Heliogen

Replacing Fuels with Sunlight

Dolf Joekes

VP, Sales

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Cost-effectively replacing fossil fuels solves the world's CO_2 problem.

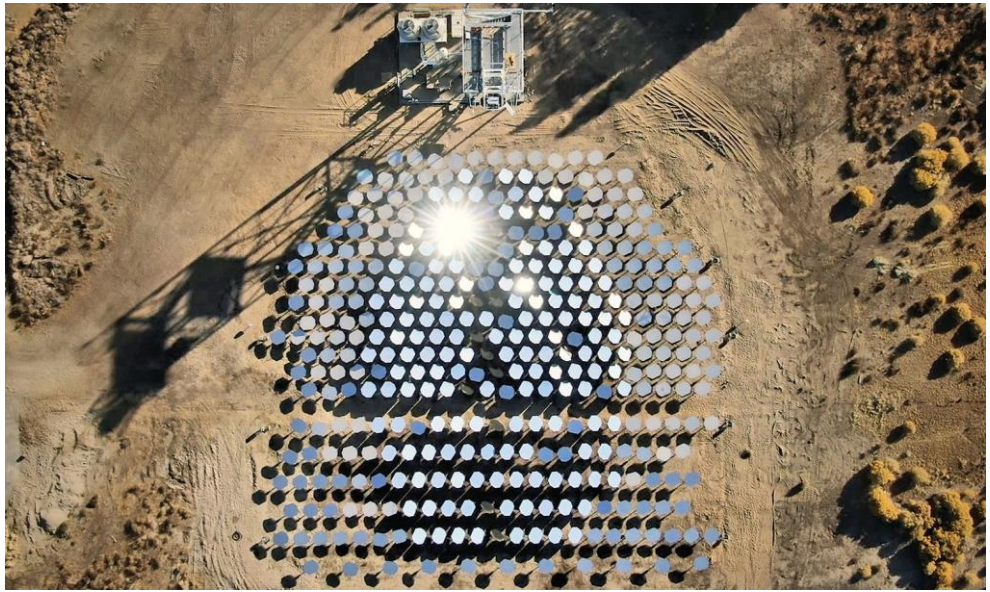
Heliogen develops the technology to do just that.

Existing Decarbonization Pathways for Mining

- Existing options
  - Equipment electrification
  - Powering with hydrogen
  - PV + batteries
- These solutions are not cost-effective or easy to deploy
- The mining industry needs a cost-effective solution to rapidly decarbonize

The Solution: Heliogen's Sunlight Refinery™

- *Sunlight Refineries* capture, concentrate, and refine sunlight into cost-effective, 24/7 energy on demand
- *Sunlight Refineries* utilize Heliogen's unique advanced computer vision software to precisely align an array of mirrors (heliostats), reflecting sunlight to a single target with unprecedented accuracy
- *Sunlight Refineries* are modular and can be easily deployed in proximity to mining operations or in remote areas



Heliogen's demonstration facility in Lancaster, California

Heliogen's 24/7 Renewable Energy Products

HelioHeat™

- Carbon-free, ultra-high temperature heat
- Energy is stored thermally as heat in rocks; most cost-effective energy storage available
- Target cost: < delivered natural gas

HelioPower™

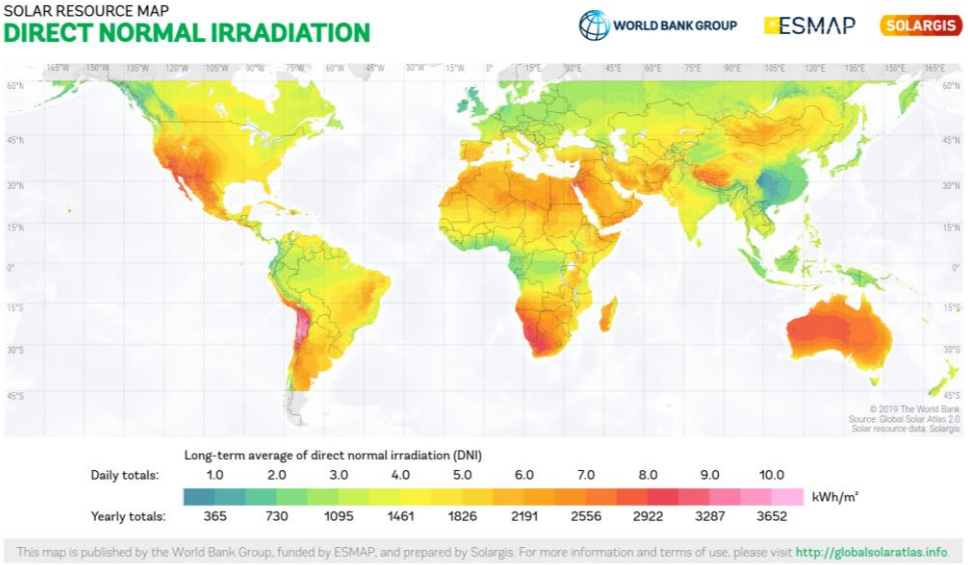
- Renewable electricity made from concentrated sunlight
- 80%+ capacity factor
- Target cost: < 5¢/kWh

