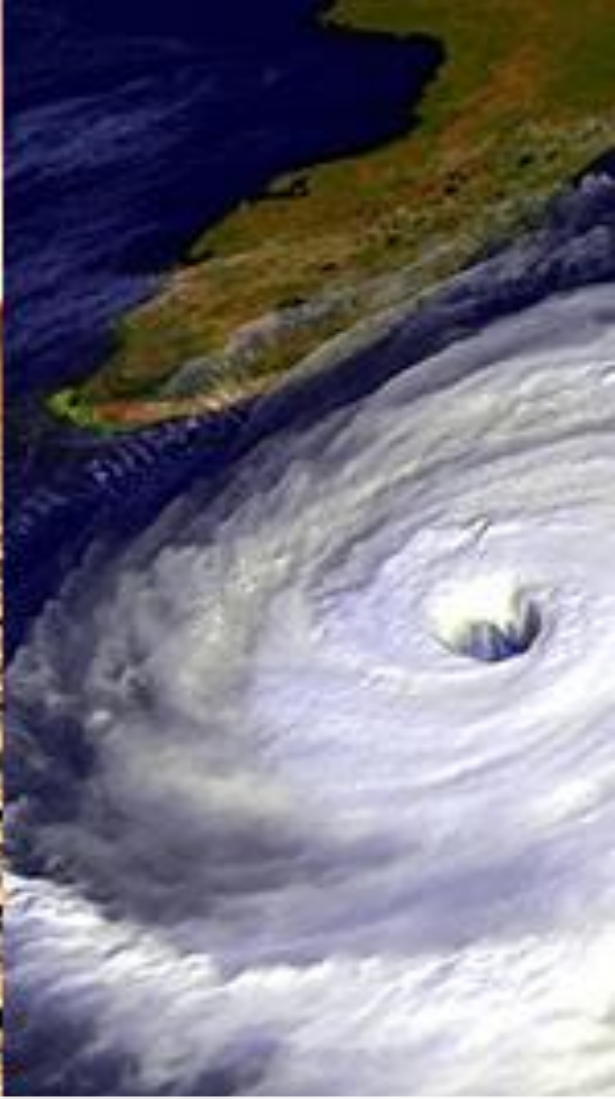


Renewable Energy in the Built Environment

Technical Information, Economics, and Myths



The Need: Why use renewables?

Climate change is the world's biggest threat, according to a new global survey

HEALTH AFFAIRS BLOG

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Climate Change Is The Greatest Threat To Human Health In History

David Introcaso

SPECIAL REPORT

Global Warming of 1.5 °C

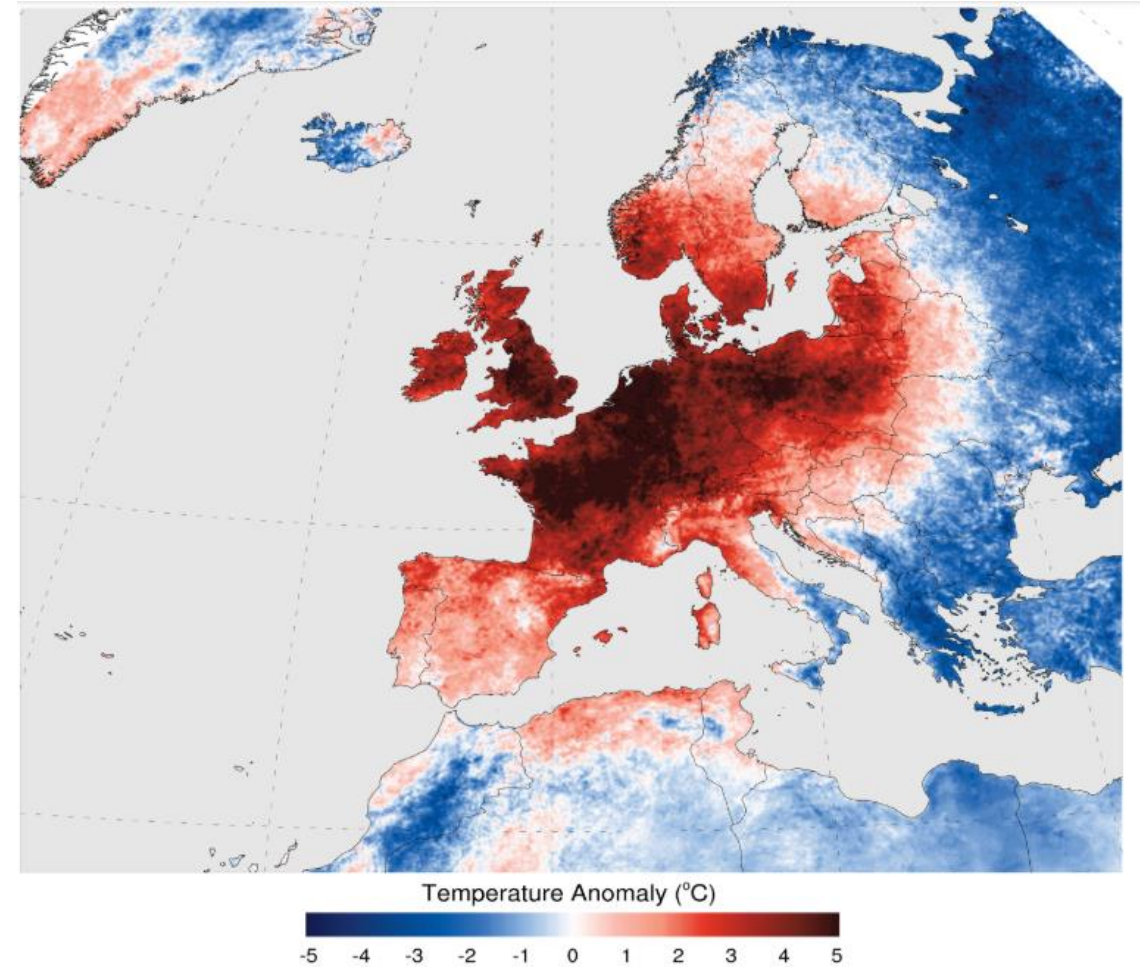
The Greatest Threat To Global Security: Climate Change Is Not Merely An Environmental Problem



