



INVESTMENT INCENTIVES FOR REHABILITATION AND PERFORMANCE IMPROVEMENT OF TPP BITOLA

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JSC MACEDONIAN POWER PLANTS (JSC ELEM)



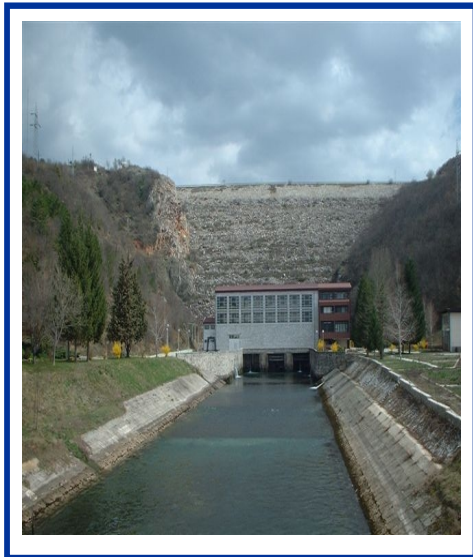
FEW NUMBERS FOR JSC ELEM

- ☉ **24 GENERATORS**
- ☉ **1,328 MW INSTALLED CAPACITY**
- ☉ **7 MILION TONS OF COAL PER YEAR**
- ☉ **~96% OF THE ELECTRICITY PRODUCED IN THE
REPUBLIC OF MACEDONIA IS COVERED BY *JSC ELEM***
- ☉ **264 MILIONS OF EUROS OF ANNUAL INCOME**
- ☉ **4,000 EMPLOYEES**



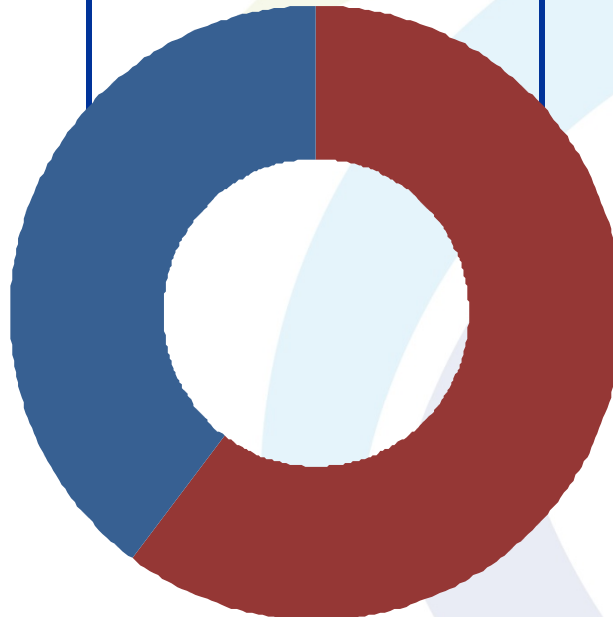
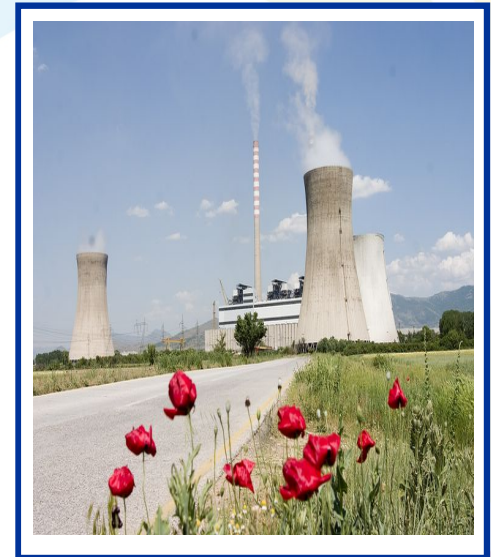
HPP

528 MW / 40 %



TPP

800 MW / 60 %



Total 1328 MW

Identifying the most appropriate rehabilitation investment Program for TPP Bitola, in order to:

- **Extend lifetime of main equipment**
- **Improve energy efficiency and overall performance**
- **Reduce negative environmental impacts**

- **The biggest thermal capacity** in our portfolio, with three units Bitola 1, 2 and 3 each of 225 MW;
- **The units have started with operation in 1982, 1984 and 1988 respectively;**
- **TPP Bitola provides almost 80% from the whole electricity production;**
- **Average annual production ~ 4.200 GWh;**
- **Average annual coal consumption ~ 6.000.000 tons.**



MAIN SCENARIOS TAKEN INTO CONSIDERATION

- **Exploitation of the existing coal reserves in Macedonia;**
- **Potential use of natural gas;**
- **Potential import of coal by way of any neighbor ports**

