INDONESIA BETWEEN ASEAN COUNTRIES AND THE WORLD IN HYDROELECTRICITY

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Abstract Hydropower is predicted to be the most favourable energy regarding the global needs to cope with the global warming and the low cost energy resources utilization. Fossil fuel tends to depletion in the coming decades and the fossil energy price will race up. The states which energy is depend only on oil will result in the fragile economic base. Hydropoelectricity is now being energy developed even in a leading petroleum producer country. Indonesia with 75.000 MW hydroelectricity potential all over the country is hoped to generate more power in hydro energy to ascend the percentage of the state renewable energy consumption as a part of Indonesia process to diversify the domestic energy consumption to keep the economic away from oil dependency. Hydropower is the largest source of renewable energy of the world. In year 2005, some 2950 TWh of hydropower was generated, equivalent to 90% of electricity from world renewable energy consumption.

Keywords: Hydropower, economic dependency, renewable energy

I. Introduction:

Hydropower plants are a promising energy source for most countries in the globe regarding the problem of CO_2 emissions and fossil fuel depletion in the coming decades. Fossil fuels are 88% of total global primary energy consumption in 2007 [11]. The world awareness of highly dependence on fossil fuels will take effect to some consequences. Fossil fuels have limited potentials and at the current rate of exploitation these resources will deplete within the coming decades [11]. The world population has passed six billion people and the pressure on basic needs to be strengthened [12]. The economic growth of developing countries and industrial activities in the developed countries, has been increasing the energy consumption globally.[18] Oceans cover approximately 71% of earth surface and hold large amount of energy more than 2 x 10^3 TW which is the largest untapped renewable energy resource around the globe.[9]

Hydropower Around The world

Hydropower becoming an imperative choice for clean and safe energy in next coming years. More than 105000 MW of hydrocapacity under construction in the world. In Asia 84.400 MW, followed by South America 14800 MW, Africa 2403 MW, Europe 2211 MW, North & Central America 1236 MW. Very often the development of hydropower is as part of multipurpose development which are also providing benefits such as irrigation, fish multiflying, drinking water supply, flood control, tourism, navigation etc.[1]

II. Indonesia and Hydro Energy

Total hydropower potential of Indonesia is 75.000 MW is one of the largest hydroelectric reserves in Asia.[3,15,17]. These potential is spreading across 1315

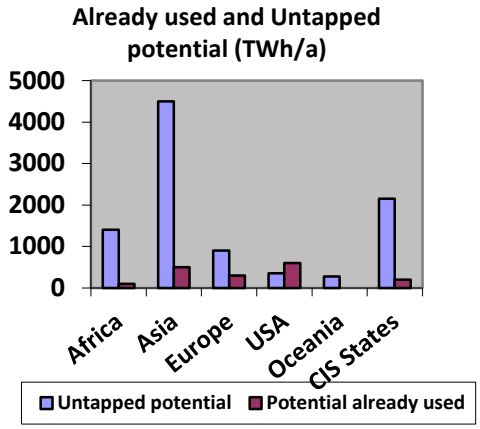

Figure 1: Water power global potential, used and untapped.[8]

locations with different size and different predicted power. A small amount of capacity could be developed by mini and micro hydropower. A target of 59.5 MW has been set by the government for commercial microhydropower by the end of 2003 and rising to 153.4 MW by 2020. Villages requiring less than 100 kW will be encourage to build off micro hydro if the water resource existed. Micro hydro schemes of 25 kW or larger will be used to replace the diesel-fired plants.[4,7,10]

By the year 2010 Indonesia government have developed 633 villages through the Village Energy Self Sufficient Program (Desa Mandiri Energi or DME Program). These are

out of 2000 villages targeted by the government to developed by the year 2014.[2,3,5,10]

DME Program in Indonesia was developed on two energy resources, i.e: *Firstly*: non-fossil energy such as micro hydropower, solar energy, wind energy and biogas ; *Secondly*: the energy from plantation, such as palm oil, Jarak Pagar, etc. The aim of DME Program is mainly to utilize the local energy for remote areas, release the remote people's from oil dependency, opening the job vacations for local people and poverty alleviation in rural areas. Micro-hydro energy is included in the first base of the DME Program. The study and academic research in hydropower, solar energy, wind energy and biogas took much attention at universities in Indonesia. At the beginning, Indonesia tend to explore the energy from plantations, such as Palm Oil and Jarak Pagar. During the past few decades total areas of forest conversion have increasingly converted for oil palm and other commercial crops. Oil palm has become one of the most important estate for Indonesian economy. It growth tremendously, from merely 106.000 ha in the late 1960s, oil palm estate had expanded to cover 8 million ha by 2010, concentrated in Sumatra and Kalimantan.[17] The government plans to develop between 2010 and 2015, an additional of 1.5 million ha of new oil palm plantations for food and biofuel. For 2015 – 2025 there is a target for additional 4 million ha.[10,17]. These plans are now to be re-evaluated by the strong repulsion from communities and NGO groups, regarding the loss of biodiversity, deforestation, community lands right and orangutan distinction.

