

**Варіантне попереднє техніко-економічне обґрунтування
модернізації котла з метою диверсифікації палива для
комунального підприємства «Жовкватеплоенерго», котельня м.
Дубляни, Львівської обл.**

**Wielowariantowe wstępne studium wykonalności modernizacji kotła w
celu dywersyfikacji stosowanych paliw dla przedsiębiorstwa
komunalnego „Żółkiewciepłoenenergo”, kotłownia m. Dubliany obw.
Iwowskiego**

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Scope of presentation

1. Existing state.
2. **Prefeasibility – used methods.**
3. Analyzed technical variants description.
4. **Fuel characteristics and conversion.**
5. Main thermal parameters.
6. **Environmental conditions.**
7. Financial analysis.
8. **Summary.**

Existing state



- High combustion air excess number ($1.3 < \lambda < 1.6$).

- Inflexible combustion control.

- Average heat power 2.136 MWth .

- Total energy demand 33807,7 GJ /year.

- Average heat power 2.136 MWth .



Thermal power and thermal efficiency of existing boiler

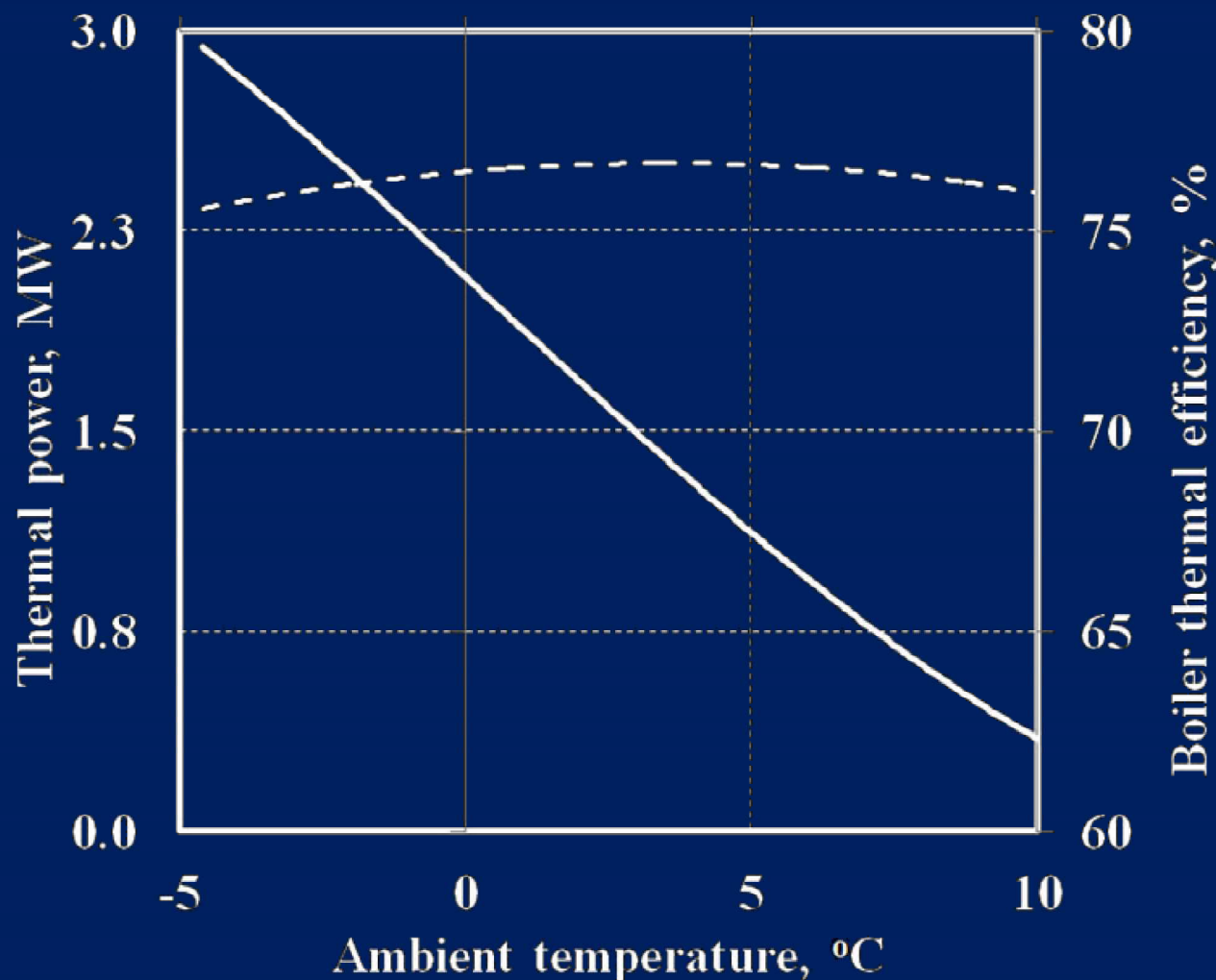


Fig. Thermal power (—), and boiler thermal efficiency (- - -) for existing state. (source: measurements)

Prefeasibility study – used methods



- 1. Simplified PID design for each variant.**
- 2. Thermal analysis.**
- 3. Combustion analysis.**
- 4. Selected unit process inside boilers / reactors modelling.**
- 5. Economical analysis on the base of actualised costs.**

Analyzed technical variants

Lp.	Variant of modernization
Ia	Combustion control change (Gas)
Ib	Combustion control change, new economizer, new boiler control devices (Gas)
Ic	Combustion control change, new economizer with condensation ,new boiler control devices (Gas)
II	Change of a existing boiler from gas to biomass pellets burner (biomass pellets)
III	Change of a existing boiler from gas to Lviv-Volyn oblast type of coal.
IV	Adding of a low temperaure pyrolysis system feeding by Lviv-Volyn oblast type of coal to existing boiler.
V	Erection of the new boiler with retort burners feeding by the biomass pellets.
VI	Erection of the new boiler with burners feeding by the coal.
VII	Erection of a small bubbling fluidized bed boiler with in situ desulphurization.