Twice the normal daily rainfall in first 16 days of February - Met Éireann

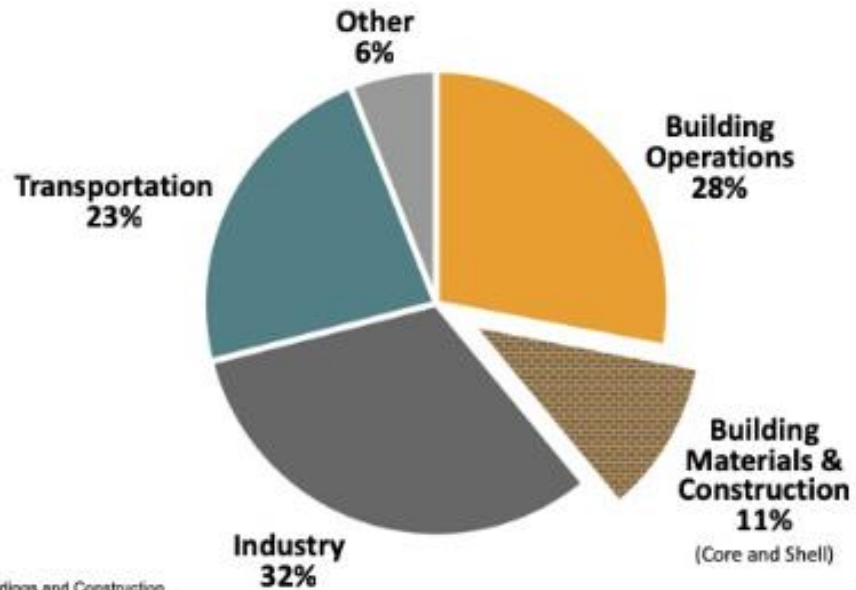
-Highest rainfall since the 1850's.

Temperature change won't be homogeneous.
Ireland will be hit hard in the long run.



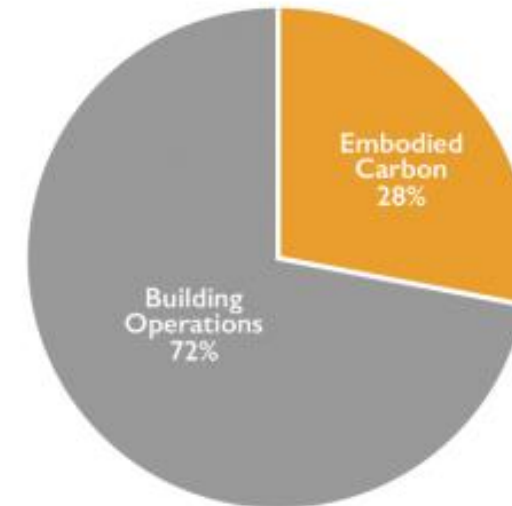
Why target the built environment?

Global CO₂ Emissions by Sector



Source:
Global Alliance for Buildings and Construction.
2018 GLOBAL STATUS REPORT.

**Annual Global Building Sector
CO₂ Emission**



Source: © 2018 2030, Inc. / Architectural 2030. All Rights Reserved. Data Sources:
UN Environment Global Status Report 2017, IEA International Energy Outlook 2017

What impact can renewables have in the built-environment (BE)?

Huge reduction in operational emissions.

Significant savings on energy bills for owners/occupiers.

Green credentials, protection against increasing energy prices, participation in energy market.

