Simulation of economic effect on electricity democracy based on clean energy at UMKM’S IPP in Indonesia

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Abstract. The facts show that most large-scale power projects in Indonesia cannot be completed on schedule. The reason is related to the dynamic constraints such as legal, political, economic, social and cultural issues. In general, there is a potential of community empowerment approach using a small size plant has not been done. Such approach may give a lot of advantages including shorter construction time and easier to use clean energy like solar, wind, and waste or biomass which is available around us. Constructing 1000 units of 1 MW power plant simultaneously will have similar capacity with the construction of one 1000 MW power plant unit that had so many obstacles. Another important advantage is that this kind of plant can be self-managed under the ownership of local communities that can empower local businesses to become small-scale IPP developers with simple technology and small capital costs. This paper will examine the economical impact of local people's electrical self-management known as IPP UMKM by simulating several scenarios.

1. Background
Until recently, we are still relying on conventional power system, aimed at optimizing efficiency and reliability. Conventional system is typically large centralized power plants, which are interconnected one into others and delivers the power to the customers using transmission and distribution lines. However, more and more problems emerged to hinder the construction of big power plant as well as its associated transmission lines, including land acquisition, right of way permit, environmental and social obligation. Many big power plants and transmission lines projects are delayed because facing the above mentioned challenges and its cost may offset the benefit of the economies of scale and interconnection system. Moreover, most conventional system plants are dominated by fossil fuel while there are huge resources of renewable energy available surrounding any communities. Other drawbacks of the large scale power plants under the conventional system include the need of large amount of money, highly dependent of imported equipment and spare parts, and mostly owned by a small group of giant investor. Those are conflicting with the energy security law (UU No 30/2007), stating that fulfilling energy need should be involving people ability and caring about environment.

“Listrik Kerakyatan” is the Indonesia term, means people owned electricity, could become an alternate solution to answer the conventional power system dilemma. It will be discussed further in this paper using the principle of math commutative law, \( 1000 \times 1 = 1 \times 1000 \), This expression is illustrated in figure 1[1].

Most of private power plants under the IPP (Independent Power Producer) scheme are usually large scale and owned by the giant investors. Furthermore, the large scale plants are still dominated by fossil
energy, which harmed the environment. In order to weigh up the situation, the government has to consider local people involvement as a small Independent Power Producer (IPP), which plants should use renewable energy. Listrik Kerakyatan (LK) is adopting the concept of distributed generation, which is small scale distributed power plants using sun, biomass, and wind energy resources, which always available close to the community.

UMKM is the abbreviation of "Usaha Mikro Kecil dan Menengah," an Indonesia term of Micro Small and Medium Enterprise (MSME). According to Sarwono and Hartadi [2]. Micro, Small and Medium Enterprises (MSMEs) have an important and strategic role in national economic development. UMKM is a very potential market for the financial services industry, especially banks to distribute financing. UMKM therefore becomes essential to the economic growth and life quality improvement. He also describes that typically, UMKM is a self-managed business and self-funded business and its assets is relatively small. It has only small number of employees and usually market its product or service locally. UMKM business may vary from a start-up informal sector like livelihood activities and micro enterprise like home craft industry, small dynamic enterprise, and fast moving enterprise. Based on the type and ownership level, UMKM consist of three levels from the smallest Micro (Mikro) with net asset IDR50 million, Small (Kecil) with net asset IDR50 million to IDR500 million, and Medium (Menengah) level with net asset of IDR 500 million to IDR2500 million.

UMKM is getting special incentives from the government including low interest credit, simple and easy business permits, and various business development support from related government agencies. Based on its characteristics and various advantages given by the government, UMKM can be very potential to own and run electricity business, compliment to the large size conventional electricity companies, which are dominated by a limited group of large enterprise.

The small size of LK, provides opportunity for local business players to own small scale power plant or waste to energy plant because the investment cost per package of LK is relatively low, less than one billion rupiah for the unit size of 30 kW to 50 kW. Such small size plant also needs only small area (200-1000 m2) and flexible to be located any where around school, housing, market, mall, hotel, and office. For remote areas that have no electricity, LK can be managed locally as a hybrid system.

**Listrik Kerakyatan (LK) as Distributed Generation**

![Diagram of LK over the conventional power system](Source: Legino & Arianto, 2017 [1]).

