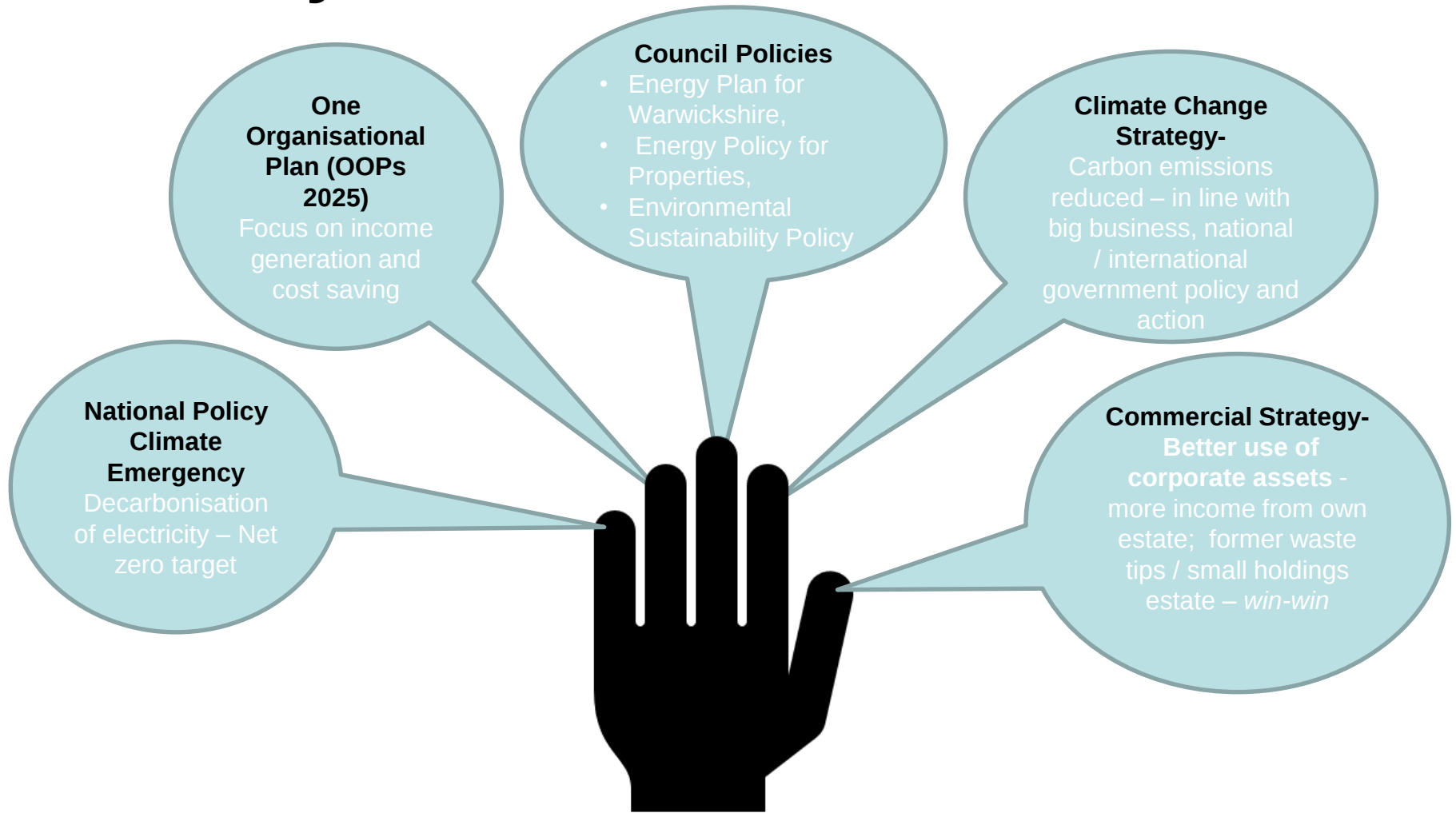


Renewable Energy and Warwickshire CC

Angeline Murungu,
Strategic Energy Advisor

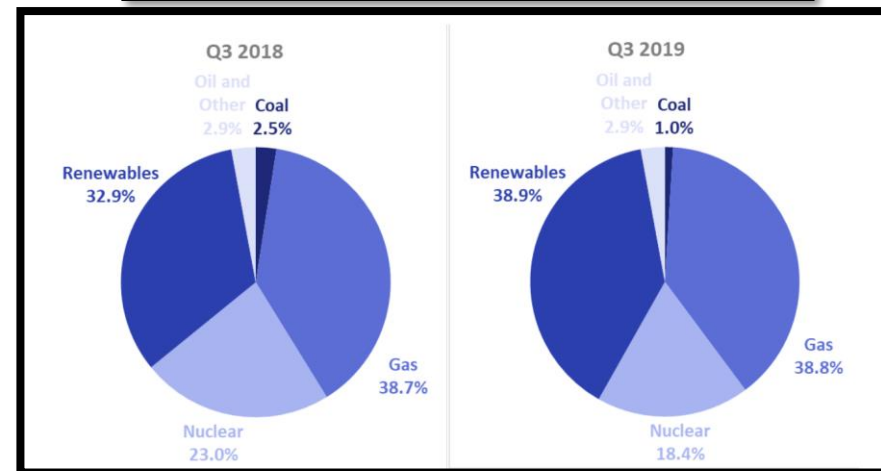
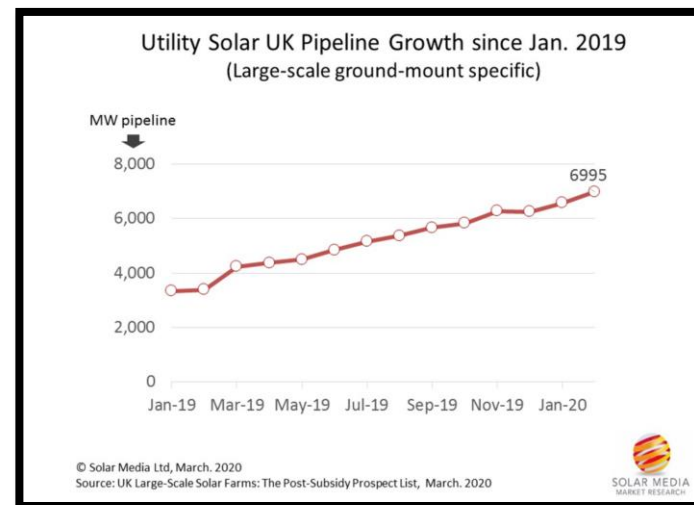
1. Why Renewables
2. Which technologies
3. Large scale- GMS generation
4. Small- medium scale generation- Roof/wall mounted
5. Case study- Recycling centre
6. Future opportunities
7. Challenges
8. Overcoming the challenges

Why Renewables for WCC



Why Renewable Energy

- Renewables are becoming central to business- incredible speed now.
- Renewable penetration on the grid has now reached roughly 33% globally. 38.9% in UK – Q3,2019
- Steady growth , 300MW/month during 2019 and 2020- now at 7GW mark- March 2020
