

The logo for GlassPoint, featuring a stylized sunburst or starburst icon to the left of the company name.

GlassPoint

# Cost-Efficient Process Heat at Scale using Enclosed Parabolic Troughs

DoE HelioCon Webinar Dec 2025 | Gerhard Weinrebe



# Introduction





# PV & Batteries on a race to the bottom

## BloombergNEF expects up to 700 GW of new solar in 2025

BloombergNEF says global solar installations could reach 700 GW in 2025, with additions rising to 753 GW in 2026 and 780 GW in 2027.

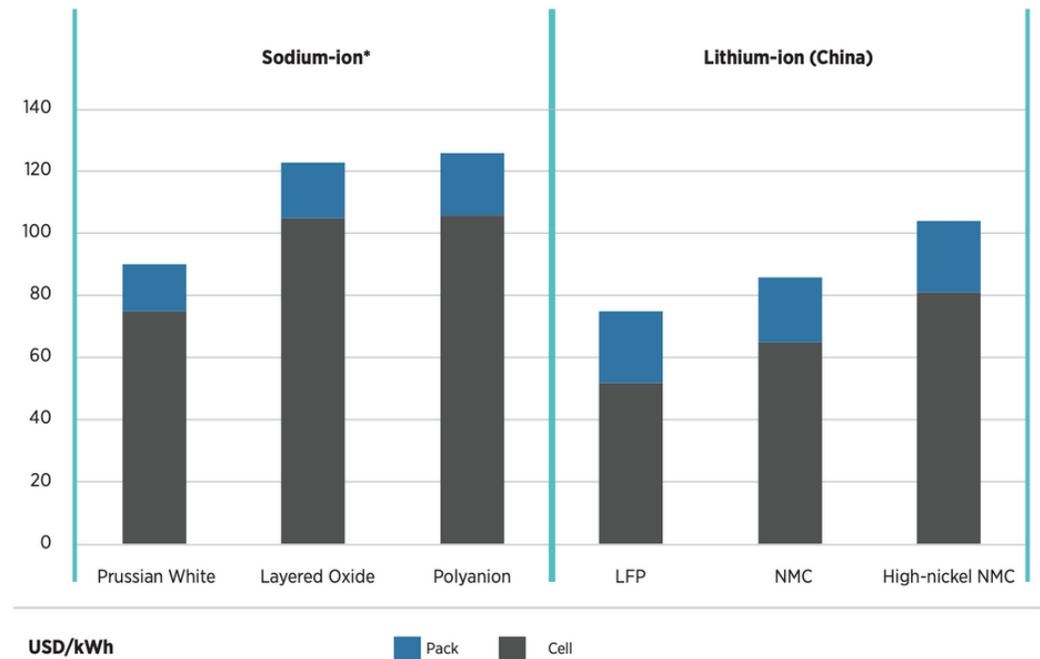
MARCH 13, 2025 EMILIANO BELLINI

COMMERCIAL & INDUSTRIAL PV HIGHLIGHTS MARKETS RESIDENTIAL PV UTILITY SCALE PV WORLD



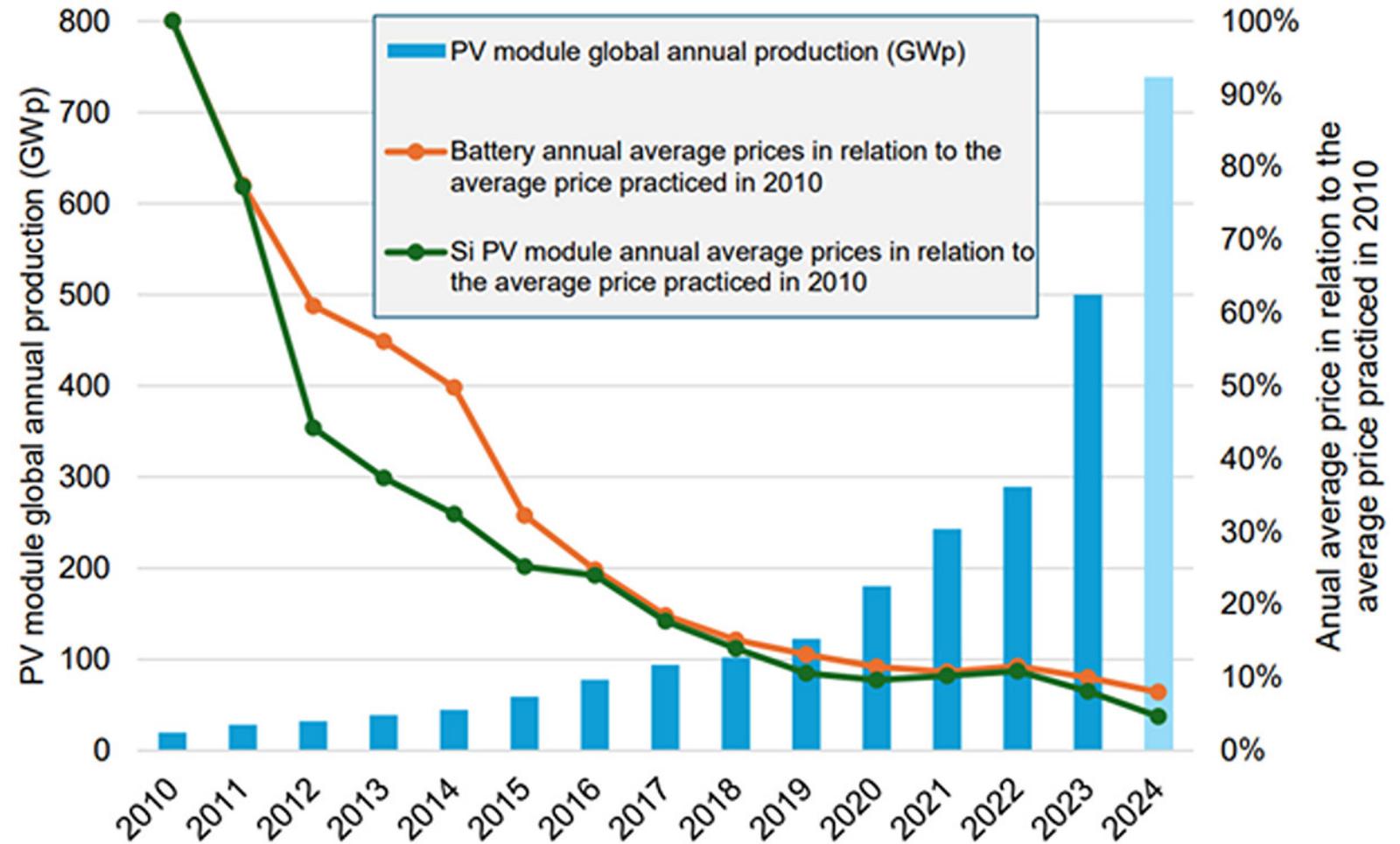
<https://www.pv-magazine.com/2025/03/13/bloombergnef-expects-up-to-700-gw-of-new-solar-in-2025/>

## Sodium-ion battery cell cost could drop to \$40/kWh, says IRENA



<https://www.pv-magazine.com/2025/11/28/sodium-ion-battery-cells-could-drop-to-40-kwh-says-irena/>

# PV & Batteries on a race to the bottom



<https://www.gov.ca.gov/2024/04/19/californias-grid-keeps-setting-new-clean-energy-records/>

<https://about.bnef.com/blog/1q-2024-global-pv-market-outlook>

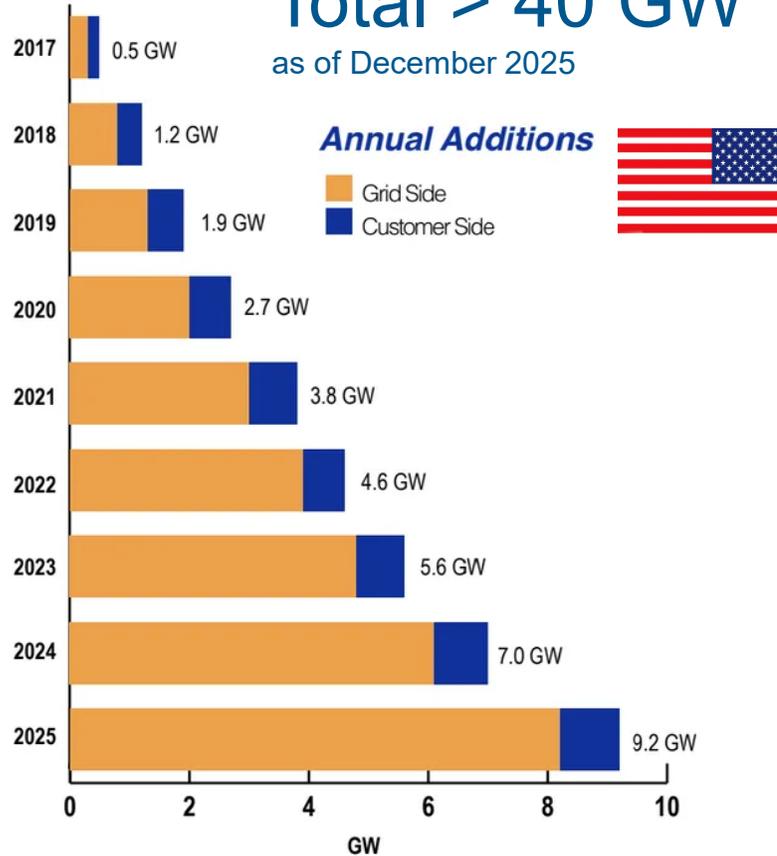
<https://pv-magazine-usa.com/2024/03/06/battery-prices-collapsing-grid-tied-energy-storage-expanding/>

<https://www.pv-magazine.com/2025/05/22/falling-li-ion-battery-prices-mirror-solar-photovoltaics-trends-is-there-a-role-for-second-life-batteries-before-recycling/>

