ESO via **Steam System Optimization**:

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A Case Study of "Energetika"
JSC Power Plants of N. Macedonia (AD ESM)

Presenters

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The business case for energy efficiency in the industries in R. N. Macedonia
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"Energetika" AD ESM at a glance

Company profile

Production capacities: Located in the industry complex ,,Zhelezarnica"-Skopje and date since 1967. After restructuring of the company, since 1997, it is a part of JSC ESM

Products and Services: Production, distribution and **supply of heat and electricity** as **regulated activities**, and production, distribution and supply with **process steam and feed water**, as **unregulated activities**

Technology:
Combined heat and power plant

No. of employees (Energetika/AD ESM**)**:
150/~4500
Location: City of Skopje, N. Macedonia

URL: http://www.elem.com.mk/?page_id=3582&lang=en

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"Energetika" AD ESM at a glance

Company profile

Energetika AD ESM joined the GEF-UNIDO-REC Project in **June 2015**, to implement the **Energy Management System (EnMS) in line with ISO 50001**, which resulted in identifying the list of **Significant Energy Users (SEU)** and proposing a set of **Energy Conservation/ Savings Opportunities (ECO/ESO)**, most of which were closely related to **Steam System Optimization (SSO)**

The good cooperation throughout implementing the EnMS was an **incentive** for the top management of Energetika AD ESM to **serve as a host plant for the SSO Expert training**

This decision brought **additional expertize** for the staff included in the SSO training and **deepened** the **knowledge** for **further IEE measures** that could lead to **additional financial benefits** for the company via **implementing the ESOs**

Why to implement the ESO assessment

1. As per the licence that AD ESM Energetika holds for heat and electricity generation, distribution, and supply,
   the **main objective** is to provide **reliability**, **security** and **continuity** of the **energy commodities**, while
   the **energy efficiency** of the processes holds a **lower priority**

2. Despite the above mentioned, **during the 1st year of EnMS implementation**, the subsidiary managed to **achieve savings in all three resource commodities** identified in the EnMS scope
   (**natural gas** (T_{NG}=4%) , **electricity** (T_{El}=16%) and **ind.water** (T_{IW}=10%))

3. This was the main incentive for the top management to **continue participating** in the GEF-UNIDO-REC project and to **offer acting as a host plant for the SSO Expert training**

The Steam System Assessment 1/2

Case Description:

Problem Definition: Via applying a **system approach for energy performance analysis** to **identify ESOs that optimize** the **steam** and **condensate system** of the CHPP Energetika, AD ESM, located in Skopje, N. Macedonia.

The **boiler plants provide superheated steam**, which is further used
(1) for **electricity** production
(2) as **process steam** for industrial customers and
(3) for **hot water** preparation intended for the **local district heating system**

The **main operational cost** in the plant is the **natural gas consumption**.

The **focus of this SSA** was to
(1) identify and **implement** a set of **IEE measures** that lead to
(2) reducing natural gas consumption, which shall
(3) decrease overall **negative impact on the environment**

The Steam System Assessment 2/2

Case Description (cont'd)

The plant is **equipped** with the **following primary equipment**:

(1) 3 gas-fired superheated-steam boilers (assigned as G32, m. TPK – Zagreb in the late 60-ties, originally designed as utilizers of metallurgical off-gas waste energy, with natural circulation and production capacity 3x32 t/h superheated steam @ p=60bar & t=500°C. Through reconstruction, in the late 90-ties, natural gas is introduced as the primary fuel and heavy fuel oil is kept as alternative.

(2) 2 Reconstructed back pressure turbines (10.2 MWe and 10.4 MWe);

(3) 2 x 110 kV substations (110/35/6kV and 110/6kV)

(4) Main district heating station with 4 heat exchangers 'steam-hot water' (4 x 18.6 MWth)

Summary of Optimization Strategies through SSO

	Energy Saving Opportunity (ESO) (identified)	Energy Savings MWh/yr	Financial Savings (EUR/yr)	Capital costs (EUR)	Simple Payback (yrs)
1	Upgrading combustion control to air trim control via implementing burner management system (reducing ox. content in flue gases from 16 % to 5% results in increase of boiler plant efficiency from 79% to 86%, i.e. reduced flue gases energy loss by approx. 7.0 %)	6438 MWh	138000[+]	TBD	NA
2	Installing speed controllers (VFD[‡]) on the primary rotary equipment where possible (based on predefined priority) (Sum 21+22+23)	495 MWh	21505	TBD	NA
2	1. Circulation pumps in MDHS[‡]	300.81	13055	133650	10.24
2	2. Static pressure and booster-pumps	10.51	450	TBD	NA
2	3. Intake and fluegas fans	183.38	8000	TBD	NA
3	Initiating steam trap & leak management programme &reducing failures (saving ~15%)	385 MWh	10500	No cost	not yet applied

Summary of Optimization Strategies through SSO (cont'd)

	Energy Saving Opportunity (ESO) (identified)	Energy Savings MWh/yr	Financial Savings (EUR/yr)	Capital costs (EUR)	Simple Payback (yrs)
4	Improving condensate recovery and reducing boiler blow-down rate (minimizing losses via improving MP recovery by at least 5%)	4141 m3/y[†]	46500	No cost	Immediately*
5	Reducing make up water in the DH[‡] system (on time leakage detection)	13650 m3/y[†]	94309	No cost	Immediately*
6	Reconstructing heat exchangers in MDHS[‡]	149MWh	4991	13983	2.80
7	Installing 2 new condensate return pumps (in the boiler plant)s	126MWh	4470	4228	0.95
8	Insulate bare steam&condensate valves at the process area to reduce heat losses (by ~10%)	232MWh 36.7m3/y[†]	4489	TBD	NA
	Total potential savings	7825MWh 17828m3/y[†]	324764	TBD	NA

