LAHENDONG MEDIUM ENTHALPY BINARY-CYCLE GEOTHERMAL PROJECT (INDONESIA): AN *EX-ANTE* FINANCIAL AND ECONOMIC GENERATING COST COMPARISON

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SUMMARY- Economic analysis of a project can be divided into a micro and macro-economic analysis. In the former, the analysis is limited to the monetary costs and benefits directly attributable to the project. This type of analysis also known as a financial analysis. On the other hand, a macro-economic analysis encompasses a much larger, and often much difficult to quantify, variables which are not readily attributable (at least at the first glance) to a project's existence. A fmancial analysis is usually used to determine a project's feasibility when the proposed project is a (monetary) profit-oriented one. On the other hand, when the society's welfare is what matter most, a macro-economic analysis is the more appropriate tool to judge a project feasibility. Such scope differences between micro and macro-economic analysis often results in, but not always, conflicting conclusions for a project. An ideal project should give a similar micro and macro-economic conclusions.

This paper tries to show how such macro-economic analysis is done to the Lahendong geothermal research project in Indonesia

1. INTRODUCTION

The Lahendong medium-enthalpy binary-cycle project, as the project is officially known, was conceived in 1986 to construct a powerplant capable of producing 2.5 MW of electricity. (Lahendong is a city located on the north-eastem tip of Celebes island in Indonesia. Celebes itself is one of five large island of the country's 13,000 islands). The project, undertaken by a cooperation between Badan Pengkajian dan Penerapan Teknologi (or BPP Teknologi, the Indonesia's Agency for Assessment and Application of Technology) and PLN (Perusahaan Listrik Negara, the Indonesia's State Electricity Company).

Originally, this cooperation was meant to utilise two geothermal wells, LH-2 and 3, drilled by PLN in 1982-1986. These were shallow steam-dominated wells, ranging fkom 365 to 595 metres and capable of producing geothermal fluids at a rate (total for both wells) close to 10 kgs/s, with temperature of as low as 146°C (LH-3) to 175°C (LH-2) (Enersystem, 1988) As these geothermal fluids were of low qualities (as far as enthalpy is concerned), a binary-cycle technology (with R-114 Freon, later changed to N-pentane, as the working fluid) was chosen for the proposed power plant. Thus, the project's goal was not merely to produce electricity but also to demonstrate the suitability of using the binary-cycle technology to harness the energy fiom low qualitity geothermal wells. It was hoped that if the demonstration is successful, the scheme could (and would) be duplicated elsewhere in the country, as there are many geothermal sources with similarly low fluid-qualitity in Indonesia.

To proceed with this plan, a softloan protocol was signed on November 23rd, 1987, between the government of Indonesia and the French's. The latter was to provide a French Franc 37,990,000 softloan to cover all the project's (foreign portion) outlays.' This softloan would be repaid in 25 years, with a grace period of 7 years, with an interest rate of 3.5% per annum.

As with other softloans, the creditor country's company must be chosen as the main contractor to execute the project funded by the softloan. In the case of the Lahendong project, the French Enersystem (a consortium of several French companies) was chosen as the main contractor.

Based on this softloan and other technical data as well as other assumptions, the project's main contractor showed (Enersystem, January 1988, op cit) that the project would be able to repay the debt. The calculated generating cost would be Indonesian Rupiah 58.8 a kWh (equivalent to FFr 0.266 at that time) while the electricity could be sold at IDR 115/kWh. Thus, while most research project can be regarded as money-losing undertakings, this should not be the case for the proposed Lahendong project.

In view of new data availability, the author seek to recalculate this early generating cost figure. The latest data available (August 1995), for this paper analysis purposes, is treated as final.

