

# **Solar Bitcoin Mining**

## **Now and Into the Future**

**Including “Distributed Thin Solar Waste Mining”**

**Open Bitcoin Design Community, please join the Slack Community, #sustainability channel**

**@bob (Slack) - Feb. 22, 2022 - Draft v1**

# Looking for talented & creative people to **envision** this shared future

Including basic math & energy utilization

what are other words for envision?



visualize, see, imagine,  
picture, foresee, envisage,  
fancy, anticipate, conceive,  
image



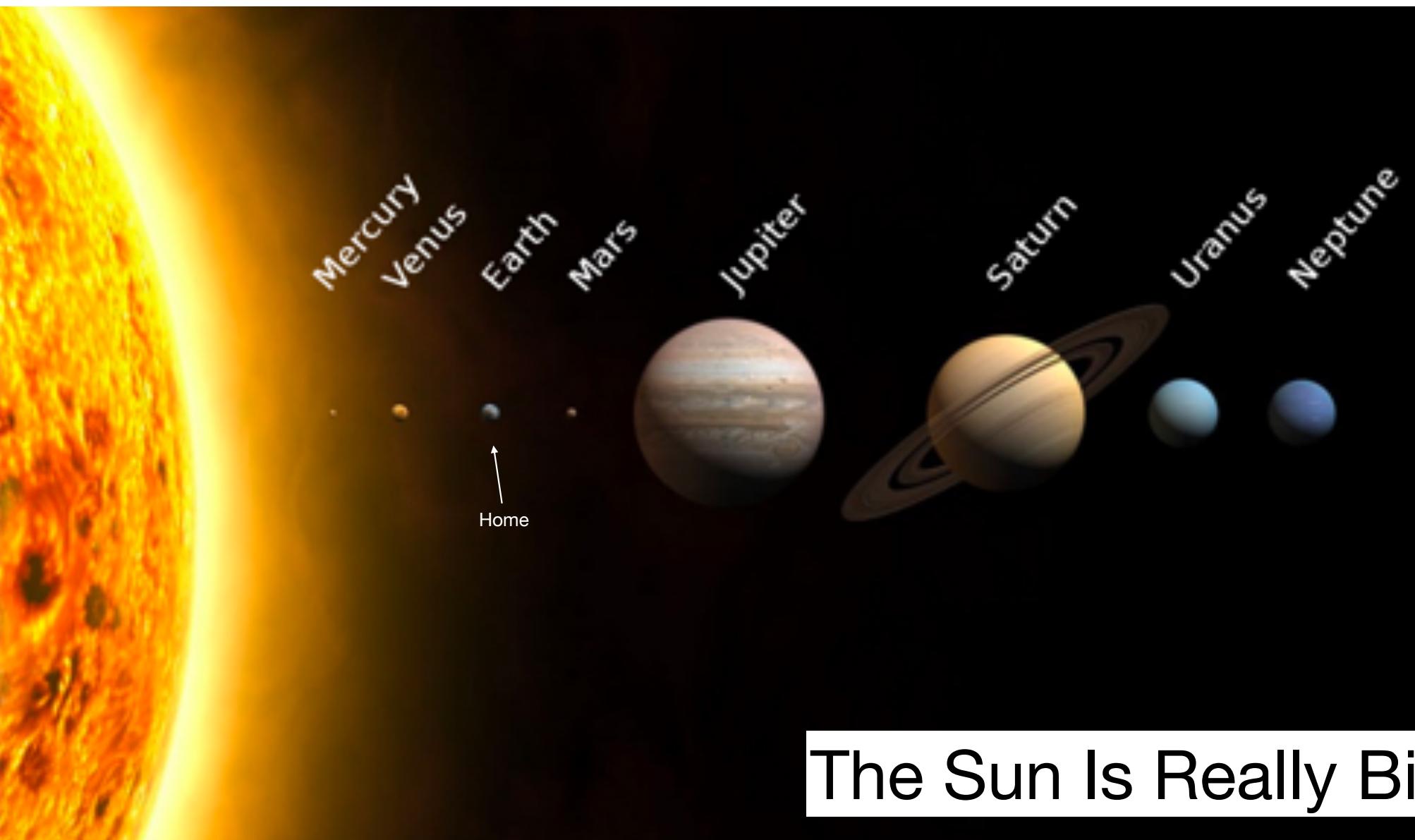
Thesaurus.plus



# Common Earth Scale Energy Units

	yotta [Y]	$10^{24} = 1\ 000\ 000\ 000\ 000\ 000\ 000\ 000$	
	zetta [Z]	$10^{21} = 1\ 000\ 000\ 000\ 000\ 000\ 000\ 000$	
	exa [E]	$10^{18} = 1\ 000\ 000\ 000\ 000\ 000\ 000\ 000$	
	peta [P]	$10^{15} = 1\ 000\ 000\ 000\ 000\ 000\ 000$	
Trillion	tera [T]	$10^{12} = 1\ 000\ 000\ 000\ 000$	Tera-Watts (TW) & Tera-Watt-hours (TWh) & Tera-Hash (TH)
Billion	giga [G]	$10^9 = 1\ 000\ 000\ 000$	Giga-Watts (GW) & Giga-Watt-hours (GWh)
Million	mega [M]	$10^6 = 1\ 000\ 000$	Mega-Watts (MW) & Mega-Watt-hours (MWh)
Thousand	kilo [k]	$10^3 = 1\ 000$	kilo-Watts (kW) & kilo-Watt-hours (kWh)
	hecto [h]	$10^2 = 100$	
	deca [da]	$10^1 = 10$	





The Sun Is Really Big

# Sun's Energy Reaching Earth

1,515,480,000 TWh per year, or

1.515 billion TWh per year, or

1.515 ZWh per year

Source: <https://explainingscience.org/2019/03/09/solar-energy/>

9500x the total energy needed for earth

# Earth's Energy Generation & Waste

160,000 TWh per year generated

50,000 TWh per year lost (waste)

Sources:

[explainingscience.org/2019/03/09/solar-energy/](https://explainingscience.org/2019/03/09/solar-energy/)

[youtube.com/watch?v=3ZP3aXUnEo](https://www.youtube.com/watch?v=3ZP3aXUnEo)

Bitcoin can thrive on 0.044% of waste energy

# Topez Solar Farm Generation

1.25 TWh per year generated  
550 MW rated capacity

Source: [explainingscience.org/2019/03/09/solar-energy/](https://explainingscience.org/2019/03/09/solar-energy/)