* for unceasing benefits from this measure, necessary is to implement the measure continuously 24/7/year
[+] assumed average price of natural gas is 200eur/1000Nm3 (12.3MKD/Nm3)
[†] this activity refers to water savings rather than energy savings, although it includes chemical and thermal preparation and the energy engaged thereby, and electricity for running e.g. the booster pumps
[‡] HD – district heating, MDHS – Main district heating station, VFD – variable frequency drives

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Benefits achieved so far through SSO

	Implemented Energy Savings Opportunity	Energy Savings MWh/yr	Financial Savings (EUR/yr)	Capital costs (EUR)	Simple Payback (yrs)
1	Upgrading combustion control to air trim control via zirconium probes resulting in reduced ox. content of ~10% (**part.implem.**O1.)	1248 MWh	27600	9596	0.347
2	Installing speed controllers on 1. Circulation pumps in MDHS‡ (only O2.1.)	300.8 MWh	13055	133650	10.24
4	Improving condensate recovery and reducing boiler blow-down rate (from water savings)	4141 m3/y†	46500	No cost	Immediately*
5	Reducing make up water in the DH‡ system (on time leakage detection)	13.650 m3/y†	94309	No cost	Immediately*
6	Reconstructing heat exchangers in MDHS‡	149MWh	4991	13983	2.801
7	Installing 2 new condensate return pumps (in the boiler plant)s	126MWh	4470	4228	0.945
	Total from implemented ESO	1823.8MWh 17791m3/y†	190925	161457	avg. 0.845yr

* for unceasing benefits from this measure, necessary is to implement the measure continuously 24/7/year
⁺ assumed average price of natural gas is 200eur/1000Nm3 (12.3MKD/Nm3)
† this activity refers to water savings rather than energy savings, although it includes chemical and thermal preparation and the energy engaged thereby, and electricity for running e.g. the booster pumps
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Value, learning and challenges with an ESO approach

Novelties for AD ESM Energetika from the perspectives of the ESO approach

i. Continuous monitoring and update of the energy consumption
ii. Applying Regression Analysis for assessing energy savings
iii. Applying Systems Approach to identify potential ESOs
iv. Respectively, continuous update of the regression models in order
- to have insight of the real and achieved energy savings and
- to verify contributions of the applied ESOs

Drawbacks:

i. Lack of commitment on all company levels

SSO implementation – Resources and returns

Allocated resources and achieved returns:

Potential ESOs: **Financial savings: 324764 EUR/yr** **Water savings: 17828m3/yr** **Energy savings: 7825 MWh/yr**	**Implemented ESOs:** **Financial savings: 190925 EUR/yr** **Water savings: 17791m3/yr** **Energy savings: ~1824 MWh/yr** **Implementation cost: 161457 EUR** **GHG reduction: ~365 tCO2eq** **Overall payback: Low** **i.e. avg. 0.845yr**

Differentiated resources allocation between staff time and cash expenditures/investments was not performed

SSO implementation – Resources and returns

Planned activities for the next fiscal year

Planned resources and expected returns:

The planned investments are to be finalized after adopting the budget for next year (foreseen within Dec 2019)
From previous investment plans the following ESO can be pointed out:

Identified ESO	Foreseen (Heat) Energy savings (MWh/yr)	Foreseen Financial savings	Foreseen investment	Simple payback yr
Installing secondary regulation in the District Heating System (at point of use, i.e. end users regulation)	6000	17343000 MKD (282000 EUR)	25000000 MKD (406500 EUR)	1.4415

Additional considerations

Overall **experience** and **benefits** gained through participation of AD ESM Energetika in the GEF-UNIDO-REC project via implementing
(1) EnMS in line with ISO 50001 (2) SSO Expert training

W.r.t. awareness and communication :

1. **Employees become more aware of the importance of no cost energy saving measures;**
2. **energy team members become aware that analyzing SEC is not enough, and it is not the correct indicator for energy savings;**
3. **Communication among responsible persons has been improved.**

Promoting and **enhancing visibility** of the **GEF-UNIDO-REC project** and the opportunities for the **companies that took part** via presenting the results on **conferences** (REMOO, SDEWES,), **publishing papers in renowned scientific journals e.g. JEPO** etc.

Conclusions and recommendations

Improving the IEE in AD ESM Energetika,
via improving the efficiency of the energy conversion processes assisted in achieving:

1. more **reliable energy supply**, thus improving the main objectives of the services Energetika offers
2. more **competitive business**, which however is with a **limited impact** due to the **regulated prices of the commodities** offered by Energetika
3. **cleaner environment**, and
4. **higher living standard** due to the more reliable energy supply and the contribution to the cleaner environment

Conclusions and recommendations

Suggestions for the policy-makers:

1. **Subsidies for IEE** based on both
   a. the amount necessary for the **capital investments**, and
   b. the achieved savings (**real and measurable savings**)
2. **Subsidies** for **consultant fees** (e.g. EBRD frames)

Carrot rather? than **Stick**

Maybe Harry Potter's wonder wand

The satisfied customer is the best add

Successful stories, however including the challenges and not only the achieved benefits are the best promoter to recommend this programme e.g. inclusion of AD ESM in the GEF-UNIDO-REC project initiated including the whole AD ESM in the EnMS, SSO and CASO Training and Programme

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THANK YOU!

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