2. TECHNICAL ASPECTS

2.1. THE HEAT SOURCE

Based on data provided by PLN and after conducting sub-surface studies, the project's main contractor reported to the project's owner (BPP Teknologi) that while the binary cycle technology could be utilised for the proposed project, the proposed LH-2 and LH-3 wells are not readily accessible, due to casing collapse and (probably) scaling, and need to be reworked (Enersystem, 1990). *Or,* if the project owner

chose, another well (or wells) could be drilled as the replacements.[2] However, as it was not possible to drill a new well (on legal as well as cost grounds), another ready-to-produce well was sought for replacement. It was a fortunate coincidence that Pertamina (the Indonesia's State Oil Company) had also drilled several deep wells (LHD-1 through LHD-7) on the area. One of these wells, the LHD-5, was deemed appropriate to be chosen as LH-2 and 3 wells replacement early in 1990. Pertamina, which originally was not included in the project, had now entered the project's overall picture by agreeing on BPP Teknologi's request to use its LHD-5 well as the project's hot source.

At the first glance, the well change (from LH-2 and 3 to LHD-5) was thought to have small impact on the project's completion.

A detailed study on the LHD-5 well's geothermal fluids had necessitated a substantial redesign of the planned power plant. The most important being the need to provide a cooling tower, as the proposed power plant's site was to be moved farther and higher away from the original location which is only three hundred metres from Lake Linau. (The original engineering scenario was to utilise the neighbouring Lake Linau's water for cooling purposes). Other than this, whereas the original LH-2 and 3 wells were steam dominated and producing geothermal fluids of medium enthalpy, the replacing LHD-5 well is a high-enthalpy water- dominated well (with around 1:4 steam-water ratio). This gave rise to the need to provide the planned power-plant with a separator.

Table 1
LH-2 AND LH-3 WELLS CHARACTERISTICS

Well		LH-2	LH-3
Final Depth	(m)	365	595
'Uncondensablegas	(%)	1-2	n.a.
Geothermal Fluid Nature		dry steam	wet steam
Discharged Steam temp.	(C)	165-175	146
Mixture Flow rate	(kg/sec)	4.99	similar
Enthalpy	(kJ/kg)	2746	similar
Well head press.	(kg/sq.cm)	18	42.51

Source: Enersystem (1988), Presentation Document v. 1.

Table 2
LHD-5 BASIC CHARACTERISTIC

Bore-hole temp.	(C)	247	(a)
Steam production	(ton/h)	48	(a)
Water flow	(ton/h)	186	(a)
Enthalpy	(kJ/kg)	1100	(b)
Final Depth	(m)	1897	(c)

Sources:
(a) PERTAMINA; (b) BPPT; (c) Lemigas

Various events, directly or indirectly related to the heat source change, had acted against the possibility of completing the project on planned time and cost. Such had been the problems encountered by the project that this power plant had only been able to actually produce electricity as late as the end of June this year, four years behind schedule. And it was only for a very short duration (less than a week) before encountering yet another problem. This time with the power plant's turbine blades. The author, to be fair to the project being investigated, has no doubt that the project will finally start producing electricity as early as October this year[3] and fully functioning at the end of the year.

2.2. ELECTRICITY PRODUCTION

Under the Contract signed on August 22 1988 between BPP Teknologi and Enersystem, it was agreed that the main contractor would design, build and install a 2.5 MW (installed capacity) geothermal powered power plant[4]. For the purpose of this study, this need to be clarified, as there has been several versions of the project's electricity production. The latest powerplant's electricity own-use figure collected by the author (June 1995) is 12,589 kWh per day, or (on average) 524.55 kWh per hour. Thus, the net installed-capacity figure (so to speak) will be 1975.45 kWe. To arrive at the generated electricity figures used in this paper, this net installed capacity figure shall be, first, multiplied by 8760/2 (half of the annual hours) The resultant figures are then multiplied further by some probability figures (chosen subjectively), from as low as .8 (half-year 15) increasing to .85 (HY 16), to .9 (HY 17-43) and again to .85 (HY 44-64). This method is used to modify the original calculation as used in Table 4.

3. THEORETICAL BACKGROUND

Although, especially within non-economists circles, both financial and economic analysis terms are often used interchangeably, there are some fundamental differences between the two.

3.1. FINANCIAL ANALYSIS

Strictly speaking, a financial analysis is normally done (to see the project's viability) to a privately-funded project, whose purposes are to serve the project's financiers interests. This kind of analysis will only include cost(s) or benefit(s) which are directly attributable to the project in their profit and loss statement. Thus, to give an extreme example, this kind of analysis would not consider any extemal effects (such as pollution) borne by the the community as whole. Neither does it consider any benefit accrued to other parties.

