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INFORSE-EUROPE
International Network for Sustainable Energy

Transition Towards Sustainable Energy – Serbia

by Nikola Perusic; August 21, 2017
CEKOR

See the Program and the Proceedings at: http://www.inforse.org/europe/seminar_17_DK.htm

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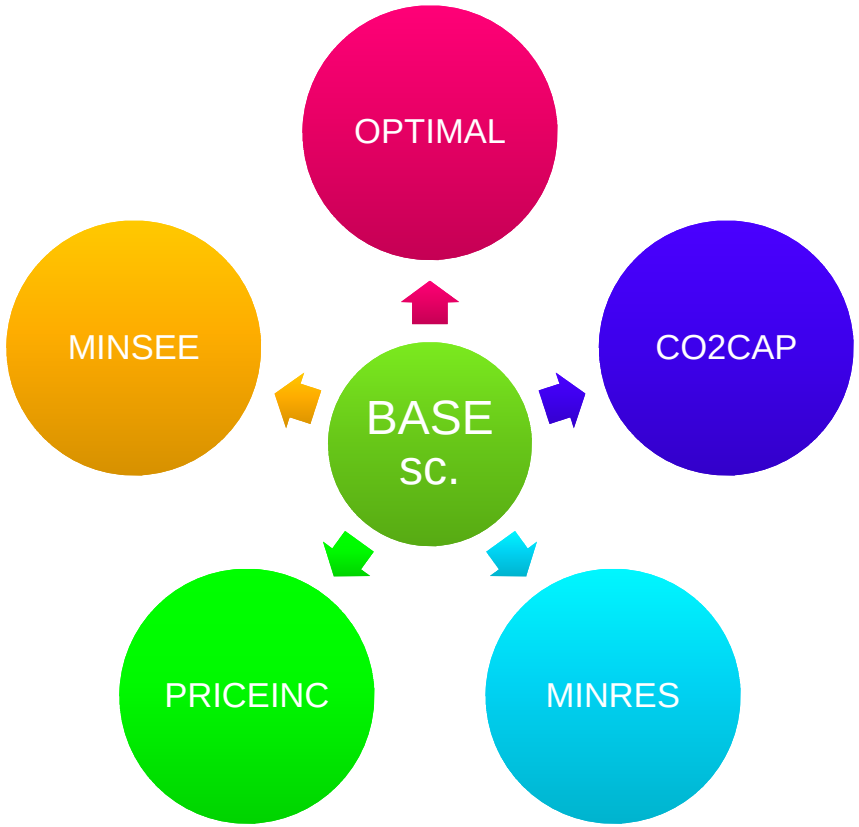
Concept of sustainable energy in Subotica

Content

Introduction

- *Subotica is the **most northern city** of the Republic of Serbia*
- *Geographic position is determined with 46º 5' 5" N and 19º 39' 47" E. **It borders** with Hungary and with 4 local self-governments: Sombor, Bačka Topola, Senta and Kanjiža.*
- *Census 2011, the total population on the territory of the*
- *City of Subotica is 140,358 citizens living in 19 settlements organized in 37 local communities*
- ***Pollution:**City of Subotica has one of most polluted atmosphere in whole Serbia especially in the winter due to individual heating and traffic*
- ***Our goal was to develope number of scenarios** for development of sustainable energy future of Subotica with aim to reduce energy poverty in City, pollution comming from heating and also to diversify sources of energy with reduction of overall price and emissions from energz sector in City*
- ***we have based our work on** the available energy ballance of city of Subotica including public consumption, supply with the heat from district heating plant in Subotica*
- *We have used HOMER model for simulation of the future production and also prices and emissions in different scenarios.*
- ***We have used most recent price**s for the investment costs of our scenarios*
- *Subotica is exposed to serious demographically problems, emigration of population and high levels of poverty*
- *Most of houses are constructed before 1980ties thus rather inefficient*
- *Subotica lacks detailed census of it s energy consumption*
- *Subotica lacks detailed estimation of its Renevable Energy Sources potentials*

