

ESTIMATING THE ECONOMIC IMPACT OF NUCLEAR POWER AND DESALINATION PLANT CONSTRUCTION IN INDONESIA*

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ABSTRACT

ESTIMATING THE ECONOMIC IMPACT OF NUCLEAR POWER AND DESALINATION PLANT CONSTRUCTION IN INDONESIA. The objective of this study is to determine the economic impacts of the construction of the nuclear power plant 2 x 100 MW(e) SMART type with desalination 4 x 10.000 m³ which would conduct in years 2008 to 2017 in Madura Island, East Java. The predicted IO tables of 2008-2017 have been created by the application of dynamic IO projection. The economic impact was estimated through multiplier effect which covers direct impact and indirect impact as well as the induced effect.

The expenditures of SMART nuclear power and desalination plant to the domestic contractors is estimated to amount to as much as 101.8 million US\$. or 1.018 trillion Rp on 10,000 Rp/US\$ exchange rate, which was distributed in sectors number 52 (Construction), and 62 (Real estate & business services).

The total impact of the project to the national economy would be Rp. 6.329.347 million, Rp.8.439.130 million, and Rp. 12.658.695 million for each scenario of the exchange rate as high as Rp.7500/US\$,Rp.10000/US\$,Rp.15000/US\$, respectively.

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Introduction

At the increase of electricity requirement, Indonesian government will consider development of nuclear power plant in peninsula of Muria and in Madura island. For the independence of electrics and water supply for Madura, result of researching into office of the Minsitry of research and technology of Indonesia suggest made available power station for Madura islands of 200 MWe and desalination plant of 4 x3000 m³/day in this area. Generating of power and desalination plant in island of Madura this can be a gas power station or other power station. The nuclear power is the alternative one, which will construct in year 2007 to the year 2015.

Considering the condition of Indonesia economics which is experiencing of cure of economics hence the big investment will have impact to national economy and related economy sector. On that account this study is expected can answer how impact development of Nuclear Power and desalination plant in Madura to the Indonesian economy.

This paper attempts to estimate the economic impact of the SMART nuclear power and desalination construction in Indonesia by using IO table and identifies the sector of Indonesian economy which has the most effect by the construction.

The Input Output Model

The projection of IO table model developed by the dynamic Leontief model is a natural extension of the static IO Leontief model to a dynamic case. As in the static case, the general equilibrium interaction among various industries in economy is explicitly taken into account. Like the static model, the dynamic model is also used extensively for empirical purposes to ascertain the industrial structure particular economies for forecasting (Takayama, 1986).

The dynamic IO assumes the existence of time lag at the production system. (Takayama, 1986; DeBresson 1996; McGregor, Swales Et al. 1996; Moczar 1997; Moczar 1998). Mathematically,

$$Y_t = [I - AD_{(1-ai)}]^{-1} AD_{ai} Y_{t-1} + [I - AD_{(1-ai)}]^{-1} F_t$$

where Y_t = output at the year t

A = technology matrix

D = the quantity of the goods invested in the industry

F_t = final demand at the year t

It is important to emphasize some special features of the projection model. First, note that the model has an assumption of fixed import coefficient so there are no mechanism such as policy incentives to induce import substitution. Second, the number of labor is increased proportionally with the number of output.

The Impact Models

Economic-base concepts originated with the need to predict the effects of new economic activity on the regions or country. Say a new plant such as the SMART nuclear power and desalination plant is located in Madura, East Java Province. The SMART nuclear power plant directly employs a certain number of people at the certain economies sector. In a input output (IO) table, these employees depend on which economy sector involved. In the IO table, the direct effect of the construction will involve certain sectors. And, the indirect effect through a market economy will affect other sector as the rounds effect or multiplier effect (Schaffer, 1999).

The impact model of the effect of SMART nuclear power desalination was showed in figure 1