Thus, in a financial analysis any monetary outlays by the project are grouped as costs and any monetary earnings to the project are grouped as the project's benefits. In an economic analysis things would be a little bit different, for some costs or benefits categories,.

3.2. ECONOMIC ANALYSIS

As most private undertakings ate concerned only with financial costs they would have to pay and financial benefits they might be able to gain, they normally do not want to be involved in activities (suppposedly) having much societal benefits but giving low financial benefits, such as research activities' and other activities having public-goods natures[6]. Thus, government agencies most often compelled to do activities beneficial to society but having low financial

returns, including research activities.

However, as in the case of private funds, governments' coffers are not limitless. Therefore, just as in private cases, governments' undertakings in public projects should also be based on gaining more benefit compared on the cost needed to undertake the project. Only this time the meaning of benefit (and also cost) should be enlarged to encompass the (country's) society as whole, and also to cover intangible benefits (and costs). [7]

Whereas the basic philosophy of financial and economic analyses are similar, namely to gain more benefit than the cost expended to execute the project, the inclusion of the whole society as the receiving (or paying) parties (not just those directly involved in the project) often makes the conclusion of an economic analysis a more complicated business. Furthermore, the conclusion reached often differs to that of. a financial analysis. Although this difference is often having negligible effects to the overall project execution, on some extreme cases the conclusions' differences between the two might be too large as to threaten the project execution.

Methodologically speaking, an economic analysis involves the questions of:

a. which costs and benefits are to be included (do secondary and intangible costs/benefits are also uded?)
b. how costs and benefits are to be valued (are market prices deemed to be sufficient to reflect social valuation?)
c. are those costshenefits to be discounted, at what interest rate?

Addressing those seemingly simple questions could actually resulting in much discussion considered beyond the space limitation of this paper. Therefore, for the sake of simplicity (without too much disregarding the basic principles, though) the author uses the following assumptions:

- all monetary outlays and earnings directly incurred by the project are included in financial analysis.
- all monetary outlays (minus, if any, all domestic taxes, subsidies and interests) and earnings (minus domestic interest earnings) , including those which are not directly incurred by the project, but has to be paid (or can be received) because of the project existence, are to be included in the economic analysis.
- all costshenefits data will not be discounted, or in other words, all monetary variables (and economic as well) will be based on *1995* values.
- all equipment procured will last until end of the project's life, and no additional major cost items, financial or economic in nature, (other than those having been listed in this paper) would arise.
- the project's scheme will not change, and the project completion delays happened so far will not affect the project's overall lifetime and performances (half-year 15, from the Softloan agreement, is taken as the *start* of electricity production in this paper, instead of HY 5 as planned).

The author recognises that, at least from a technical point of view, the last two assumptions may not be entirely correct. However, as removing them would require forecasting on each plant component's lifetime as well as their costs, the author chooses the simpler (if not entirely correct) approach.

4. PROJECT ANALYSES

4.1. EX-ANTE ANALYSIS

An ex-ante analysis means that it is done prior to the project commissioning. The opposite being an ex-post analysis, when the project has reached its end life. *An* on-going analysis is done between these two extremes. Those analyses each has its own advantages as well as disadvantages.

An ex-ante analysis, being done when actual data are scarce, obviously having the least degree of certainty among the three analyses. However, this analysis is needed early on a project life to forecast the project's future performances as well as to plan for any needed remedial action to enhance the project's performance. *On* the contrary, an ex-post analysis, being done when much actual data has been collected, will undoubtely having the greatest degree of certainty. On the other hand, in an ex-post analysis, being normally done when a project has ended its lifetime, little benefit could actually be gained for the (concerned) project performance enhancement. *An* on-going analysis is done to check the conclusions reached during earlier ex-ante analysis.

4.2. FINANCIAL AND ECONOMIC COSTS

With all neccessary assumptions put in place, the previous Table 3 and the following Table 4 and 5 should serve as the starting point for our financial and economic analises of the Lahendong project.

