Polarization of the Green Energy Transition in Improving the Economy of Coastal Communities Through Ocean Thermal Energy Conversion

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Abstract: The economy and population will improve significantly in the next four decades Based on an estimated annual gross domestic product (GDP) growth rate of 5.6 percent from 2015 to 2050 and an average population growth rate of 0.8 percent per year (2015- 2050). The potential of the Riau Archipelago Province for renewable energy is enormous, but it has not been widely utilized, climate adaptation and investment show that improving the economy of coastal communities, is in an open participatory process, namely an alternative people-based economic activity that is competitive by utilizing the conversion of marine thermal energy into electricity is a method by utilizing the temperature difference between the sea surface temperature which is influenced by a certain depth, NPW as a technology that converts sea level at the maximum temperature, which is evaporated and the condensity continues to the water temperature which is integrated in the turbine to generate electricity, the main obstacle faced in this process is how to direct the ability to manage the character and dynamics of coastal communities, in accordance with the economic conditions of the community. processes generate a large quantity of heat which cannot be used due to its relatively low temperatures (400C – 2000C). In 2012, global energy production was 153 PWh. and at least a third of it was wasted as thermal waste. Thus, recovering only a few percents out of thermal waste generated in industrial and household processes would represent an extremely valuable source of green energy. Thermal engines are too complex and costly to to put these heat sources to use; therefore, a precious energetic resource is lost. Thus, a simpler and more direct way is required for the conversion of thermal energy into electric energy.

1 INTRODUCTION

The Government of Indonesia has determined a non Business as Usual (nonBAU) economic development plan according to the Masterplan for Acceleration and Expansion of Indonesia Economic Development as decreed by the Presidential Regulation no 32, 2011, Energy development to support national economic growth, MP3EI scenario is a scenario that optimizes growth in accordance to the Masterplan for Acceleration and Expansion of island Economic Development (MP3EI). Development is done with a breakthrough approach and not business as usual. MP3EI is intended to promote the establishment of high economic growth, balanced, equitable and sustainable. Assumstion of MP3EI scenario is same with the Base scenario except for GDP, GDP growth and GDRP growth, The energy demand of the industrial sector, which is considered as the national economy driver, is expected to increase continuously and dominate the total final energy demand, followed by that of the transportation sector which supports the economic activity. The share of energy consumption in industrial sector increases continuously from 39% in 2010 to 41% by 2015, and to reach 43% in 2030. Energy consumption of the transportation sector increases from 24% to 28% by 2015 and to reach 35% in 2030. Firewood will be less used in the household sector resulting in a declining share from 31% to 24% by 2015 and down to 13% in 2030, using the Base scenario. However, by the MP3EI scenario, contribution of the household sector in 2030 will be less significant compared to that by the Base scenario. This is due to projected improvement in living standard of the general public, such that the use of firewood will continuously diminish. one that supporting economic growth through the regional potential development is energy diversification, Biofuels and CTL has a large prospect to be developed in the future to reduce import dependancy.

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However, oil fuels market need to be managed properly to encourage development of biofuel and CTL, Liquid fuels are used in the transportation, industry, commercial, households, and other sectors. The transportation sector is projected to still rely on combustion engines as prime movers using oil fuels in the future. Consequently, the transportation will dominate the use of oil fuels.

The share of the transportation sector in oil fuels consumption reached 63% (2010) is projected to grow to 71% by 2030. According to the MP3EI scenario, oil fuels consumption in the industry sector will also increase causing the share of the transportation sector to be suppressed to 68% in 2030.

2 RESEARCH PROBLEM

The crucial issue given the dominant role of coastal communities are, Local oil and gas management capabilities tend to decline, as a result economic growth is disrupted, which is caused by fuel imports.

to meet energy demand in the future because efforts to substitute oil fuels with other types of liquid fuels (biofuels and CTL) will not be adequate. By 2030, crude oil import according to the Base scenario will reach 86% of domestic supply and oil fuels import will reach 55% of domestic supply.

