education. Innovative energy solutions such as the use of smart grids enable optimized energy use through real-time adjustments which ensure that demand is met sustainably and wastage is reduced (Berardy et al., 2021).

By employing these holistic solutions through systems thinking approaches, the Philippine energy sector will be able to address systemic inefficiencies and problematic mechanisms and support a more resilient and sustainable energy future for the country.

### Existing Issues and Concerns in the Philippine Energy System

Foremost in the issues facing the Philippine energy system is the high cost of electricity and energy poverty. This continuing increase in energy cost across the country is due to heavy reliance on imported fuels, making electricity inaccessible for lower-income households (Quirapas & Tongco, 2022). There also exists the issue of environmental degradation brought about by heavy emissions from fossil fuel-based energy. Such energy sources contribute to the already problematic issues on pollution and climate change (Asuncion & Cruz, 2020). Also, the heavy reliance on imported fuel renders price and supply vulnerable to fluctuations (Department of Energy Philippines, 2022). Contributing to this issue on energy insecurity as well is the archipelagic nature of the Philippines which makes transitioning to a unified energy network hugely challenging.

Given the challenges mentioned above, the Philippine energy sector has several systemic challenges that significantly and negatively impact its sustainability and equity. The heavy reliance on imported fossil fuels has caused high energy costs, exacerbating energy poverty and limiting economic opportunities (Quirapas & Tongco, 2022). At the same time, fossil-based energy production and importation has taken a toll on the environmental integrity of the country, significantly accelerating climate change and pollution effects, undermining and affecting the country’s sustainability objectives (Asuncion & Cruz, 2020).

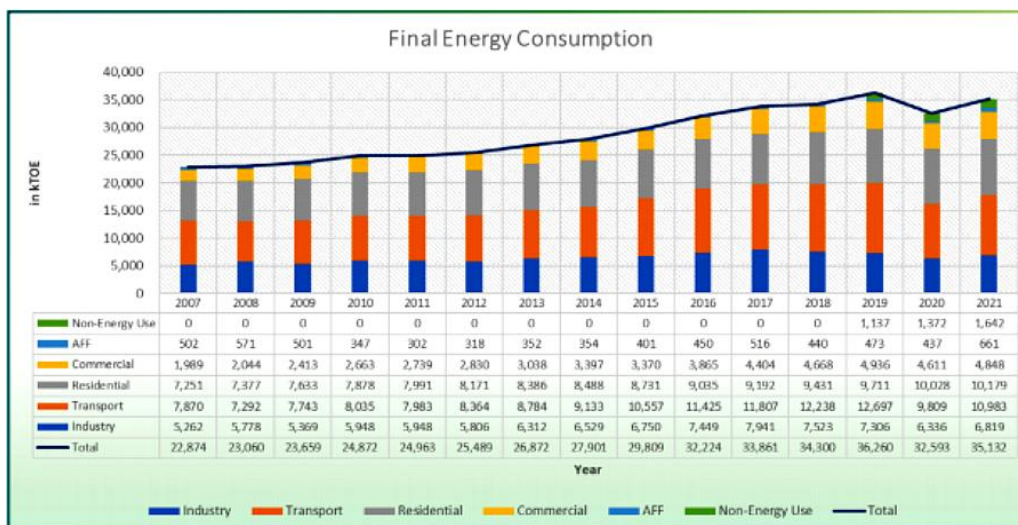


Figure 1. Final Energy Consumption (2007-2021)

Source: DOE Key Energy Statistics

Important information on the Philippines' total energy usage from 2007 to 2021 can be found in the Department of Energy's (DOE) publication on Key Energy Statistics. The report claims that the Philippines' ultimate energy consumption has been rising significantly over time (Fig 1). The nation's growing energy needs were effectively and sustainably satisfied in 2007. Energy consumption may be adequately controlled and adverse environmental effects can be minimized by implementing energy conservation measures, promoting renewable energy sources, and adopting energy-efficient technologies. Among the tactics that can help control energy use and lessen its effects on the environment are the adoption of energy-efficient technologies, the promotion of renewable energy sources, and the implementation of energy-saving measures.

