Solar Bitcoin Mining
Now and Into the Future

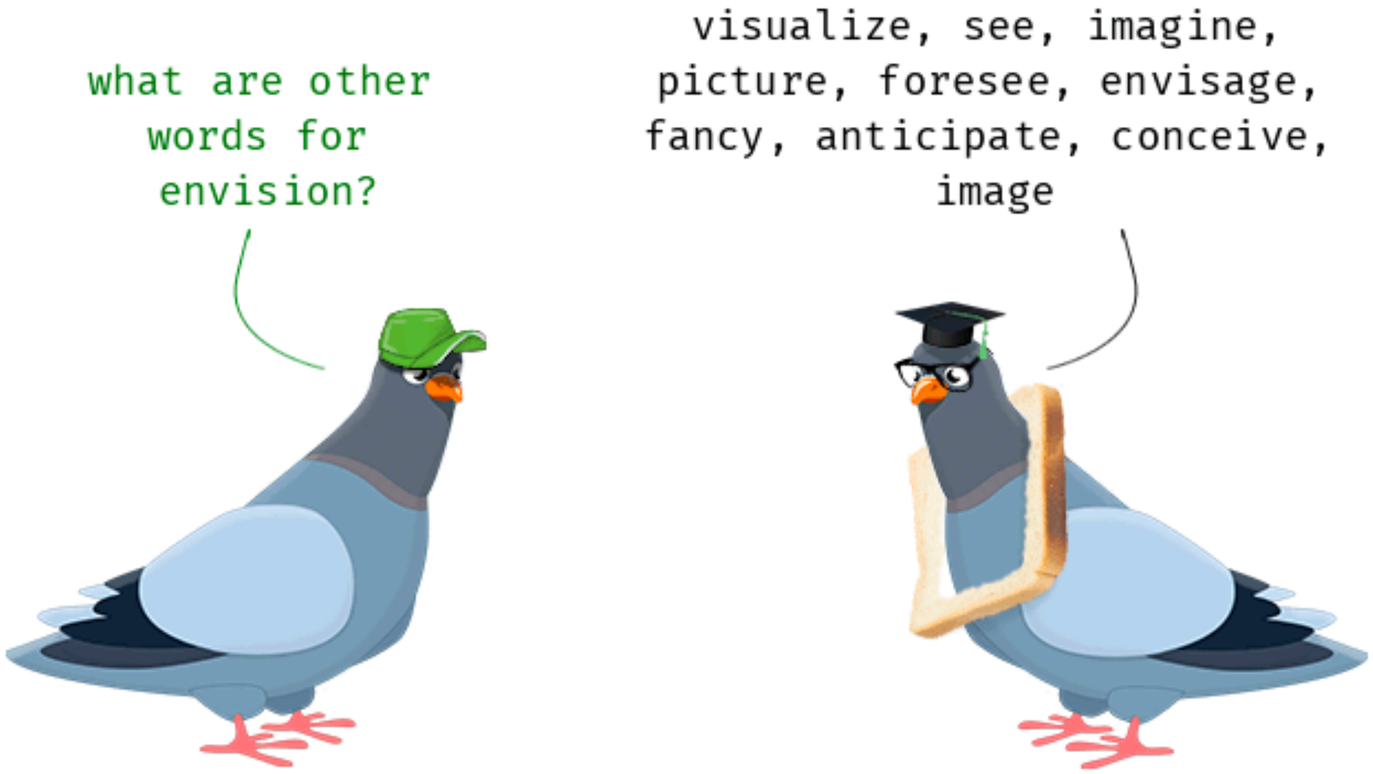
Including “Distributed Thin Solar Waste Mining”

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

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

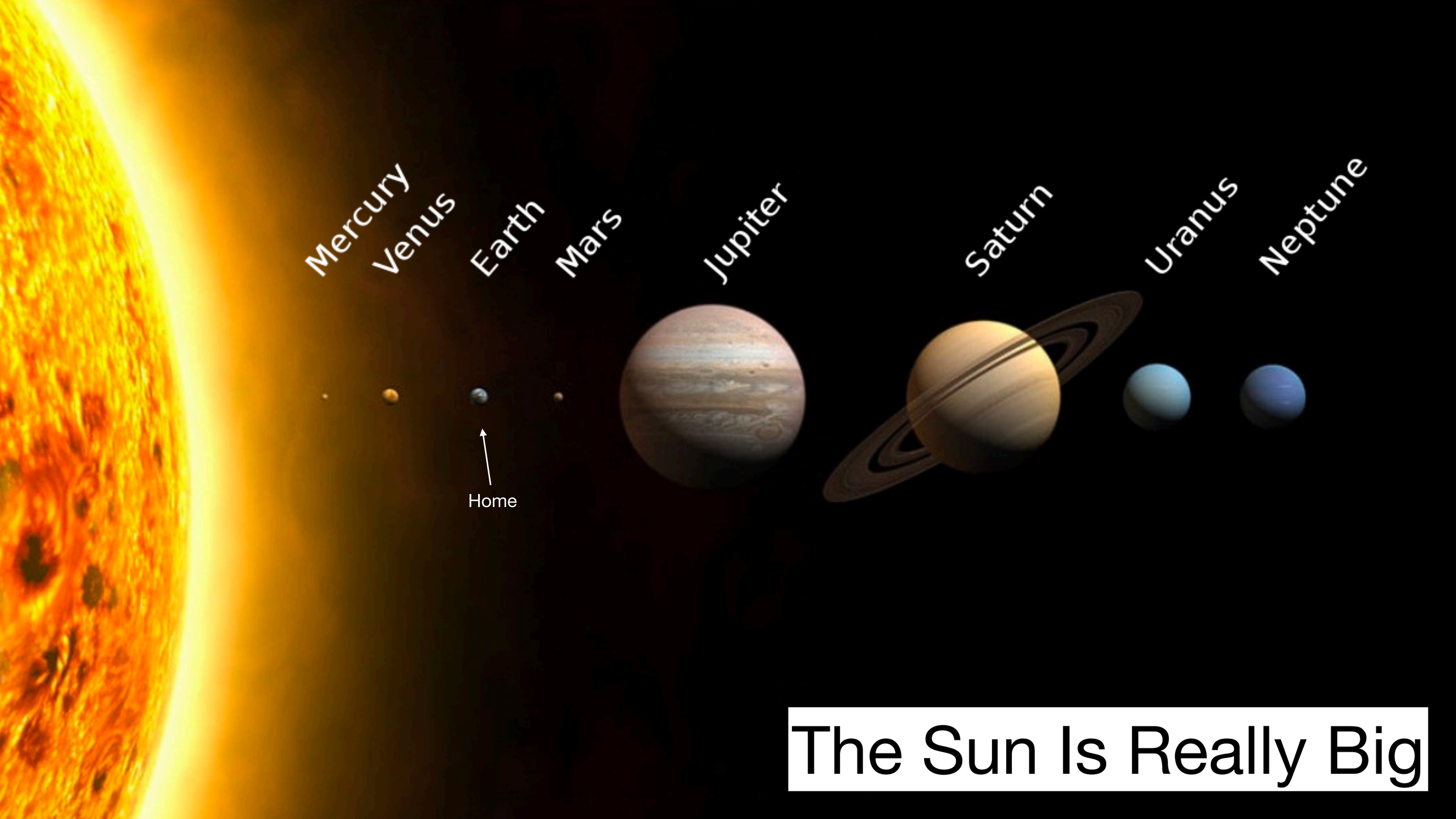
Looking for talented & creative people to **envision** this shared future

Including basic math & energy utilization



Common Earth Scale Energy Units

	yotta	[Y]	10^{24}	= 1 000 000 000 000 000 000 000 000	
	zetta	[Z]	10^{21}	= 1 000 000 000 000 000 000 000	
	exa	[E]	10^{18}	= 1 000 000 000 000 000 000	
	peta	[P]	10^{15}	= 1 000 000 000 000 000	
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

