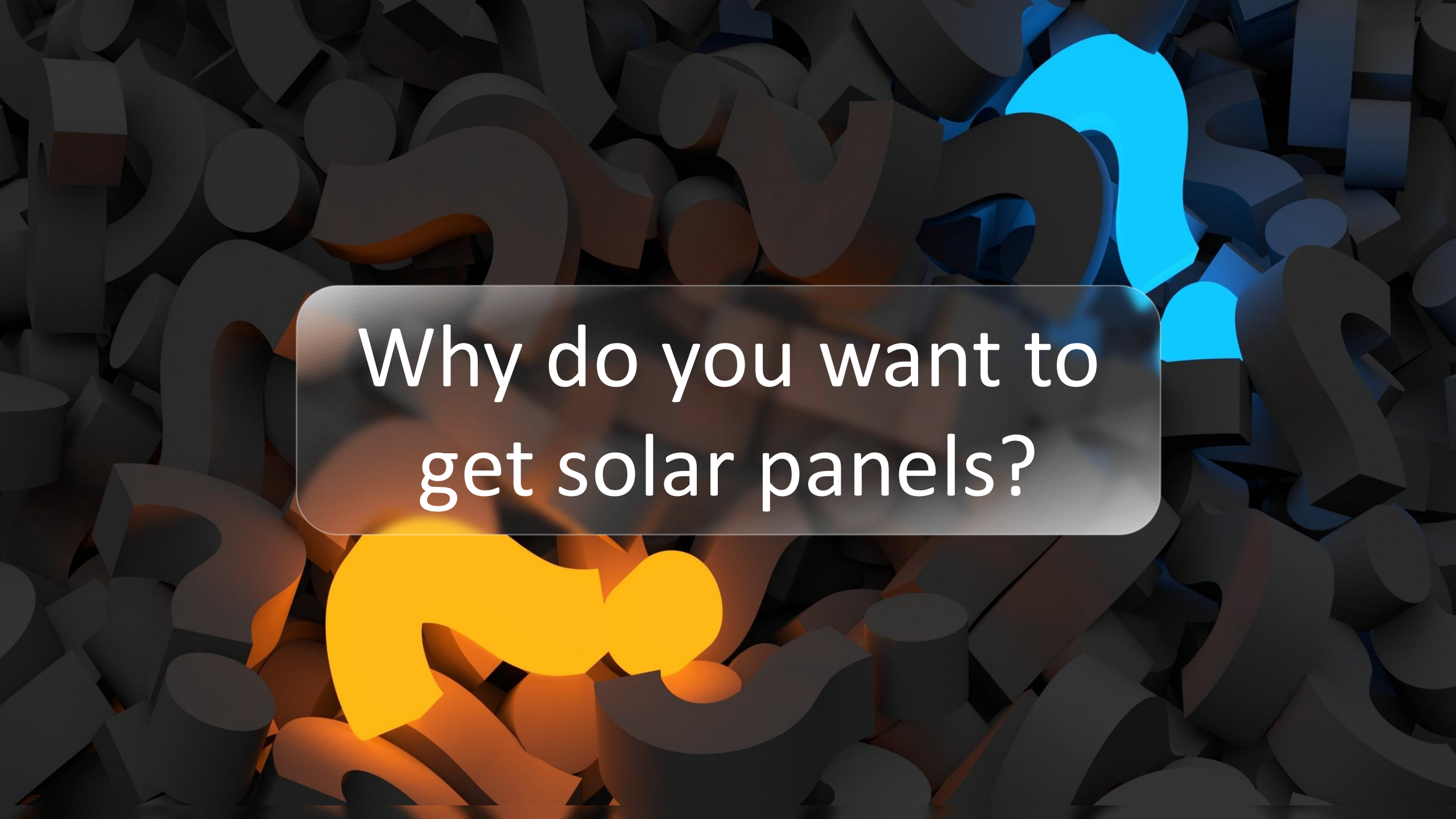
Go Solar!

Dr Chris Jardine
Honorary Research Associate, ECI


Why do you want to get solar panels?

Three classic motivations

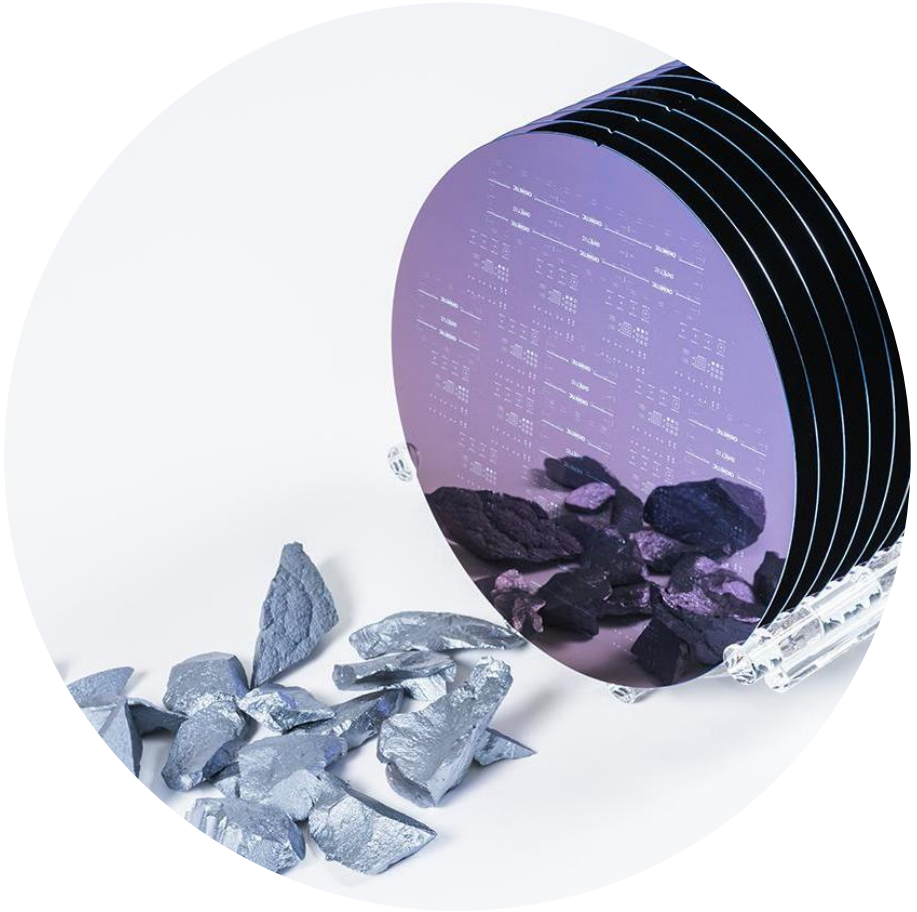
- Environmental
  - Saves carbon
  - Saves other pollutants
- Financial
  - A sound investment
  - Protects against rising bills
- Self-sufficiency
  - Reward of generating your own
  - Self-reliance protects against shocks

