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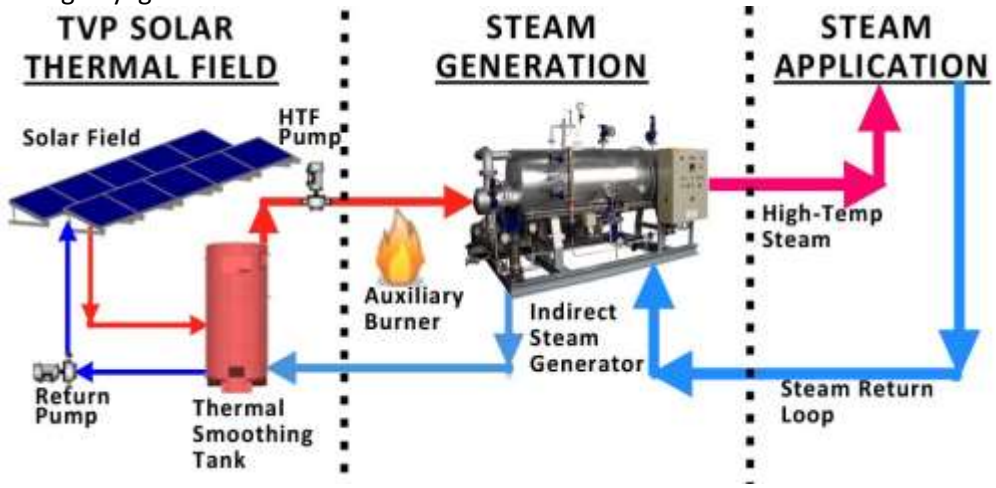
APPLICATION FACTSHEET: **Solar Thermal for Enhanced Oil Recovery**

Predictable, consistent performance without concentration

High-performance solar thermal contribution to indirect steam generation or feedwater pre-heat

Thermal Vacuum Power Charged™ are revolutionary, high-end, high-vacuum flat solar thermal panels able to drive steam generators up to 8 bar, or pre-heat feedwater up to 180°C (via heat exchanger) for enhanced oil recovery (EOR) applications, offering a renewable energy alternative for the oil extraction industry. Irrespective of climate conditions and location, the need for fossil fuels and other CO_2-producing combustibles is reduced. Even in highly diffuse light conditions (hazy, dusty, polluted, sandy, etc), TVP panels provide a cost-effective thermal energy source anywhere EOR is required; ideal for remote locations.

The solar-driven indirect steam generator configuration benefits from an auxiliary burner (diesel, LPG, natural gas, etc.) to provide constant and smooth thermal input for uninterrupted steam generation run-time. The adoption of a burner maximises the use of solar energy, fully exploiting all heat generated by the solar field during daylight hours.



In the case when greater temperatures up to 310°C or pressures up to 100 bar are required, a pre-heating system configuration with a once-through steam generator (OTSG) is applied, with solar field offering baseline thermal input up to 180°C (via heat exchanger).

In remote areas (both on- and offshore), TVP Charged™ panels reduce operational and transportation costs related to combustible fuels used in steam generation.

Key BENEFITS: *TVP Solar Panels*

- ✓ **Independent add-on**: no impact to existing thermal/steam system infrastructure
- ✓ **Highest peak efficiency**: 500 W_{th}/m^2 at 180°C (MT-Power)
- ✓ **Highest yearly average production:** due to maximum diffuse light capture
- ✓ **Zero panel maintenance:** no need for precision cleaning and no serviceable mechanical moving parts
- ✓ **Reliable energy output:** stabilized cost of thermal energy over lifetime of panel, vs. varying fuel prices
- ✓ **Off-grid autonomy:** ideal for uses outside of urban areas and combustible/electrical delivery grids
- ✓ **Modular & Portable:** simple integration allows for easy installation and breakdown of solar field
- ✓ **"Greening" the industry image**: reduce emissions, improve carbon footprint and save on fuel
- ✓ **Reduce water treatment costs**: heat the same feedwater used in traditional systems (pre-heating case)