Analyzed technical variants



Scope of modernization

	M.pal	M.aot	Mk	Me	BK	BE	BKon	BP	BZ	BO	BPR	BRet
Ia	Burner modernization	Controll system modernization	Boiler with automation construction	ECO modernisation	Boiler construction+control system	ECO constr.	Condensation.	Solid fuel bean constr.	Pre gasifier	Dust collector (cyclone)	Dutch oven	Retort burner.
Ib												
Ic												
II												
III												
IV												
V												
VI												
VII												

Legend: M.pal - modernisation of the burner; M.aot - modernization of control system; Mk - modernization of existing boiler; Me - modernization of the economizer; BK - boiler with control system construction; BE - economizer construction; BKon - construction of condensation and small SOx adsorption system; BP - construction of the reservoir pellet / carbon and coal handling systems; BO - construction dust collector (multicyclone); BPR - construction of dutch oven; BZ - pregasifier construction; BRet- retort burner.

Natural gas composition



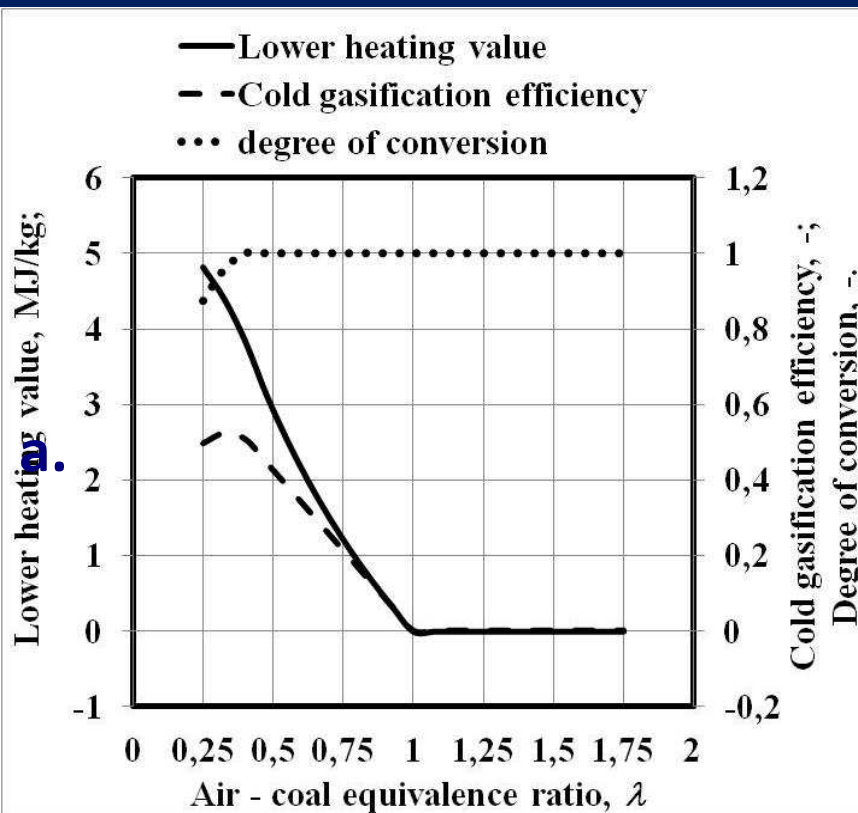
l.p	Parameter	Dimension	Value
	Natural gas composition		100
1	Methane, CH ₄	% vol.	96,044
2	Ethane, C ₂ H ₆	% vol.	1,952
3	Propane, C ₃ H ₈	% vol.	0,358
4	n-Nutane	% vol.	0,052
5	i-Butane	% vol.	0,057
6	n-Penthane	% vol.	0,008
7	i-Penthane	% vol.	0,011
8	Sum C ₆ +	% vol.	0,012
9	Carbon dioxide, CO ₂	% vol.	0,309
10	Nitrogen, N ₂	% vol.	1,197
11	Oxygen, O ₂	% vol.	0
11	Higher calorific value	MJ/m³n	40,18
12	Lower calorific value	MJ/m³n	36,234
13	Wobbe number Wo	MJ/m³n	52,837
14	Hydrogen sulfide H ₂ S	mg/m³n	0,242
15	Organic sulphur	mg/m³n	0,175
16	Density	kg/m³n	0,747

Solid fuels composition.