Solar bitcoin mining pays for **more** solar

# Kauai Island Utility Coop Generation & Storage

26 GWh per year generated  
13 MW rated capacity

52 MWh of storage

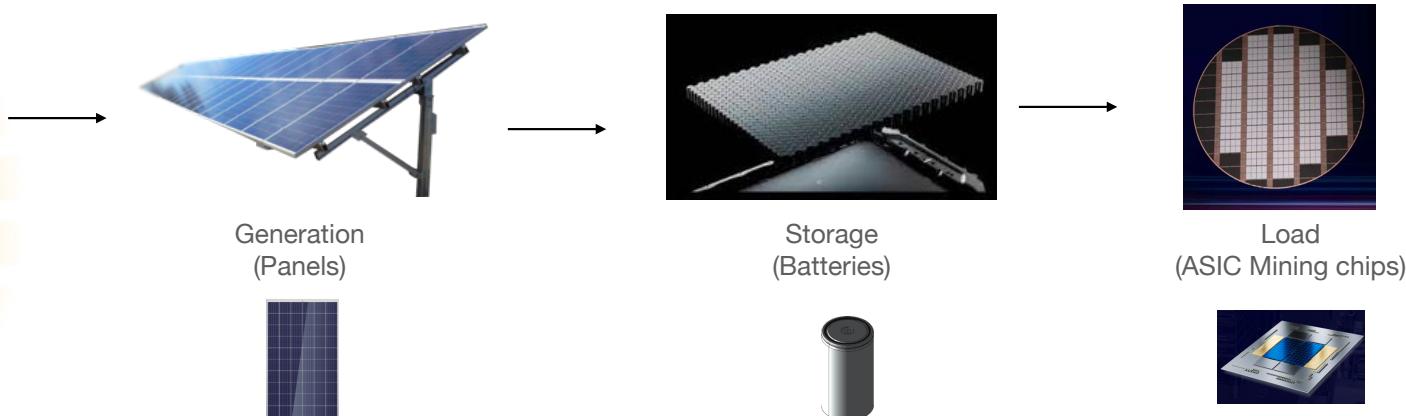
Provides energy shifting for the island, while saving 1.6 million gallons of fossil fuel each year

Source: [tesla.com/utilities](http://tesla.com/utilities)

Bitcoin creates value for 7.9 billion humans

# Components of Solar Energy

## Generation, Storage & Load



# Panels

## Generation

- Panels are rated for an energy generation capacity, like **400 Watts (W)**
- Usually rated for a **25+ year life**
- If a 400 W panel receives full sunlight for 6 hours, it would produce **2400 Watt-hours (Wh)** of electricity
- This is **2.4 kWh per day** or **876 kWh per year**
- At **\$1 per Watt**, this panel costs **\$400**

Ref panel: [LG400Q1C-A6](#)  
Cost Refs: [Price of Solar Panels](#)



<https://www.cleanenergyreviews.info/blog/solar-panel-components-construction>

# Batteries

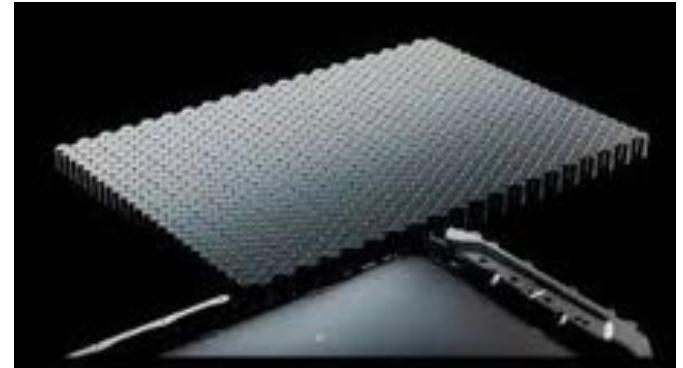
## Storage

- Batteries are rated for an energy storage capacity, like **26 Amp-hours (Ah)**
- A single battery can then store **120 Wh** of energy and deliver it later to a load
- Usually rated for a **10+ year life** in solar applications
- A single solar panel generating **2400 Wh** of electricity per day would require **20 batteries**
- At **\$100 per kWh**, these 20 batteries cost **\$240**

Ref battery: [Panasonic/Tesla 4680 Cell](#)  
Battery Costs: \$100 per kWh



Single Battery



Array of Batteries



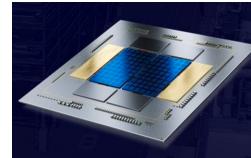
Cabinets of Battery Arrays

# ASIC Mining Chips

## Load

- ASIC chips produce a hash rate, like **137 Giga-Hash per second (GH/s)**, when powered by **2.5 W**
- If this ASIC chip operates for a full 24 hrs a day, it consumes **60 Wh**
- If solar panels and batteries provide 2400 Wh of energy a day, **40 ASIC chips** could run continuously
- At **\$10 per chip**, these 40 ASIC chips cost **\$400**
- At **0.137 TH/s** per chip, these 40 ASIC chips mine at **5.48 TH/s** while drawing 100 W

Ref chip: [BMZ1](#)



Single ASIC Chip



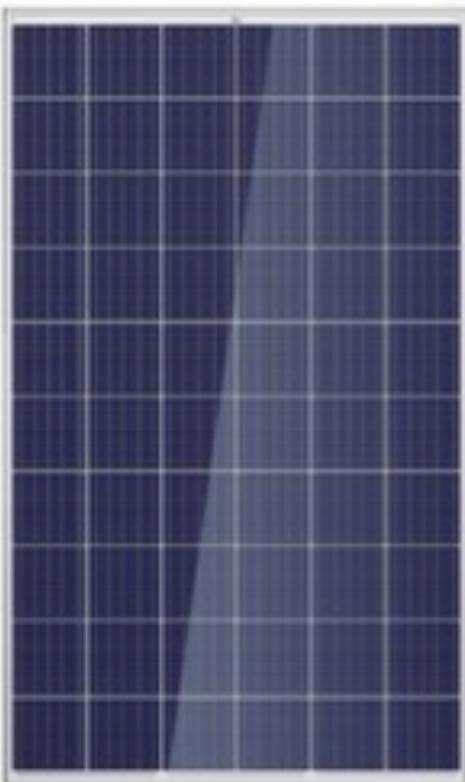
Array of ASIC Chips mounted on Printed Circuit Board (PCB)



