

The Potential for Renewable Energy in Warwickshire

This note lists the relevant issues that should be considered if a proportion of local electricity demand is to be met from renewable energy sources in order to meet regional and national targets.

It covers:

Infrastructure

Energy / Electricity Demand

Available Technologies

Strategic Framework

The Impacts of Climate Change in Warwickshire

Success Criteria

Example Renewable Technology Mix – meeting targets

Warwickshire's Carbon Hierarchy

Questions to consider before capital investment

- Policy

- End User

- Technology Options

- Resource Availability

- Labour Force

- Economics

- Environment H&S

- Local Support

Notes compiled by:

Dr. Jacky Lawrence

Climate Change Team, Warwickshire County Council



Infrastructure

Electricity supplied by power stations is transferred via the high voltage national transmission system owned by the National Grid Company plc (NGC) to the Public Electricity Suppliers distribution network (PESs, Public Electricity Distributors under the Utilities Bill, Distribution Network Operators (DNOs)).

Connections to the NGC transmission system are called Grid Supply Points (GSP) and the PES lower voltage distribution networks rely on the availability of electricity supplies at these GSP's to enable them to meet supply security criteria. Generators connected in the PES distribution network, not at the GSP, are referred to as embedded. Embedded generation is generally smaller plant located on industrial sites, combined heat and power, refuse burner generators, wind farms, domestic electric solar panels and other renewables.

GSP are connections to the NGC transmission system at voltages of at least 132 kV. Transformers reduce the network voltage to 33 kV. Primary transformers further reduce the voltage to 11 kV and this network is connected to distribution transformers which again reduce the voltage to either 3 phase 415 V or single phase 240V.

The existence of embedded generation can release capacity in a distribution system permitting the deferment of expensive infrastructure reinforcement and replacement, or allowing new customer load to be connected. For lengthy rural circuits and other weak high impedance networks, embedded generation, properly designed, sized and located can provide valuable voltage support.

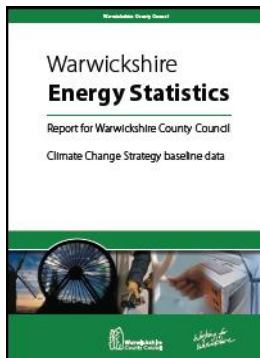
To delay reinforcement and maintain voltage profiles within statutory limits, the embedded generator must be available at times of excessive or peak demands in the associated PES network and match local load profiles. This enables the generator to be considered as 'firm' capacity and can be achieved through appropriate commercial agreements and contracts.

Embedded generators may operate as base-load, day-load or peak-opping sets or for on-site generation. The technical requirements for connection of generators up to 5 MW at voltages up to 20 kV in PES distribution networks appear in Engineering Recommendation G.59/1¹ and Engineering Technical Report Number 113². G.59/1 states the generic requirements and ETR 113 provides guidelines on how the requirements can be met.

¹ Electricity Association (1993), Engineering Recommendation G.59/1, Recommendations for the connection of embedded generating plant to PES'S distribution systems.

² Engineering Technical Report No 113 (1994), Notes of guidance for the protection of private generating sets up to 5 MW for operation in parallel with PES's distribution systems.

Energy / Electricity Demand



The baseline data for electricity demand, renewable energy capacity and carbon dioxide emissions for Warwickshire has been reported in the Warwickshire Energy Statistics Report.

Available Technologies



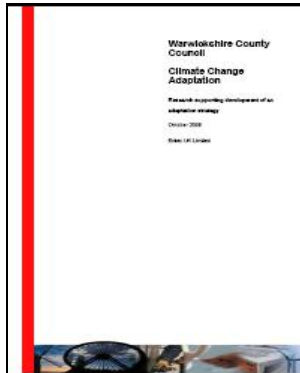
The potential for a variety of technology options to contribute to meeting renewable energy targets in the Warwickshire appear in the Renewable Energy 10% Scenarios Report.