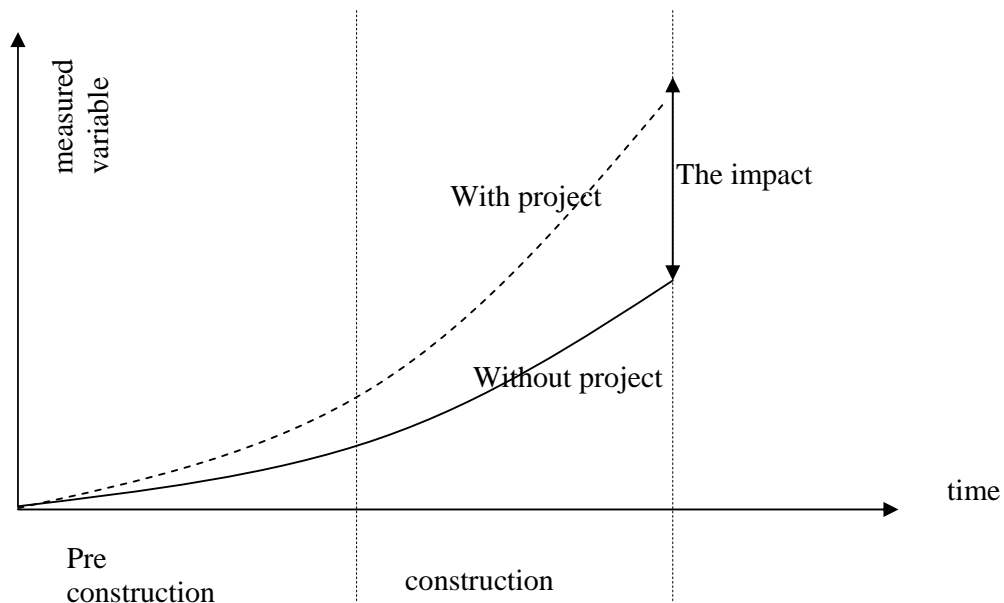


Figure 1. Model of the impact of SMART nuclear power plant desalination

An IO model is designed to trace the effects of changes in an economy, which has been represented in an IO table. Theoretically, the direct effect is the cost allocation to those sectors at the initial effect. Whereas the indirect economic effect of the constructions of SMART nuclear power plant desalination as traced through an IO model can take two forms: (1) structural change or (2) change in final demand including import, value added or gross product domestic and output which originated source from the direct effect. So, with the IO model we can determine which sector could be effected by the construction of the SMART nuclear power desalination.

The impact on the economic performance has been based on the Input-Output database of Indonesia of 1995 and 2000, Input-Output tables of year 1994 and 2000 for the East Java economy, as well as on the inflation data in the form of time series. There were scenarios applied in the projection: scenario using dynamic growth, and scenario using static growth with the rate of 5 % and 3.5 % per annum on the constant value. Time span for the analysis covers the pre-construction and construction periods of the SMART type Nuclear Power and Desalination Plant, i.e. from 2008 to 2017. Types of impact taken into account are direct impact, indirect impact and induced effect. The latter is the impact of the people income, working in the effected sectors. Whereas the elasticity has been measured in terms of impact elasticity and of the Gross Domestic Products (GDP).

Projection of the IO table

As discussed above, the SMART NPP will be constructed in the 2008 to 2017, so the Indonesian IO table was estimated until the period. By using data of Indonesian IO year 2000 at constant price year 1996, the result of the projection indicated that the Indonesian economy will grow continuously. The total output increased from Rp 1,491,249,288 millions in 2000 to become Rp 2,076,825,941 in 2008. Similarly, the total of final demand and gross value added increased from Rp 998,447,933 millions and Rp 754,430,683 million in year 2000 to Rp 1,511,175,241 millions and Rp 1,064,915,606 million, respectively, in 2008 (Table 2). The increase of output, final demand and gross value added from year 2000 to 2008 was equal to 39.27%; 51.35% and 41.16%, respectively.(Table 3). Meanwhile the import rose only at 36.74% for period 2000-2008, from Rp 93,320,851 million in 2000 to Rp 127,610,676 millions in

2008. The Indonesian economic structure in year 2000 and 2017 showed detail in Table 4.

In the period of construction (2008-2017), the expectations of Indonesian economy will have positive growth with the average growth of output, final demand and gross value added about 8.17%; 8.23% and 8.68%, respectively, for 2008 -2017. However, the growth of import will only at 2.71% since import will decline in period 2013-2014 and 2014-2015 at -13.42% and -3.02% respectively.

Table 2. Number of Output, Final Demand, Gross Value Added and Import, Indonesia (2000 -2017)

Year	Output	Final Demand	Gross value added	Import
	in millions rupiahs.			
2000	1,491,249,288	998,447,933	754,430,683	93,320,951
2008	2,076,825,941	1,511,175,241	1,064,915,606	127,610,676
2009	2,175,871,305	1,572,376,765	1,117,493,783	133,648,798
2010	2,282,510,868	1,637,702,578	1,174,194,633	140,215,781
2011	2,397,458,671	1,707,499,304	1,235,393,966	147,366,250
2012	2,512,006,186	1,778,135,382	1,296,249,910	154,245,031
2013	2,647,597,886	1,858,818,473	1,368,560,729	162,889,299
2014	2,768,331,824	1,874,948,011	1,459,324,887	180,365,405
2015	2,966,772,570	1,969,370,985	1,576,125,369	197,445,016
2016	3,170,896,996	2,087,304,755	1,684,762,284	211,265,767
2017	3,394,816,263	2,215,464,963	1,803,565,389	226,522,327

Sources: Anindita, et al (2004)

Table 3. Percentage Growth of Output, Final Demand and Import, Indonesia (2000 – 2017)