Bitcoin miners with ASIC chips in a shipping container

With **876 kWh per year** of energy available

**1 Panel**

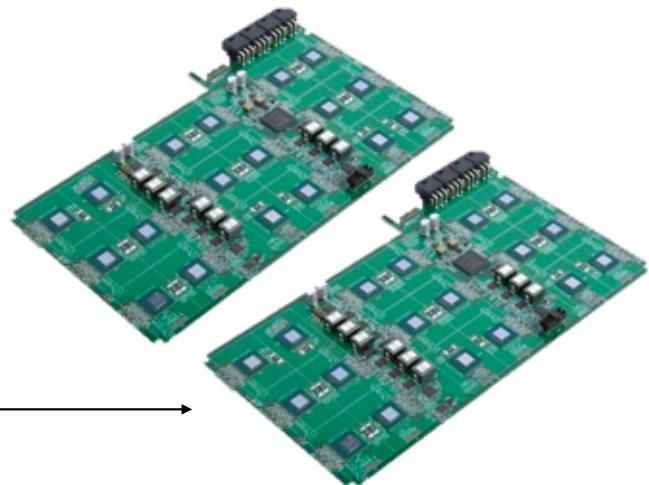


**\$400**

**Mining** generates **\$0.46 per kWh**, or **\$403 a year**

Component costs, \$1040, are paid back in **2.5 years**

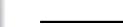
**40 ASIC Chips**



**20 Batteries**



**\$240**



**+**

**+**

**\$400**

**=**

**\$1040**

# Payback Alternatives

## Load Options

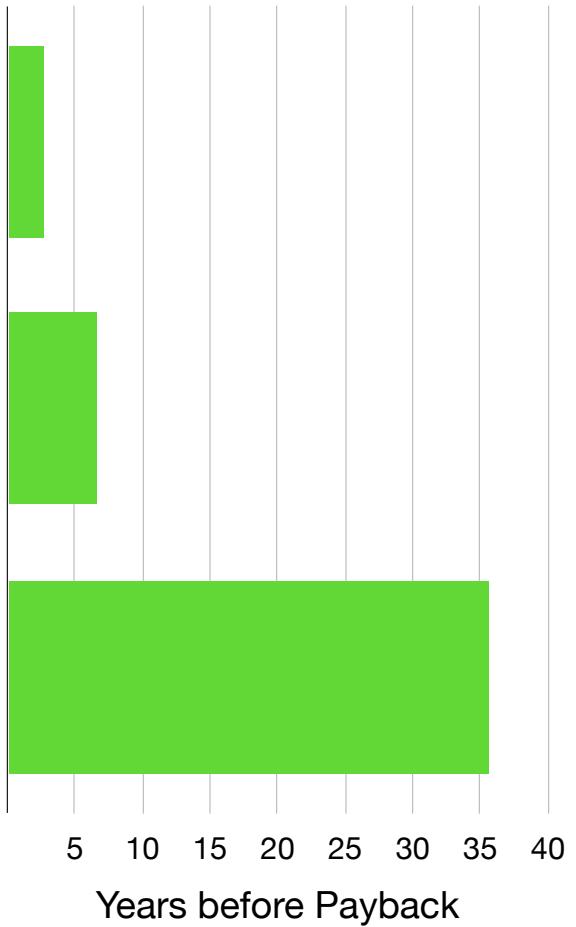


Mine Bitcoin

$$876 \text{ kWh} \times \$0.46 / \text{kWh} = \$403$$

$$\$1040 / \$403 = \text{2 years 7 months}$$

Bitcoin



Solar Bitcoin Mining creates a **2.6x faster payback** compared to grid energy savings



Use energy instead of paying grid prices

$$876 \text{ kWh} \times \$0.11 / \text{kWh} = \$96$$

$$\$640 / \$96 = \text{6 years 8 months}$$

Typical

Solar Bitcoin Mining creates a **13.8x faster payback** compared to selling back to the grid



Sell back to the Grid

$$876 \text{ kWh} \times \$0.02 / \text{kWh} = \$18$$

$$\$640 / \$18 = \text{35 years 8 months}$$

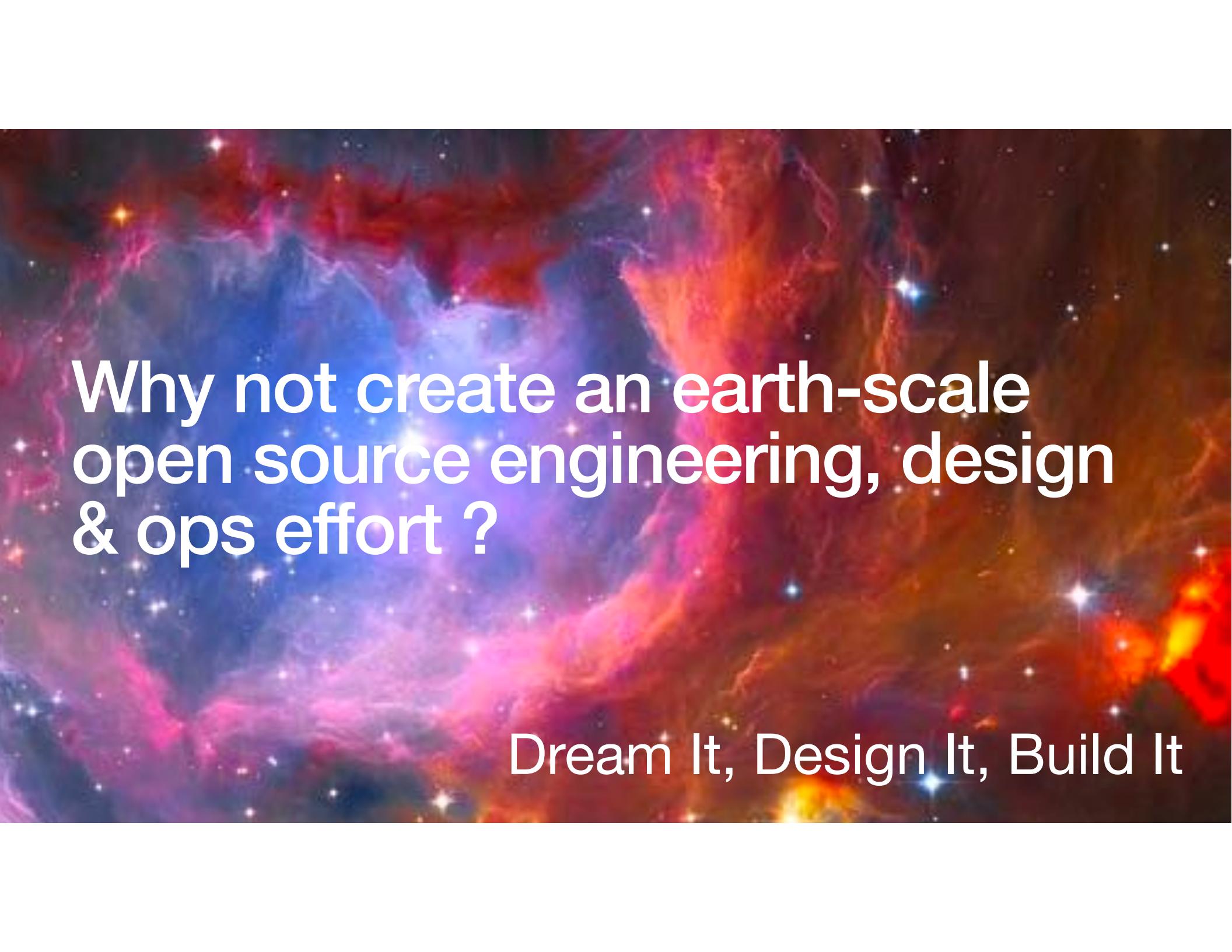
Grid

Solar Bitcoin Mining creates a **5x faster payback** compared to a mix of energy saved & selling back to the grid

**2.5 years is 5x faster than  
typical 10 year payback periods**

**Solar bitcoin minings pays for the costs of  
transitioning to a solar powered world!**

Without any extra innovation, this would be good enough... **but what if we can do more?**

The background of the slide features a stunning, colorful nebula or galaxy. It has swirling patterns of red, orange, yellow, and blue, with numerous small white stars scattered throughout. The overall effect is one of deep space and celestial beauty.

Why not create an earth-scale  
open source engineering, design  
& ops effort ?

