Planning Policy Wales

Technical Advice Note

8: Planning for Renewable Energy

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

July 2005

This document is one of a series of Technical Advice Notes (Wales) (TANs) which supplement "Planning Policy Wales". Technical Advice Note 8 Planning for Renewable Energy is being published in English only, and not bilingually.

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PLANNING FOR RENEWABLE ENERGY

1. Introduction and Context

1.1 This Technical Advice Note (TAN) provides technical advice to supplement the policy set out in Planning Policy Wales (PPW) and the Ministerial Interim Planning Policy Statement (MIPPS) on Renewable Energy, which amends PPW, and should be read in conjunction with both documents. These documents should be taken into account by local planning authorities in Wales in the consideration of unitary development plans that have not yet progressed to Inquiry, and preparation of local development plans. They may be material to decisions on individual planning applications and appeals and will be taken into account by the Assembly's Planning Decision Committees when taking decisions on called-in planning applications and by Planning Inspectors in the determination of appeals in Wales. The TAN will also be relevant to the authorisation of electricity generation schemes by the UK Government under section 36 of the Electricity Act 1989. It will also be relevant to Transport and Works Act Orders.

UK and Welsh Energy Policy

1.2 This TAN is a replacement for TAN 8 Renewable Energy 1996. It has been developed with partners and stakeholders and included commissioning a series of research contracts to provide the technical basis for the policy.

1.3 This TAN relates to the land use planning considerations of renewable energy, however UK and national energy policy provide its context. Energy policy is a reserved function that is not devolved to the Assembly Government. Nevertheless, all decisions relating to renewable energy in Wales must take account of the Assembly Government's policy. Details of Assembly Government energy policy are available elsewhere[1] but a summary statement on energy is contained in Annex A to this TAN. A number of other annexes to this TAN also provide background to the development of planning policy for renewable energy in Wales.

1.4 The provision of electricity from renewable sources is an important component of the UK energy policy, which has an established target of producing 10% of electricity production from renewable energy sources by 2010[2]. The Assembly Government has a target of 4TWh of electricity per annum to be produced by renewable energy by 2010 and 7TWh by 2020. In order to meet these targets the Assembly Government has concluded that 800MW of additional installed (nameplate) capacity is required from onshore wind sources and a further 200MW of installed capacity is required from off shore wind and other renewable technologies[3] [4].

1.5 Delivering these targets through the planning system is therefore at the core of this TAN. The planning and locational implications of many forms of renewable energy are not as strategic or challenging for local planning

[1]Joint Ministerial Assembly Government Energy Statement, July 2004

[2]Energy White Paper. Our Energy Future - creating a low carbon economy. DTI 2003

[3]Joint Ministerial Statement ibid

[4]A detailed assessment of the potential of wind power and a bibliography on the subject can be found in the Sustainable Development Commission's Report Wind Power in the UK 2005. www.sd-commission.org.uk

authorities as onshore wind. Nevertheless this Note covers a number of other potential technologies. Local planning authorities should develop appropriate policies so that they put in place a comprehensive framework for other forms of renewable energy, as well as wind power.

Energy Efficiency

1.6 As well as developing new sources of renewable energy which are essential to meeting the targets set by energy policy, the Assembly Government is fully committed to promoting energy efficiency and energy conservation[5]. The land use planning system is one of a number of mechanisms which can help deliver improved energy efficiency and local planning authorities are expected to consider matters of energy efficiency when considering planning policy and applications. More details of how energy efficiency and energy conservation can be incorporated into planning can be found in TAN 12: Design and in paragraphs 4.1-4.5 below. Recent and forthcoming publications by the World Wildlife Fund (WWF), Planning Officers Society for Wales (POSW)[6], Office of the Deputy Prime Minister (ODPM)[7] and Countryside Council for Wales (CCW)[8] may also be of interest.

1.7 Detailed energy efficiency standards for new buildings are established through Building Regulations, which are not a devolved function. Details of Building Regulation standards are produced by ODPM[9] and will be amended in 2006.

2. Renewable Energy and Planning

2.1 The Planning system has an important role to play in achieving the Assembly Government's commitment to enabling the deployment of all forms of renewable energy technologies in Wales. This section of the TAN outlines the major land use planning aspects of these technologies, with an emphasis on the strategic national planning issues raised by their development. Further detailed descriptions of these technologies are contained in Annex C.

Onshore Wind

2.2 As noted above and in the Ministerial Interim Planning Policy Statement on Renewable Energy 2005, onshore wind power offers the greatest potential for an increase in the generation of electricity from renewable energy in the short to medium term. In order to try to meet the target for onshore wind production the Assembly Government has commissioned extensive technical work[10], which has led to the conclusion that, for efficiency and environmental reasons amongst others, large scale (over 25MW)[11] onshore wind developments should be concentrated into particular areas defined as Strategic Search Areas (SSAs).

[5]Additionally the Energy Savings and Carbon Trusts can provide independent assistance on renewable energy and energy efficiency
[6]Work by WWF and CRiBE (Cardiff University), 'Building a Future for Wales: A Strategy for Sustainable Housing' February 2005 and by POSW 'A Model Design Guide for Wales: Residential Development' April 2005
[7]The Planning Response to Climate Change – Advice on Better Practice. ODPM 2004
[8]Building in Green. CCW
[9]http://www.odpm.gov.uk/stellent/groups/odpm_buildreg/documents/page/odpm_breg_609257.pdf
[10]Facilitating Planning for Renewable Energy in Wales: Meeting the Target. Review of Final Report Arup June 2005.
[11]for the purposes of this TAN developments of 25MW or more are considered to be large scale

2.3 SSAs have been identified through a variety of means as outlined below in paragraphs 2.4-2.9 and in the Arup Final Report 2004. This approach addresses the issue of location of onshore wind facilities at a strategic all-Wales level. Local planning authorities are best placed to assess detailed locational requirements within and outside SSAs in the light of local circumstances.

Strategic Search Areas (SSAs)

2.4 The 7 Strategic Search Areas (SSAs) are shown on Maps 1-8. The SSA boundaries are at a "broad brush" scale. Not all of the land within the SSAs may be technically, economically and/or environmentally suitable for major wind power proposals; however the boundaries are seen as encompassing sufficient suitable land, in one or more sites, to deliver the Assembly Government's energy policy aspirations. It is a matter for local planning authorities to undertake local refinement within each of the SSAs in order to guide and optimise development within each of the areas. If there is robust evidence that land outside (but close to) the SSA is suitably unconstrained local planning authorities might wish to consider the possibility of development of wind farms in these areas as well.

2.5 For each of the SSAs there are indicative targets of installed capacity (in MW), outlined in Table 1 below, compiled on the basis that the majority of technically feasible land for wind turbines in each area is utilised. Although the Assembly Government has an established target of 800MW of installed onshore capacity, Table 1 indicates that SSAs may be capable of accommodating up to approximately 1120MW of additional capacity. This degree of flexibility is necessary to ensure that the proposals for a total of 800MW come forward by 2010. The installed capacity targets are intended to assist the planning process and are not to be seen as the definitive capacity for the areas. There may be practical, technical and/or environmental reasons why the capacity may be more or less than that indicated.

Table 1: Indicative Capacity targets for SSAs

Strategic Search Area	*Capacity*
A Clocaenog Forest	140MW
B Carno North	290MW
C Newtown South	70MW
D Nant-y-Moch	140MW
E Pontardawe	100MW
F Coed Morgannwg	290MW
G Brechfa Forest	90MW
Total	1120MW

The above figures represent a 1/3 reduction on the maximum capacities identified by Garrad Hassan as reviewed by Arup in their 2005 Report. These figures will allow local discretion in identifying the best sites.

2.6 Limited clear-felling of trees will be required if a wind farm is sited in a woodland within an SSA. The clear-felling should be the minimum area required to facilitate the construction of the wind farm and the efficient operation of the turbines but sympathetic to the surrounding landscape and environment.

2.7 Large areas of Wales were excluded from consideration as SSAs by features that militate against larger wind power developments. In particular large wind power proposals within a National Park or designated Area of Outstanding Natural Beauty would be contrary to well established planning policy and thus SSAs have not been considered for these areas. Similarly, the highest level of nature conservation and heritage designations, and thus Natura 2000 sites, the core area of the Dyfi Biosphere Reserve, and the World Heritage Site at Blaenafon were all excluded from consideration as SSAs.

2.8 Details of the extensive assessment used to derive the SSAs together with the various constraints are contained in Arup's Final Report of 2004.

