Chapter 1

Prolog: Embracing the Future with Things May Renewed

Sudi Ariyanto, Septina Is Heriyanti

Amidst the emerald islands' strain of Indonesia, blue oceans gleam so wide
The sun, wind, and tide weave tales forevermore
Through woods and mountains that stand with pride
A prospering nation is in the making, under the equatorial sun's golden shine

Sudi Ariyanto

On the day before the 78th anniversary of Indonesian independence in 2023, the President of the Republic of Indonesia reiterated the dream of being one of the five biggest economies in the world in the golden age of Indonesia, i.e. in the year of 100th anniversary of the independence of the country in 2045. This dream was aspired by the founding fathers and is written in the country's constitution. Therefore, the statement of the President, said one day before the

S. Ariyanto & S. I. Heriyanti
National Research and Innovation Agency, e-mail: sudi004@brin.go.id

Ariyanto, S., & Heriyanti, S. I. (2023). Prolog: Embracing the future with things may renewed. In S. Ariyanto & S. I. Heriyanti (Eds.), *Renewable energy: Policy and strategy* (1–12). BRIN Publishing. DOI: 10.55981/brin.900.c809 E-ISBN: 978-623-8372-25-6

anniversary of Indonesian independence in 2023, strengthened the determination of the constitutional mandate for the welfare of the nation. Like other nations, and that has been shown by Indonesia, prosperity will not be achieved without struggle, and one of those struggles is to provide reliable and adequate energy.

Some literature shows that energy consumption has positive and significant impacts on economic growth (Dai et al., 2022). Some studies reveal that there is a two-way causality between energy consumption and economic growth (Zhixin & Xin, 2011). Using the data from the Shandong Province of China, Zang Zhixin and Ren Xin show that an increase in energy consumption drives economic growth which then stimulates more increase in the energy consumption. Studies conducted by Łukasz Topolewski on 34 countries in Europe (Topolewski, 2021) and Jaruwan Chontanawat on Indonesia, Thailand, and Malaysia (Chontanawat, 2020) show a one-way relationship, namely that the increase in economic outputs or activities, could lead to an increase in energy consumption. This means that when economic activity results in higher growth, the energy demand will also be higher. In their papers, Topolewski and Chontanawat promote the utilization of renewable energy based on environmental considerations.

Those are general statements of relations for all energies. What about energy that may be renewed, which is generally referred to as renewable energy? Of course, renewable energy can also play a role in the optimum energy mix. Since renewable energy comes from nature and uses natural resources, Indonesia has considerable resources that can potentially be used to produce renewable energy. Perhaps, therefore, it would not be too much to start this book with a poem about nature and the journey to prosperity of the nation. It is closely related to the dream of being a big economy in the world. This poem tells about the nature of Indonesia, which was blessed with seas, sunrays, wind, forests, and mountains, from where renewable energy can play a role in the welfare of the nation to be a prosperous country that is still in the making.

A. Renewable Energy and Natural Resources

The relationship between nature and the availability of renewable energy is important, as renewable energy sources depend on natural resources for production. Here is the relationship between nature and various renewable energy sources, including physical, chemical, or biological principles for its practical uses.

1. Solar energy

Solar energy comes from solar radiation. On solar panels, sunlight is converted into electricity through the photovoltaic effect, i.e., the conversion of photons to electrons, and electrons then flow in electrical circuits. Solar energy may be used for residential and commercial power generation, solar water heaters, and solar-powered appliances.

2. Wind energy

Wind energy is generated by the movement of air masses. Wind turbines capture the kinetic energy of the wind and convert it into electricity. The rotating blades of a turbine rotate a generator, generating electrical energy. Practical applications include wind farms for grid-connected power generation and small-scale wind turbines for local power supply.

3. Ocean energy

Ocean energy refers to all forms of energy derived from the sea. It comes from various sources, including waves, tides, currents, thermal energy, and salinity gradients. Wave energy is generated from the motion of ocean waves. Wave energy converters capture the kinetic energy of the waves and convert it into electricity. Current energy is generated from the kinetic energy of ocean currents. Underwater turbines capture the energy of ocean currents and convert it into electricity. Tidal energy is generated from the movement of tides. Tidal stream devices capture the kinetic energy of the currents flowing in and out of tidal areas, such as seashores. Ocean thermal energy is generated by converting the temperature difference between the ocean's

surface water and deeper water into energy. Salinity gradient energy is generated from the energy associated with the salinity gradient at the mouth of rivers where freshwater mixes with saltwater. Pressure-retarded osmosis processes and associated conversion technologies are used to harness this energy.