Period	Output	Final Demand	Gross Value Added	Import
2000-2008	39.27%	51.35%	41.15%	22.96%
2008-2009	4.77%	4.05%	4.94%	2.70%
2009-2010	4.90%	4.15%	5.07%	2.71%
2010-2011	5.04%	4.26%	5.21%	2.73%
2011-2012	4.78%	4.14%	4.93%	2.90%
2012-2013	5.40%	4.54%	5.58%	2.77%
2013-2014	4.56%	0.87%	6.63%	-13.42%
2014-2015	7.17%	5.04%	8.00%	-3.02%
2015-2016	6.88%	5.99%	6.89%	4.71%
2016-2017	7.06%	6.14%	7.05%	4.80%
Average	8.17%	8.23%	8.68%	2.71%

Sources: Anindita, et al (2004)

The projection result for labor force participation rate also showed positive growth as depicted in the Figure 2. The number of labor force participation in the

Indonesian economy grew at 8.7% a year from 93,320,951 in 2000 to 226,522,327 in 2017.

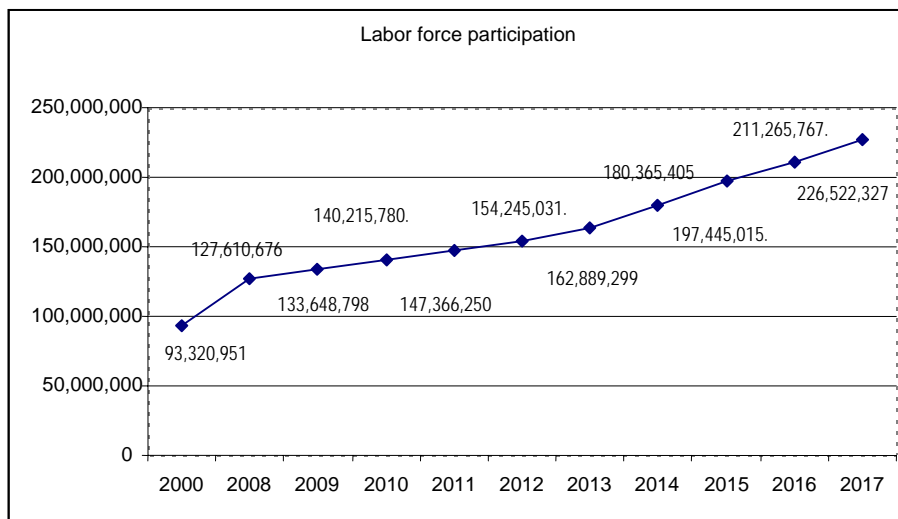


Figure 2. The Number of labor force participation of the Indonesian economy, 2000-2017 (Anindita, et al , 2004)

Table 4. Indonesian economic structure in the years 2000 and 2017, by dynamic economic growth.

Year 2000				Year 2017			
No	Sector	Value (trillion Rp)	%	No	Sector	Value (trillion Rp)	%
1	Trades (53)	102.792	13.63	1	Trades (53)	2,089.998	30.22
2	Crude oil & natural gas mining (25)	64.681	8.57	2	Construction (52)	1,743.638	25.22
3	Construction (52)	42.275	5.60	3	Crude oil & natural gas mining (25)	418.449	6.05
4	Financial Intermediaries (61)	35.507	4.71	4	Petroleum refinery (41)	250.155	3.62
5	Petroleum refinery (41)	29.967	3.97	5	Manufacture of textile & wearing (36)	214.551	3.10
6	Paddy (1)	26.229	3.48	6	Manufacture of machine, electrical machinery & apparatus (48)	207.988	3.01
7	Others	452.979	60.04	7	Others	1,989.889	28.78
Total		754.431	100	Total		6,913.667	100

Sources: Anindita, et al (2004)

It is predicted in general that there will be structure shift in national economy from the domination of trade sector, crude oil & natural gas mining, construction,

financial intermediaries, petroleum refinery and paddy, towards the domination of trade sector, crude oil & natural gas mining, manufacture of textile & wearing apparel, manufacture of machine, electrical machinery & apparatus. See Table 4.

Estimation of Cost Investment

Limited data availability of component cost structure on the 2x100 MWe SMART NPP with the desalination plant of 4 x3000 m³/day, as well as the construction details, has called for a set of assumption and correlation efforts to be applied. The desalination installations, however, have been built and are operating in a number of steam power plants and chemical industries for their own use since the eighties. A foreseen plan to deploy a nuclear power and desalination plant in Madura Island represents the first of a kind in Indonesia

The low specific investment cost mentioned in the KAERI data (1615 US\$/KWe), and the short construction period (3 years for one unit), would justify a turn-key contract to be implemented by advanced modularization and sophisticated management giving the domestic industrial participation of only about 20 %.

Typical component-and-cost structure of non-integral PWR ^[1] in comparison with the integral PWR SMART data ^[2] have helped the derivation of the cost structure. In this case relatively small units of desalination plants (3x3000 m³/day) are added to the BOP part of the plant in an amount of 7.924 million \$, making the contract plant cost of $323.017 + 7.924 = 330.941$ million \$.