- Be honest and let these guide your decisions


The case for solar

What are Photovoltaics

- Photovoltaics are made out of materials called semiconductors
- Photovoltaics can absorb the energy of light to generate electric current
- Most commonly made from silicon (98% market share)
- Silicon is the second most abundant element in the earth's crust
- So supplies of silicon are truly sustainable



https://www.iea.org/energy-system/renewables/solar-pv

Why PV? Environment

- Available resource much larger than other renewables

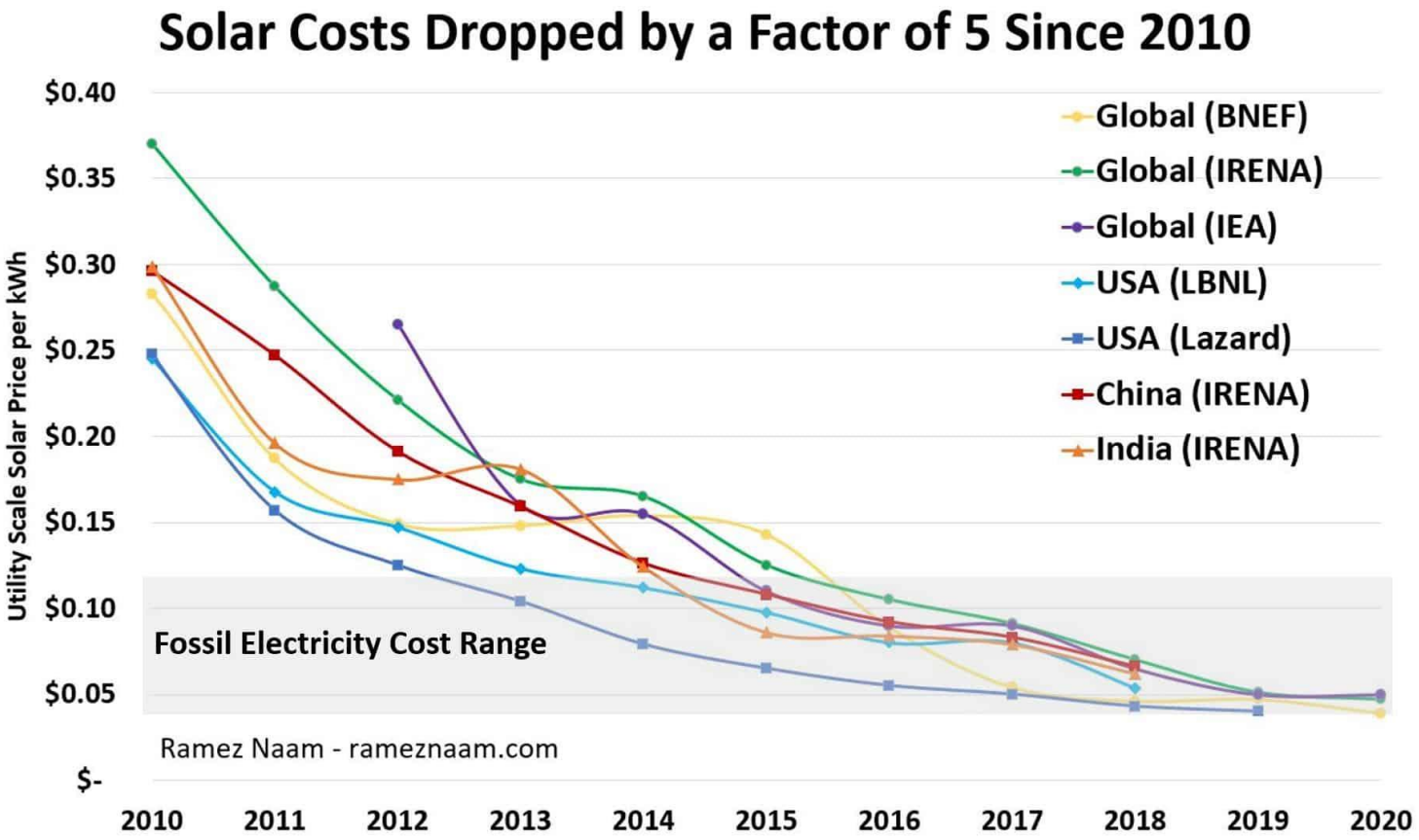
- No climate altering CO_2 emissions during operating lifetime
- Carbon payback roughly 3 years in UK

- No NO_x, SO_x, mercury or dioxin emissions during operating lifetime

Why PV – Technical Aspects

- No moving parts - Silent & maintenance free
- Warranties lifetime 25 years
- Actual lifetime > 25 years
- Suitable for use within an urban environment
- Modular technology; can be sized to suit needs
- Secure supply of energy; distributed generation

Why PV? The new reason



- It's really, really, really cheap
- Competititive with fossil fuel production
- The cheapest way of supplying electricity to a building (no distribution costs, policy costs, or utility profits)

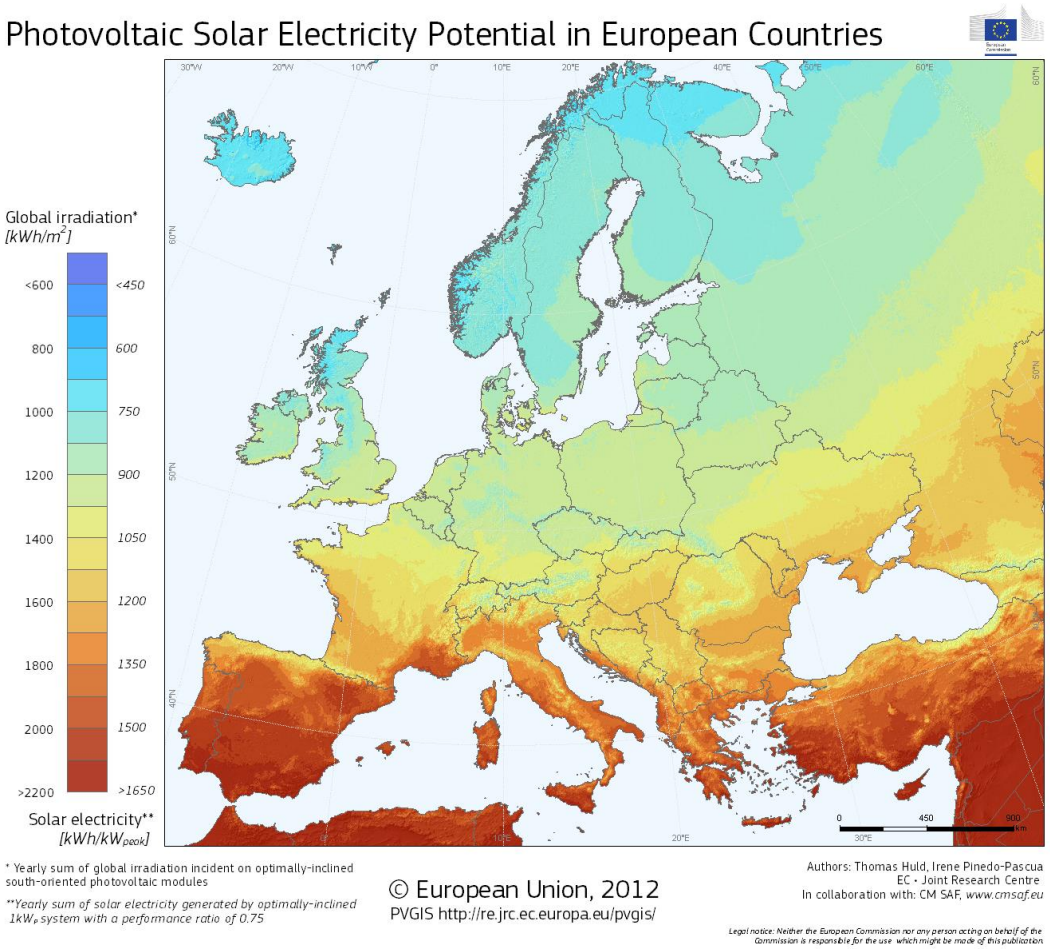
https://rameznaam.com/2020/05/14/solars-future-is-insanely-cheap-2020/

Why not PV?