Dream It, Design It, Build It

# **Open:** **Innovation, Teamwork, Funding, and Returns**

Humanity needs to work together on a solar powered future... it can be paid for with solar bitcoin mining returns

Open Collective People Powered **Design & Engineering**

1 million hours ( 1000 contributors , 25 weeks per contributor )

People Powered **Funding** for Planetary Benefits

\$25 billion ( \$1000 per person, 25 million people)

Distributed People Powered **Operation**

10 million people

## **Open Innovation for Humanity**

# Earth-scale solar mining looks like this:

137 Million TH/s

Recent total Bitcoin network hash rate

1 billion ASIC chips

Mining for the Bitcoin network

\$10 billion

\$1000 by 10 million people

2.5 billion Watts

Total ASIC chips load

**21.9 TWh per year**

Total energy for the Bitcoin Network

**New ASICs are 10x more efficient**

500 million batteries

Needed to store energy for continuous use

\$5 billion

\$1000 by 5 million people

25 million panels

Needed to generate the energy needed

\$10 billion

\$1000 by 10 million people

# Common Integrated Circuit (IC) Units

deci [d]  $10^{-1} = 0.1$

centi [c]  $10^{-2} = 0.01$

milli [m]  $10^{-3} = 0.001$

Millionth  
↓  
Micro [μ]  $10^{-6} = 0.000\,001$

Billionth  
Nano [n]  $10^{-9} = 0.000\,000\,001$

Trillionth  
Pico [p]  $10^{-12} = 0.000\,000\,000\,001$

nano-meter (nm)  
Latest ASIC chips are at 7 nm and 5 nm scales

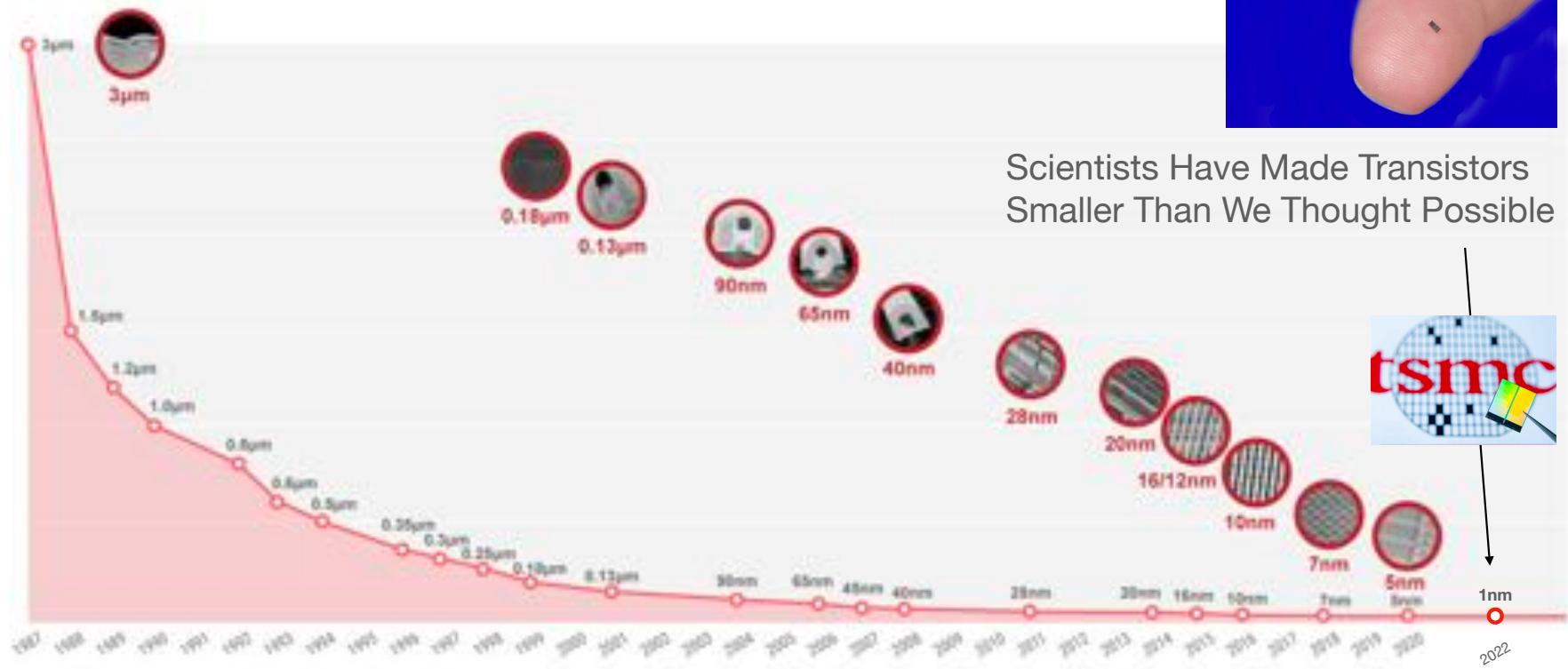
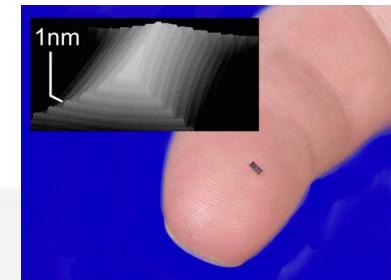
Femto [f]  $10^{-15} = 0.000\,000\,000\,000\,001$

Atto [a]  $10^{-18} = 0.000\,000\,000\,000\,000\,001$

Zepeto [z]  $10^{-21} = 0.000\,000\,000\,000\,000\,000\,001$

Yocto [y]  $10^{-24} = 0.000\,000\,000\,000\,000\,000\,000\,001$

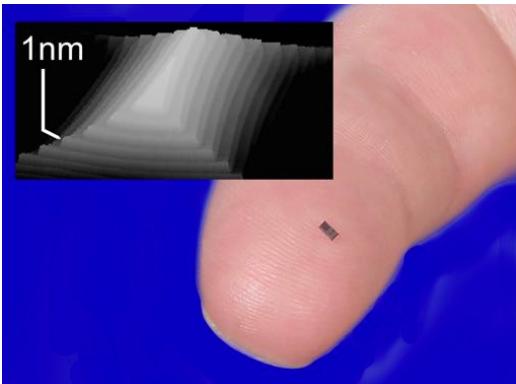
# Moving from nano to pico scale in ICs & ASICs



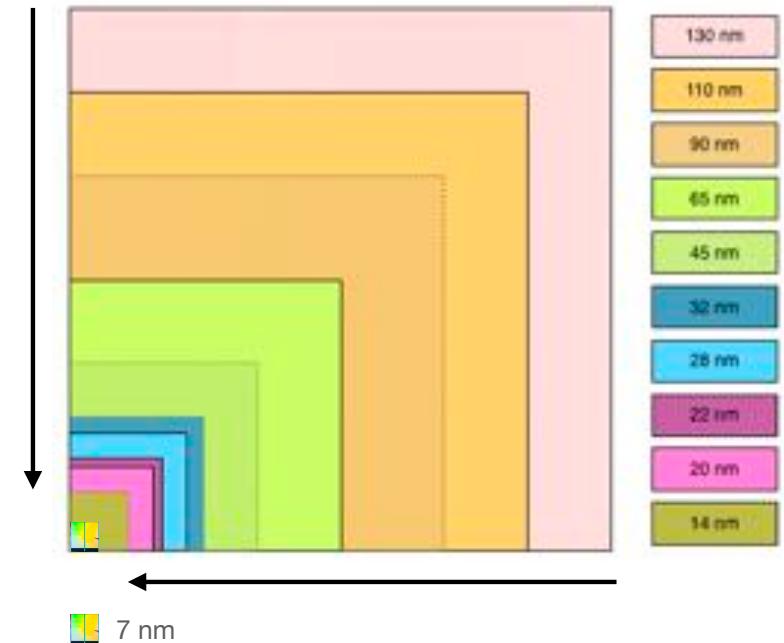
[https://www.tsmc.com/english/dedicatedFoundry/technology/logic/l\\_5nm](https://www.tsmc.com/english/dedicatedFoundry/technology/logic/l_5nm)