2.9 SSAs display all of the following characteristics. They are:

- extensive areas with a good wind resource (typically in excess of 7 metres per second).
- upland areas (typically over 300m above ordnance datum) which contain a dominant landform that is flat (plateau) rather than a series of ridges.
- generally sparsely populated.
- dominated by conifer plantation and/or improved/impoverished moorland.
- has a general absence of nature conservation or historic landscape designations.
- of sufficient area to accommodate developments over 25MW, to achieve at least 70MW installed capacity and to meet the target capacity.
- largely unaffected by broadcast transmission, radar, MoD Mid Wales Tactical Training Area (TTA) and other constraints.

2.10 Local planning authorities should take an active approach to developing local policy for SSAs in order to secure the best outcomes. Further advice is contained in Annex D. Some of the local issues, which could be addressed in this way are:

- The extent to which tree felling in the SSA is considered desirable. Whilst the clear felling of an area of conifer plantation might be preferable from an economic point of view (retaining the trees is likely to reduce the energy yield from the turbines) there is no requirement that this should be the case. There may be a range of reasons why clear felling should be considered unwarranted e.g. if the woodland provides habitat for rare species. If clear felling is required, then it should be the minimum required subject to environmental and landscape needs and the requirements of the Forestry Act 1967.

- The extent to which alternative wildlife habitat creation is desirable. There could be opportunities to enhance, extend or re-create habitats of significant wildlife or landscape value. These opportunities should be grasped.
- The geo-technical implications of any proposals, especially with regard to ground conditions.
- The possible impact on tourism and recreational opportunities in the SSA. Developers and local authorities are encouraged to enter into constructive dialogue over the positive provision for visitors to wind power projects and ways in which any negative impacts can be minimised or mitigated.
- Local historic and landscape considerations and micro-siting in relation to issues of local importance.
- Safeguarding wind farm sites. Local planning authorities should be aware that other developments could sterilise land for wind power proposals, and bear this in mind during policy formulation and decision making.
- Access considerations, including the acceptability of new and existing roads for access and construction.
- The de-commissioning of wind farm development, the restoration of the site at the end of its life and ensuring that sufficient finance is available to implement these requirements.

Onshore Wind in Other Areas

2.11 The potential for the development of wind power within urban/industrial brownfield sites is so far largely untapped. A number of urban/industrial sites have been identified as having some potential based on strategic assessment in a report prepared for the Assembly Government[12]. Local site-specific evaluations are needed to confirm the findings. There may be further opportunities for the development of wind farm or other renewable energy schemes on urban/industrial brownfield sites up to 25MW within Wales and these should be encouraged.

2.12 The Assembly Government expects local planning authorities to encourage, via their development plan policies and when considering individual planning applications, smaller community based wind farm schemes (generally less than 5 MW). This could be done through a set of local criteria that would determine the acceptability of such schemes and define in more detail what is meant by "smaller" and "community based". Local planning authorities should give careful consideration to these issues and provide criteria that are appropriate to local circumstances.

2.13 Most areas outside SSAs should remain free of large wind power schemes. Local planning authorities may wish to consider the cumulative impact of small schemes in areas outside of the SSAs and establish suitable criteria for separation distances from each other and from the perimeter of existing wind power schemes or the SSAs. In these areas, there is a balance to be

[12]The Potential for Wind Power in urban, industrial and commercial sites in Wales. Powys Energy Agency Report 2003

struck between the desirability of renewable energy and landscape protection. Whilst that balance should not result in severe restriction on the development of wind power capacity, there is a case for avoiding a situation where wind turbines are spread across the whole of a county. As a result, the Assembly Government would support local planning authorities in introducing local policies in their development plans that restrict almost all wind energy developments, larger than 5MW, to within SSAs and urban/industrial brownfield sites. It is acceptable in such circumstances that planning permission for developments over 5MW outside SSAs and urban/industrial brownfield sites may be refused.

2.14 There will also be opportunities to re-power and/or extend existing wind-farms which may be located outside SSAs and these should be encouraged provided that the environmental and landscape impacts are acceptable.

Community Involvement and Benefits

2.15 Developers, in consultation with local planning authorities, should take an active role in engaging with the local community on renewable energy proposals. This should include pre-application discussion and provision of background information on the renewable energy technology that is proposed.

2.16 Experience has shown that there are opportunities to achieve community benefits through major wind farm development. Some benefits can be justified as mitigation of development impacts through the planning process. In addition, developers may offer benefits not directly related to the planning process. Annex B provides further information and examples about the types of community benefit which have been provided. Local planning authorities, where reasonably practical, should facilitate and encourage such proposals. The Welsh Development Agency, and others[13] can support and advise on community involvement in developing renewable energy and benefiting from it. Local planning authorities should make clear in their development plans the scope of possible "planning contributions". However, such contributions should not enable permission to be given to a proposal that otherwise would be unacceptable in planning terms.

3. Offshore Wind and Other Onshore Renewable Energy Technologies

Offshore Wind

3.1 The development of offshore wind farms provides the prospect of additional renewable energy production. The consent processes lie outside the land use planning system. However, local planning authorities are consultees in the offshore decision-making process and wherever practicable proposals for offshore wind developments should be supported. Planning permission may be required for onshore installations associated with offshore wind farms. Local planning authorities should plan positively for such installations and minimise their environmental impact.

[13]Energy Savings Trust, Carbon Trust for example

Other Onshore Renewable Energy Technologies

3.2 Other onshore technologies provide energy in the form of electricity and heat. Some of the 2010 renewable electricity target will be met from these technologies, but the likelihood is that it will only be a small proportion. This is, however, neither to underestimate their value nor a sign of any lack of the Assembly Government's commitment to their implementation. The technologies are described below and their planning implications identified. Many can be accommodated through standard planning policies on design and rural and employment development. Annex C provides more technical detail and definitions to assist local planning authorities and the public in understanding their characteristics.

Anaerobic Digestion (Biogas)

3.3 The siting of biogas plant and the associated energy generation equipment is dependent upon the source of the digestate. That material might be human sewage, in which case the plant is almost certain to be within the sewage treatment works. Animal wastes are more likely to be transported into a central site from the surrounding area and kitchen and catering wastes could come from further afield again. Criteria based policies should be supportive subject to appropriate siting, adequate vehicular access etc. Planning applications will need to be carefully assessed and planning permissions adequately conditioned to ensure good practice is followed and nuisance avoided.

3.4 Local planning authorities should adopt policies for larger sewage treatment facilities to include anaerobic digestion facilities with a positive utilisation of the methane fuel. Intensive livestock units such as large poultry or pig units should also be required to demonstrate responsible waste management practices (which might include anaerobic digestion).

Bio-Fuels for Vehicles

3.5 Whilst not every local planning authority in Wales will receive an application for manufacturing plant (refinery) for bio-diesel or other bio-fuel, it is likely that additional capacity will be developed in Wales by 2010. Bio-diesel can be produced from waste vegetable oil and can be made in small quantities in relatively small buildings. Advice on proposals should be sought from the Health and Safety Executive and Environment Agency on safety and potential pollution aspects. Developments at a larger scale will normally be attached to, or incorporated within, existing vehicle fuel refineries and thus unlikely to require separate policies in development plans

Combined Heat and Power

3.6 A Combined Heat and Power (CHP) plant is an installation where there is simultaneous generation of usable heat and power (usually electricity) in a single process. The basic elements of a CHP plant comprise one or more prime movers usually driving electrical generators, where the heat generated in the process is utilised via suitable heat recovery equipment for a variety of purposes including: industrial processes, community heating and space heating. CHP plant allows "waste" heat produced from electricity production through thermal processes to be put to valuable use thus providing an opportunity for significant savings in carbon emissions. Local planning authorities should take an active role in facilitating CHP systems through development plan and development brief processes.

Community (or District) Heating

3.7 It is sometimes more appropriate to install a community heating main and central boiler house rather than a CHP system. This may often be the only sensible or even possible way of introducing woodfuel heating to a group of buildings. Such installations will require collaborative working between developers, energy companies and planning authorities in order to achieve significant results. In circumstances where design briefs are being prepared for larger developments, community heating networks utilising CHP or low-carbon fuels should be thoroughly investigated. The encouragement of community heating solutions using low carbon technologies should also be introduced into development plans and supplementary planning guidance.

Energy from Waste

3.8 All three regional waste plans have adopted mechanical and biological treatment (MBT) plants as their preferred option with some specifically stating that this would be in combination with energy from waste. A possible, or even likely, output from the MBT process would be refuse derived fuel which could be burnt to generate heat and/or electricity. Local planning authorities are urged to take sound expert advice on such matters as emissions and to deal with the issues in an objective manner. Some of the output from energy from waste plants is deemed to be "renewable" but the Assembly Government's priority is to see the amount of waste reduced with the energy recovery usually only coming after recycling and composting (anaerobic digestion is covered under the "composting" heading).