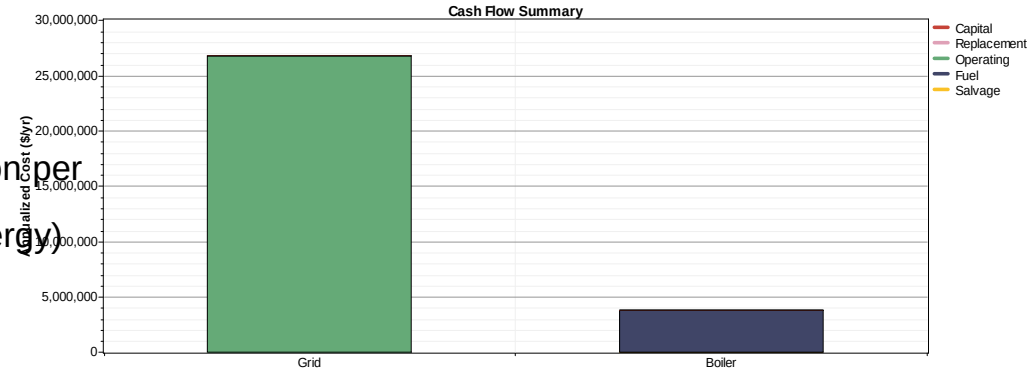
Overview of scenarios

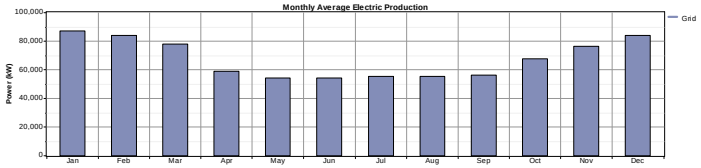


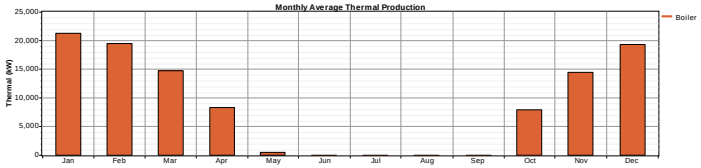
- BAZNI – present day status of energy sistem.
- OPTIMAL Least cost scenario.
- CO2CAP – Cap (maximal allowed) on annually GHG emissions.
- PRICEINC – prices from nacional electricity grid increased.
- MINRES decision about the level of Renevable energy sources (RES) in energy mix
- MINEE Decision about the minimal energz savings (EE) of primary energy(gas, wood, bio mas, coal)

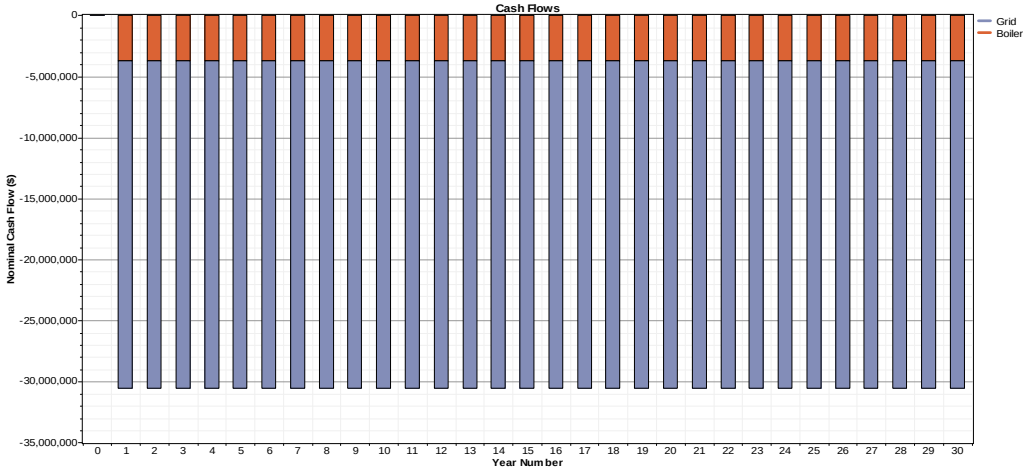
Base scenario and calibration of present status (BASE)

- LCOE 0.045 c€/kWh (price of el)
- 1,622,000 kWhel/dan (consumpt/day)
- 592,029,696 kWhel/god (electricity consumpt/year)
- 77,014,800 kWhth/god (heat consumption per year)
- 30,501,630 M€/god (yearly spent for energy)
- 551,513,088 tCO2/god (CO2 equivalent emitted annually)