The previously-mentioned assumptions are used to distinguish available financial data as follows:

a. Softloan installments, (with interest payments) is included in financial as well as in economic analyses.
b. Additional costs, distinguished between those paid by BPPT and by PLN. *On* the first three years of the project operation, only costs borne by BPPT will be included both in financial and economic analyses, while those paid by PLN will only be included in economic analysis. This scheme will be reversed after the first three year period. The costs borne by BPPT, if any, will now be treated as economic costs only.

This seemingly inconsistent treatment for the same cost category is perfectly in line with the operational agreement between two institution, namely BPPT will hold the project legal title three years after the project commission to execute some research activities. Thus agreed, any PLN outlays during the research period should be treated as external costs to the project.

c. Local loan installments will be fully included in financial analysis, while for economic analysis the interest payment parts should be excluded (interest paid locally is

(in 1000 of French Francs)

ITEMS	a)	(b)
1. Site tests	70.0	570.0
2. Engineering of the project	1010.0	1388.4
3. Thermo-mechanical equipment	16600.0	843.0
4.Electrical equipment	3645.0	96.2
5. Transportation and Insurance	1228.5	
6. Supervision of Erection	1271.5	
7. Local works, supplies and	3070.0	450.0
8. Coordination, management of the project	840.0	616.0
9. Training, transfer of manufact know-how.	2215.5	
Sub-total 1	27735.0	6179.1
10.Administrative expenses and Contingencies, overhead 6.99% of Sub-total 1	1938.7	431.9
Sub-total 2	29673.7	6611.0
11.COFACE,INSURANCE(except transprtation), bank guarantees (0.047of Sub-total 2)	1394.7	310.7
Total of Items 1-11	31068.3	6921.7
12.Total Price of the skid (1-6),8 plus 8.89% of 10a and 11a)	27629.4	

Table 4.

BASIC PARAMETERS FOR GENERATING COST CALCULATION

Installed power capacity (kW)	2500
Construction period (months)	22
Annual production (GWh)	15.84
2500 kW x 8760 hrs x .723*	
Investment cost (MFFr)	38
Opr & Maintnc (MFFr)	0.997
Softloans conditions:	
.Amount (MFFr)	38
.Rate of Interest (Yo p.a.)	3.5
.Duration, with grace period (years)	25
.Grace period (years)	7
.Management fee (%) .	0.5
.Commitment fee (%) (every 6 months)	0.3
.COFACE (Fr. part)(% p.a)	0.63
.COFACE (Ind.part)(% p.a)	0.69
.Repayment installment	half-yearly

classified as transfer payment from one society members to another, and thus, economically speaking, do not represent cost to the society).

d. Steam cost will be included in both financial and economic analyses.

The next Table 6, listing additional expenses paid by both PLN and BPPT, is prepared to divide which expenses to include in financial and economic costs. The division is based on the project's original scenario, i.e. BPPT to hold the project's title the first 3 years of project's operation.

These costs are, first, amortised for 25 years, and then divided into 50 half-yearly figures. PLN paid for these outlays on the understanding that the proposed powerplant will be handed-over to them after the three-year research period.

COST SUMMARY

Half year	Soft loan Installments MFFr)	Local loan Installments (MFFr)	O&M (MFFr)
1*	0.26845		
2*	0.28039		
3*	0.51978		
4*	0.71124		
5 to 14	0.79013	0.21511	0.4985
15	0.93625		0.4985
16	1.04577		0.4985
17	1.26502		0.4985
18	1.44723		0.4985
19 to 50	1.52029		0.4985
51	1.21639		0.4985
52	0.98846		0.4985
53	0.53262		0.4985
54	0.15195		0.4985

(MFFr 7.9013) are amortised for 25 years (starting HY15-64) to cater for the project competion delay. Hence in Table 7 the soffloan installments differ.

Table 6.

