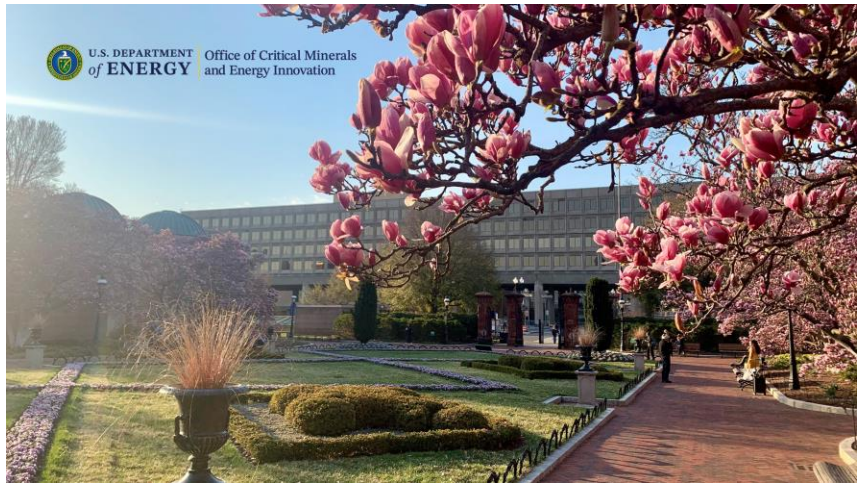
Solar Heat for Industrial Processes (SHIP): Delivering Affordable Heat to American Industries

Rebecca Mitchell, HelioCon Seminar Series
March 25, 2026

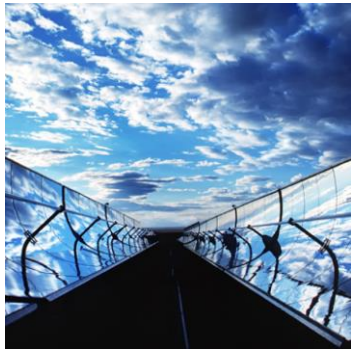
From Colorado to DC

Joined DOE as a fellow in 2024



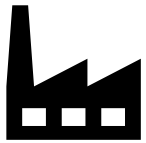
Joined the lab in 2018

Focused on commercialization of collectors for industrial heat applications



Joined Industrial Technologies Office (ITO) in 2025

Why industrial heat?

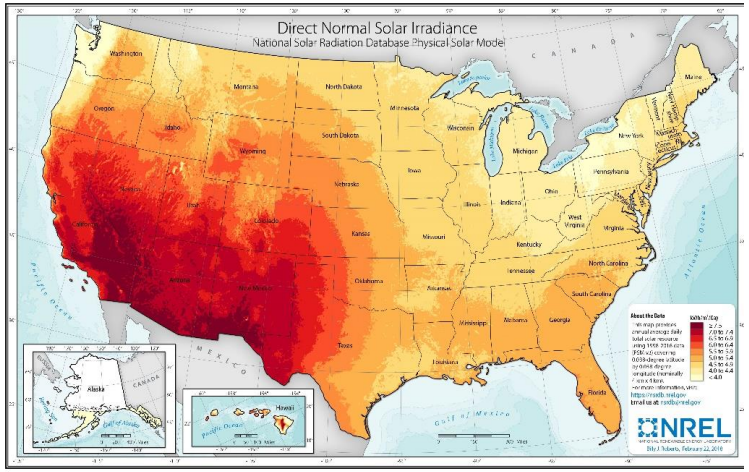


Industry makes up a third of US energy consumption, almost twice all electricity used annually.