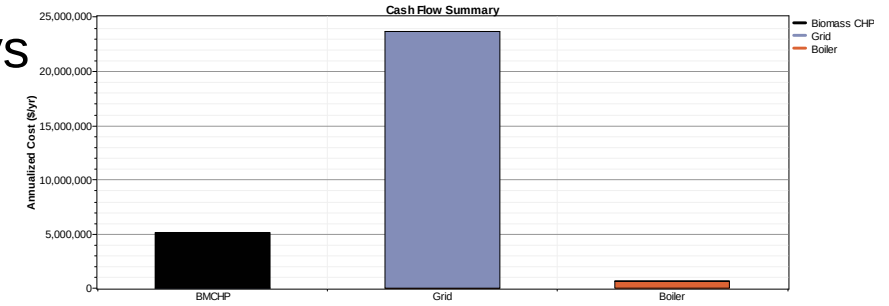


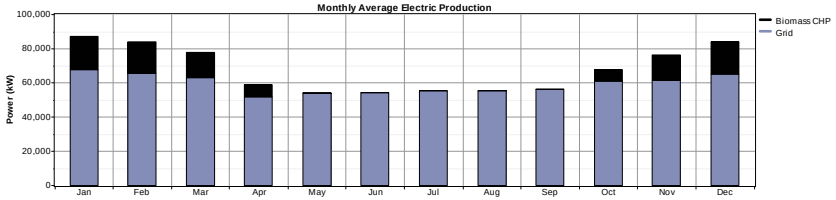
Meaning of BASE scenario

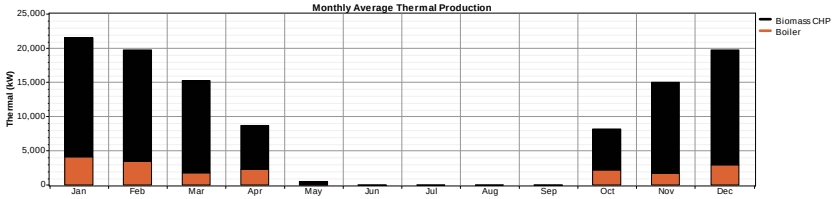
- We see cost of annually spent electricity from national grid andalso of heating from GAS boiler in district heating in Subotica
- We also see monthlz consumption of electricity and of the heat from city heating boilers
- Also we see how much subotica spends on fuel and buying from national network

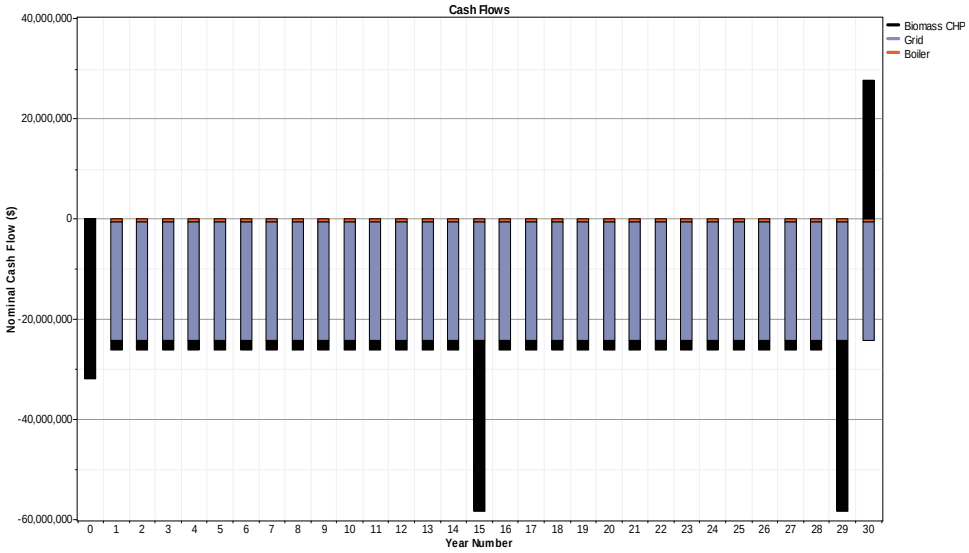
Economically optima scenario(OPTIMAL)

- LCOE 0.043 c€/kWh (price stays same)
- 470,192,320 tCO2/god
- 518,847,776 kWh/god
- CHP (20MW):
  - 73,181,928 kWhel/god (12%),
  - 65,645,424 kWhth/god (83%)