Technologies

Renewable Technology Options in the Built Environment:

- Geothermal Power

- Heat pumps

- Biomass & Products

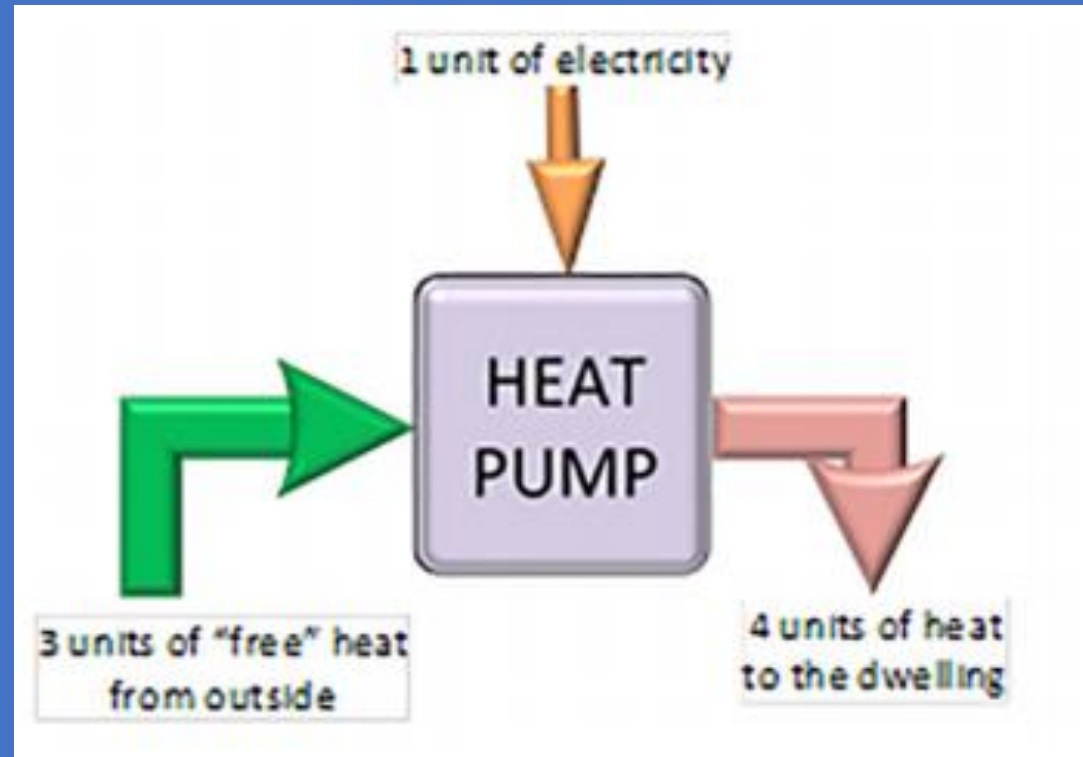
- Biomethane
- Bio Diesel
- Bioethanol
- HVO
- Wood chip/pellets

- Solar Power

- Solar PV
- Solar Thermal

Heat Pumps

- Ground-to-air (very high efficiency)
- Water-to-air (very high efficiency)
- Air-to-air (lower efficiency)
- Air-to-water (lower efficiency)



Essentially acting like a “backwards” fridge, electrifying space and water heating needs

