Analyze the economic efficiency for the small solar plant

Mostly solar panels are used by small, local houses. This is a convenient form of obtaining additional energy, so let's calculate the payback of a solar panel.

Manufacturer (Solar World, Germany). One panel cost 350$. 100 panels will cost $35,000. Fixing costs - $6,000, Cable 1.000$. Inverter -10.000$.

So , a 100-panel farm costs $52,000

Actual power generation:

Under ideal conditions, one panel should generate approximately 220-230 watts per hour. In a consistently sunny summer month, with a long daylight hour, such a farm will produce a maximum of 4500-4700 kWh.

In Germany 32,1 cents per kilowatt hour. That's means 1603 euro per month. 19236 per year.

That's mean 2,7 years payback period. But I did not take into account the cost for installation and considered that the whole year would be sunny. I think for the local solar farm payback period around 10 years.

Analyze the economic efficiency for the Wind plant compared with thermal power plant.

To calculate investment costs, we need to know the capacity utilization rate of different types of stations.

Thermal power plant- 87 %

Wind power plant - 35 %

For this capacity utilization rate , a gas TPP (in our example, with a capacity of 550 MW) will produce electric energy per year: 550 MW × 8760 h × 87% = 4191.66 GWh

For the annual generation of the same amount of electricity at plants using renewable energy sources, taking into account the capacity factor, it is required to build:

550 MW × 87% / 35% = 1367 MW (Wind power plant)

The total investment costs will be, for a gas thermal power plant 917 thousand

The total investment costs will be, for Wind power plant 2213 thousand

550 MW × $ 917 thousand / 1 MW = $ 504 million - TPP

1367 MW × $ 2213 thousand / 1 MW = $ 3025 million ($ 2521 million higher) - Wind power plant

We can calculate gas prices, included in the indicators of variable costs for gas TPP.

Actually, fuel costs are: 0.05 - 0.004 = $ 0.046 per 1 kWh. Based on the fact that to work out

1 kWh consumes about 0.3 m3 of gas, the cost of 1 m3 of gas will be: 0.046 / 0.3 = $ 0.15 per 1 m3 , and 0,15/3= $ 0,05 per 1 kWh

Total variable costs for annual output of 4191GWh will be: $ 0.05 × 4191 GWh = $ 209 million per year.

Compare them with the total operating costs (including only fixed costs) of the WPP generating the same amount of energy:

$ 48 / 1 kW × 1367 MW = $ 66 million.

Excess investment costs for the construction of wind farm above the gas thermal power plant are: $ 3025 million - $ 504 million = $ 2521 million

Annual savings the operating costs of a wind farm in comparison with a gas thermal power plant will be: $ 209 M - $ 66 M = $ 143M

We can calculate a simple payback period of WPP relative to TPP:$ 2521 M / $ 143 million per year = 17.6 years

Analyze the economic efficiency for the Hydropower plant compared with thermal power plant.
Capacity utilization rate is 50%

We are comparing with TPP.

550 MW × 87% / 50% = 957 MW (Hydropower plant)

Operating costs for hydropower plants is around $70 per megawatt-hour.

$ 70 / 1 kW × 957 MW = $ 66 million.

Total investment costs will be: 2500 thousand

550 MW × $ 2500 thousand / 1 MW = $1375 millions

Excess investment costs for the construction of hydro farm above the gas thermal power plant are: $ 1375 million - $ 504 million = $ 871 million

Annual savings the operating costs of hydro farm in comparison with a gas thermal power plant will be: $ 209 M - $ 66 M = $ 143M

Payback period of HPP relative to TPP : $ 871 M / $ 204 million per year = 4.2 years

Imagine an analysis of a geothermal plant compared with thermal power plant.

Capacity utilization factor for geothermal is 71.6%

As usual we are comparing with TPP.

550 MW × 87% / 72% = 664 MW

Operating costs for geothermal plants is around $0,02 per megawatt-hour.

$ 0,02 / 1 kW × 664 MW = $ 13 million.

Total investment costs will be: 3000

550 MW × $ 3000 thousands / 1 MW = $1650 millions

Investment costs for the construction of geothermal power plant farm above the gas thermal power plant are: $ 1650 million - $ 504 million = $ 1146 million

Annual savings the operating costs of geothermal farm in comparison with a gas thermal power plant will be: $ 209 M - $ 13 M = $ 196M

That means that the payback period will be: 1146/196= 5.8 years