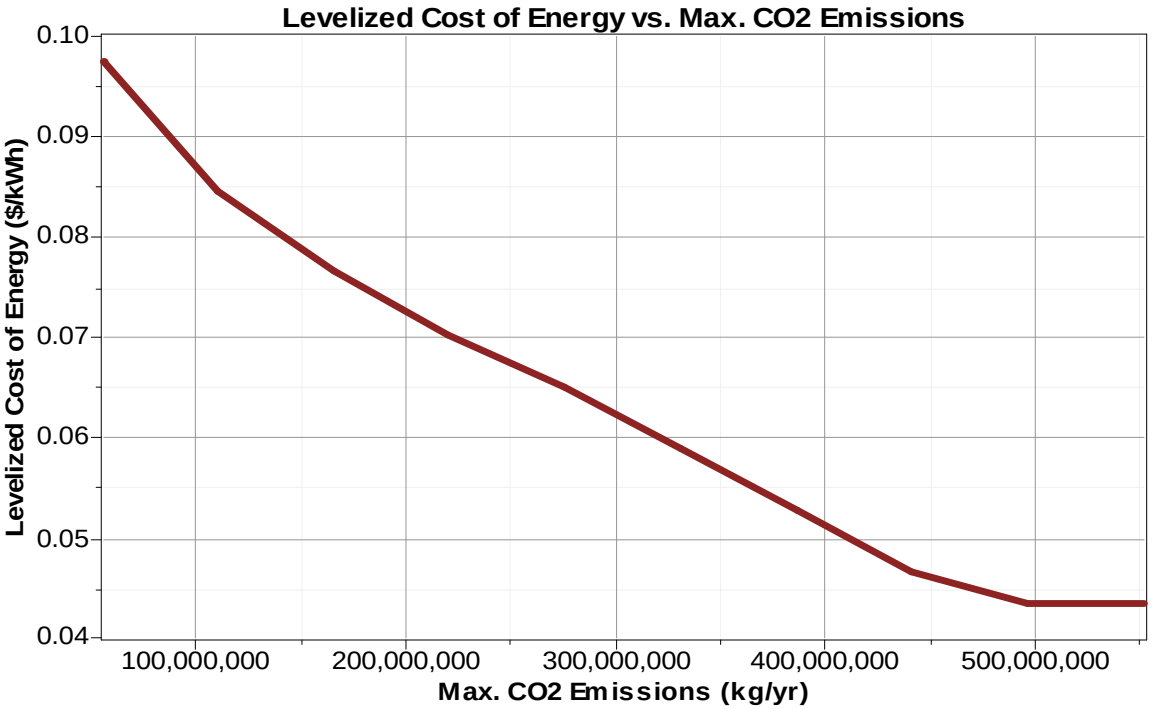
Comparing BASE and economically scenario

- We see that Base scenario is no economically optimal
- In his scenario we introduce bio mas cogeneration
- We see over the period of 30 years reduction of almost 16mEUR for energy
- In same time important this scenario increases local economy and rduces significantly pollution and also increases income from electricity that is selled to the national grid.
- Investment will pay back in 8 years

Scenario limiting CO2 emissions (CO2CAP)

Maksimalna emisija [tCO2/god.]	Smanjenje emisije CO2 [%]
551,513,088	0
496,361,779	10
441,210,470	20
386,059,162	30
330,907,853	40
275,756,544	50
220,605,235	60
165,453,926	70
110,302,618	80
55,151,309	90
-	100

- Covenant of majors envisions reduction of emissions for 40%
- LCOE 0.059 €/kWh (+0.014 €/kWh electricity price increased for BASE)

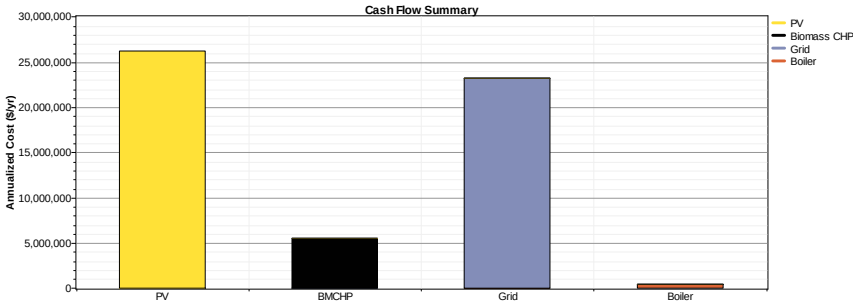


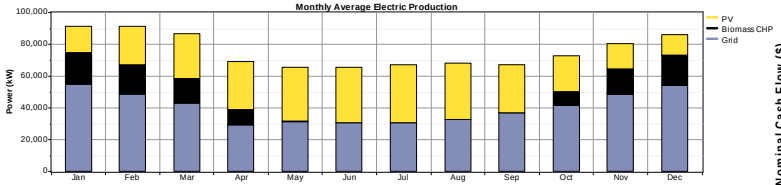
Explanation of CO2CAP scenario

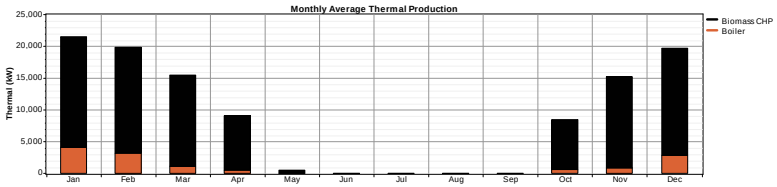
- We are introducing reduction of emissions according to obligations of Serbia
- Also this reduction is in line with covenant of majors for 40%
- We have accepted this number a optimal ballance between more expensive and more radical reduction scenarios and also between less ambitious scenarios that are mostly prevailing in Serbia