4. Hydroelectricity

Hydroelectricity is generated from the energy of flowing or falling water through potential and kinetic energy conversion. Flowing or falling water rotates turbine blades, which are connected to generators to produce electricity. Practical applications include large-scale hydroelectric dams for power generation and small-scale hydro systems for off-grid power supply.

5. Biomass energy

Biomass energy is derived from organic materials such as wood, crops, as well as agricultural and animal wastes. It involves the combustion or conversion of biomass through chemical processes such as pyrolysis. The principles involved are the release of stored chemical energy through combustion or a chemical reaction. Others use biological processes in producing gas that can be utilized as an energy source, such as the fermentation process in biogas generation. Practical applications include biomass power plants for electricity generation, biomass stoves for cooking and heating, and biofuels for transportation.

6. Geothermal energy

Geothermal energy is obtained from the heat stored in the earth's crust. It uses the principles of heat transfer and thermodynamics. Geothermal power plants extract heat from underground reservoirs and convert it into electricity through steam turbines or binary cycle systems. Practical applications include geothermal power plants for electricity generation and geothermal heat pumps for heating and cooling buildings.

B. Renewable Energy and Economic Development

Here are some ways in which renewable energy can contribute to Indonesia's economic development.

1. Diversification of the economy: The transition to clean energy can help Indonesia diversify its economy and make its energy supplies more secure and affordable (IEA, 2022).
2. Improved socio-economic outcomes: A report by the International Renewable Energy Agency (IRENA) shows that a more comprehensive and ambitious energy transition will lead to improved socio-economic outcomes in Indonesia. Under the 1.5°C Scenario, Indonesia is projected to achieve 0.5% higher GDP, 2.6% more economy-wide jobs, and 8.1% higher social welfare than in the Planned Energy Scenario over the 2021–2050 period. In the renewable energy sector, the energy transition could increase employment substantially, from around 0.6 million currently to around 2 million by 2030 and 2.5 million (mainly bioenergy and solar technologies) by 2050 under the 1.5°C Scenario (IRENA, 2023).
3. Promotion of economic growth: Renewable energy, energy efficiency, and green finance promote economic growth and reduce carbon emissions in Indonesia. It is also suggested that investing in renewable energy can help Indonesia achieve sustainable economic development (Tiawon & Miar, 2022).

There are many benefits to using renewable energy in Indonesia. It is appropriate for renewable energy to be fought for its implementation.

C. How to Make the Best Use of Renewable Energy?

To optimally utilize renewable energy, enabling conditions are necessary. The Asian Development Bank (ADB) presents 6 factors for the successful exploitation of renewable energy: resource base, availability of proven technology, market for power output, implementation capability, availability of capital, as well as government policies and

regulations (Asian Development Bank, 2020). Table 1.1 displays data sourced from Asian Development Bank, which has been reorganized to gain a better understanding of its positive enabling support.

Table 1.1 Enabling Factors for Renewable

No	Factor	Information/Data	Remark
1	Resource	• annual average insolation of 4.5 to 5.5 (kWh/m²/day) • 17,506 MW of reserves and 11,073 MW of resources for geothermal • 9.3 GW potential for wind energy • potential biomass production • potential ocean power	Favorable
2	Technology	Commercially proven generation technology is available from international markets for most of the renewable energy resources in Indonesia	Favorable
3	Market	• 2019–2028 forecasts power sales to grow at an annual average of 6.4% • 15% renewable share of total derated Perusahaan Listrik Negara (PLN) capacity in 2024, 21% share of planned total derated generation capacity in 2028	• Favorable • Realization of these planned additions will depend on a supportive enabling regulatory and policy environment
4	Human Resource	Many qualified engineering, procurement, and construction contractors	• Favorable • Some local developers for small projects lacks sufficient understanding of project risks and development requirements • Land access is still challenging
5	Finance	A wide range of commercial banks, multilateral and bilateral finance institutions, and private investors are available	• Favorable • Available funding schemes have not been fully utilized

No	Factor	Information/Data	Remark
6	Policy and Regulation	• policies and regulations issued by many agencies • interministerial coordination is weak • no apparent impacts analysis prior to the implementation of new policies and regulations	unfavorable

As is shown in the Table 1.1, ADB notes that most factors are sufficiently present in Indonesia to create a favorable environment for renewable energy development. However, government policies and regulations become the principal impediment to greater uptake of renewable energy (Asian Development Bank, 2020). It seems that the government creates challenges of spread authorities of policies and regulations provision, weak coordination among responsible ministries or agencies, and no apparent impact analysis for new policies and regulations.