Heat Pumps

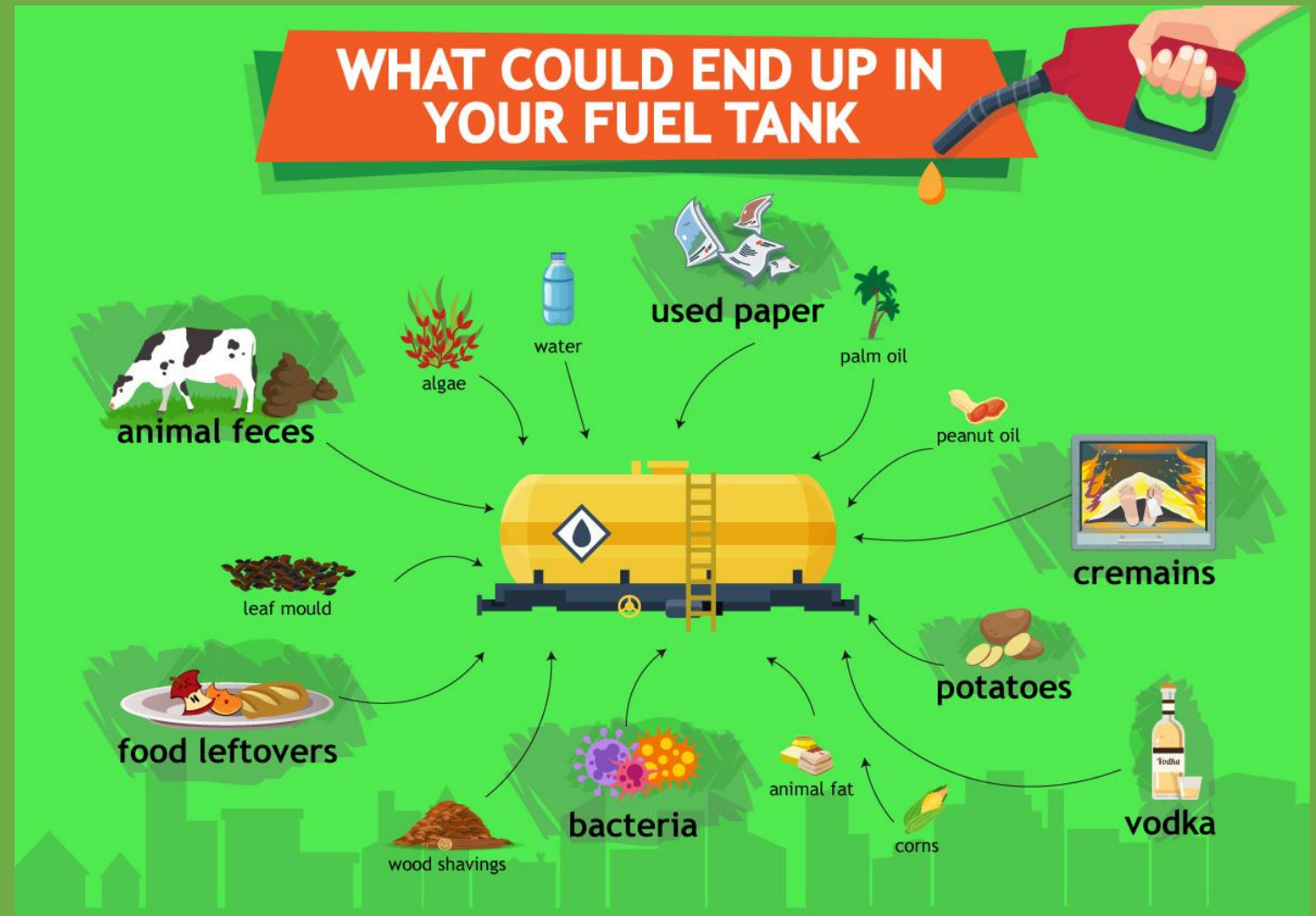
- Ground-to-air (very high efficiency)
 - Water-to-air (very high efficiency)
 - Air-to-air (lower efficiency)
 - Air-to-water (lower efficiency)
- Can supply both heating and cooling.
 - Technologically mature.
 - Growing market penetration.
 - Very good energy efficiency device.
 - Unlike true renewable devices, requires a source of power.

Heat Pumps

- Ground-to-air (very high efficiency)
 - Water-to-air (very high efficiency)
 - Air-to-air (lower efficiency)
 - Air-to-water (lower efficiency)
- Air source still most common due to capital costs.
 - Ground source much more efficient, especially in winter.
 - Ground temperatures in the 7-21 degrees, typically better in the south and within Dublin.
 - Water source very site dependent.
 - Hot water pumps experience a comparatively low Coefficient of Performance (COP) due to the temperatures required.

Biomass

- Biomethane
- Biodiesel
- Bioalcohols
- Wood chip/pellets



Biomass

- Biomethane
- Biodiesel
- Bioalcohols
- Wood chip/pellets

- Biomethane- upgraded biogas, produced by anaerobic respiration in a bioreactor.
- Biodiesel- (e.g. HVO) made through transesterification of fats and oils. Diesel replacement.
- Bioalcohols- (e.g. bioethanol) made through fermentation process of biomass. Petrol replacement.
- Wood chip/pellets- direct combustion of waste products (ideally).

Biomass

- Biomethane
- Biodiesel
- Bioalcohols
- Wood chip/pellets

- Carbon neutral.
- Source of Biomass crucial environmental factor.
- Suitability highly dependent on current usage.
- Can be an effective replacement of fossil fuels when electrification is not possible.
- Industry still immature in Ireland.
 - Low production volumes.
 - Poor visibility and availability.