# PV & Batteries on a race to the bottom

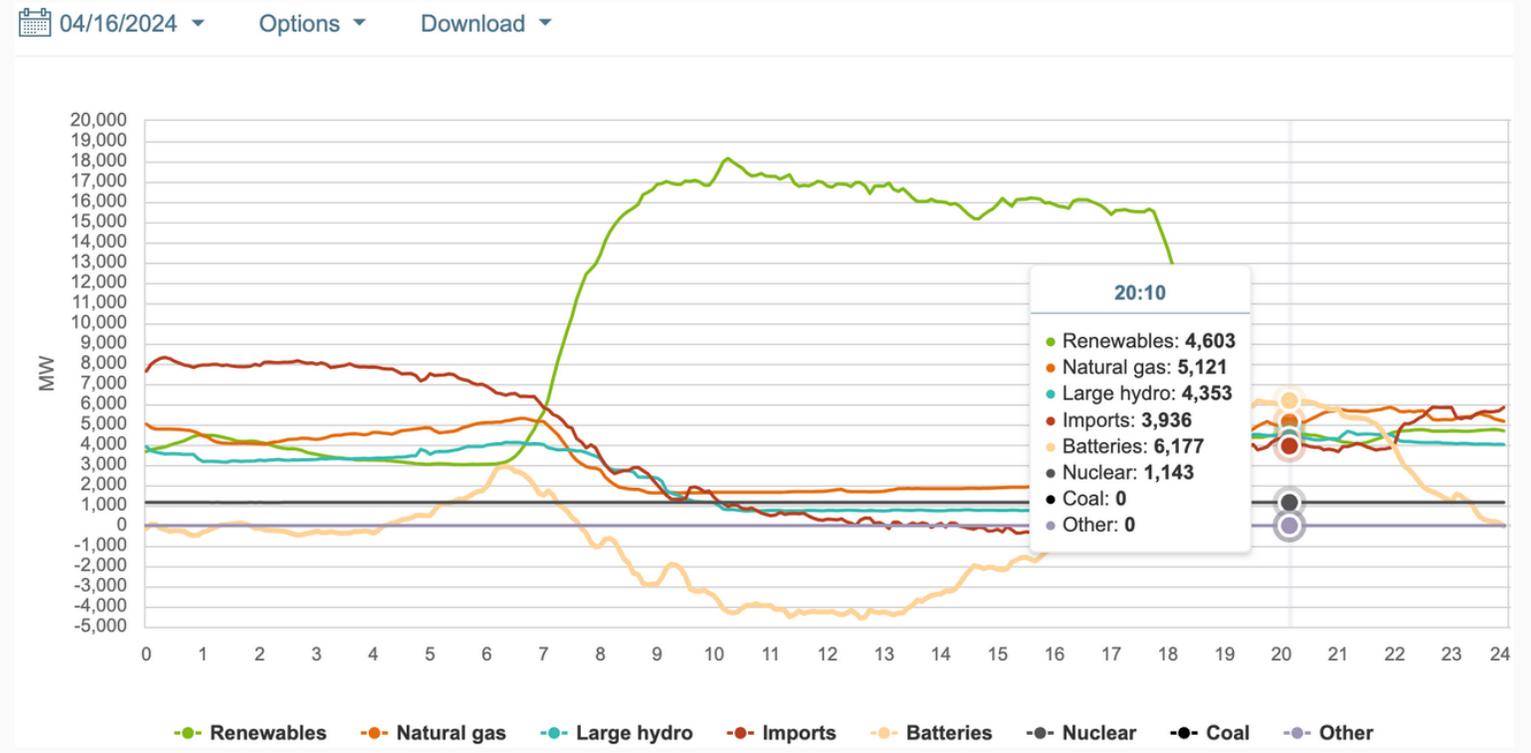
Total > 40 GW

as of December 2025



(Source: Navigant Research)

**MORE BATTERY STORAGE POWERING THE GRID THAN EVER BEFORE:** For the first time ever, battery storage discharge exceeded 6 GW and batteries were the largest source of supply to power the grid at a point during the day. California has built out 6,600 MW of battery storage capacity, a 1020% increase since 2020.

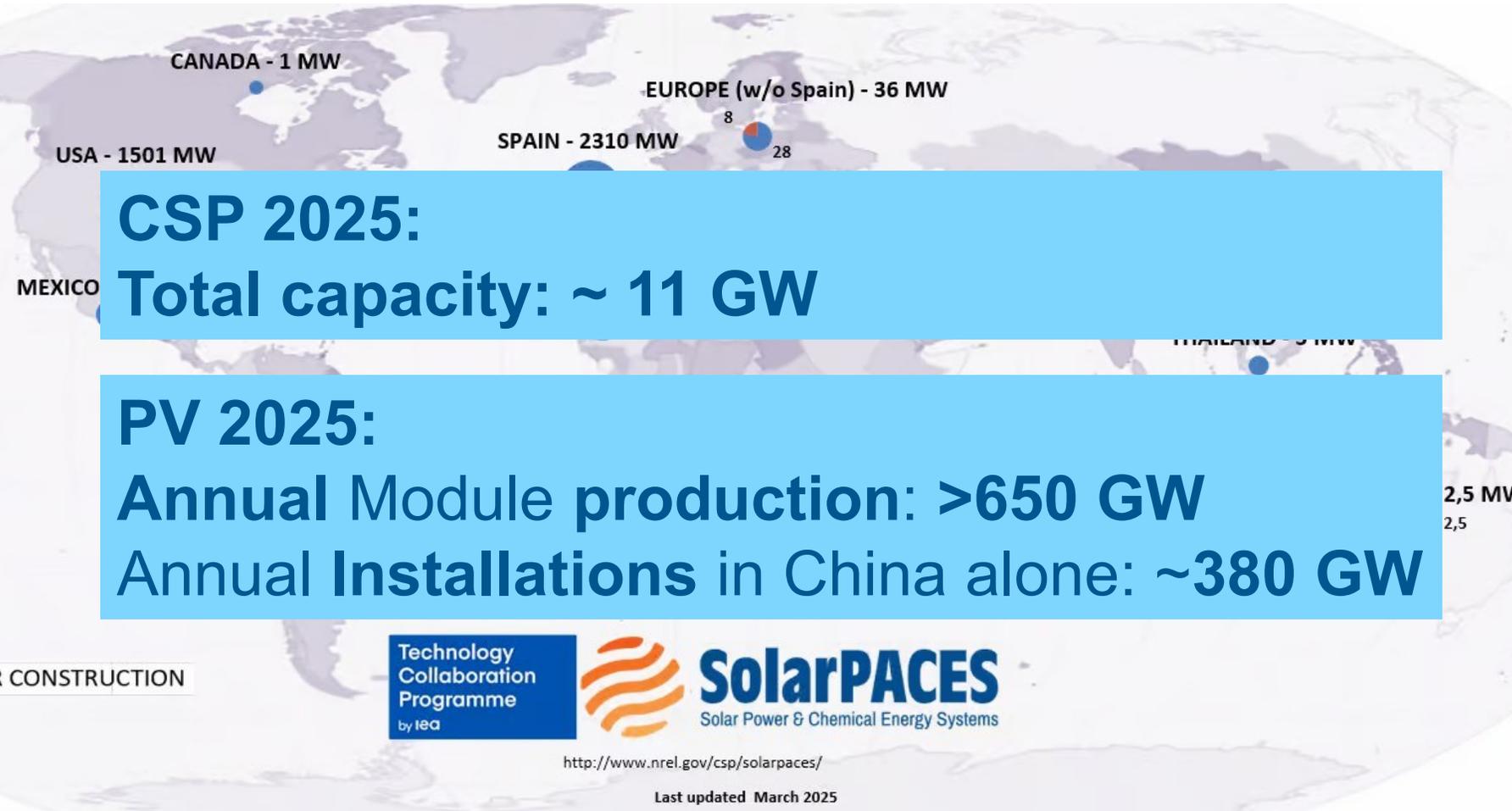


<https://www.gov.ca.gov/2024/04/19/californias-grid-keeps-setting-new-clean-energy-records/>

<https://www.canarymedia.com/articles/energy-storage/grid-storage-industry-crushes-2025-goal>

<https://www.ess-news.com/2025/11/19/europes-energy-storage-fleet-set-to-hit-the-100-gw-mark-and-more-than-double-by-2030/> Europe about 50 GW battery storage as of December 2025

# CSP & PV Markets – 2025 Snapshot



Technology  
Collaboration  
Programme  
by fea

**SolarPACES**  
Solar Power & Chemical Energy Systems

<http://www.nrel.gov/csp/solarpaces/>

Last updated March 2025

[https://www.solarpaces.org/wp-content/uploads/2025/03/CSP\\_2025\\_3\\_overviewMap.png](https://www.solarpaces.org/wp-content/uploads/2025/03/CSP_2025_3_overviewMap.png)

<https://docs.nrel.gov/docs/fy25osti/95135.pdf>

<https://www.pv-magazine.com/2025/07/10/china-on-track-to-deploy-380-gw-of-pv-in-2025/>

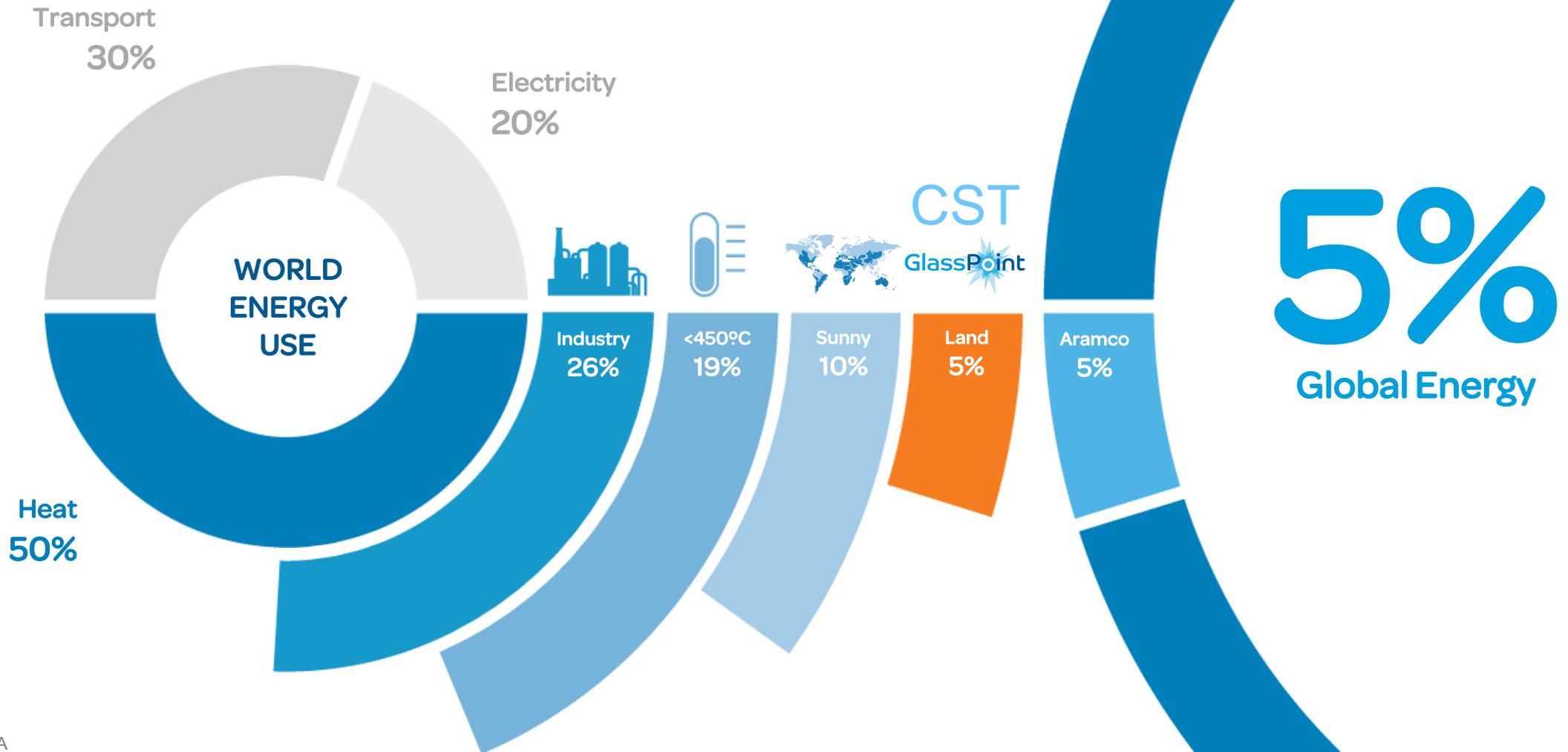
<https://www.pv-magazine.com/2025/05/06/global-pv-installations-may-hit-655-gw-this-year-says-solarpower-europe/>