Strategic Framework



The Strategic Framework for the development of renewable energy systems in Warwickshire is the Warwickshire Climate Change Strategy which was launched with full Member support on July 3rd 2006.

The Impacts of Climate Change in Warwickshire



The potential impacts of climate change in Warwickshire are described in the Climate Change Adaptation Report. This covers projected changes in temperature, precipitation, cloud cover, relative humidity, average wind speed and soil moisture. Changes are all with respect to the mean 1961 to 1990 climate, for the UKCIP02 Low Emissions and High Emissions scenarios.

Success Criteria

There is considerable potential in the County of Warwickshire to exploit renewable energy resources. Renewable energy developments have the potential to:

- Contribute to local sustainable development and regional climate change and energy targets;
- Improve the environment by assisting the UK to meet national and international targets for the reduction of greenhouse gases and other emissions;
- Help to provide secure, diverse, sustainable and competitive energy supplies;
- Encourage new employment opportunities by stimulating the development of new technologies;
- Strengthen the local community by contributing to rural development.

The criteria for successful measures that could contribute most in the long term to a low carbon future for Warwickshire and combat climate change are:

1. They should entail acceptable economic and environmental life cycle costs.
2. They should be cost effective.
3. They should improve resource use efficiency.
4. They should be able to be implemented relatively quickly.

Example Renewable Technology Mix – meeting targets

The UK target is for 10% of all electricity generated to come from renewable sources by 2010. The West Midlands Energy Strategy contains a differently phrased target – for 5% of the electricity consumed in the region to come from renewable sources by 2010.

In 2003 the total electricity consumption in the domestic, commercial & industrial sectors in Warwickshire was 2,728 GWh. To meet 5% of this means that 136 GWh is required from renewable sources. Currently 81 GWh is generated annually by landfill gas sites in Warwickshire. This source will remain in the short term, however it is a declining resource as the fraction of biodegradable waste sent to landfill reduces. This output is equivalent to 3% of Warwickshire electricity demand.

Technology Option	What does each (notional) installation look like?	How many would we need?	Which would supply		Contribution
Landfill gas	Existing plants	7	81 GWh		60%
Small biomass electricity generating stations	2 MW combustion plants in small industrial units	2	27 GWh		20%
Mid-size wind installations	Small industrial scale turbines (600 kW) on 50m tall masts, with rotor diameters of 45m	34	21 GWh		16%
Small wind installations	6 kW small turbines (with rotor 4- 6 m diameter) on 11m masts (similar to telegraph poles)	321	5 GWh		4%
Micro wind installations	Roof top mounted 1.5 kW turbines (Swift or Windsave) with rotor diameters of 1 -2 m)	1,071	2 GWh		1%
Solar PV (electrical) installation	78 sq m of solar modules on a community or commercial building - 10 kWp systems	72	1 GWh		0.4%
TOTAL		1,508	136 GWh		100%

In order to estimate the number of renewable energy installations required to meet targets, a ranking was developed for those renewable energy

Warwickshire **Climate Change Partnership**

technologies which appear in the 10% Scenario Report. The ranking was based on cost per unit of electricity (p/kWh), number of installations required to meet the target and capital investment (£). It shows that if this technology mix was used then around 1,500 extra installations would be required.

Technology Option	What does each (notional) installation look like?	How many would we need?	Which would supply		Contribution
Small biomass electricity generating stations	2 MW combustion plants in small industrial units	5	66	GWh	49%
mid-size wind installations	Small industrial scale turbines (600 kW) on 50m tall masts, with rotor diameters of 45m	85	53	GWh	39%
small wind installations	6 kW small turbines (with rotor 4- 6 m diameter) on 11m masts (similar to telegraph poles)	795	12	GWh	9%
micro wind installations	Roof top mounted 1.5 kW turbines (Swift or Windsave) with rotor diameters of 1 -2 m)	2,648	4	GWh	3%
Solar PV (electrical) installation	78 sq m of solar modules on a community or commercial building - 10 kWp systems	179	1	GWh	1%
		3,712	136	GWh	100%

When landfill gas runs out, around 3,700 renewable energy installations of this size would be required. This would require a considerable resource to accomplish and perhaps some larger scale projects would be easier to deliver. This could be achieved through the Partnership for Renewables Scheme operated by The Carbon Trust.