As shown in figure 1, LK plants location are scattered around the communities or electricity customers. Therefore, technically, LK will reduce the transmission losses and the problem of excessive transformer overload and drop voltage. From the energy balance aspect, LK offers the additional renewable energy capacity to the system without any transmission lines construction.

On top of the above advantages, LK will be the concrete way to use both local material and man power, especially for biomass power plant. If LK is expanded nationally, the government target to have 100 percent electrification ratio and to reach renewable portion of 23% by 2025 can be achieved in less
than three years. Unlike, the giant project that needs foreign funding, LK can be funded by local people equity and social support allocation for villages. In addition, LK also has opportunity to get a low interest credit from national bank under the UMKM scheme.

2. Objective
The objective of this paper is to examine whether UMKM can feasibly apply small-scale model electricity business economically under the corridor of existing regulation. This paper will undertake a financial simulation using cash-flow analysis to determine the profit by calculating NPV (Net Present Value), Payback period, and Internal Rate of Return (IRR). The main criteria is the electricity price regulation in which the tariff offers by UMKM IPP should be lower than the Electricity Production Cost of the region

3. Literature review
According to IEA[3] : Energy security is “the uninterrupted physical availability at a price which is affordable, while respecting environment concerns.” In this case, any effort to increased energy efficiency, energy storage, CO2 capture , maximizing renewables, and nuclear power plants will all be important. According to Ohja, Kuldeep[4]: The centralized power system ignores energy needs of the rural areas and poor and has also led to environmental degradation, whereas decentralized energy planning model is in the interest of efficient utilization of resources. They also depict decentralized renewable energy as non-polluting plants is essential. In the other opinion, Allan, Grant Eromenko, Igor Gilmartin, Michelle Kockar, Ivana McGregor, Peter[5] said that decentralized electricity system is recognized as one means of achieving efficient and renewable energy provision, as well as addressing concerns over ageing electricity infrastructure and capacity constraints.

In other study by I Wayan Dipta [6], small and medium enterprises have been recognized as highly strategic and important not only for economic growth but also for equitable revenue sharing. Due to its strategic and important role, Indonesia pays special attention to their developments, including fostering an environment with a conducive business climate, facilitating and providing access to productive resources and strengthening entrepreneurship and competitiveness. The role of government and other support agencies is strategic and important, for instance by means of providing facilities and support such as financial assistance and other needs to bridge the partnership between the two parties.

To determine financial viability [7], one of the major topics which is taught in the field of Finance is the rules of capital budgeting, including the Payback Period and the Net Present Value (NPV). Bhandari, Shyam B [8], introduces the discounted payback period criterion for small business capital budgeting decisions; properties and limitations of the traditional payback technique; discussion of the discounted payback approach; Comparison of the payback methods with other capital budgeting techniques

According to Kierulf, Herbert [9], the article explains significant problems with the measurement of reinvestment issues, multiple IRRs, timing problems, problems of choice among unequal investment opportunities, and practical difficulties with multiple discount rates. And according to Bhattacharyya, Nalinaksha[10], establishes the validity of the IRR interpretation as returns earned on funds still internally invested in the project. Using this interpretation, IRR can be viewed as a tool to evaluate the risk of capital budgeting proposals.

\[
IRR = i_1 + \frac{\text{NPV}_1}{(\text{NPV}_1 - \text{NPV}_2)} (i_2 - i_1)
\]  

(1)

where: IRR = Internal Rate of Return

\[i_1 = \text{The resulting Discount Rate NPV+}\]

\[i_2 = \text{The resulting Discount Rate NPV-}\]

\[\text{NPV}_1 = \text{Net Present Value positive}\]
NPV2 = Net Present Value negative

Payback period is the period of return of investments that have been incurred through the profits derived from a project that has been made. According to [11] To support the specific systems' sustainable character one should be able to ensure minimum period of energy pay-back.

\[
Payback \ Period = n + \frac{(a-b)}{(c-b)} \times 1 \ year
\]  
\(\text{(2)}\)

\(n = \) The last year in which the amount of cash flow still cannot close the initial investment
\(a = \) The amount of initial investment
\(b = \) The cumulative sum of cash flows in year \(n\)
\(c = \) The cumulative sum of cash flows in year \(n + 1\)