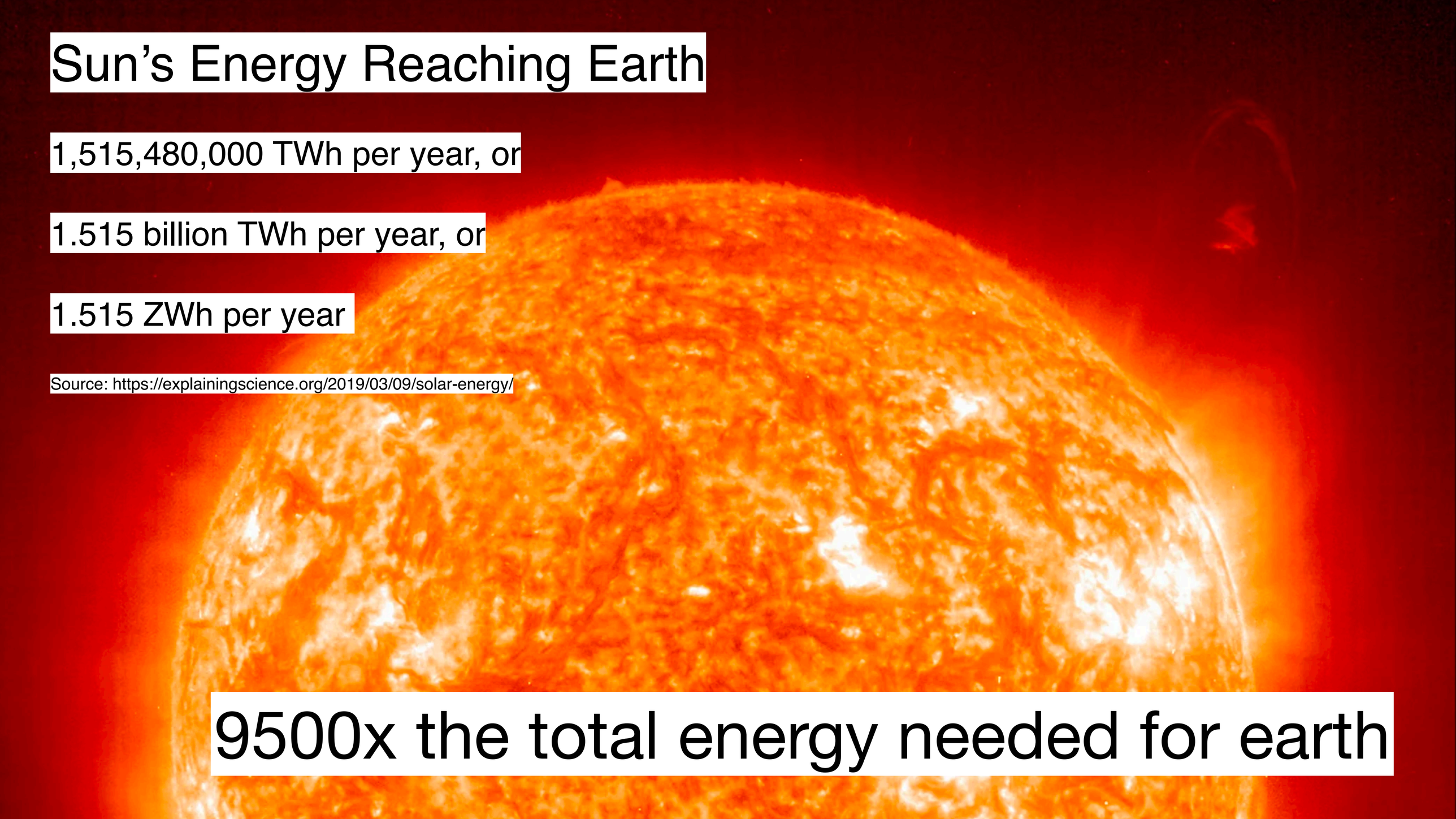
Sun’s Energy Reaching Earth

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

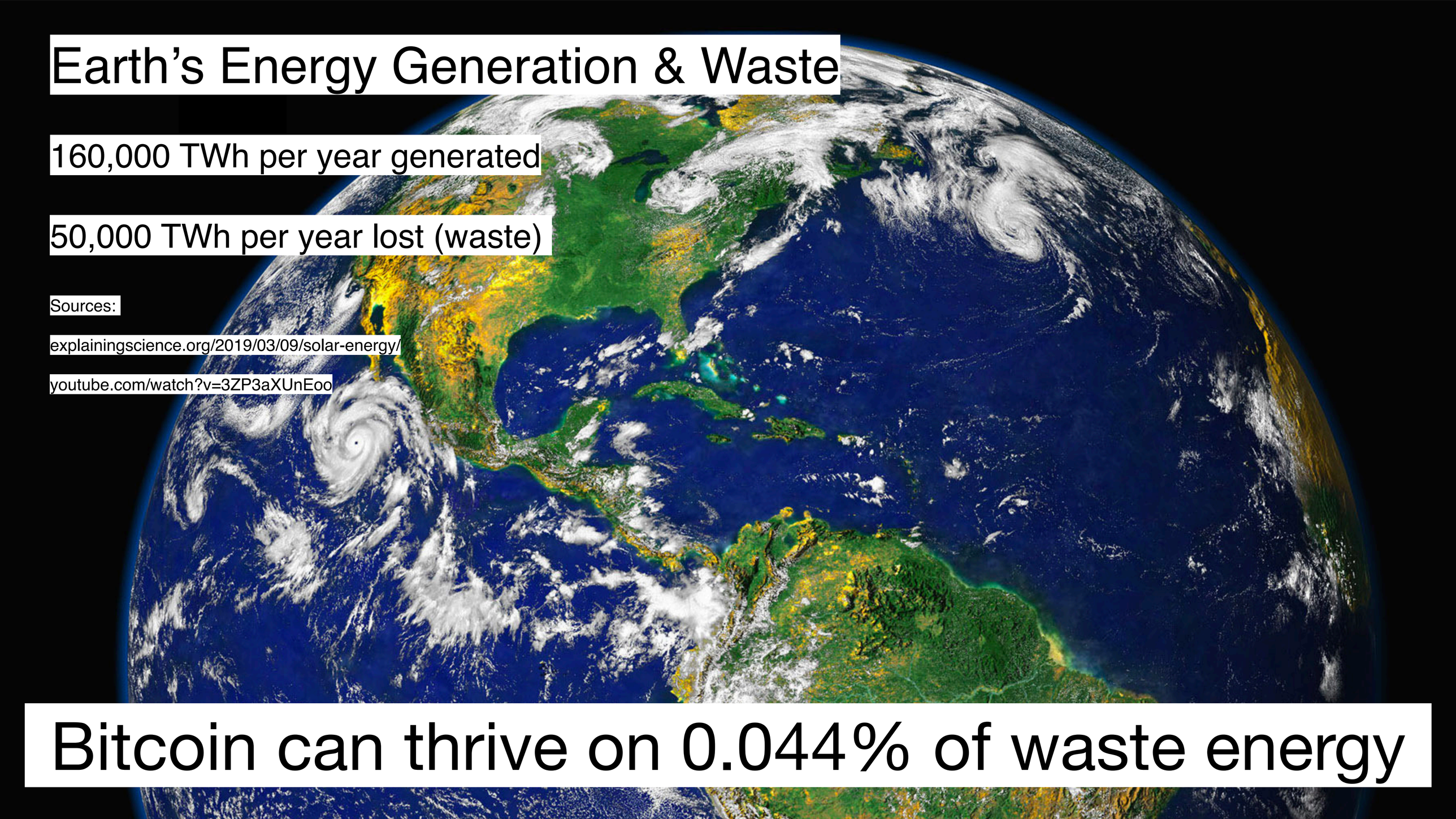
160,000 TWh per year generated

50,000 TWh per year lost (waste)