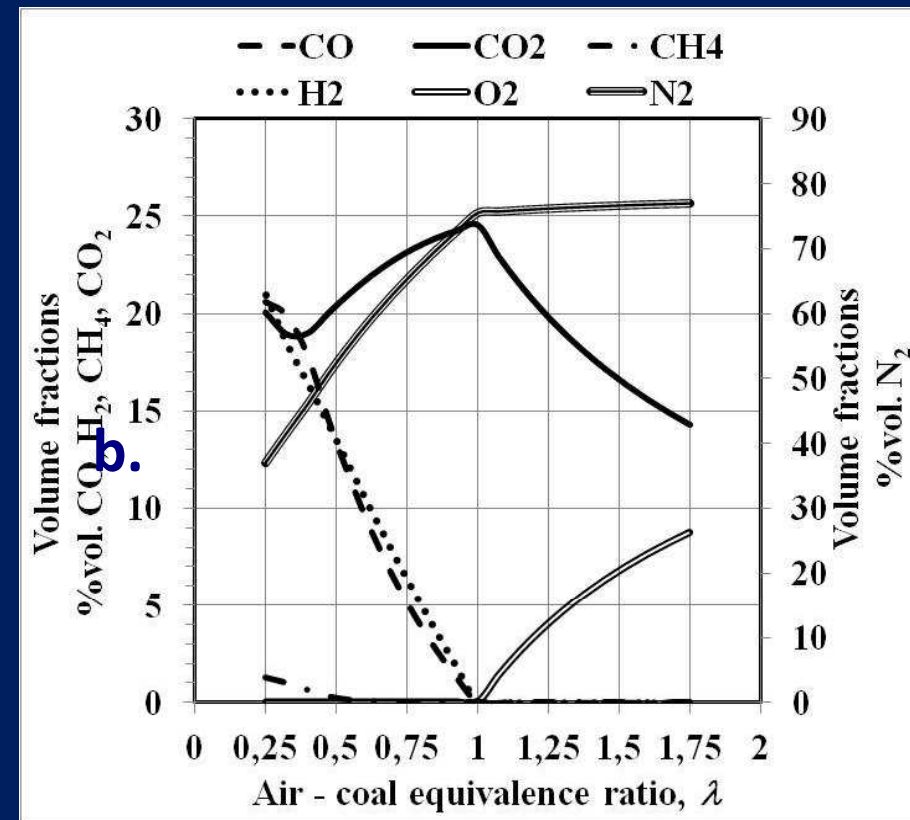


Lp. / Л.П.	Parametr / параметр	Rodzaj biomasy / Тип біомаси	
		Pellet drzewny / деревних пеллет	Węgiel Czerwononogrodzki / Вугілля Червоний -городзкий
1.	Zawartość popiołu; A, % mas.	0,72	6,47
2.	Zawartość węgla; C, % mas. / Вміст вуглецю; C, мас.%	39,42	76,44
3.	Zawartość wodoru; H, % mas. / Вміст водню; H, мас.%	4,50	5,06
4.	Zawartość tlenu; O, % mas. / Вміст кисню; O, мас.%	55,02	8,59
5.	Zawartość azotu; N, % mas. / Вміст азоту; N, мас.%	0,33	1,42
6.	Zawartość siarki; S, % mas. / Вміст сірки; S, % макс.	0,01	2,02
7.	Zawartość chloru; Cl, % mas. / Вміст хлору; Cl, мас.%	0,02	-
8.	Wartość opałowa stan suchy, MJ/kg / Калорійність сухого стану, МДж / кг	15,61	28,3
9.	Zawartość wilgoci w stanie roboczym, % mas. / Вміст вологи в робочому стані, % мас.	7-:10	5,0-:7,5
10.	Wartość opałowa w stanie roboczym, MJ/kg / Калорійність в робочому стані, МДж / кг	14,1-:14,6	26,1-:26,8 (DAF)
11.	Temperatura adiabatycznego spalania dla $l=1$ / Адіабатичній температури горіння для коефіцієнт надмірного повітря $l=1$	2404 (DAF)	1949 (DAF)

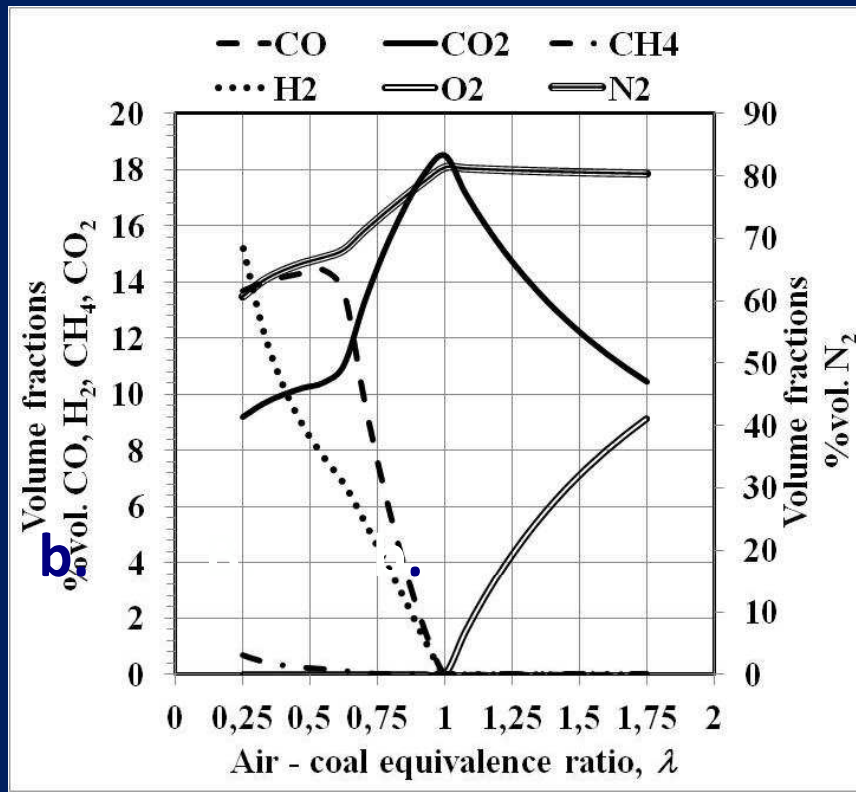
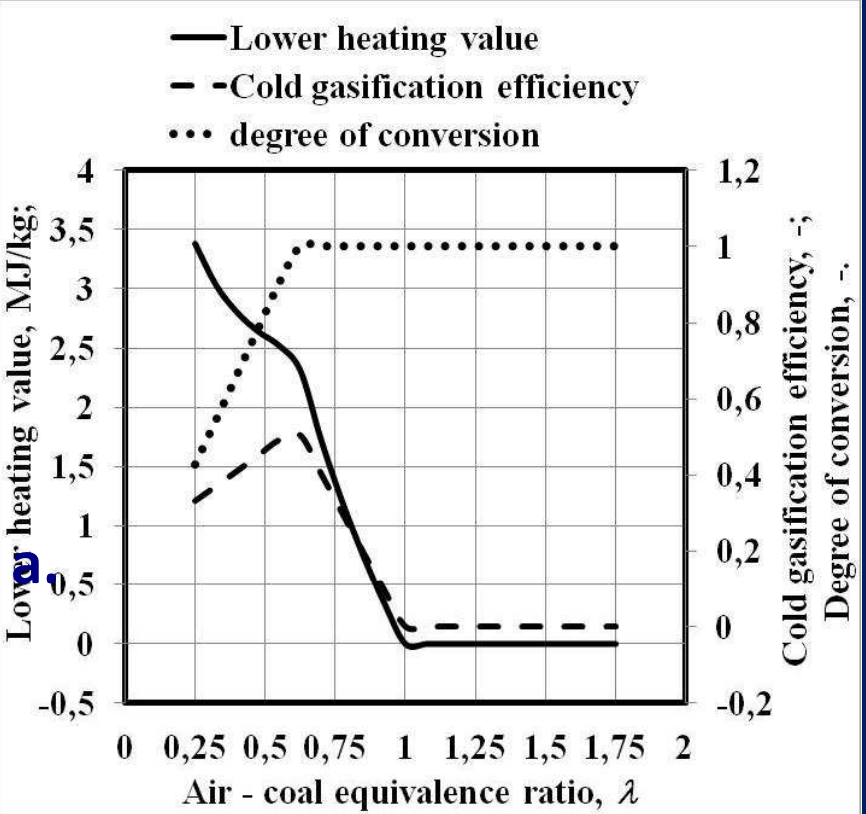
Solid fuels combustion analysis



b.