- Space requirements
- Intermittency
- Daily:
  - “Solar panels don’t work at night!”
  - Alternative take: “Solar produces during the day when we demand more”
- Seasonal
  - Mismatch is problematic at northerly latitudes
  - Well matched at southerly latitudes (AC loads)
- But we’re not trying to run a 100% solar grid


Is my roof suitable?

Location



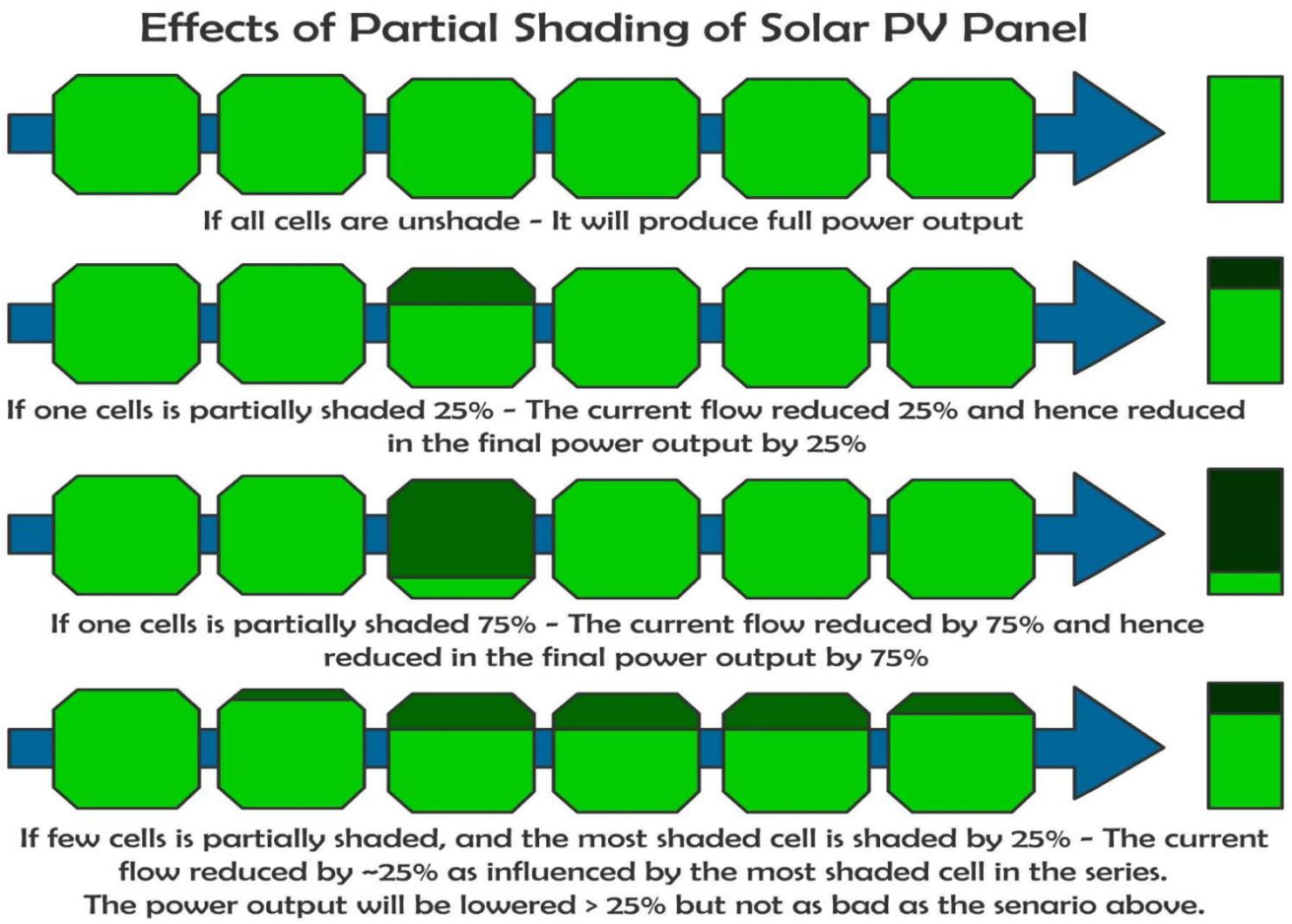
- In London, 900 kWh/kWp
- 1kWp is ca. 5m2
- Typical domestic installation 4kW (3600 kWh/yr)
- = typical average electricity use on lights and appliances
- More if you are energy efficient

Orientation

	West	75	60	45	30	15	South	15	30	45	60	75	East
Flat	90	90	90	90	90	90	90	90	90	90	90	90	90
10	89	91	92	94	95	95	96	95	95	94	93	91	90
20	87	90	93	96	97	98	98	98	97	96	94	91	88
30	86	89	93	96	98	99	100	100	98	96	94	90	86
40	82	86	90	95	97	99	100	99	98	96	92	88	84
50	78	84	88	92	95	96	97	97	96	93	89	85	80
60	74	79	84	87	90	91	93	93	92	89	86	81	76
70	69	74	78	82	85	86	87	87	86	84	80	76	70
80	63	68	72	75	77	79	80	80	79	77	74	69	65
Vertical	56	60	64	67	69	71	71	71	71	69	65	62	58

- In the UK:
- Optimal is 30 degrees, due south
- Large hotspot of 95%+ generation (SW-SE)
- Even flat is 90%
- E and W facing 85%

Shading



- Kirchoff's Law demands current is equal
- Modules limited by worst cell
- Strings limited by worst module
- Avoid shade wherever possible
- Can be mitigated with optimisers or microinverters

https://www.skyworth-pv.com/info/shading-effect-of-pv-panels-72899263.html

Coping with dirt

- Solar panels have anti-reflective and surfactant coatings
- Beads up water to help it run away
- Takes dirt with it