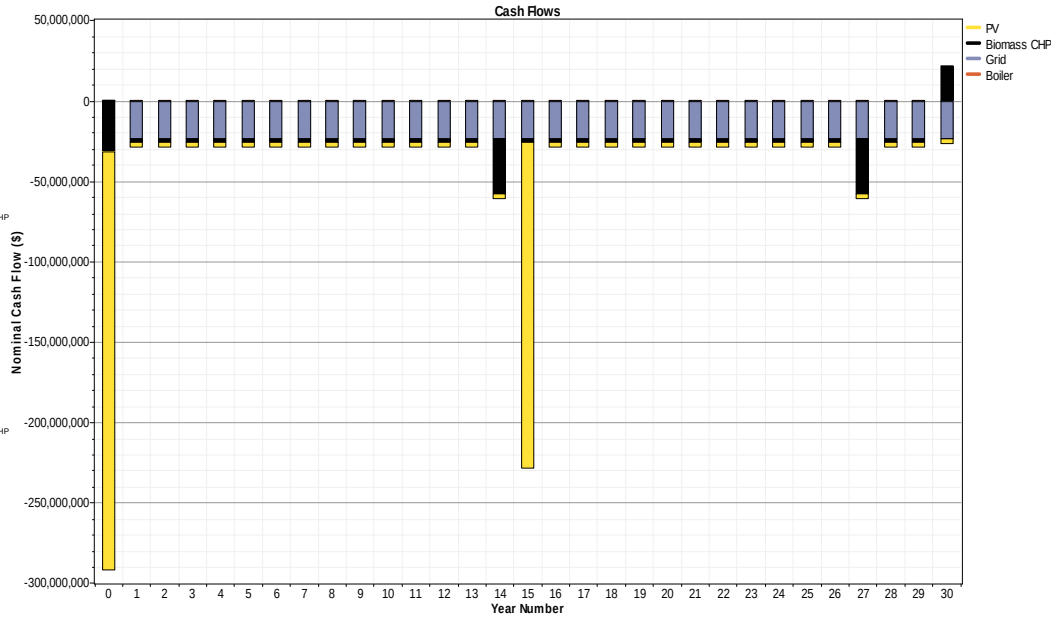
Price increasing scenario (PRICEINC)

- Price increased in national network accorixng to demands of IMF and WB[100-118%]
- LCOE 0.087 c€/kWh (93%)
- We envision RES SOLAR investment in Photo voltaic 260M€ (200MW), share of RES 51%
- City would sell annually 72,585,168 kWh/god
- City will take from national grid 352,225,760 kWh/god







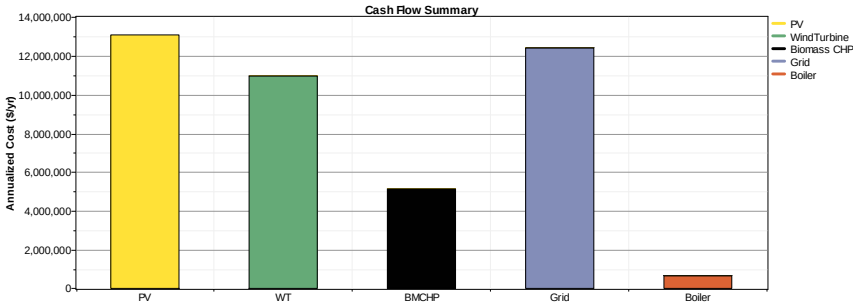


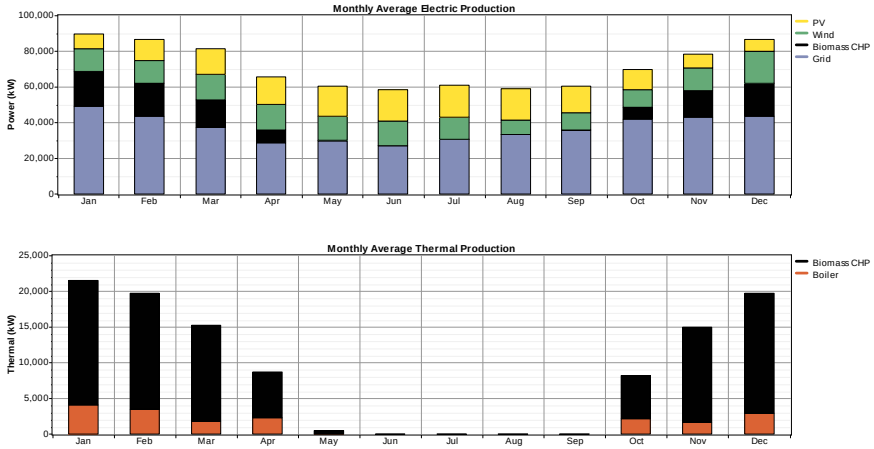
Price increasing scenario (PRICEINC), explanations