SUB-SCENARIOS - EXPLOATATION OF DOMESTIC COAL

- 1. Rehabilitation of the (3) three existing units;**
- 2. Rehabilitation of the (2) two existing unit, and building of (1) one new 300 MW unit;**
- 3. Rehabilitation of (1) one existing unit, and building of (1) one new 500 MW unit;**
- 4. No rehabilitations and building of (2) two new units, (1) one 500 MW unit, and one (1) 300 MW unit**

REHABILITATION OF THE EXISTING POWER UNITS

SCOPE OF WORKS

- **Turbine Modernization (LP, MP and HP)**
(turbine blades, turbine regulation and protection systems)
- **Generator Modernization**
- **Boiler Modernization**
- **Control & Monitoring System Modernization**

EXPECTED RESULTS

- **Extend lifetime of the main equipment for add. 120.000 hours**
- **Capacity increase of about 7,2 MW/unit, by efficiency increasing**
- **Reduction of outages and maintenance periods**

REHABILITATION OF THE EXISTING POWER UNITS

SCOPE OF WORKS

- **Boiler Modernization (incl. its Control Modernization)**
- **NO_x reduction (mills & burners)**
- **SO_x reduction**
- **Dust & Small Particles emission reduction**

EXPECTED RESULTS

- **Extend lifetime of the boiler for additional 120.000 hours**
- **Potential increase of the boiler efficiency and fuel utilization**
- **Reduction of pollutants and potential achievements of EU environmental directives**

COAL vs. NATURAL GAS

	Lignite / Coal	Natural gas
Current availability	Available	Very small amount is currently available in the Northern part of Macedonia
Future availability	The domestic coal is going to be fully exploited in the next 25-30 years. Some studies have been carried out, but further studies will be required.	Actual availability shall be verified at national strategic levels.
Plant efficiency	The best achievable electric efficiency is around 40-42%	The best achievable electric efficiency is around 55-57%
Specific investment	The overall specific investment (<i>including pollutant abatement systems</i>) ranges between 1.200 and 1.500€/kW	The overall specific investment (<i>including pollutant abatement systems</i>) ranges between 700 and 900 €/kW
Fuel cost	Very cheap at 10-15€/t. Imported coal would be 4-5 times more expensive.	The cost of natural gas is very high (> 400€ per 1000Nm ³ , and is expected to be fully in line with the future EU market levels.
LHV	The average LHV of lignite used at Bitola TPP is about 7,5 MJ/kg. Imported coal has some 3-4 times higher LHV.	The average LHV of natural gas adopted in Western European countries is about 34 MJ/Nm ³
Environmental performance	It requires the adoption of pollutant abatement system for dust, NO _x and SO _x	Only NO _x primary measures are required.

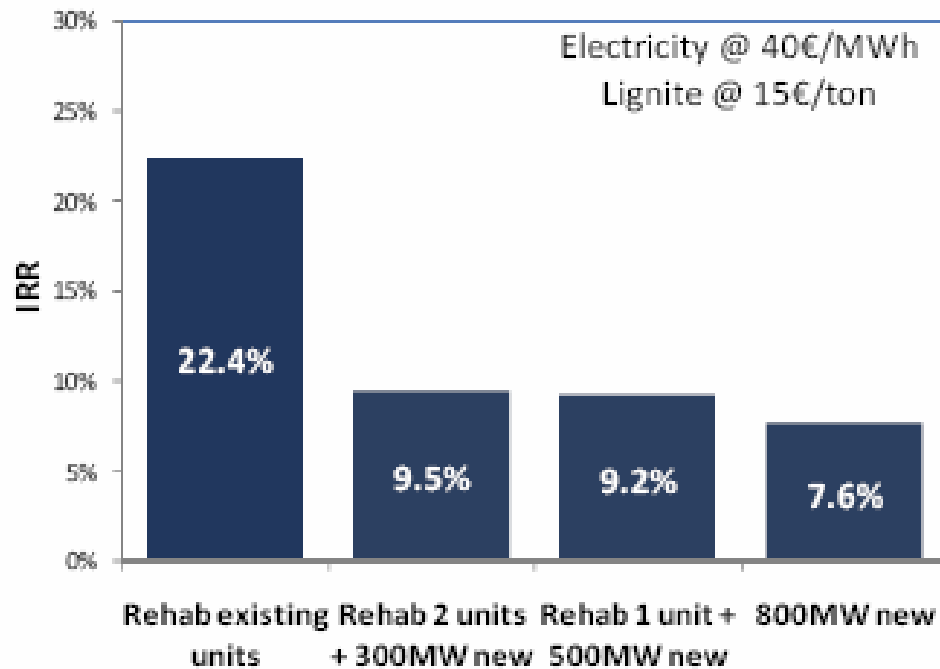
EXPLOATATION OF DOMESTIC COAL

For each sub-scenario IRR, Pay Back time and Levelised general costs have been calculated for two different cases:

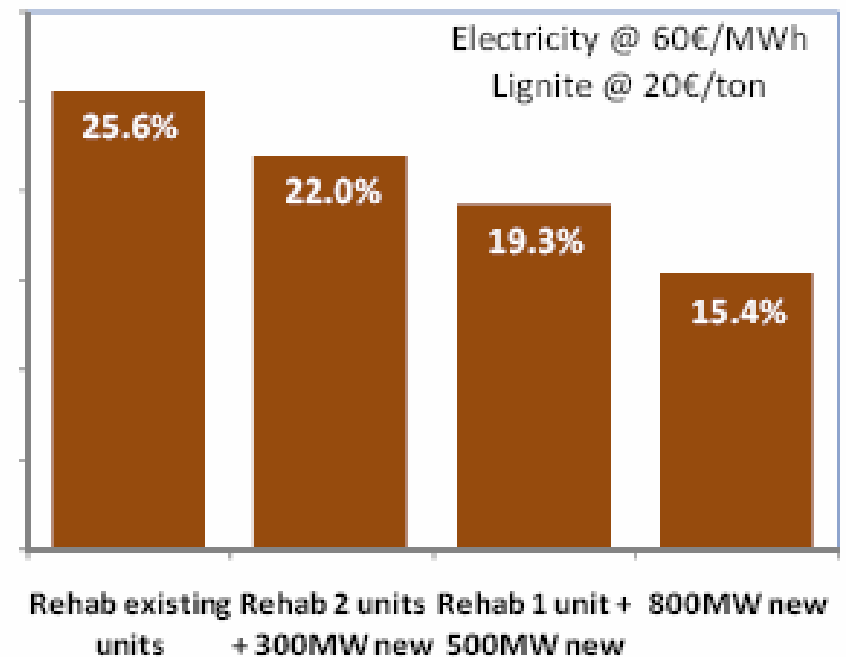
- **Most probable case** – Fuel cost and electricity price conservatively considered
 - **Possible future case** – Evolution of the fuel cost and electricity price (*liberalization*)
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- **Levelised general costs** indicate that the actual electricity price is not sufficient to repay the investment in no case!
 - **Significantly lower initial investment for rehabilitation of existing units**, allows for a better financial performance over the period of analysis!
 - **Introduction of BAT equipment** will have a key role with increasing of electricity selling price!

COMPARISON OF IRR FOR THE VARIOUS SCENARIOS IN TWO MARKET CONTEXT

Conservative Scenario



Liberalization Scenario



ENVIRONMENTAL ASPECTS

(REHABILITATION OF EXISTING ABATEMENT SYSTEMS)

EU emission limit from LCP Directive

Pollutant	LCP Directive Current emission limit for existing TPP	Current emissions at Bitola TPP	Minimum Abatement Requirement
NO _x	500	600-900	40-45%
SO _x	400	2500-3500	85-89%
Dust	50	400-500	88-90%

EU emission limit from LCP Directive – beyond 2016

Pollutant	LCP Directive Current emission limit for existing TPP	Current emissions at Bitola TPP	Minimum Abatement Requirement
NO _x	200	600-900	67-78%
SO _x	400	2500-3500	85-89%
Dust	50	400-500	88-90%

COMBINATION OF ABATEMENT SYSTEMS TO MEET LCP DIRECTIVES REQUIREMENTS

To meet the current emission limits, the following investment is required:

Pollutant	Single Unit [€]	Total Plant [€]
NOx	10,000,000	30,000,000
SOx	23,000,000	65,000,000
Dust	13,000,000	35,000,000
Total investment		130,000,000

The combined introduction of **NOx and **SOx** abatement (reduction) systems, plus the higher efficiency dust collectors (water treatment, injection systems, chemicals, sludge disposal, etc) **will imply an increase in internal consumption of electricity!****

- **Existing efficiency is 5-10% lower than current international standards. It is not possible to increase main thermodynamic parameters without major equipment replacement!**
- **The power plant is not in compliance with existing emission limits in Europe!**
- **The power plant has a total number of operating hours close to completion of design lifetime, so it needs important rehabilitation programs for extension of a lifetime!**
- **There is enough coal reserves for 25-30 years operation of a rehabilitated plants; Development of a new units must be based on BAT providing the best efficiency and excellent environmental performances. In terms of sizing, a larger unit has an advantage in order to exploit benefit in terms of efficiency and costs!**
- **The current levels of electricity selling prices are very low to support a large investment on a gas-fired power system!**

THANK YOU FOR THE ATTENTION!

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