- Green power is becoming more accessible. There is increasing demanding for fossil free power meaning now is the opportunity to adopt renewables.
- Green power is becoming increasingly affordable. Such options more often than not, require capital investments, energy efficiency and energy as a service model as avenues towards financial enablement
- Evolving energy market
- Organisations that buy **Energy Attribute Certificate** (EACs) to meet carbon-reduction goals

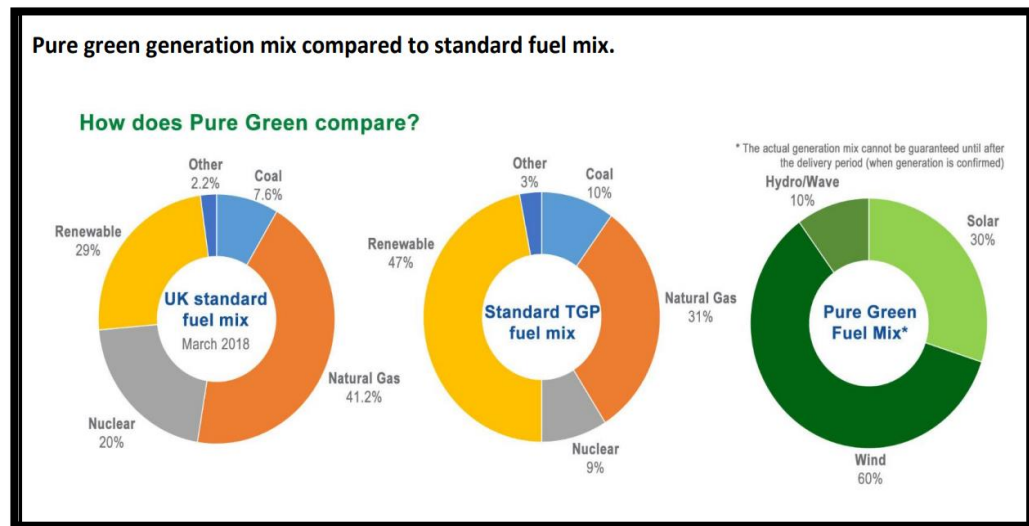


Source: [DBEIS, Energy Trends December 2019](#)

Why Renewable Energy : Green & brown power drives evolution

- Energy buyers that used to simply accept the traditional grid electricity mix and pricing are getting more strategic about how, when and what type of energy they use