Almost 90% of US industry energy, is **process heat**, used in nearly everything in the manufacturing world

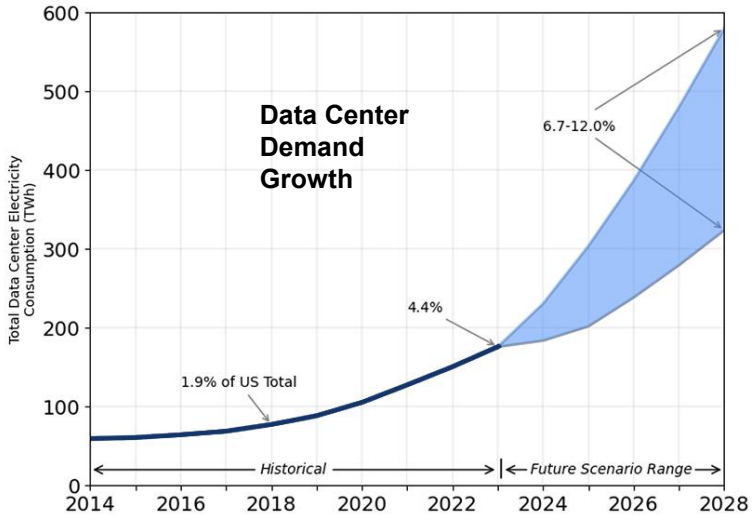
Why use sunlight for industrial heat in the U.S.?

Competitive today in sunlight-abundant regions



https://www.nlr.gov/gis/solar-resource-maps

Stable onsite heat to protect from energy price fluctuations



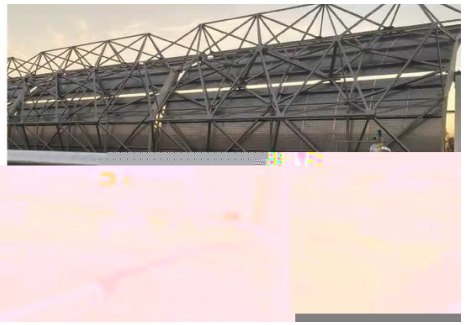
https://eta-publications.lbl.gov/sites/default/files/2024-12/lbnl-2024-united-states-data-center-energy-usage-report.pdf?utm_source=substack&utm_medium=email

Built with domestically-sourced common materials

Collectors
steel
aluminum
glass

https://www.solardynllc.com/parabolic-trough

Storage
water
salt
sand



https://www.prweb.com/releases/durion-appoints-paul-lesure-as-ceo-to-lead-commercialization-of-breakthrough-thermal-energy-storage-technology-302706190.html

How is solar heat for industry different from solar heat for power?

For power applications, the product is electricity, and the main input is solar heat

For industrial applications, they have a specialized product, heat is one of many inputs, and is usually less than 10% of product costs

Industrial customers are focused on production, not heat. They do not have the bandwidth or expertise to manage novel heat sources.

Performance: How good is good enough?

Power

Power production depends directly on solar heat production

Collectors are optimized for high performance to reach high temperatures to increase power cycle efficiencies

Industrial Heat

Most industrial heat is not that hot (<400° C)

Collectors must meet industry-specific temperatures at competitive cost

“Don’t let perfect get in the way of good enough. People buy good enough.”

Sizing: How big and will it fit?

Power

100-500 MWth capacity

100s of acres, large collector apertures

Industrial Heat

10-100 MWth capacity

Collocated with industrial facility that may have land constraints, requiring smaller collectors or solar fields

Deployment: Retrofit rather than new build

Power

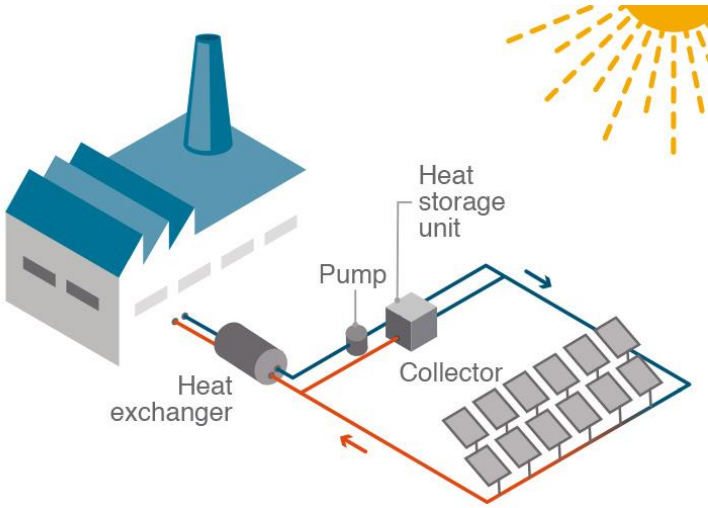
Deploying solar heat for power means building a new facility.