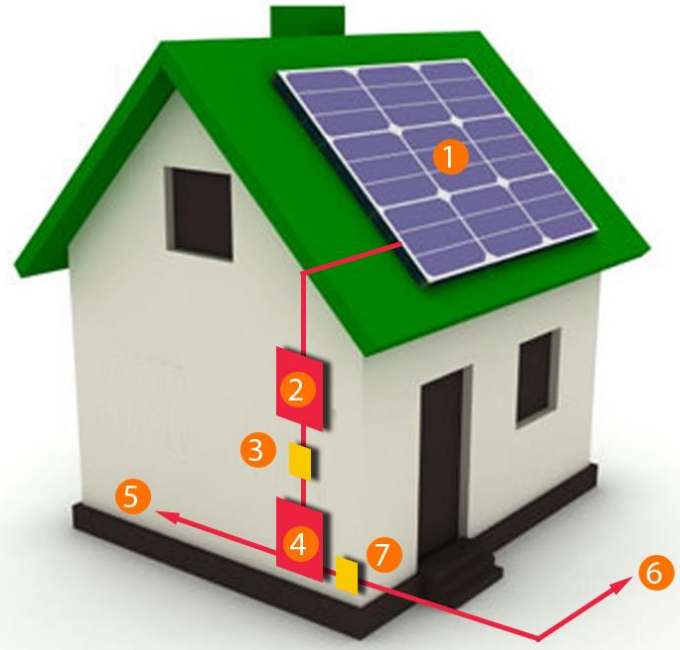
- Solar panels are considered self-cleaning if pitched > 5 degrees


Building Solar
Projects

System Components

- PV modules – to generate DC electricity
- Inverter – to turn DC electricity in 240V AC electricity and match this to the phase of the grid
  - Implies no production if grid goes down for safety reasons
- Isolation switches
- String fuses and G99 relay for larger installations
- Generation meter
- Optional export meter

- Potentially batteries, AC or DC connected. AC is predominant now – more versatile, can charge from grid

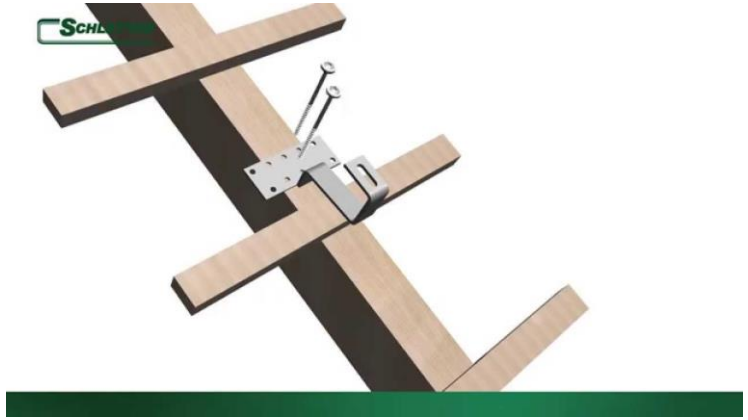


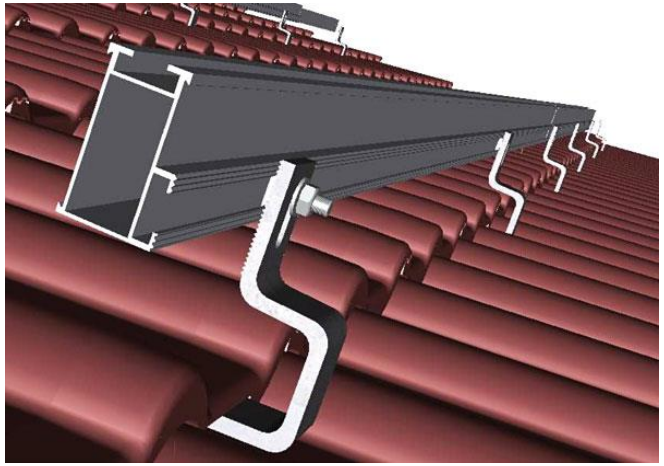
1. The solar PV modules convert the energy of daylight into electricity
2. The inverter converts this into 240V AC electricity for use in the home
3. The generation meter records how much is produced
4. The PV system is wired into your main fuseboard
5. Electricity is used in lights and appliances in the home
6. Any excess electricity can be exported to the national grid
7. Your conventional import meter measures any electricity you buy from your supplier, when your solar PV system is not enough (*e.g.* night-time)

Solar modules

- Modules can be simply roof mounted on frames
- Standard Modules
- Possible to get all black modules – black cells, black frames, black backing.

Tiled roofs





- Use system of roof hooks and rails
- Different hooks for different tile types
- Modules bolt onto horizontal rails

Slate Roofs

- Slate roofs more tricky as slates are thinner
- Either trim slates to allow hook and waterproof sheath
- Or Solar Limpets, plate and sealant system
- Slate is very fragile
- Most expensive conventional rooftype

Recessed modules

- Aesthetically can look better to remove tiles and recess modules into the space
- Waterproof membrane behind
- Sit flush with the tiles
- Especially black/black on slate

Flat roof systems

- Typically mounted on a ballasted frame
- South facing rows need spacing apart (self-shading)
- Alternative – E/W arrays
  - Small spacing
  - Greater capacity (x2)
  - Lower yield per m2 (x0.85)
  - But great overall generation (x1.7)
  - Lower ballast (more enclosed)


Choosing an Installer

Three types of installer

- Utilities
  - Known brands (e.g. Octopus)
  - Only touch easy roofs
- Dedicated solar companies
  - Solar specialists
  - Regional
  - Sales, design, project management
- One-man bands
  - Local
  - Cheapest (no overheads)
  - May fit alongside general roofing/electrics
  - Some great, some awful