HelioFuel™

- Clean, renewable fuels like green hydrogen
- 24/7 electricity enables near 100% electrolyzer utilization for hydrogen production
- Target cost: < $2/kg

Decarbonizing with Sunlight

- Direct Normal Irradiation (DNI) is a measure of annual solar resource available per m^2
- The greater the DNI, the better the economics
- South America is well known for having the best sunshine on the planet, followed closely by Australia and Africa
- Many mines are already located in these regions



Source: Solargis

Leveraging Breakthrough Technology

Heliogen's demonstration facility in Lancaster, California

Moore's Law (Software vs. Hardware)

Heliogen uses software and computer vision to precisely control thousands of small mirrors to create ultra-high temperatures, **unlocking low-cost thermal energy storage**

Fewer Parts / Smaller Carbon Footprint

Materials like steel and aluminum – which have embedded carbon and are costly – are replaced with **software and Artificial Intelligence (AI)**

Reduced Installation Costs

Heliogen's heliostats are ready out-of-the-box and easy to deploy, **requiring little in-field assembly**

Faster Installation Time

Heliogen's patented closed-loop control system **eliminates the need for months-long manual calibration**

Heliogen Advantages over Traditional CSP

- **Traditional CSP systems:**
  - Large budgets (hundreds of millions / project)
  - Long timelines (5 years)
- **Heliogen's Sunlight Refinery™:**
  - Modular system in 5 MW blocks that can be customer sited
  - Small budgets (tens of millions / project)
  - Short timelines (~2 years)
  - Economies of scale for facilities with multiple modules