	PARTICULAR		UNITCOST	EXPECTED	HALF-
	Paid for by PLN				
1	Staff salaries	15	600000	25 Yrs	54000000.0
2	New Separator	1	1500000000	25 Yrs	30000000.0
3	Miscellaneous expenses	1	2505680000	25 Yrs	501 13600.0
4	Overhaul	1	305881115	25 Yrs	6117622.3
5	Research fee	1	1200000000	25 Yrs	24000000.0
6	Redesign*	1	3532222435	25 Yrs	70644448.7
	Paid for by BPPT				
7	Old Separator	1	1200000000	25 Yrs	24000000.0
8	Cooling tower	1	250000000	25 Yrs	5000000.0
9	Routine 1989	1	74349000	25 Yrs	1486980.0
10	Routine 1990	1	16500000	25 Yrs	330000.0
11	Routine 1991	1	1276690000	25 Yrs	25533800.0
12	Routine 1992	1	47962000	25 Yrs	959240.0
13	Routine 1993	1	66769000	25 Yrs	1335380.0
14	Routine 1994	1	1252858000	25 Yrs	25057160.0
15	Routine 1995	1	76399000	25 Yrs	1527980.0
16	Redesign**	1	1370574383	25 Yrs	2741 1487.7

A. As Financial Cost

		112642027.7
Year 4-25		234875671.0
B. As Economic Cost	Incl. tax	Exc.Tax
Year 1-3	347517698.7	315925180.6
Year 4-25	347517698.7	315925180.6

Sources:1-4, Mr. FX Parimo (pers.comm, July 1995); 6+16:Aggreement No.339A/DB-PKA/BPPT/XII/1993, recalculated;9-15: BPPT Annual Project Lists (DIP), slightly modified for the 1995 figure to cater the non-payment of steam costs. Other figures, esp. no.5,7 and 8 are known to have been paid. *PLN part; ** BPPT part.

As for the research fee, this payment is supposedly to support BPP Teknologi's research activities, calculated at

Rp25/kWh for three years, totalling Rp 1.2 billions. This fee was later paid in advance (of the research activities) and be used by BPP Teknologi to purchase the first separator.

Based on those tables, the ex-ante financial generating costs (similar generating cost figures are not included in the table for brevity reasons) are as listed in the following Table 7.

Table 7.
EX-ANTE FINANCIAL GENERATING COST CALCULATION

	SOFTLN (MFFr)	O&M (MFFr)	LOCAL LOAN (MFFr)	STEAM COST (IDR)	ADDITNL COSTS (IDR)	ELECTR. PRODCT (kWh)	GEN COST (IDR)
15	1.09428	0.4985	0.2151	372,125	112642028	6921974	136.00
16	1.20380	0.4985	0.2151	395,383	112642028	7354598	134.83
17	1.42305	0.4985	0.2151	418,641	112642028	7787221	140.24
18	1.60526	0.4985	0.2151	418,641	112642028	7787221	150.96
19	1.67832	0.4985	0.2151	418,641	112642028	7787221	155.26
21	1.67832	0.4985	0.2151	418,641	234875671	7787221	170.96
25	1.67832	0.4985	0	418,641	234875671	7787221	158.30
40	1.67832	0.4985	0	395,383	234875671	7354598	167.61
51	1.37442	0.4985	0	395,383	234875671	7354598	148.68
52	1.14649	0.4985	0	395,383	234875671	7354598	134.48
53	0.69065	0.4985	0	395,383	234875671	7354598	106.08
54	0.30998	0.4985	0	395,383	234875671	7354598	82.36
55	0.15803	0.4985	0	395,383	234875671	7354598	72.89
to 64							

See Table 6 for Additional costs calculation. See point 2.2. for electricity production calculation.

