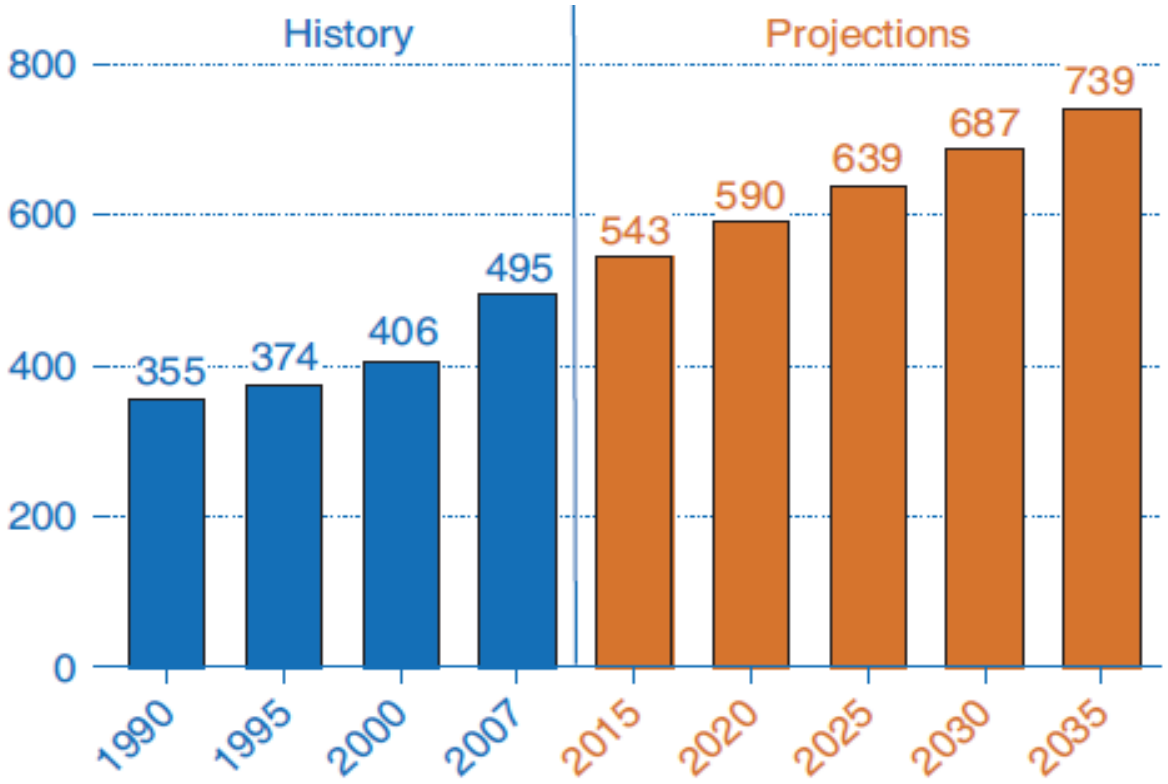
Energy Co-operatives as a Means of Achieving Sustainability Within the Housing Sector

Sarah Borthwick
& **Prof Tariq Muneer**

Edinburgh Napier University

World Marketed Energy Consumption, 1990 to 2035 *(quadrillion Btu)*

Note: 1 quadrillion Btu = 293 TWh

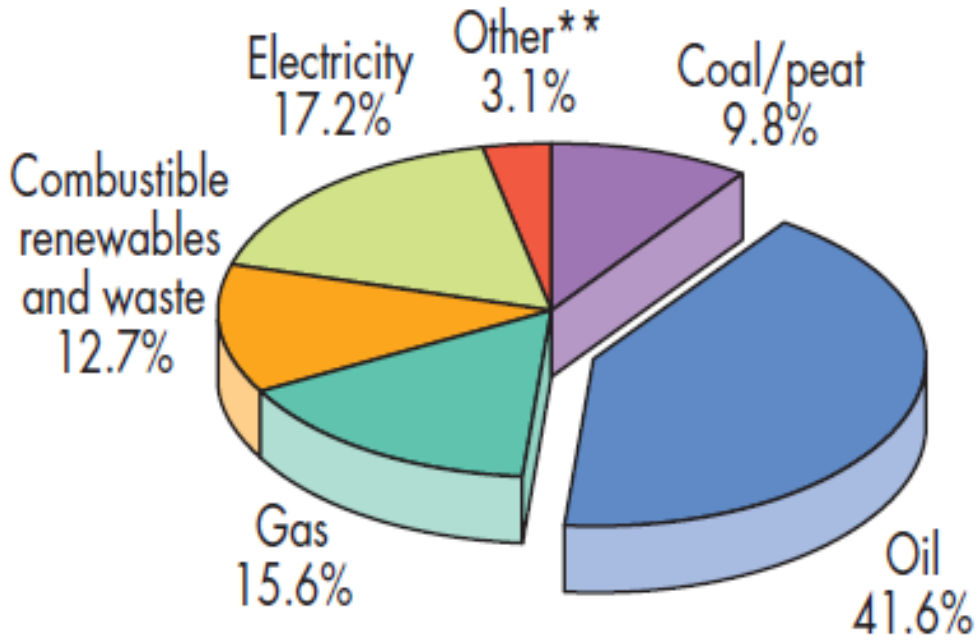


US Energy Information Administration 2010

- *Coal reserves should last for about*
  200 years
- *Oil for approximately*
  40 years
- *Natural gas for around*
  60 years

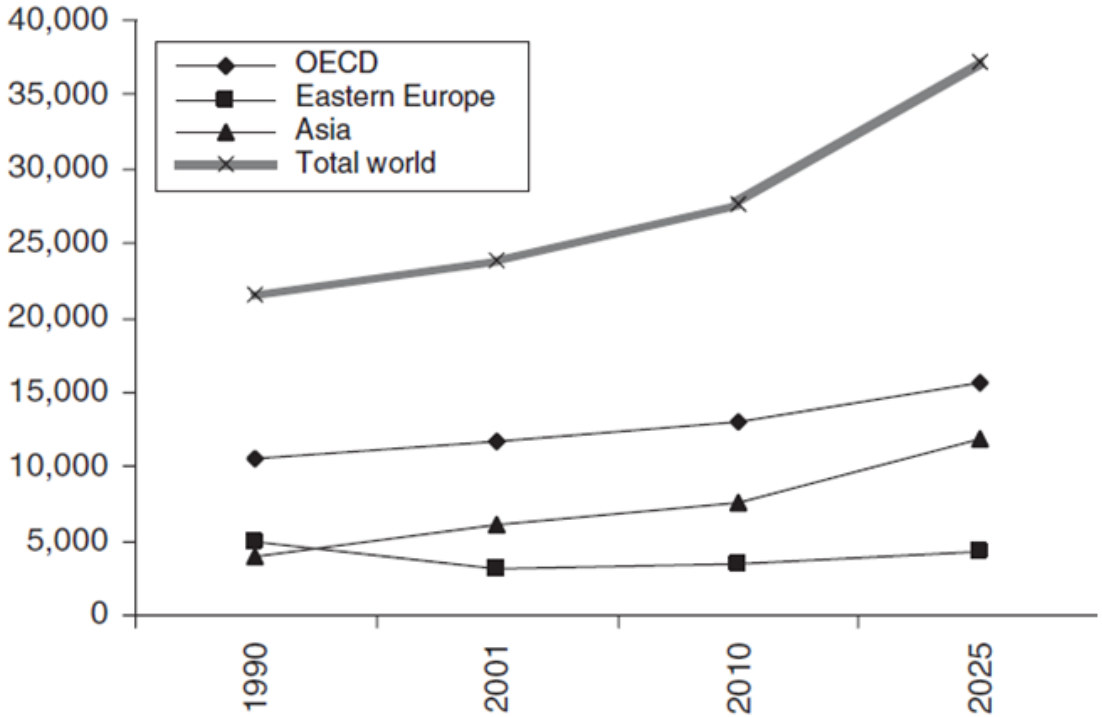
Fuel Shares of Total Final Consumption

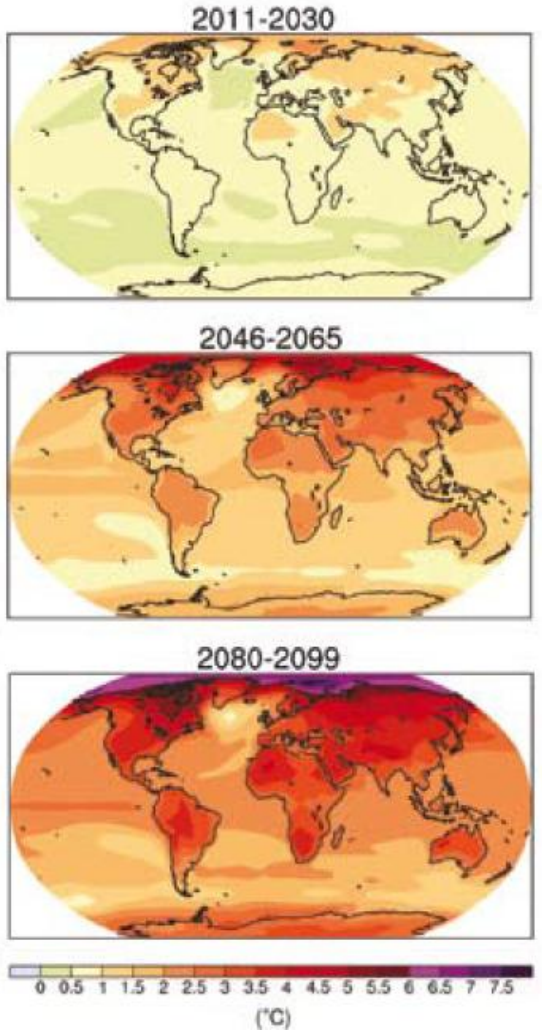
International Energy Agency 2010



CO2 Emissions Under a Business-As-Usual Scenario *(million tonnes)*

Dincer & Rosen 1999





IPCC 2007

"Most of the global average warming over the past 50 years is ***very likely*** *due to* ***anthropogenic*** *greenhouse gas increases"*