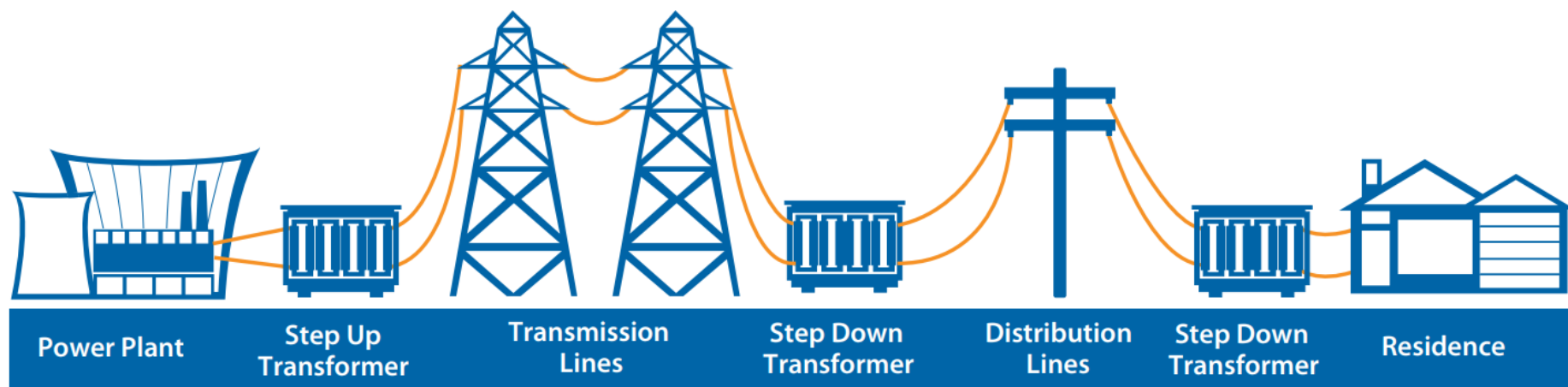
- **WCC's Electricity is 100% Renewable Energy from October 2016**



**However, WCC is committed to cutting energy waste at consumer level as an organisation with energy efficiency as a core component.

Why renewables

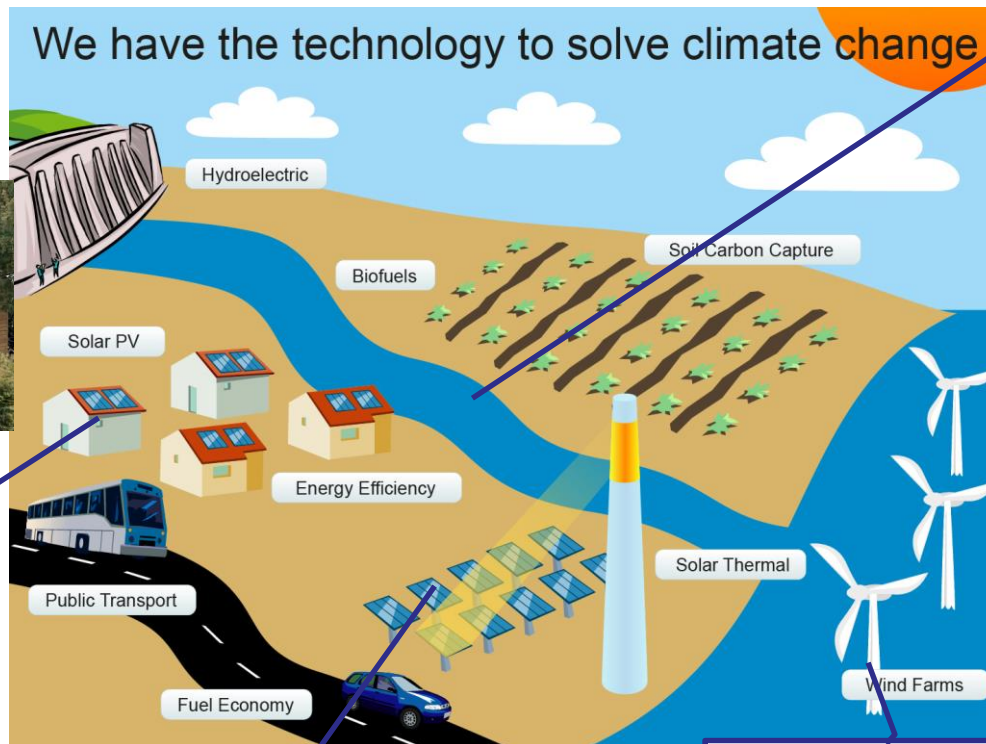
Cheaper and to generate power locally in order to reduce losses in the transmission and distribution systems



5-7% of electricity generated from the distant power station and transmitted through grid lines is lost along the way but charged to the end consumer.