Warwickshire **Climate Change Partnership**

Here is a list of things to consider in a multi-criteria analysis of renewable energy technologies:-

1. Visual impact
2. Emission savings
3. Capital Costs
4. & M Costs
5. Unit cost of electricity or heat
6. Number of installations required
7. Level of community ownership
8. Contribution to sustainability objectives
9. Impact on designated areas
10. Involvement in the development process
11. Jobs created and lost
12. Distribution of schemes around Warks
13. Location
14. No of planning applications needed
15. Public support
16. Public opposition
17. Transport impact
18. Cost of delivered energy
19. Changes to infrastructure
20. Environmental impact
21. Lifestyle changes
22. Security of supply

Warwickshire's Carbon Hierarchy

To help prioritise actions to reduce emissions of carbon dioxide, a carbon hierarchy for Warwickshire has been developed:



1. Re-think - do you really need that new appliance in the first place? Is there a better energy option available?
2. Stop wasteful use of energy
 - a. Switch it off if you're not using it – only use what you need to
3. Use what you do need efficiently
 - a. Use more efficient equipment
 - b. Recover and re-use what you can e.g. heat recovery
4. Switch to low carbon supply: CHP, gas, bio-fuels, hybrids and biomass
5. Increase the % of renewables used
 - a. Increase on-site renewables
 - a. Biomass heating
 - b. Small wind
 - c. Solar Thermal
 - b. Green tariffs for long term supply contracts
6. Investigate options for offset schemes and costs of sequestration
 - a. Explore well managed verified and certified schemes

REDUCE
ENERGY USE

ALTERNATIVE
FUELS

GREEN
PLANTING

IDENTIFY
OPPORTUNITIES TO
IMPROVE ENERGY
EFFICIENCY

INVESTIGATE OPTIONS
TO MOVE TO LOW
CARBON AND
RENEWABLE ENERGY
SOURCES

AIM TO BE CARBON
NEUTRAL THROUGH
CARBON OFFSETS AND
SEQUESTRATION

Identify opportunities to improve energy efficiency.

1. Re-think - do you really need that new appliance in the first place? Is there a better energy option available?
2. Stop wasteful use of energy
 - a. Switch it off if you're not using it – only use what you need to
3. Use what you do need efficiently
 - a. Use more efficient equipment
 - b. Recover and re-use what you can e.g. heat recovery

Investigate options to move to low carbon fuels and renewable energy sources.

4. Switch to low carbon supply: CHP, gas, bio-fuels, hybrids and biomass
5. Increase the % of renewables used
 - a. Increase on-site renewables
 - i. Biomass heating
 - ii. Small wind
 - iii. Solar Thermal
 - b. Green tariffs for long term supply contracts

Aim to be carbon neutral through carbon offsets and sequestration

6. Investigate options for offset schemes and costs of sequestration
 - a. Explore well managed verified and certified schemes

Warwickshire's Carbon Hierarchy – costs
estimated 2005/6 prices

Scheme	£ Cost per tonne CO ₂ saved
Industrial wind turbines	33
Community wind turbines	36
Carbon Trust Allowed schemes 7. 5 year payback	50
Biodiesel / bio-ethanol	60
Carbon Trust Allowed schemes 5 year payback	100
Domestic wood-fuelled boilers	101
Farmyard wind turbines	142
Community biomass combined heat and power (CHP district heating)	150
Micro wind turbines	153
Roof top solar hot water systems	155
Purchase of green electricity	201
Domestic micro CHP	433
Community gas fired CHP (district heating)	585
Domestic condensing boilers (do nothing option)	649
Solar Photovoltaics (PV)	672
References: Encraft, Carbon Trust and Carbon Neutral Cornwall	

Capital costs per tonne of CO₂ saved are lowest for industrial and community scale wind turbines (up to 2 MW) and energy efficiency schemes. These technologies are supported by the Carbon Trust in their Partnership for Renewables and Salix Financing schemes.