Fuel Crops, including Woodfuel

3.9 Local authorities should encourage the use of modern woodfuel heating systems and their necessary fuel stores.

3.10 Whilst development plan policies should be supportive of the generation of electricity from woodfuel, there is no particular need to identify sites for power stations. The locational criteria are not so specific as to justify special consideration through the planning system. The fuel supply will clearly be an important locational factor as will the availability of a good transport infrastructure, and connection to a suitable electricity system with available capacity.

3.11 There is likely to be a close locational relationship between the energy generation plant and the growing of crops specifically for fuel in rural areas. The growing of the fuel crop is an issue that lies outside of planning control; the planning process can only directly influence the development of plant and associated infrastructure.

Hydro-Power

3.12 Most new hydro-power structures involve "run-of-river" schemes, by far the most likely for developments in Wales. These are relatively small, with some flexibility in siting along a length of river or stream, although as with any power generation scheme, there should be cost-effective access to the electricity network.

3.13 Though generally supported, there could be occasions where some hydro schemes are unacceptable because of potential ecological damage. All of the parties involved should work constructively to find acceptable solutions. Adequate technical advice on the relevant issues should be sought when a proposal is being considered. A water abstraction licence is also required to operate a hydro scheme and close liaison with the Environment Agency, as the licensing authority, is strongly advised.

Methane

3.14 Opportunities may arise to include measures to generate energy from landfill gas or other facilities where methane might otherwise escape into the atmosphere. The generation plant will usually only occupy a small piece of land, usually on land already forming part of a landfill site or mine. These opportunities should be encouraged, will be usually site specific and can be covered by criteria based local policy. Close liaison with the Environment Agency is essential.

Solar Thermal and Solar Photo-Voltaic (PV)

3.15 Other than in circumstances where visual impact is critically damaging to a listed building, ancient monument or a conservation area vista, proposals for appropriately designed solar thermal and PV systems should be supported.

3.16 Local planning authorities should interpret the provisions of the General Permitted Development Order as constructively as possible when these systems are proposed; specific advice in respect of houses has already been issued[14]. They should also consider ways in which further encouragement can be given to these technologies, including the introduction of planning policies for building types with a high demand for hot water, especially if this is likely to occur mainly during the summer months.

3.17 Housing of all types is appropriate for the utilisation of solar water heating. Local design guides and supplementary planning guidance should encourage this, and incorporate appropriate advice.

4. Design and Energy

4.1 Design and energy should be considered when development plan policy is produced, in supplementary planning guidance such as design briefs, and during the submission of planning applications. Local planning authorities should actively consider the inclusion of design guidance in their development plans or Supplementary Planning Guidance (SPG see paragraphs 5.6-5.7), which consider the issues of solar panels, CHP and other forms of renewable energy technology (micro-generation).

[14] Planning: A Guide for Householders. Welsh Assembly Government 2003

4.2 TAN 12: Design provides advice on national planning design policy including considerations such as resource efficient layout and resource efficient buildings. Welsh research has been published on residential design and sustainable development in 2005[15]. The WDA published "Creating Sustainable Places" in April 2005, which provides advice for those engaged with WDA developments, while the CCW publication 'Building in Green' is also appropriate.

4.3 Design, infrastructure and site layout are key to achieving energy efficient development by optimising passive solar gain in domestic and non-domestic buildings. The main aspects to consider are the orientation of the buildings and the overall site layout, to avoid overshadowing and exposed locations and to optimise sunlight penetration.

4.4 The Assembly Government considers that the standards established under the EcoHomes[16] scheme for residential development and BREEAM[17] scheme for non-residential development form a useful framework for energy efficiency consideration. These include the use of whole lifetime costs (i.e. initial capital costs, maintenance and running costs and, in particular, energy costs) in evaluating schemes.

4.5 In order to further promote energy efficiency and energy conservation, local planning authorities should consider requiring in development plan policies or supplementary planning guidance that planning applications (other than outline) for new non-residential buildings over 1000 sq. m should be accompanied by an Energy Design Advice Report if appropriate. The report should include recommendations relating to energy efficiency and appropriate renewable energy technologies that could be incorporated into the development. A response to that report from the developer should also accompany the application. If local planning authorities feel that insufficient consideration has been given to energy issues in project design, they should consider refusing planning permission.

5. Implications for Development Plans

5.1 The local implications of TAN 8 including the SSAs, should be incorporated into Local Development Plans (LDP) in line with the requirements of the LDP process, including sustainability appraisal, and Strategic Environmental Assessment (SEA).

5.2 Local Development Plans should promote high standards of energy efficiency, energy conservation and the use of renewable energy as a part of the national and international response to climate change, and this should be reflected in the strategy of development plans. Local planning authorities should consider the local availability of renewable energy resources and develop suitable policies that promote their implementation. Additionally, local planning authorities should consider the specific requirements of individual renewable energy technologies, outlined in this TAN, which are likely to come forward during the plan period.

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[15] Work by WWF and CRiBE (Cardiff University), 'Building a Future for Wales: A Strategy for Sustainable Housing' February 2005

[16] EcoHomes - The Environmental Rating for Homes. www.bre.co.uk

[17] BREEAM - the BRE Environmental Assessment Method. www.bre.co.uk

5.3 Local planning authorities should seek to maximise the potential of renewable energy by linking the development plan with other local authority strategies including the community strategy. They should also develop generic development control policies which might include housing, employment, and rural development proposals and consider the implications for landscape protection, the re-use of previously developed land and waste management. Local development plans should also be clear about the issues that would be covered by planning obligations and/or planning conditions for the various forms of renewable energy. Local planning authorities, particularly those with SSAs, should involve the Countryside Council for Wales in refinement work or landscape assessment in relation to local development plans and planning applications at the earliest possible stage.

5.4 The SSAs for onshore wind as identified on Maps 1-8 are of key importance to the achievement of energy policy targets; they must be referred to in local development plans and, if refined, incorporated into local development plan proposal maps. Further advice is contained in Annex D. Where SSAs cross the boundaries of more than one local planning authority those authorities affected will need to co-operate and work together to develop any locational refinements or criteria based policies in a consistent manner. The Assembly Government will scrutinise local development plans to ensure that SSA installed capacity targets are capable of being met and that there is consistency across administrative boundaries.

5.5 Climatic considerations need to be addressed in LDPs' land allocations and whilst climate and particularly, aspect, should not be over-riding considerations in allocating land in LDPs, these factors need to be considered from the outset.

Supplementary Planning Guidance (SPG)

5.6 The inclusion of a large amount of detail relating to renewable energy and energy efficiency is not appropriate in local development plans, and local planning authorities should consider producing complementary SPG to cover detailed technical guidance on the various forms of renewable energy. The Assembly Government has produced guidance in relation to the production of SPG[18].

5.7 Design and energy SPG could cover such wide ranging topics as housing fenestration and estate layout relating to passive solar gain or the requirement of renewable energy generating capacity for new office developments, such as the utilisation of heat pumps, microgeneration systems and community heating networks. Development briefs for major development should also incorporate requirements regarding renewable energy, energy efficiency and conservation.

6. Development Control

6.1 Consideration of renewable energy sources, energy efficiency and conservation measures at the outset of any new development is vital. This TAN and relevant development plan policy should alert developers to the need to consider these at an early stage.

[18] Unitary Development Plans Wales, National Assembly for Wales 2001

6.2 Preliminary enquiries and pre-application discussions are also crucial to the success of integrating these elements into any proposed schemes. Local planning authorities should be acquainted with, and have an understanding of the various forms of renewable energy technology currently available and should have access to experts when necessary. It is helpful to be able to discuss options for the inclusion of a range of renewable energy technologies into developments and to direct developers to the variety of sources of advice available to facilitate renewable energy and energy efficiency measures. Developers and local planning authorities should endeavour to enter into discussions with local communities at the earliest possible opportunity when formulating proposals.

6.3 The paragraphs above and Annex C provide a brief overview of the main forms of renewable energy technology in Wales, which could come forward over the next few years.

6.4 Local planning authorities should consider including appropriate conditions for the decommissioning of wind farms or individual turbines and their restoration when they reach the end of their design life, taking into account any proposed after-use of the site. In addition, operators should ensure that sufficient finance is set aside to enable them to meet restoration obligations. An authority may require financial guarantees by way of a Section 106 planning obligation/agreement, as part of the approval of planning permission to ensure that restoration will be fully achieved.

7. Monitoring

7.1 Local planning authorities should ensure that they monitor the deployment of renewable energy technologies. It is a matter for each local planning authority to devise systems that are most appropriate for technologies other than onshore wind. However, the specific monitoring of the provision of installed onshore wind capacity will be sought through Development Control returns to the Assembly.