# **The End of Concentrating Solar-Thermal Technology?**



# We address 5% of global energy use



# Cooperation to reach this ambitious target



UNIVERSIDADE  
DE ÉVORA



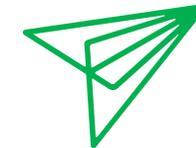
Deutsches Zentrum  
DLR für Luft- und Raumfahrt



Bundesministerium  
für Wirtschaft  
und Klimaschutz

**NREL tools SAM and SolTrace  
are used daily at GlassPoint**

SolarDynamics



Vola Alto  
CONSULTING



RIOGLASS

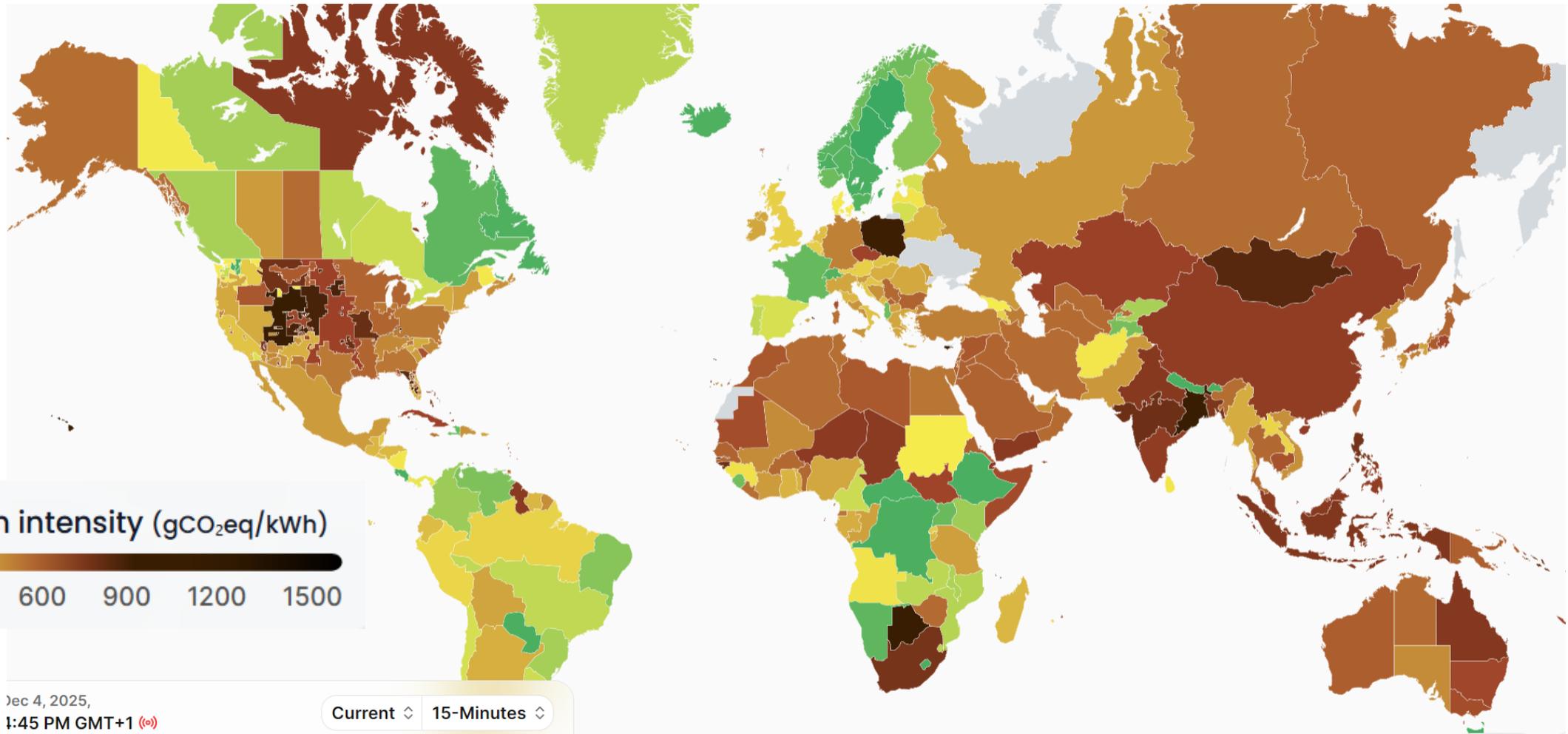




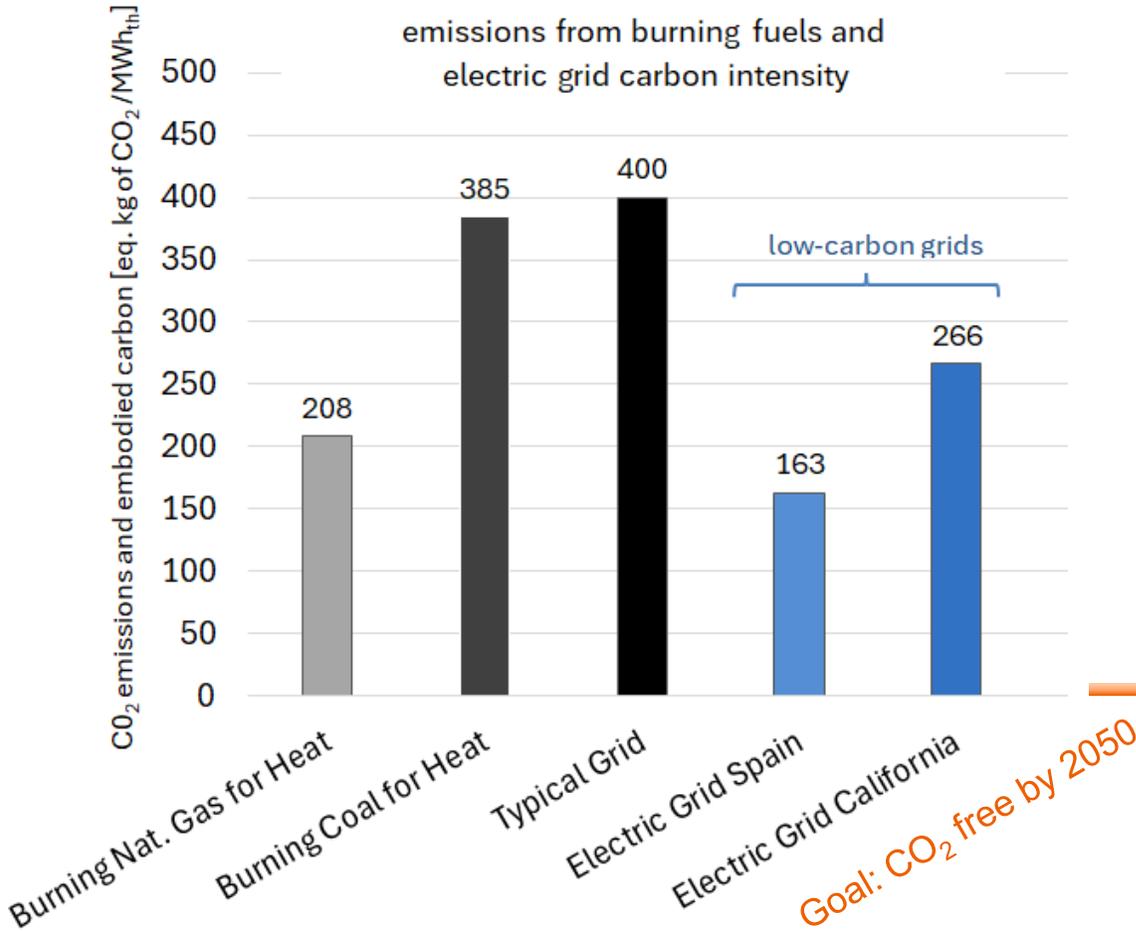
**Electrify everything?**



# Carbon Intensity of Electric Grids



# Greenhouse Gas Emissions of Burning Fuel and Electric Grid attributable Emissions

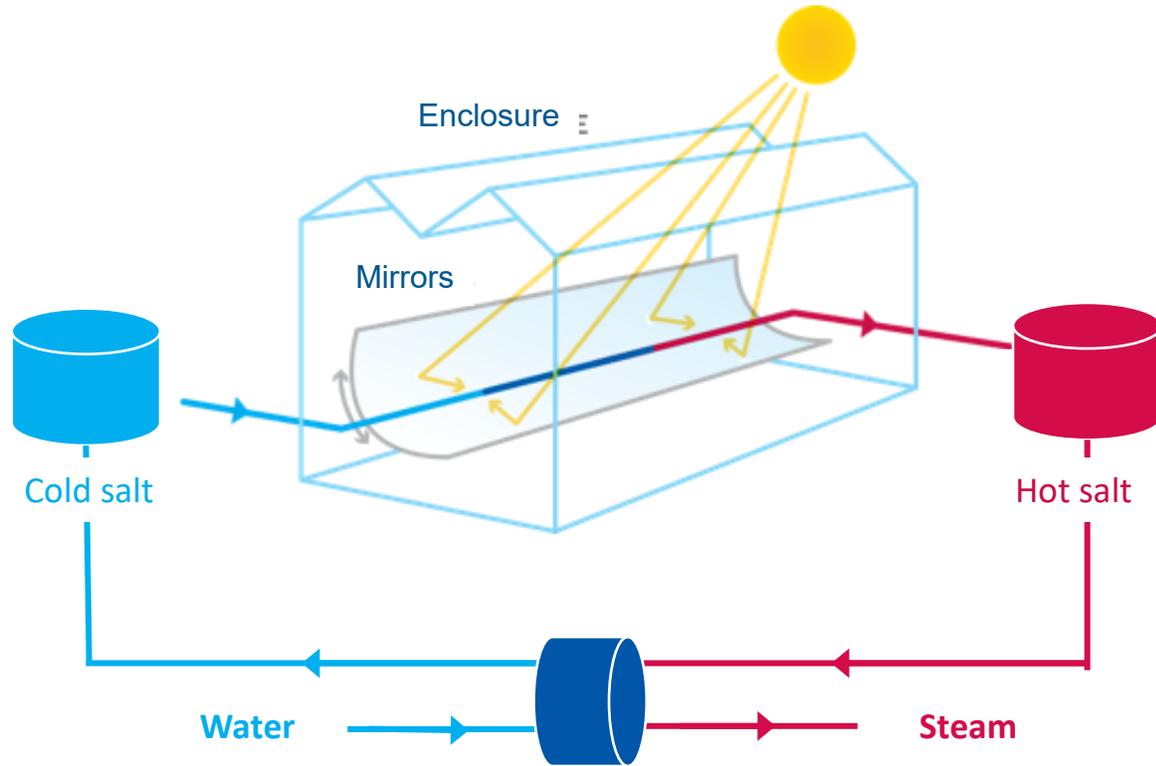




# GlassPoint Technology



# GlassPoint offers low-cost emission-free heat



Available day & night

# Enclosed Trough Technology Reduces Costs



Automated washing  
with water recapture  
reduces operating costs

Glasshouse enclosure  
protects mirrors and  
reduces capital cost

# Enclosure

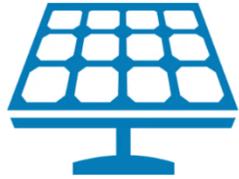


Material: ETFE

# Optimized Enclosure Design

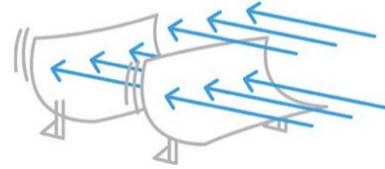


# Lowest Material Use leads to Cost Reductions



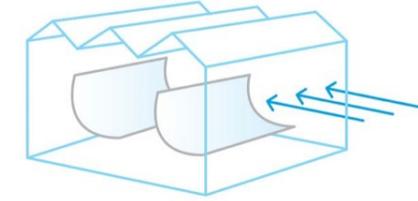
**93** kg/kW<sub>p</sub>

Material Use: 20 kg/m<sup>2</sup>  
10 kg structure, 10 kg module  
Solar field output: 215 W<sub>p</sub>/m<sup>2</sup>