Multiyear construction and commissioning timelines are accepted

Industrial Heat

Deploying SHIP means retrofitting an **active** facility. Plant downtime is serious and industrial operators are risk-averse.

The deployment timelines needs to be shorter to meet industrial plant scheduled downtime.



Operation & Maintenance: how will they get cleaned?

Power

Solar heat is the plant's expertise and primary revenue generator

Power plants have a dedicated solar field O&M staff, trained for working in the solar field

Industrial Heat

Industrial plant workers already have a job to do, they don't want to spend time in the collector field

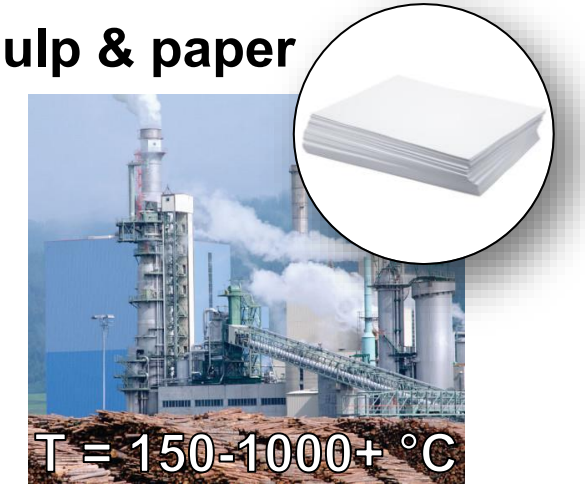
Solar field O&M, especially cleaning, should require little effort from plant staff

How hot does SHIP need to be?