Intergovernmental Panel on Climate Change 2007

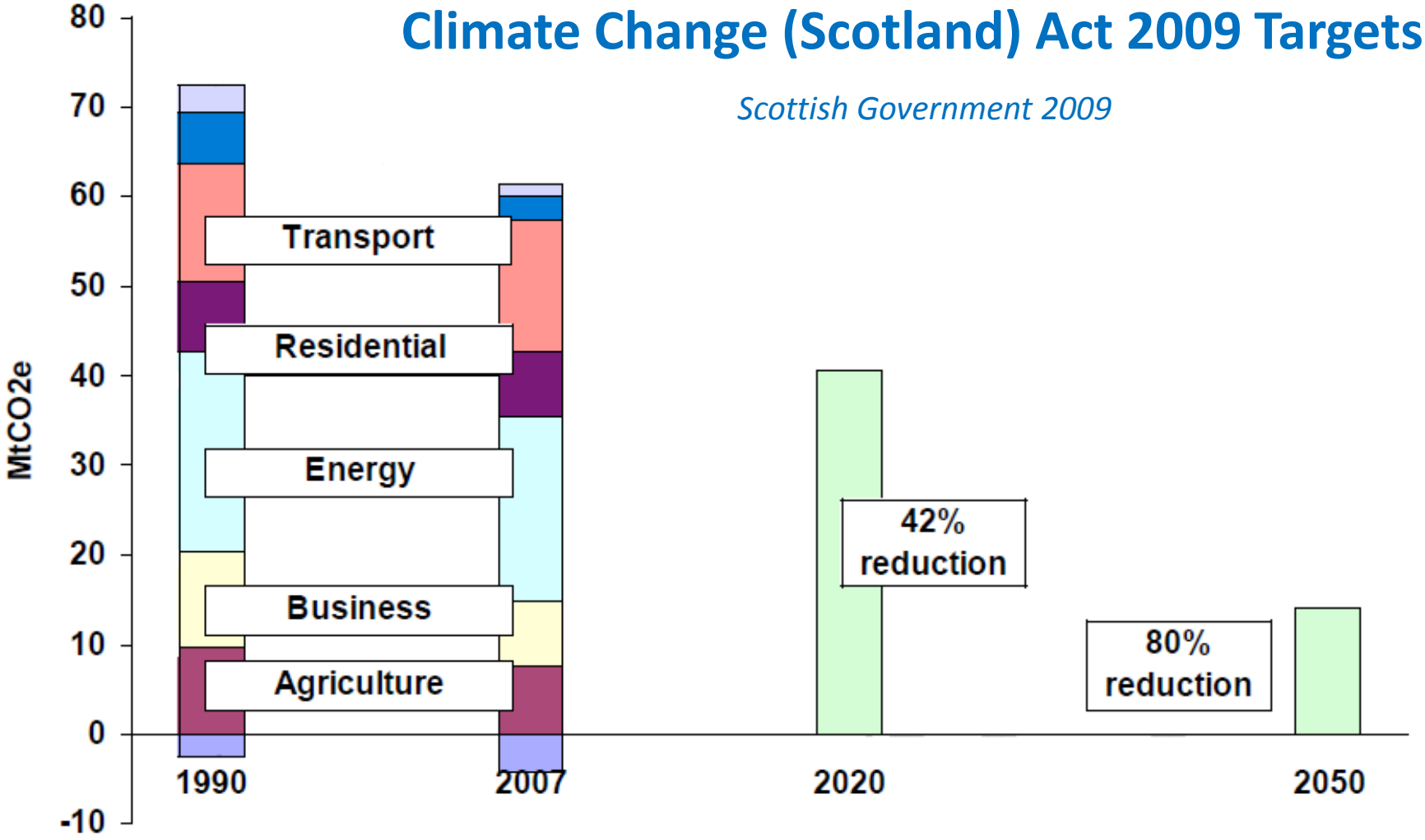
Kyoto Protocol

Target for a 5.2% reduction (from 1990 levels)

by 2008-2012

Climate Change (Scotland) Act 2009 Targets

Scottish Government 2009



Cost of mitigation <u>now</u>

1% of GDP

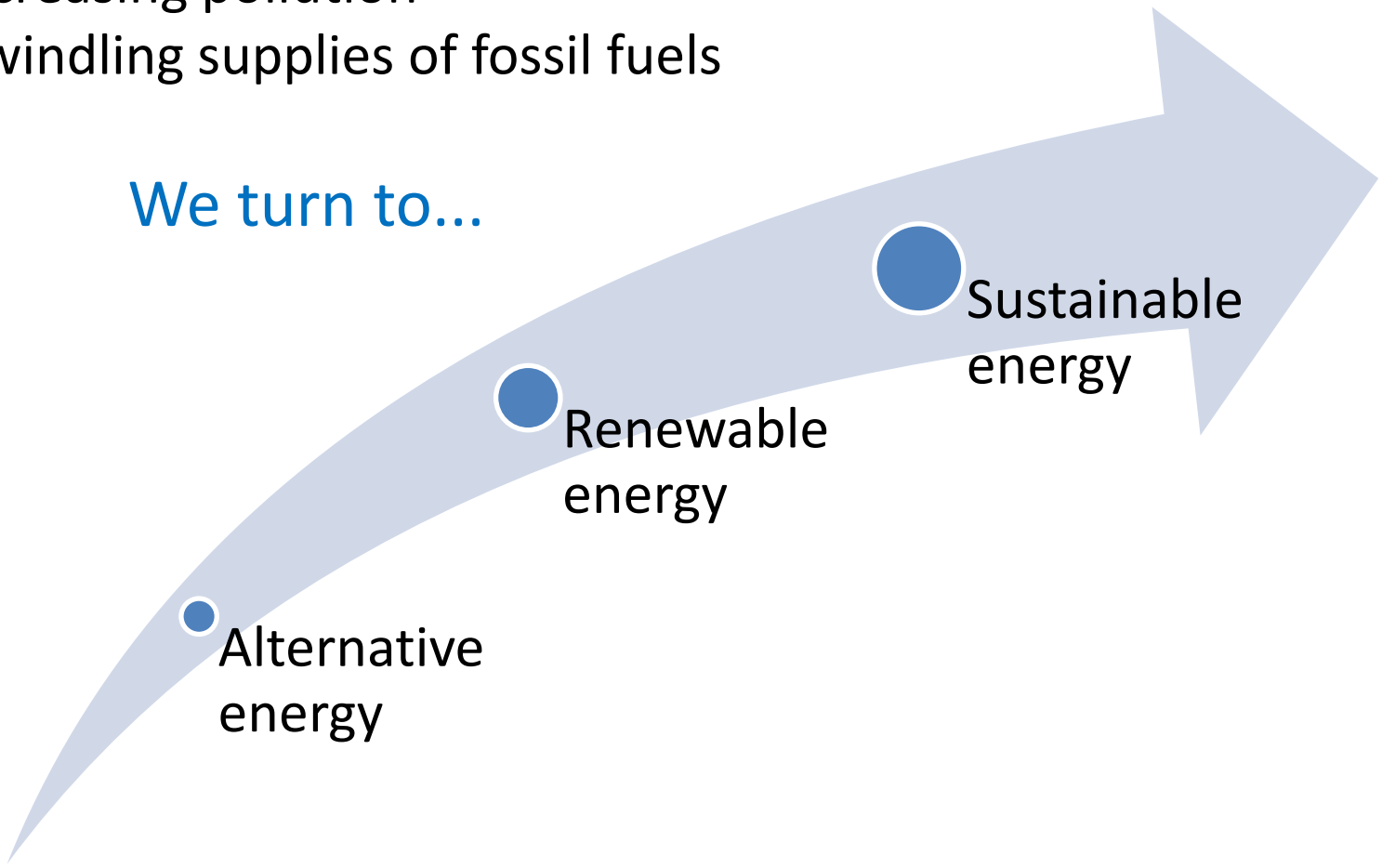
Cost of mitigation <u>later</u>

20% of GDP

Faced with two realities:

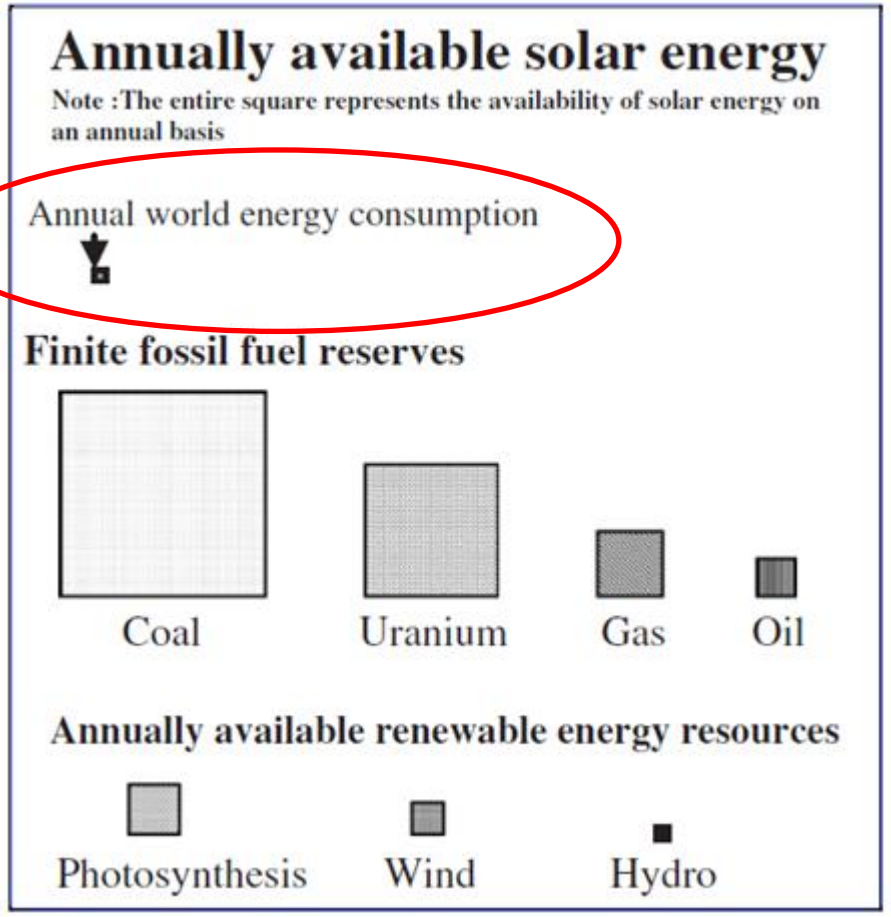
1. Increasing pollution
2. Dwindling supplies of fossil fuels

We turn to...