**43** kg/kW<sub>p</sub>

Material Use: 30 kg/m<sup>2</sup>  
Steam output: 700 W<sub>p</sub>/m<sup>2</sup>



**20** kg/kW<sub>p</sub>

Material Use: 13 kg/m<sup>2</sup>  
Steam output: 660 W<sub>p</sub>/m<sup>2</sup>

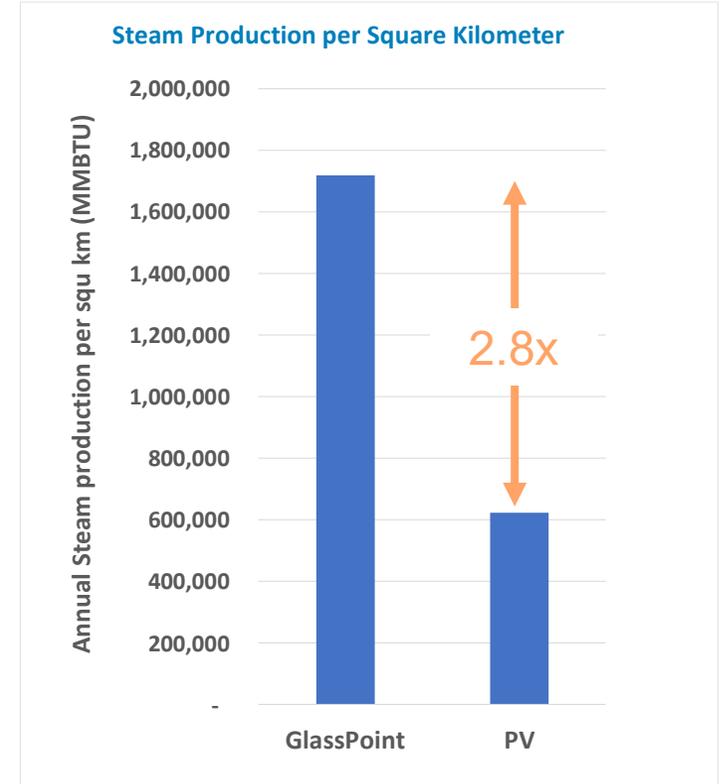
# Three times more steam from the same land



**GlassPoint**  
**66% Efficiency**  
**sunlight to steam**

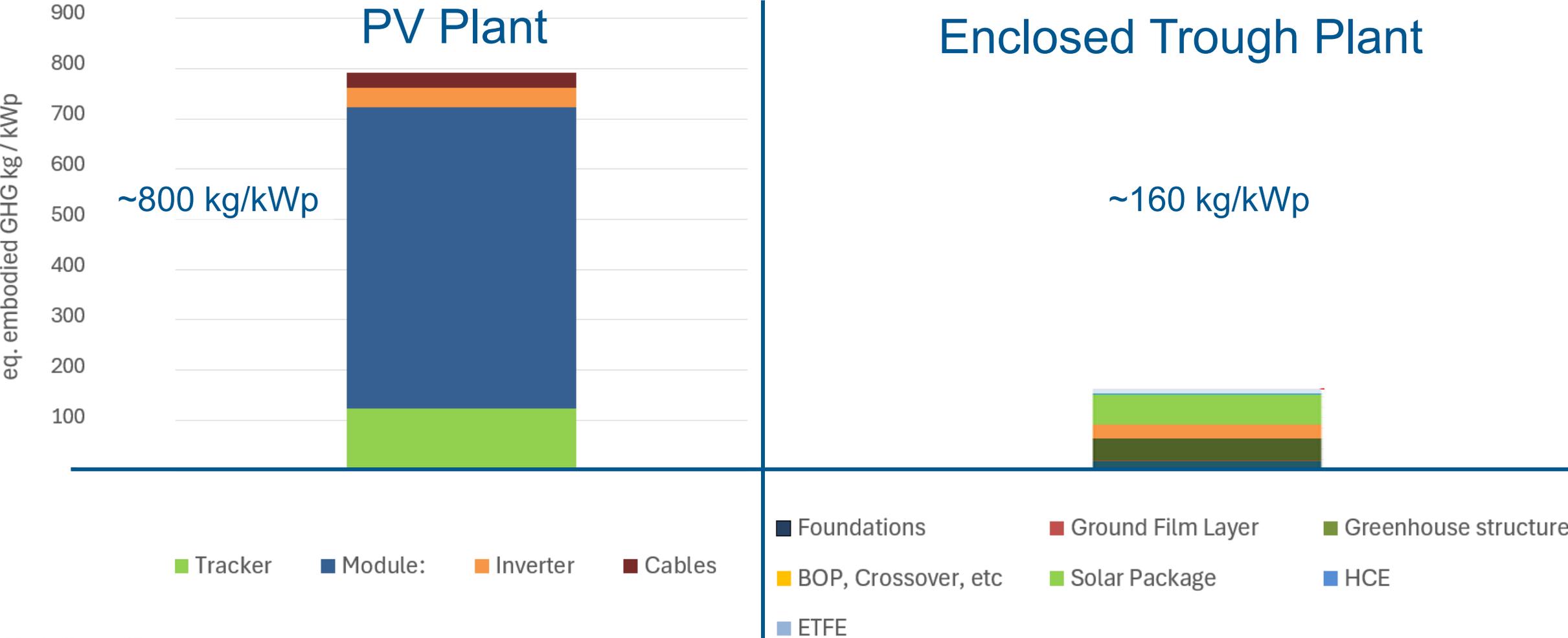


**PV**  
**22% Efficiency**  
**sunlight to electricity**  
**20% Efficiency**  
**sunlight to steam**



Bakersfield  
California

# Embodied Carbon per Peak Capacity (Solar Fields)



\* Peak efficiency GP on Aperture area  
<https://doi.org/10.52825/solarpaces.v3i.2371>