The impediment may raise an impression of government ineffectiveness in securing its programs to introduce renewable energy to hold the biggest share in the energy production system, of an uncertain regulatory environment existence, or perhaps of a lack of government support. The obstacles coming from the government are indeed unnecessary since the government is supposed to issue policies and regulations that are conducive to renewable energy development and utilization. Erdiwansyah and his friends also expressed the same arguments in line with the Asian Development Bank. Erdiwansyah et al. (2022) concluded that the obstacles to renewable energy development in Indonesia were funding, policies, and laws; the funding was not adequate, while the policies and laws had not improved.

Based on information from ADB issued in 2020 and Erdiwansyah et al in 2022, one can say that there has been little improvement on the policy and regulatory side in a direction that is more conducive to the development and utilization of renewable energy in Indonesia until the 2020–2022 period.

The lack of conducive policies and regulations was one of the considerations and background for writing this book and for pinpointing the focus of this book. The focus of this book is on policies and strategies for the use of renewable energy in Indonesia. The authors' writings may contribute to improving policy and regulatory environment. Surely, this book will not provide a total solution to the problem, but at least it can provide a part of the overall solution.

D. A Glimpse at the Book's Chapters

This book is organized into several chapters on technology, policy, financing, and social aspects. The first chapter, which is meant to be a prologue, essentially conveys information about the background of the writing and organization of this book.

Chapter 2 is the first article addressing the aspect of technology. It is dealing with ocean-renewable energy in Indonesia. The content of the chapter is very relevant to the condition of Indonesia as an archipelagic country with the sea area of about two-thirds of the total area of the country. The authors provide a brief on the current state of ocean energy including technology to produce energy from waves, tides, currents, and thermal. One of the technologies discussed is offshore wind turbines. This is a type of renewable energy technology that generates electricity from wind blowing across the sea. Even though this technology is not energy that comes from the ocean, it is still related to the characteristics of the ocean, in particular the characteristics that affect the wind speed. The chapter is also discussing the development potential of ocean-renewable energy in the islands of Indonesia.

The second article addressing the aspect of technology is Chapter 3. It takes an issue relating to biomass energy. It may be well understood that human activities produce waste. Sometimes, the waste may affect the quality of the environment. In many cases, waste causes environmental problems which can also affect human health. One creative way to deal with waste is to turn it into something useful, for example, in the economic, artistic, or energy fields. The authors

are forwarding an argument that the waste is convertible as biomass fuel for producing electricity. The case addressed is the success of DKI Jakarta, and it may be precedence for other cities in converting urban waste into sources of renewable energy. The practice may also provide double benefits in waste management and electricity production.

Chapter 4 deals with policy and regulation issues. The author describes the Government's commitment to renewable energy and the law on renewable energy. The policy and regulatory framework is described, including matters related to funding. This chapter also presents the successes and challenges of utilizing renewable energy. The author of this chapter also states that the development and utilization of renewable energy are still hampered by aspects of limited infrastructure and funding. It is hoped that the recommendations and steps to increase the use of renewable energy in this chapter can make a positive contribution to overcoming challenges in policy and regulatory aspects.

In Chapter 5, a different approach to dealing with the policy and regulation aspect is addressed using the United Nations Sustainable Development Goals as the basis for assessment. This chapter opens with a very factual statement, namely that extraordinary technological advances have enabled access to energy sources that have never been possible before, but it turns out that these are not able to overcome the challenges of environmental degradation and climate change. The authors opt to use the SGDs as the assessment tool because they may stand as comprehensive indicators measuring the progress toward well-being. Based on a theoretical approach, this chapter shows that it is difficult to achieve both economic and environmental goals simultaneously due to the complex relationships between various energy sources, including their different characteristics. The authors show that the adoption of low-carbon energy sources is inevitable to simultaneously achieve socioeconomic and environmental objectives in the context of sustainability. However, there is a reminder, that renewable energy cannot fully meet economic targets because other fossil energy sources are still needed. Therefore, every country

should develop an optimum energy mix considering economic and environmental targets.

