



Solar Thermal For Petroleum Industry

*Innovative High-Vacuum Solar Thermal Flat Plates
Replacing Fossil Fuels In Core Processes*

December 2017


A Complex Industry With Big Challenges

Low fossil fuel prices squeeze margins, government commitments to sustainability and alternative energies are challenging demand for petroleum products

With solar producers can:

- ✓ cut costs
- ✓ achieve sustainability targets
- ✓ clean up the petroleum industry image





Solar Thermal – Cleaning The Oil Industry

Directly cutting liquid fuel and gas use in petroleum core processes, from upstream to downstream
Saving OPEX and reducing CO2 every year, consistently over the lifetime of the solar field



THE SUN IS AN INEXHAUSTABLE RESOURCE



SOLAR THERMAL WORKS BEST WHERE ITS HOTTEST

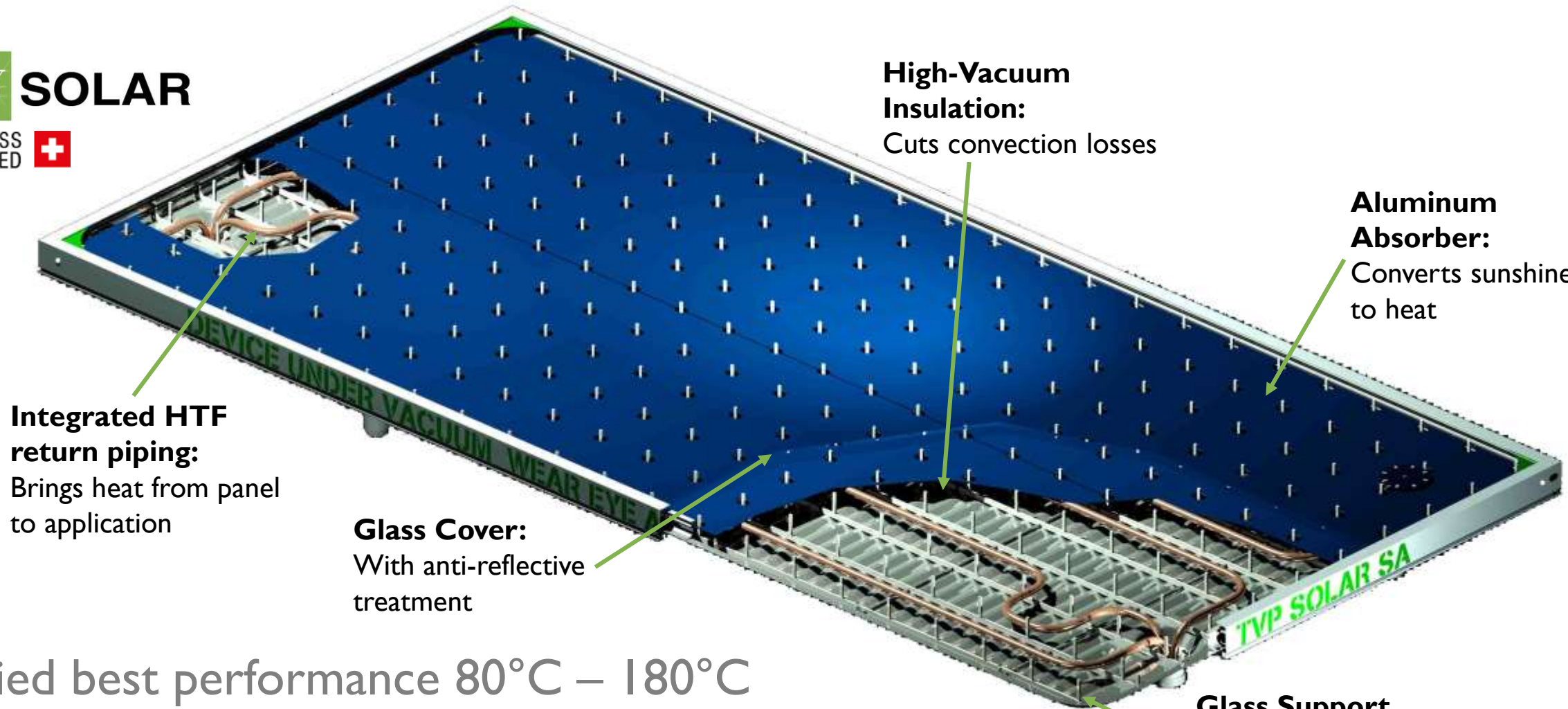


ADD-ON WITH NO CHANGE TO EXISTING SYSTEM



SOLAR THERMAL GENERATES IMMEDIATE SAVINGS

Best Solar Thermal Collector In The World



High-Vacuum Insulation:
Cuts convection losses

Aluminum Absorber:
Converts sunshine to heat

Integrated HTF return piping:
Brings heat from panel to application

Glass Cover:
With anti-reflective treatment

Glass Support Structure:
Supports 20 tons of pressure

Certified best performance 80°C – 180°C
Predictable, consistent, and massive energy output
in any light conditions, at any operating temperature