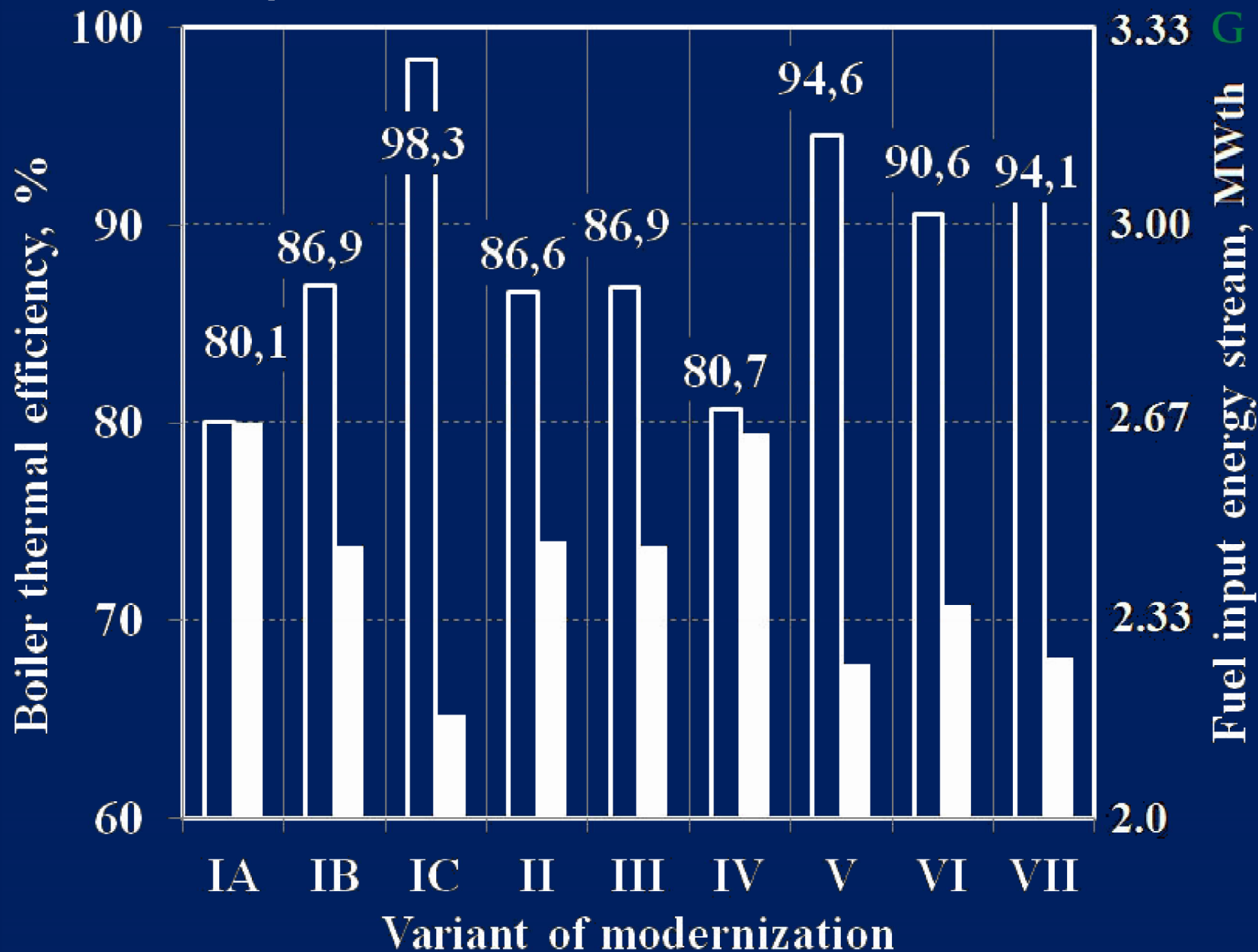
SOLID FUELS COMBUSTION ANALYSIS





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Main thermal parameters.





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Environmental conditions.