# Berry Petroleum, McKittrick, CA



**300 kW thermal**

# Amal I, Oman, conventional glass house



**2013– with conventional glass enclosure  
50 tonnes of steam per day (7 MW<sub>th</sub>)**

**2500t CO<sub>2</sub> avoided per year**

# Miraah, Oman



**2018– with conventional glass enclosure  
2000 tonnes of steam per day (330 MW<sub>th</sub>)**

**100,000 tons of CO<sub>2</sub> avoided per year**

# Optimized Enclosure Design

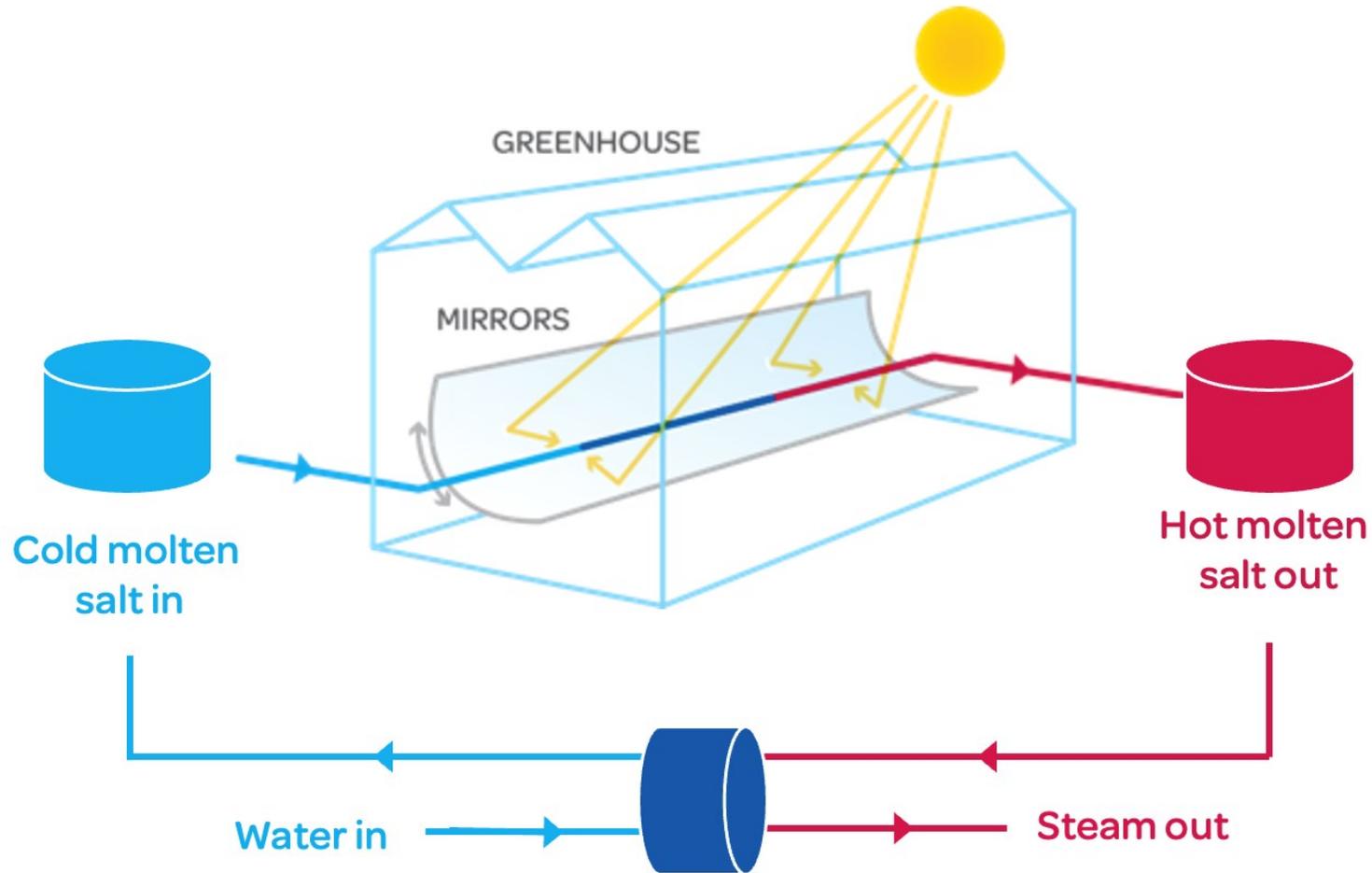




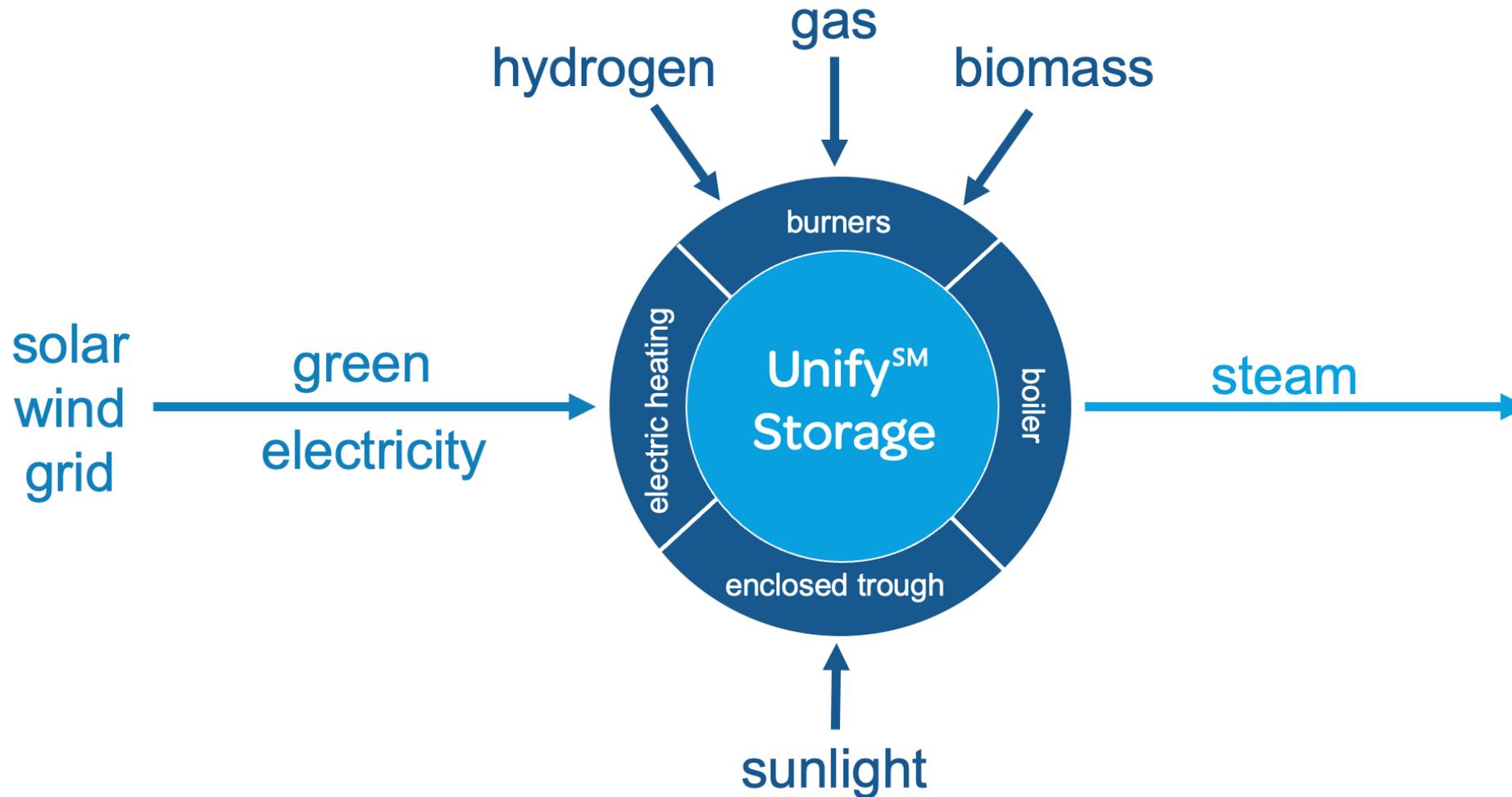
# From Direct Steam to Molten Salt



# Solar steam delivered day and night



# Integrate all sources of renewable energy



# Reflectors Rotate around Absorber





# Ma'aden Solar I

**Peak Output:** 4 x 325 MW Thermal

**Energy Output:** 4 x 750 GWh/year

**Daily Steam Output:** 14,000 Tons

**Solar Field Area:** 6 km<sup>2</sup>

**Total Project Area:** 7 km<sup>2</sup>

**Project Start:** 2024

**Gas Savings:** 12,000,000 Million Btus Per Year

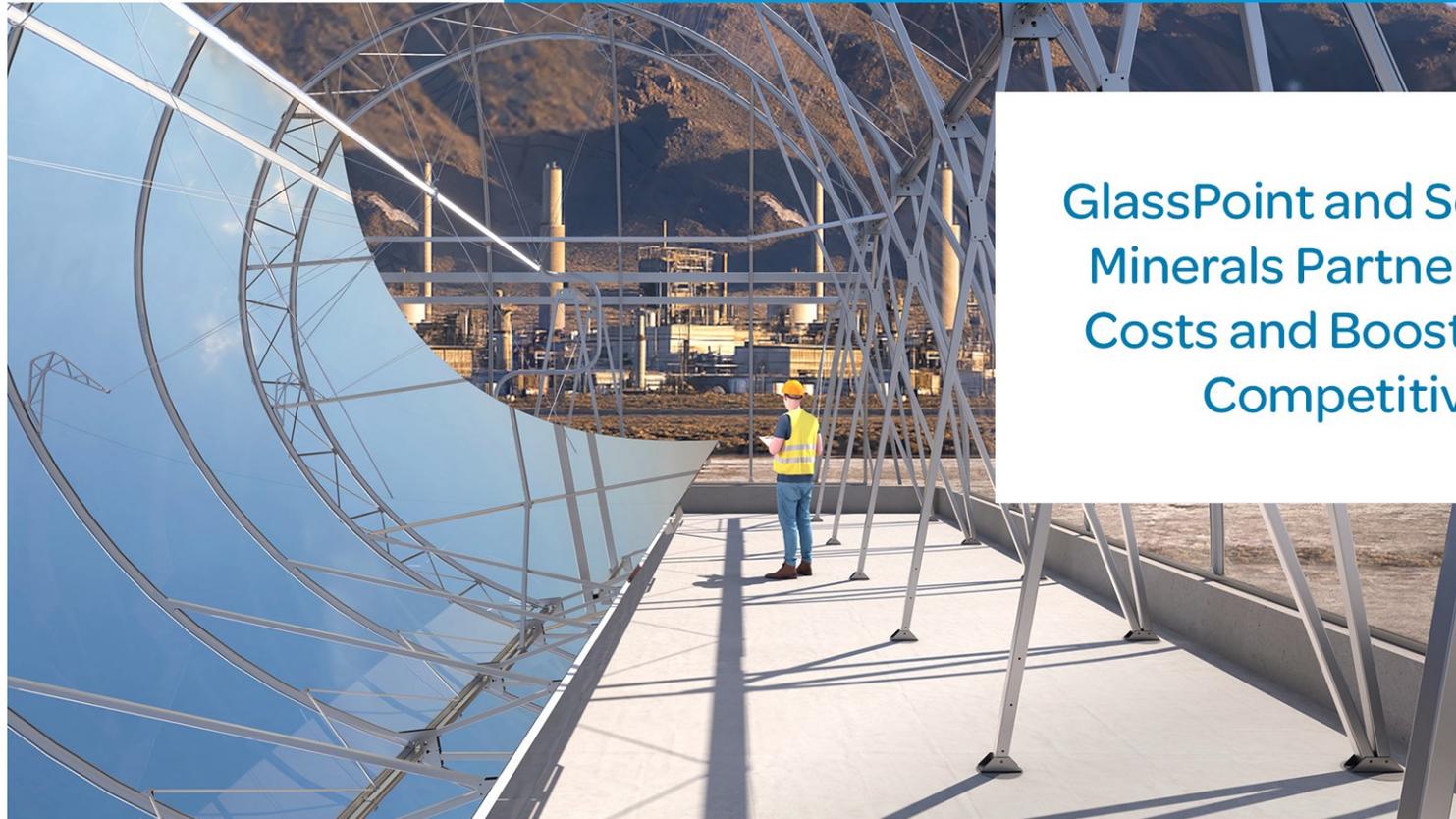
**CO<sub>2</sub> Emissions Saved:** 600,000 Tons Per Year

**Status:** FEED Study finished



**Alumina Refinery in the Kingdom of Saudi Arabia**

# Announced 750 MW + 3,650 MWh Storage Project



GlassPoint and Searles Valley Minerals Partner to Reduce Costs and Boost US Mineral Competitiveness