Which Renewable Energy Technologies- Generation opportunities for businesses

PV Slate-roof integrated



Building fabric mounted

Bioenergy

Biomass can be sourced from any living substance as well as from material such as biodegradable waste, food waste and animal manure. Biomass can be burnt in thermal power and heat generation. It can also be used in the anaerobic digestion process, making a bio-gas that can be burnt in electricity or heat generation. This gas can also be refined to become methane and injected into the gas grid.

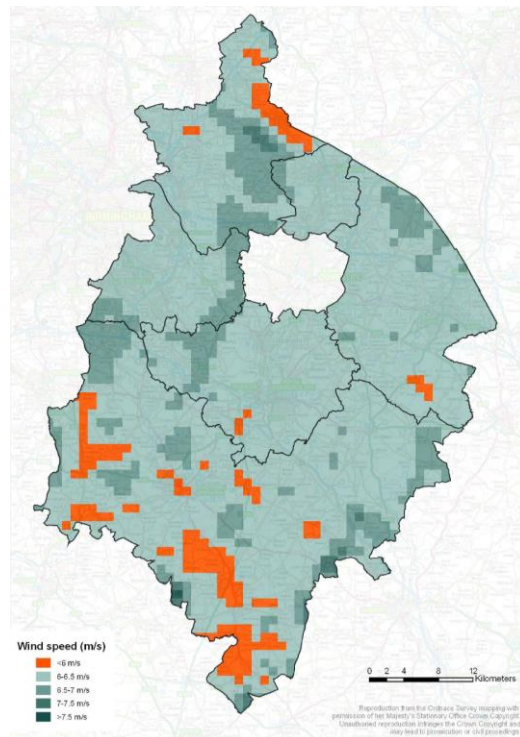
Solar Car port/ £900/kW installed



Ground
mounted solar

Wind power
Offshore

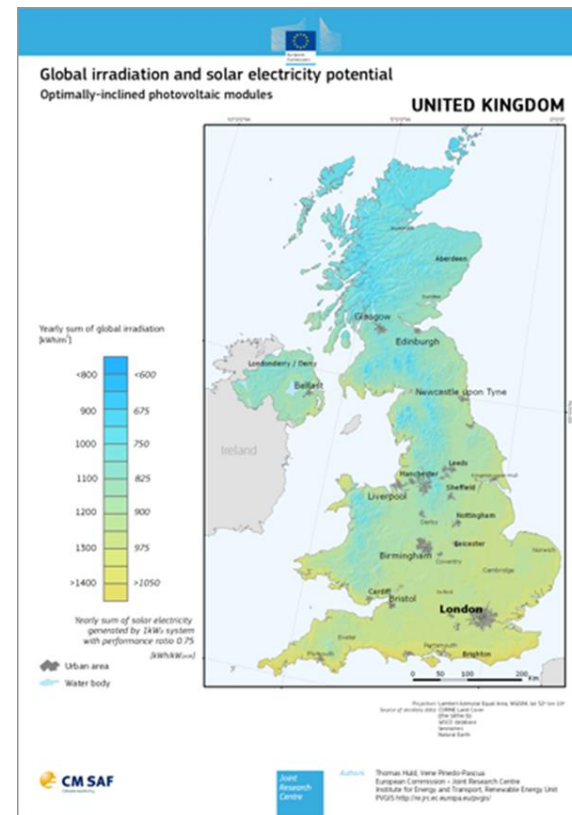
Generation Opportunities: Has a renewable resource assessment been carried out ?



Source: Renewable and Low carbon Resource assessment and feasibility: Camco 2010- Wind mapping

WIND POTENTIAL

- 93% sites greater than 6m/s-within viability threshold
- Wind potential at a number locations.
- Large area concentrated around Stratford on Avon and Rugby but marginal resource.
- The Warwickshire wind resource assessment-identified land areas suitable, with sufficient wind speed and no planning constraints for up to 178 * 1.5MW wind turbines or 445 * 600kW wind turbines
- Key limiting factors- proximity to housing and landscape capacity



Solar Resource mapping: Solar irradiance = Post code Irradiation look up <https://www.rensmart.com/Weather/PVGISSolar>, http://re.jrc.ec.europa.eu/pvgis/cmmaps/eu_cmsaf_opt/G_opt_UK.png

Key considerations for renewable projects

1. Naturally available resource
2. Technically accessible resource
3. Physical environment constraint
4. Planning and regulatory constraint
5. Economically viable potential
6. Deployments constraint
7. Local ambition/ target setting