Next to this chapter on policy is those for financing. Developing a financing plan to implement new and renewable energy is necessary. The author of Chapter 6 notes that the aspects of renewable energy financing cover various matters related to funding, investment, and financial management for renewable energy projects. Financing for low-carbon energy in Indonesia is quite complex because it covers various aspects, including Indonesia's macroeconomic conditions. Sources of funding can come from the government, from other countries, as well as from the private sector. There is one good opportunity that can be exploited; funding from abroad is currently being directed more toward energy transition programs. Indonesia should prepare a financing plan for the success of the renewable energy program, and the government's role is needed, both as a provider of funds and as a bridge between renewable energy providers and funders. One of the interesting things about funding discussed in Chapter 7 is the potential for sharia funding, namely *sukuk* for renewable energy programs. As presented in Table 1.1, the funding potential in Indonesia has not been fully utilized. The arguments presented are very valid and interesting because the majority of Indonesia's population is Muslim. The author shows that *sukuk* can have extraordinary potential for funding renewable energy programs, although there are still several challenges that must be overcome. It is hoped that the recommendations and strategies presented can be part of the success of the renewable energy program in Indonesia.

The success of the renewable energy program, like any other program, depends on the communication with stakeholders as well as stakeholder engagement. Chapter 8 is an article that discusses social aspects, i.e., communication development and youth empowerment to support renewable energy programs. The authors show a new approach, namely utilizing youth to communicate government programs, and herein lies the importance of youth empowerment for the success of renewable energy programs. There is optimism on

the authors' part that empowered youth will play a role in spreading information about renewable energy to wider circles, ultimately increasing public awareness.

The final chapter will be an epilogue of this book. The main contents are recommendations and strategies for accelerating the utilization of renewable energy in Indonesia's energy system to achieve the Net Zero Emission target in 2060.

The parties involved in making this book hope that they can contribute to Indonesia's renewable energy program with several arguments that may be new and several recommendations that can be implemented. Like the majority of the Indonesian people who wish for a prosperous Indonesia to be realized on the 100th anniversary of Indonesia's independence, the parties here have the same hopes as them. Hopefully, this book may be a contribution to a better Indonesia in the future. Again, it needs to be reiterated that this book is not aimed to offer all solutions to the problems in the use of renewable energy in Indonesia, but at least several things can be used as solutions for them.

References

Asian Development Bank. (2020). *Renewable energy tariffs and incentives in Indonesia: Review and recommendations.* ADB. http://dx.doi.org/10.22617/TCS200254

Chontanawat, J. (2020). Relationship between energy consumption, CO_2 emission and economic growth in ASEAN: Cointegration and causality model. *Energy Reports, 6*(Supplement 1), 660–665. https://doi.org/10.1016/j.egyr.2019.09.046.

Dai, L., Jia, R., & Wang, X. (2022). Relationship between economic growth and energy consumption from the perspective of sustainable development. *Journal of Environmental and Public Health, 2022*. https://doi.org/10.1155/2023/9847034

Erdiwansyah, Gani, A., Nurdin, M.H., Mamat, R., & Sarjono, R.E. (2022). Policies and laws in the application of renewable energy Indonesia: A reviews. *AIMS Energy, 10*(1), 23–44. http://www.aimspress.com/article/doi/10.3934/energy.2022002

Intenational Energy Agency (IEA). (2022, September 2). *Indonesia's push to reach net zero emissions can help power a new phase in its economic development.* Accessed August 25, 2023, from https://www.iea.org/news/indonesia-s-push-to-reach-net-zero-emissions-can-help-power-a-new-phase-in-its-economic-development

IRENA. (2023). *Socio-economic footprint of the energy transition: Indonesia.* International Renewable Energy Agency. https://www.irena.org/Publications/2023/Jan/Socio-economics-of-the-energy-transition-Indonesia

Tiawon, H., & Miar, M. (2023). The role of renewable energy production, energy efficiency and green finance in achieving sustainable economic development: Evidence from Indonesia. *International Journal of Energy Economics and Policy*, *13*(1), 250–260. https://doi.org/10.32479/ijeep.13915

Topolewski, L. (2021). Relationship between energy consumption and economic growth in European countries: Evidence from dynamic panel data analysis. *Energies*, *14*(12), 3565. https://doi.org/10.3390/en14123565.

Zhixin, Z., & Xin, R. (2011). Causal relationships between energy consumption and economic growth. *Energy Procedia, 5*, 2065–2071. https://doi.org/10.1016/j.egypro.2011.03.356.