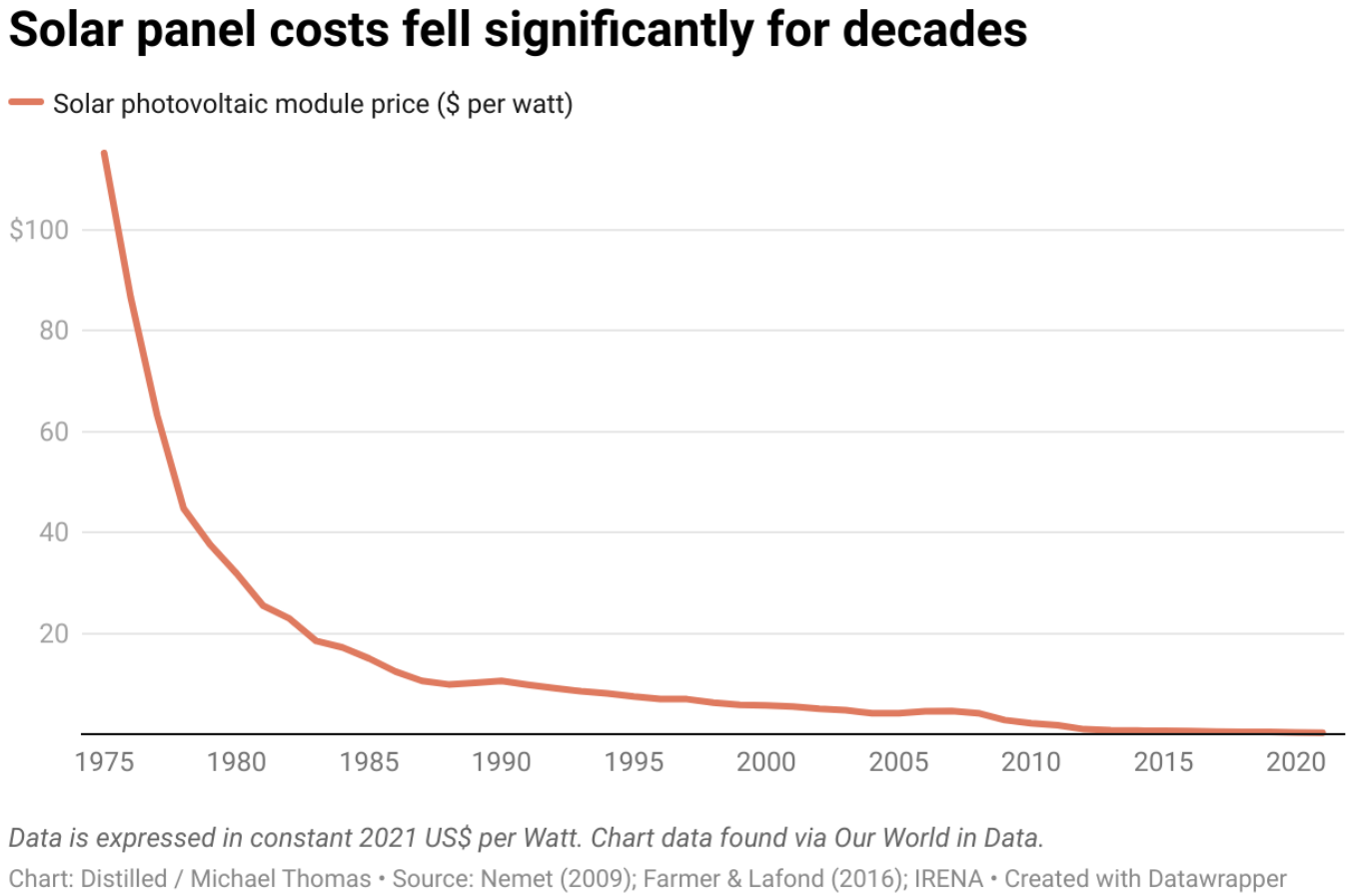
Things to look out for

- Accreditations: Must be MCS registered
- Age of company. A lot of new installers since energy crisis.
- See a panel layout before signing. Some installers design AFTER selling to you
- Is scaffolding included?
- DNO application and structural checks?
- Use of stock images versus own photos on website.
- Check reviews, of course


£10
LONDON
FOR THE GOVERNOR AND COMPANY
OF THE BANK OF ENGLAND
CHIEF CASHIER
£20
BANK OF ENGLAND
I PROMISE TO PAY THE BEARER ON DEMAND THE SUM OF TWENTY POUNDS
£5

Economics

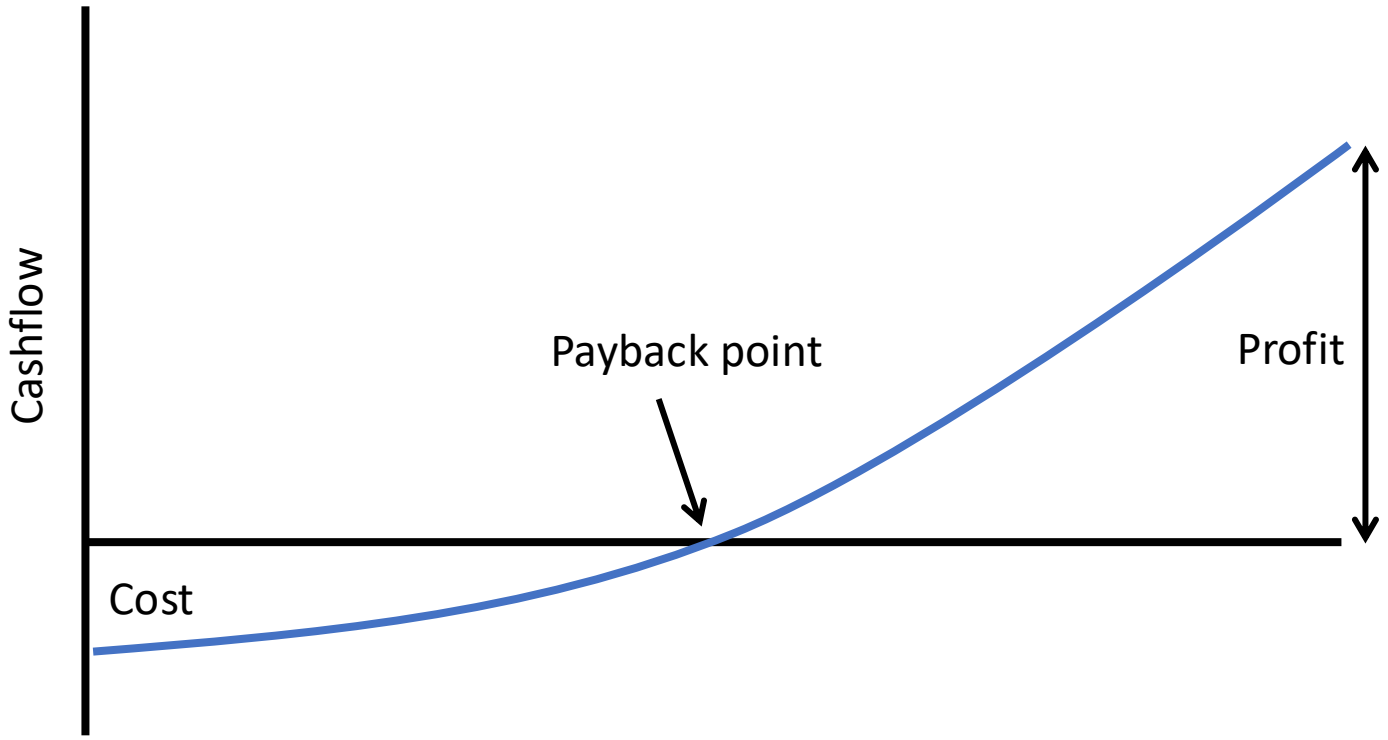
Module Costs



- Solar costs have been falling dramatically since the 1970s
- >$100/W in 1975
- $1/W by 2012
- $0.1/W in 2025