Wider considerations for large scale renewable projects

- Land- use, size (usable space- how many hectares- acres will be occupied), Agricultural grade, location and ownership. Could the land be used for something else. Alternative land use- could any other technologies be better suited for the site, topography, visual and landscape impact, future land use post de-commissioning.
- **Grid mapping**- and capacity (import and export availability),
- **Planning**- Ecological, archaeological, cultural heritage, Ecology, Planning designation-Green Belt, Flood risk, conservation, Local Plan- are there any future developments, Environmental Impact assessments. Impact and mitigation.
- Personnel skills- Any skills gap- is expertise inhouse or to be outsourced, Stakeholder engagement – legal, finance, procurements etc. and timing
- Design and Implementations: Decent site access, Construction management plan, security, plant layout
- Delivery partners- Consultants (grid, storage, planners), design modelling , suppliers, EPC (Engineering, Procurement Construction) provider, Independent Connection Provider, ICP (Contestable and non contestable power connection)
- Delivery Model- Joint venture- (potential partnerships to minimise risk), Aggregation, Sleeve Power Purchase Agreements (PPA), Private Wire, Own use onsite or sell to the grid (how much is onsite demand), Offsetting, Is it co- located with storage or standalone, behind the meter or in front of the meter.
- Funding streams: Prudential Borrowing, Salix interest free loans, Self capital funding
- Income/Support mechanism- Smart Export guarantee- how long for will it be in place
- Procurement Process- OJEU, Frameworks, who has already delivered a similar scale project. To use a framework- pay to use a framework. Can cost up to £50K

Nottingham CC has one set up already, RE-Fit, PPS

- Benefits: Financial- viability, expected ROI/ NPV/IRR -5% or more, +ve cash flow in early years, social, environmental, economic impact- local energy demand, jobs
- Sensitivities- critical to success e.g. what will happen if electricity inflation goes up by 2%
- What are the timings-

Project for consideration

Solar PV

Some Solar basics:

Commercial- Ground Mounted Solar

Some Solar basics

1MW(1000kW) installed solar capacity;

- Involves approximately 4000 solar panels:
- Estimated to generate c935,040kWhrs/year
- Spikes driven into the ground to support mounting frames
- Related equipment inc' substations and future short term electricity storage

Positive income flows over 30 years or more

Most land remains available for grazing & Ecological improvement



Studies undertaken: Grid Network connection, site scoping and land grade assessments

Within Land Holdings at ...	Indicative Capacity ³
Dunsmore Home Farm Clifton on Dunsmore	3.34MW
Former Landfill site Stockton	0.62MW
Glebe Farm Wasperton / Barford	1.25MW
Former landfill sites within Ryton Pools Country Park	4.25MW
Adjacent to Shipston High School	0.33MW
Swan Farm, Grendon	5.10MW

- Initial assessment = 20 to 25 sites
 - Reduced this to 8 to 10 sites - due to grid connection issues –
 - Formal approaches were made to WPD for affordable grid offers and
 - 6 sites remained.
 - Grade 3b, 4 and 5 suitable for grazing only.
- Also looked at the potential for co-location of solar pV with battery storage - and the import/export capacity at various grid locations within the county.

All this work is backed up by Cabinet reports which are available on all this activity.

Making the numbers work- Economic viability, Funding & Financial modelling

WCC Land Holding	Capacity MW	Annual Gen'n kWhrs	Investment	GROSS incomes 30 year project life	NET incomes ⁹ 30 year project life
Dunsmore Home Farm, Clifton on Dunsmore	3.34	3,307,412	£3.16M	£11.55M	£3.76M
Former Landfill site, Stockton	0.62	602,663	£0.58M	£2.10M	£0.68M
	3.96	3,910,075	£3.74M	£13.65M	£4.44M

WCC got Member agreement for up to £5.4 million Prudential borrowing for renewable energy projects that meet the three financial criteria before any procurement can be started, all of which must be met;

- a positive NPV
- a positive cash flow in early years
- an IRR of 5% and above

Other Funding Options for consideration:

- Self fund- Capital fund
- Rural Community Energy Fund- through DBEIS.
- Salix Loan- Interest free loans
- Green Finance- apparently 2% cheaper than PWLB

Stockton Former Land Fill (2016)

Estimated Plant size		625	Financial Variables	
	£/kWp	£	Project - No. years	30
Capital Costs			Interest rate	2.40%
Development costs			Grace Period	1
Planning	£25.00	£15,625	Start year	2017/18
Site acquisition	£0.00	£0	Inflation	
Developer Prj Mgt fees	£0.00	£0	Electricity costs	5.00%
External consultants	£5.00	£3,125	RPI	3.25%
WCC Internal business costs	£0.00	£0	Discount Rate	3.25%
Other costs	£0.00	£0		
EPC costs	£750.00	£468,750		
Grid connection costs	£142.34	£88,962		
Total Capital Investment costs		£576,462		
Annual Revenue Costs		£/pa		
O&M				
Internal	£1.00	£625	Financial Results	
Inverter Repair	£2.00	£1,250		
External	£8.00	£5,000		
Warranty periods (yrs)	2			
Rent of Electricity Meters/Month	£0.00	£0		
Insurance	£3.00	£1,875	Project IRR	2.06%
Business Rates	£3.60	£2,250	Positive cashflow from year	29
Non-GMS costs budget			Largest Negative Value	-145,770
Area (acres)	4.00		Total overall net profit/loss	24,413
			Discounted NPV	-£44,065