The activity schedule is assumed to start with the pre-construction phase in the year minus 6, e.g. site acquisition, Site Permit application, preparation and execution of tender for the Turnkey Contractor, as well as application for the Construction Permit. Beginning with site excavation in the year minus 1 the first concrete pouring commences in the first year, whereas the construction/erection and test & commissioning of the twin unit of power and desalination plant, will be completed at to the year plus 4. Since the impact assessment covers only the pre-construction and construction periods, excluding the operation and decommissioning, then the sum of expenditures giving the economic impact is related only to all the work (hardware and services) which are performed in Indonesia.

These expenditures are grouped in two categories. The first category contains all expenditures spent/paid by the Owner and by the Main Contractor for the work in

Indonesian territory (domestic), whereas the second category covers imported packages. Concerning the first category, it includes the expenses:

- spent by the NPP Owner to acquire and prepare the site, to apply for the necessary licenses and permits, and to comply the requirements thereafter, to carry out the tender, to determine the main contractor and to finalize the main contract.
- paid by the Main Contractor to the Indonesian Subcontractors on his orders.
- spent by the Main Contractor or on his behalf in Indonesia or at the site (e.g. for site project management, supervision, etc.)

Table 5 shows the sum of the expenditures causing the economic impacts is valued to be 15.1 + 71.3 + 1.4 million US\$, expressed as base overnight cost in the 2002. But this sum is expended for 5 years during pre-construction phase and 5 years during construction phase of the plant. Whilst the work (sub-contracted domestically and all those performed in Indonesia) will give effect directly, the imported packages will impart the taxes, insurance and transports.

Table 5. Classifications of activities in I-O sector table and its schedule.

Year	Activities in 66 I-O sectors	Cost			Direct Cost
		Owner	To subcont	Contractor	
		Million \$	Million \$	Million \$	Million \$
-6	(52) Construction	5.0	-	-	5.0
2008	(62) Real estates & business services	-	-	-	-
-5	(52) Construction	3.1	-	-	3.1
2009	(62) Real estates & business services	1.6	-	-	1.6
-4	(52) Construction	-	-	-	-
2010	(62) Real estates & business services	0.1	-	-	0.1
-3	(52) Construction	-	-	-	-
2011	(62) Real estates & business services	0.1	-	-	0.1
-2	(52) Construction	-	-	-	-
2012	(62) Real estates & business services	0.1	-	-	0.1
-1	(52) Construction	-	7.0	-	7.0
2013	(62) Real estates & business services	2.1	-	1.0	3.1
1	(52) Construction	-	23.0	-	23.0
2014	(62) Real estates & business services	0.1	-	2.1	2.2
2	(52) Construction	-	21.6	-	21.6
2015	(62) Real estates & business services	1.3	-	2.1	3.4
3	(52) Construction	-	6.6	-	6.6
2016	(62) Real estates & business services	1.4	-	5.1	6.5
4	(52) Construction	-	13.1	-	13.1
2017	(62) Real estates & business services	0.2	-	5.1	5.3
Total		15.1	71.3	1.4	101.8

Sources: Anindita, et al (2004)

The plant construction will directly effect two sectors of economy, namely: construction (sector No. 52); and real estate and business services (sector No.62), since the cost allocation of the constructions goes to those sectors. The indirect effect of the constructions goes to the increase in output and final demand excluding imported packages (sector No. 48). Manufacture of machines, electrical machinery and apparatus). Actually, the large and important economic impacts of the plant construction would affect also in the operation & maintenance of the plant through the whole plant life, which are not, however, included in this study.

Impact of SMART Nuclear Power Desalination Construction in Indonesia

The analysis of the impact of SMART NPDP construction in Indonesia is based on the three different exchange rate assumptions. The exchange rate assumes at Rp 7,500/US\$; Rp 10,000/US\$ and Rp 15,000/US\$. The exchange rate will influence the number of the expenditure of the SMART NPDP to the domestic construction. The results exhibited a different pattern among the year of constructions and are reflected in Figure 3.

The direct impact of SMART NPPD is the expenditures of SMART NPDP construction in Indonesia as much as US\$ 101,8 millions and it converted to domestic currency will give the direct impact at the difference exchange rate assumption (Rp 7,500/US\$; Rp 10,000/US\$ and Rp 15,000/US\$) approximately at Rp 763,500 millions ; Rp 1,018,000 millions and Rp 1,527,000 millions, respectively.

The initial impact of the construction of SMART NPDP depends on which economy sector is involved. In 2008 the construction impact goes to construction (sector No. 52); but in 2014 the construction impact goes to construction (sector No. 52) as well as the real estate and business services (sector No.62) (Table 1). The increase of output represented **the indirect impact** of the SMART NPDP construction.

The economic impact of SMART NPDP construction will increase the output, final demand and import showed in Table 7. The increase of output, final demand and import due to the SMART NPDP construction has a positive effect since the construction will be done by the Indonesian contractors but the import packages will not be included in the analysis. The reason for the import packages excluded from the calculation is that the import packages will not effect to the domestic output.