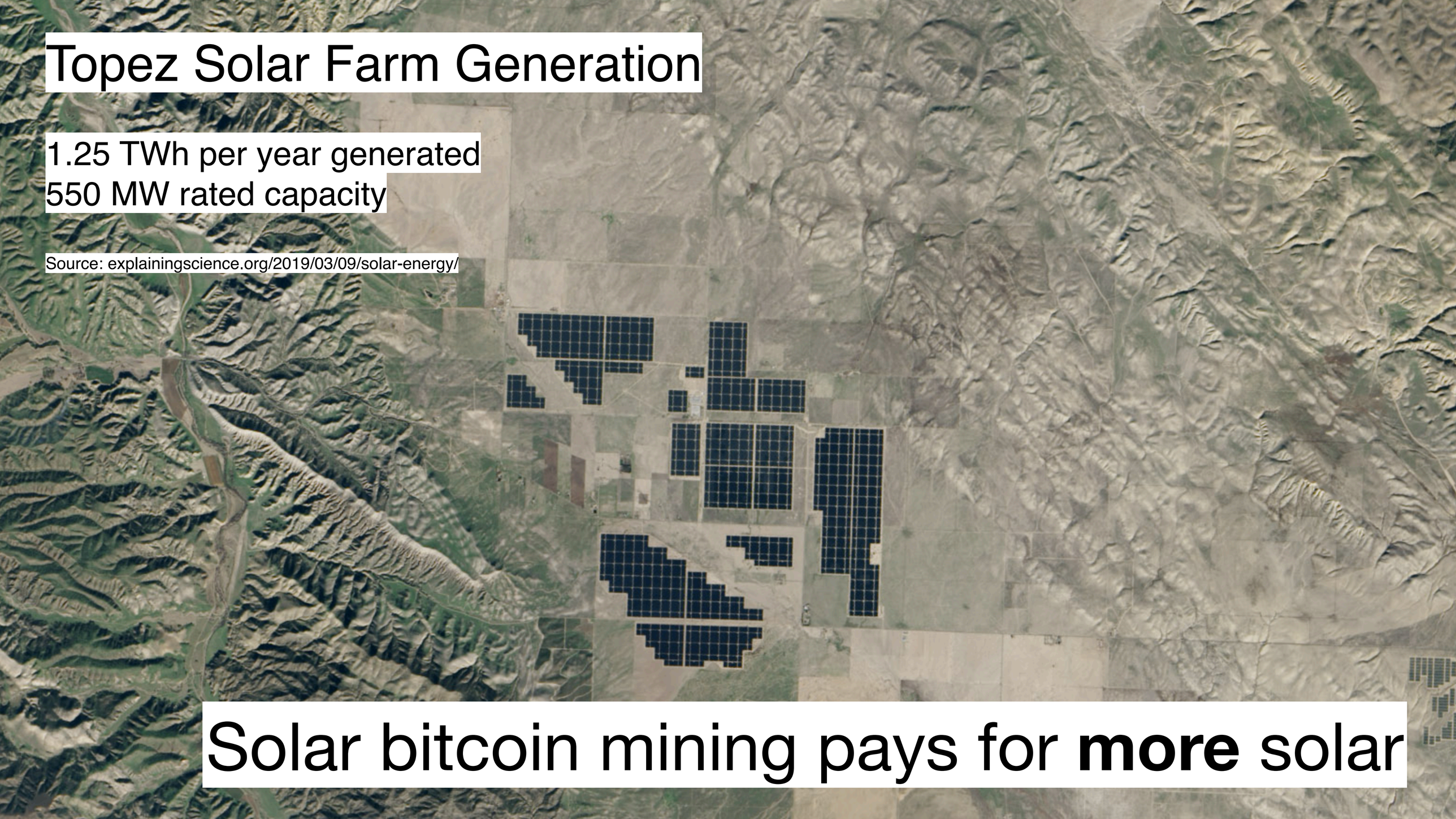
Sources:

explainingscience.org/2019/03/09/solar-energy/

youtube.com/watch?v=3ZP3aXUnEoo



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/

Solar bitcoin mining pays for **more** solar

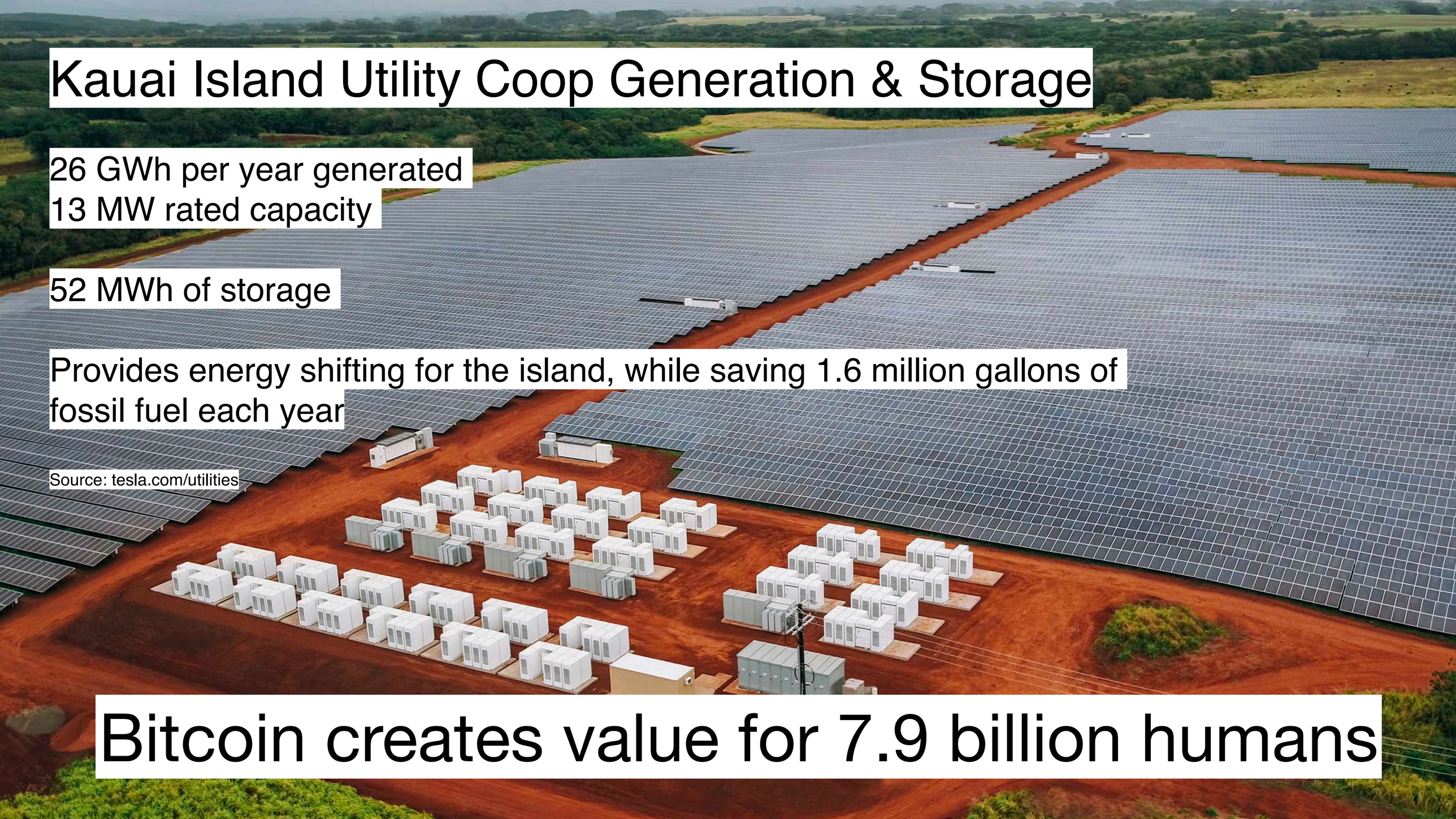
Kauai Island Utility Coop Generation & Storage

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

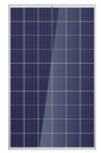


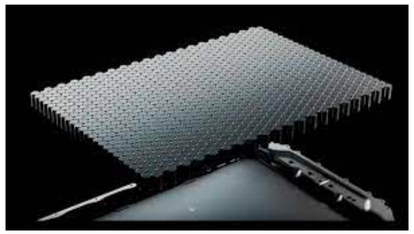
Bitcoin creates value for 7.9 billion humans

Components of Solar Energy

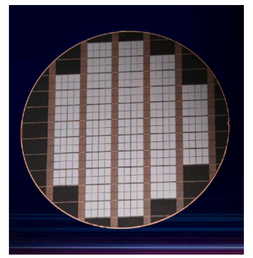
Generation, Storage & Load

Generation
(Panels)

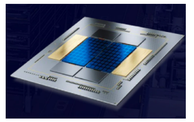




Storage
(Batteries)



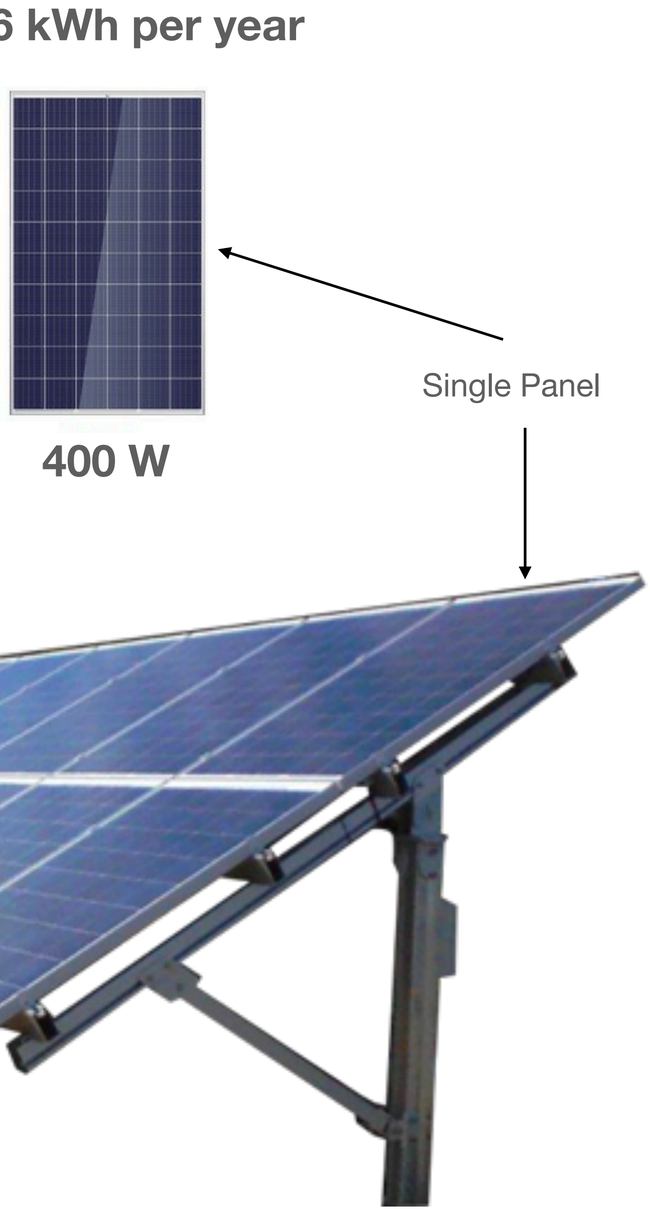
Load
(ASIC Mining chips)