# Awarded more than \$230M in government support



Federal Ministry  
for Economic Affairs  
and Climate Action

**\$3M**

Jul 2024

German BMWK GlassPoint  
SPOT R&D project funding



وزارة الاستثمار  
Ministry of Investment

**\$60M**

Nov 2024

Announces completion of NIDC  
phase of funding package approval



**\$168M**

Jan 2025

US Department of Energy 48C award  
grant for the SVM project



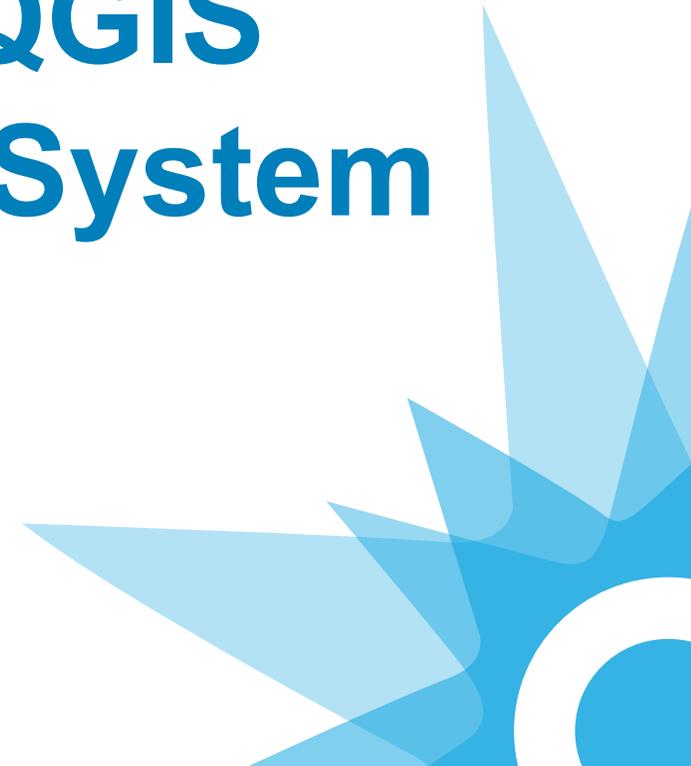
# **A Glimpse behind the Curtain**



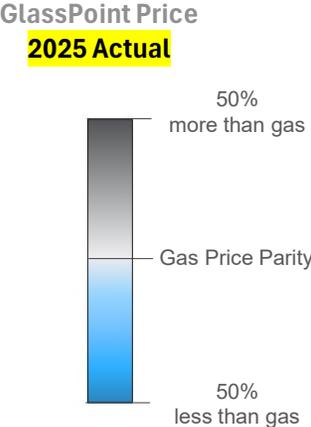
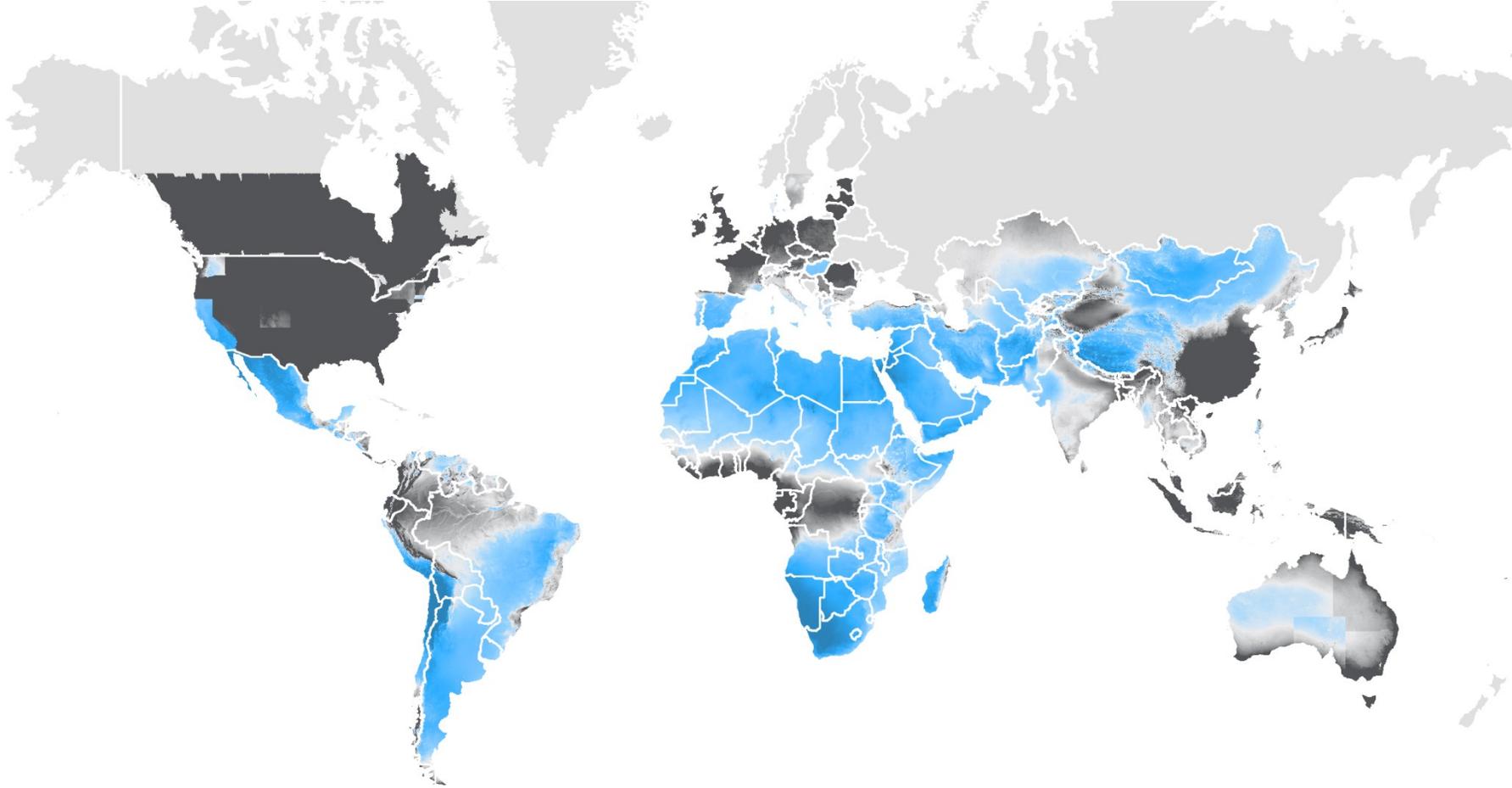


# **Market Analysis using QGIS**

## **Geographical Information System**

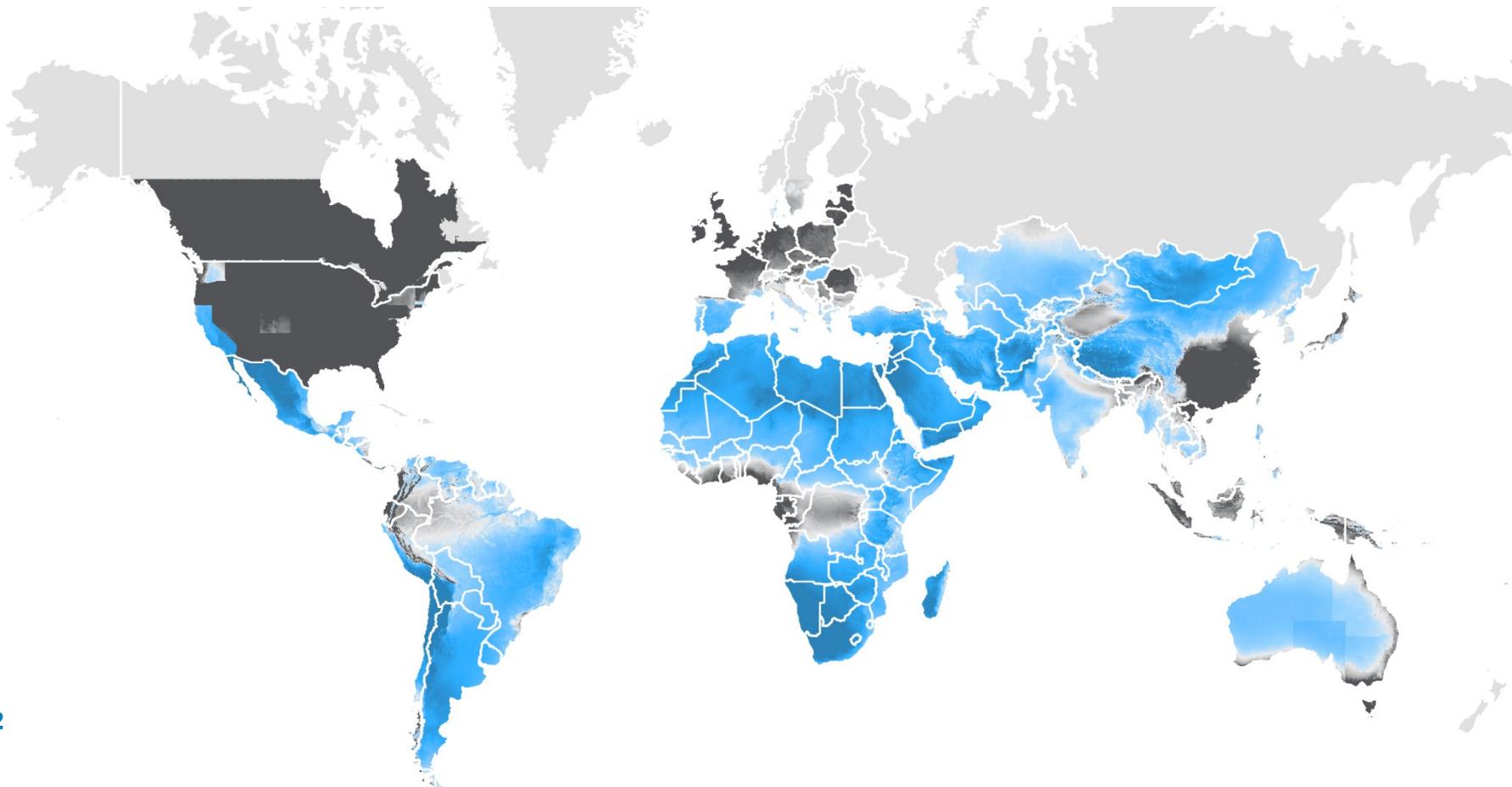


# Locations where GlassPoint is cheaper than gas

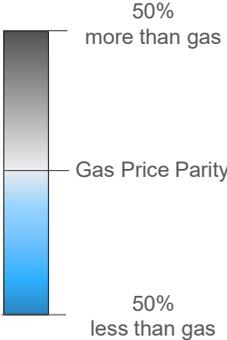


Source: EU Detailed Study 2024, updated 2025, US detailed Study 2024, updated 2025, Australia detailed study 2025  
Arabian Peninsula and ROW international LNG prices used: 2025: \$12/MMBTU, using eta=85%, \$2/MWh o&m cost): \$50.1/MWh (2025)  
DNI maps: <https://globalsolaratlas.info>  
Page 36 | © 2025 GlassPoint, Inc.