https://www.distilled.earth/p/the-remarkable-growth-of-solar-power

Economics of PV

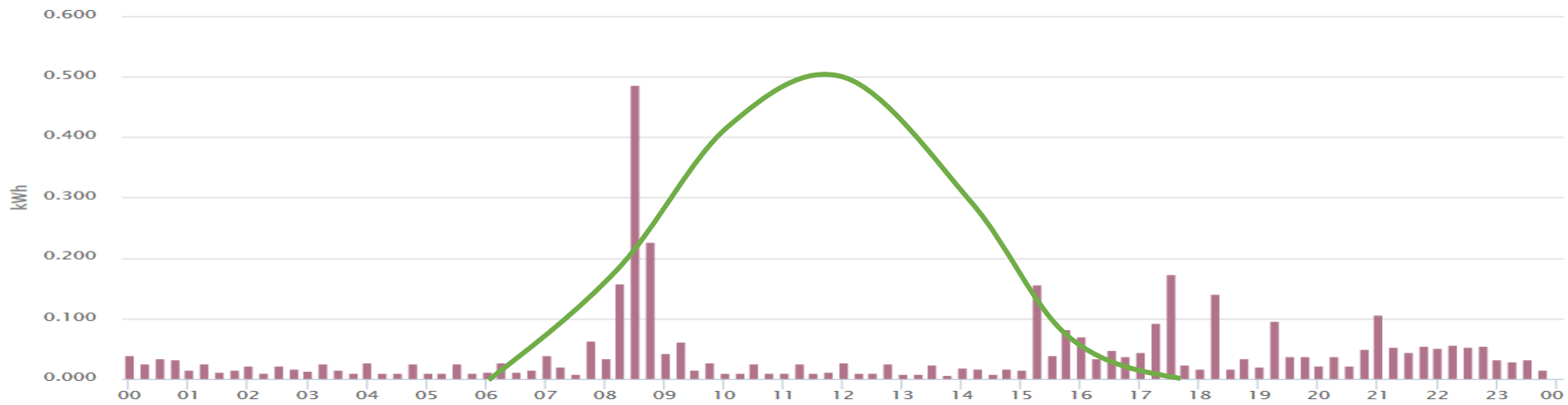


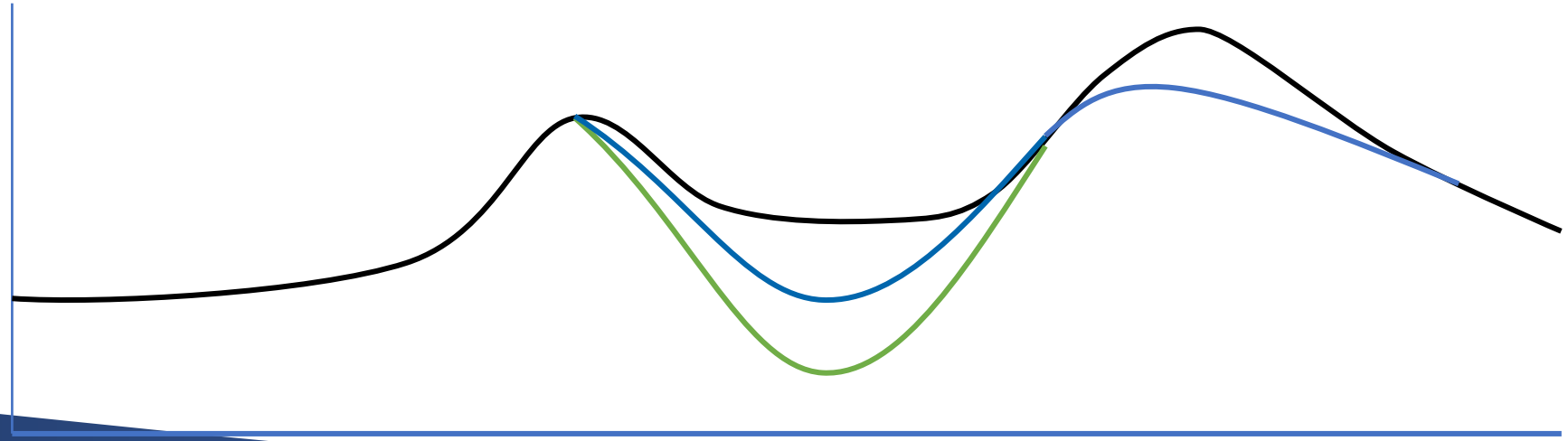
- Typical costs £5-10k
- Depends on
  - Roof type
  - Height
  - Installer choice
  - Orientation and shade
- Payback 5-10 years
- ROI:4-8%
- Cost of electricity 10p/kWh
- You're buying 25 years upfront


Should I get a battery?

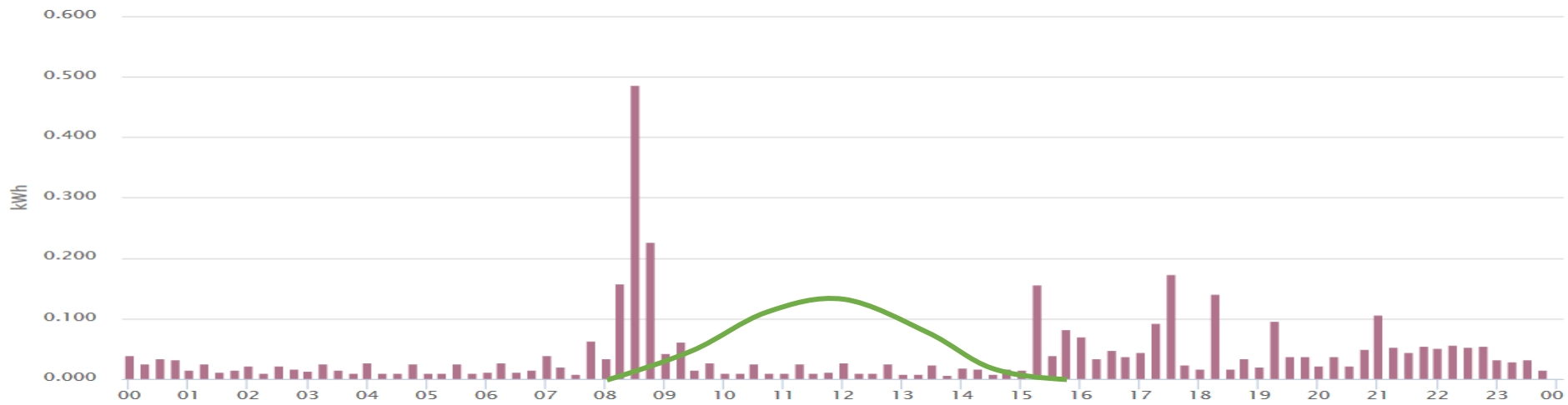

Why do you want a battery?