Only TVP Panels Work When Covered In Dust



Dirt, dust, and other fouling have less than 15% effect on yearly performance
No water-based cleaning required
With dry cleaning (brush or cloth only) panels return to nominal performance

Data published at IEA Task 49

TVP Achieves Energy Targets

City	Solar Input	TVP Yearly Energy Output (kWh _{thermal} /m ² /year) @ Operating T _{mean}								
		85°C	100°C	110°C	120°C	130°C	140°C	155°C	170°C	180°C
Riyadh	2,217	1,528	1,427	1,355	1,279	1,200	1,118	1,034	861	773
Jeddah	2,117	1,346	1,246	1,176	1,102	947	947	826	704	622
Dubai	2,003	1,269	1,168	1,097	1,024	948	870	752	633	555
Kuwait City	1,988	1,363	1,266	1,297	1,125	1,050	974	857	738	659
Abu Dhabi	1,957	1,333	1,234	1,163	1,090	1,013	935	814	691	609
Dhahran	1,957	1,333	1,234	1,163	1,090	1,013	935	814	691	609
Muscat	1,937	1,195	1,112	1,054	995	934	873	779	685	623

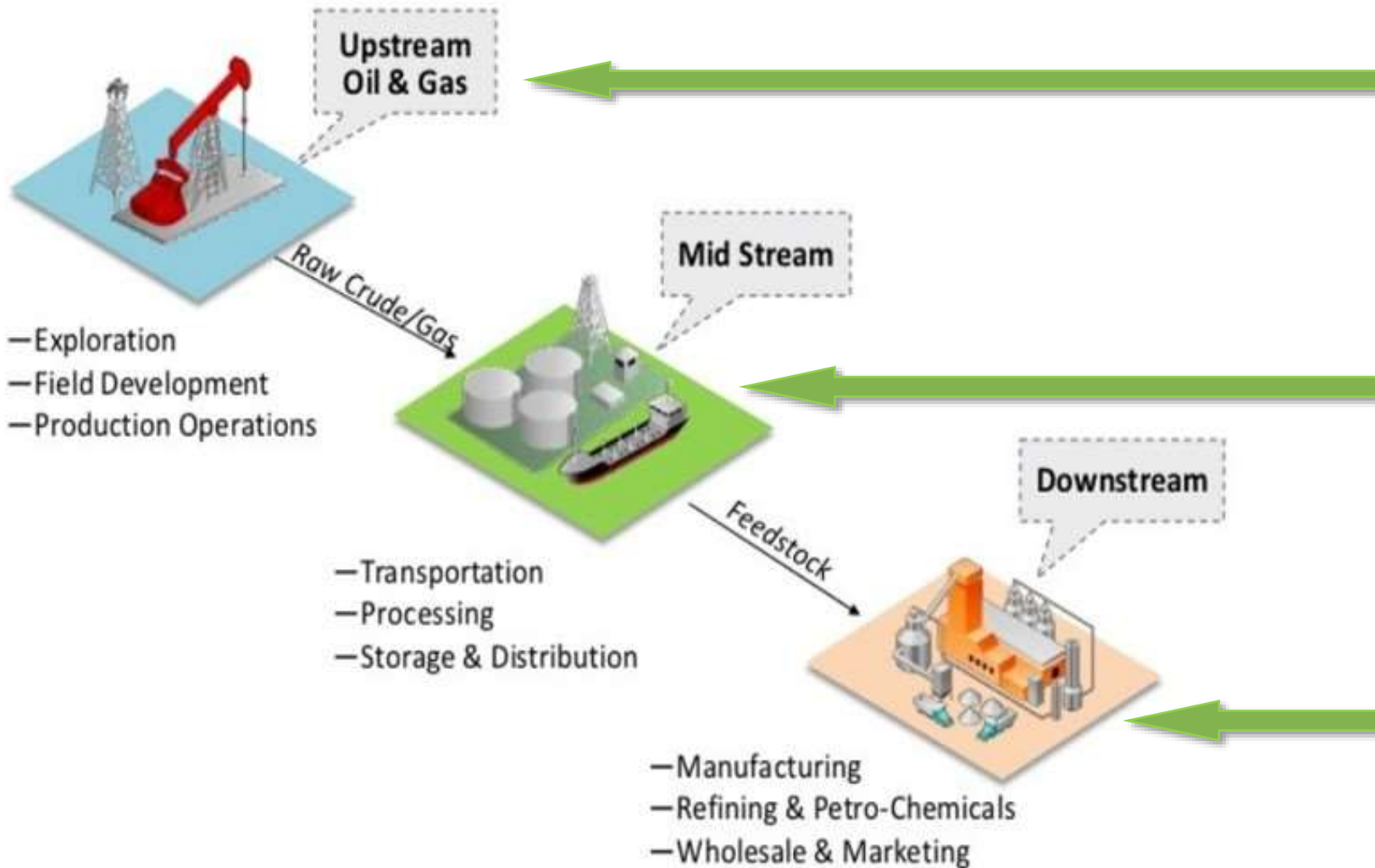
Massive yearly production of thermal energy due to:

High system reliability: low maintenance, minimal operating down-time

Minimal impact from environment: climate conditions, dust, dirt, pollution, haze

No performance degradation: vacuum ensures same output over panel lifetime

TVP Serves Applications Along Oil Value Chain

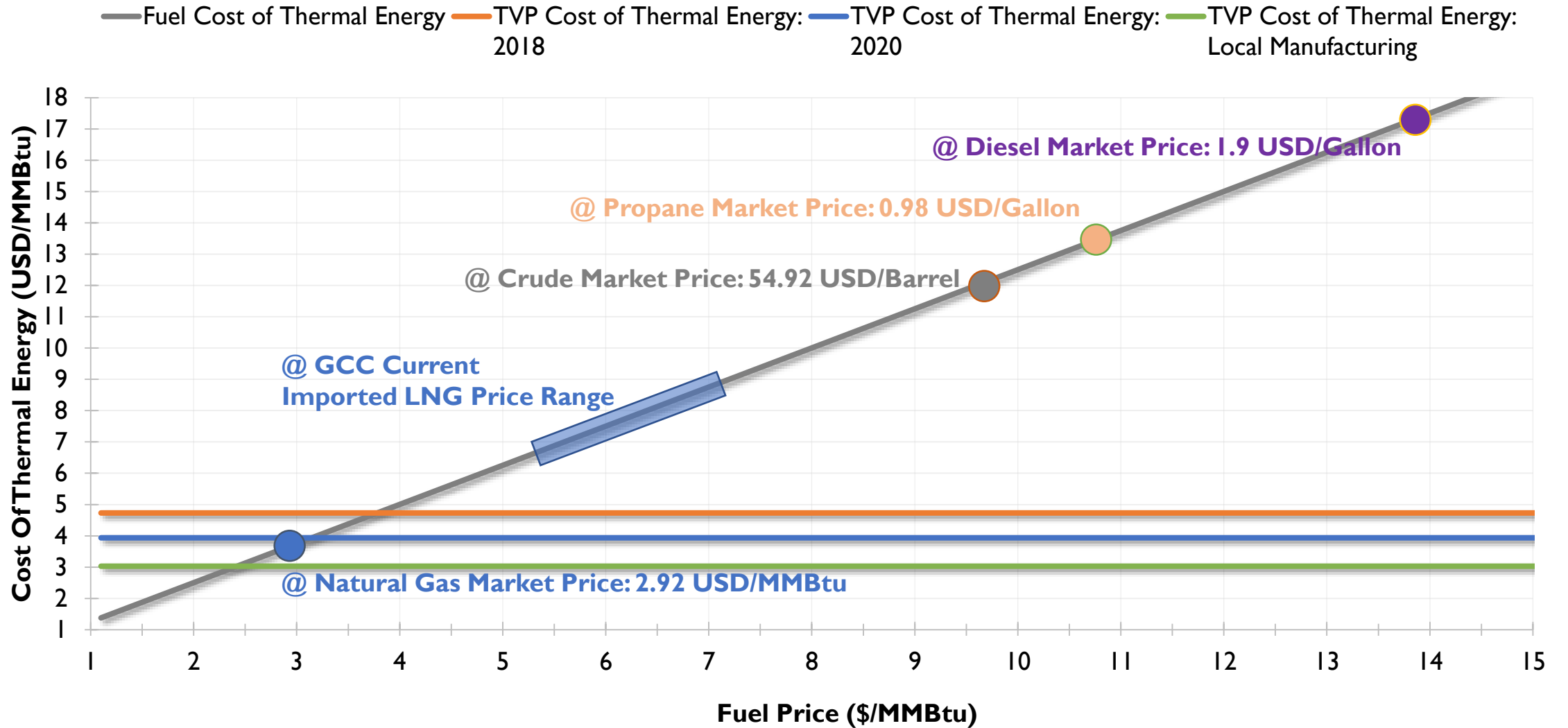


Heavy Oil:
Pre-heating boiler feedwater

Gas/Oil Separation Plant:
Desalter & trim heating
Reboilers
Amine, glycol regeneration
Sour water stripping
Stabilization columns

Processing & Storage Tanks
Utility BFW Pre-Heat
Petrochem & Refining

TVP Energy Already Cheaper Than Fuels



TVP Can Clean The Oil Industry

The world's best-performing solar thermal panel

Clean, predictable, consistent, and reliable energy

Serving upstream and downstream oil processing

TVP thermal energy already cheaper than fuels

Ideal for hot, dusty, off-grid locations

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