Heliogen's demonstration facility in Lancaster, California

Heliogen-Enabled Applications for Mines

Steam:
150º – 450ºC
Medium-temperature heating, drying, and leaching

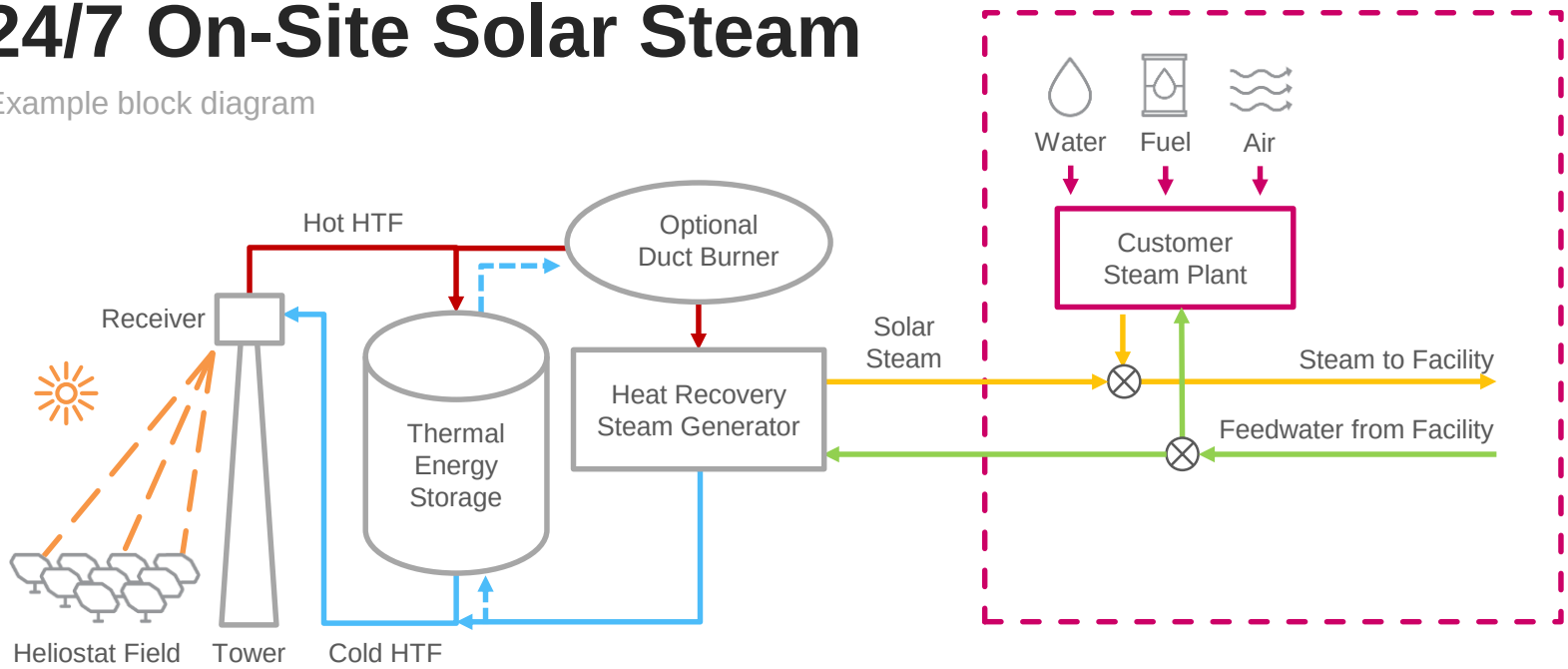
Electricity:
>700ºC
Power generation

Ore Processing:
600º – 1200ºC
Comminution (rock crushing), smelting, refining / treating

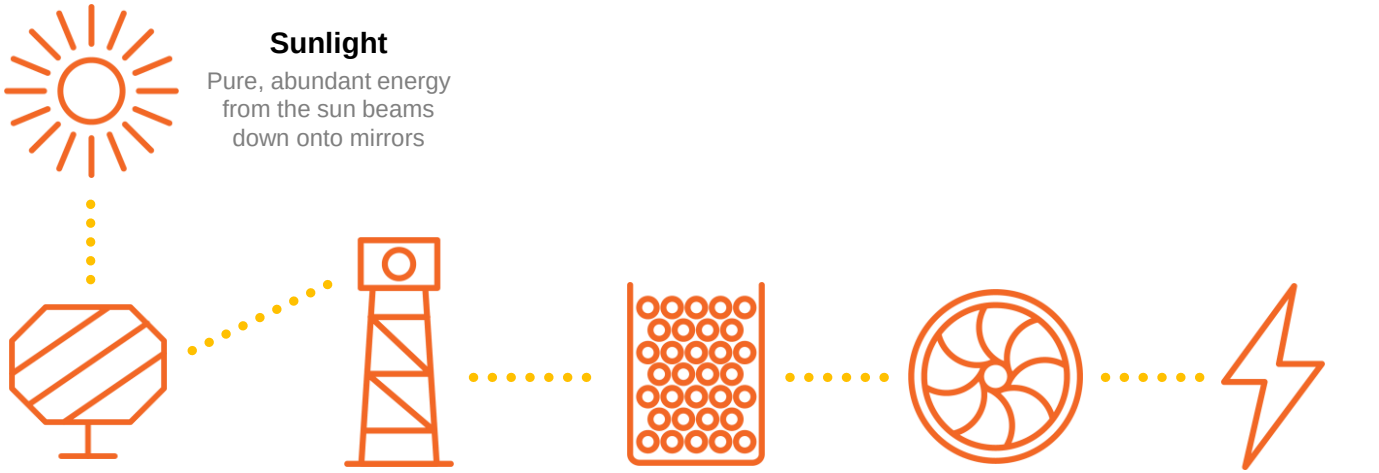
Electrolysis:
Ambient – ~800ºC
Green hydrogen production with low or no greenhouse gas emissions