<https://www.verdict.co.uk/tsmc-trumps-ibms-2nm-chip-tech-hyperbole-with-1nm-claim/>

As the process scale decreases, so does chip size



Bitcoin mining can operate anywhere in new integrated PV and battery systems



# Distributed Thin Solar Waste Mining (DTSWM)

Mine with Direct-Current (DC) locally on the back of PV cells

# What can we learn from history?

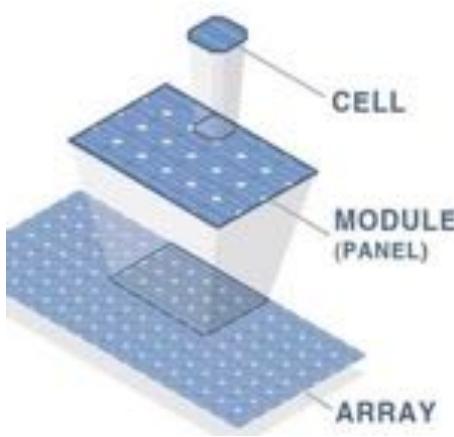


Smaller, Thinner, and More Integrated is the Trend



# Distributed

Mine anywhere, at any scale



Mine with **3 PV cells, 1 battery, and 2 ASICs** for the same payback / ROI

Current **Panel** Ratio

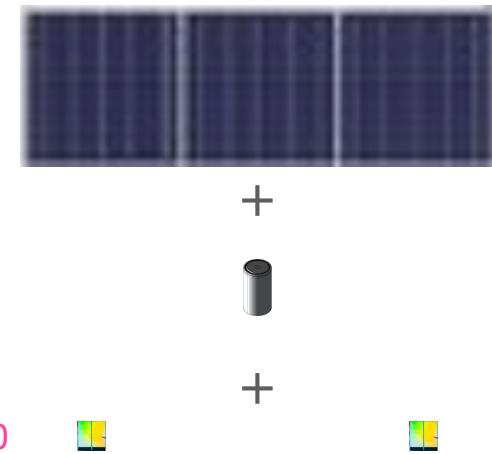
1 PV **Panel**, 20 Batteries, 40 ASICs



Component ratios  
**NOT** to scale

Current **Component** Ratio

3 PV **Cells**, 1 Battery, 2 ASICs

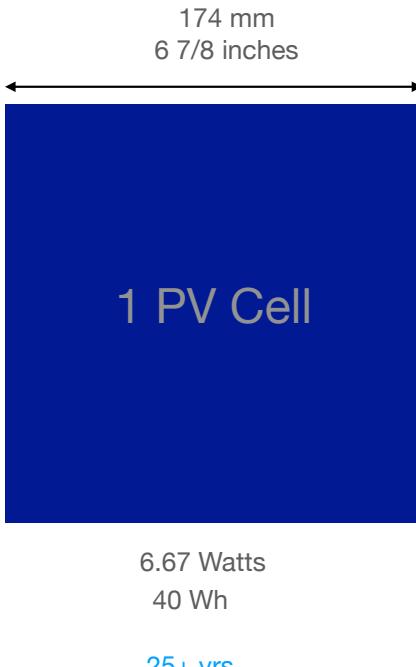


**Solution to centralized mining & install scaling**

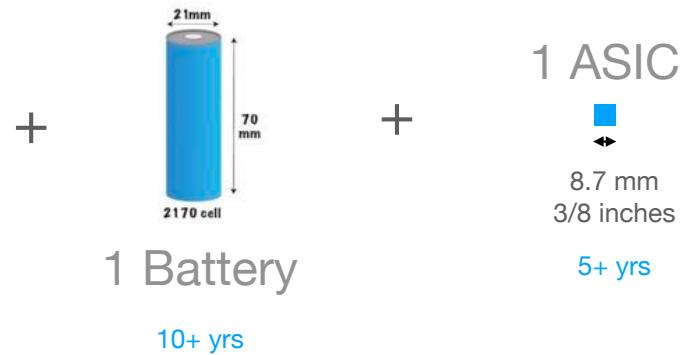
# Thin

## PV cell + batteries + ASICS

So much free space available for new integrations



### Component Ratios to Scale



Optimized Design Goal Component Ratio

1 PV Cell, 1 Battery, 1 ASIC

Leaves ample space for heat dissipation and any other electronics packaging needed

Batteries could be in various shapes or sizes and still work well

Typical assembly **thickness** would be dictated by the battery diameter / thickness

The assembly **height & width** would be driven by the PV cell size

Passively cooled ASICs

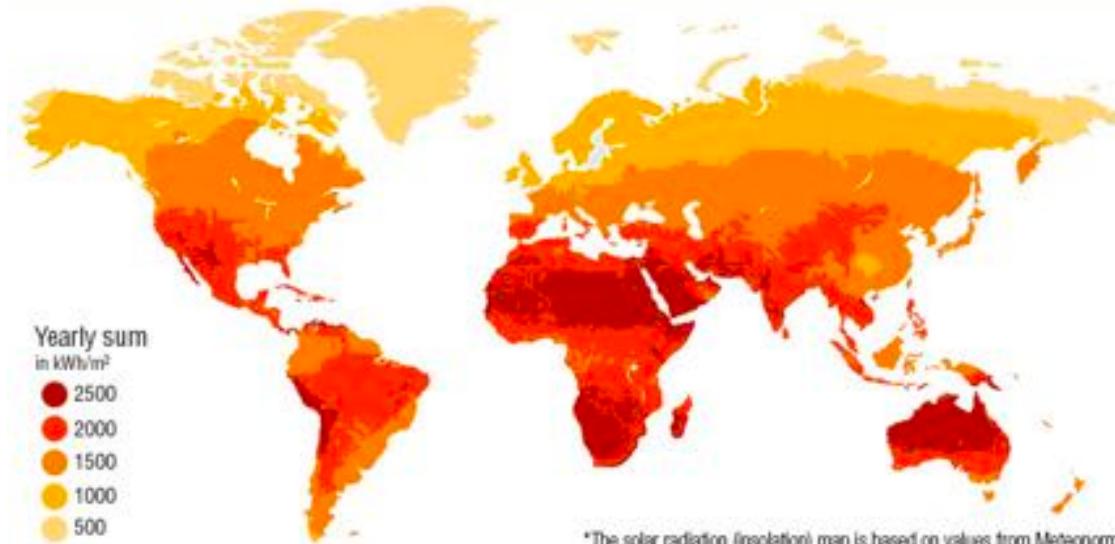
Design would make **easy battery and ASIC swap-ability**