The increase of crude oil import will only be made possible with construction/expansion of oil refinery capacity up to 400 MBCD (Base scenario) and 1.200 MBCD (MP3EI scenario), it will be an irony in the future (where Indonesia is currently one of the major LNG exporter) when LNG imports up to 41% of domestic supply become necessary to meet domestic gas demand in 2030.

This research also projects that future energy situation will require energy supply infrastructure to be built that include LNG plant, oil refineries, LPG plant, electricity generation sector, CTL, coal ports, and gas refiling station for transportation sector with an investment at least 311 billion USD (constant price 2000) for the Base scenario and 460 billion (constant price 2000) for the MP3EI scenario. This total investment funding will be approximately 2.73% and 3.03% of total GDP during 2011-2030 period for the BASE scenario and MP3EI scenario, respectively.

3 RESEARCH METHODOLOGY

Thermal energy can be converted directly into electric energy by using the Seebeck effect: the heat transfer into an electric conductor will engage charge carriers, resulting in electromotive force. Two junctions A and B between different conduction materials a and b will generate electromotive force between ends C and D if the two junctions are maintained at different temperatures (Figure 1). In an open circuit, the electromotive force generated is proportional with the difference of temperature between the two junctions: Geometric gradient occurs when cash flow changes up/down by a certain percentage. Present Worth (PW)factor:

$$E = \propto (T_1 - T_2)$$

A being the Seebeck differential coefficient for the two materials. The Seebeck coefficient for metals is around 10 μV/K, therefore the voltages generated are used only for measuring the temperature in thermocouples. The most widely used is thermocouple K (junction with chromel alumel alloys). This provides 41 μV/K and can function between -200 ^{0}C and +1260 ^{0}C. (Biofuels News, 2019) (Figure 2). In order to obtain higher voltages, tens or hundreds of thermocouples can be connected in series, forming thermopiles.

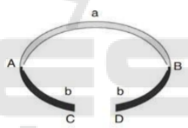

Figure 1: The junctions between different points.

Figure 2: Thermocouple.

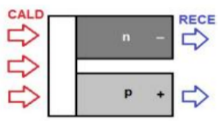

Figure 3: Semiconductors.

In semiconductors, the Seebeck effect can generate much higher voltages, hundreds of mV/K. The majority carriers are engaged by the heat flow. Thus, electromotive force is obtained, the polarity of which is indicated in Figure 3. Tens or hundreds of serial elements form Seebeck modules, which can provide tens of mV/K (Figure 4). In our experimental investigations we used modules TEG-40-40-19/200, produced by Eureca (Germany). These generate 54 mV/K (Migas, 2018), If current runs through a circuit made up of junctions between different materials, a heat flow will appear between the two junctions. This is the Peltier effect. Thus, one of the junctions adsorbs the heat generated at the other junction. The Peltier effect can be used for cooling components or spaces. Peltier modules with semiconductors are built similarly with Seebek modules, but they are cheaper, as they are optimized for cooling and not for generating thermoelectric force. Peltier modules can be used for generating thermoelectric force, but their performance is inferior to the Seebek module performance. In our research we used Peltier modules TEC1-12705A.

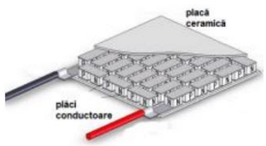

Figure 4: Seebeck module.

Analysis of energy needs and supply is carried out based on the calculation results from the model LEAP and Balmorel. LEAP is a capable energy planning simulation model carry out energy analysis from need to supply in an integrated manner.

3.1 Economic Growth Models

Geometric gradient occurs when changes in cash flow increase/decrease by a certain percentage.
Present Worth (PW)factor:

$i \neq g$:

$$(P/A, g, i, n) = \left[\frac{1-(1+g)^n(1+i)^{-n}}{i-g}\right]$$

$i = g$:

$$(P/A, g, i, n) = [n(1+i)^{-1}]$$

where Q(P, A) is a positive differentiable function. We now essentially repeat the computation made in Section 2, i.e., we want to compute the corresponding gradient flow for shortening length relative to the new metric, the design this evolution geometric gradient of the potential well described by the gradient flow we may also add a constant inflation term (which may be interpreted as a Lagrange multiplier for a constrained version of the given optimization problem), and so derive a models efficient, geometric Gradient 3-D contour models based on surface evolution ideas, by modifying the Euclidean area in this case by a function which depends on the salient features which we wish to capture. In order to do this, we will need to set up some notation.