HelioHeat™ Integration: 24/7 On-Site Solar Steam

Example block diagram



HelioPower™: 24/7 renewable electricity



Sunlight
Pure, abundant energy from the sun beams down onto mirrors

Heliostats
An array of computer-controlled mirrors (heliostats) collects and concentrates sunlight

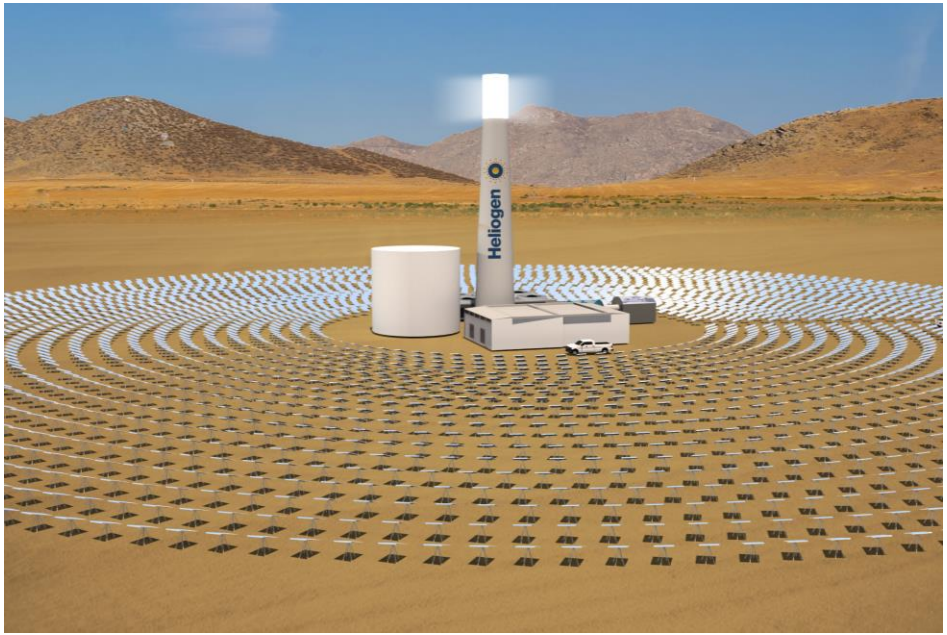
HelioHeat™
Captured sunlight equivalent to 1.2k suns is converted to carbon-free, ultra-high temperature heat