### Solution to ASIC crowding & heat problems

# Solar

Everywhere, cleanest, cheapest, safest

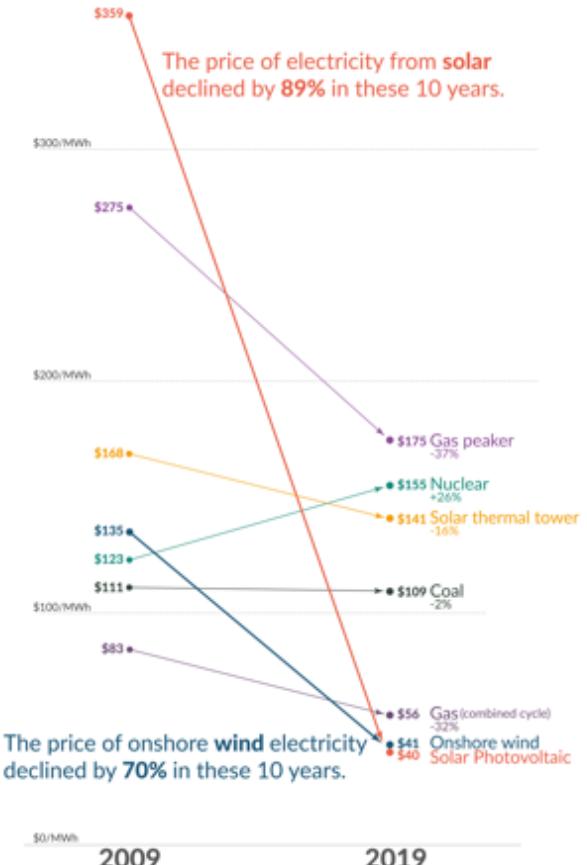
We need to increase solar installations by **7x to 100x** in the next two decades,  
Solar Bitcoin mining can accelerate the install incentives by **2x to 20x depending on location**



We're currently generating about **1000 TWh** of Solar energy per year

The price of electricity from new power plants  
Electricity prices are expressed in 'levelized costs of energy' (LCOE).  
LCOE captures the cost of building the power plant itself as well as the ongoing costs for fuel and operating the power plant over its lifetime.

Our World  
in Data



Data: Lazard Levelized Cost of Energy Analysis, Version 13.0  
OurWorldInData.org – Research and data to make progress against the world's largest problems.

Licensed under CC-BY  
by the author Max Roser.

## Solution to CO<sub>2</sub> generating energy sources & energy availability challenges

<https://www.iea.org/reports/solar-pv>

<http://www.alternative-energy-news.info/benefits-solar-power-infographic/>

# Waste

Free energy **not captured** or  
**not used (lost)** is waste

New Solar project installs should have a long-term “**primary**” energy load at any scale

The goal is for all new solar installations to generate energy for purposes in addition to mining bitcoin.

Swapping ASIC chips in 5 yrs would provide a renewed mining revenue stream if needed.

Alternatively, ASICs could be retired in favor of the “**primary**” load.

During operation, the ASIC mining load could be switched on and off as needed.

Primary load use cases would typically drive automatic switching.

## Example “primary” loads:

### Utility

- Cities
- Communities
- Governments
- Large scale commercial

### Commercial

- Powering Buildings
- Commercial Processes
- **Road Side Car Charging**
- Vehicle Fleet Charging

### Residential

- Homes
- **Personal Car Charging**
- Appliances
- AC & Heat

### Personal

- Cell Phones
- Computers
- **Bitcoin Nodes**
- Van Living

**Solution to “mining only” energy loads, all new energy generation should have **2+ load options****

# DTSWM Examples

One day, solar panels on earth, at any scale, could also **store the energy & mine bitcoin instead of wasting the excess free energy from the sun**



New Road Side EV Charging + DTSWM



Additional PV capacity for charging an electric car + DTSWM



Portable mobile charger + DTSWM



New Net Zero Energy Home + DTSWM



Running a remote bitcoin node + DTSWM



Off-grid shelter + DTSWM

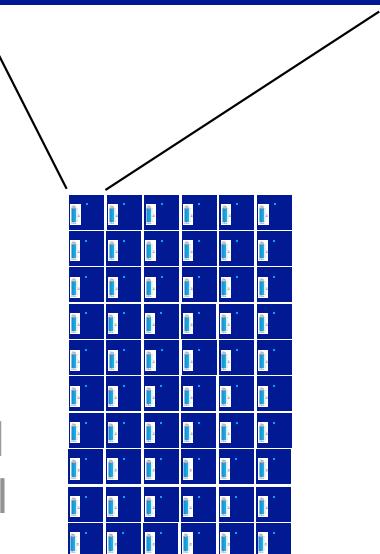
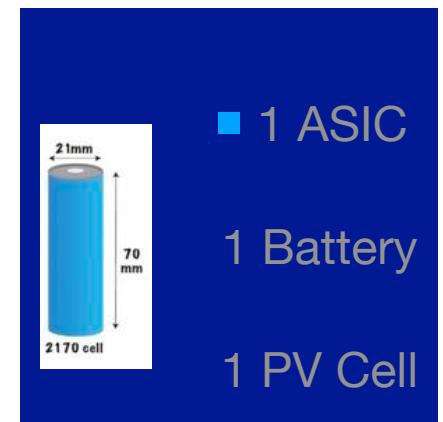
# Together we can create open DTSWM integration designs

- Designers & engineers to create 3D realistic concepts
- Designers & storytellers to create & share these concepts
- Open designs for integrating PV Cells, Batteries, and ASICs
- Collective funding to create initial real world examples
- Partners & suppliers that would build prototypes



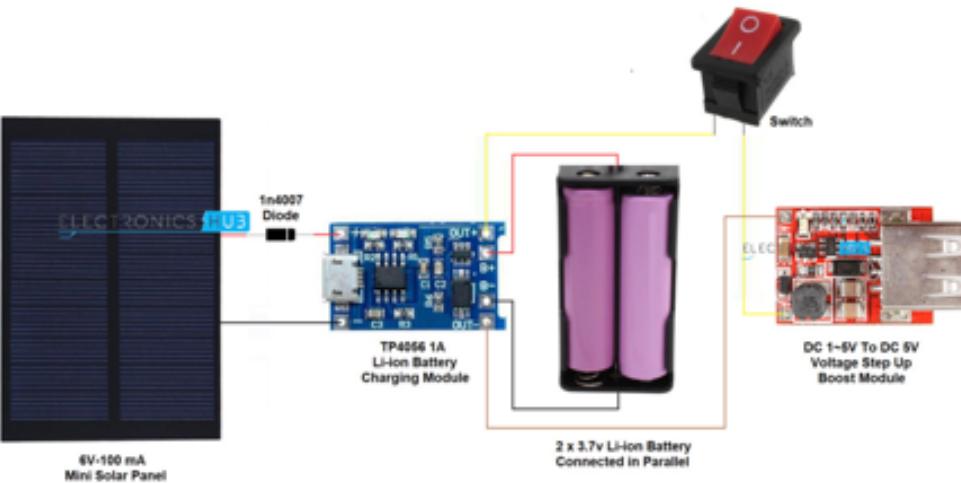
## Ratios to Scale

Envision an integrated design



1 Typical  
PV Panel

# DIY Deconstructed Parts for Clearer Understanding



Source: <https://voltaicsystems.com/small-solar-panels/>



## Components Required

- 6V – 100mA Mini Solar Panel
- 2 x 18650 Li-ion Batteries
- 18650 Battery Holders
- TP4056 Li-ion Battery Charger Module with protection
- 1V to 5V Input to 5V Output Step-up Converter (Boost Converter)
- 1N4007 PN Junction Diode
- Switch (Push to ON and Push to OFF)
- Connecting Wires

Source: <https://www.electronicshub.org/solar-battery-charger-for-18650/>

If energy storage and bitcoin mining can be integrated directly on the unused side of PV cells or panels, most of humanity would be able to mine & secure the bitcoin network.