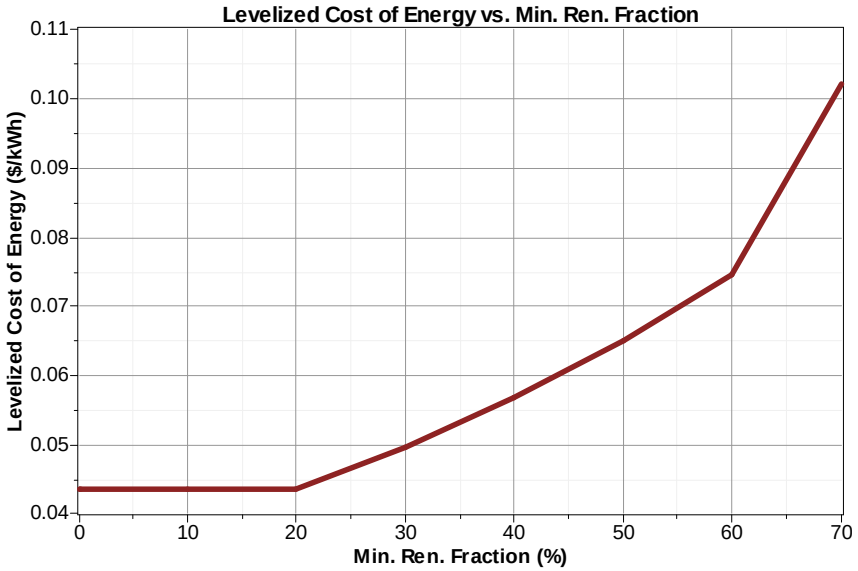
- Prices will increase in national networks due to pressure from IFIs
- In same time we have envisioned significant increase in own production of city
- After 15 years we envision major reconstruction of PV

Scenario with minimal share of RES (MINRES)

- LCOE 0.043-0.108 €/kWh
- 51% udeo RES, LCOE 0.065 €/kWh
- Prodato 33,929,068 kWh/god
- Preuzeto 324,903,104 kWh/god