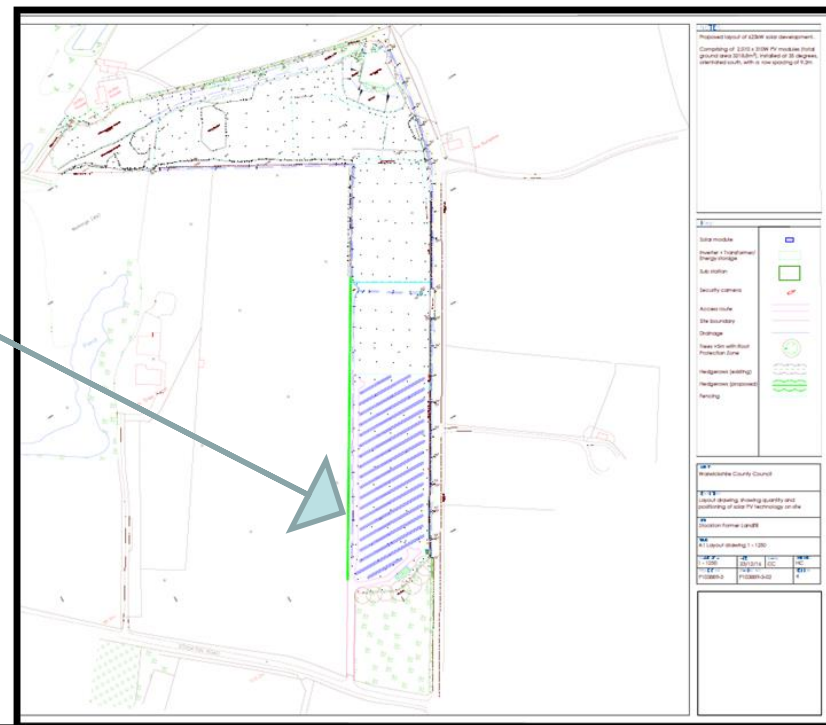
Further studies- 3D Modelling and design layouts

WPD reference	Site Name	Agreed export capacity	Proposed solar generation capacity	Proposed limit on AC output
2195535	Dunsmore Home Farm	2750 kVA	3436 kWp	3300 kVA limited to 2750 kVA
2195429	Glebe Farm	1000 kVA	1250 kWp	1100 kVA limited to 1000 kVA
2195518	Stockton Landfill	500 kVA	623 kWp	550 kVA limited to 500 kVA