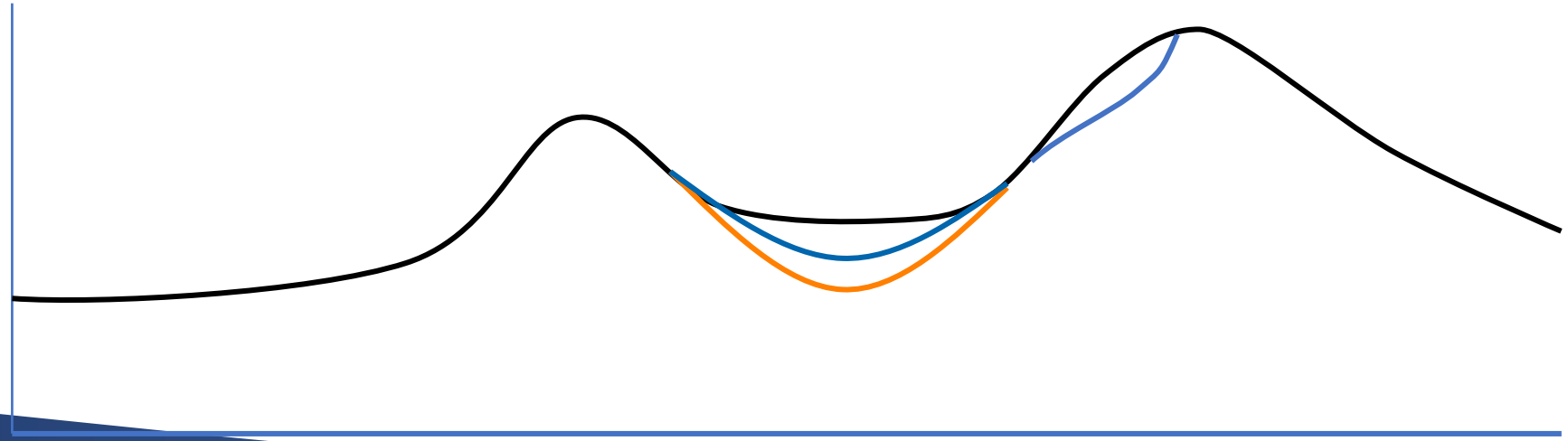
Batteries make you more self-sufficient



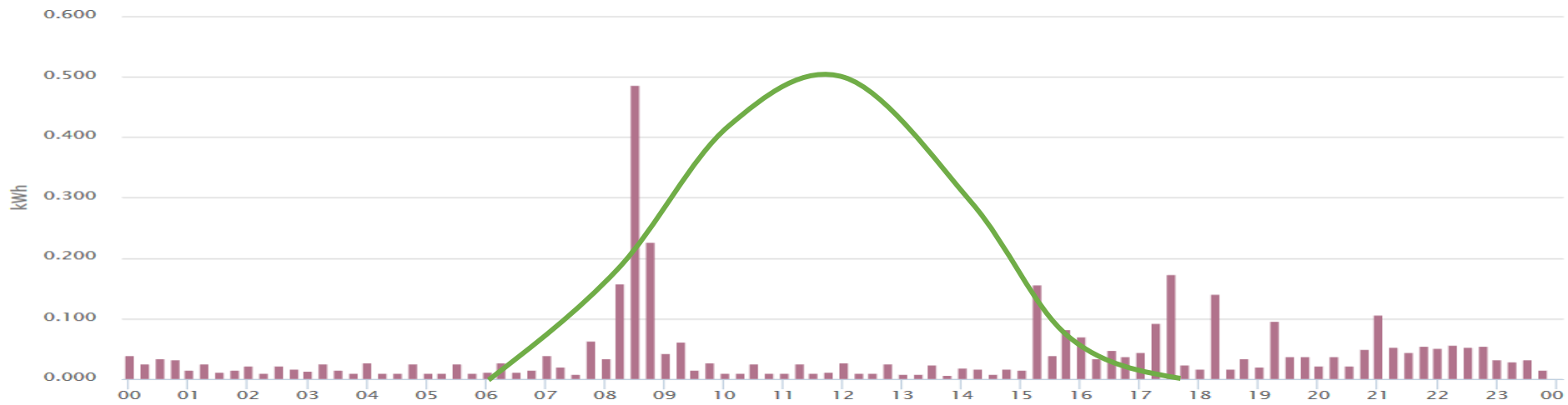


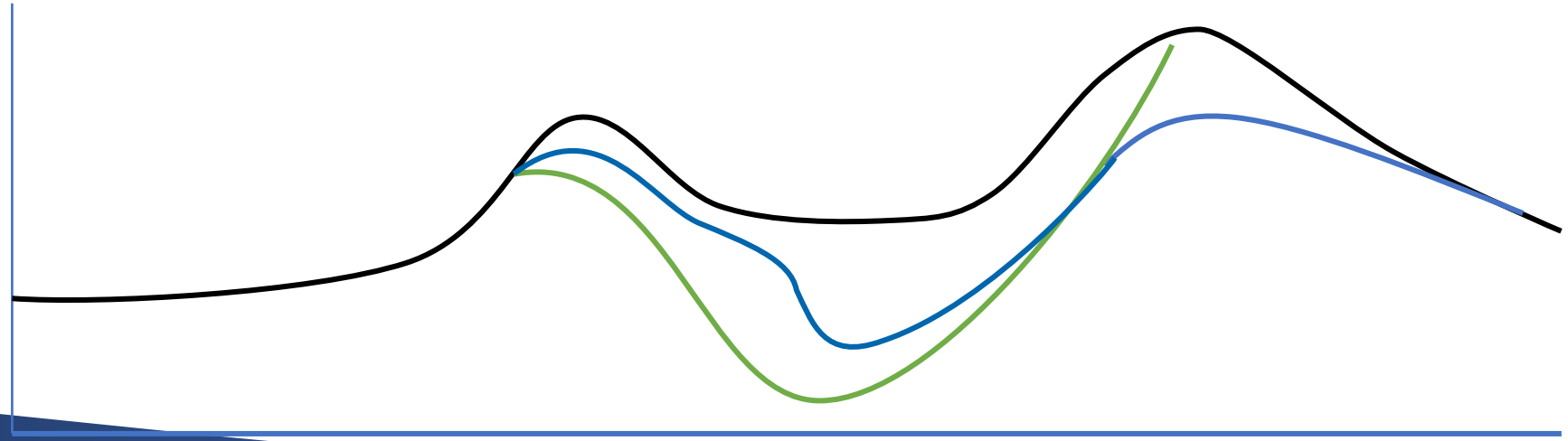
But not all year (winter)





You can’t use all you generate (summer)



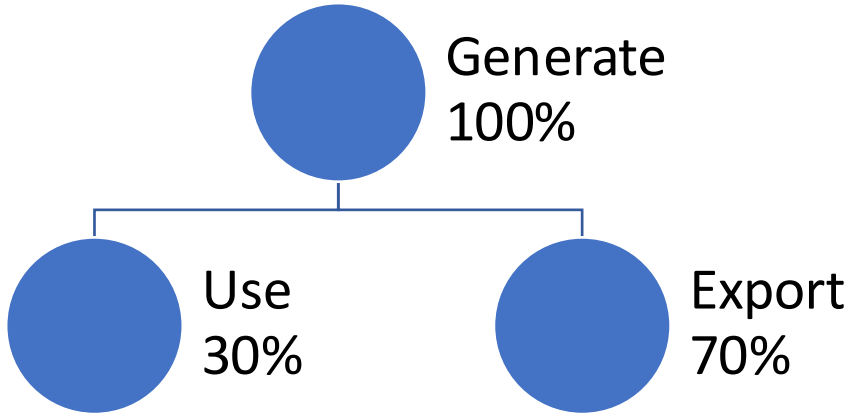


Economics of batteries

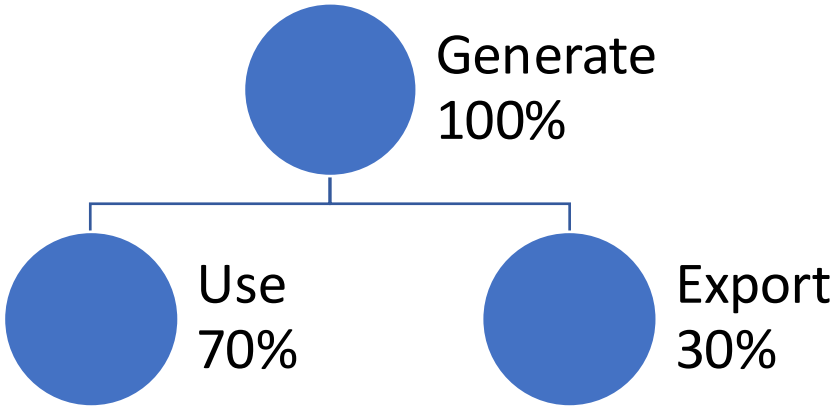
- You use more of your own generated electricity
- So you save more money on your bills
- But it costs more
- Which one wins?