Potential for Various Renewable Energy Sources as Compared to Global Energy Needs

Asif & Muneer 2007



Target for renewable sources by 2020...

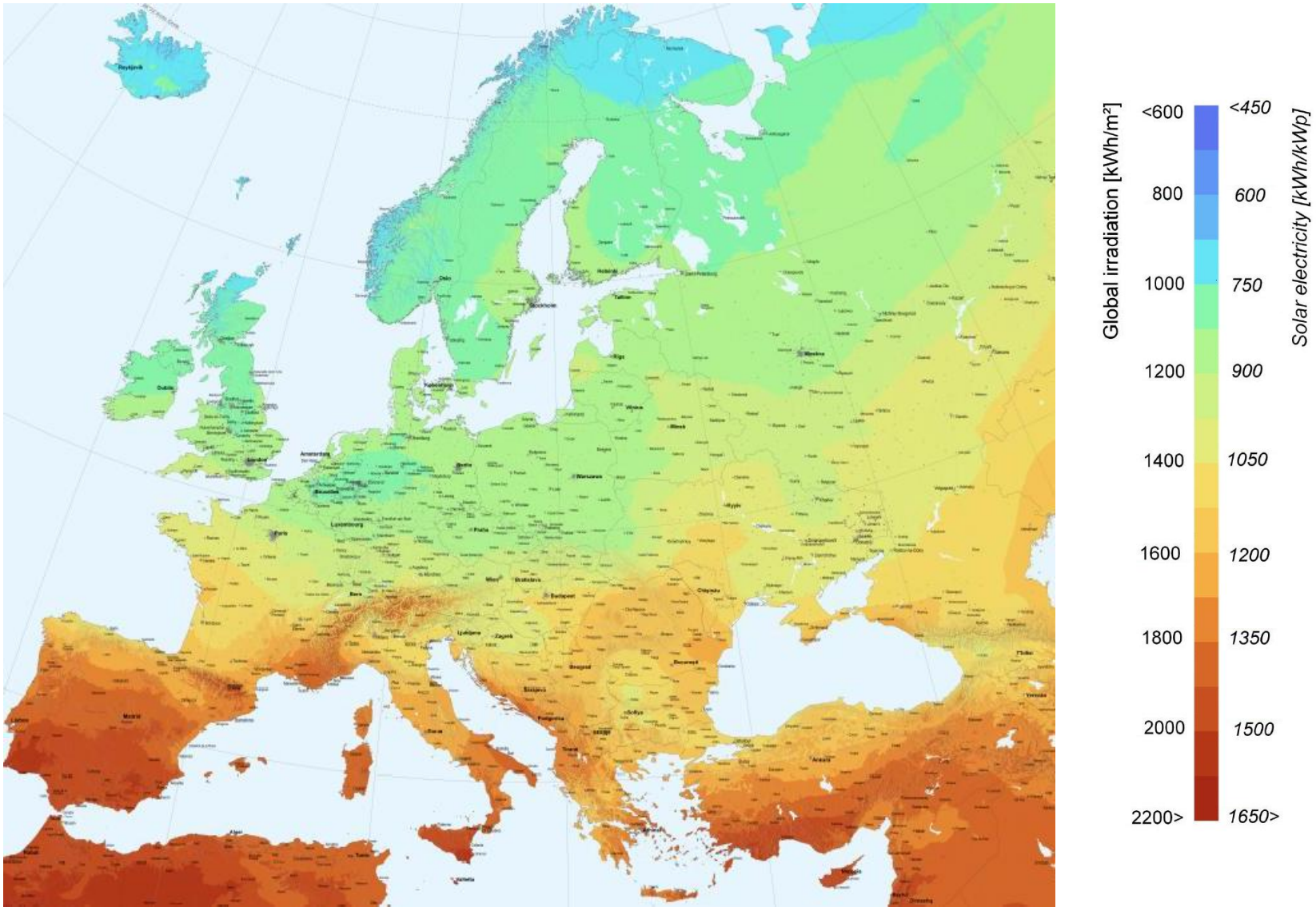
80%

20%

15%

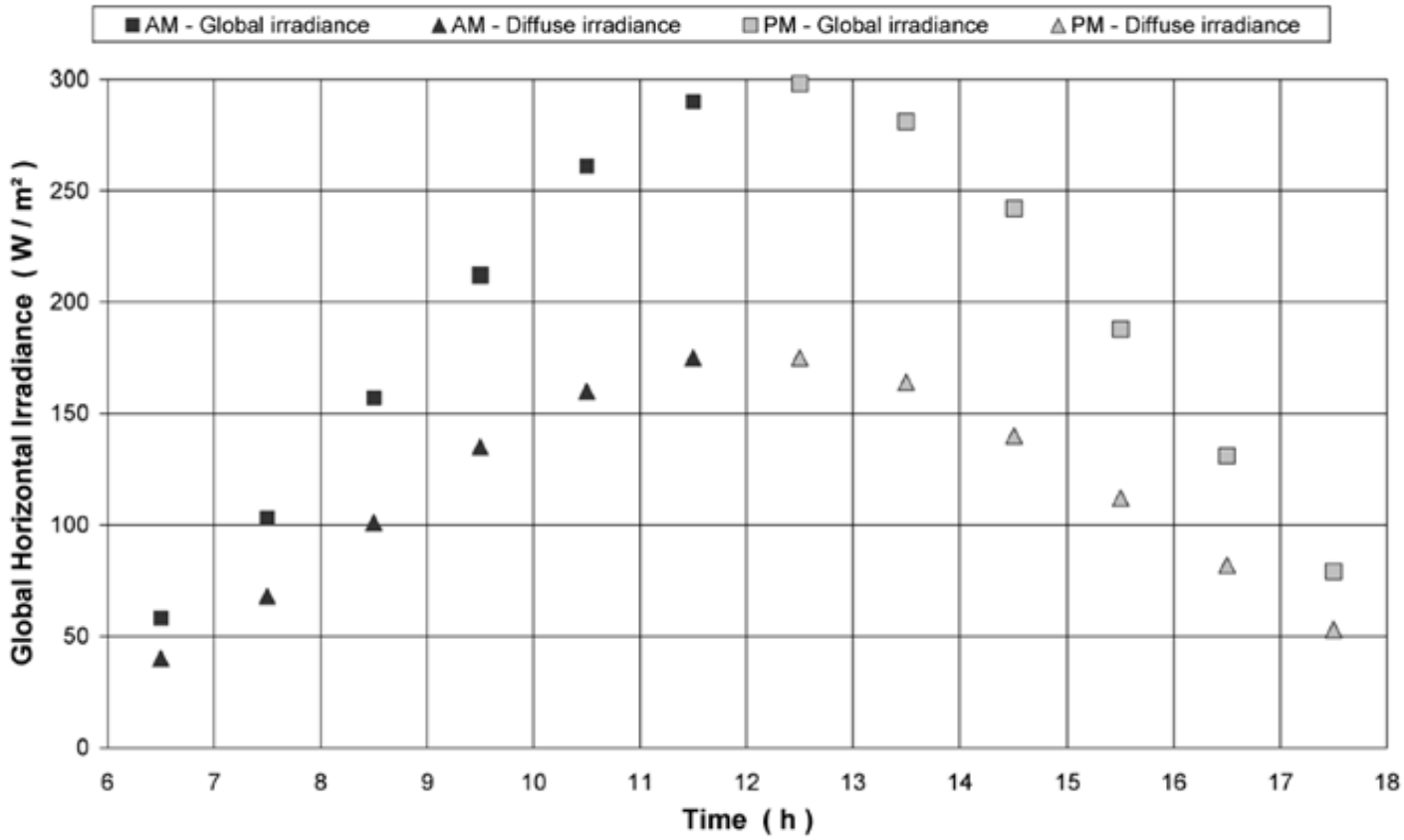
People use less energy in 27 years than the solar energy reaching the earth in one day!