According to careful observation and analysis of energy consumption trends, the Philippines used about 22,874 kilotons of oil equivalent (kTOE) of energy. But consumption increased to 35,132 kTOE by 2021. This notable rise over a 14-year span reflects a rising energy demand, which is influenced by a number of variables, including urbanization, population growth, economic development, and easier access to contemporary energy services.

Making sure that the growing demand for energy is satisfied in a sustainable and effective manner is a major concern for nations, including the Philippines. Adopting energy-efficient technologies, supporting renewable energy sources, and putting energy conservation measures into place are all necessary to help manage energy consumption and lessen its environmental impact. It makes sense that as economies and technologies advance, so does energy consumption. Since effective measures can only be implemented when rules and mechanisms are in place, this move has significant consequences for policymaking. The Philippine government and relevant stakeholders can create efficient energy policies and systems to fulfill the nation's energy demands while reducing greenhouse gas emissions and advancing sustainable development by using data-driven analysis of patterns of energy consumption.

### **Potential Solutions Using Systems Thinking**

The challenges in the Philippine energy sector are overwhelming and need to be addressed from a systemic perspective. Strategic interventions that focus on diversification, efficiency, localization, and policy support are essential. Furthermore, the government needs to look into investing in renewable energy sources like solar, wind, and geothermal sources to reduce heavy reliance on imported fuels. When there is energy security from resources sourced locally, energy security can be enhanced and environmental impacts from fossil fuels can be significantly lowered (Berardy et al., 2021). On the other hand, microgrids and distributed energy generation are crucial for improving access in remote and rural areas, as these localized systems reduce dependence on centralized infrastructure and mitigate transmission losses (Alzona et al., 2018).

Other sustainable practices to enhance energy efficiency that may be adopted for use are through the use of smart grids and incentivizing responsible energy consumption by households and industries. Incentivizing will motivate citizens to employ energy conservation practices and thus curb excessive demand, making the energy system more sustainable (Asuncion & Cruz, 2020). At the governmental level, robust regulations and policy frameworks, such as feed-in tariffs and renewable energy incentives, are imperative for ensuring investment in sustainable energy solutions as the country moves toward a cleaner and more resilient energy future (Quirapas & Tongco, 2022).

### **Aligning with Circular Economy Principles**

Circular economy emphasizes the importance of eliminating waste and encouraging the continuous use of resources, according to the Ellen MacArthur Foundation (2013). Product designs that consider durability, reuse, remanufacturing, and recycling are emphasized and encouraged by the circular economy paradigm. The result is a closed-loop system that significantly lowers waste production and resource input compared to the conventional linear economy, which uses a "take-make-dispose" approach.

This sustainable model focuses on resource efficiency, waste reduction, and continuous resource circulation, providing opportunities for inputs and resources to have a "second life". In the case of energy resources, this translates to using renewable resources, improving energy efficiency, and managing energy waste effectively.

Employing the circular economy framework in the energy sector can promote sustainability through emphasizing resource efficiency, waste minimization, and the continuous reuse of materials. Effective mechanisms such as transitioning to renewable energy sources such as solar and wind aligns with circular principles, as these resources are abundant and non-extractive, reducing reliance on finite resources (Berardy et al., 2021).

The Philippines has 160 renewable energy facilities as of 2023, according to the DOE report from 2023 (Figure 2). By diversifying the nation's energy sources, these plants can minimize reliance on fossil fuels. The energy industry can investigate these plants and use them to help the nation's attempts to switch to a more climate-friendly and sustainable energy system.