Questions to consider before capital investment

The success of a renewable energy project depends on opportunity, national policy & local planning support, public enthusiasm and economic viability. For each energy option it is necessary to evaluate the technical, economic, social and environmental aspects of developing the resource by considering points such as:

Policy

1. How will the option fit in with long term international, national policies and regional and local planning (policy objectives on renewables obligations, climate change levy, CHP, possible future targets for embedded generation)?
2. Exhaustion of fossil fuel reserves, security of supply, fuel diversification, reductions in emissions, targets.
3. Will the project make a significant / substantial contribution to the national / local existing energy demand?

Infrastructure

4. Does the DNO encourage the development of embedded generation? Do they pay for load management and embedded generation system support services?
5. Does the DNO levy a "use of system charge" depending on local supply and demand or charge for "deep connections"?
6. Does the DNO take into account the contribution to security and diversity of supply from embedded generation and load management in planning and operating their network?
7. Does the DNO have techniques for managing active rather than passive networks?
8. Are maps of the 33kV system available identifying planned network reinforcement, maintenance schedules, expected loads and load growth?
9. Are maps of the 33 kV system available identifying where generation could be easily embedded (i.e. showing maximum in-feed 1MW, 5MW, 20MW, 40MW that could be accommodated with minimum investment)?
10. Are maps available identifying where load management would be welcomed?

End User

11. Are the essential services that provide for the needs of the end-user defined?
12. What is the relationship between those needs and consumption of energy and materials?
13. What is the most efficient way of meeting those needs?

14. Have energy efficiency targets been achieved?
15. Is there a demand for the form and the quantity of the energy produced?
16. Do prospective consumers understand the tariff structures?

Technology Options

17. Have different technology options and energy resources been compared?
18. What are the performance characteristics?
19. Will the option yield more high quality energy than it consumes?
20. Have opportunity costs been considered?
21. Is the conversion technology to exploit the resource readily available?
22. Has the performance of similar schemes in the region been examined?
23. Are manufacturers of the system easily and quickly accessible?
24. Have possible variations and/or increases in demand been considered in sizing the system?
25. Embedded generation can be connected at 240 or 415 V as long as maximum total production does not exceed the sum load below the point of connection.

Resource Availability

26. Are there sufficient energy resources available for the project?
27. Is the availability of the physical resource secure for the foreseeable future?
28. How much energy would the option provide?
29. Is it the best use of the resource?
30. Will the option tie up resources in such a way that other projects are limited?

Labour Force

31. Does the local labour force have the necessary skills for efficient operation of the system?
32. Are servicing and maintenance providers reliable?

Economics

33. Could the price of the option fall dramatically in the next year or so? Although there are many obstacles to implementation and the uptake is slow, the economic costs of renewable energy technologies are falling.
34. Will the project be financially viable?
35. How expensive will the energy be?
36. Have the economic impacts of removal of available subsidies been considered?

37. If the availability of the resource varies is this taken into account in the proposed tariff?
38. Are management and communications sufficient for reporting on performance?
39. What are the market opportunities – business development, employment created, rural diversification?

Environmental Health and Safety

40. Are there any significant adverse effects or risks associated with the project?
41. What are the environmental burdens, added emissions, saved emissions?
42. Has land surplus to food requirements for growing SRC been assessed if sustainable organic farming methods are employed rather than intensive farming?
43. If using bio-fuels has a check been made that it is not more polluting than existing supplies?

Local Support

44. Does the project have sufficient support from local people and environmental groups?
45. Are all interested parties satisfied with the proposal?
46. Has a survey of local opinion been carried out?