Annual solar radiation received by the earth is 9 times greater than total reserves of non-renewable energy resources


Global irradiation [kWh/m²]
<600
800
1000
1200
1400
1600
1800
2000
2200>
Solar electricity [kWh/kWp]
<450
600
750
900
1050
1200
1350
1500
1650>

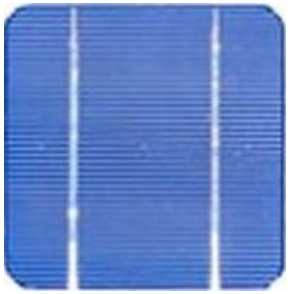
Scatter Plot of Morning and Afternoon, Horizontal Global and Diffuse Irradiance Based on 27-year Hourly Edinburgh Irradiance Data

Muneer et al. 2006

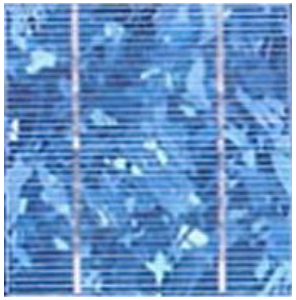


Thin film

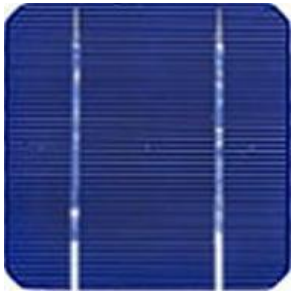
Monocrystalline



Polycrystalline

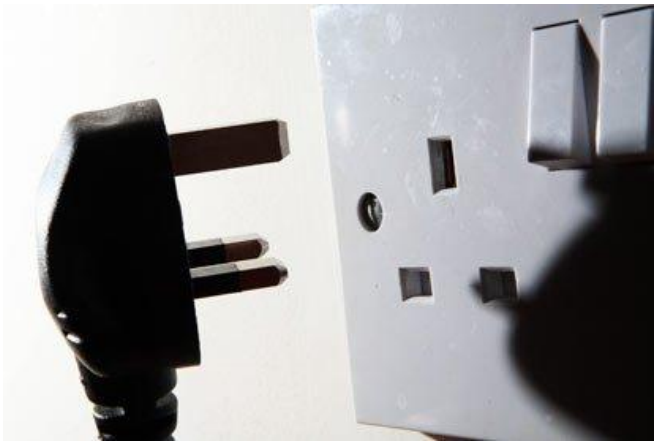


Hybrid



Average efficiencies range from 12% to 18%

Up to 30% efficiency in the future?



Cost:

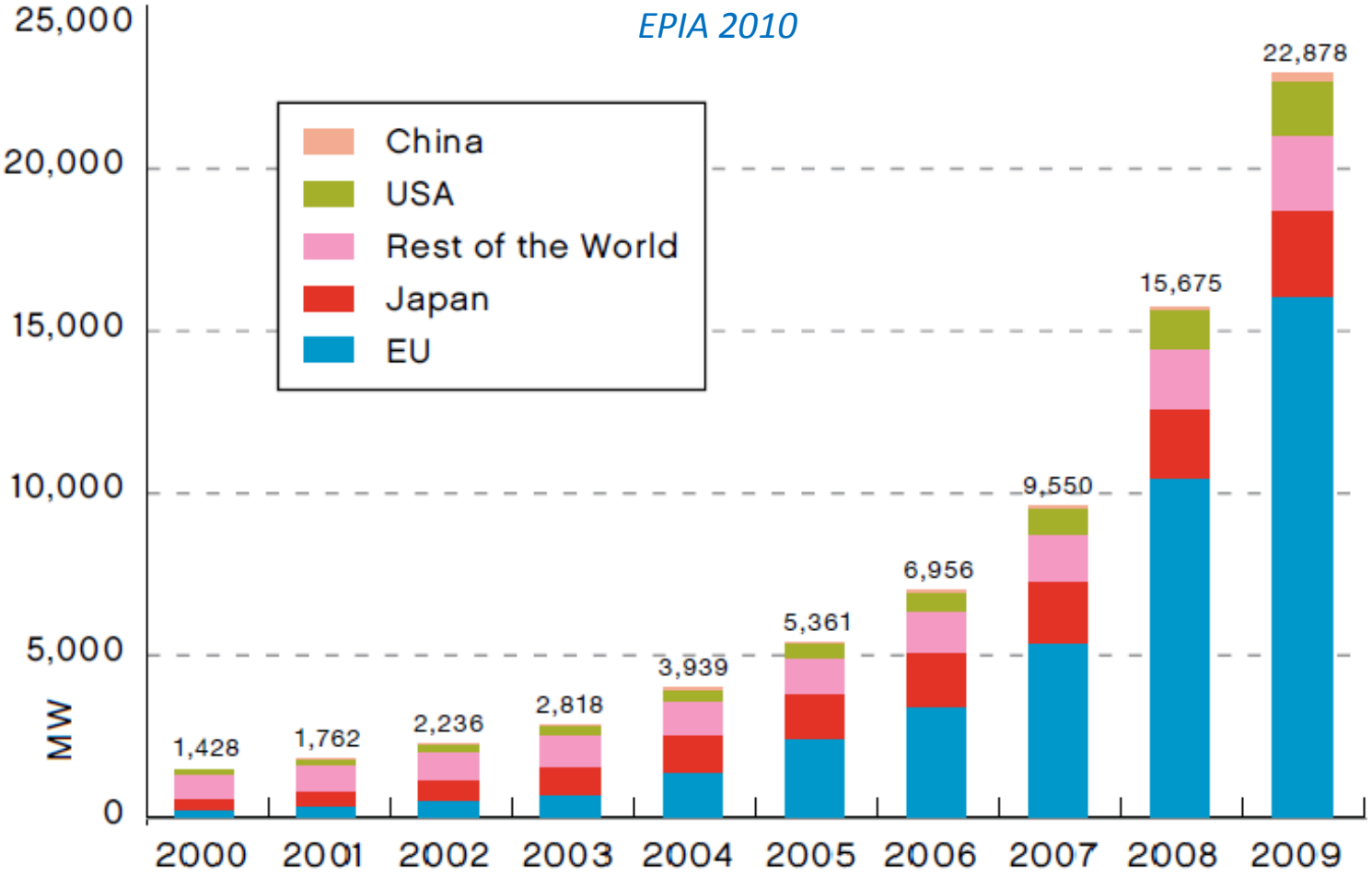
- PV modules
- Forming arrays, the necessary support infrastructure including land, cabling, invertors etc
- And either storage batteries or connection to the grid

BUT...

- No fuel required
- Solar energy is free to collect
- Low maintenance
- And a reduction in energy bills

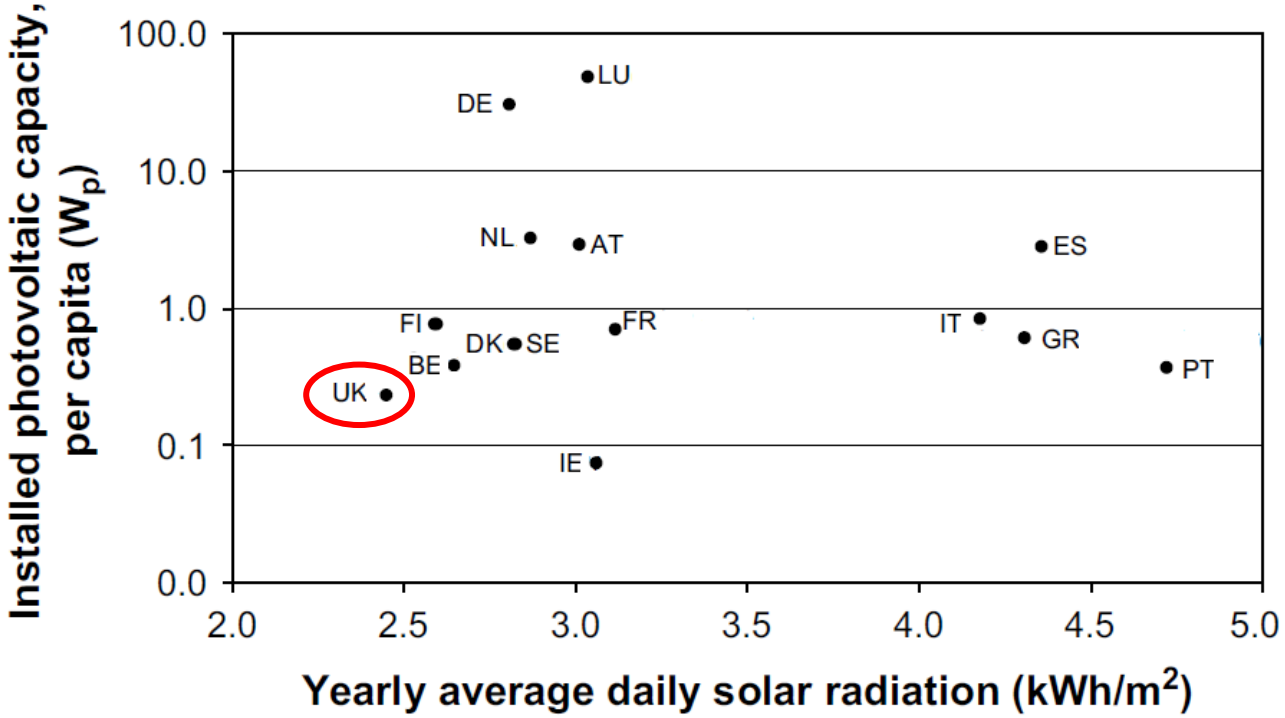
Historical Development of World Cumulative PV Power Installed in Main Geographies

EPIA 2010



Installed PV Capacity Per Capita as a Function of Annual Average Daily Solar Radiation