Storage
Ultra-high temperature heat is stored safely in hot rocks

Turbine / Generator
Generated heat then drives a turbine engine

HelioPower™
Producing 24/7, low-carbon electricity

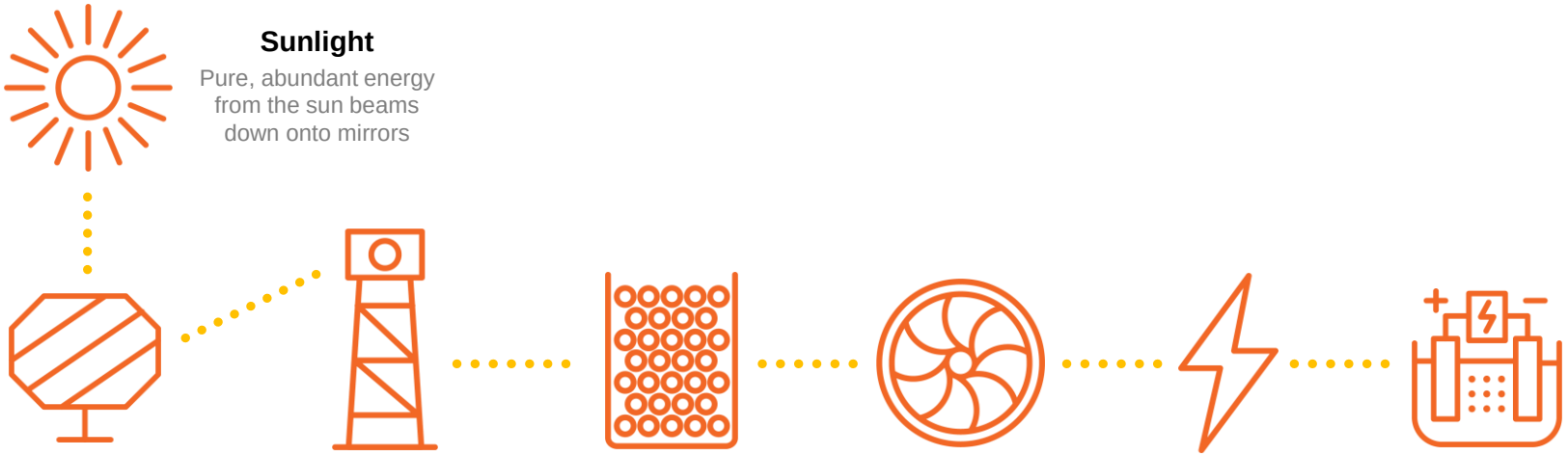
Heliogen's Sunlight Refinery™ module



Rendering of Heliogen's Sunlight Refinery™

- **Providing Energy Security**
  - Limited, to no reliance on the power grid
  - Ideal for off-grid situations
- **Minimizing Transportation** Losses and **Costs**
  - Compact module can be sited close to load center as a distributed energy resource

HelioFuel™: Clean, renewable fuels like hydrogen



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HelioPower™
24/7, low-carbon electricity

HelioFuel™
Electrolyzer generates green hydrogen

A Natural Fit for the Mining Industry

Heliogen's concentrated solar technology is the only commercially available solution today that can cost-effectively provide 24/7 decarbonization of mining operations.

Our modular *Sunlight Refineries* require less than half the cost and take half the time to deploy, compared to traditional CSP.

We are currently exploring deployments with key players in the mining industry who are eager to become early adopters.

We welcome the opportunity to green your operations cost-effectively.

Heliogen's demonstration facility in Lancaster, California

Our Team

Bill Gross
CEO & Founder

Heliogen is the brainchild of Bill Gross, founder of renowned technology incubator, Idealab. Bill has founded many innovative companies including several in solar energy such as eSolar, RayTracker, Thermata, and EI Solutions.

Vikas Tuteja
COO

Vikas is an operations, finance and strategy professional with over 25 years of experience as an engineer, management consultant, investor and operator for companies in a wide variety of industries.

Steve Schell
CTO

Steve is a mechanical engineer by training and an entrepreneur at heart, with over 15 years of experience in R&D and commercialization of new technologies spanning solar energy, robotics, and 3D printing.

Fatimah Bello
VP, Business Development

Fatimah is a technology and strategic business development leader with 20 years of global experience in growth projects development, process engineering, and operations management across chemicals, cleantech, and downstream oil and gas industries.

Dolf Joekes
VP, Sales

Dolf has been commercializing cleantech for 17 years across 4 continents, bridging the startup and corporate worlds in hydrogen fuel cells, biomass and EV smart grid charging.

Our Backers

Swaroop ‘Kittu’ Kolluri
NeoTribe

Patrick Soon-Shiong
Nant Capital

Steve Case
Revolution’s Rise of the Rest Fund

Bill Gates
Gates Foundation


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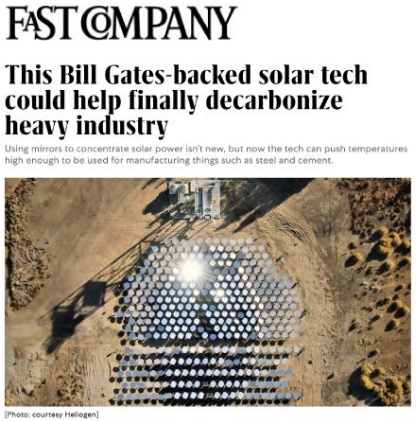
QUARTZ


FAST COMPANY
This Bill Gates-backed solar tech could help finally decarbonize heavy industry
Using mirrors to concentrate solar power isn't new, but now the tech can push temperatures high enough to be used for manufacturing things such as steel and cement.
[Photo: courtesy Heliogen]


Climate Change / Clean Energy
How heat from the sun could help clean up steel and cement
Serial entrepreneur Bill Gross has launched a new solar thermal venture, designed to cut climate emissions from industrial heat.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THE BIGGEST BREAKTHROUGH IN HARNESSING HEAT FROM THE SUN!


Dr. Patrick Soon-Shiong
Investor and Board Member | Heliogen
Bill Gross
Founder and CEO | Heliogen

Thank You

Dolf Joekes

VP, Sales

Dolf@heliogen.com