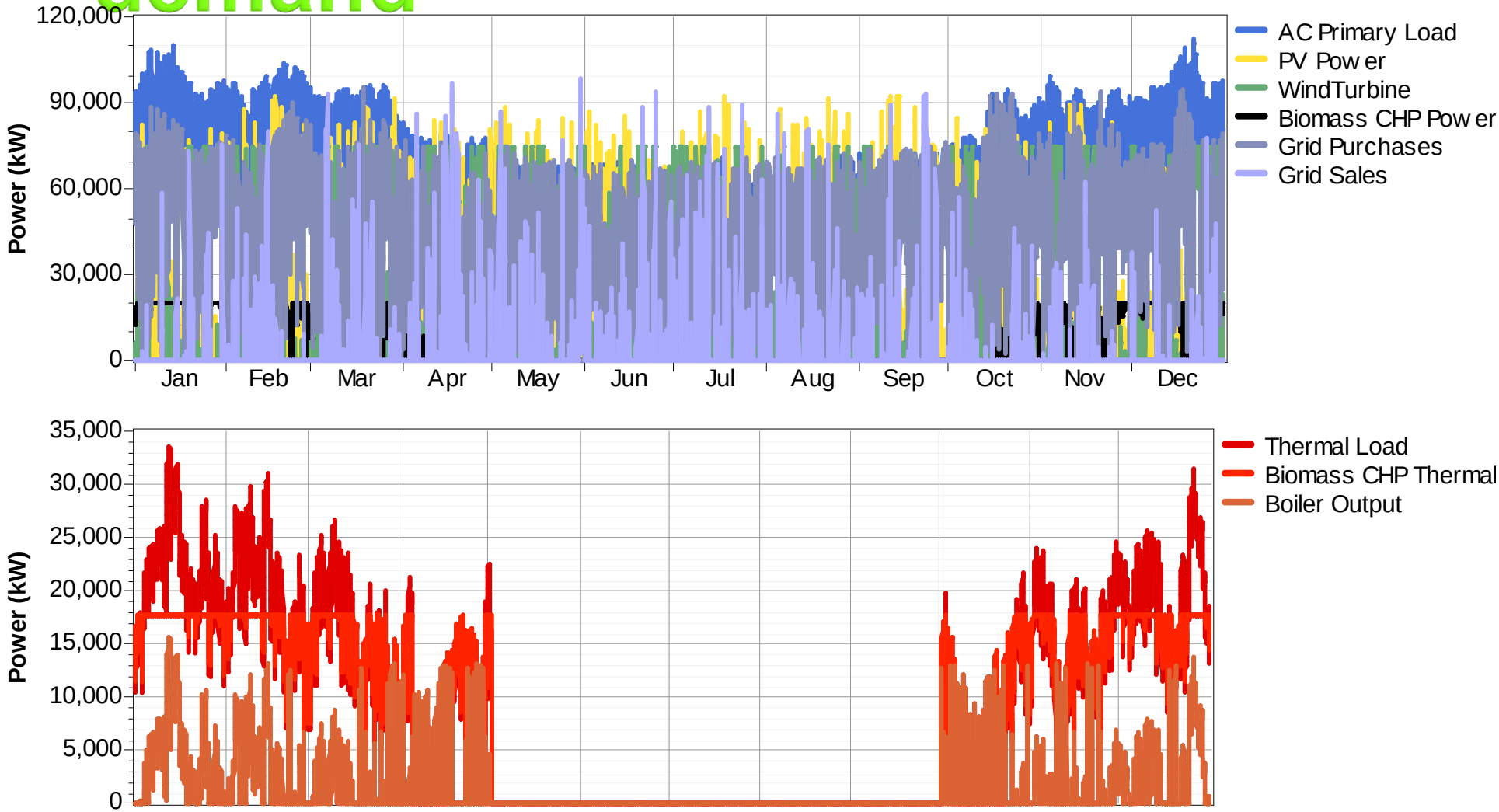




Scenario with minimal share of RES (MINRES)

- We establish minimal level of renewable sources
- We envision between 0-70% of electricity produced from RES
- This scenario provides most demaning mix, but also envisions much better situation with regards to diversification, reduction of CO2 emsiison, local jobs
- It introduces also wind, Solar and bio mas as most important part of the energz mix

Hourly diagram of production showing how mix will satisfy demand



Scenario with minima saving of primary energy (MINEE)

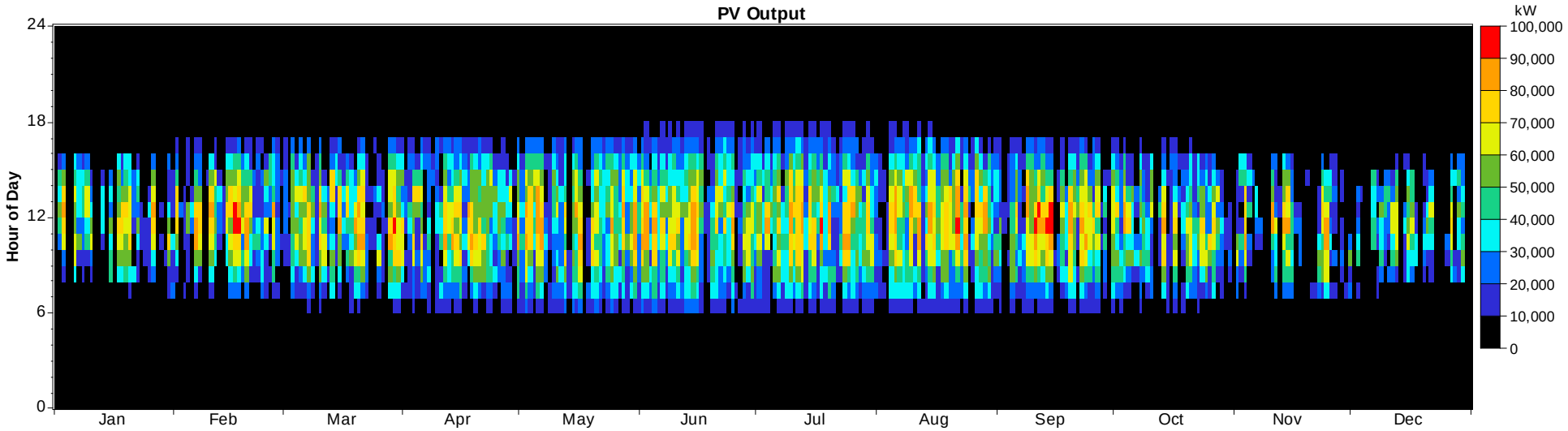
- Referent :
  - Etael=40%, (electricity in boiler)
  - Etath=75% (heath in boiler)
- Technically measures on demand side:
  - Reducing consumption for electricity for 10% 30 godina,
  - investment 3M€.
  - Saving: 37,785,504 €
- Technical measures on production side (change of fuel): Co generation (CHP) on bio mass
  - 39.2% saving in primary energy.
  - Financial saving: 16,566,775 €.

what	value
Share of RES	0.227
Saving of primary energy	39.2 %
Primary energy for bio mas CHP	164,356 MWh/god
Electricity produced in CHP	73,182 MWh/god
Production of heat CHP	65,645 MWh/god
Energy Efficiency of CHP	44.5 %
Thermal efficidncy of CHP	39.9 %

Scenario with minima saving of primary energy (MINEE)