(in 1995 IDR)

	FINGCOST	DOMINT (MFFr)	DOMINT (IDR/kWh)	ADDTCST (IDR/kWh)	ECGCOST
15	136.00	0.10588	7.009064	50.20	179.1984
16	134.83	0.09822	6.119584	47.25	175.9610
17	140.24	0.09003	5.297332	44.63	179.5716
18	150.96	0.08126	4.78124	44.63	190.8092
19	155.26	0.07187	4.228959	44.63	195.6604
21	170.96	0.05108	3.005502	44.63	212.5806
22	170.96	0.03958	2.328705	44.63	213.2574
23	170.96	0.02727	1.604449	44.63	213.9816
24	170.96	0.01410	0.829408	44.63	214.7567
25	158.30	0.00	0.000000	44.63	202.9287
40	167.61	0.00	0.000000	47.25	214.8625
51	148.68	0.00.	0.000000	47.25	195.9288
52	134.48	0.00	0.000000	47.25	181.7282
53	106.08	0.00	0.000000	47.25	153.3282
54	82.36	0.00	0.000000	47.25	129.6115
55	72.89	0.00	0.000000	47.25	120.1446
to 64					

Domestic Loan repayment are reduced to "principal payments" only. Additional costs (excl. Tax) **are , for simplicity, calculated on per kWh basis.**

Average production cost figures for PLN Region XI have been IDR **116.23** a kWh **(1989); 130.5 (1990); 147.25 (1991); 174.01 (1992)** and **208.28 (1993).** (FX. Parimo, pers.comm, July **1995). As** the **1995** figure has not yet available, this has to be assumed. Due to inflation alone (currently stands close to **10%** annually), it is fair to assume that the **1995** average generating cost figure will be higher **than** previous years figure. Subjectively, the author assumed this figure to be **15%** higher than the **1993** figure. Thus, the assumed **1995** figure is IDR **239.52.** Average selling price (the latest available figure, for **1993,** is IDR **161.16** per kWh) will have to be revised **as** well. Again, subjectively, the author assumed that the **1995** figure will be **15%** higher than the **1993** figure, or IDR **185.33.**

This px-ante study has thus shown that , financially, the proposed geothermal powerplant would still perform better than the other powerplants currently exist in the area. Even if the **1993** average generating cost figure is used for comparison. Compared to the (assumed) **1995** average selling figure, the ex-ante financial generating cost for the Lahendong project is clearly competitive. Average financial generating cost for this paper is IDR **135.28** (French Francs **.295** on current rates of IDR **458.21).**

The next Table **8** (with domestic loan installments reduced to principal payments only) lists the project's ex-ante economic generating costs calculation.

This table shows that, subject to the assumptions used in this paper hold, most of time the resultant economic generating costs will be higher than the average (assumed) selling price, although these figures are still lower than the current average generating costs. On average, the economic generating cost is IDR **185.89** or **Ffi .405.**

4.3. PROJECT BENEFITS

Since this paper's main purpose is to discuss the Lahendong project fiom the cost sides, the project benefits are not to be fully discussed here. This must not be construed that the project is lacking any benefits, financially or otherwise. Nor that the foreseen benefits were not worth mentioning. Space and time limitations have prevented the author fiom treating those project benefits **as** fully **as** the project costs treatment in this paper. The following paragraphs should give the readers an idea of what constitutes the project benefits. **As** with project costs, project benefits can be divided into:

4.3.1. FINANCIAL BENEFITS

The project's financial benefit will mainly come **from** electricity sales earning by PLN. Average **PLN** Region XI selling price for **1993** was IDR **161.16** a kWh, or **IDR 185.33** for (assumed) **1995.**

4.3.2. ECONOMIC BENEFITS

Other than that PLN's earning arises out of the produced-electricity sales, Pertamina's earning from geothermal steam sales to the project also represents the project's direct economic benefits. Earning by labour (unskilled or otherwise) , otherwise not employed had the project was not undertaken, can also be included **as** the project's economic benefit. Society's electricity consumption worth, perceived or otherwise, also represents part of the project's overall economic benefits. (There are several theories on how **to** quantify this society's worth of electricity consumption. Interested readers are advised to look further in many available textbooks on energy economics **as** well **as** on welfare economics).

4.3.3. INTANGIBLE BENEFITS

This type of benefits may as important as the project's tangible benefits. As well, they may represents the larger parts of a project benefits. While in privately-funded projects intangile benefits are (most probably) never becoming considerations, in publicly-funded projects. both of these benefits are usually given (more or less) similar weight. Unfortunately, intangible benefits (and costs as well), as their names imply, are not easy to quantify. It is for this very reasons that intangible benefits have often been given qualitative treatment in economic analysis of a project.