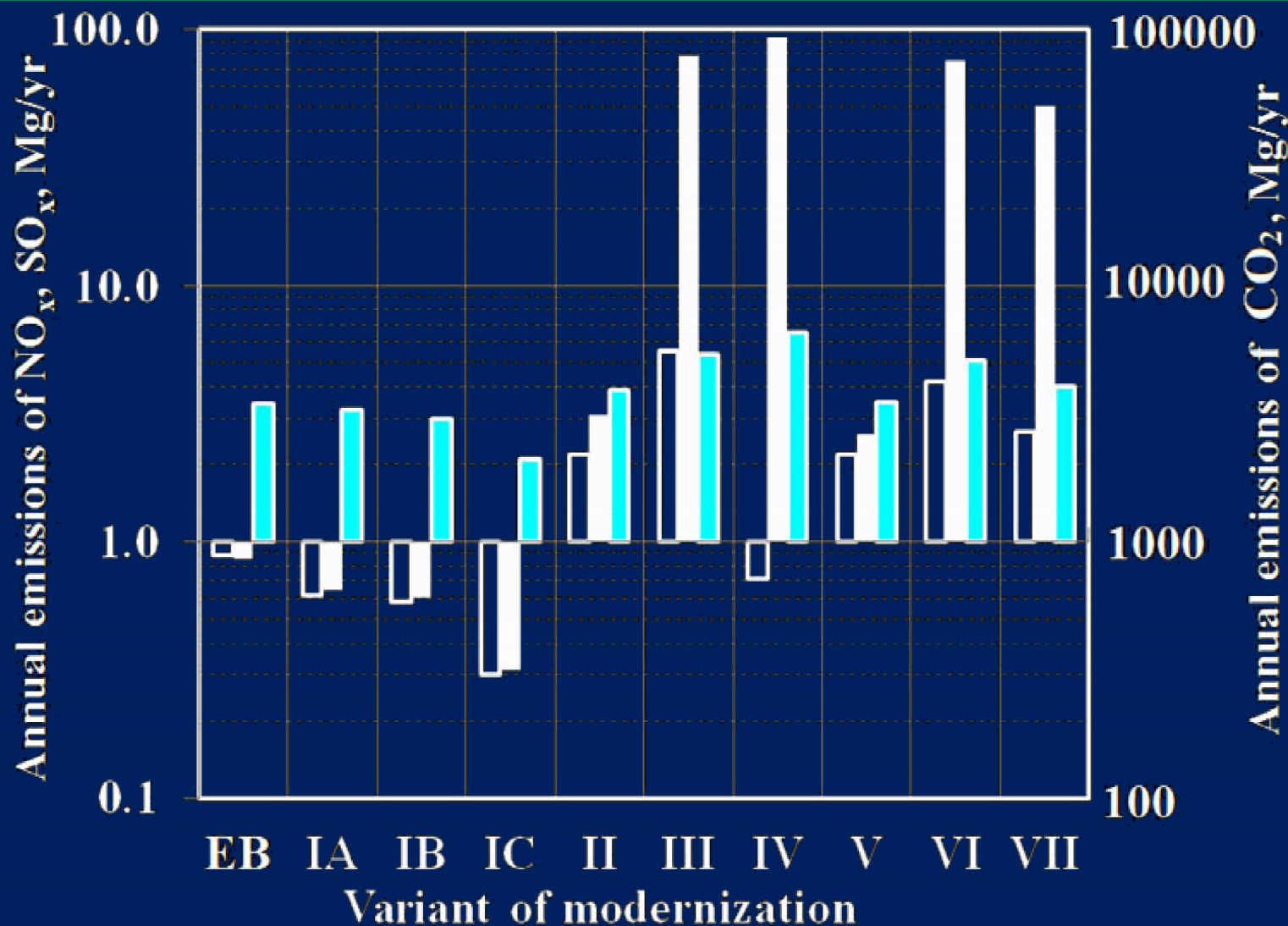


Fig. Annual emissions of: □ - NO_x; ■ - SO_x; ■ - CO₂.
EB - existing boiler. (source: own calculations)



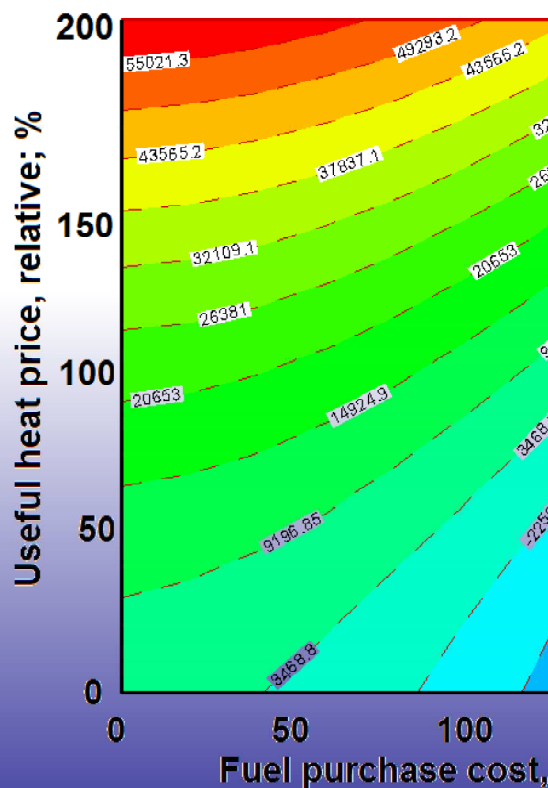
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Financial analysis – sensitivity analysis

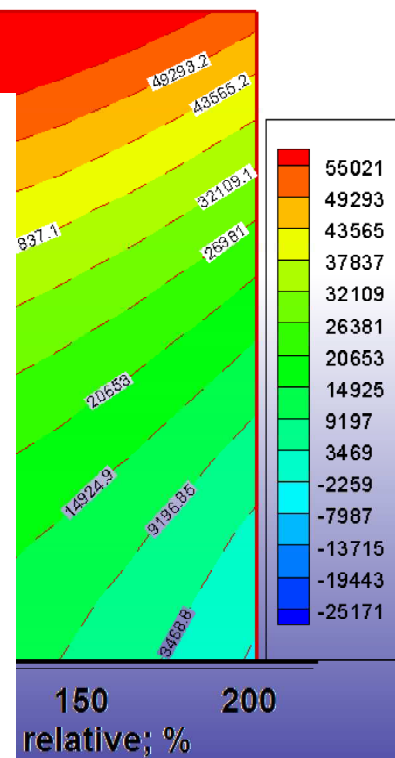
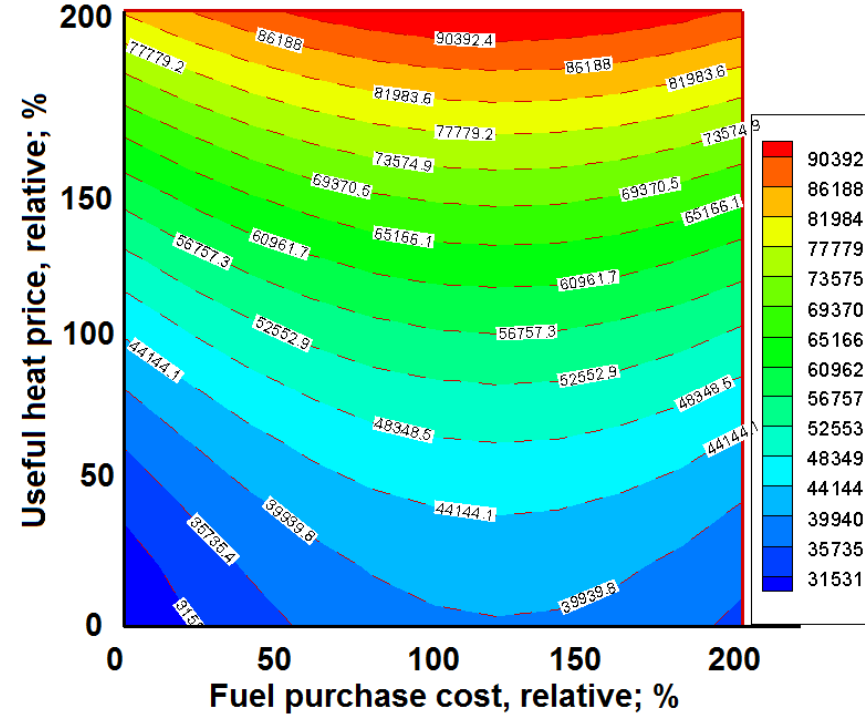
Net Present Value as a function of fuel cost and heat price change.- nat. gas fuel

Variant Ia.