- Beside introduction of rES in sustainable energy sistems we introduce also Energy Efficiency measures that are saving significant primary energy
- We introduce at least 0-9% of saving

Annual production1/4



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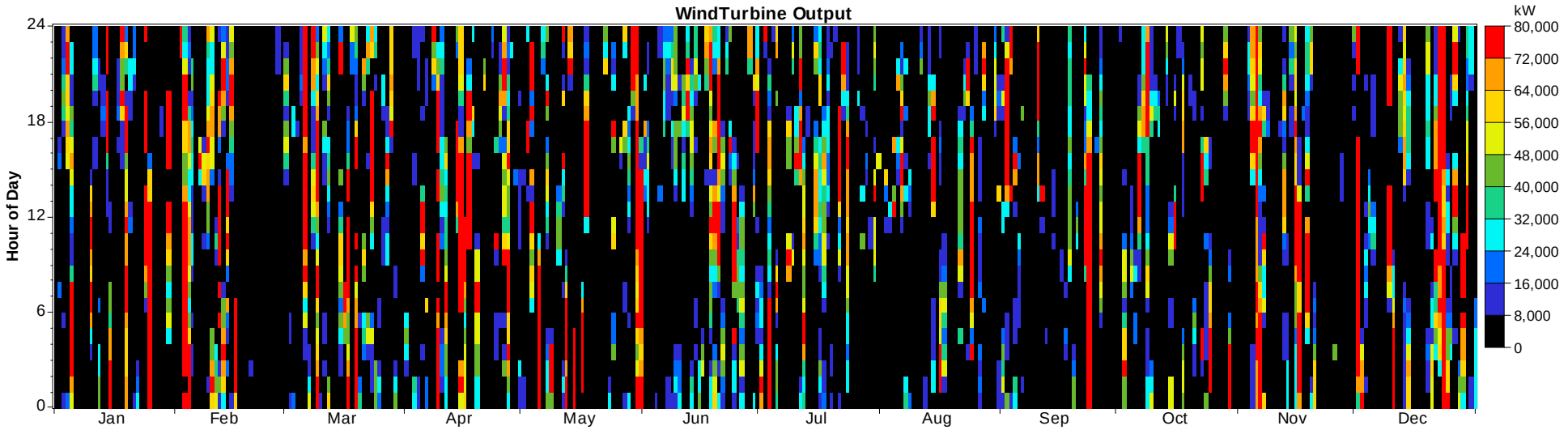
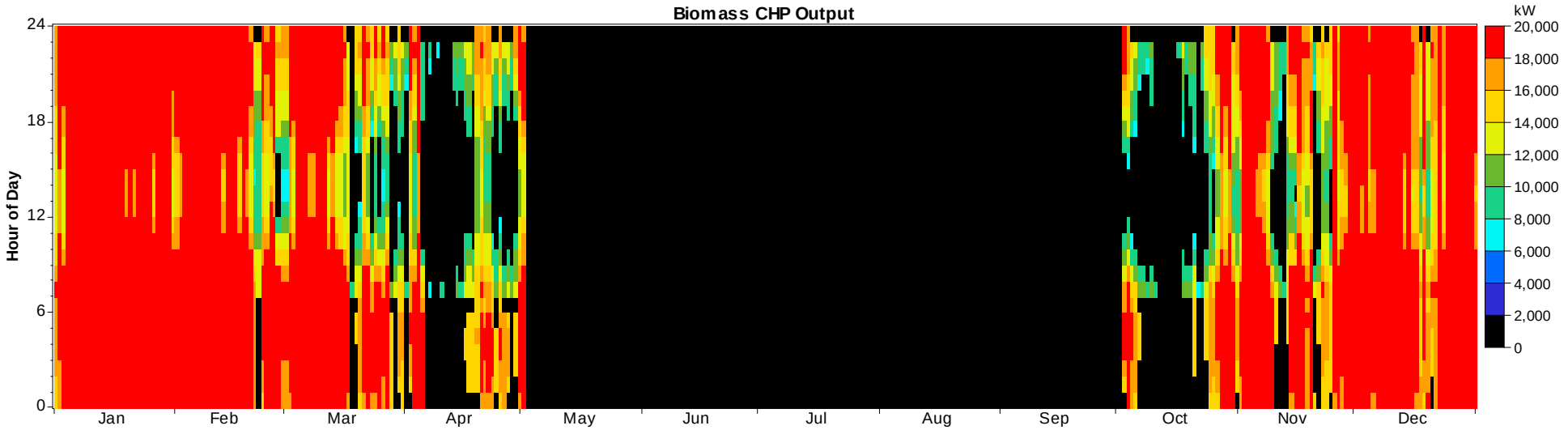
Matrix of annual production 2/4



Matrix of annual production 3/4



Matrix of annual production 4/4