Having been conceived from the start with research activities in mind, the Lahendong project's intangible benefits need.to be given a proper treatment.

The Lahendong project's intangible benefits will, mainly, come through BPP Teknologi engineers (as well as those of PLN's) having the chance to closely study the binary-cycle geothermal technology, to recognise the technology's advantages as well as its disadvantages for electricity generation. This Lahendong binary-cycle geothermal project has the distinction of being the only one of its kind in the country. There is no doubt that had the project not been beset by commissioning slippages, the project's earlier idea of using the project as a pilot plant for other small, low to medium enthalpy geothermal fields might come to realisation. (The Indonesian geothermal situation has now so much changed. Whereas formerly, when the Lahendong project was conceived, any party wishing to utilise geothermal energy for electricity generation would, invariably, have to deal with Pertamina, any small geothermal fields having electricity generation potential of less than 10MW can now be developed by any party.).

5. CONCLUSIONS

The resultant generating cost figures in this paper are depended, among others, on the assummed electricity generation figures. The author has tried not to become an optimistic or a pessimistic in assumming these figures. An on-going study may be done in the future to verify the figures resulted in this paper.

As can be compared between Table 7 and 8, the Lahendong project's ex-ante economic generating costs are somewhat higher than its financial generating costs figures.The higher economic generating costs are attributable, among others, to the nature of the project's legal title (in which BPPT, and eventually PLN, will legally own the project). Such ownership scenario often make some cost figures "disappear" from the cost calculation. The very reason for doing an economic analysis it is exactly to revise that misleading tendency. However, this higher average economic generating costs (compared to financial generating cost figures), are still lower when compared to the current average generating cost, and slighlty higher than (assumed) average *1995* selling price figures in PLN Region XI.

Thus, it can be summed up that, notwithtanding of the problems encountered by the project so far, this ex-ante study has shown the the project commissioning will be beneficial financially (for PLN Region XI).

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DISCLAIMER

The views and opinions contained in this paper are fully the author's and they do not necessarily reflect those of the institution in which the author works, nor any persons assisting the author in completing this paper. No harms, nor wrong opinions, toward any parties involved in the project were deliberately intended by the author.

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[1] Mr. Vincent T. Radja has , mistakenly and on several occasions, mentioned that the nearly FFr 38 millions fund is a *grant* (see, for examples, ***Review of the Status of Geothermal Development and Operation in Indonesia 1985-1990,*** Geothermal Resources Council TRANSACTIONS, v.14, pt.1, August 1990; ***The Geothermal Steam for Electricity Price in Indonesia,*** a 1990 Indonesian Institute for Energy Economics' seminar, in Indonesian language).. This difference should not be treated as a mere difference in terminology, as ***grants*** would have reduced the project's generating cost so much so that any generating cost calculation would invariably result in very low misleading figures.

[2] Enersystem, ***Lahendong Medium Enthalpy Geothermal Project: Sub Surface Report,*** undated; ***Enersystem, Addendum no.2 (draft no.3) to the Contract (between BPPT and Enersystem for the Implementation of the Project),*** October 1988.

[3] The project contractor quoted three months (from June) as the possible time needed to replace the damaged turbine blades.

[4] Badan Pengkajian dan Penerapan Teknologi, ***Contract for Lahendong Medium Enthalpy Geothermal Project,*** August 1988.

[5] This is not to say that private companies do not engage in research activities. However, their research activities are normally done for their own (financial) benefits.

[6] Goods (or rather, mostly, services) having the nature of *public goods* are those goods which no person will be able to prevent (at least on reasonable costs) others from enjoying the same benefit he/she enjoys. Or, his/her enjoying the benefit will not exclude others from doing the same. A classical example of this category is the secure feeling provided by the armed forces. This nature is opposite to ***private goods***.

[7] The question of whether any intangible costs (and benefits) can be given a certain (monetary) value is still hotly debated even among economists. The extent of this debate is clearly beyond the scope of this paper. Any readers interested in this subject should read papers or books on Cost-benefit Analysis (or Benefit-cost Analysis in American parlance).