

PROSPECTS OF SOLAR CSP INTEGRATION IN THE OIL & GAS INDUSTRY IN THE MIDDLE EAST FOR PROCESS HEATING

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Overview

Oil & Gas Industry, like any other industrial sector, comprises of numerous processes with varying energy consumption. These processes include but not limited to oil stabilization, desalting, demulsification, gas sweetening, dehydration, NGL and LPG recovery, fractionation, sulphur recovery, compression and pumping. Oil & gas industry main product is also energy in the form of oil and natural gas. Therefore, at NOC or IOC level, any energy saved at plants indirectly increases the hydrocarbon yield. It means, economics of energy savings in oil & gas industry may not just depend upon the tariff of saved fuel and power. Economics of energy savings may be more promising in terms of opportunity cost of additional yield or of avoided import in some cases (like natural gas import by UAE).

Renewable electricity generation has seen tremendous growth globally in last one decade. Solar electricity generation installed capacity has increased more than 27 times from year 2006 to 2014. Solar electricity generation increased by 39% just in year 2014, in comparison to year 2013. More than 95% of solar installed capacity as well as power generation in year 2014 is by Solar PVs. Although capacity or production share by Solar CSP is much lower than Solar PV but the former has also seen substantial growth. Solar CSP electric power production has increased more than 15 times from year 2006 to 2014. More than 38% yearly increase in installed capacity was observed for five consecutive years (2009 to 2013).

World record of lowest cost of electricity for Solar PVs had been broken in the Middle East. Recently a consortium submitted bid of 2.42 cent per kWh for a PV plant of 350 MW capacity in Abu Dhabi. Levelized Cost of Electricity (LCOE) comprises of numerous heads including equipment, land, engineering, construction and financing costs in addition to profit and risk coverage etc. Most of these heads, perhaps other than equipment cost, are equally applicable on Solar CSP. So, it can be safely predicted that world record of lowest cost of electricity for Solar CSP can also be achieved in the Middle East.

Solar CSP generates steam from solar thermal energy then steam is used to generate power using steam turbine. If Solar CSP is integrated with Oil & Gas Industry then thermal energy or heat can be directly used for process heating. Eliminating power generation block will not only reduce the project cost and accordingly cost of energy but will also improve the overall thermal efficiency of Solar CSP plant. Oil & Gas Industry have numerous process users where temperature requirement can safely be met Solar CSP. Application of Solar CSP for process heating is generally applicable in all industrial sectors but in case of Oil & Gas Industry, particularly in the Middle East, there are numerous individual large energy consumers with high energy demand of the order of 50 to 100 MW (thermal). High energy consumption by individual consumer saves cost on thermal heat distribution, as small energy consumers dispersed over large area needs additional expenditure for thermal energy distribution network. Oil & Gas Industry runs 24 hrs so continuous energy supply is required. This requirement can be fulfilled by thermal storage along with Solar CSP which is practically more viable compared to power storage for Solar PV.

Methods

Overall evaluation of Solar CSP prospects in Oil & Gas Industry was split into the following individual tasks:

- Review of technical viability by addressing temperature requirements, energy transport, distribution, storage and space requirements.
- Review of Solar PV cost of electricity heads to identify heads applicable on Solar CSP.
- Review of impact on thermal efficiency and cost of energy on eliminating power generation block from Solar CSP.
- Review of opportunity cost of oil and natural gas fuel as saleable product or avoided energy import by fulfilling energy demand with Solar CSP.

Results

Key findings are listed below:

- Solar CSP has generally been considered for electricity generation and hence LCOE has always been compared with Solar PV, where latter is always more economical historically.
- Solar CSP thermal efficiency and cost of energy reduce significantly if heat is directly used for process heating by eliminating the power generation cycle.
- Oil & Gas Industry has numerous individual large energy consumers which can utilize thermal energy like regenerators in Gas Sweetening.
- Replacing existing oil or natural gas fuel consumption in the Oil & Gas Industry, with thermal energy from Solar CSP results in significantly higher economic benefits due to attractive opportunity cost of saved oil and natural gas, instead of merely fuel tariff based cost savings.

Conclusions

Solar CSP has very high prospects of its integration in the Oil & Gas Industry in the Middle East. These prospects will increase further in the coming years. This integration is technically and economically viable.

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