The highest increase of output and final demand will reach in 2014 but the highest import will happened in 2008. However, the high of import implying that the Indonesian economy did not has a self-supporting to produce goods and services.

The results of the increase of gross value added at exchange rate Rp 7,500/US\$, raises proportionally for Rp 10,000/US\$, and therefore, at the exchange rate Rp 15,000/US\$ has the greatest number.

1. Compared to the period of construction, the gross value added has a greatest number in 2014 at Rp 2,111,197 millions when exchange rate at Rp 15,000/US\$ but the lowest in 2011. The different number of the increase in gross value added since the expenditure of SMART NPD construction to domestic economy has a different number as shown in table 6. From the figures of Table 6 can be found the elasticity of GDP to total expenditure for the project was about 0.52 to 6.58.

Table 6. The increase of gross value added in Indonesia due to SMART NPD plant construction (2008-2017)

Year	The increase of gva if exchange rate at		
	Rp 7,500 US\$	Rp 10,000/US\$	Rp 15,000/US\$
..million Rp.			
2008	168,956	225,614	338,421
2009	114,955	153,510	230,265
2010	417	558	837
2011	403	539	808
2012	12,142	16,222	24,333
2013	279,707	373,478	560,217
2014	1,054,404	1,407,464	2,111,197
2015	1,050,233	1,401,689	2,102,533
2016	324,989	433,734	650,601
2017	147,948	197,447	296,171
Total	3,154,154	4,210,255	6,315,383

Sources: Anindita, et al (2004)

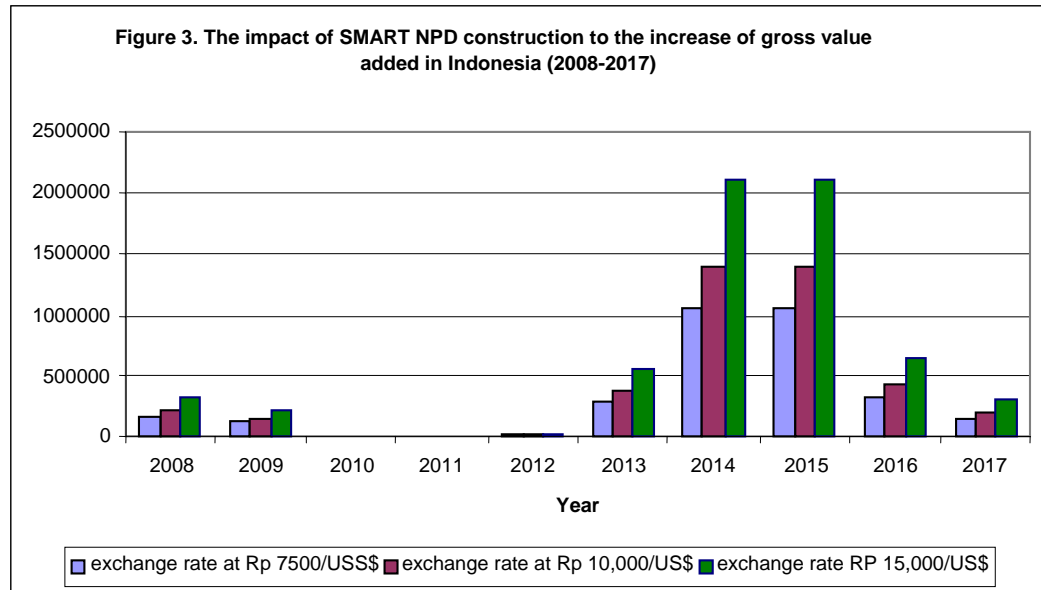
Table 7. The increase of output, final demand and import due to the SMART NPDP construction (2008-2017)

Year	Output			Final demand			Import		
	Exchange rate at Rp 7,500/US\$	Exchange rate at Rp 10,000/US\$	Exchange rate at Rp 15,000/US\$	Exchange rate at Rp 7,500/US\$	Exchange rate at Rp 10,000/US\$	Exchange rate at Rp 15,000/US\$	Exchange rate at Rp 7,500/US\$	Exchange rate at Rp 10,000/US\$	Exchange rate at Rp 15,000/US\$
2008	261,194	348,259	522,388	135,123	180,164	270,247	71,350	95,134	142,701
2009	194,853	259,804	389,706	108,612	144,816	217,224	9,180	12,241	18,361
2010	2,057	2,743	4,114	1,382	1,843	2,764	564	752	1,129
2011	2,057	2,743	4,114	1,343	1,791	2,686	555	739	1,109
2012	63,768	85,024	127,536	40,475	53,966	80,950	16,871	22,495	33,742
2013	410,926	547,902	821,853	237,367	316,489	474,734	11,758	15,678	23,516
2014	1,271,431	1,695,242	2,542,862	757,357	1,009,809	1,514,714	12,908	17,211	25,816
2015	1,262,065	1,682,753	2,524,130	736,718	982,290	1,473,435	21,099	28,131	42,197
2016	381,803	509,070	763,605	224,567	299,423	449,134	5,995	7,993	11,990
2017	156,716	208,955	313,433	96,397	128,530	192,794	48,872	65,162	97,743
Total	4,006,870	5,342,494	8,013,741	2,339,341	3,119,121	4,678,682	199,152	265,536	398,304