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

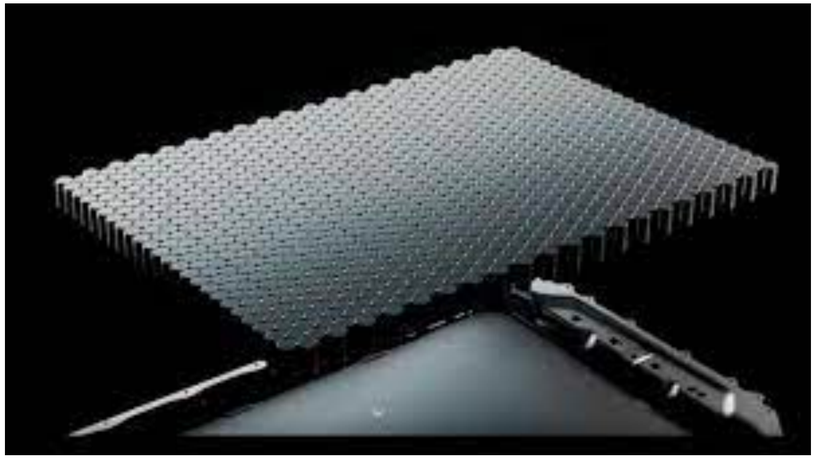
Batteries

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

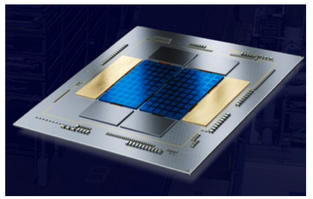
Cabinets of Battery Arrays

ASIC Mining Chips

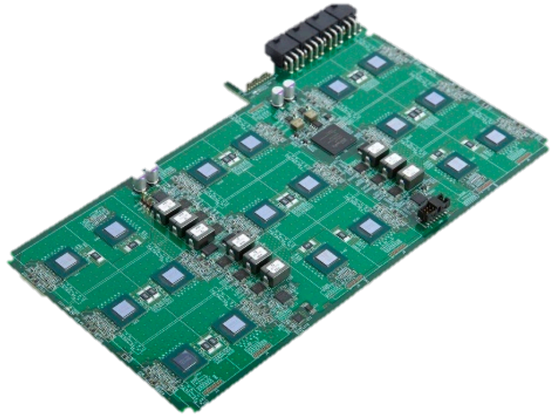
Load

- 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)

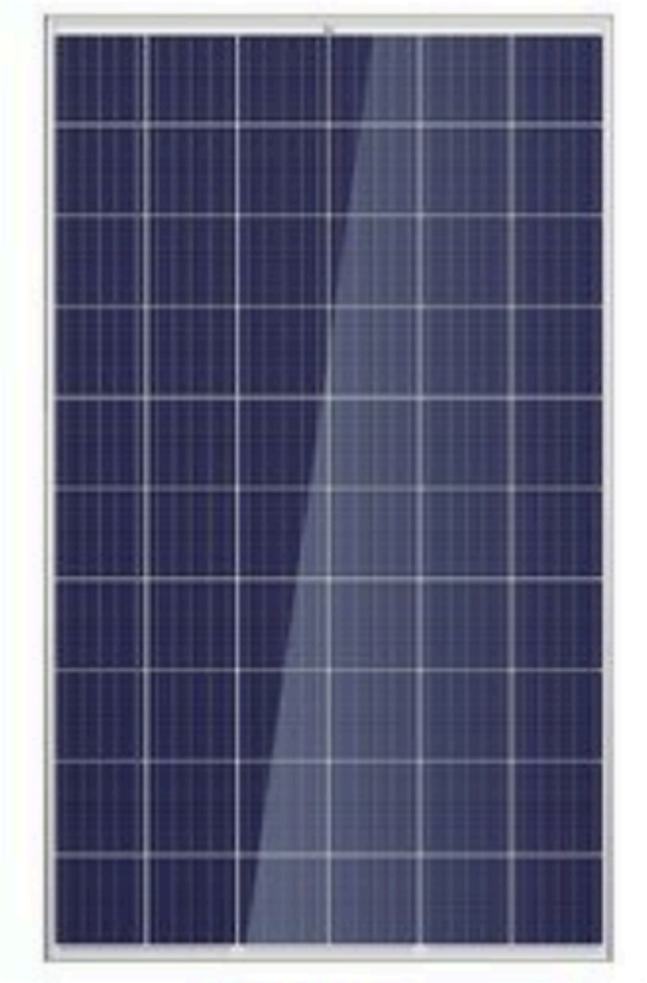
Bitcoin miners with ASIC chips in a shipping container