Let g: [O, i x [0,1] + n denote a compact embedded surface with (local) coordinates (g, .). Let g denote the mean curvature and $ the inward unit normal limit.

4 RESULT

The analysis is divided into three stages, namely analysis of energy needs, energy transformation and energy supply. The analysis is based on energy projections or forecasts from the three stages the. In addition to sectoral conditions such as activity, technology, and intensity, in doing Projections of energy demand and supply require input related to roadmaps and plans strategy (Renstra), energy regulations that apply or are enacted. Assumptions regarding conditions of macroeconomic indicators such as GDP growth, demographics, and energy prices Technology penetration is also necessary because it is a dynamic driving factor Present value (Present Worth) is the equivalent value at the present moment (time 0). This PW method is often used before other methods because it is usually relatively easier to assess something project at the moment. Fixed Input Maximize the PW of Benefit Fixed Output Minimize the PW of Cost Neither input nor output is fixed Maximize (PW of Benefit – PW of Cost) or Maximize NPW, The energy balance is a description of the equilibrium conditions between the energy supply side and the energy supply side sectoral energy needs. The energy balance is depicted in an energy system that includes starting from production, conversion and transportation/ distribution to the end user. This decrease in the number of resources and reserves is due to reduced exploration activities and production, so that the economic routine of coastal communities is disrupted.

5 CONCLUSIONS

Geothermal water, the hot and cold water in households and farms can become the hot and cold sources for generating electrical energy. The hot water thermoelectric generator is made up of four serial Peltier modules placed between two metallic boxes filled with hot and cold water, respectively. The metallic boxes are placed into a larger box made of expanded polystyrene, for thermal insulation The thermogenerator can fuel small electrical devices

(LED lamp, ventilator, radio, phone) for around 15 minutes, until the temperature in the two metallic boxes becomes the same. The resulting lukewarm water can be used in the household.

A variant in continuous flow, placed before the chamber for mixing the warm and cold water in a tap and also on the thermal water heating system can provide electrical energy for free, with no moving parts and with no maintenance costs! Fuel consumption continues to increase as a result of economic growth and population growth, while domestic crude oil production continues to experience decline and stagnant refinery capacity led to imports of crude oil and fuel continues to increase, so that the construction of a fuel refinery is an impossible solution avoided, as an attempt to and encourage the acceleration of economic growth and increase the competitiveness of the coastal island industry. The devices we built prove that Seebeck and Peltier modules can be used successfully for the use of energetic waste in households, greenhouses, etc.

Thermoelectric generators can exploit heat flows with small temperature differences, they do not have moving pieces, they do not require maintenance and their life spans over decades. Seebeck modules have proven to be very efficient (9% conversion efficiency for a difference of temperature of 150^0C).

Peltier modules have lower efficiency (2%), but they can exploit successfully resources with temperature differences of only a few tens of degrees Celsius.

The heat wasted from geothermal water, domestic hot water and the central heating system in the apartment can be used for converting thermal energy into green energy useful in households, greenhouses, farms, etc, especially when electric power from the network is not available. Solar radiation can be converted into electrical power with the use of thermoelectric generators, which are a more robust alternative than photovoltaic panels. Any rooftop of façade of a building can thus become a source of electrical energy, all materials and components used for building the generators, except for Peltier and Seebeck modules, came from discarded materials, in order to put the wastes to use and to protect the environment.

REFERENCES

APERC (2019) APEC Energy Demand and Supply Outlook, 7th Edition 2019, Vol. II, Asia Pacific Energy Research Centre, Tokyo.

Biofuels News (2019) First biofuel produced at Total's La Mède biorefinery in France, biofuels-news.com, access 09/13/2019

Ditjen Migas (2018) Neraca Gas Bumi Indonesia 2018-2027, Direktorat Jenderal Minyak dan Gas Bumi, Kementerian ESDM, Jakarta.