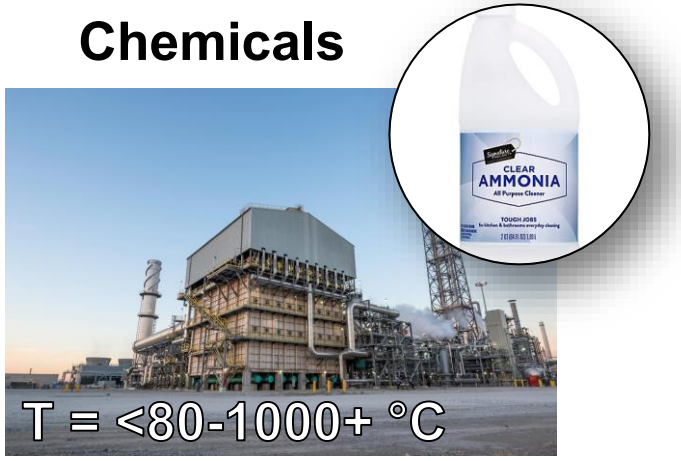
Cement

Iron & steel

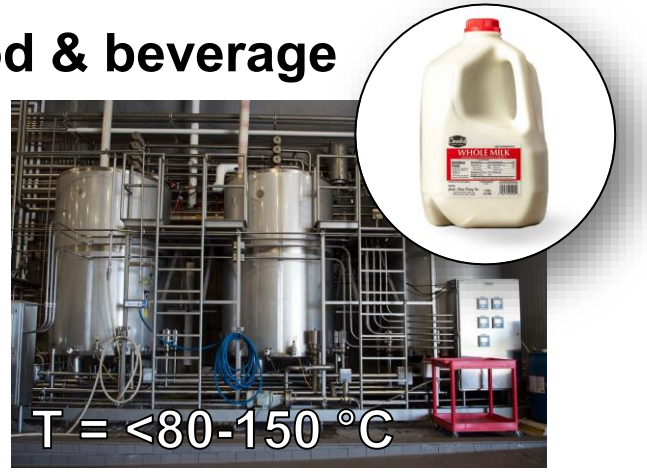
Pulp & paper



Chemicals

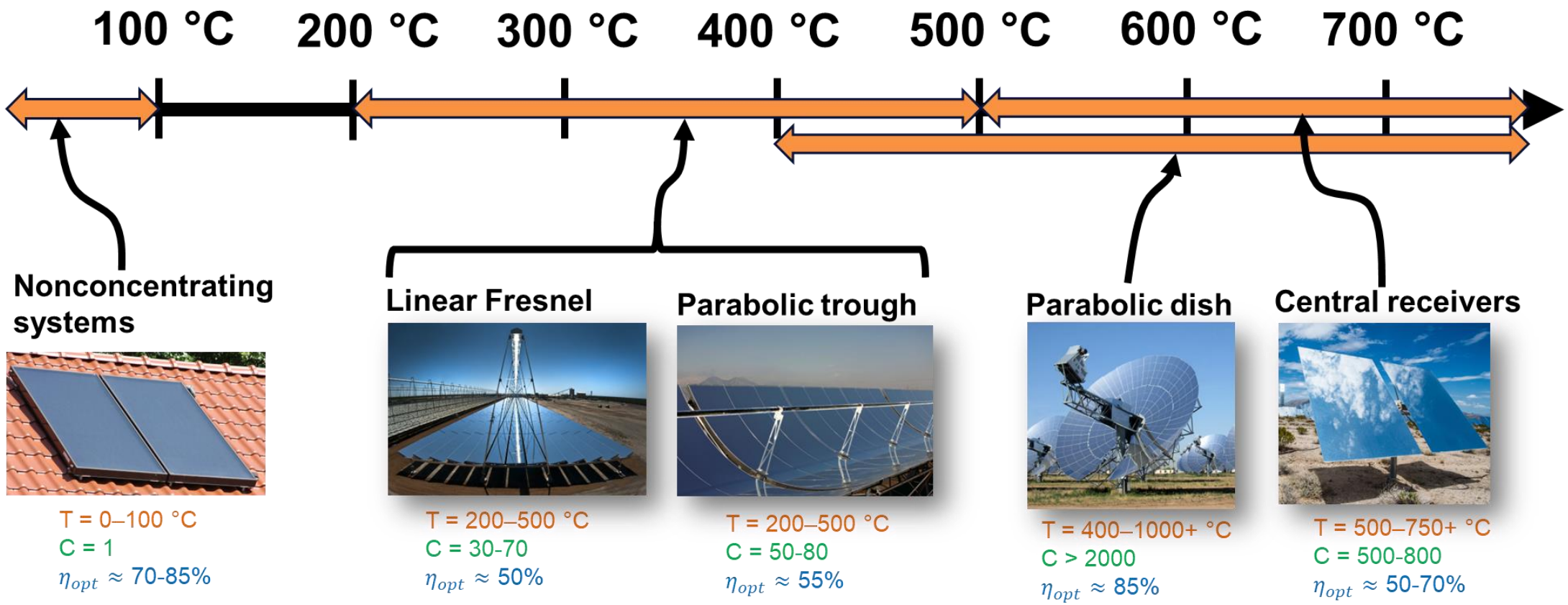


Food & beverage



Oil refining

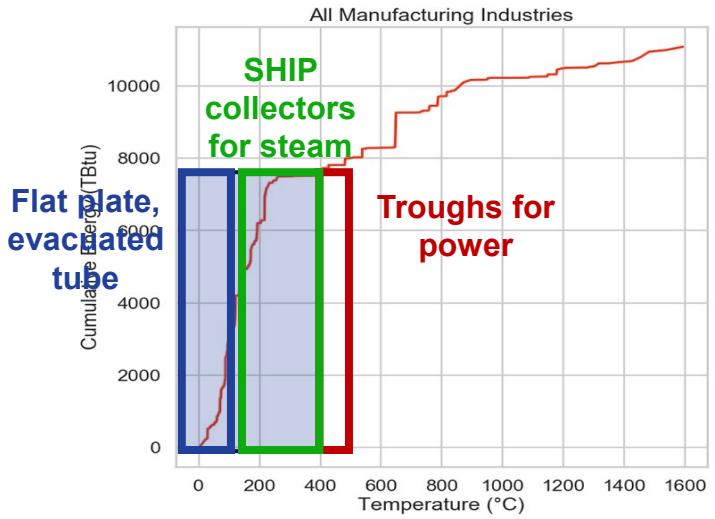
What is the right collector for the job?