Variant Ib.



Variant Ic.





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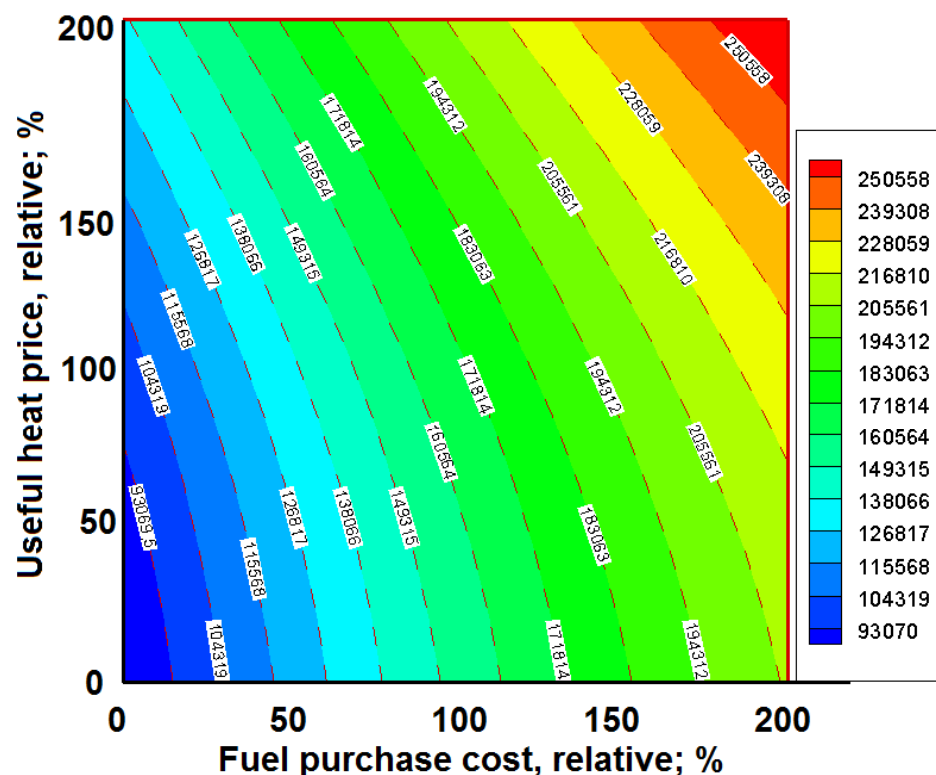
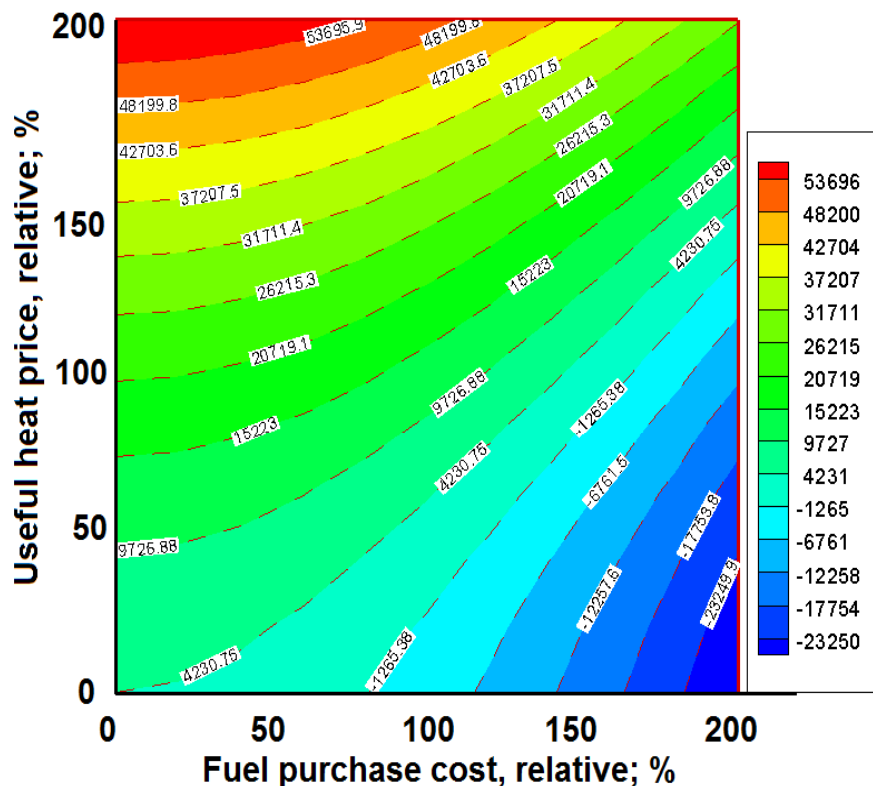


Financial analysis – sensitivity analysis

Net Present Value as a function of fuel cost and heat price change – solid fuels.

Variant II. (Conversion of fuels in existing boilers – biomass)

Variant III. (Conversion of fuels in existing boilers – coal)