DNV (2019) Digitalization and the Future of Energy, DNV GL

Arnhem. Ernst & Young (2018) Shale Gas and Coal Bed Methane – Potential Sources of Sustained Energy in the Future, Ernst & Young, access 07/20/2018.

Brosch, T., Sander, D. and Patel, M.K. (2016) Understanding the Human Factor of the Energy Transition: Mechanisms Underlying Energy-Relevant Decisions and Behaviors, Frontiers, Lausanne

Hock, S.S. The Population of Peninsular Malaysia; Institute of Southeast Asian Studies: Singapore, 2007; ISBN 978-981-230-427-8.

The Land (West Malaysia). Encyclopedia Britannica. 2020. Available online: https://www.britannica.com/place/Malaysia/Plantand-animal-life. (accessed on 30 April 2020).

Department of Statistics Malaysia. 2016. Available online: https://www.dosm.gov.my. (accessed on 30 July 2008).

Malaysia Maritime Claims 2019—Geography. Available online: http://www.indexmundi.com/ (accessed on 29 January 2020).

ASEAN Centre for Energy. 2019. Available online: https://aeds.aseanenergy.org/country/malaysia/ (accessed on 25 April 2020).

Nakaoka, T.; Nishida, T.; Ichinose, J.; Nagatomo, K.; Mizatani, S.; Tatsumi, S.; Matsushita, M.; Pickering, T.; Ikegami, Y.; Uehara, H. Oceanographic observations and an estimate of the renewable energy for ocean thermal energy conversion in the coast of the Fiji Island. Deep Ocean Water Res. 2003, 4, 57–66.

Uehara, H.; Dilao, C.O.; Nakaoka, T. Conceptual Design of Ocean Thermal Energy Conversion (OTEC) Power Plants in the Philippines. J. Sol. Energy 1988, 41, 431–441. [CrossRef]

Wolff, A.W.; Hubert, E.W.; Wolff, M.P. OTEC World Thermal Resource. In Proceedings of the Ocean Conference, Washington, DC, USA, June 19–22 1979; pp. 13.5.1–13.5.7.

Rajagopalan, K.; Nihous, G.C. Estimates of Ocean Thermal Energy Conversion (OTEC) resources using an ocean general circulation model. Renew. Energy 2013, 50, 532–540. [CrossRef]

Nihous, G.C. An estimation of Atlantic Ocean thermal energy conversion (OTEC) resources. Ocean Eng. 2007, 34, 2210–2221. [CrossRef]

Hammar, L.; Ehnberg, J.; Mavume, A.; Cuamba, B.C.; Molander, S. Renewable Ocean energy in the Western Indian Ocean. Renew.Sust. Energ. Rev. 2012, 16, 4938–4950. [CrossRef]

Liu, T.; Hirose, N.; Yamada, H.; Ikegami, Y. Estimation of ocean thermal energy potential in the Aguni Basin. Appl. Ocean Res. 2020, 101, 102185. [CrossRef]

VanZwieten, J. H.; Rauchenstein, L.T.; Lee, L. An assessment of Florida's ocean thermal energy conversion. Renew. Sust. Energ. Rev. 2017, 75, 683–691. [CrossRef]

Zahraee, S. M.; Golroudbary, S.R.; Shiwakoti, N.; Kraslawski, A.; Stasinopoulos, P. An investigation of the environmental sustainability of palm biomass supply chains via dynamic simulation modeling: A case of Malaysia. J. Clean. Prod. 2019, 237, 117740. [CrossRef]

Benjamin, M.; Okamura, S.; Nakamura, Y.; Yasunaga, T.; Ikegami, Y. Status of the "Kumejima Model" for advanced deep seawater utilization. In Proceedings of the 2016 Techno-Ocean, Kobe, Japan, 6–8 October 2016.

Takahashi, M. M. Ocean fertilization using deep ocean water (DOW). Deep Ocean Water Res. 2003, 4, 73–8