4. Data

For the purpose of simulation, the data for capital expenditure (Capex), operational expenditure (Opex), and estimated revenues are taken from actual cost incurred during the pilot projects done by STT PLN at two locations, Pondok Kopi, and Duri Kosambi regencies as shown in table 1. Capex including civil work, briquetting equipment, and electric equipment; Opex including operators salary, material, and other overhead. Revenue condition 1 is based on Feed in Tariff IDR 850 for Java Island, tipping fee of IDR100,000, briquette price of IDR500,- and other valuable material of IDR400/kg. Revenue condition 2 is based on average outside Java Feed in Tariff IDR 1,500, tipping fee only IDR20,000, briquette price of IDR500, and no income from valuable material.

| Table 1. | Capex, Opex, and estimated Revenues of UMKM LK plant (3 ton waste per day). |
|---|---|---|---|
| No | Description | IDR | USD | USD/today* |
| 1. | Capital Expenditure | 668,500,000 | 51,423 | 17,141 |
| 2. | Operational expenditure | 355,248,000 | 27,327 | 9,109 |
| 3. | Annual Rev (Java) | 511,920,000 | 39,378 | 13,126 |
| 4. | Annual Rev (Out. Java) | 410,400,000 | 31,569 | 10,523 |

*1USD: IDR13000

5. Result

The results of the simulation are calculated using two scenarios by using cash flow analysis and the above criteria. As seen in table 2, the project in Java-Bali with the Feed in tariff of IDR 850 is financially viable (IRR>1) by using UMKM 7% credit scheme, if there is capex subsidy.

| Table 2. | Financial simulation result for Java and Bali areas. |
|---|---|---|---|---|
| Scenario | i (%) | Capex Subsidy | NPV (IDR) | IRR (%) | Viability |
| 1 | 7 | 0 | 407,579,681 | 11 | Moderate |
| 2 | 7 | 10% | 474,429,681 | 14 | Good |
| 3 | 14 | 40% | 398,862,478 | 20% | Good |

For outside Java areas, the Feed in Tariff are vary from IDR 1100 to around IDR 2200. Since people income is lower than that of Java, it is assumed that no income from valuable waste and the tipping fee is assumed only IDR20,000, much lower than that of Java. The result in table 3 indicates that the project UMKM outside Java-Bali is viable under the UMKM credit scheme of 7%.
Table 3. Financial simulation result for outside Java Bali areas.

| Scenario | Feed in Tariff | i (%) | Capex Subsidy | NPV (IDR) | IRR (%) | Viability |
|----------|----------------|-------|---------------|-----------|---------|-----------|
| 1        | IDR 1100       | 7     | 80%           | 107,978,194 | 15      | Good      |
| 2        | IDR 1100       | 14    | 85%           | 80,012,940  | 17      | Moderate  |
| 3        | IDR 2000       | 7     | 60%           | 247,355,044 | 16      | Good      |
| 4        | IDR 2000       | 14    | 70%           | 182,540,516 | 18      | Good      |

6. Discussion
The government of Indonesia provides incentive for UMKM by giving special low interest credit (around 7%) compared to the commercial credit of 14%. In addition, the government allocates special budget for rural area around one billion IDR per village. On the other hand, the income from electricity sales is limited by the ceiling value of the production cost of the Electricity State Owned Enterprise (PLN) as stipulated in Ministry of Energy and Mineral Resources decree (Kepmen ESDM No. 1404.k/20/MEM/2017). Therefore the financial viability for UMKM IPP can still be attained if the government allocates some portion of rural funding to support UMKM capital expenditure.

As simulated in table 2 for Java-Bali island and table 3 for Outside Java Bali island, the UMKM can still get good profitability to sustain their business. If there are averagely 2 UMKM run 100 kW IPP business in each villages, the nation will get additional renewable plant capacity of 14,000 MW from 70,000 villages all over the country.

7. Conclusion
Based on the result of simulation, the idea to apply self-management of electricity democracy, particularly by using UMKM’s IPP scheme can be used as alternatives to solve the on-going dilemma that challenges the construction of large scale conventional electricity system. By using the available instruments, such as special budget and soft credit incentive for rural people, the Indonesia government can apply the UMKM’s IPP model nationally. By applying this model, the national energy policies including 100 percent electrification ratio, 100 percent rural electrification, and 23 percent of renewable energy portion can be achieved as fast as two years completion time.

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