- Rates of return on investment are broadly equal with and without
- So choosing a battery is an emotional decision

Solar Only



Solar and Battery



Batteries and the environment

- Broadly, it's the solar panels saving carbon
- Batteries just choose WHO gets to use the green electricity
- Comparing solar with and without battery
  - Household carbon ↓
  - Everyone else ↑
  - Overall →

What to look for

- Battery capacity
- Aim for 1 days use
- Typically 10kWh
- Smaller and you'll risk disappointment
- Larger and you're wasting money

- Power output
- Ranges for 2- 5 kW usually, sometimes higher
- Need 3kW to cover a kettle

- Power cut ride-through
- Ethics

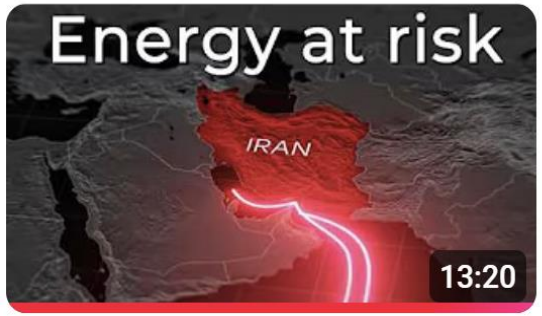
Conclusions

- Solar is the cheapest way of providing electricity to a building
- You can get electricity at about 10p/kWh
- But you have to buy 25 years worth up front
- Consider why you want to do this
- And then GO SOLAR

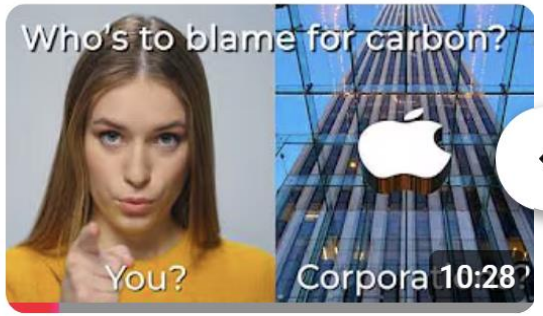
Energy Efficiency: The Most Underrated Solution to ...

The Rebound Effect: Why Efficiency Doesn't Always ...

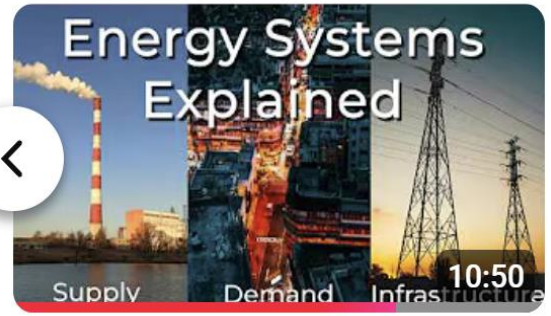
Why We Can't Just Switch to Clean Energy | Energy 101 E...



Why Energy Security Isn't What You Think | Energy 10...



Who's really to blame for carbon emissions? An ...

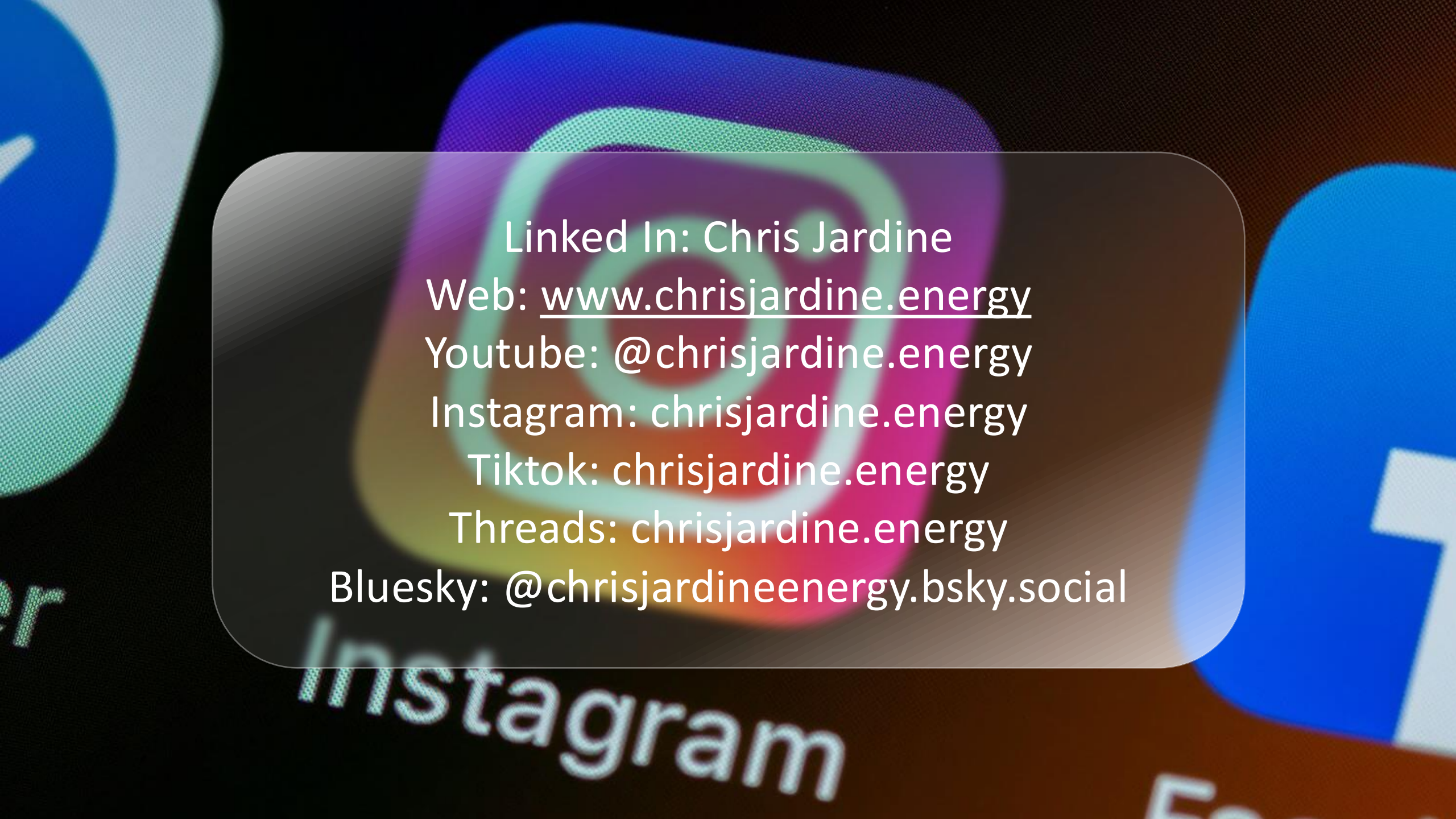


How Energy Systems REALLY work - here's 3 ways of ...

The Kaya Identity: the equation that helps solve ...

Energy services explained: the hidden reason why we ...

What is energy, and why is it important to society? | ...



Linked In: Chris Jardine
Web: www.chrisjardine.energy
Youtube: @chrisjardine.energy
Instagram: chrisjardine.energy
Tiktok: chrisjardine.energy
Threads: chrisjardine.energy
Bluesky: @chrisjardineenergy.bsky.social