7.2 Those local planning authorities which contain all or part of a SSA should monitor the provision of installed capacity from onshore wind within the parts of the SSA for which they are responsible on an annual basis commencing at 1st April 2006. Such installed capacity within SSAs should be clearly identifiable within the overall monitoring of renewable energy deployment.

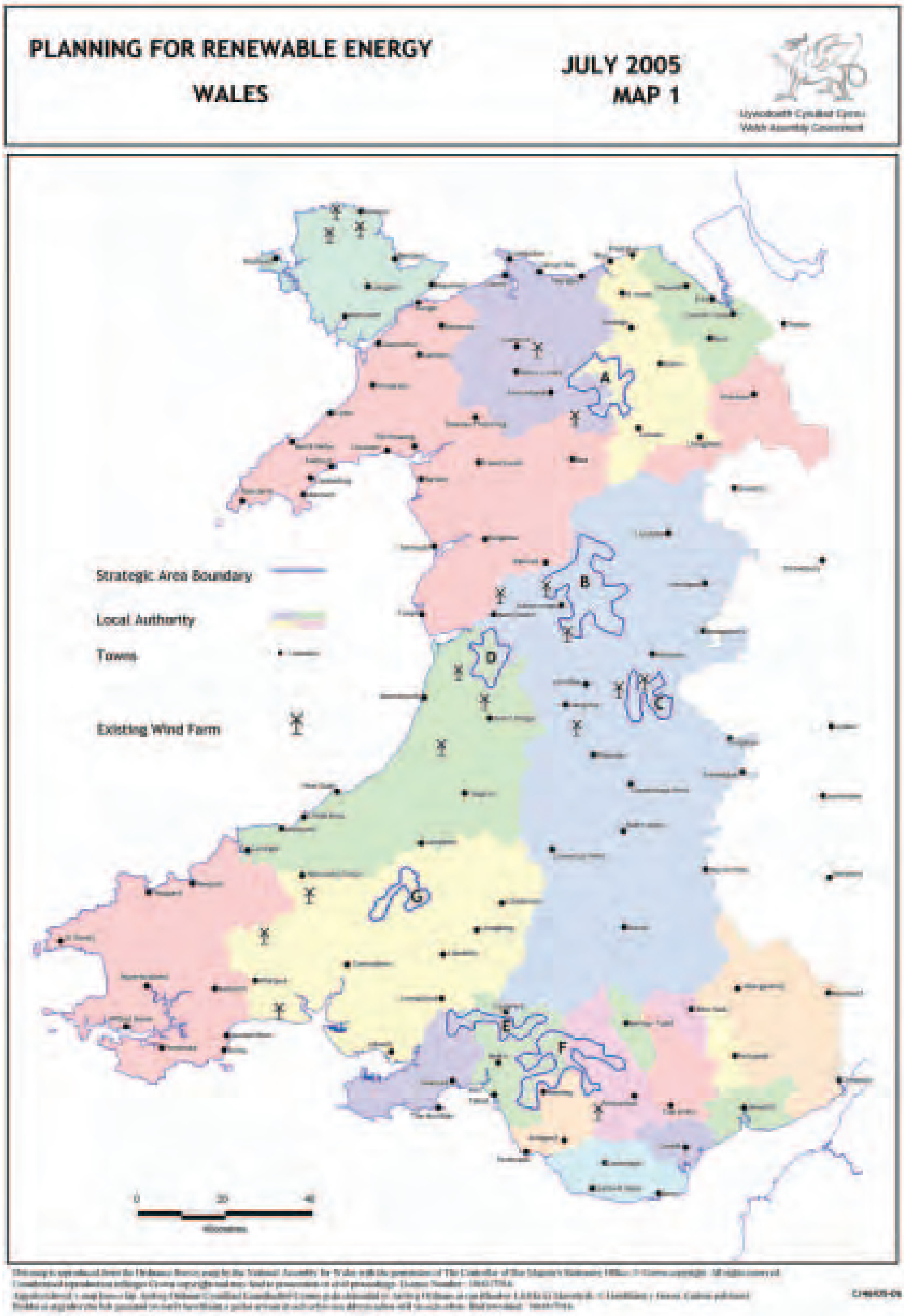
7.3 In monitoring such provision local planning authorities should maintain data on developments which have been completed over the previous year, proposed developments which have full planning permission but which have yet to be implemented and developments which are under construction.

7.4 Once Local Development Plan Annual Monitoring Reports are in place, headline figures for wind power development should be included in these.

