A Cost Performance Analysis of Electricity Production in Thailand

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Abstract
Rapid growth in industrial and household sections causes increasing electricity demand in Thailand. Power Development Plan (PDP) is created to ensure adequate electricity supply in electricity planning, procurement and generation for stability of power energy. When demand situation change, PDP is also adapt to other version in appropriate time. This paper is to study cost performance analysis of electricity production in Thailand by implement PDP 2010, PDP 2010 Revision 3 and PDP 2012 (by NGOs) and investigate how power development plan (PDP) affect to cost performance. The result shows that Power Development Plan 2010 reflects the best electricity production cost performance because of operation of nuclear and coal power plants. Although Power Development Plan 2012 focus on energy efficiency (EE), PDP 2012 reflect the worst electricity production cost performance because of much operation of renewable and co-generation plants.

Keywords: Electricity Cost Management, Cost Performance, Electricity Production

1. Introduction

Rapid growth in electricity demand in Thailand is a major challenge for electric utilities trying to ensure adequate supply. Continued reliance on natural gas for power supply makes the supply mix non-diversified and exposes the country to supply risks while a diversification to other fossil fuels imposes additional environmental burdens. It is found that the lowest environmental emissions are obtained from the scenario where power generation is highly dominated by natural gas [1]. Power Development Plan (PDP) is the plan of expanding electricity capacity supply and transmission system in Thailand. When demand situation change, PDP is also adapt to other version in appropriate time from PDP 2010 to PDP 2010 Revision 3 and PDP 2012 by NGOs which focus on renewable energy. The development of industrial cogeneration of heat and power, the development of wind energy as an instrument used by utilities to stimulate demand reduction of end users [4]. Regions in Thailand present different potentials for renewable supply on biomass, municipal wastes, hydropower, and wind. To maximize renewable energy development in each area, location is matter. Meanwhile, deployment of wind and solar energy has been slow and needs to speed up to the large extent in comparison with energy proportion from biomass. Nuclear power has already been included in the Thai power development plan 2010 (PDP 2010). However, public acceptance is a major issue [2]. So we need to study cost function of electricity production. Estimating cost functions and investigates the degree of scale economies, overinvestment, and technological progress electricity generation sector using long-run and short-run translog cost functions [3]. Thai power market and their potentials for reaching the policy targets stated in the Energy Strategy of Thailand for Competitiveness. The main results show that reaching the policy targets is possible, while the price can be extremely high if the targets are to be achieved on schedule [5]. Possible reforms to the Thai electricity regulation are proposed with the aim of creating market competition and efficiency in the Thai electricity sector [6]. This paper is to study cost performance analysis of electricity production in Thailand by implement PDP 2010, PDP 2010 Revision 3 and PDP 2012 (by NGOs) and investigate how power development plan (PDP) affect to cost performance. The least cost electricity generation is achieved from the case if nuclear power plant is added into the Thai power system [1].

2. Summary of Power Development Plan (PDP)

Power Development Plan (PDP) is the plan of expanding electricity capacity supply and transmission system in Thailand for 15 – 20 years. When demand situation change, PDP is also revised to meet electricity demand in appropriate time. This plan will identify correctly load demand forecasting needed to correctly plan in new power plant investment. PDP can also identify which type of energy resource such as natural gas, coal, nuclear and amount of new power plant will be constructed. PDP also investigate fuel cost, financial statement and emission pollution of electricity generating system.

2.1 PDP2010 (2010-2030)

PDP was designed as a “Green PDP” which focuses on greenhouse gas emission reduction and encourage of efficiently energy utilized and electricity production through cogeneration system, in addition to system reliability. Not only Cooperating power purchase projects from domestic producers and neighboring countries that were approved but also
power generation from renewable energy the Alternative Energy Development Plan (AEDP) 2008–2022. Besides, opinions and comments obtained from the public hearing of PDP 2007 Revision 2 were taken into account. Therefore, the new PDP could be a complete guideline for power system development that encourages generation from renewable energy and lessens greenhouse gas emission, and thus a balance of generation resources.[PDP2010]

2.2 PDP2010 Revision 3 (2010–2030)

The PDP 2010 Revision 3 is revised from PDP 2010 Revision 2 because of 1) Increasing electricity demand on infrastructure policy as 2 lines high speed sky train and 10 major lines sky train. 2) The new target of power generation from renewable energy the Alternative Energy Development Plan (AEDP) from 6% to 10% and for energy conservation from Energy Efficiency Plan (EE) 20 years that need to lessen electricity demand to 96,653 GWh in 2030. 3) Decreasing affect of greenhouse gas as the policy of PDP2010 Rev.2 that limit CO2 Commission will be not exceed than 0.386 kgCO2/kWh

2.3 PDP2012 (2012 – 2030 by NGOs)

NGOs (Non Governmental Organizations) presents their Power Development Plan (PDP) called PDP2012 in this paper. This PDP 2012 need to lessen electricity demand capacity from 52,256 MW (PDP 2010 Rev.3) to 35,579 MW by seriously implement Energy Efficiency Plan (EE) and Demand Side Management (DSM) policy. PDP 2012 also focus on Co-generation power which will be 33% of electricity production, 27% of natural gas and 13% of renewable energy resource in 2030.