Solar Power

- Solar PV
- Solar Thermal

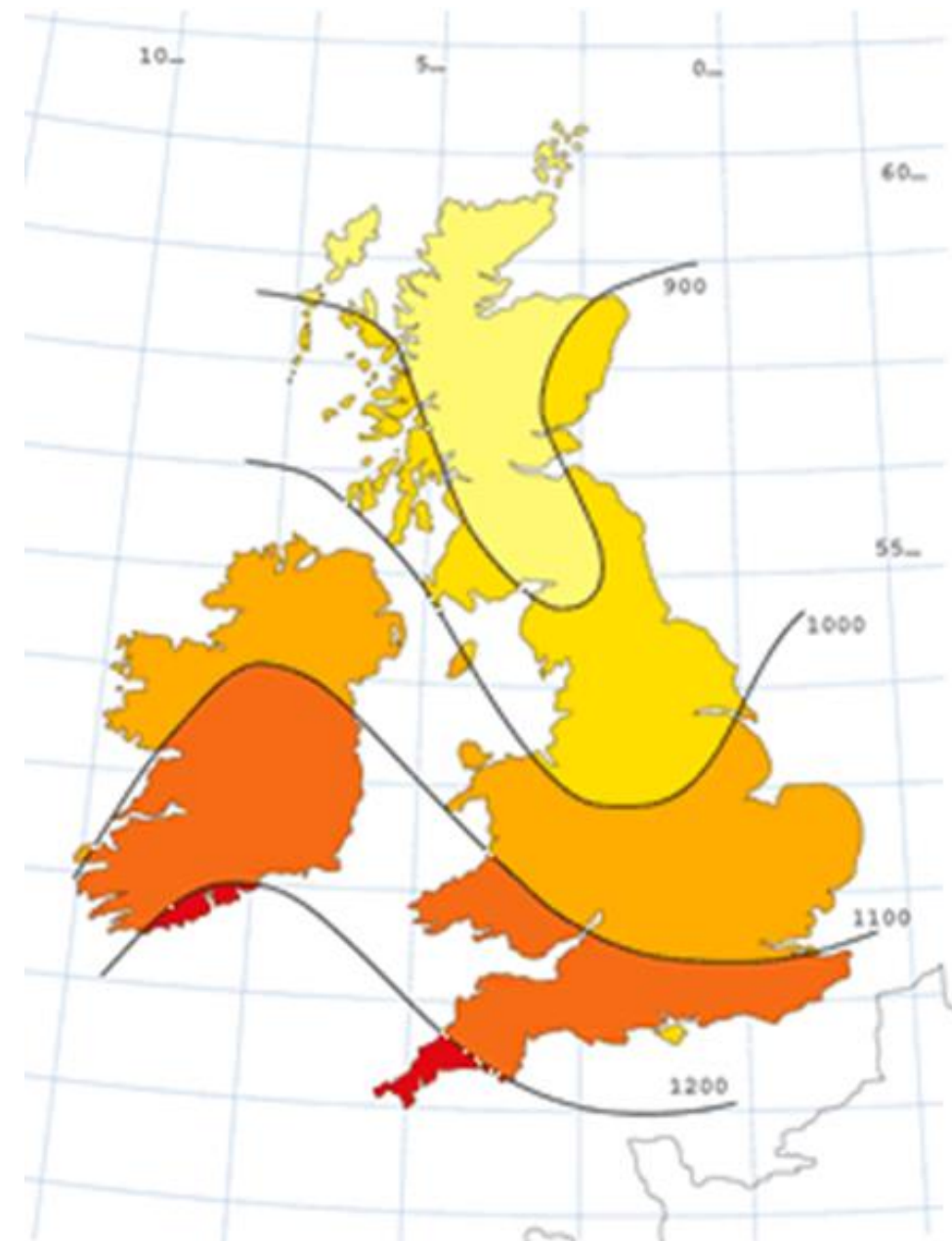
- The obvious fit for the built environment.
- Technologically mature, directly harnessing the sun's energy.

Solar Power

- Solar PV
- Solar Thermal

Severely underutilized in Ireland compared to UK:

- Ireland 2019 installed capacity: ~25MW.
- UK 2019 installed capacity: ~13,000MW.



Solar Thermal

Solar Power

- Solar PV
- Solar Thermal

Solar Power

- Solar PV
- Solar Thermal

Solar Thermal

- Economic solution for hot water supply due to high conversion efficiency (up to 70%).
- Demand decreasing rapidly in recent years due to drop in price for Solar PV.
- Requires replacement of fluids every 5-10 years to remain efficient.