Table 8. The distribution of the increase of output, final demand and import due to the SMART NPDP construction (2008-2017)

Year	Output			Final demand			Import		
	Exchange rate at Rp 7,500/US\$	Exchange rate at Rp 10,000/US\$	Exchange rate at Rp 15,000/US\$	Exchange rate at Rp 7,500/US\$	Exchange rate at Rp 10,000/US\$	Exchange rate at Rp 15,000/US\$	Exchange rate at Rp 7,500/US\$	Exchange rate at Rp 10,000/US\$	Exchange rate at Rp 15,000/US\$
2008	6.5%	6.5%	6.5%	5.8%	5.8%	5.8%	35.8%	35.8%	35.8%
2009	4.9%	4.9%	4.9%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%
2010	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.3%	0.3%	0.3%
2011	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.3%	0.3%	0.3%
2012	1.6%	1.6%	1.6%	1.7%	1.7%	1.7%	8.5%	8.5%	8.5%
2013	10.3%	10.3%	10.3%	10.1%	10.1%	10.1%	5.9%	5.9%	5.9%
2014	31.7%	31.7%	31.7%	32.4%	32.4%	32.4%	6.5%	6.5%	6.5%
2015	31.5%	31.5%	31.5%	31.5%	31.5%	31.5%	10.6%	10.6%	10.6%
2016	9.5%	9.5%	9.5%	9.6%	9.6%	9.6%	3.0%	3.0%	3.0%
2017	3.9%	3.9%	3.9%	4.1%	4.1%	4.1%	24.5%	24.5%	24.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Sources: Anindita, et al (2004)



The similar results showed in the increase of labor force participation as shown in Table 9 and Figure 3. The labor force participation had the highest labor force at 94,501 in 2014 when the exchange rate at Rp 15,000/US\$.

Table 9. The increase of labor force participation due to the SMART NPD plant construction in Indonesia (2008-2017)

Year	The increase of labor force participation if exchange rate at		
	Rp 7,500 /US\$	Rp 10,000/US\$	Rp 15,000/US\$
2008	8,693	11,590	17,385
2009	6,121	8,161	12,242
2010	38	51	76
2011	38	50	75
2012	1,143	1,524	2,285
2013	14,050	18,734	28,100
2014	47,251	63,001	94,501
2015	41,168	54,891	82,337
2016	12,908	17,211	25,817
2017	5,729	7,638	11,458
Total	137,139	182,851	274,276

Sources: Anindita, et al (2004)

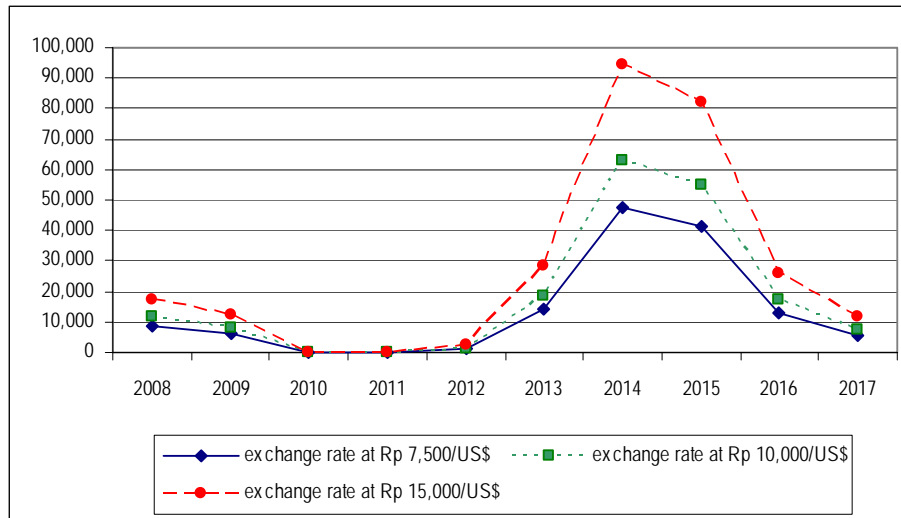


Figure 4. The increase of labor force participation due to SMART NPDP construction in Indonesia (2008-2017).

The expenditure of SMART nuclear power desalination plant construction in Indonesia goes to the domestic contractors at only 88,2 million US\$ could be expected to contribute the economic growth approximately at 0.2% up to 0.4%. This number depended on the exchange rate assumption. The similar results are experienced to the output, final demand and import (Table 8).