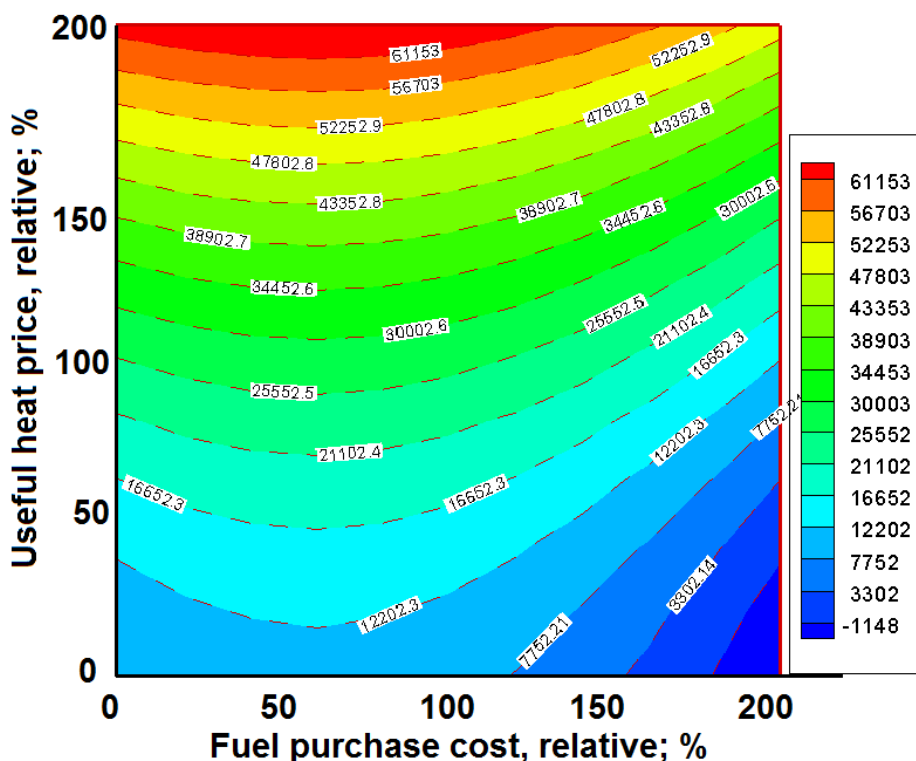
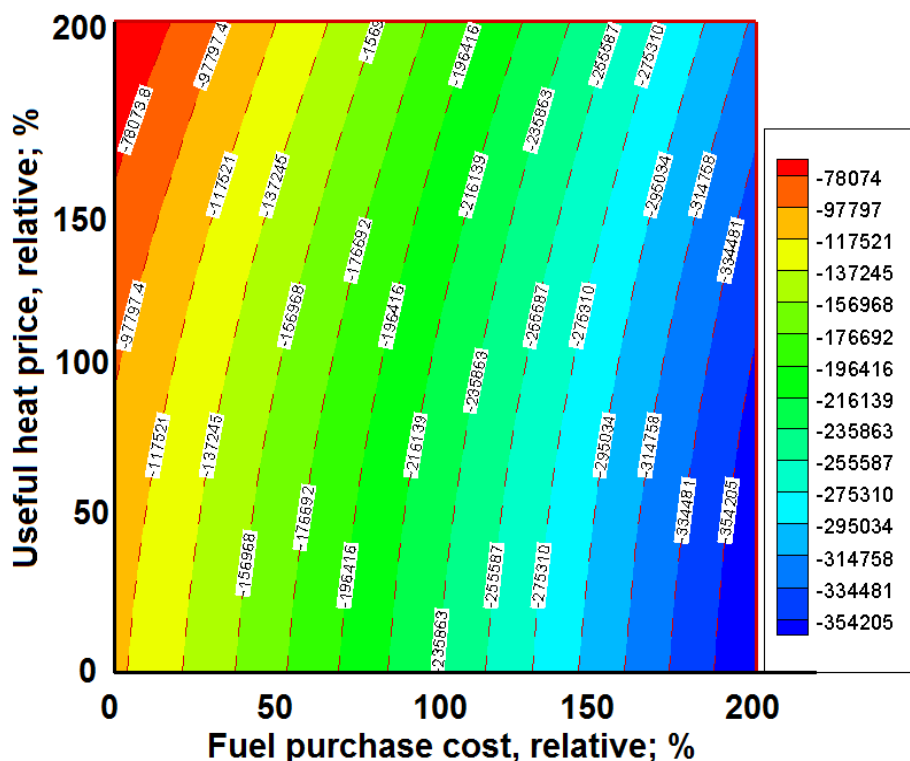
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Financial analysis – sensitivity analysis

Net Present Value as a function of fuel cost and heat price change solid fuels.

Variant IV. (Conversion of fuels in existing boilers – adding pregasifier)

Variant V. (New boiler – biomass pellets)





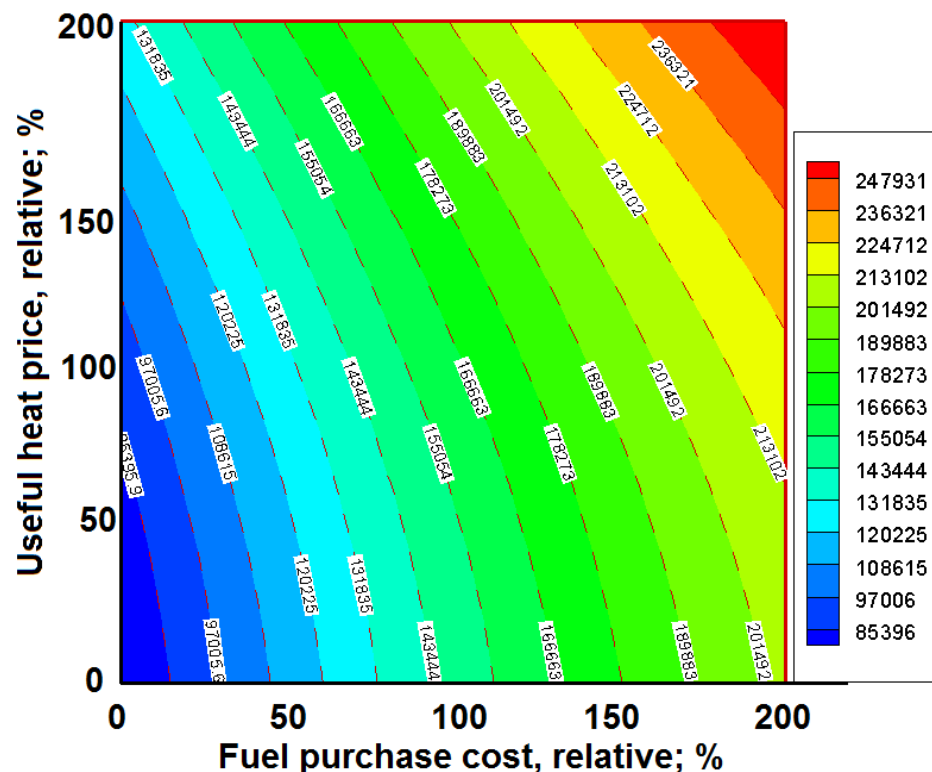
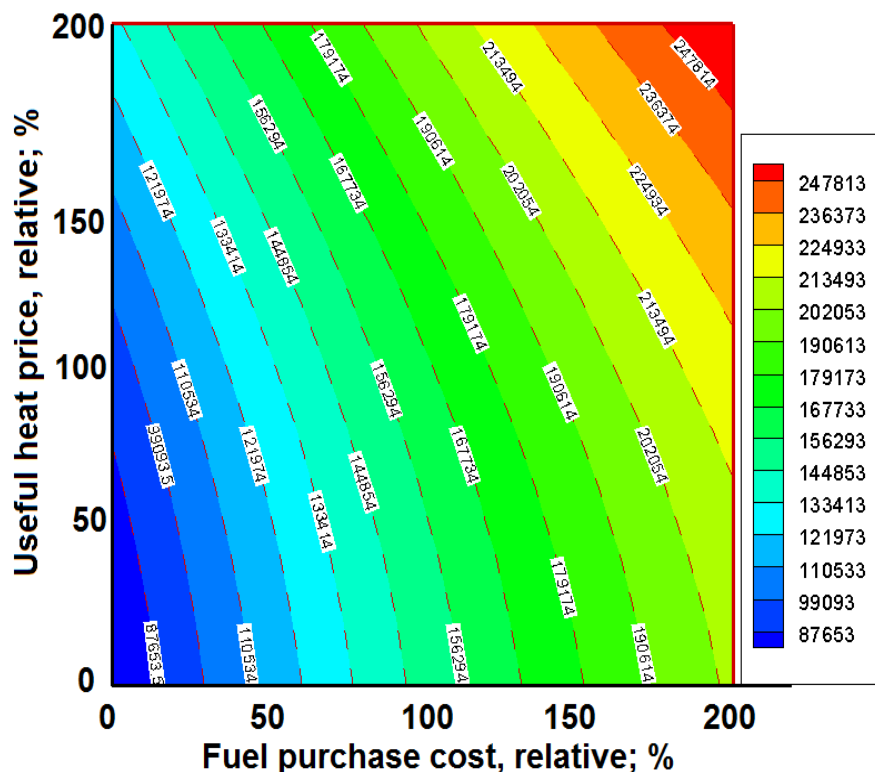
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Financial analysis – sensitivity analysis