Plant Type	Number of plants
Biomass	73
Geothermal	7
Hydropower	41
Solar	68
Wind	7
TOTAL	<b>160</b>
<b>Source:</b> DOE, Consolidated Eligible RE Power Plants for RPS Compliance as of March 2023	

Fig.2 Renewable Energy Plants in the Philippines

While scaling up the generation and integration of renewable energy (RE) is essential, responsible, safe, and sustainable manufacturing, deployment, and decommissioning of solar, wind, and battery technology are necessary for RE to be a truly clean and safe power source. According to the U.S. Agency for International Development (n.d.), a circular economy for RE infrastructure may guarantee that communities and workers gain as much as possible from the shift to a clean energy economy, decrease waste, create jobs, empower women, and provide a lower-emission supply chain for materials.

Moreover, energy recovery strategies ensure that valuable resources are reintegrated into the energy cycle, minimizing waste and supporting long-term sustainability (Asuncion & Cruz, 2020). Such strategies include the development of energy storage systems and the recycling of materials from decommissioned infrastructure. Initiatives such as waste-to-energy approaches can further fortify circularity through the conversion of organic waste into bioenergy, decreasing landfill use while contributing to renewable energy generation (Quirapas & Tongco, 2022).

### Social Impact of Circular Economy

Implementation of these initiatives will have a profound effect not just on the environment and industry. It also impacts all sectors of society with particular benefit to marginalized or rural areas where energy poverty persists. Programs such as localized renewable energy systems and waste-to-energy technologies can bring communities improved access to affordable and reliable electricity. It can both enhance energy equity and reduce dependency on centralized, vulnerable infrastructures. Furthermore, these programs can build jobs in construction, maintenance, and even recycling of renewable energy infrastructure. Empowering communities through skill-building and workforce development in these sectors can lead to long-term socio-economic benefits, particularly for underprivileged populations (Technoserve, 2023).

Another social benefit is the potential for robust collaboration among stakeholders - public, private, CSO and local communities. Multi-stakeholder partnerships, such as the one initiated in Baguio City in 2023, illustrates

one model for promoting circular economy by working together that fosters shared ownership of solutions, enhances the likelihood of success and ensures that benefits are equitably distributed (UNDP, 2023).

### **Integrating Global Perspectives and Considerations**

For responsible energy conservation efforts to become truly sustainable and long-term, global considerations should be taken into account, as these play a critical role in shaping sustainable energy initiatives in the Philippines, aligning local efforts with international standards and opportunities. Meeting climate change commitments, such as those outlined in the Paris Agreement, necessitates reducing greenhouse gas emissions and transitioning to renewable energy sources (Quirapas & Tongco, 2022). Global collaborations and partnerships facilitate access to advanced green technologies, including offshore wind energy systems and battery storage and accelerate the transition to cleaner energy (Berardy et al., 2021). Access to funding and investments from international development banks and climate funds borne from global partnerships further support the development of sustainable infrastructure, bridging financial gaps (Department of Energy Philippines, 2022).

The government and the private sector can also forge partnerships aimed at promoting knowledge and technology transfer. Likewise, energy management and policy development strengthen local capacity and the regulatory framework, thus ensuring long-term energy resilience and sustainability (Alzona et al., 2018).

### **CONCLUSION**

The application of systems thinking to the Philippines' energy production and consumption highlights how crucial it is to have a broad view in order to address its intricate problems. The nation can lessen its reliance on imported fossil fuels while preserving the environment by embracing a variety of energy sources, such as solar, wind, and geothermal. By creating localized solutions like microgrids, we can guarantee dependable electricity supply to even the most isolated areas, promoting resilience and inclusivity. Innovation and sustainable practices can be stimulated by supportive regulations and incentives, such as those that encourage investments in renewable energy.

By adopting the concepts of circular economy, such as recycling materials from outdated infrastructure and converting organic waste into bioenergy, waste can be reduced and resource use can be increased. The energy sector in the Philippines can also be strengthened through collaborations with foreign organizations for finance and technology transfer. In addition to creating a more robust and sustainable energy system, these coordinated initiatives give communities the chance to prosper in a cleaner and more just future.

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