3. Cost Performance Criteria

In this paper the cost performance is measured in cost/electricity unit (Baht/kWh) which is consist of three main costs that is Production Cost, Environment Cost and Social Cost so total cost will be form in this formula

Total Cost = Production Cost + Environment Cost + Social Cost

(1)

3.1 Production Cost

Production Cost include investment cost, fuel cost, Operation and Maintenance Cost (O&M) so production cost will form be in this formula

Production Cost = Investment Cost + Fuel Cost + Operation and Maintenance Cost

(2)

3.1.1 Investment Cost

A summary of capital cost estimate was developed for each power plant technology, based on a facility of a certain size (capacity). The total project is engineering, procurement and construction (EPC) cost was defined into the following categories:

- Civil structural material and installation
- Mechanical equipment supply and installation
- Electrical instrumentation and controls (I&C) supply and installation
- Project indirect costs, fees and contingency
- Owner’s costs (excluding project financing costs).

It should be noted that an EPC (turnkey) or equipment supply and balance of plant, as applicable to a chosen technology. The investment cost will be included plant cost, transmission cost and working capital. In this paper investment cost has a unit in Baht/kWh.

3.1.2 Fuel Cost (Baht/kWh)

Fuel cost in a variable cost of source of energy such as coal, natural gas, etc. Fuel cost is in term of cost/unit of each source of energy. In this paper fuel cost has a unit in Baht/kWh.

3.1.3 Operation and Maintenance Cost

Operation and maintenance Cost is separated in two parts as Fixed Operation and Maintenance Cost and Variable Operation and Maintenance Cost

3.1.3.1 Fixed Operation and Maintenance Cost

(Fixed O&M)

Fixed O&M expenses are expenses incurred at a power plant that do not vary significantly with generation and include the following categories:

- Staffing and monthly fees under pertinent operating agreements
- Typical bonuses paid to the given plant operator
- Plant support equipment which consists of equipment rentals and temporary labor
- Plant-related general and administrative expenses (postage, telephone, etc.)

3.1.3.2 Variable Operation and Maintenance Cost

Variable O&M expenses are production related costs which vary with electricity generation and include the following items, as applicable to the chosen power plant technology:

- Raw water
- Waste and wastewater disposal expenses
- Purchase power (which is incurred inversely to operating hours), demand charges and related utilities
- Chemicals, catalysts and gases
- Lubricants
- Consumable materials and supplies. In this paper operation and maintenance Cost has a unit in Baht/kWh

3.2 Environment Cost

Environment Cost is separated in two parts as emission treatment cost and project environment cost.

3.2.1 Emission Treatment Cost

Emission Treatment Cost is the cost to treatment of the emission such as CO2, NOx, and SOx to have quantity below in standard. In this paper emission
treatment cost will be a treatment equipment cost included in plant cost when construct the power plant.

3.2.2 Project Environment Cost

The project environment cost include cost of environmental plan during implement constructing power plant and cost of environmental development plan in the radius area around the power plant.

3.3 Social Cost

Social cost is cost for social understanding to construct the power plant and cost for develop people life in area around the power plant. Social cost include the following categories:
- Social Information Announcement
- Social Connection with firm and social participation
- Education, sport, culture developing plan.
- Career encouragement
- Healthy development
- Recreation
- Social welfare

The project environment cost and the social cost is about 5-6% of power plant cost.

4. Cost Performance Analysis

From the 3 PDP (PDP2010, PDP2010 Rev.3 and PDP 2012), the graph show forecasting electricity load demand in Figure 1.

Electricity production cost when implementing PDP 2012 increases slightly from 3.97 Baht/kWh to 4.99 Baht/kWh because of much operation of renewable and co-generation power plant which have higher cost than natural gas plant.

| Table 1 Electricity production cost from each source of energy. |
|-------------|-----------------|
| Source      | Cost (Baht/kWh) |
| Nuclear     | 2.79            |
| Coal        | 2.94            |
| Natural gas | 4.34            |
| Thermal     | 13.74           |
| Solar       | 17.50           |
| Wind        | 5.50            |
| Biomass     | 4.00            |
| Renewable   | 9.00            |

Electricity production cost when implementing PDP 2010 decreases slightly from 3.92 Baht/kWh to 2.43 Baht/kWh because of operation of nuclear and coal power plant which have lower cost than natural gas plant.

5. Conclusion

The result show that Power Development Plan 2010 reflect the best electricity production cost performance as the lowest production cost per unit since 2012 – 2030 for 19 years because of operation of nuclear and coal power plant. Although Power Development Plan 2012 focus on energy efficiency (EE), PDP 2012 reflect the worst electricity
production cost performance as the highest production cost per unit since 2012–2030 for 19 years because of much operation of renewable and co-generation power plant which have much higher cost than natural gas plant.

References