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

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

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

1 Panel



$400

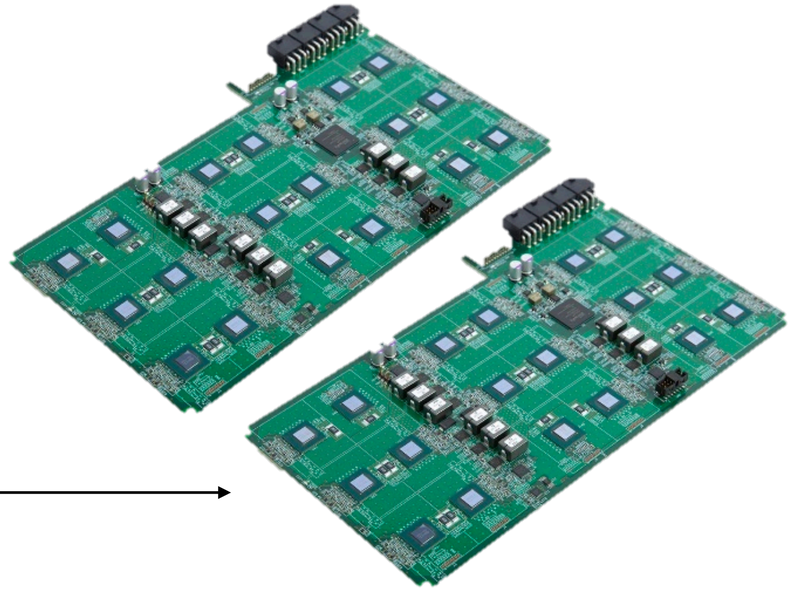
+

20 Batteries

$240

+

40 ASIC Chips



$400

=

$1040

Payback Alternatives

Load Options

Mine Bitcoin

876 kWh x **$0.46 / kWh = $403**

$1040 / $403 = **2 years 7 months**

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

Use energy instead of paying grid prices

876 kWh x **$0.11 / kWh = $96**

$640 / $96 = **6 years 8 months**

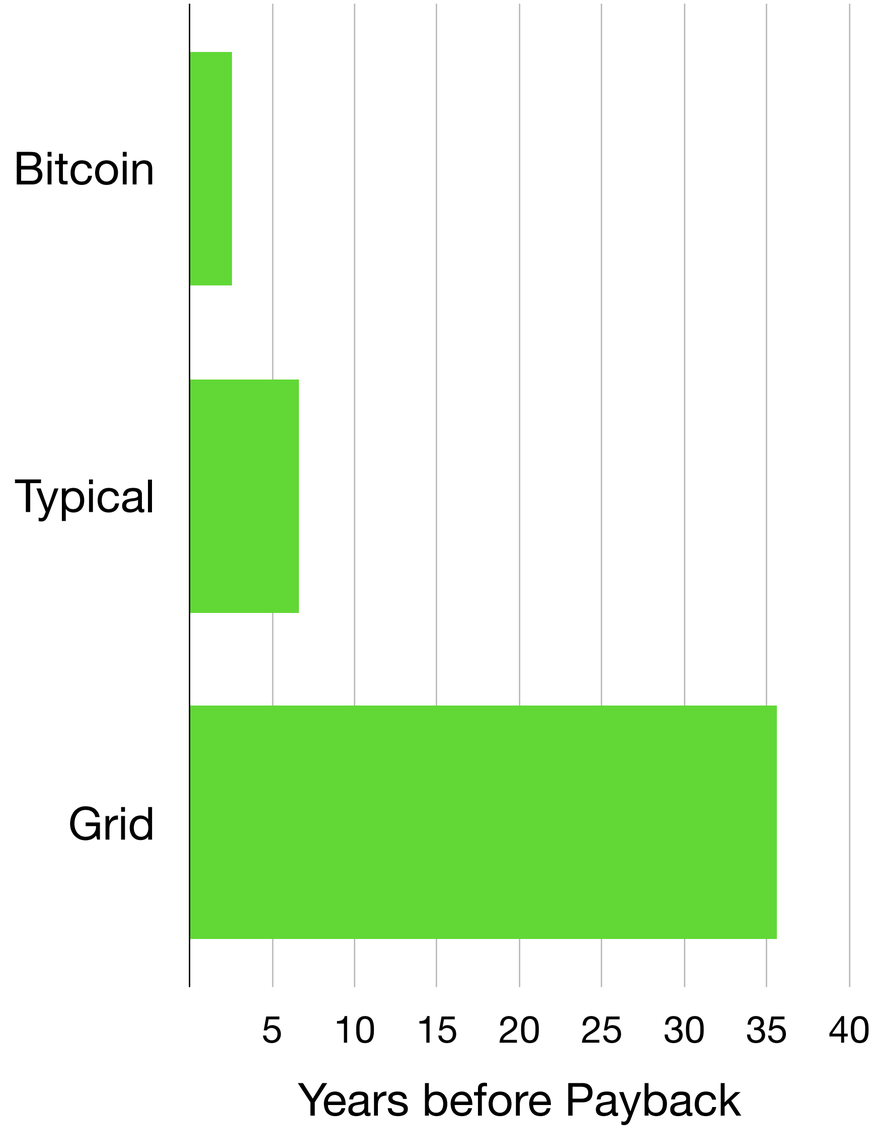
Solar Bitcoin Mining creates a **13.8x faster payback** compared to selling back to the grid

Sell back to the Grid

876 kWh x **$0.02 / kWh = $18**

$640 / $18 = **35 years 8 months**

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?**


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
micro	[μ]	10^{-6}	= 0.000 001
nano	[n]	10^{-9}	= 0.000 000 001
pico	[p]	10^{-12}	= 0.000 000 000 001
femto	[f]	10^{-15}	= 0.000 000 000 000 001
atto	[a]	10^{-18}	= 0.000 000 000 000 000 001
zepto	[z]	10^{-21}	= 0.000 000 000 000 000 000 001
yocto	[y]	10^{-24}	= 0.000 000 000 000 000 000 000 001