Celik et al. 2009



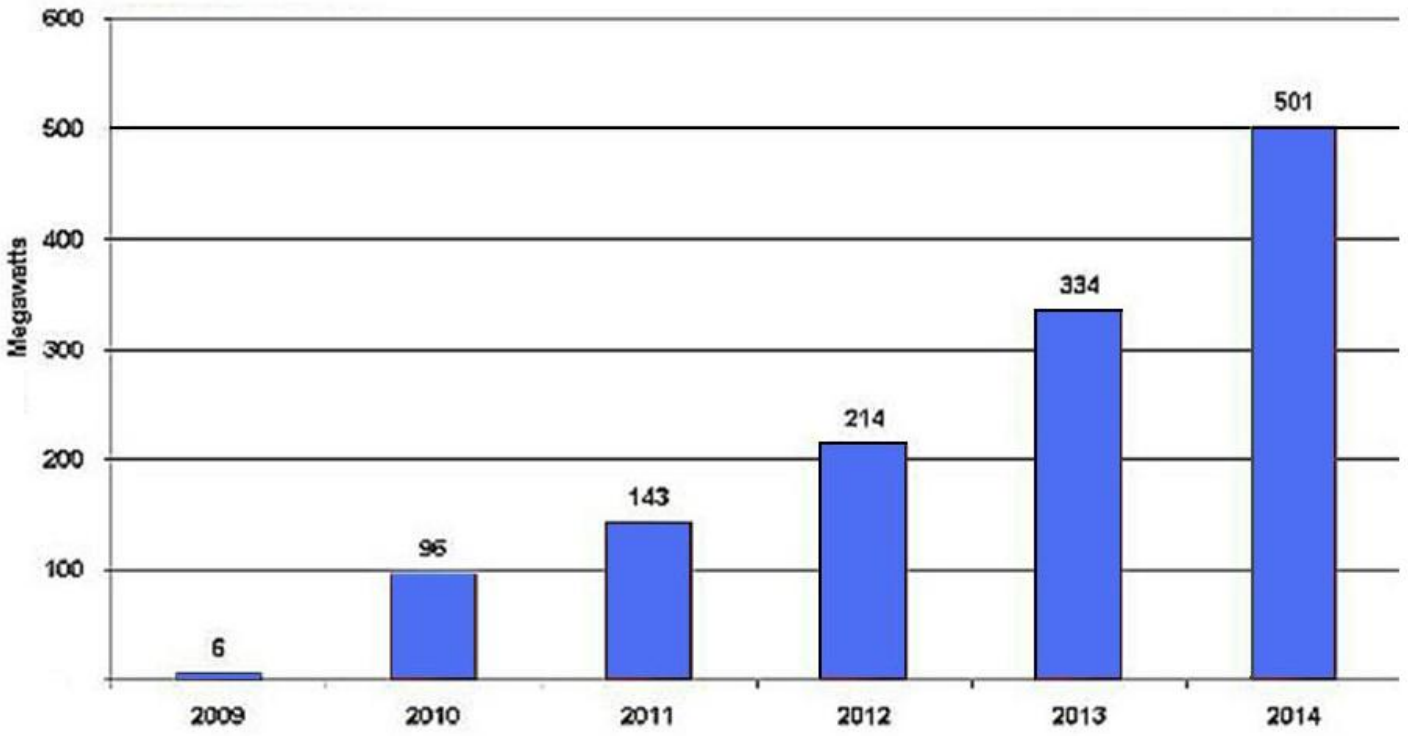
- *Annual solar energy incident on UK buildings = 1614 TWh*
- *UK peak oil production = 1504 TWh*

- *UK electricity consumption = 300TWh*
- *Potential for solar electrical generation = 200TWh*

"UK is [the] world's fastest growing PV market"

Photovoltaic System Installation Forecast in UK

iSuppli Corp 2010

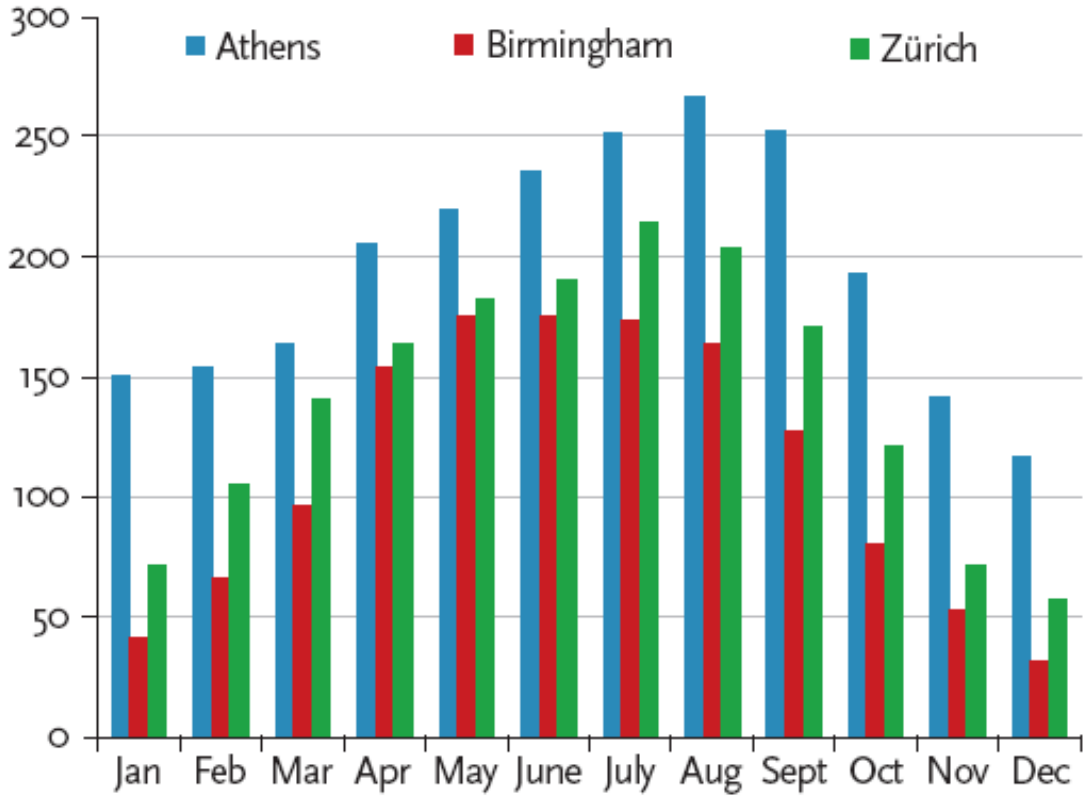


Glazed Flat Plate

Evacuated Tube Collectors

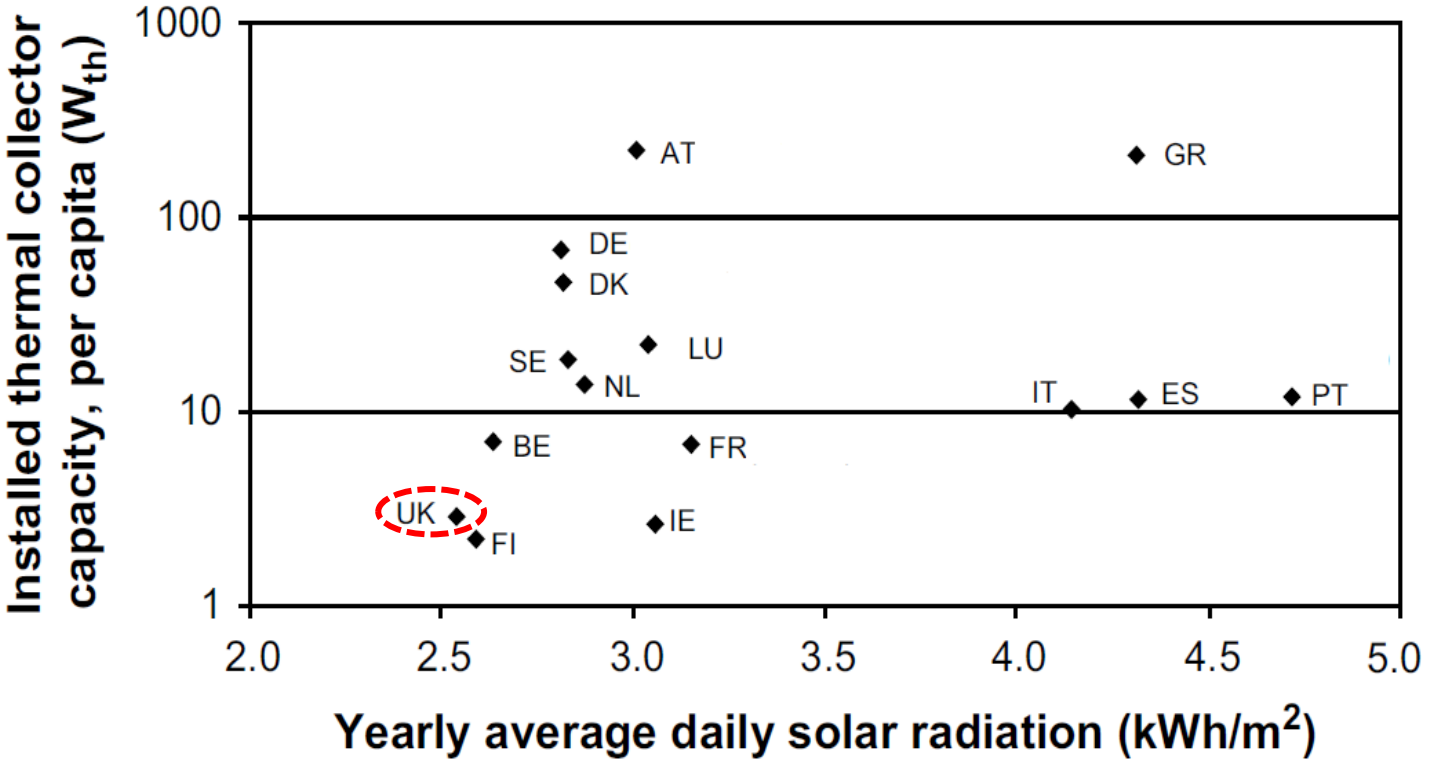
Monthly Solar Irradiance on a Flat Plane Facing South with a Tilt Angle of 45° for Athens, Birmingham and Zurich

Evans & Dwyer 2009



Capable of displacing up to 50% of the hot water load in Scottish households – saving £38 million per annum