Solar PV- Rooftop

Solar Power

- Solar PV
- Solar Thermal

Solar PV - Facade

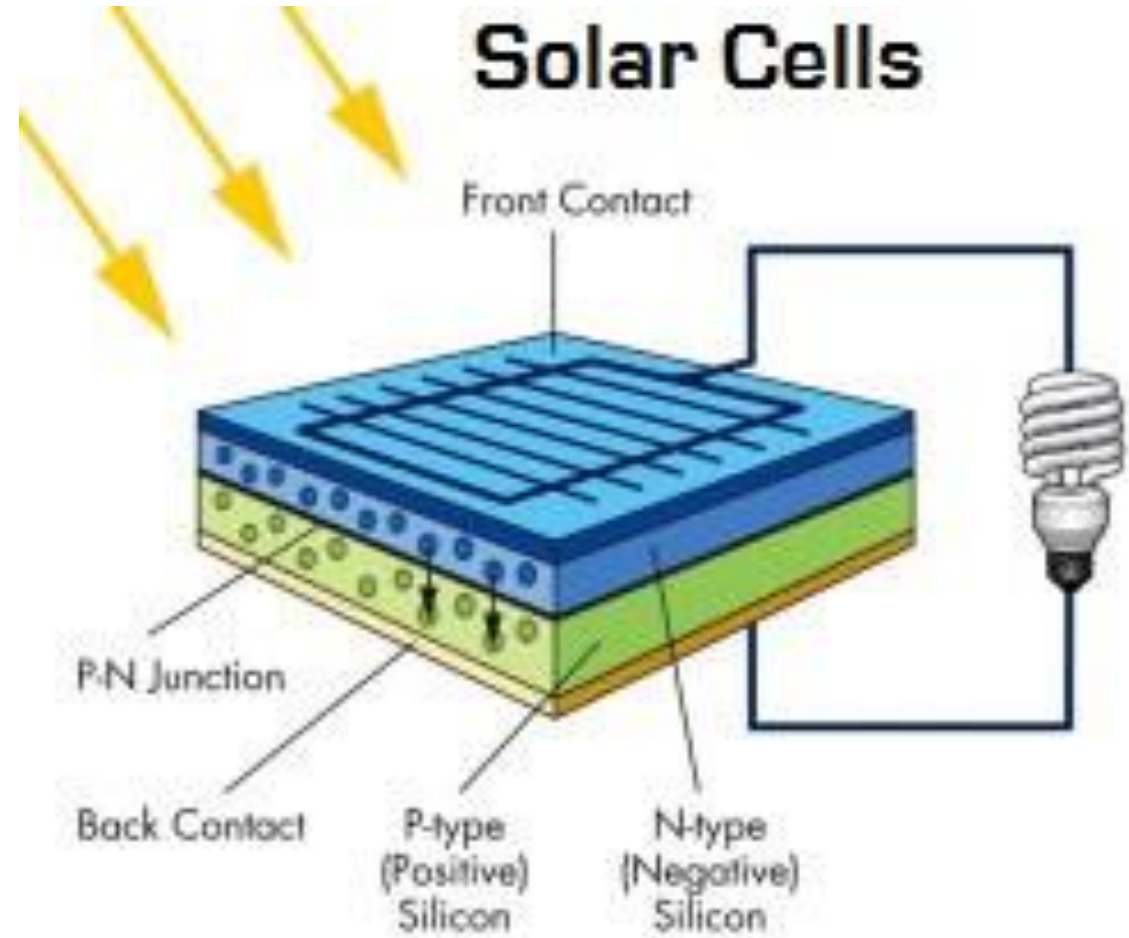
Solar Power

- Solar PV
- Solar Thermal

Solar Power

- Solar PV
- Solar Thermal

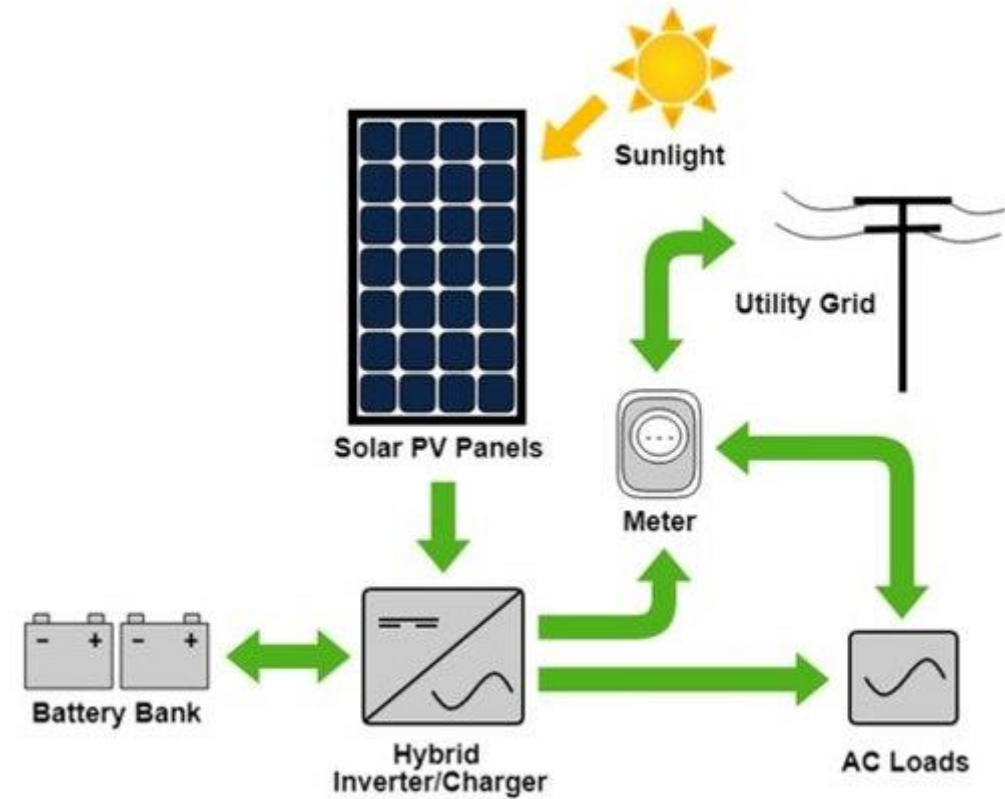
Solar PV



Solar Power

- Solar PV
- Solar Thermal

Solar PV



Solar Power

- Solar PV
- Solar Thermal

Solar PV

- Arranged in “Strings” of modules, with up to two strings connected to a DC/AC inverter
- PV systems completely modular, can be designed to any size
- Module efficiency growing with time
- Current market average around 17-19%
- Produces high quality energy (electricity)

Solar Power

- Solar PV
- Solar Thermal

Solar PV

- Can be combined with battery storage systems or diversion controllers to maximise self-usage and prevent grid spillage.
- Many variables affecting output and production profile- tilt, orientation, shading, string layout...