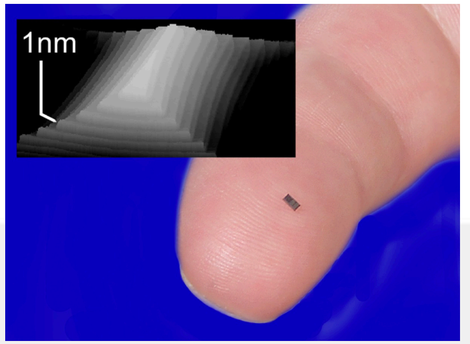
Millionth

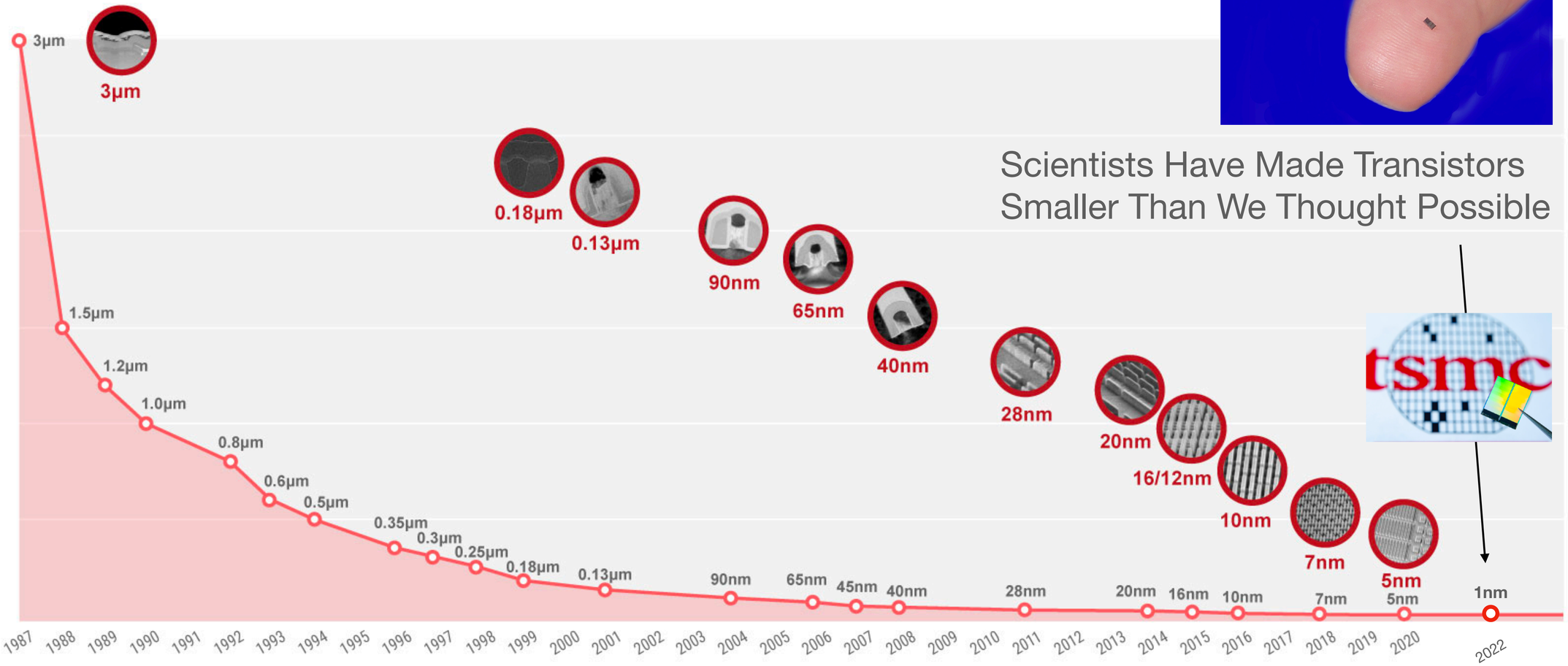
Billionth

Trillionth

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

Moving from nano to pico scale in ICs & ASICs

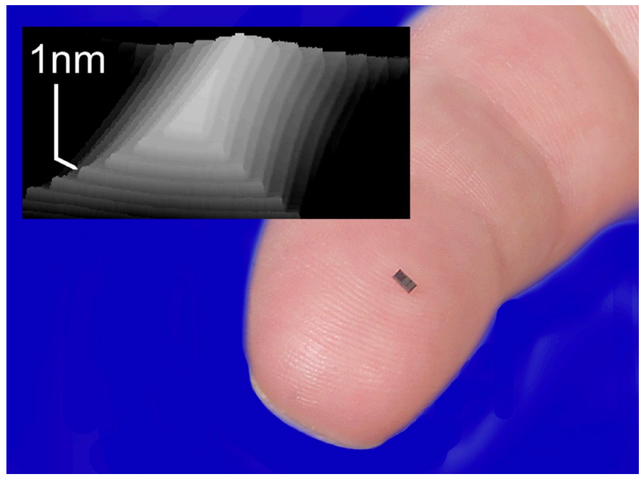


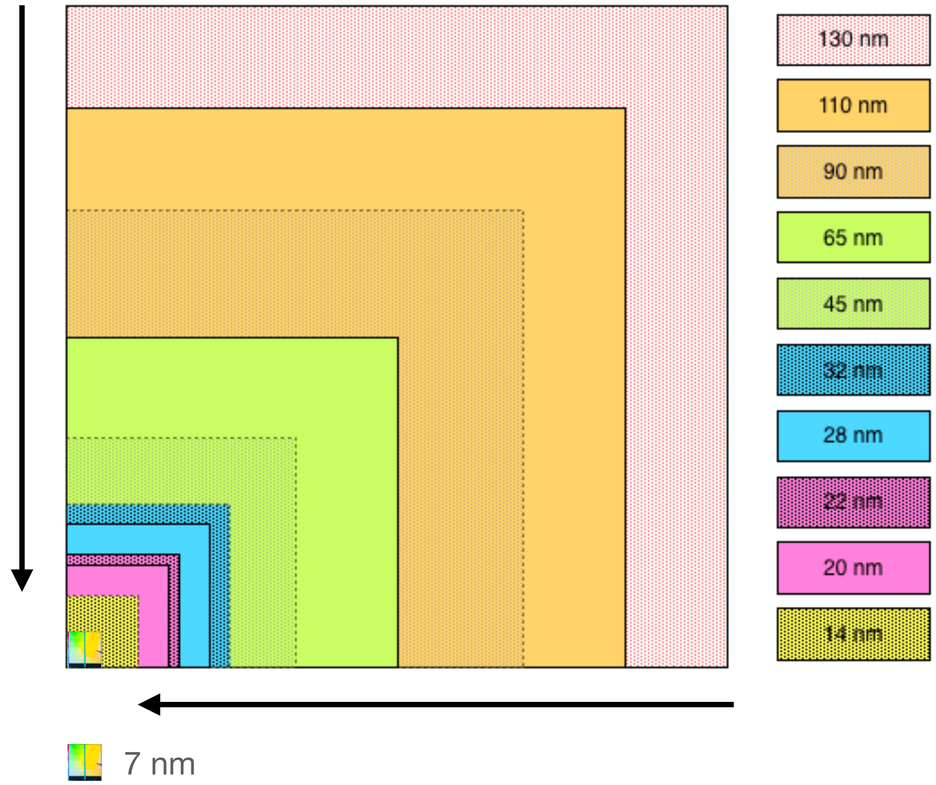


https://www.tsmc.com/english/dedicatedFoundry/technology/logic/l_5nm

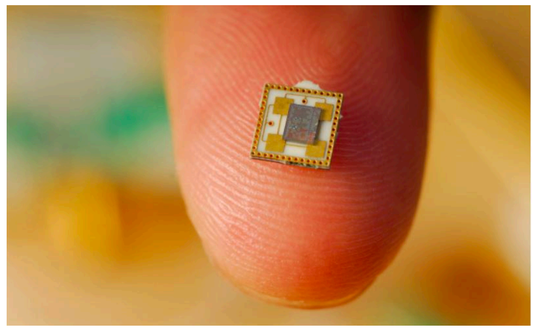
https://www.verdict.co.uk/tsmc-trumps-ibms-2nm-chip-tech-hyperbole-with-1nm-claim/

As the process scale decreases, so does chip size





7 nm



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

Distributed Thin Solar Waste Mining (DTSWM)

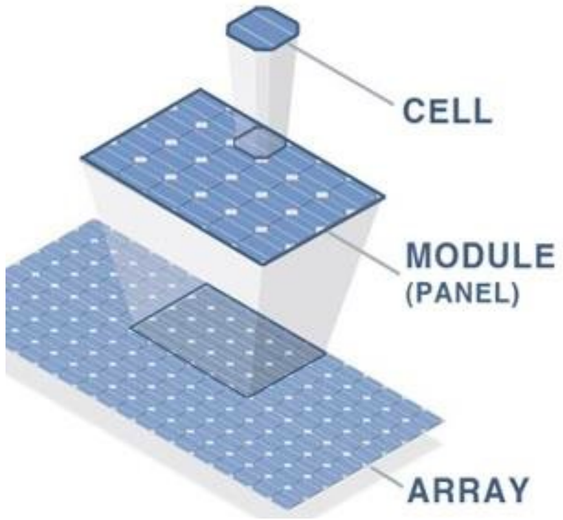
Mine with Direct-Current (DC) locally on the **back of PV cells**

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

Optimized Design Goal Component Ratio

1 PV Cell, 1 Battery, 1 ASIC

174 mm
6 7/8 inches

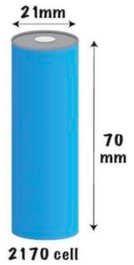
1 PV Cell

6.67 Watts
40 Wh

25+ yrs

Component Ratios **to Scale**

+



1 Battery

10+ yrs

+

1 ASIC

8.7 mm
3/8 inches

5+ yrs

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

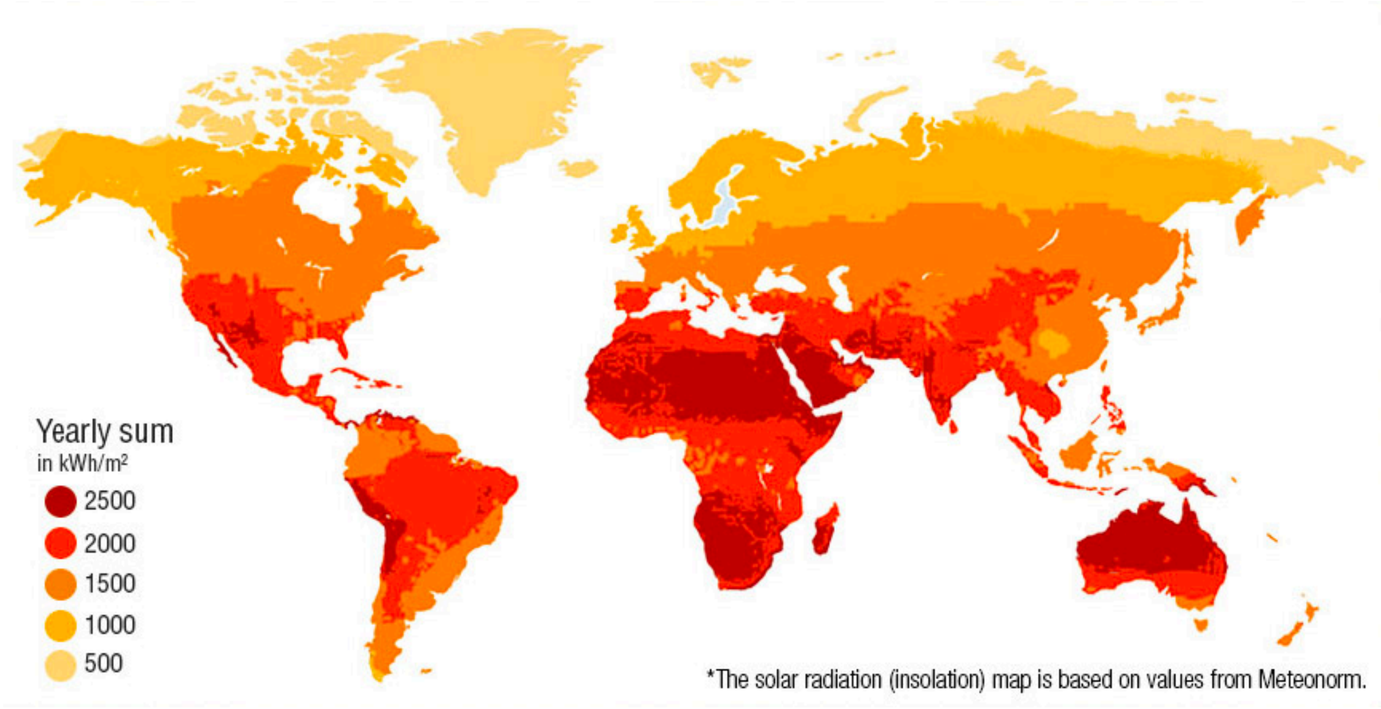
Design would make **easy battery and ASIC swap-ability**