# Locations where GlassPoint is cheaper than gas



GlassPoint Price  
2030 Baseline



**GlassPoint**  
Levelized Cost of Heat



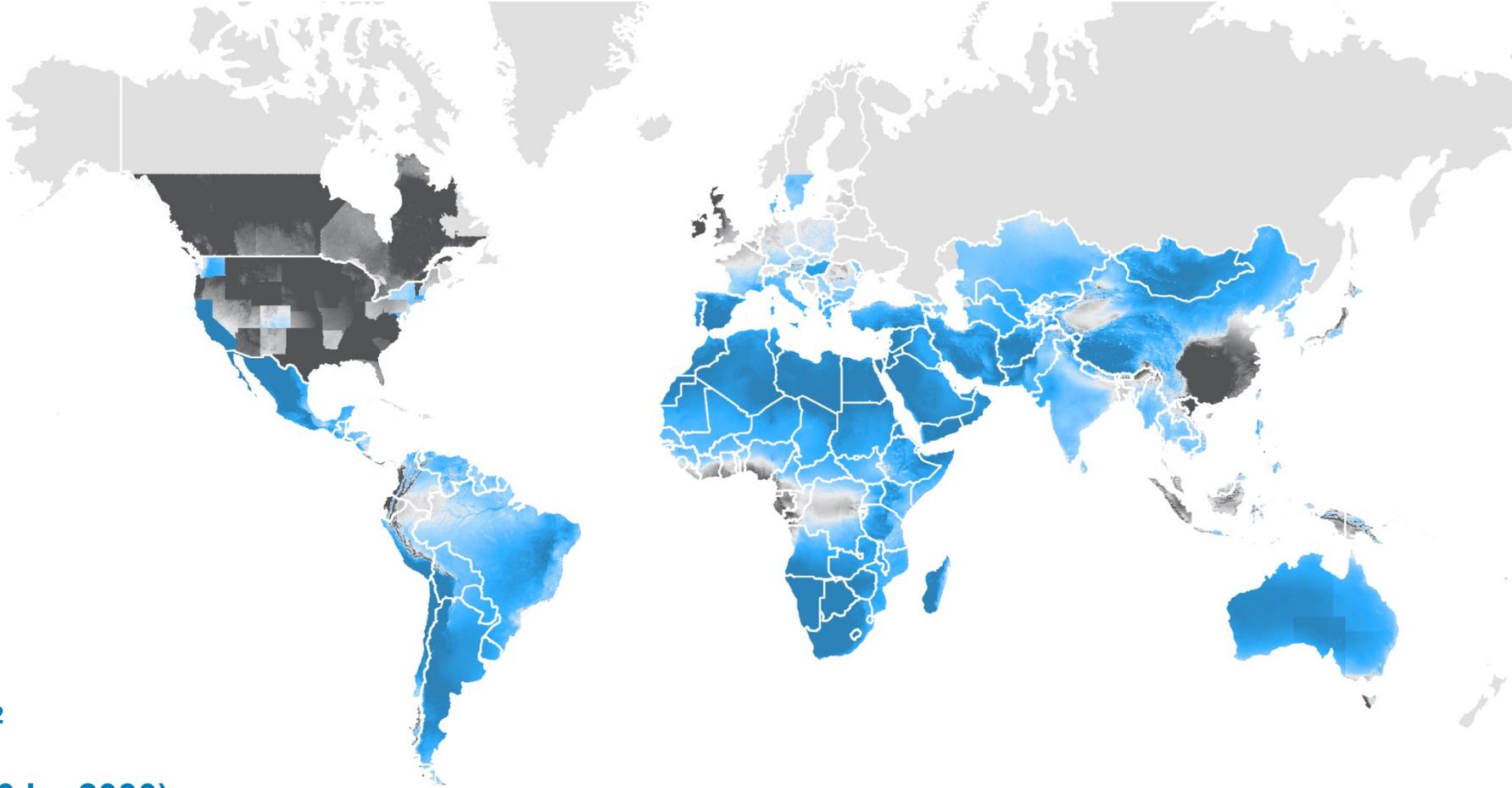
**Cost of CO<sub>2</sub>**  
In regulated locations



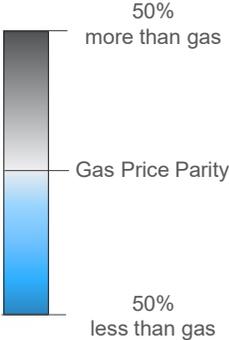
**Subsidies (0 by 2030)**

DNI maps from <https://globalsolaratlas.info>

# Locations where GlassPoint is cheaper than gas



GlassPoint Price  
2035 Baseline



**GlassPoint**  
Levelized Cost of Heat



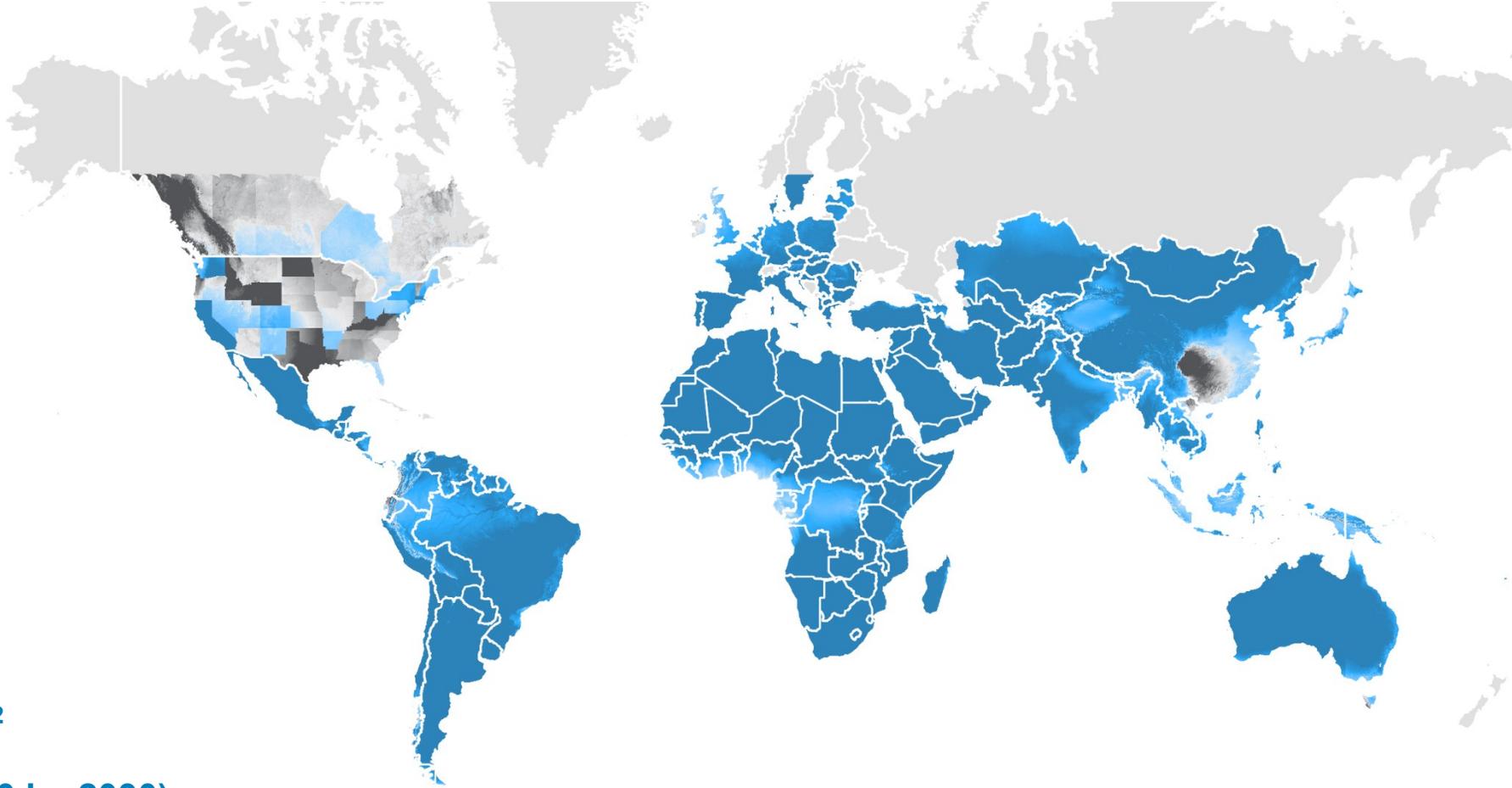
**Cost of CO<sub>2</sub>**  
In regulated locations



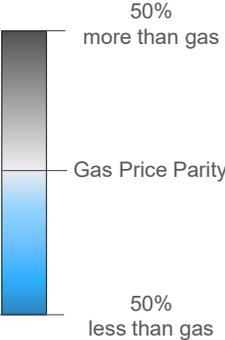
**Subsidies (0 by 2030)**

DNI maps from <https://globalsolaratlas.info>

# Locations where GlassPoint is cheaper than gas



GlassPoint Price  
2045 Baseline



**GlassPoint**  
Levelized Cost of Heat



**Cost of CO<sub>2</sub>**  
In regulated locations



**Subsidies (0 by 2030)**



**Solar pre-heating and melting  
instead of impedance heating**

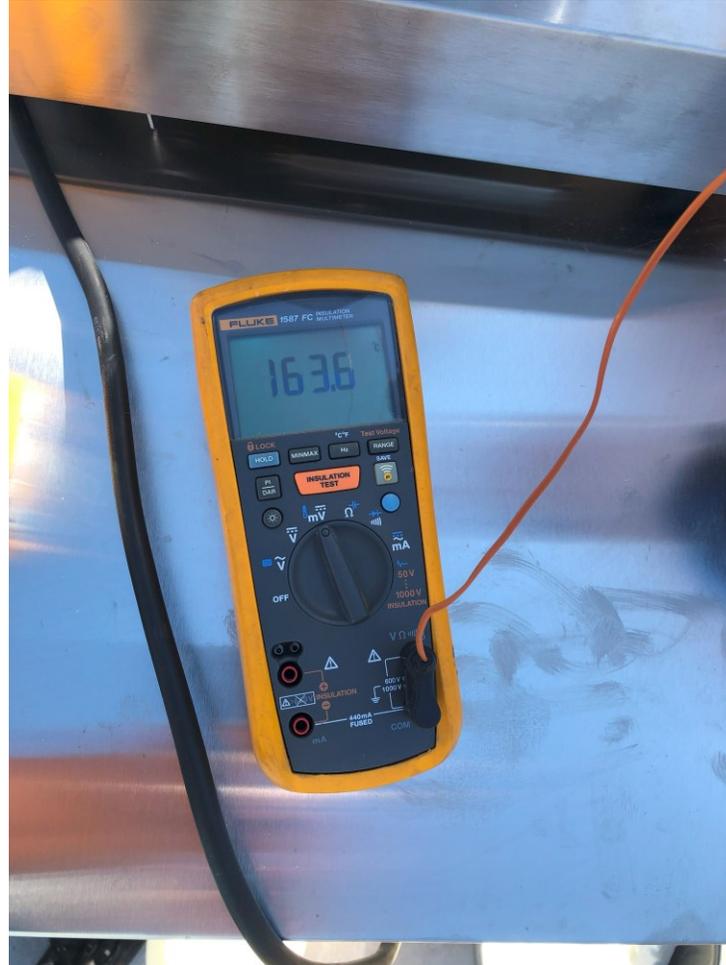
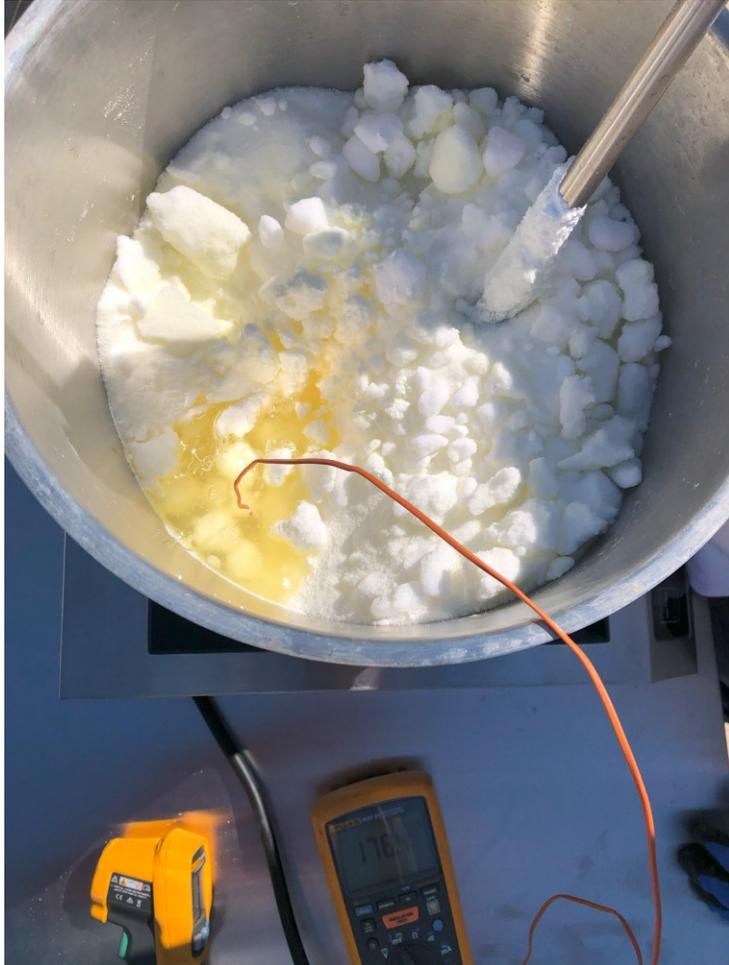


# Test setup



- HCE in north-south orientation. Flanges welded on both ends for safe filling with liquid salt including venting
- HCE from Schott test loop (12 HCEs) at Aznalcóllar, Spain

# Pre-heating and salt melting



No significant boiling out of water. Yellow color indicates that water is not present!