Solar Power

- Solar PV
- Solar Thermal

Solar PV

- Not all systems are equal!
- Huge variety in components available.
- Tier 1 is not everything.

Solar Power

- Solar PV
- Solar Thermal

Solar PV

- Good systems have 30+ year lifetime.
- Inverter most likely point of failure (and therefore should be the highest quality component).

Solar Power

- Solar PV
- Solar Thermal

Solar PV

- Can supply a significant proportion of a building's electricity needs.
- Level of self consumption can be optimized through array layout.
- Small amount of O&M per year recommended.

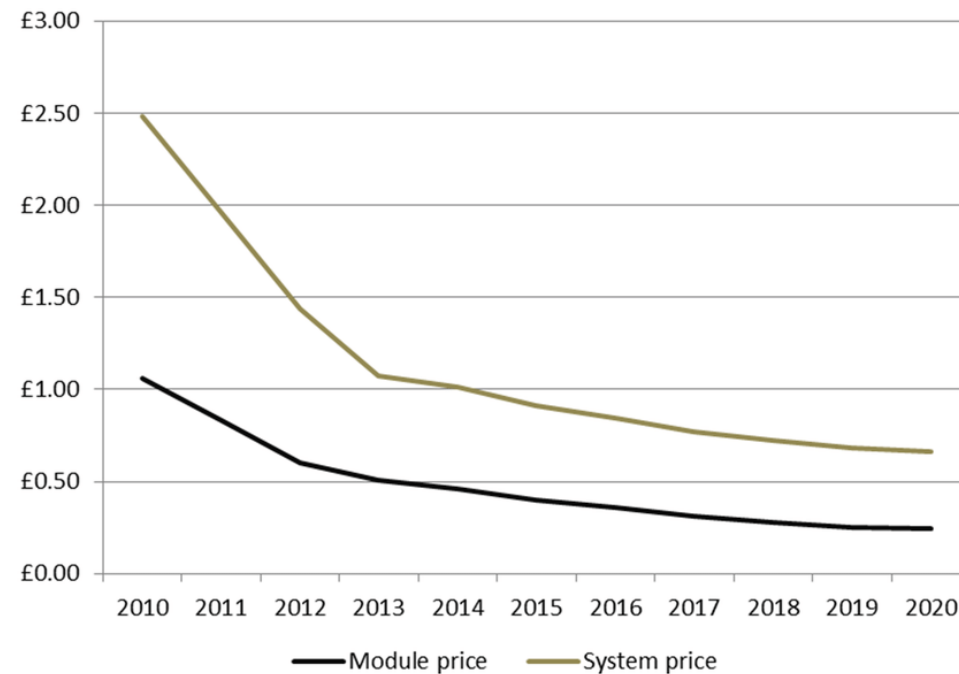
Economics

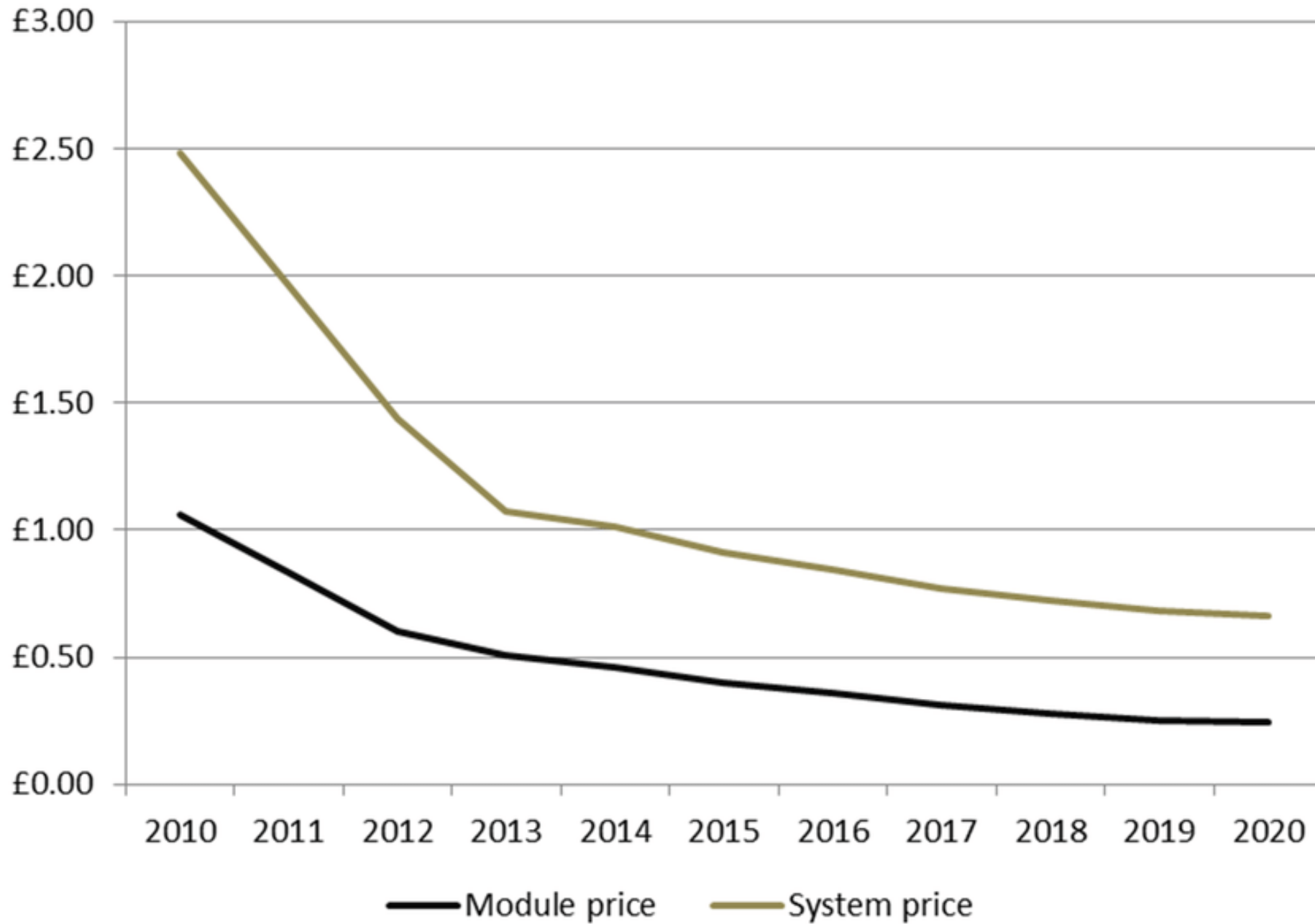
Solar Power

- Solar PV
- Solar Thermal

Solar PV

Rapidly decreasing system price is driving uptake





Solar Power

- Solar PV
- Solar Thermal

Solar PV

Economics of payback highly dependent on current cost of grid energy and current rate of usage.

Solar Power

- Solar PV
- Solar Thermal

Solar PV

Best projects (with grant support) can have:

- 3-4 year payback.
- 25%+ Internal Rate of Return (IRR).

Synergies and other Technologies

Solar PV and Heat Pumps



PROFILE OF ROUGHLY MATCHES
PROFILE OF USAGE.



WAY TO TRULY GREEN HEAT- A
HUGE CHALLENGE.



HOLISTIC APPROACH TO ENERGY
SYSTEM, HUGE ECONOMIC
SAVINGS OVERALL.

Solar PV and Infrared Heating Panels



A good solution when a heat pump is not possible



Gives a very high quality of heat and excellent thermal comfort



Heating surfaces instead of air is much more efficient when there is a lot of air flow