Since the IO model explained that the activity of one sector depends on the other, the effect of SMART NPD plant construction in Indonesia is not only goes to the origin sector which the expenditure of SMART NPD plant goes to. But the effect will goes to sectors which has the most inter link to the initial sector. The analysis showed that the most sector having an effect goes to sector such as: other food crops (sector No. 6); fibre crops (sector No.15); other forest products (sector No.22); other mining and quarrying (sector No. 26); manufacture of cement (sector No. 44); railway transport (sector No.55) and unspecified sector (sector No.66) (Table 9). This means that the actual impact of the construction of SMART NPD plant in Indonesia will not only effect the construction (sector No. 52) and real estate and business services (sector No.62) but also it will push the activity of other sector in apparently measurable quantities.

The Induced effect

The induced effect is the effect of the increase of income generation which showed the increase of income to whom involved in the NPPD construction. The induced effect and the most sector effected presented at Tables 10, which showed that the biggest induced effect will happend in the year 2014 and 2015 namely each of Rp. 340.529 million and Rp 337.513 million at Rp 7.500/US exchange rate. The similar results showed for the other exchange rate.

Table 10. The Induced Effect and the most sector effected

Tahun	Induced effect (million Rp)			The most sector effected
	Rp.7.500/US\$	Rp 10.000/US\$	Rp 15.000/US\$	
2008	55.685	74.246	111.370	52, 26, 47, 43
2009	37.739	50.319	75.479	52, 26, 47, 43
2010	.132	.177	.265	63, 62
2011	.127	.170	.255	63, 62
2012	3.814	5.086	7.268	63, 62
2013	91.238	121.650	182.476	52, 26, 47, 43
2014	340.529	454.039	681.058	52, 26, 47, 43
2015	337.513	450.017	675.025	52, 26, 47, 43
2016	104.466	139.288	365.407	52, 26, 47, 43
2017	182.703	243.605	95.324	52, 26, 47, 43
Total	1.153.946	1.538.597	2.193.927	

Sources: Anindita, et al (2004)

The Total Impact

The total impact covers the direct impact and the indirect impact as well as the induced effect. The results of total impact shown in Table 11, which indicated that the higher exchange rate the higher the total impact since the increase of currency will not effect to the increase of inflation. However, this phenomena will happened if the price is in rigidities by assumption. The highest effect of NPPD construction will occupy in year 2014 and 2015 where the highest expenditures will spend. The construction (sector No. 52) and real estate and business services (sector No.62); other mining and quarrying (sector No. 26); and cement industry (sector no.44) will get the highest

effect. These impact can be calculated to the initial investment, it will give the elasticity of total impact to the cost of investment(total expenditure) as much as 8.439 trillion Rp (which is 8.3 folds of the direct impact) at exchange rate Rp 10,000/US\$.

Table 11. The total impact and the most sector effected

Years	Total Impact			The most sector effected
	Rp.7.500/US\$	Rp 10.000/US\$	Rp 15.000/US\$	
2008	354.379	472.505	522.388	52, 44, 26
2009	267.842	357.123	389.706	52, 44, 26
2010	2.940	3.919	4.114	62
2011	2.934	3.913	4.114	62
2012	90.832	121.110	127.536	62
2013	571.164	761.552	821.853	52, 44, 26
2014	1.809.960	2.413.281	2.542.862	52, 44, 26
2015	1.810.328	2.413.770	2.524.130	52, 44, 26
2016	549.269	732.358	763.605	52, 44, 26
2017	226.878	1.159.599	1.201.492	52, 44, 26
Total	2,071,145	2,460,115	2,641,067	

Sources: Anindita, et al (2004)

Conclusion

1. The construction project of NPP-Desalination of SMART type is expected to have a direct impact in construction sector (sector no.52) and real estate & business services sector (62) as much as 101.8 million US\$. The direct impact is distributed along a 6-year period of pre-construction, 2008–2013 and a 4-year period of construction, 2014–2017.
2. The indirect impact of the NPDP project to the national economy amounts to 4,006,870 million Rp, 5,342,494 million and Rp, 8,013,714 million Rp, at exchange rate Rp 7,500/US\$; Rp 10.000/US\$ and Rp 15,000/US\$.

3. The induced effect of the the NPDP project to the national economy as much as 1,153,956 million Rp; 1,538,597 million Rp; 2,193., 927 million Rp. at exchange rate Rp 7,500/US\$; Rp 10.000/US\$ and Rp 15,000/US\$.
4. The total impact of the NPDP project to the national economy is 8.439 trillion Rp (which is 8.3 folds of the direct impact) for exchange rate of 10,000 Rp/US\$.
5. Elasticity of the total impact on national economy to total expenditure for the project varies by the years (2008–2017) due to different effected sectors at any year concerned. The values of the elasticity are in the range of 2.9 to 18.55.
6. Elasticity of national GDP (Gross Domestic Product) to total expenditure for the project was about 0.52 to 6.58.
7. The impact represents some improvement to the economic growth approximately at 0.2% up to 0.4% and it will absorb approximately 137,139 up to 274,276 labor force during the whole construction period.
8. Sectors receiving high effect of nuclear power and desalination (NPD) plant construction are : other food crops (sector No. 6); fibre crops (sector No.15); other forest products (sector No.22); other mining and quarrying (sector No. 26); manufacture of cement (sector No. 44), railway transport (sector No.55) and unspecified sector (sector No.66). This means that these sectors apparently have high interlink to the initial sectors, that are : the construction (sector No. 52) and the real estate and business services (sector 62).