We can decentralize solar energy generation and its rewards.

# More Examples

Design, Scale, Build & Install for other use cases like **powering homes & cars**

San Francisco



Source: <https://www.phius.org/2018-phius-passive-house-projects-competition>

India



Source: <https://www.pv-magazine.com/2021/09/09/indian-home-gets-36-72-kw-pv-system-with-540-w-panels/>

# The Fly Ranch in the Nevada Desert

319 MWh per year generated  
224 kW rated capacity

Off-grid (large waste potential)

Source: <https://www.yankodesign.com/2021/04/05/this-solar-farm-provides-300-mwh-of-renewable-energy-per-year-is-a-community-space-at-the-burning-man/>

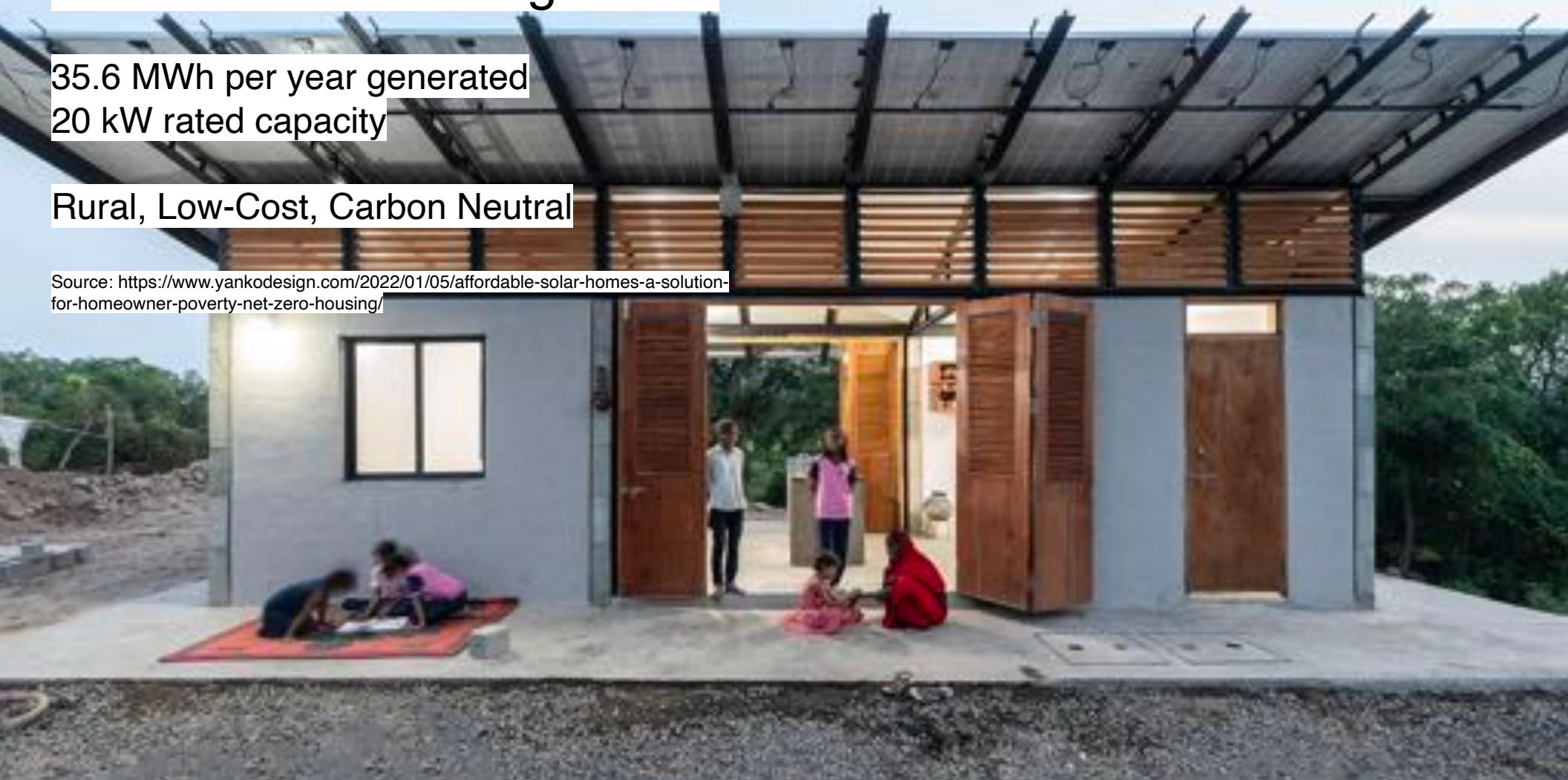


# PowerHYDE housing model

35.6 MWh per year generated  
20 kW rated capacity

Rural, Low-Cost, Carbon Neutral

Source: [https://www.yankodesign.com/2022/01/05/affordable-solar-homes-a-solution-for-homeowner-poverty-netzero-housing/](https://www.yankodesign.com/2022/01/05/affordable-solar-homes-a-solution-for-homeowner-poverty-net-zero-housing/)



# Solar Canopy For Highways

Free Land Availability

Source: <https://cleantechica.com/2020/09/05/european-trio-creating-solar-highway-system/>