Solar PV and Solar Thermal



Can more fully utilize a complex roof space with shading concerns

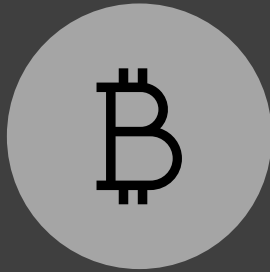


Mix can be optimized to match profile of consumption.

Solar PV and EV Chargers



HIGHLY EFFECTIVE WAY
TO GREEN TRANSPORT.



HIGH VALUE PRODUCT
(EV ELECTRICITY VALUED
AT AROUND €0.3/KWH).



REDUCES GRID EXPORT.



EXCELLENT FOR
COMPANY IMAGE.

Combined Heat & Power (CHP) and Biogas/Biomass



CHP typically highly efficient, but requires fuel (like a heat pump).



Replacing fuel with green fuel can green electricity and heat at the same time.

Myths



Myth : Energy Payback


“Renewable technologies never pay back their embodied energies!”





Myth : Government Support Needed

“Renewables need government support to be economically worthwhile.”





Myth :
Renewables are
too intermittent

“Renewables can’t replace fossil fuels.”

KRA Renewables Role

KRA renewables.

- Independent built environment renewable-energy consultants.
- Trusted project partners, managing projects from first conception to post-completion.
- Match renewable solutions to client's goals, instead of a cut-and paste solution.
- 20 years expertise in the built environment-ensuring renewable energy solutions don't compromise integrity of building fabric.

Thank you
for your
attention

Finnbar Howell, h.BSc, MA, MSc

KRA Visionary Project Partners

KRA Renewables

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20 Harcourt Street, Dublin 2