# Opening of south end



Expected plug at the end. Seeing shrinking effect on top. Second phase including air bubble? Unfortunately, a perfect insulation from HCE wall to the solid phase!

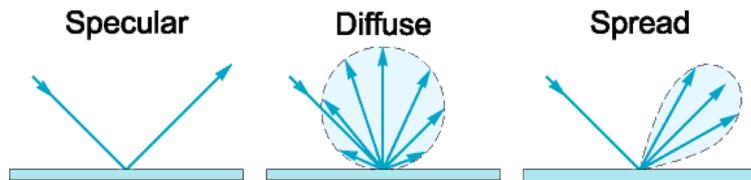
# Melting of plug with hot air gun



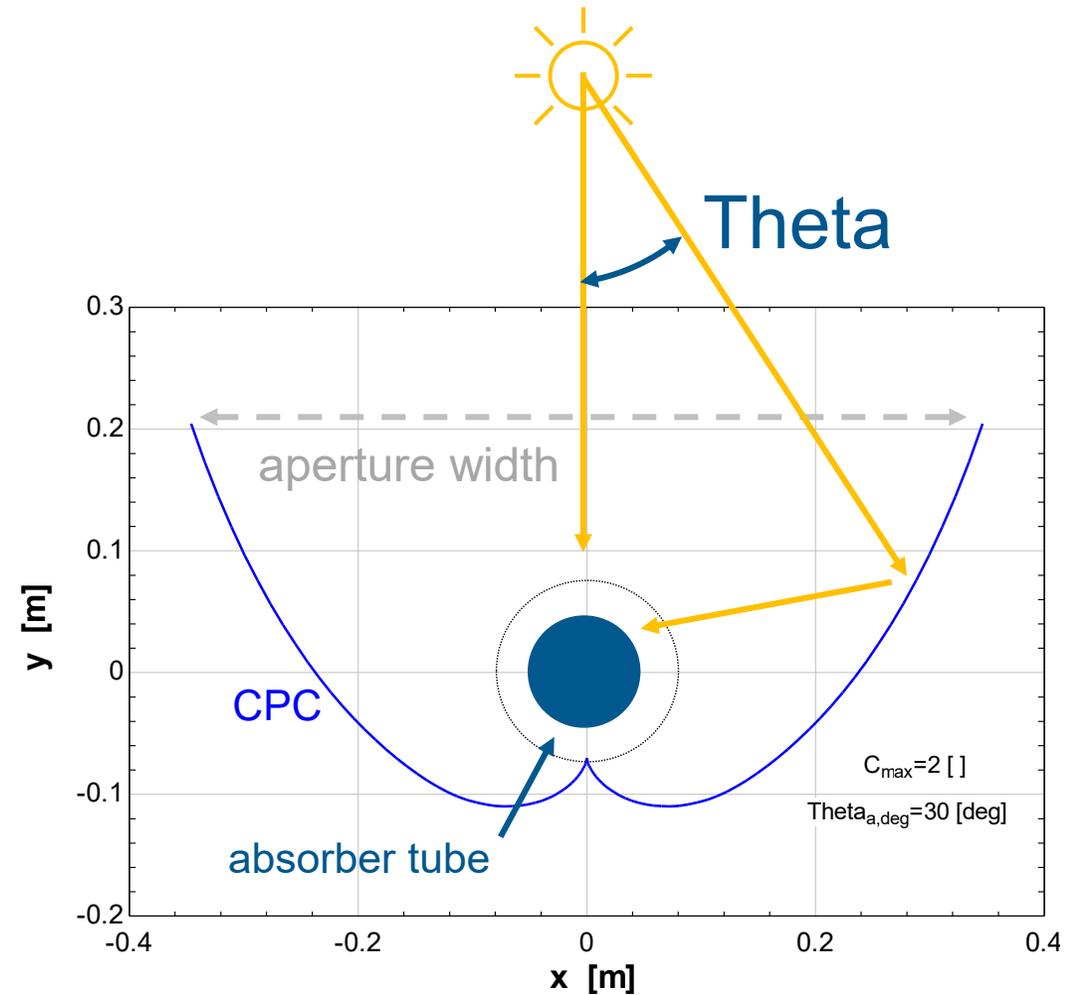
# Compound Parabolic Concentrator (CPC)

## Key parameters:

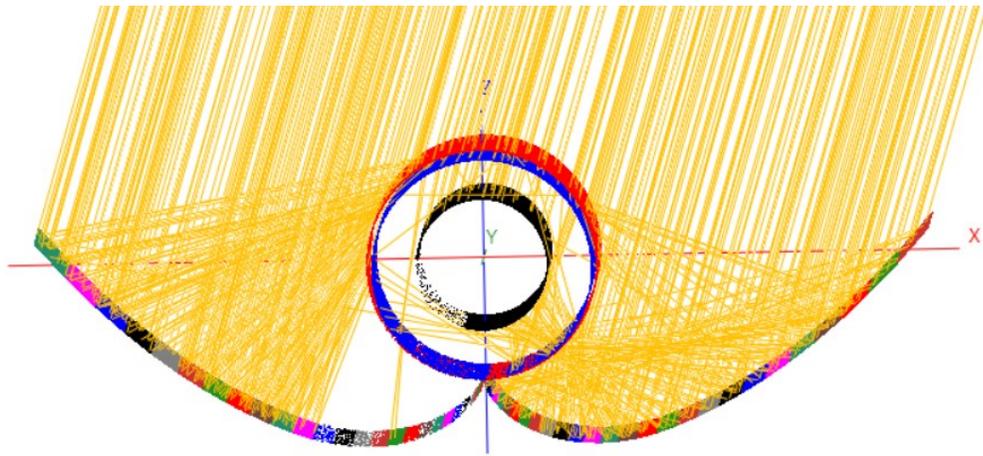
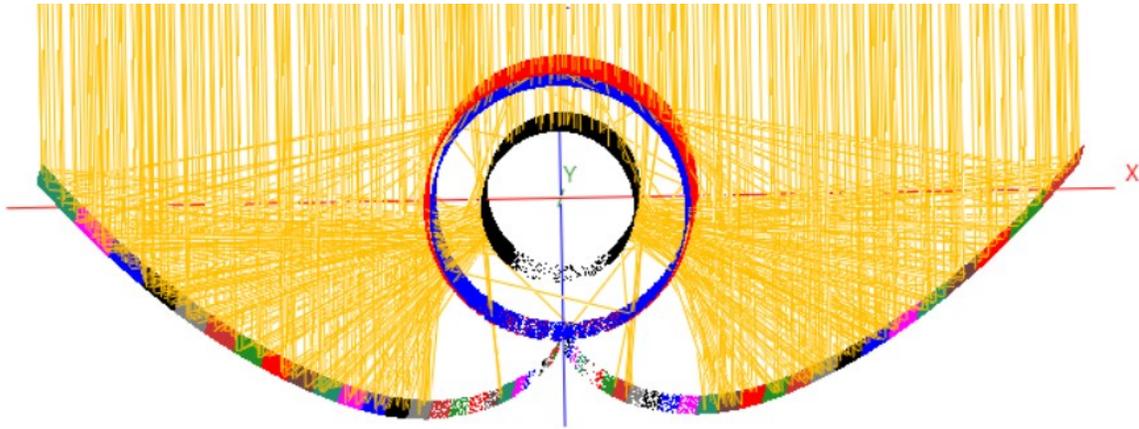
- **Acceptance half angle  $\Theta$**   
(maximum angle where reflected light still hits the target)
- **Concentration ratio**
- **Aperture width**
- **Mirror specularity** (to reduce peaks)



All these values can be carefully selected to achieve the desired total power and intensity distribution.



# Temporary Reflector – CPC



## Key Equations for CPC

If  $(t < \pi/2 + \theta_a)$  then

$$i = r \cdot t$$

else

$$i = \frac{r \cdot (\pi/2 + t + \theta_a - \cos(t - \theta_a))}{1 + \sin(t - \theta_a)}$$

endif

$t$  usually runs from 0.1 to  $3 * 0.5 * \pi - \theta_a$ , but the upper limited can be reduced...  
...for truncation of the CPC

$$C_{max} = \frac{1}{\sin(\theta_a)}$$

$$I = i(t, r, \theta_a)$$

$$x = r \cdot \sin(t) - I \cdot \cos(t)$$

$$y = -r \cdot \cos(t) - I \cdot \sin(t)$$



**AI on premise to protect IP**



# LM Studio + qwen3 4B for Python Programming

The image displays two overlapping windows of the LM Studio application. The background window shows the 'Your Models' list with columns for Recency, Size, and Downloaded. The foreground window shows a chat interface for the 'qwen/qwen3-4b' model, displaying a 'Mathematical Model' section with a differential equation and a list of variables.

Model Name	Provider	Size	Downloaded
Qwen3 4B	qwen	4B	2.33 GB
Deepseek R1 0528 Qwen3 8B	deepseek	8B	4.68 GB
Qwen3 Coder 30B	qwen	30B-A3	
OpenAI's gpt-oss 20B	openai	20B	
Nomic Embed Text v1.5	nomic-ai		

**Mathematical Model**

The transient cooling is governed by the lumped capacitance model:

$$mc_p \frac{dT}{dt} = -hA(T(t) - T_{env})$$

Where:

- $m$ : mass of the liquid in the pipe.
- $c_p$ : specific heat capacity of Hitec salt.
- $h$ : convective heat transfer coefficient.

Send a message to the model...

INPUT TOKENS: 0 | CONTEXT IS 302.1% FULL | RAM: 2.51 GB | CPU: 0.00 %

On 3 yr old laptop computer!

# Summary

- PV and batteries lead the power market...
- ...but there is heat, where Concentrating Solar Thermal is characterized by 3 x higher efficiencies:
  - Solar-to-heat, and
  - Land use efficiency
- Heat market is much larger than electricity
  - Addressable market < 450°C: 10% of global Greenhouse Gas Emissions
- GlassPoint offers proven technology at scale
- Still many opportunities for improvements and optimization

# Season's Greetings from GlassPoint & Stable Diffusion



# Thank you!

[gerhard.weinrebe@glasspoint.com](mailto:gerhard.weinrebe@glasspoint.com)



Contact Gerhard Weinrebe