Solution to ASIC crowding & heat problems

Solar

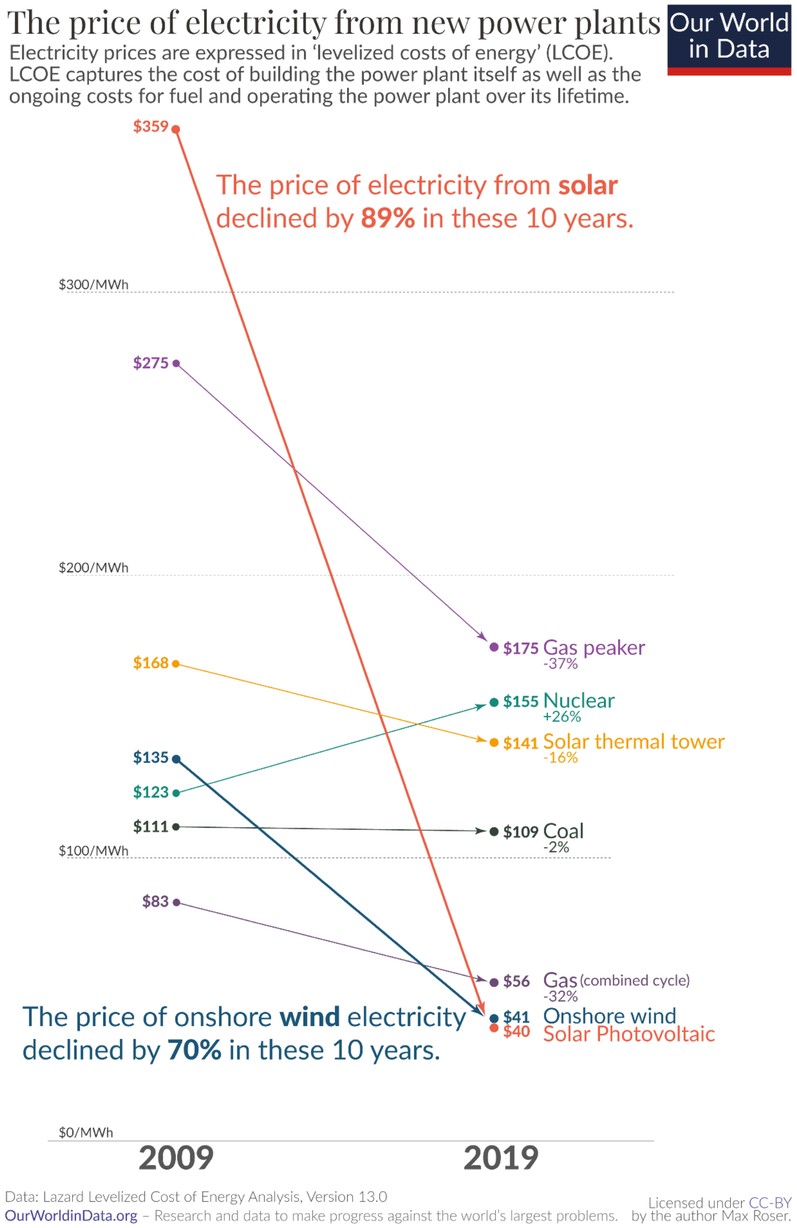
Everywhere, cleanest, cheapest, safest

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**



*The solar radiation (insolation) map is based on values from Meteonorm.

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



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

Solution to CO2 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

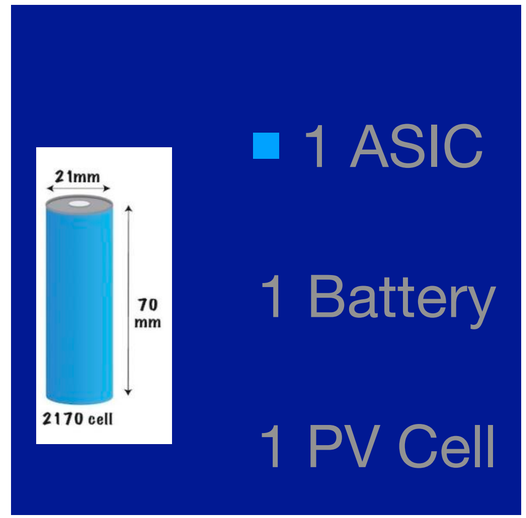
Off-grid shelter + DTSWM

Together we can create open DTSWM integration designs

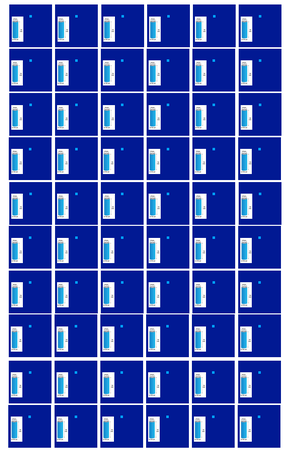
- Designers & engineers to create 3D realistic concepts
- Designers & storytellers to create & share these concepts
- Open designs for integrating PV Cells, Batteries, and ASICs
- Collective funding to create initial real world examples
- Partners & suppliers that would build prototypes

Ratios to Scale

Envision an integrated design

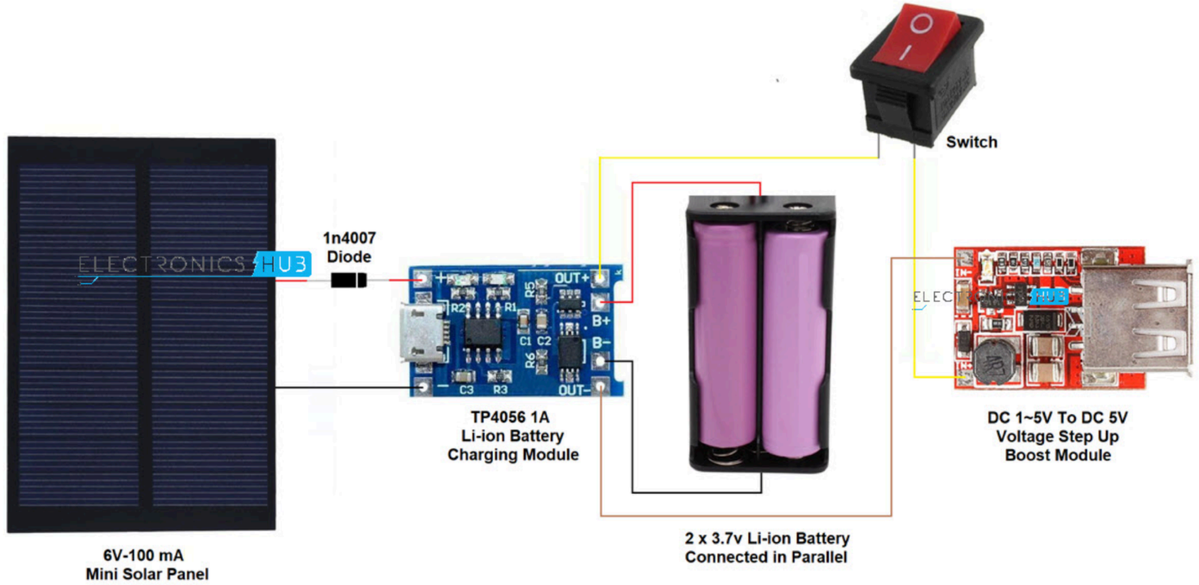


1 Typical PV Panel



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

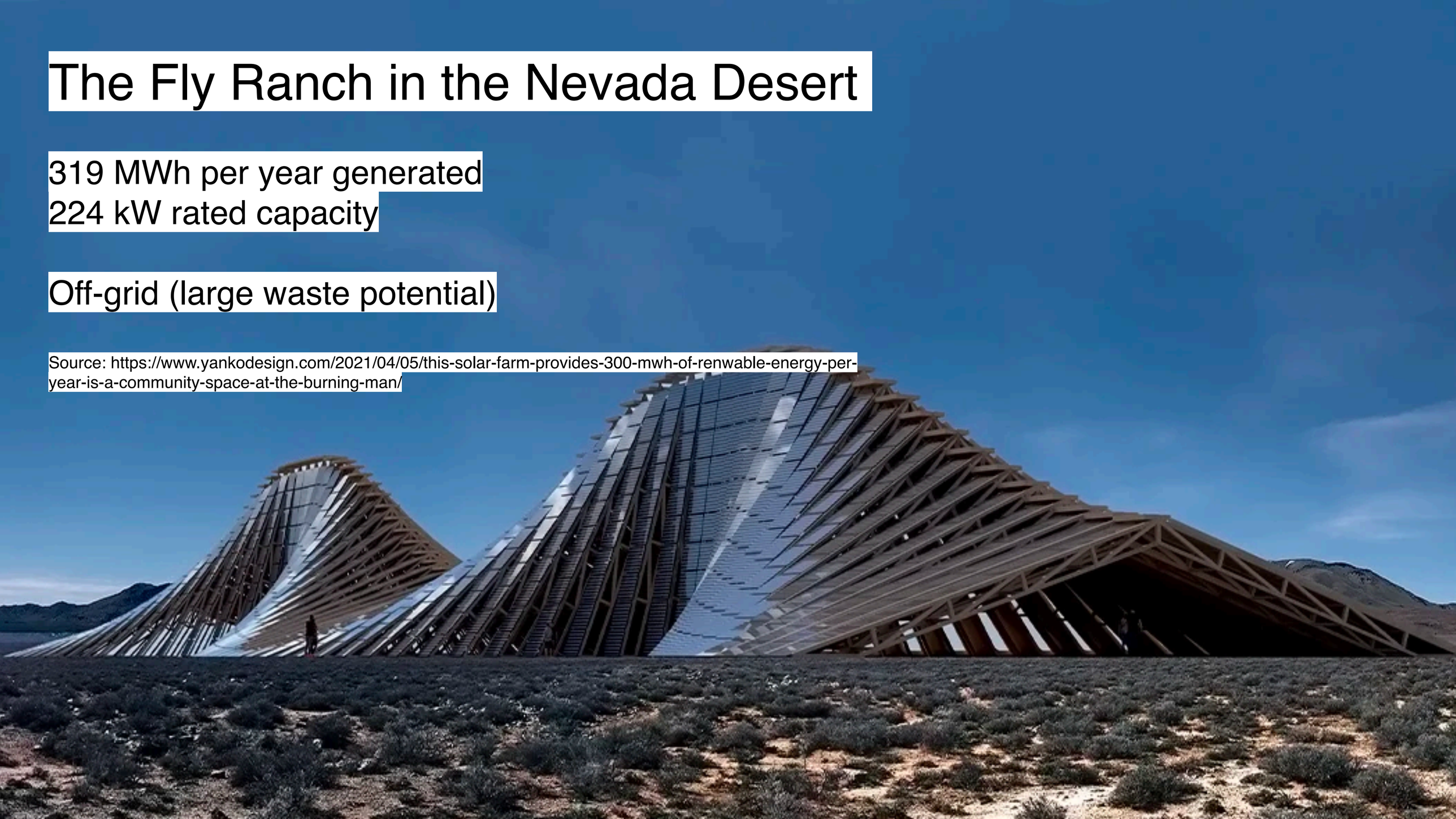
Source: https://www.pv-magazine.com/2021/09/09/indian-home-gets-36-72-kw-pv-system-with-540-w-panels/