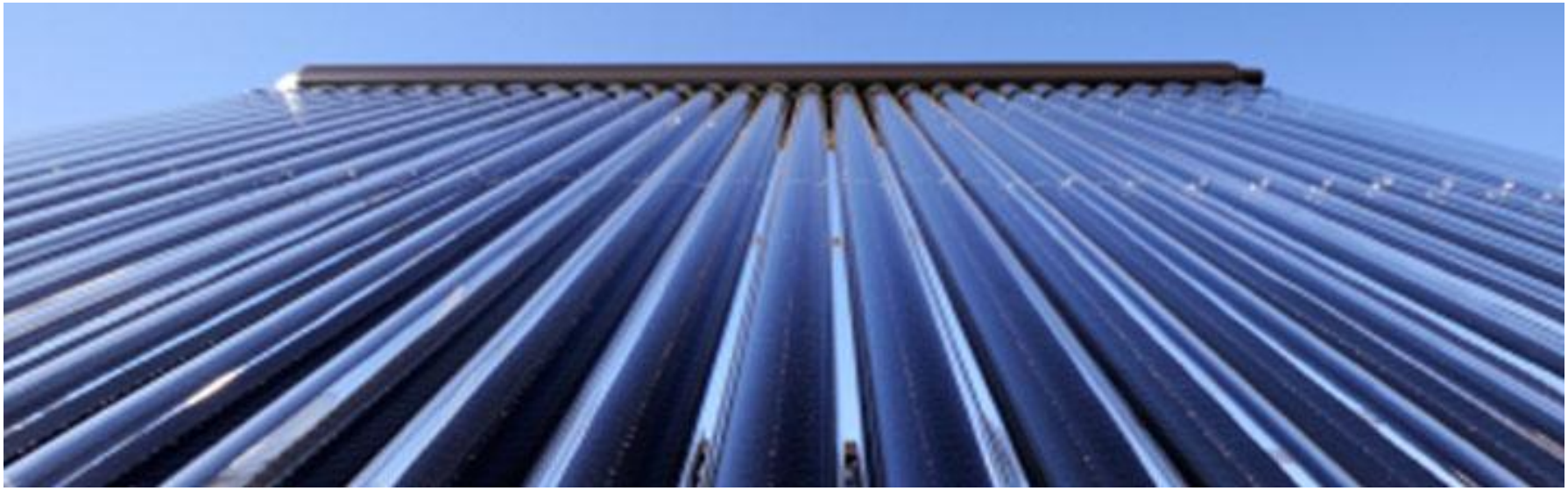
Installed Solar Thermal Collector Capacity Per Capita as a Function of Annual Average Daily Solar Radiation



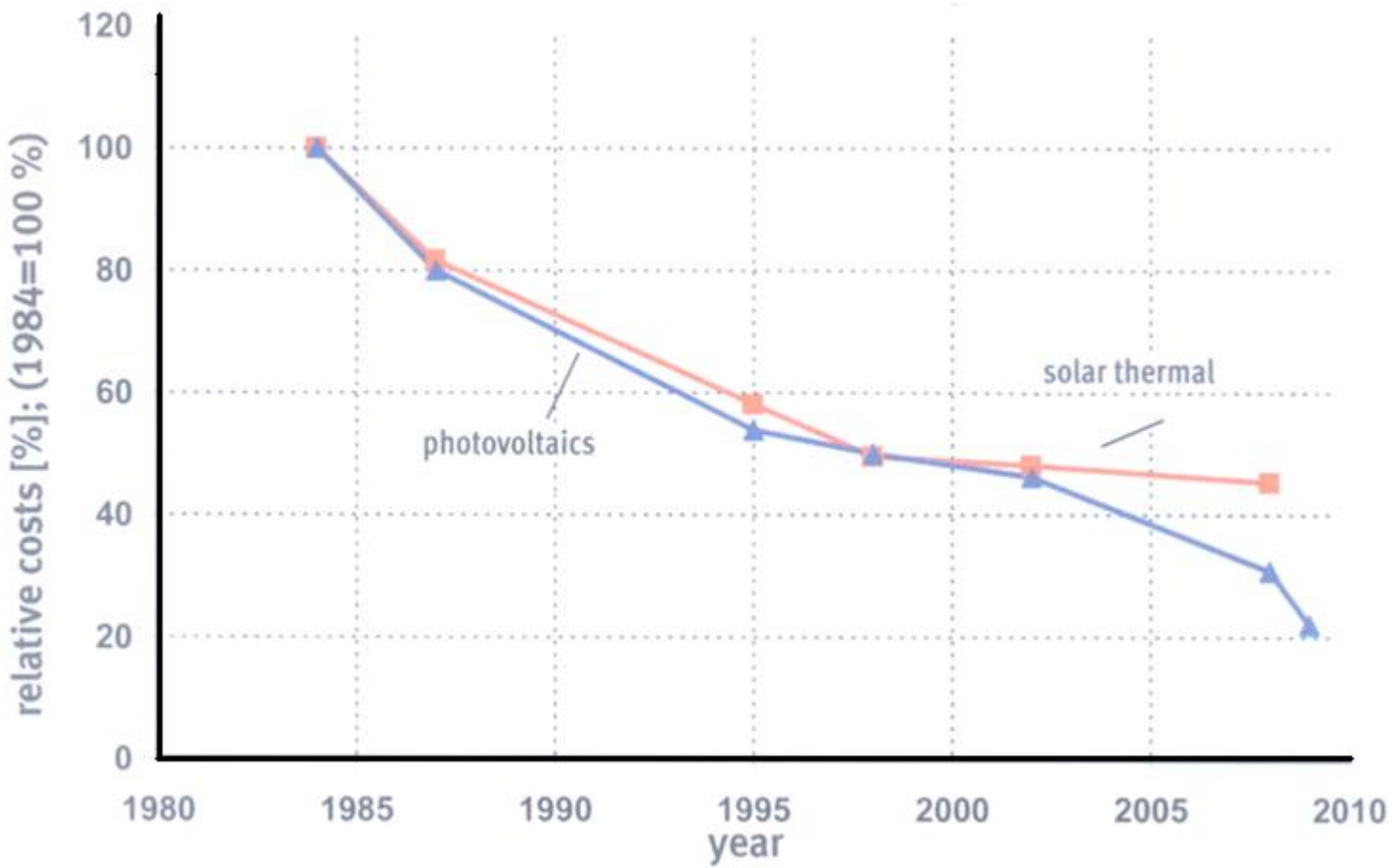
Celik et al. 2009

- Meet our energy needs
- Low maintenance
- Solar energy is free to collect
- And a reduction in energy bills

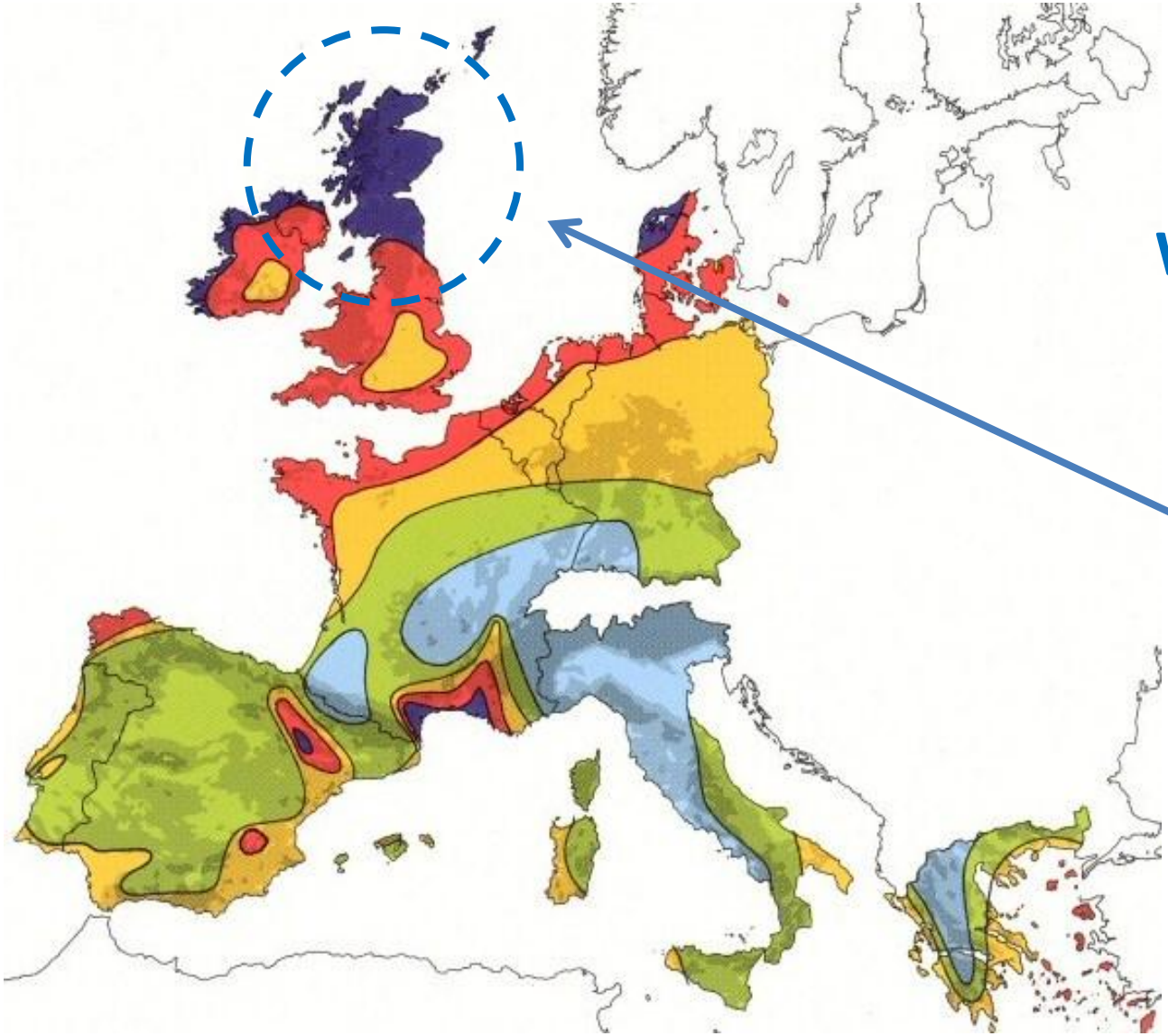
- Quality of sunlight
- Risk of freezing in low temperatures
- Capital costs



Cost Development in Solar Thermal/Photovoltaics



ITW, 2009



Wind Resources at 50 Metres Above Ground Level

- > 6.0 m/s
- 5.0 – 6.0 m/s
- 4.5 – 5.0 m/s
- 3.5 – 4.5 m/s
- < 3.5 m/s

74% FOR

6% AGAINST

IPSOS 2003

77% FOR

9% AGAINST

BWEA 2002

"I am in Favour of the Use of Wind Power"

50% Agree Strongly	30% Agree Slightly	10% Neither Agree nor Disagree
4% Disagree Slightly	3% Disagree Strongly	3% Don't Know

BERR 2008

Wind Power Installed in Selected European Countries (2009)

EWEA 2010

In the future...