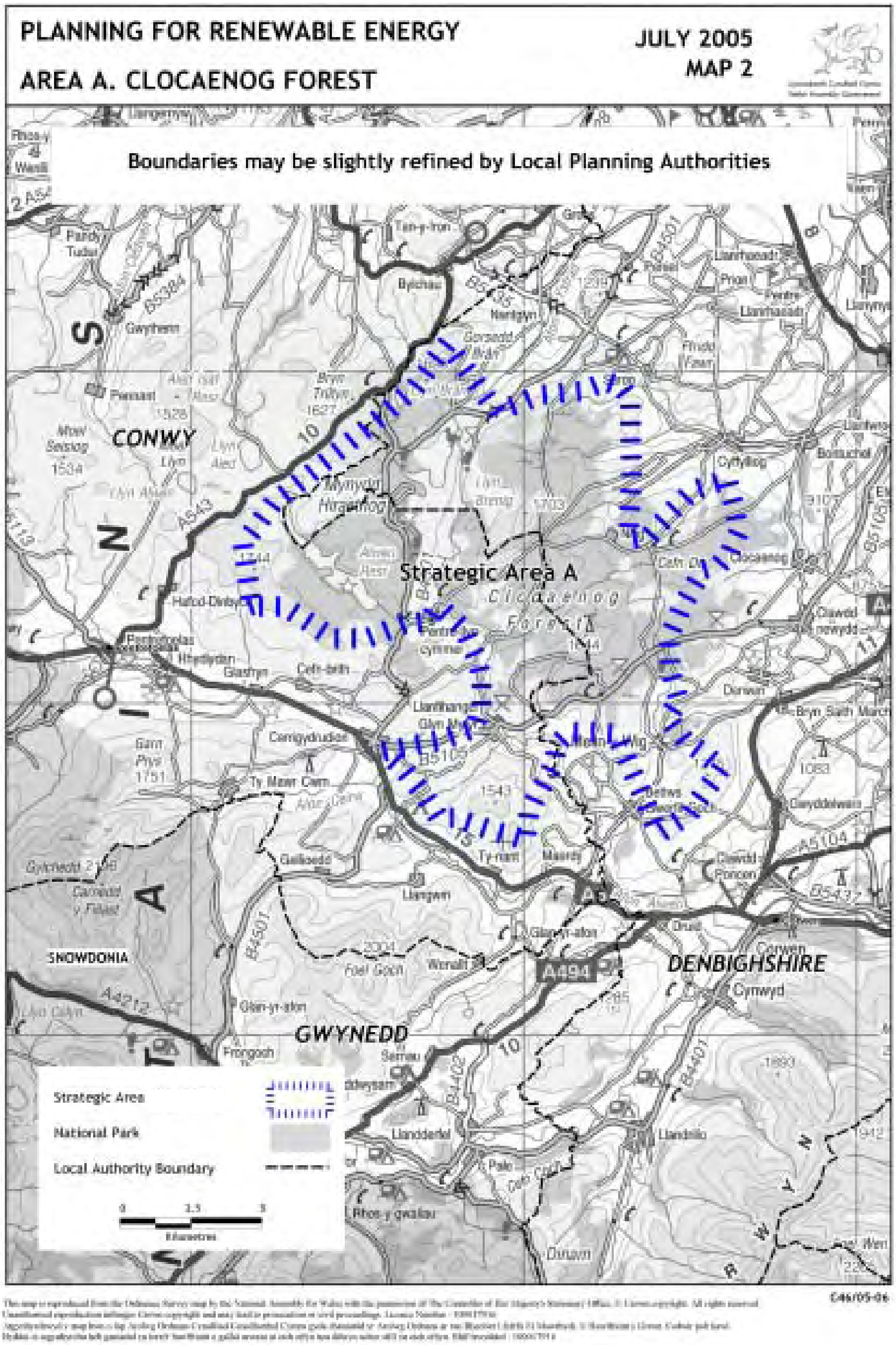
8. Cancellation

8.1 This Technical Advice Note cancels Welsh Office Technical Advice Note (Wales) 8 Renewable Energy November 1996.

Map 1

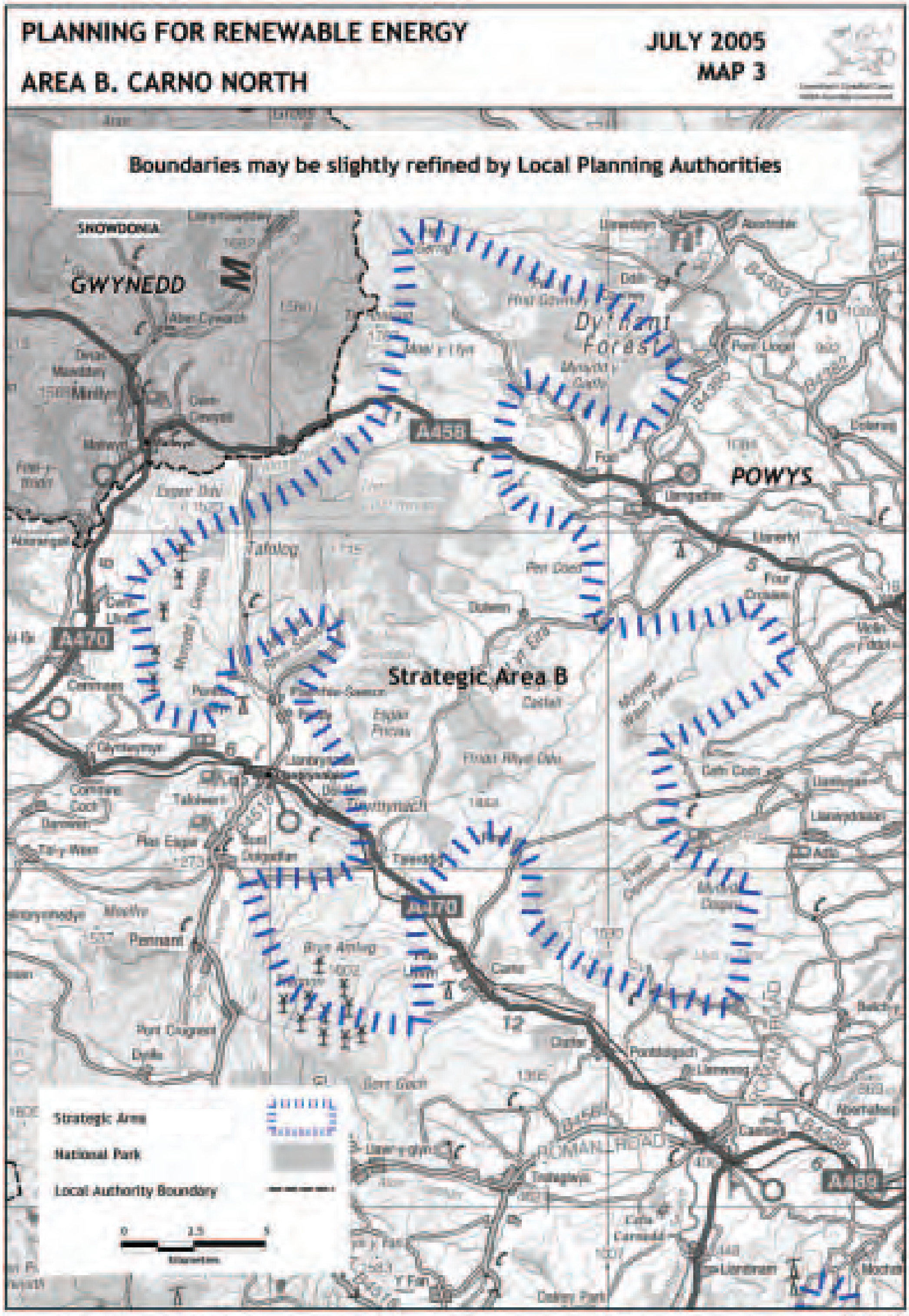

PLANNING FOR RENEWABLE ENERGY
WALES
JULY 2005
MAP 1
Strategic Area Boundary
Local Authority
Towns
Existing Wind Farm
A
B
C
D
E
F
G

Map 2

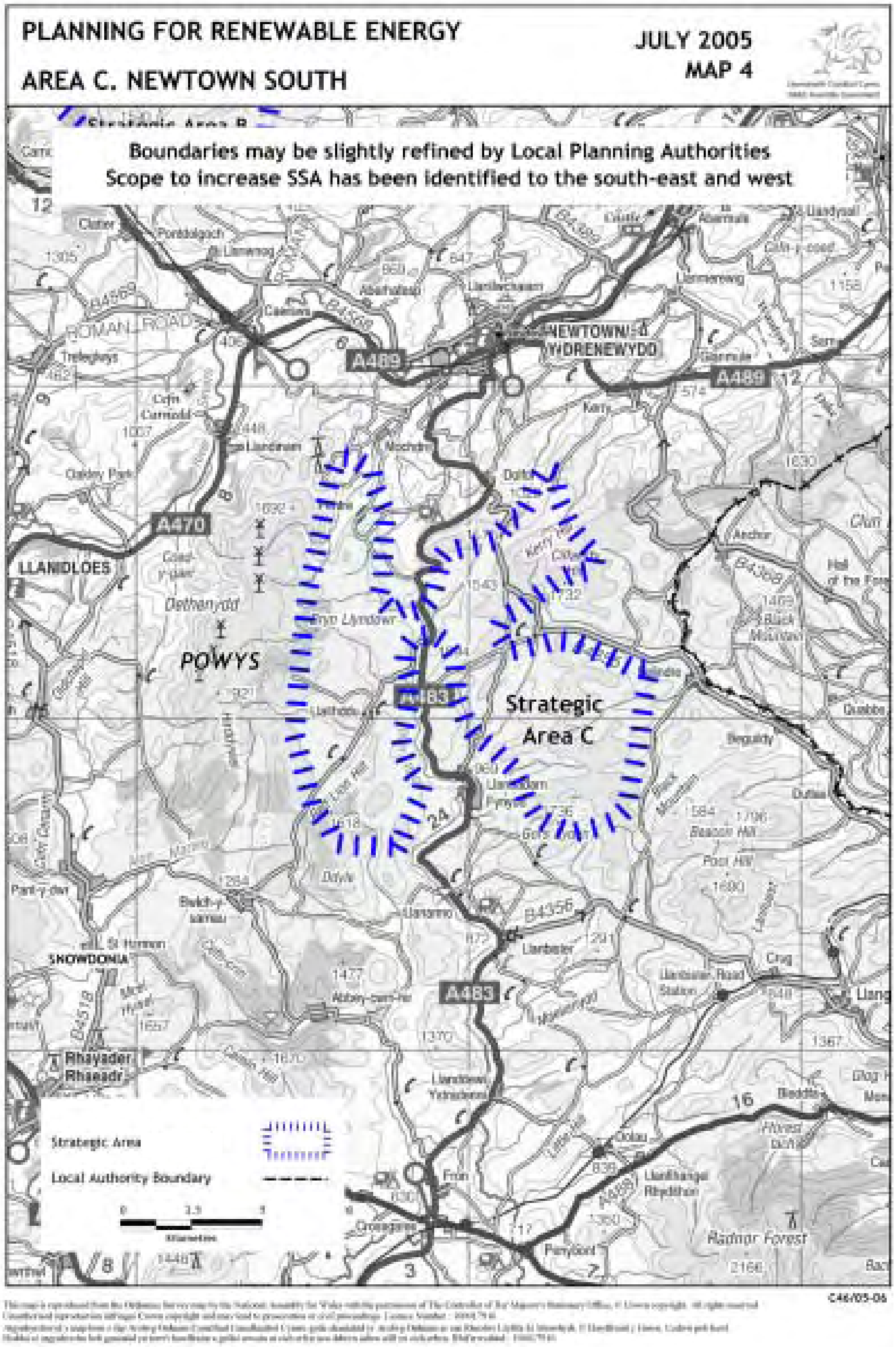


PLANNING FOR RENEWABLE ENERGY
AREA A. CLOCAENOG FOREST
JULY 2005
MAP 2
Boundaries may be slightly refined by Local Planning Authorities
Strategic Area A
Clocaenog Forest
CONWY
DENBIGHSHIRE
GWYNEDD
SNOWDONIA
Strategic Area
National Park
Local Authority Boundary
C46/05-06