Export limitation and connection agreements

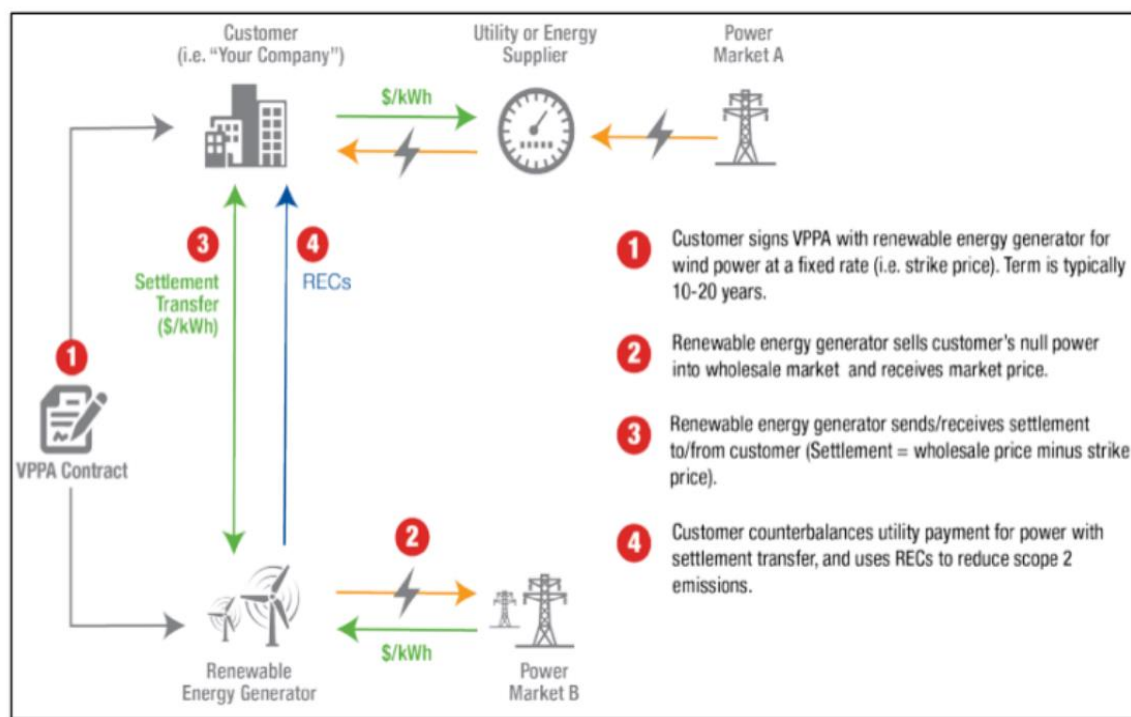
Former land-fill Rugby Rd, Stockton

- 17.9 acres – let to adjacent farmer as low grade grazing.
- 3D Modelling and design layouts
- Adjacent to local wildlife sites – so ecology is important



Possible revenue streams & delivery business models

- Smart Export Guarantee (SEG)
- Direct Power sales to the grid
- Onsite generation, storage and use
- Renewable obligation certificates- REGOs
- Slewing Power Purchase Agreements (PPA)
- Private wire, PPA sales to nearby users
- Aggregation & Joint Venture



Commercial roof top solar

Key considerations

- 300kW and below does not require planning permission
- If on a rack- it is treated as a building.
- Grid connection required.
- Project team is small.
- Car park £900/kW installed
- Need to know building energy profiling- modelling.
- Co-location with battery storage to be considered.
- Roof orientation
- Roof structure
- Shading etc



Barrack Street offices

BAPV- Roof Top Solar PV for WCC- Office Building



A project developed and delivered by Maintenance & Minor Works Group, Physical Assets

- Commissioned 2 March 2012- benefitted from the government's higher generation FiTs
 - Cost of project £2,273/kW installed
 - IRR- 8.5% against a borrowing of 5%
 - Grid electricity price- 9p per kWh
1. **Barrack St PV, 47 kWp- installed capacity**
 2. Bilton Infant School PV, 22.2 kWp
 3. Camperdown Farm PV, 20 kWp
 4. Carpenters Farm PV, 10 kWp
 5. Northgate House PV, 2.16 kWp
 6. Old House Farm wind turbine, 10 kWp
 7. Poplars Farm, 47.5 kWp
 8. Saltisford 1 PV, 16.8 kWp
 9. Saltisford 2 PV, 40.8 kWp
 10. Sir Frank Whittle Business Centre PV, 15.8 kWp
 11. Lower House Farm HWRC building 1 new office PV, 14.31 kWp
 12. Lower House Farm HWRC waste building PV, 14.57 kWp
 13. Lower House Farm HWRC new shop PV, 3.68 kWp
 14. Lower House Farm HWRC new BIFFA building, 19.08 kWp
 15. BIPV- façade- Eliot Park Innovation Centre (EPIC) in Nuneaton- 105kWp



Grid constraints and expensive grid connection costs- Difficulty is location of solar farms proximity to the grid

- Western Power Distribution(WPD) grid costs- 6 sites investigated for Ground Mounted Solar
- Export range 0.25 – 4 MW Cost of connection for export range £10,600 to £170,000 per MW: A viable project should be around £600/kW-fully installed or (£60-£70/MW).
- Most cases are-there could be land to develop but limited grid capacity. Increasing capacity requires major grid enhancement works or installing a new substation to be done. As a result, delivery may not be viable
- **May not be possible to meet local renewable energy targets.**

	Capacity MW	Non-Contestable Grid Connection (ex VAT)	Date of Grid Offer	£/MW	Est Total Project Cost	Est IRR* (Unlevered)	£/MW Proj Cost
Glebe Farm	1.00	112,708	30/09/2015	112,708	624,560	3.33%	624,560
Ash Tree Farm (Stockton)	0.50	56,977	13/02/2016	113,953	312,903	3.40%	625,805
Dunsmore Home Farm	2.75	29,294	30/09/2015	10,652	1,436,887	7.53%	522,504
Shipston	0.25	42,583	30/09/2015	170,333	170,546	2.34%	682,185
Ryton Pools	4.00	93,964	16/05/2016	23,491	2,141,371	7.05%	535,343
Swan Farm	4.23	513,863	03/02/2016	121,481	2,678,996	2.50%	633,332