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Table 12. The percentage impact of SMART NPDP construction to the number of output, final demand, import and gross value added in Indonesia, 2008-2017

Year	Output			Final demand			Import			gross value added		
	Exchange rate at Rp 7,500/US\$	Exchange rate at Rp 10,000/US\$	Exchange rate at Rp 15,000/US\$	Exchange rate at Rp 7,500/US\$	Exchange rate at Rp 10,000/US\$	Exchange rate at Rp 15,000/US\$	Exchange rate at Rp 7,500/US\$	Exchange rate at Rp 10,000/US\$	Exchange rate at Rp 15,000/US\$	Exchange rate at Rp 7,500/US\$	Exchange rate at Rp 10,000/US\$	Exchange rate at Rp 15,000/US\$
2008	0.0126%	0.0168%	0.0252%	0.0089%	0.0119%	0.0179%	0.007%	0.0089%	0.0134%	0.016%	0.02115%	0.0318%
2009	0.0090%	0.0119%	0.0179%	0.0069%	0.0092%	0.0138%	0.0008%	0.0011%	0.0016%	0.010%	0.01372%	0.0206%
2010	0.0001%	0.0001%	0.0002%	0.0001%	0.0001%	0.0002%	0.0000%	0.0001%	0.0001%	0.000%	0.00005%	0.0001%
2011	0.0001%	0.0001%	0.0002%	0.0001%	0.0001%	0.0002%	0.0000%	0.0001%	0.0001%	0.000%	0.00004%	0.0001%
2012	0.0025%	0.0034%	0.0051%	0.0023%	0.0030%	0.0046%	0.0013%	0.0017%	0.0026%	0.001%	0.00125%	0.0019%
2013	0.0155%	0.0207%	0.0310%	0.0128%	0.0170%	0.0255%	0.0009%	0.0011%	0.0017%	0.020%	0.02725%	0.0409%
2014	0.0459%	0.0612%	0.0919%	0.0404%	0.0539%	0.0808%	0.0009%	0.0012%	0.0018%	0.072%	0.09634%	0.1447%
2015	0.0425%	0.0567%	0.0851%	0.0374%	0.0499%	0.0748%	0.0013%	0.0018%	0.0027%	0.067%	0.08885%	0.1334%
2016	0.0120%	0.0161%	0.0241%	0.0108%	0.0143%	0.0215%	0.0004%	0.0005%	0.0007%	0.019%	0.02572%	0.0386%
2017	0.0046%	0.0062%	0.0092%	0.0044%	0.0058%	0.0087%	0.0027%	0.0036%	0.0054%	0.008%	0.01094%	0.0164%
Total	0.14%	0.19%	0.29%	0.12%	0.17%	0.25%	0.02%	0.02%	0.03%	0.21%	0.29%	0.43%

Table 13. The sector getting the highest effect on SMART NPDP construction in Indonesia (2008-2017)

Year	Sector *)
-6, 2008	Other food crops (6); fibre crops (15); other forest products (22); other mining and quarrying (26); manufacture of cement (44), railway transport (55) and unspecified sector (66)
-5, 2009	Other food crops (6); fibre crops (15); other forest products (22); other mining and quarrying (26); manufacture of cement (44), railway transport (55) and unspecified sector (66)
-4, 2010	Other food crops (6); fibre crops (15); other forest products (22); railway transport (55); real estate and business service (62) and unspecified sector (66)
-3, 2011	Other food crops (6); fibre crops (15); other forest products (22); railway transport (55); real estate and business service (62) and unspecified sector (66)
-2, 2012	Other food crops (6); fibre crops (15); other forest products (22); railway transport (55); real estate and business service (62) and unspecified sector (66)
-1, 2013	Other food crops (6); fibre crops (15); other forest products (22); railway transport (55); real estate and business service (62) and unspecified sector (66)
+1, 2014	Fibre crops (15); other forest products (22); railway transport (55); real estate and business service (62) and unspecified sector (66)
+2, 2015	Fibre crops (15); other forest products (22); railway transport (55); real estate and business service (62) and unspecified sector (66)
+3, 2016	Other forest products (22); manufacture of cement (44), railway transport (55); and unspecified sector (66)
+4, 2017	Other forest products (22); other mining and quarrying (26); manufacture of cement (44) and railway transport (55)

*) Based on the Indonesian classification of IO table.