Map 3

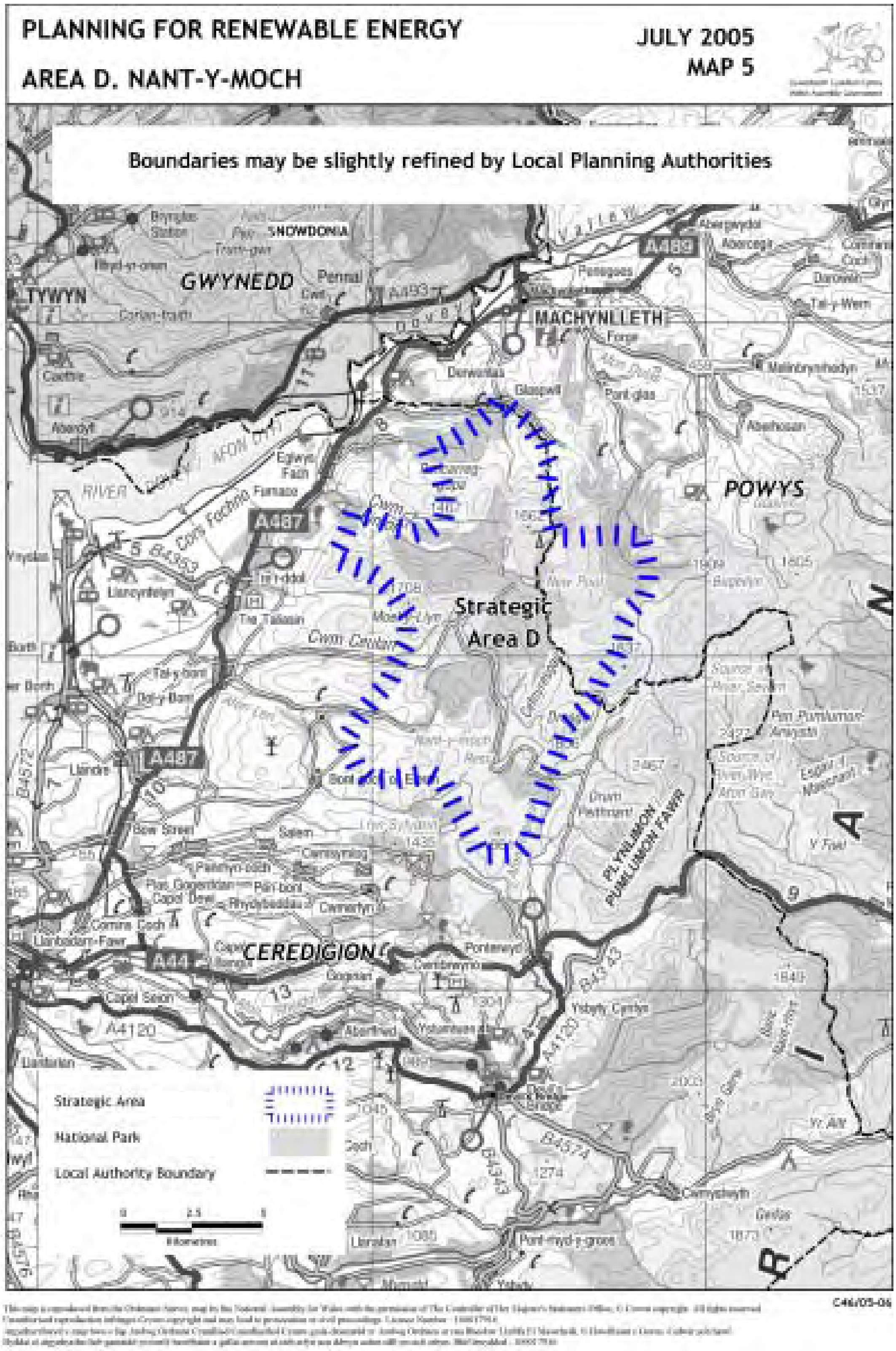

PLANNING FOR RENEWABLE ENERGY
AREA B. CARNO NORTH
JULY 2005
MAP 3
Boundaries may be slightly refined by Local Planning Authorities
SNOWDONIA
GWYNEDD
POWYS
Strategic Area B
A458
A470
A489
Strategic Area
National Park
Local Authority Boundary

Map 4



PLANNING FOR RENEWABLE ENERGY
AREA C. NEWTOWN SOUTH
JULY 2005
MAP 4
Boundaries may be slightly refined by Local Planning Authorities
Scope to increase SSA has been identified to the south-east and west
Strategic Area C
POWYS
LLANIDLOES
NEWTOWN/ Y DRENEWYDD
A489
A470
A483
B4356
Rhayader
Rhaeadr
Radnor Forest
Strategic Area
Local Authority Boundary
C46/05-06

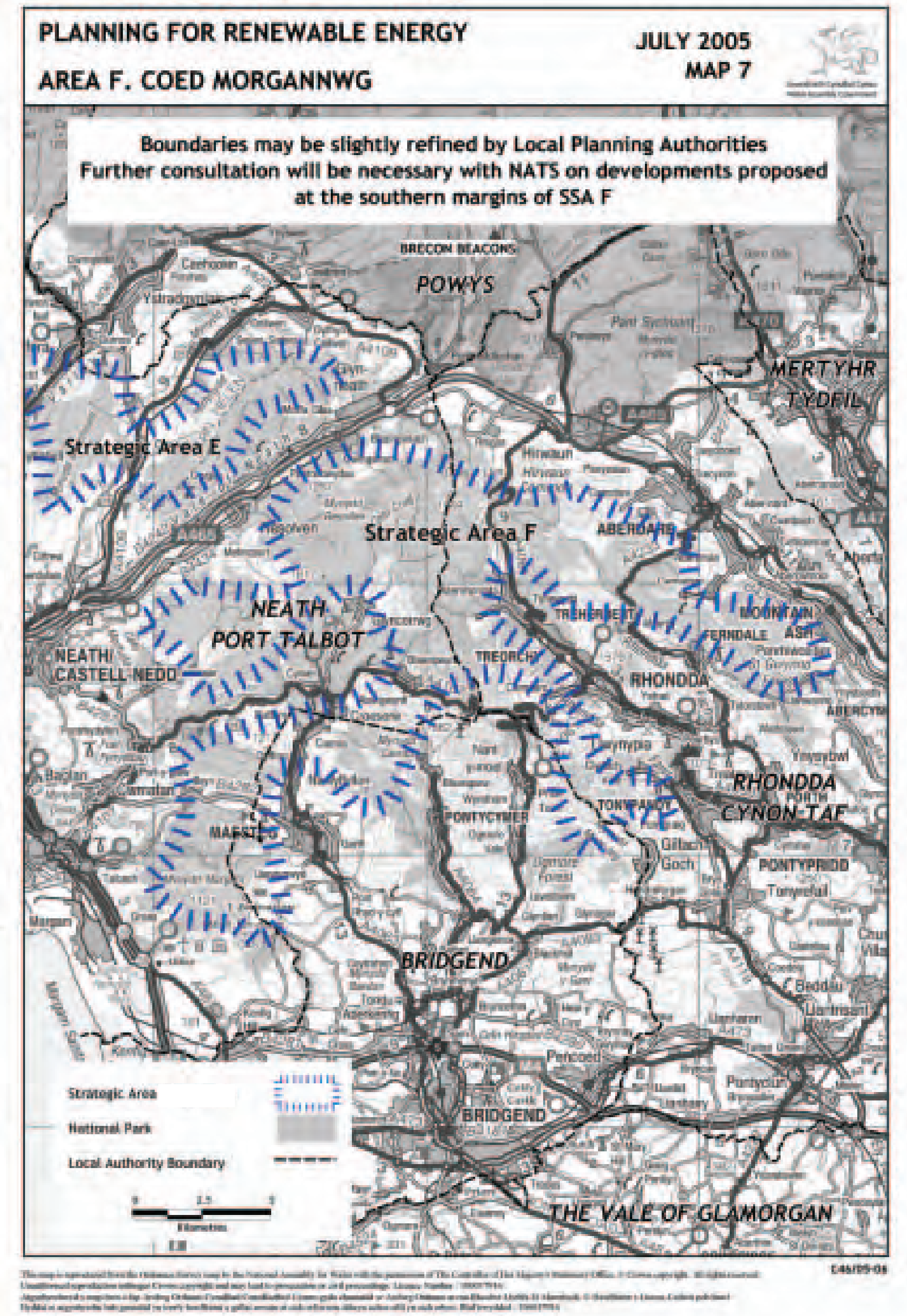
Map 5


PLANNING FOR RENEWABLE ENERGY
AREA D. NANT-Y-MOCH
JULY 2005
MAP 5
Boundaries may be slightly refined by Local Planning Authorities
Strategic Area D
GWYNEDD
POWYS
CEREDIGION
TYWYN
MACHYNLLETH
SNOWDONIA
Strategic Area
National Park
Local Authority Boundary
C46/05-06