Rising the challenge



1. Renewable Energy Bigger Opportunity Mapping
Identify and evaluate transaction opportunities. Make informed, quick decisions with the support of the Commercial Support unit and Climate Change unit to overcome internal obstacles to investment in renewable energy projects on the corporate estate
2. Local planning policy review- establish an expert low carbon technical assessments service for planners- provide renewable energy toolkits
3. High resolution heat mapping and analysis of the potential for fuel switching in off gas locations. Carrying out viability assessments and site energy studies for new developments and refurbishments works. Consider renewables to be part of a new development and retrofit .e.g. make solar PV to be part of the roof/fabric structure.
4. Look out and make use of available financial and technical support services from the government DBEIS and the private sector. E.g. Keep abreast with activity in the Coventry and Warwickshire LEP, Rural Energy Community Fund (RCEF) feasibility and implementation funding bids
5. Explore and know alternative funding channels such as the Green Bonds which can prove to be 2% cheaper than PWLB
6. Review delivery model and test emerging business models(Joint Venture, aggregation of assets, Private wire PPA Sleeving etc.)

Future-upcoming opportunity for the county!

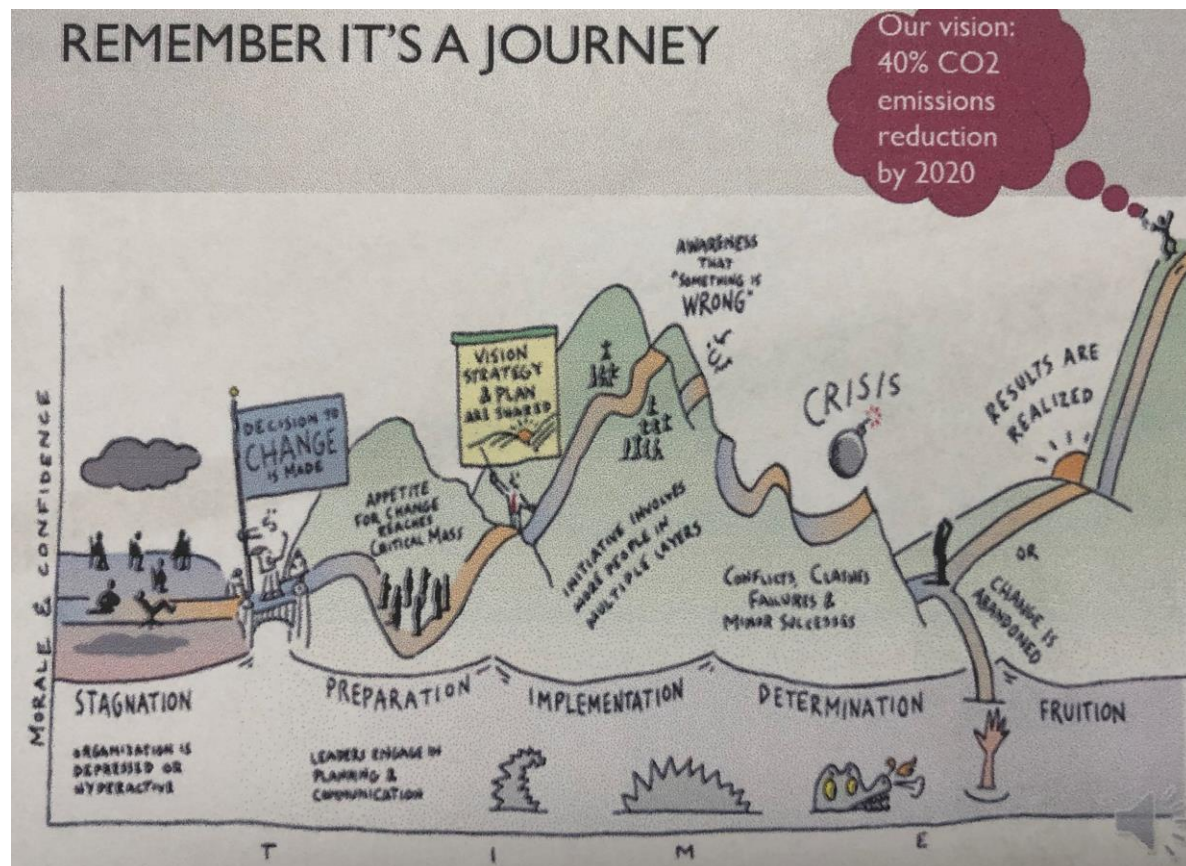
Introducing Solar Together Warwickshire:

Significant measurable carbon reduction driven by resident investment in green energy- Roof top solar pV



Conclusion

- Warwickshire needs more clean energy
- Solar PV power generation is one route
- Wide range of other benefits
- Can Officers work pro-actively with Members and residents to deliver projects that give positive benefits all-round



Thank
you for
listening

Angeline Murungu, BSc, MSc (Eng), MCIBSE.

Strategic Energy Advisor

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