Over 100,000 MW in Europe by 2030

180-474 GW worldwide by 2020

Celik et al. 2007

Roof Mounted Wind Turbine

1 – 2 kW

Starting at £2,000

Mast Mounted Wind Turbine

2.5 – 6 kW

£14,900 - £22,600

Micro Wind Turbines

Annual outputs range from
18 to 375 kWh

Makkawi et al. 2008

(Average electricity demand for a typical dwelling house in the UK is 4,400kWh/annum)

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Nenthead (Alston, Cumbria)
33% CF

Makkawi et al. 2008

Cockermouth
13% CF

Higher Meadow Head Farm (Lancashire)
25% CF

Wind Turbine Options and Properties

BWEA, 2010

wind systems				
	Power (kW)	Annual energy production (kWh)	Total height (m)	Total installed cost (£k)
Micro wind	0 – 1.5	Up to 1,000	10 – 18	0.5 – 5
Small wind	1.5 – 15	Up to 50,000	12 – 25	2 – 50
Small-medium wind	15 – 100	Up to 200,000	15 – 50	50 – 250

Asif & Muneer (2007) estimate that large-scale wind turbines can deliver 50% of the UK electricity demand with only a fraction of offshore/onshore area utilised


On-Grid


Off-Grid

Three blades
Vertical design

- Design
- Number of blades
- Cut-in and cut-out limits
- Stabilisation
- Exact location

Horizontal
design

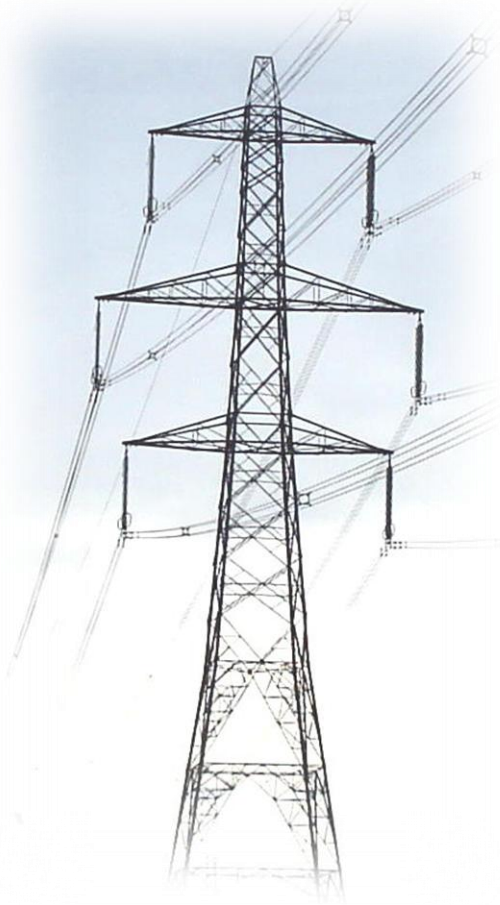
Feed-In-Tariff

- Clean energy cash-back
- Guarantees a minimum payment for both the electricity generated and also the excess exported back to the grid

- A fixed rate is offered for every kilowatt hour generated – including the electricity actually used

- Electricity exported back onto the grid is worthy of an additional supplement

- Plus bill savings from using the electricity generated on site



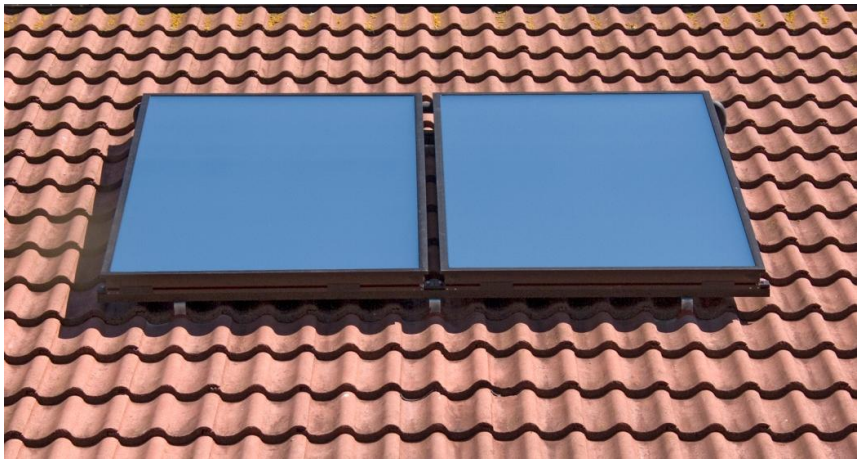
Feed-In-Tariff Levels for Systems Installed before April 2012

+3p for exports

Energy Source	Scale	Generation Tariff (p/kWh)	Duration (years)
Solar PV	≤4 kW new	36.1	25
	≤4 kW retrofit	41.3	25
	>4-10kW	36.1	25
	>10 - 100kW	31.4	25
	>100kW - 5MW	29.3	25
	Standalone	29.3	25
Wind	≤1.5kW	34.5	20
	>1.5 - 15kW	26.7	20
	>15 - 100kW	24.1	20
	>100 - 500kW	18.8	20
	>500kW - 1.5MW	9.4	20
	>1.5MW - 5MW	4.5	20
Existing generators transferred from ROCs		9.0	to 2027

Feed In Tariffs Ltd, 2010

Designed to provide financial support for individuals, communities & businesses who switch from using fossil fuels to renewable sources for heating



Saturation in the market for solar thermal has been greatest in European countries where there are national and long term policies and support measures in place *Celik et al. 2009*

Renewable Heat Incentive for Solar Thermal Systems

RHI	Scale	RHI tariffs p/kWh	Tariff lifetime (years)
Solar thermal	Up to 20 kW	18.0	20
	20-100 kW	17.0	

BERR, 2010

Based upon:

- Exact amount of heat produced (via a meter); OR
- Estimation of what the technology is likely to produce (taking into account the age & size of the building)

Other Possible Incentives for the Uptake of PV and Thermal Water Heaters

- A reduction in annual property tax, in proportion to displacement of fossil fuels via renewable energy and/or the export of electrical energy back to the grid
- Easing of planning restriction for new housing which integrates renewable energy technologies

Celik et al. 2009

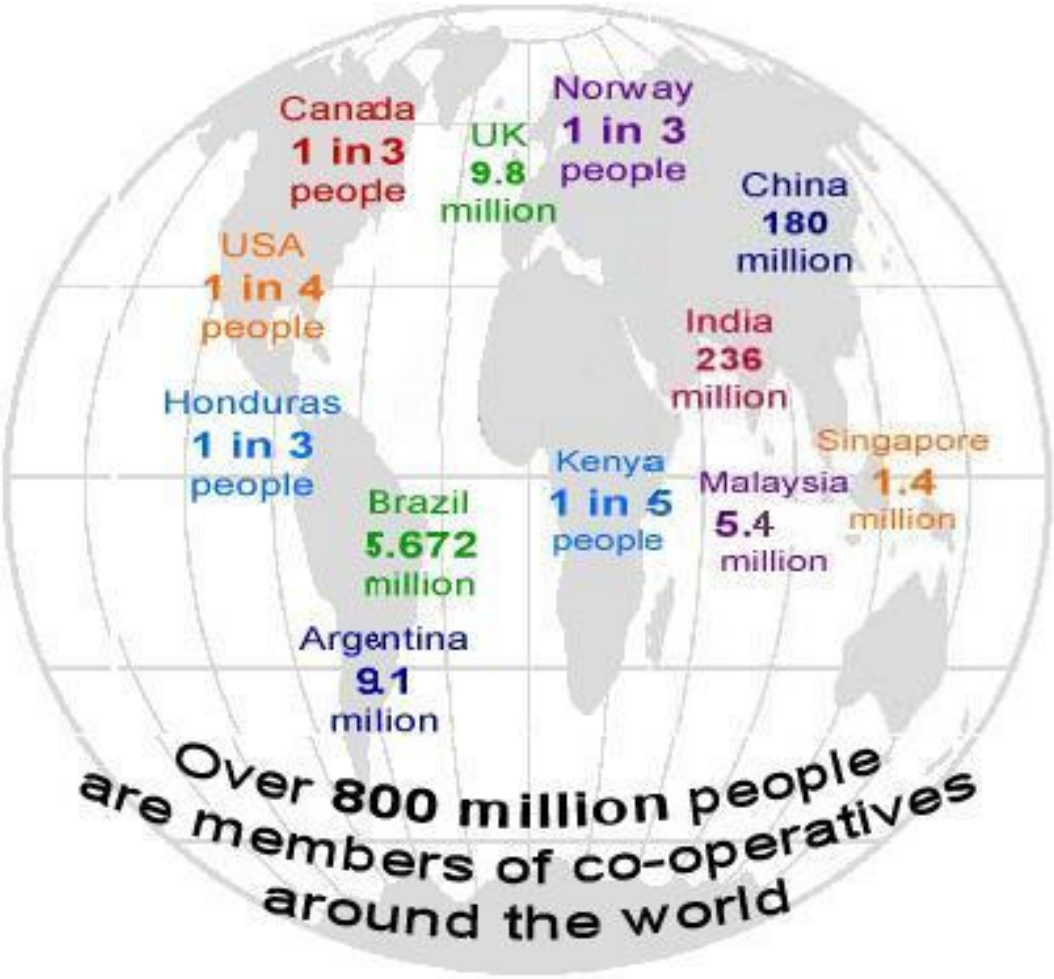
Fenwick Weavers Society
1761

Co-operative Wholesale Society
(The Co-operative Group)
1863

Co-operative News
1871

Co-operative Bank
1872

Co-operative College
1919



ICA, 2010

"For many people in the UK, their perception of 'The Co-op' will be defined by the local retail stores that they know and visit.