A huge opportunity to develop collectors for industrial steam

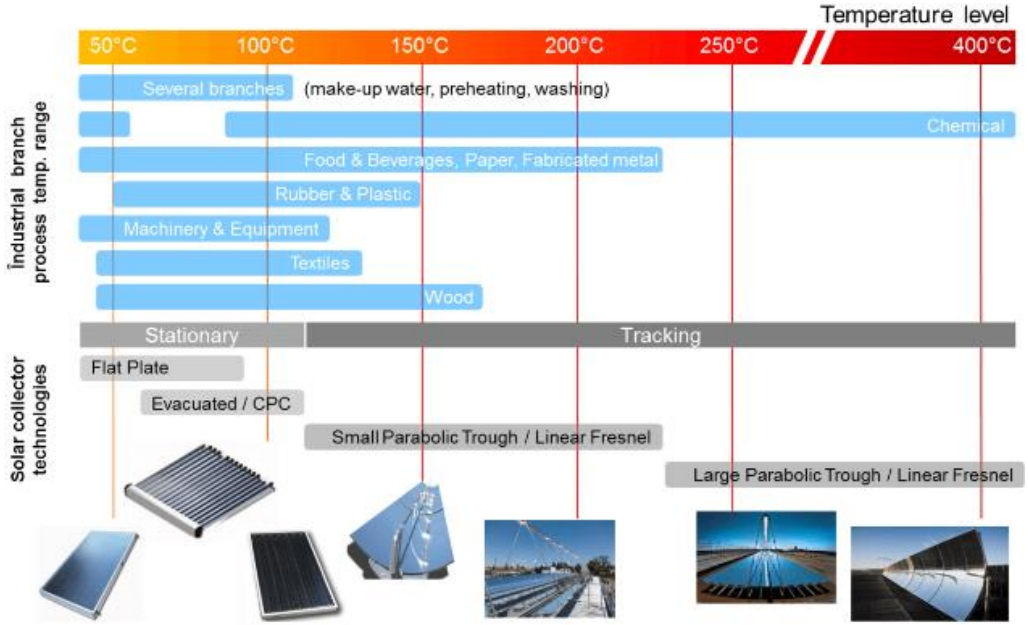
1/3 of All Process Heat used to make steam ~2,300 TBtu (2.3 Quads or ~675 TWh)

~2/3 of Process Heat Below 400 ºC



https://www.nlr.gov/analysis/solar-industrial-process-heat

Collectors to deliver 150-400 ºC steam for Process Heat Applications



https://task49.iea-shc.org/Data/Sites/1/publications/Task%2049%20Deliverable%20A1.3_20160504.pdf

How do we deliver commercially ready collectors for SHIP?

1. Develop collectors that meet requirements for SHIP product-to-market fit:

   Cost-competitive, industrial-sized (likely smaller, lower temperature) collectors that are easy to install and easy to operate and maintain

2. Risk-averse industrial customers need to see them working without a shadow of a doubt:

   Ground truth testing and demonstration of collector performance in a realistic operating environment through all seasons, weather, and environments

What are the product requirements for cost-competitive industrial-sized collectors?

Temperature

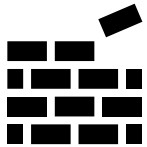
What bracketing of temperature product classes are needed?

What is an acceptable optical “error budget”?

Sizing

How big does a collector need to be?

What space is available? A brownfield? A rooftop?



Deployment

How do you ship it?

How do you make assembly/install easy for local labor crews?

How do you verify that it’s working once installed?

Operation & Maintenance

How do you make control and fault-detection automated?

How do you maintain required performance with automated/easy cleaning?

Cost

How do you balance cost, risk & reliability, and manufacturing & scaling to deliver economically viable collectors?

How do you raise the funds to get the job done?

What is the supplier-developer-customer relationship?