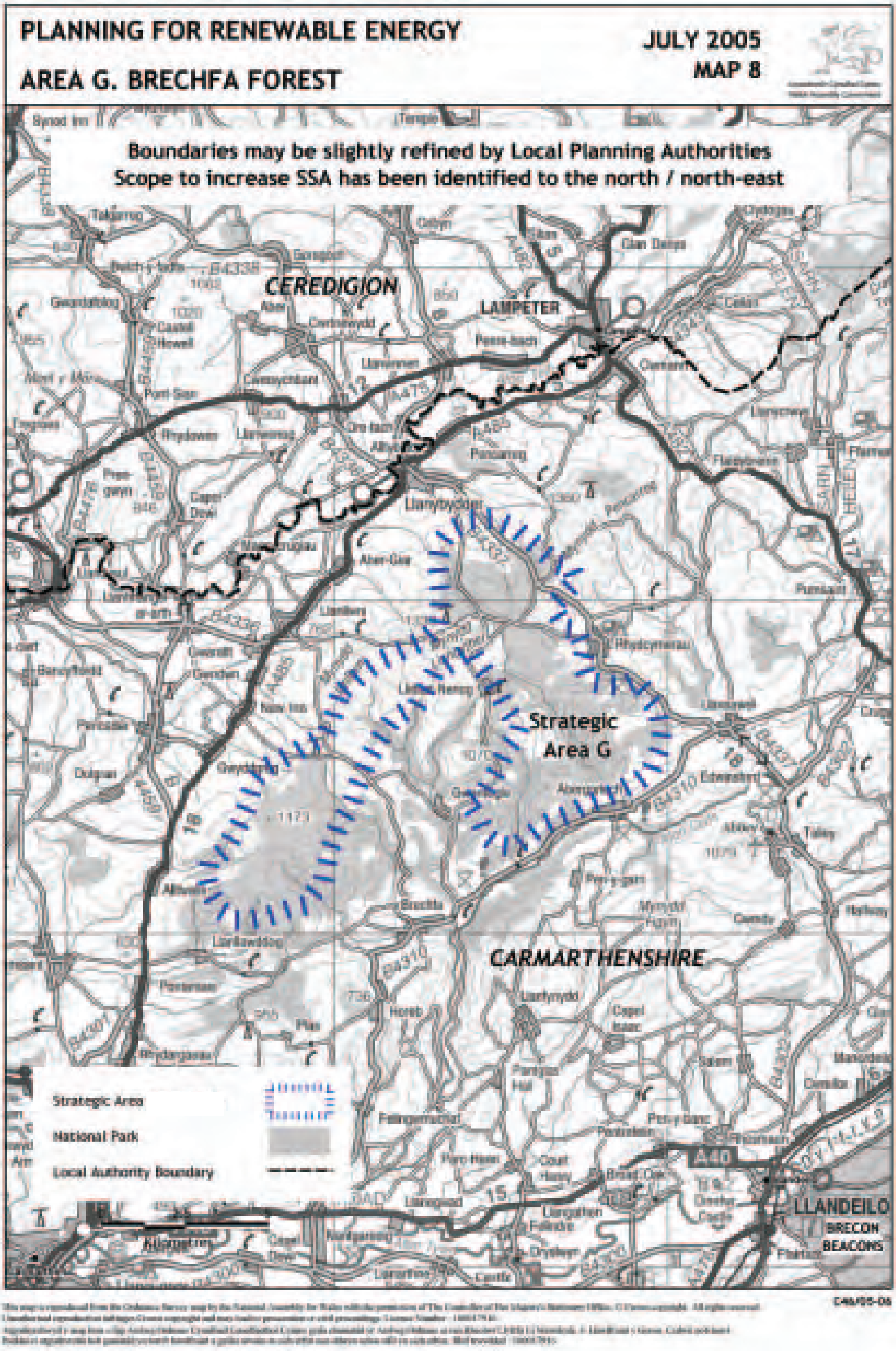
Map 6


PLANNING FOR RENEWABLE ENERGY
AREA E. PONTARDAWE
JULY 2005
MAP 6
Boundaries may be slightly refined by Local Planning Authorities
Scope to increase SSA has been identified to the north-west
BRECON BEACONS
POWYS
CARMARTHENSHIRE
Strategic Area E
Pontardawe
SWANSEA
Strategic Area F
NEATH/ CASTELL-NEDD
NEATH PORT TALBOT
BRIDGEND
Strategic Area
National Park
Local Authority Boundary

Map 7


PLANNING FOR RENEWABLE ENERGY
AREA F. COED MORGANNWG
JULY 2005
MAP 7
Boundaries may be slightly refined by Local Planning Authorities
Further consultation will be necessary with NATS on developments proposed
at the southern margins of SSA F
BRECON BEACONS
POWYS
MERTHYR
TYDFIL
Strategic Area E
Strategic Area F
ABERDARE
NEATH
PORT TALBOT
NEATH
CASTELL-NEDD
TREHERBERT
FERNDALE
RHONDDA
RHONDDA
CYNON TAF
PONTYPRIDD
BRIDGEND
BRIDGEND
THE VALE OF GLAMORGAN
Strategic Area
National Park
Local Authority Boundary
C46/05-06

Map 8


PLANNING FOR RENEWABLE ENERGY
AREA G. BRECHFA FOREST
JULY 2005
MAP 8
Boundaries may be slightly refined by Local Planning Authorities
Scope to increase SSA has been identified to the north / north-east
CEREDIGION
LAMPETER
Strategic Area G
CARMARTHENSHIRE
LLANDEILO
BRECON BEACONS
Strategic Area
National Park
Local Authority Boundary
C46/05-06

Annex A

Policy Statement on Renewable Energy

1. The purpose of the draft TAN 8 Consultation Document was to consult on the planning aspects of the implementation of Welsh Assembly Government energy policy. Some respondents have commented on, and raised questions about, various aspects of the energy policy itself. The purpose of this note is to answer the main issues raised.

2. Details of the Assembly Government's intentions for energy generation and improving energy efficiency are provided in the Welsh Energy Route Map[19] which is the subject of public consultation between 20th June and 12th September, 2005. The Route Map builds on the strategy for clean energy production and energy efficiency set out by the Minister for Economic Development and Transport on 26th February 2003. This strategy states that the aim of the Welsh Assembly Government is to secure the right mix of secure and affordable future energy provision in Wales, whilst minimising associated environmental impacts. Key aspects will involve strengthening our renewable energy production, a greater focus on efficient energy use, seizing opportunities for utilising clean gas and coal technologies and developing our relevant energy research base.

3. Energy policy formulation at the UK level is a reserved function and the UK Government is committed to a market-based approach to delivering secure energy supplies. Competitive energy markets are considered central to UK energy policy. Within this context the UK Energy White Paper set out a new strategy for energy policy until 2050. It puts climate change issues at the heart of decisions about the way in which we generate and use energy. It established a clear and long-term framework against which business and domestic consumers can plan and make decisions with confidence within the market framework.

4. In Wales, we are determined through strong private/public partnerships to seize the opportunity of being a global showcase for clean energy by 2010. This is at the heart of the Welsh Assembly Government's energy strategy. We will look to help build on existing exciting developments in Wales including: the world's highest efficiency gas turbine developed by GE at Baglan Energy Park, Sharp placing its European PV manufacturing plant at Wrexham, the UK's first operational offshore wind farm off North Wales, and the LNG projects in train in Milford Haven. More needs to be done, especially to enable more onshore wind farm developments, preferably with significant community and supply chain benefits, alongside a more integrated and stronger approach to the pursuit by all of greater energy efficiency.

[19]Welsh Energy Route Map consultation website
http://www.wales.gov.uk/subitradeindustry/content/consultations/ewrm-ltr-e.htm

5. Electricity from renewable sources was one of the key issues in the UK White Paper as it is in the Welsh Energy Strategy. The UK has set a 15% renewables target to 2015, and we have set a 4TWh per annum renewable electricity production target by 2010[20] and a 7TWh target by 2020 as stepping-stones to our ambition of 60% carbon savings by 2050.

Welsh Renewables Target and Technology Analysis

6. The Wales target, of 4TWh, equates to an installed renewables capacity of about 1500MW. We currently have an installed capacity of around 450MW, comprising onshore and offshore wind, biomass and hydro, which generates approximately 1.4TWh per year. We therefore require about 2.6TWh to meet our target; this means about 900 - 1000MW of additional renewable generating capacity, depending on the capacity factors of the technologies used.

7. The Welsh Assembly Government proposes that 800MW of this power requirement will come from onshore turbines in the form of strategic large-scale developments (over 25MW). It is possible that new offshore turbines at Scarweather and Rhyl Flats could contribute a further 200MW by 2010 and there may also be some contribution (0.1TWh or so) from other sources of renewable energy, such as biomass.

8. The above proposals have the potential, if fully realised, to result in the renewable generation of slightly more than 4TWh per year, a margin of 10% or so above the target being considered appropriate to allow for the challenging difficulties and delays which may be experienced by any new major energy projects.