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-renwable-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-net-zero-housing/

Solar Canopy For Highways

Free Land Availability

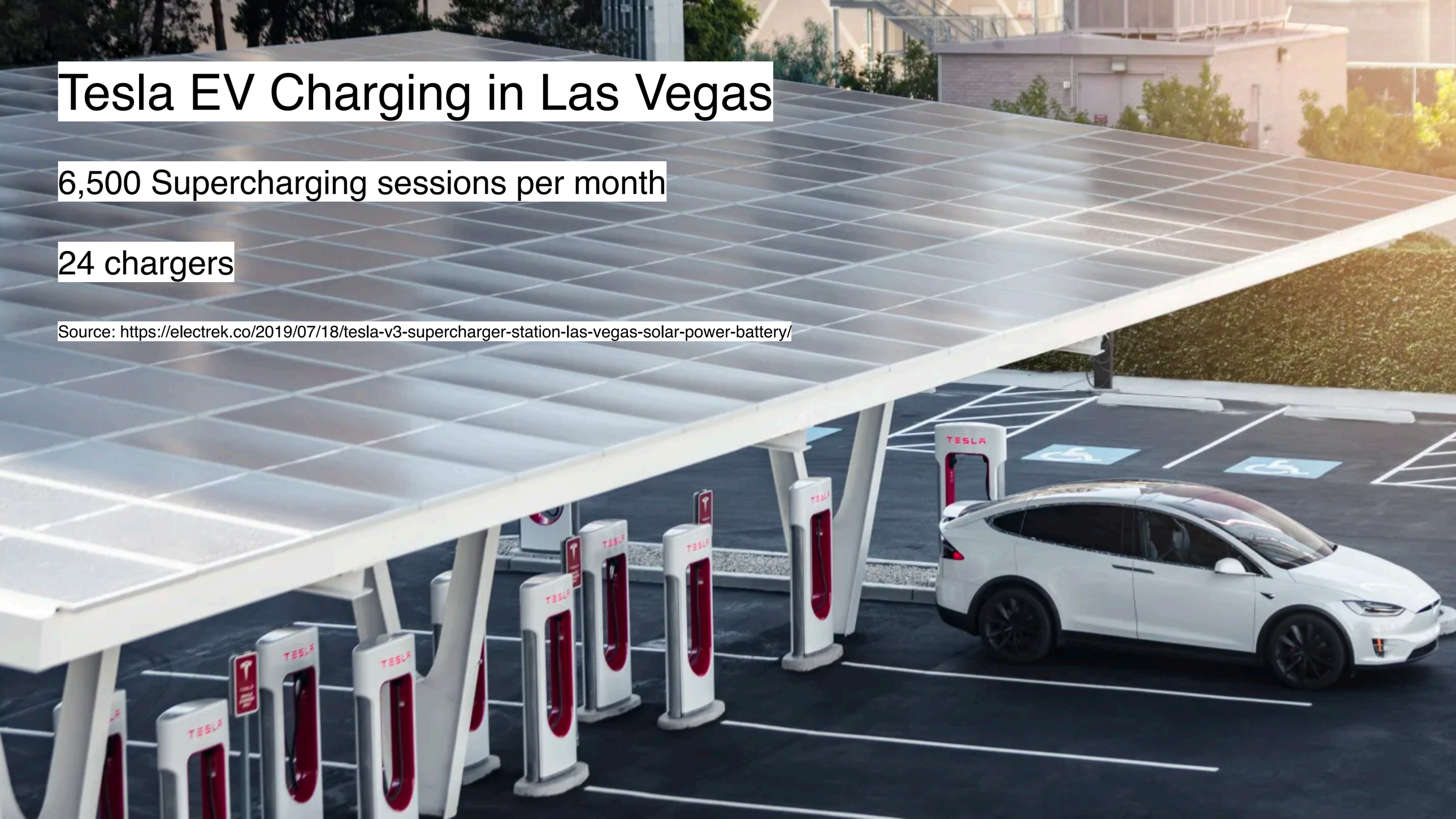
Source: https://cleantechnica.com/2020/09/05/european-trio-creating-solar-highway-system/

Tesla EV Charging in Las Vegas

6,500 Supercharging sessions per month

24 chargers

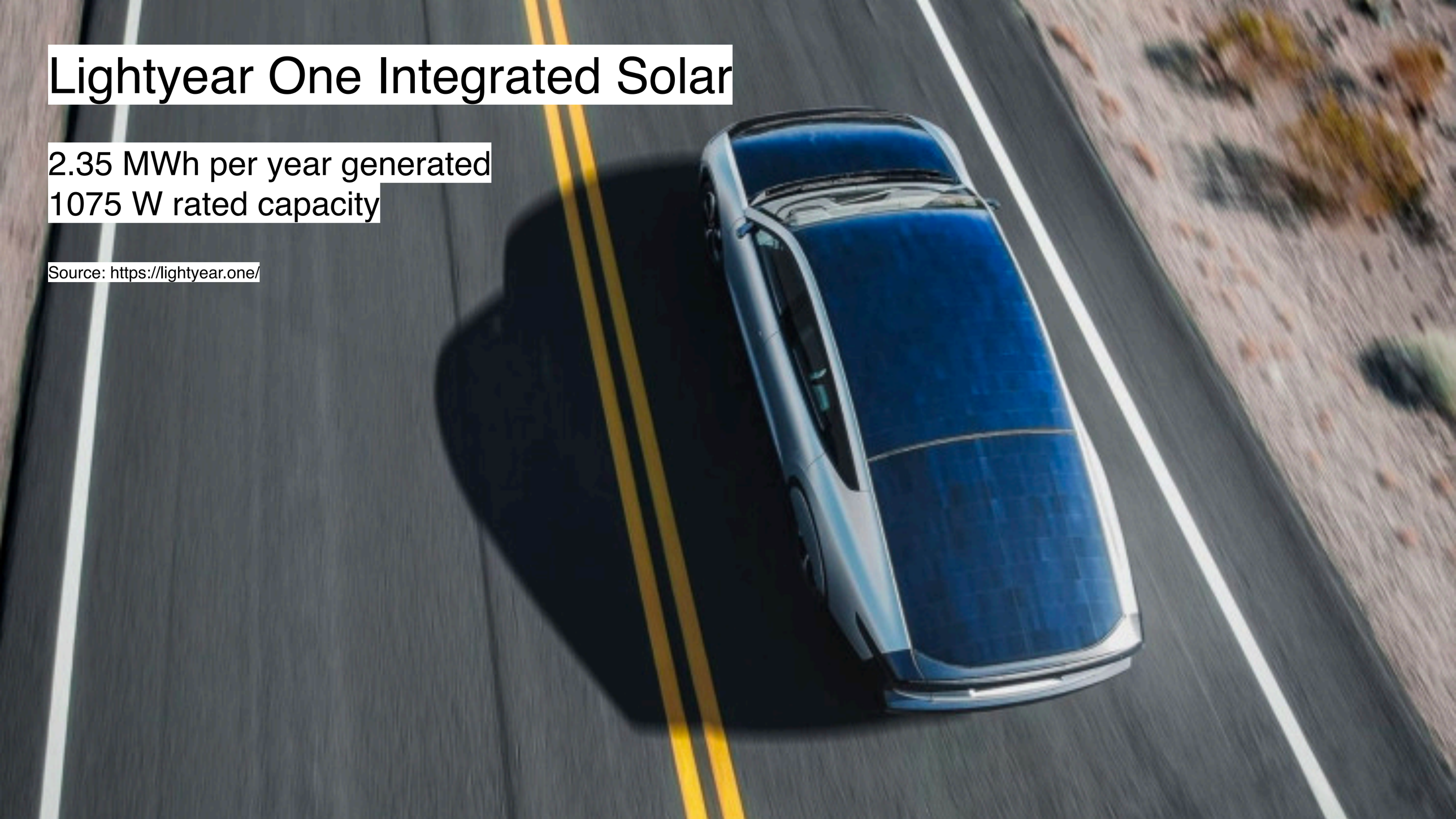
Source: https://electrek.co/2019/07/18/tesla-v3-supercharger-station-las-vegas-solar-power-battery/



Lightyear One Integrated Solar

2.35 MWh per year generated
1075 W rated capacity

Source: https://lightyear.one/



Draft v1:
More Coming Soon…