Net Present Value as a function of fuel cost and heat price change solid fuels.

Variant VI. (New boiler - coal)

Variant VII. (New boiler – small BFB coal)

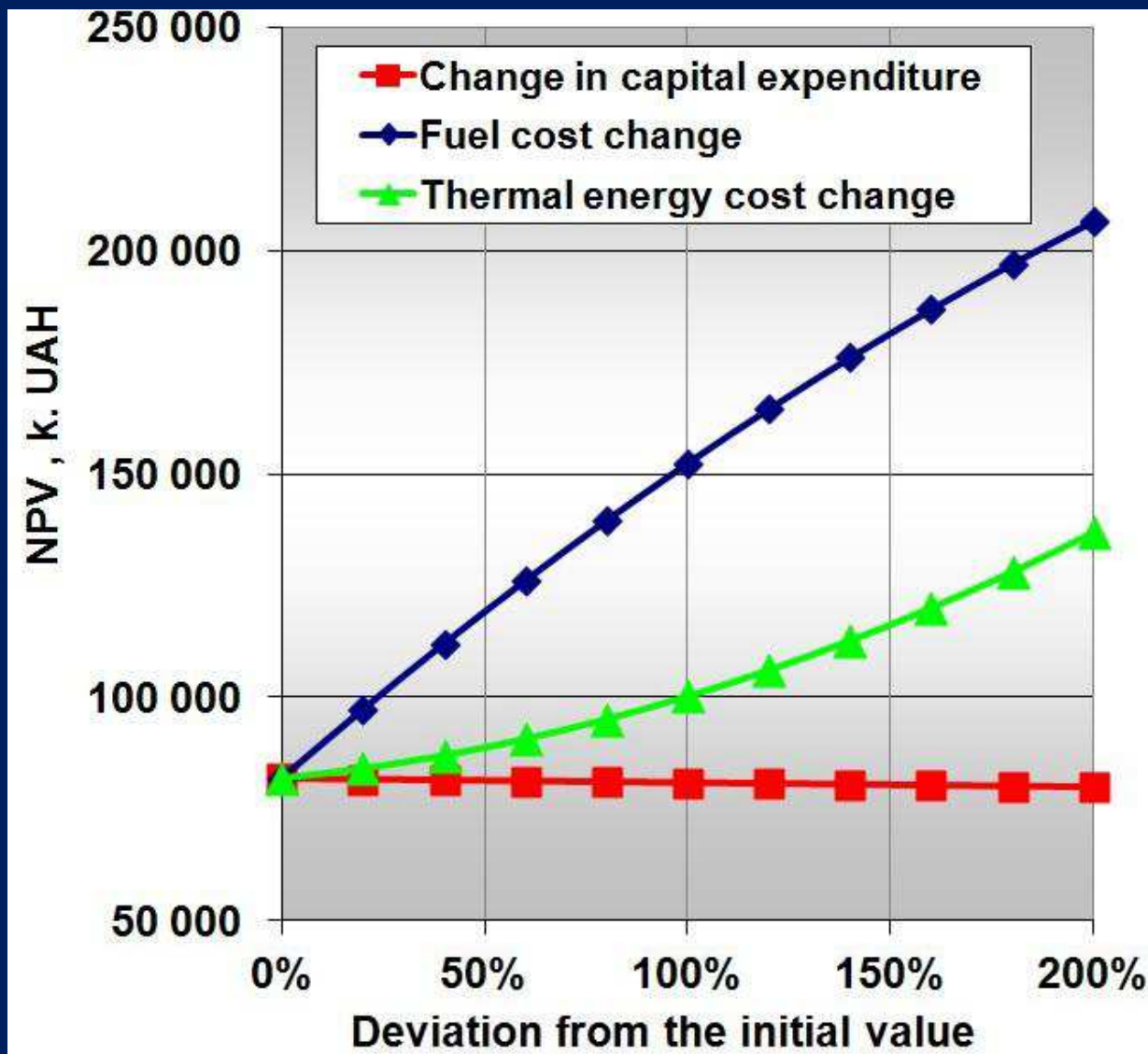




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Financial analysis – sensitivity analysis for Variant III



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