The way to get more energy is openly possible from renewable energy resources such as hydro energy, wind energy and solar energy. Hydro energy potential of Indonesia is 75.000 MW which is one of the largest hydro reserves in Asia. These potential is spreading across 1315 locations with different size and predicted power. Most of the capacity could developed by mini and micro hydropower. A target of 59.5 MW has been set for commercial hydropower by the end of 2003 and rising to 153.4 MW by the year 2020. Villages requiring less than 100 kW will be encourage to build off micro hydro where the water resource existed. Microhydropower of 25 kW or larger will be used to replace the diesel-fired plants.[2] Indonesian government have already developed 633 villages through the program of Energy Self Sufficient Village by 2010. These villages are out of 2000 villages targeted by government to be developed by 2014. In Indonesia, there are 80,000 villages, which 45% is located on undeveloped areas. 6500 villages is not yet getting electricity. [2]

According to Lidula (2007), Indonesia is the largest hydropower potentials between ASEAN countries. From the hydropower potential, 4264 MW has utilized through large and mini hydropower generation or 5.6% from theoritical potential. This percentage is increased by 1.8% from utilized hydropower in the year 1993.[13]

Table 1: Hydropower Potential and Utilization in ASEAN countries

Country	Technical Potential	Utilization
Cambodia	10.000 MW (large) 300 MW (mini/micro/pico)	20 MW (large) or 0.2% 1 MW (mini/micro/pico) or 0.3%
Indonesia	75.000 MW (large) 459 MW (mini/micro)	4200 MW (large) or 5.6% 64 MW (mini/micro) or 13.9%
Lao PDR	18.000 MW	615 MW (large) or 3.4% 13 MW (mini/micro/pico)
Malaysia	29.000 MW (large)	2026 MW (large) or 6.9% 40 MW (mini)
Philippines	11.223 MW (large & small) 1847 MW (mini) 27 MW (micro)	2867 MW (total) or 25.5 %
Thailand	700 MW (small)	139 MW (small) or 19.8%
Vietnam	800 – 1400	110-115

	MW (small) 90 – 150 MW (pico) 300–600 MW (isolated mini-grids) 400-600 MW (mini grid-based)	(small) or 13.7% 30-75 MW (pico) or 33%-50% 20 MW (isolated mini-grids) 60 MW (grid-based mini)
Brunei	-	-
Singapore	-	-

Source: Adapted from [14]

Compared to China, the hydro energy utilized in Indonesia is relatively small. The energy from tidal current solely in China is 61.3 Twh/yr. [13]. The country with area of $960x10^4$ km^2 and population of 1.328 billion in 2008 produce 36.665 billion ton energy in 2007.[19] China is a country which is extensively use the hydro energy in Asia aimed to support the internal electricity requirements and economic development. BRIC (Brazil, Russia, India and China) are hydropower-rich states where hydro energy is progressively exploited to promote internal industrialization. Most of economic development worldwide has been hydropowered, whether it came off the waterwheel or from the hydropower plant. In South America, urbanization has been largely hydropowered. Hydropower finds general acceptance as a domestic energy source.[20]

Switzerland and Italy, two states without domestic coal resources, calling the hydropower as 'white coal' energy. At this time, the hydropower goes as the lowest cost electricity in the world. In the recent years in Asia, the country such as China, Turkey and Iran have committed large capital resources for the construction of large hydropower projects. China has 95 dams in varied construction stages, where 50 units of it exceed 100 meters in height and 10 of these are 100 meters or higher. Iran as a worlds leading petroleum producers, has 48 hydropower projects under construction and 16 of these exceed 100 meters in height. Turkey has 51 units hydropower projects under construction, 15 of these is exceeding 100 meters in height. Japan has 35 units in varied phases of construction, 8 of these exceed 100 meters in height. Vietnam has 17 hydropower projects, 10 of these are 100 meters or higher. [20]

Regarding the hydropower development in Indonesia in coming years, we remind all stakeholders some problems and challenges to be solved ,ie. the availability of ready use step-up gear transmission system in the market to facilitate the researches and scientists and the people to conduct the experiments of the wind and hydro energy around them [5]. The availability of low RPM alternator should also easily found in the market. The step up gear transmission system and the low RPM alternator should resistance to atmosphere corrosion and the aqueous corrosion.[5]

Conclusions

Regarding the discussion we conclude that hydro energy is hoped becoming important and reliable energy source in next coming decades in Indonesia. Indonesia is potential in hydropower among Asean countries. Significant actions in hydropower development and hydro energy utilization are proposed to realize the national energy diversity consumption in 2025 and increase the percentage of national renewable energy consumption. However, the support to the hydro energy development is also required. It should easy to find the anti corrosion step-up gear transmission system to couple hydro turbine and produce power [5].

Acknowledgement

Author deliver thanks to the Engineering Faculty of Sriwijaya University for the financial support of this presentation..

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