Existing quality assurance testing standards are not enough

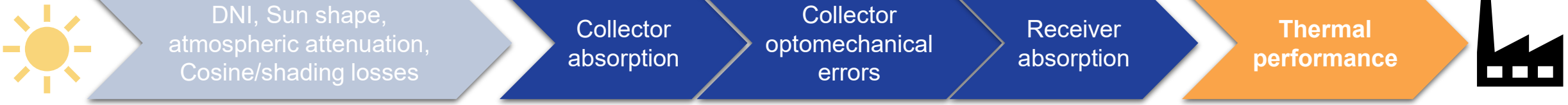
Existing standards: qualification over a few weeks of a single module, possibly only in a lab environment, projections of annual performance. The priority is consistency for certification testing, not realistic operating conditions.

What is needed: outdoor testing of a Solar Collector Array (SCA) over months of seasonal fluctuations, weather conditions, and realistic industrial environments

We can’t improve collectors without good data

Data to help collector developers troubleshoot and correct efficiency losses

What matters to industry customers



Existing:
Off-the-shelf instruments and well-documented practices for reflectance measurements

Still needed:
Reflectance sampling standard procedures for each collector type/size

Existing:
Drone or ground based imaging tools, lasers, inclinometers for parabolic troughs

Still needed:
Adapt, verify, and standardize tools for different collector types (Linear Fresnel, compound parabolic, etc.)

Existing:
Laboratory-scale techniques to measure receiver absorption

Still needed:
Standard procedures in an outdoor operating environment

Still needed:

Standardized analysis and reporting of efficiency loss data for each collector type

Demonstrating performance through all seasons, weather, and environments

Industrial operators are risk-averse to any major process changes that could impact plant uptime. No one wants to be the first guinea pig.

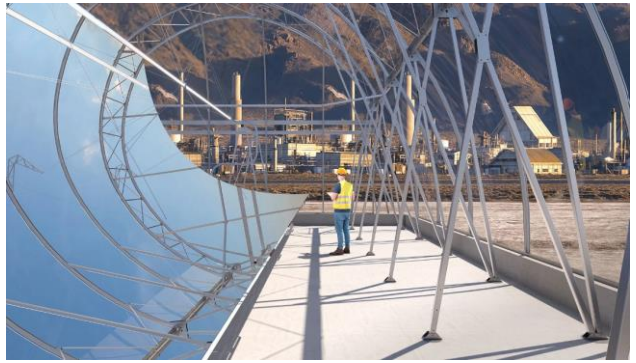
What's needed:

- Outdoor testing environments that show ground-truth performance of collector **arrays** over multi-month periods
- **Site Acceptance Testing** (SAT) to reduce financial risk for the off-taker

US SHIP deployment is in development now

Searless Valley Minerals and Glasspoint

700 MWth SHIP plant for borax mining facility producing 1.75 million tons/year



https://www.glasspoint.com/press-release-glasspoint-and-searles-valley-minerals

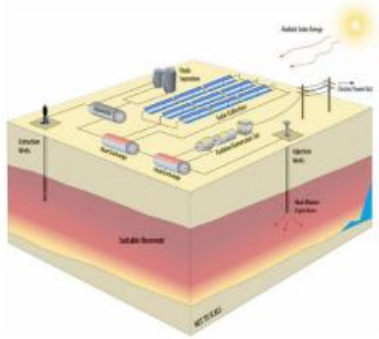
Firestone Walker

SHIP plant to deliver 250° C steam to a brewery producing over half a million barrels per year

https://californiathroughmylens.com/firestone-brewery-paso-robles/

Premier Resource Management

100 kWe demonstration of a hybrid SHIP geothermal plant for 12-hour seasonal storage and enhanced oil recovery



https://synthetic-geothermal.com/#5b1c0737-c035-410d-83f8-17be4f304503

Key Takeaways

SHIP systems transform sunlight into low-cost, reliable, and localized process heat using abundant materials to support American Industries.

Commercially viable SHIP products will need cost-competitive, industrial-sized collectors that are easy to deploy and easy to operate and maintain.

Risk-averse industrial customers will not consider SHIP solutions unless they see ground-truth evidence of collector performance through all seasons, weather, and environments.

Contact Information
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Questions?