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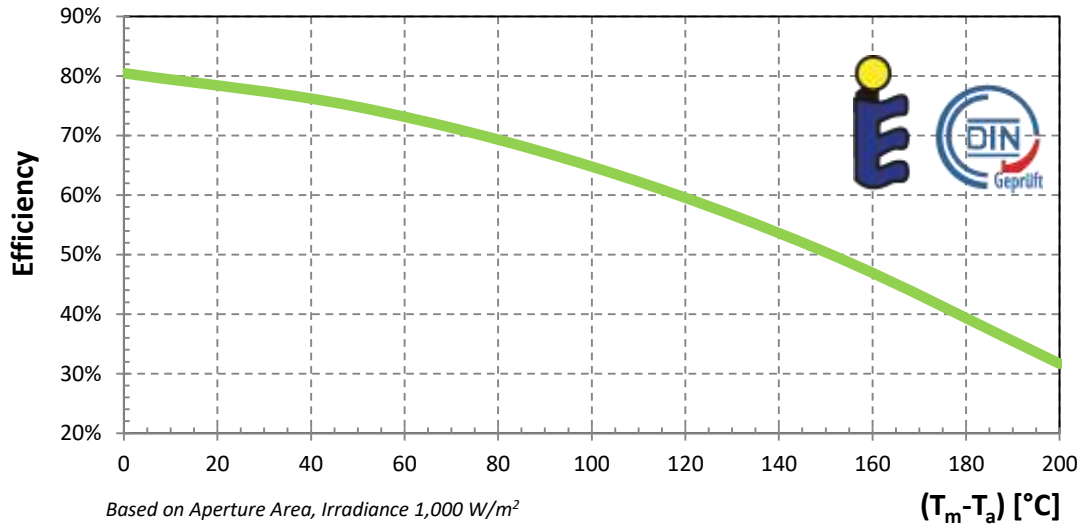
Some Application Parameters

Application	Configuration	System Output	Temperature (°C)	Pressure (bar)	Panel Peak Power*
EOR	Indirect Steam	Steam	up to 170	up to 8	520 W
	Pre-Heating	Pressurized Water	up to 180	up to 6.2	500 W

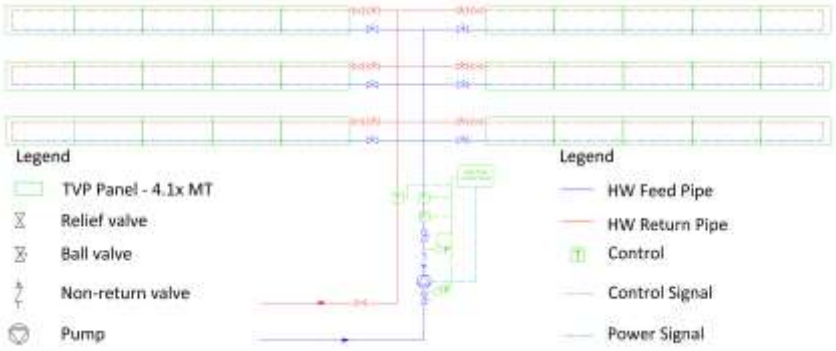
** considering ambient temperature of 30°C*

MT-Power Performance Chart



Based on Aperture Area, Irradiance 1,000 W/m²

Sample Solar Field Schematic



- ✓ **Adaptable**: to any surface
- ✓ **Compact**: inter-panel connectors
- ✓ **Scalable**: multiple strings, ≦ 15 panels
- ✓ **Embedded return pipe:** within panels
- ✓ **Simple to engineer**: modular layout
- ✓ **Simple to install**: same mounting as PV

TVP Solar Offer

Product Supply	Support	Service Activity
TVP Charged™ Panels	Preliminary Solar Field Engineering and P&ID	In-field Compliance Checks for Installation of Solar Field
TVP Connectors	Solar Field Simulation	In-field Compliance Checks for Installation of Monitoring Sys.
TVP Monitoring System	Introduction to TVP-partnered Application Machine Vendors	Remote Data Reporting & Analysis
BoS Components via TVP Pre-Qualified Vendors	Introduction to TVP-partnered EPCs & System Integrators	Remote Troubleshooting