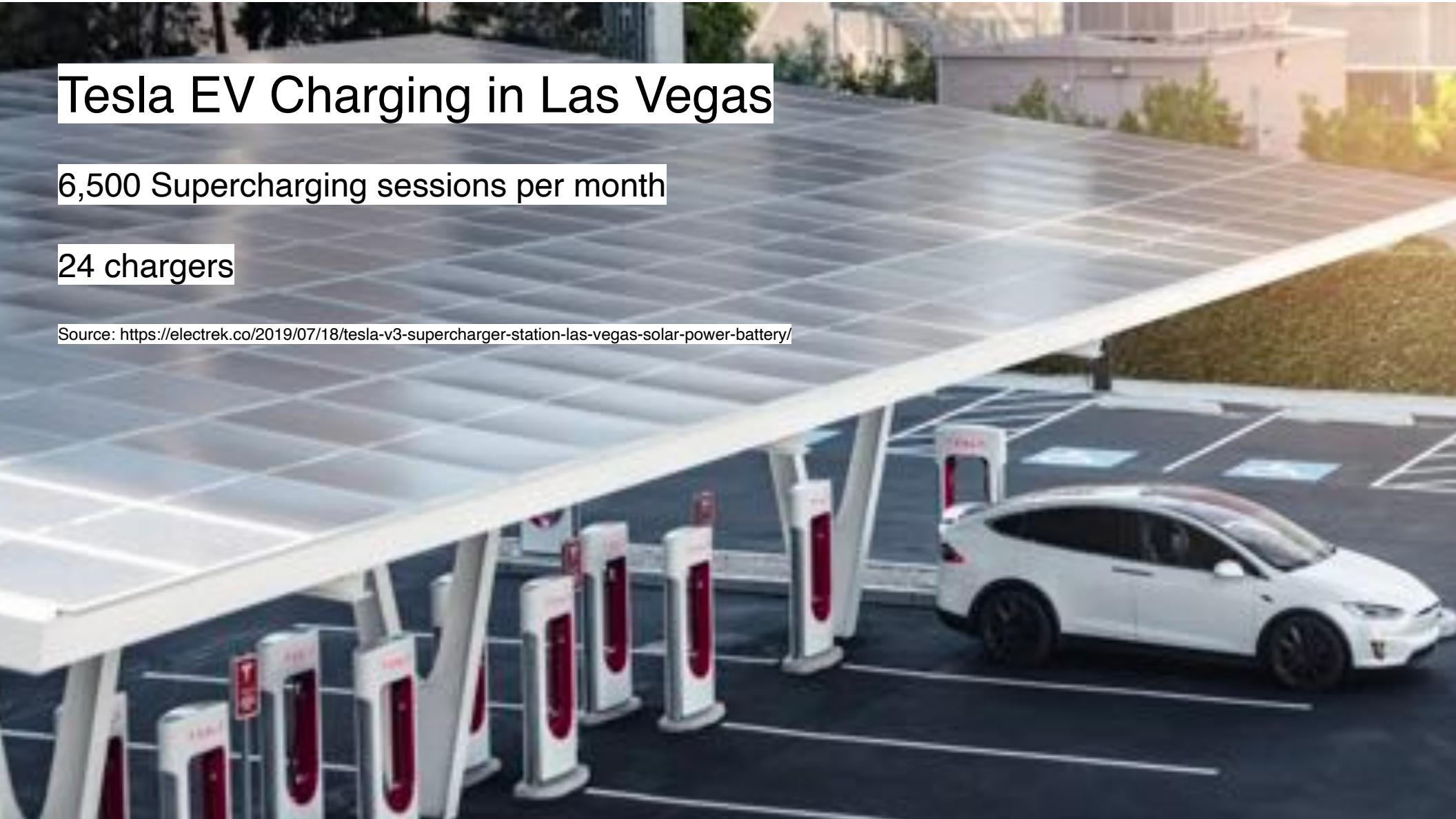


# Tesla EV Charging in Las Vegas

6,500 Supercharging sessions per month

24 chargers

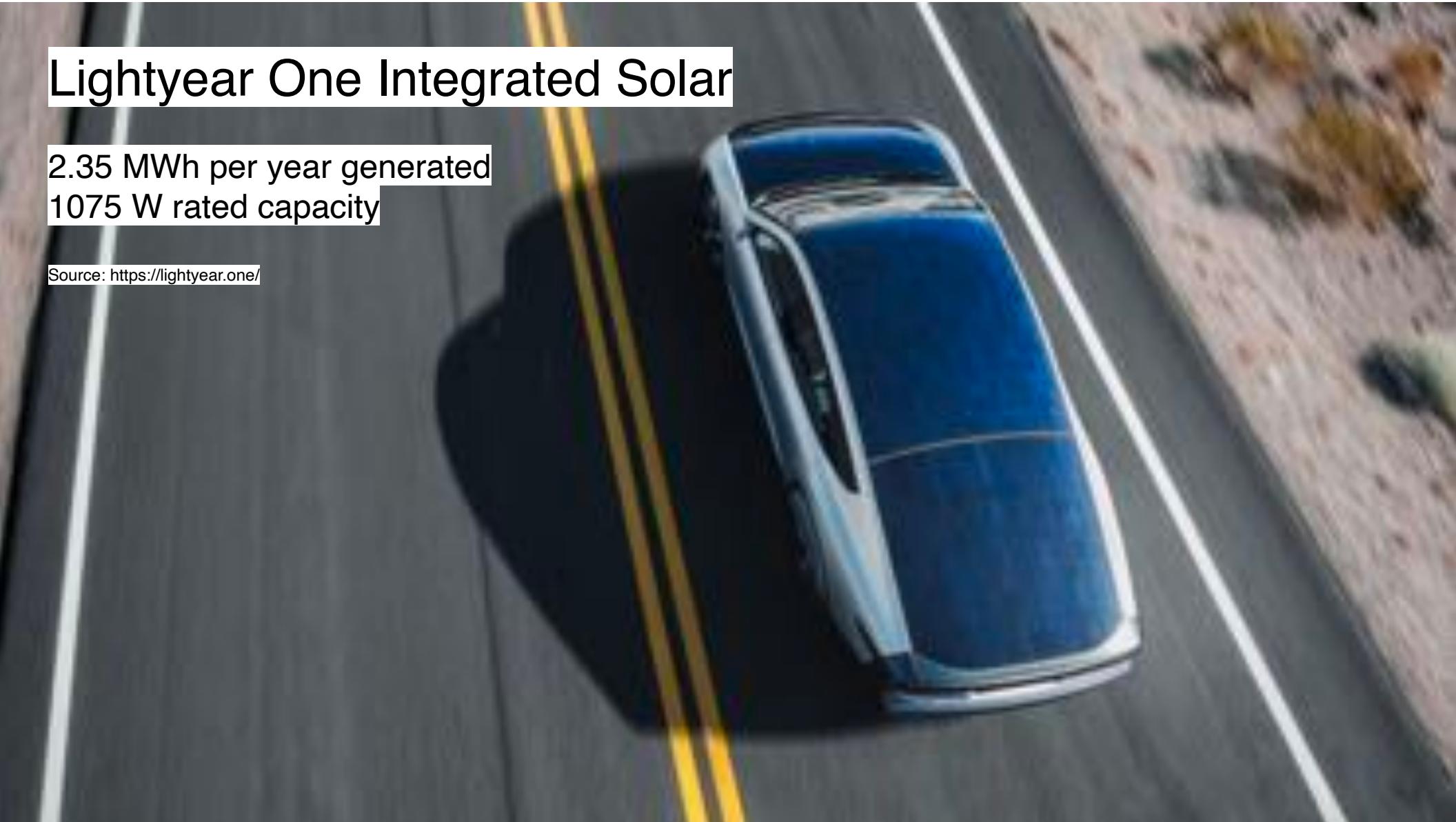
Source: <https://electrek.co/2019/07/18/tesla-v3-supercharger-station-las-vegas-solar-power-battery/>



# Lightyear One Integrated Solar

2.35 MWh per year generated  
1075 W rated capacity

Source: <https://lightyear.one/>



**Draft v1:**  
**More Coming Soon...**