The co-operative

But this view of co-operative enterprises in the UK only tells part of the story."

Ben Reid
Chair of Co-operatives UK, and Chief Executive of the Mid-countries Co-operative

- Owned and controlled by the members (employees, businesses or consumers)
- Set up to meet shared needs (economic, social or cultural)
- Run democratically, for the mutual benefit of members
- Strong sense of ethics and social responsibility
- Profits distributed amongst members or invested in community development

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1. Voluntary and open membership

2. Democratic member control

3. Member economic participation

4. Autonomy and independence

5. Education, training and information

6. Co-operation among co-operatives

7. Concern for the community

ica

"It is noticeable that those countries which have been most successful in embracing renewable energy are those that have encouraged people to become involved."

Energy4All

"Co-operatives play a growing and important role in the renewable energy sector"

Ekosgen

Co-operative Consortium

- A collaboration of businesses – whilst retaining original brands, independence and control
- Share risks and reduce costs through economies of scale
- Gain access to new opportunities and new processes

EXAMPLE 1:

- Comprising of forest owners, private sawmills and a Swedish wood products company
- Used to collect forest chips & sawmill by-products
- Supply around 3.5 billion kilowatts of wood fuel

The consortium business model can allow smaller suppliers of wind technologies to team up, and as a larger entity, find themselves being able to better compete for major contracts

Employee Owned Businesses

- Employees hold the majority of the shares & control
- Help secure the future of the business & its employees, and keep jobs & wealth creation in the local economy
- A greater sense of individual well-being & fulfilment in their employment
- Commonly have an interest in the environment & that of sustainable development within their local area

EXAMPLE 2:

Eaga
delivering sustainable living

"We can prove that employee ownership drives employee engagement and delivers increased profitability"

Dave Routledge, Executive Director, Eaga

Driving the carbon agenda & delivering improvements in energy efficiency across residential and commercial sectors

→

37% owned by its 4,500 employees and partners

→

Plus support for disadvantaged communities to help create low carbon neighbourhoods

‘Rent My Roof-Space’ Schemes – *Eaga*

- Install PV modules at low/zero cost to the consumers, who recoup the installation cost by collecting the FIT
- Consumers benefit from free solar electricity – thus reducing electricity bills
- Eaga also maintains the system for 25 years

Community Co-operatives

- Owned by their customers or members to provide the goods and services which are required
- *Community defined by location or the sharing of common values*

Owned, controlled and run for the benefit of the community

Community Co-operatives

- Investment in a local project
- Individual commitment to low carbon initiatives
- Attractive financial return
- Extended economic benefits for local area
- Delivery of local energy conservation projects
- Educational support on environmental issues
- Membership of a nationwide network of 'green' co-operatives

- *Solar PV*
- *Thermal water heaters*
- *Wind turbines*

- Set up amongst a ‘community’ (geography and/or shared values)
- Funds raised from a public share offer
- Purchase a share in a wind farm
- Electricity is received (excess can be exported)
- Receipt of an annual dividend, plus share capital is returned at end of project
- Minimum cost to join is £250; maximum is £20,000
- Preference for membership for those living locally

EXAMPLE 3:

Boyndie Wind Farm Co-operative

- Aberdeenshire -

- Set up in 2005
- First Wind Farm Co-operative for Scotland
- Seven 2MW Enercon turbines (& planning permission for an eighth)
- Generate enough electricity to meet the demands of 8,500 homes
- There are 716 members – £730,000 was raised at the share launch

EXAMPLE 4:

ISLE OF SKYE RENEWABLES CO-OPERATIVE LIMITED

Ben Aketil Wind Farm
- Isle of Skye -

10 x 2.3 MW
turbines

EXAMPLE 5:

Great Glen Energy Co-operative

- Invergarry -

16 x 2.5 MW turbines

GREAT GLEN ENERGY CO-OP
CO-CHOMANN LÙITHS A' GHLINNE MHÒIR

EXAMPLE 6:

Kilbraur Wind Energy Co-operative
- Brora -

19 x 2.5 MW turbines

KILBRAUR WIND ENERGY CO-OPERATIVE LIMITED

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EXAMPLE 7:

Edinburgh Community Energy Co-operative

Giving Edinburgh residents a vehicle to promote and develop renewable and low-carbon energy

HOME | ABOUT THE CO-OPERATIVE | EDINBURGH MAP | NEWS | LINKS | ENQUIRY

Edinburgh Community Energy Co-operative

To help offset the effects of climate change, we need to reduce the level of Greenhouse Gases being emitted. The only plausible way that this can be achieved is by generating our energy from sources that emit very low or even zero levels of greenhouse gases, such as renewable energy.

Edinburgh Community Energy Co-operative Ltd was formed at the end of 2007 with the support of Co-operative Development Scotland. It is a non-profit, member owned organisation, which was set up to give Edinburgh residents a vehicle to promote and develop renewable and low-carbon energy in the city.

RECENT POSTS

- Community energy online resource from DECC
- Slides from Conference on 11/9/2010
- Conference – Community Energy in Edinburgh
- Minutes from 10th April 2010 Board Meeting
- Minutes from 9th January 2010 Board Meeting

A substantial order, sufficient for the whole community, individual households and buildings, can receive very generous discounts from suppliers – as opposed to separate orders by single members of the community.

EXAMPLE 8:

- Assist local authorities, housing associations in making their homes more energy efficient
- Introduce the technology which enhances energy and carbon efficiency
- Reducing the burden of energy costs
- Pooling resources from funding organisations, solution partners & delivery partners
- Knowledge transfer with households
- Identification of possible sources of funding
- Contributions to regional regeneration

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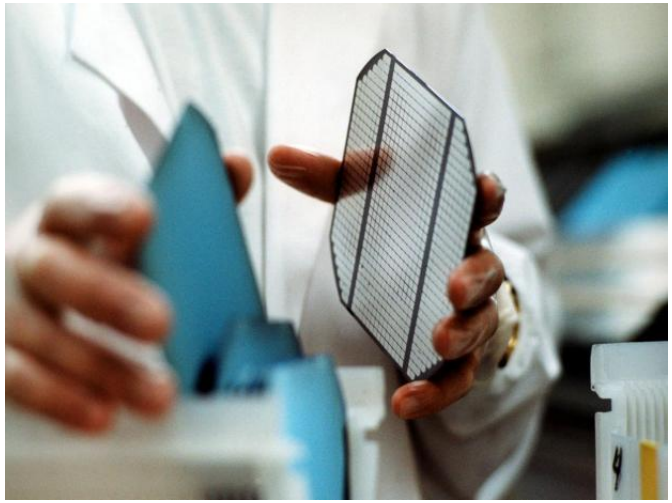
EXAMPLE 9:

Renew Energy Solutions Ltd

- Develop, fund and manage sustainable energy solutions for the benefit of the communities
- New builds and existing properties, public and private sectors, housing and other energy users
- A five stage project generation process:

- Training with colleges and centres & employment opportunities

Setting up the plant, equipment etc



Production

EXAMPLE 10:

- 10 kilowatts of solar PV panels
- Four 6 kilowatt wind turbines
- Three hydro generators (over 100 kilowatts)

95% of the Island's energy requirements

"What we've done on Eigg is being repeated across the UK; communities of all sizes are deciding that they too want to make a difference, reduce CO2 and start living lighter on the planet's finite and dwindling resources"

islandsgoinggreen.org

EXAMPLE 11:

Unique track record of
success in delivering community ownership
of renewables through co-operatives

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"Our job is to enable co-operative enterprise to flourish in Scotland"

co+operative development scotland

Government Interest in Co-operatives?

- Keeps the business/entity and its wealth local, which supports the local economy
- Greater survival rates, improved sustainability, with a positive impact upon employment opportunities
- Skills development on both a business and individual level
- Projects aimed towards local community regeneration

"Innovation and enthusiasm of civil society is essential in tackling the social, economic and political challenges the UK faces"

HM Government

"Ministers are very keen to see benefits from renewables accrue to communities, including local ownership of energy"

The Scottish Government

- Renewable technologies for the generation of electricity & hot water in our buildings.
- Rising levels of pollution & dwindling supplies of fossil fuels
- Alternative technologies exist and are becoming increasingly available
- Co-operative approaches to renewable energy
- Environmental, financial, economic and social benefits of co-operation
- Can be adapted to suit all types of situations

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"Put something back into society, to make a difference and give people opportunities to make the best of themselves"

"It's a different way of running a business – it's a better way of running a business"

"People can absolutely transform their lives and those of people in their communities"

"The model for the future"

Co-operatives UK
THE UNION OF CO-OPERATIVE ENTERPRISES

CICSTART ONLINE

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There is an

alternative...

References & Further Reading

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- British Wind Energy Association (now RenewableUK) - http://www.bwea.com/
- Community Energy Solutions - http://www.cesgroup.org/
- Co-operative Development Scotland - http://www.cdscotland.co.uk/
- Co-operatives UK - http://www.uk.coop/
- Department of Energy & Climate Change - http://www.decc.gov.uk/

References & Further Reading

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- Edinburgh Community Energy Co-operative - http://edinburghcommunityenergy.wordpress.com/
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- Energy Saving Trust - http://www.energysavingtrust.org.uk/
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- Intergovernmental Panel on Climate Change - http://www.ipcc.ch/
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- International Energy Agency - http://www.iea.org/
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