9. In considering the technologies capable of delivering the 4TWh target we have had to take account of market forces and the commercial status of renewable technologies. Gas is likely to be the main provider of electricity generation in the UK and is likely to provide a cost benchmark for the foreseeable future. However, onshore wind, biomass electrical plants fuelled by wood wastes, and small-scale hydro are already commercially competitive with the support of the renewables obligation (RO). In the future, offshore wind and biomass electrical plants fuelled by energy crops are predicted to become commercially competitive with RO support. Other technologies such as wave and tidal systems have still to reach the large-scale demonstration phase and, while keen to see a strong marine renewables sector in Wales, we do not believe these developments will contribute significantly to our 2010 target. This analysis was confirmed by the 2004 DTI Renewables Innovation Review, the findings of the Royal Commission on Environmental Pollution report of May 2004 on biomass, and the studies undertaken for the DTI 2005 Renewables Obligation review.

10. We have therefore concluded that onshore wind will be the main large-scale technology capable of achieving our 2010 target. In the longer term, the Severn Barrage with its tremendous renewable energy potential could also be of significant interest.

[20]A recommendation by the Economic Development Committee in their renewable energy report in January 2003

Annex B

Community Benefits Arising out of the Development of Wind Farms in Wales

1. Planning Obligations

To enable development to proceed

1.1 Where a development would have implications for the public provision of infrastructure a local planning authority may require the developer to make an in-kind or financial contribution towards its provision. It is possible that the development of a wind farm would have such implications and lead a local planning authority to invoke its legal powers to require, for instance:-

- highway infrastructure improvements outside of the application site.
- wildlife habitat management or creation in mitigation for adverse impacts of the construction.
- payments to overcome adverse implications for communication networks such as TV or radar.

1.2 Under such circumstances the developer would be required to enter into an "obligation" under section 106 of the Town and Country Planning Act (S.106 obligation) to enable development to proceed.

Developer offers

1.3 The developer might wish to volunteer "gains" outside obligations that could be legitimately described as necessary for the development to proceed. Such "gains" could be offered as part of the planning process, as outlined below, or they could be undertaken as a separate exercise. The courts have held that this approach is not, in itself, unlawful. Whether the developer enters into an agreement with the local planning authority or offers these extra benefits unilaterally (as he is permitted to do under section 106), the important point here is that, as such offers are not necessary for the development to proceed, **they must not impact upon the decision-making process.**

2. Community Benefits – outside of the planning process

2.1 It is perfectly acceptable for a business to enter into a legally binding agreement with third parties to deliver particular and agreed benefits to the community. Many local planning authorities would be more comfortable with this approach as it separates, more clearly, community benefits from the planning decision. It is important that the developer is able to identify suitable local representative people or organisations with whom it can negotiate. If there are funds to be administered then an appropriately constituted and regulated body must be identified or created.

2.2 Such benefits offered to local communities could take the form of one or more of:-

- in-kind benefits such as the construction of a needed community facility.
- a lump sum financial payment for the benefit of the community.
- annual payments to the community.
- a commitment from the developer to use local labour and/or contractors/services wherever possible.

2.3 It is, however, considered to be essential that:-

- benefits are negotiated with appropriate and representative persons or bodies.
- benefits are channelled through a regulated and properly constituted body or trust (this could include the local authority).
- benefits are utilised for an agreed range of appropriate uses that would all fall within the definition of sustainable development.
- at least part of any annual payment benefits should be invested in carbon emissions reduction measures in the local community.

2.4 It must be clear that the provision of benefits is on a purely voluntary basis with no connection to the planning application process.

3. Case Studies

3.1 Four case studies are presented in order to provide an idea of the range of options that might be available to LPAs and their partners. One of these is from outside Wales but the developer concerned is already active here. The sums of money involved have been left out of most of the descriptions as this will need to be negotiated on a case by case basis. In the Ail Wynt case the figures have been left in to facilitate proper understanding. **Listing these examples does not indicate their endorsement or otherwise by the Welsh Assembly Government**.

The Village of Carno, Powys

3.2 The planning permission for Carno Windfarm included the offer of community benefits from the developer, Npower Renewables (formerly National Windpower). This was incorporated, along with payments initially linked to bio-diversity monitoring, into a "section 106" obligation and the annual payments have been administered by the two local community councils. This is not untypical of many wind farms in Wales.

3.3 **Management of the Trust.** The Fund is managed by an Executive Committee who under the terms of the constitution of the Trust are also the members of Carno Community Council. The constitution, which is recognised by the Charity Commissioners, sets out how the Trust will operate in terms of members, co-opting people, financial regulations, what can and cannot be done to enhance the status of the fund. There is also a set of rules which in summary, deny grants to political organisations, for repairs or the purchase of second-hand equipment but otherwise any one who lives in the Carno electoral district can apply with each case treated on its merits. The Trustees meet approximately once a month to consider applications.

These are co-ordinated through an administrator who vets the application to ensure all correct documentation and information has been supplied in support of the application. In recognition of the agreement with Npower Renewables, the Trust and individual recipients of grants do have to agree to co-operate with any publicity that might be requested. The Trustees organise an annual press event at which the work of the Fund is promoted.

3.4 **The Grants Awarded**. A total of 113 grants have been awarded, the majority of those made to individuals having been for educational purposes. The Fund does have a policy of making a payment to all students from Carno who have been accepted at universities/colleges and this also applies to those undertaking nursing and other courses relevant to the furtherment of an individual's career. Help has also been given to members of the Young Farmers Club to attend international rallies, and to the WI who send members on courses at Denham College.

3.5 The Fund has also been, and remains, very sympathetic to the needs of the local school which has been helped through grants to improve the facilities it can offer. The prime example of this was a grant towards a computer suite. This has in turn made it possible to run a range of adult computer courses in the evening, and the Trust helped individual attendees with a contribution towards their registration fees. The football and bowls clubs have received grants for new equipment and facilities and more recently grants from the Trust have helped the formation of very successful Gardening and Quilting Clubs. The grants helped them overcome the burden of their initial set up costs.

3.6 The Community Centre has also benefited from the Trust. A good example has been grants towards the costs of ensuring the catering facilities are of the highest standard. This is important to the Centre as a large proportion of the income it raises itself is through the offering of a conference/meeting venue which is able to cater for delegates. The Trust paid for a Food and Hygiene course that ensured the people providing the catering held the relevant certificates. A regular contribution is made to a club that helps Carno senior citizens through the provision of a place to meet and through the arranging of excursions.

3.7 Energy Issues. A more recent development has been the establishment of the Mid Wales Community Energy Trust, which has strong links with Mid Wales Energy Agency but is a separate entity. The Community Energy Trust has been able to draw in funding from various sources (including Npower Renewables) and is proposing to set in train a "Green Village Project" utilising the skills of the Energy Agency to identify opportunities for energy efficiency and small-scale renewable energy developments in Carno and other local villages. Monies from the fund and other available sources will be used to help implement the identified projects. An important point here is that money from wind power developments is usually able to be used as match-funding for grants from other sources.

Power Factory, Rhondda Cynon Taff

3.8 The following information derives directly from the project business plan. Planning permission for the development has been granted.

3.9 A joint venture company will be created between Arts Factory and Eon-UK to ensure a 'win win' partnership model that will meet developer and community interests:

- Eon-UK will utilise its technical expertise and project management experience in delivering large capital projects, and provide access to finance and specialist knowledge of the renewable energy market place to secure long term sustainable electricity sales.
- Arts Factory, a deep rooted community development trust with a 15 year track record, will focus on delivering a wide range of economic, social and environmental projects for community benefit.

3.10 The demonstration onshore windfarm project will deliver:

- 10.4MW of renewable energy in Rhondda Cynon Taf.
- Reductions in $CO2$ emissions of approximately 240,000 Tonnes over the lifetime of the project.
- Renewable energy to power the equivalent of 6,300 homes – 21% of homes in the Rhondda.
- A long term income stream to fund economic, social and environmental regeneration projects that will immediately and directly create 20 new jobs.
- The project will expand the range of services Arts Factory is able to offer to include:
- More Lifelong Learning opportunities in parts of the Rhondda not yet reached with current programmes – in particular in the Rhondda Fawr.
- More Youth Work and Early Years provision to disadvantaged young people.
- Energy Efficiency advice services to local people at risk of fuel poverty.
- A Business Support Service to grow and develop social economy organisations in the area.
- A Green Tourism initiative.

Protocol Between ScottishPower and Argyll and Bute Council, Scotland

3.11 The following concordat has been developed between the local authority and the developer. It is in addition to voluntary "community benefits" packages that have been subject to the Scottish equivalent of "section 106" obligations. The Council has resolved that community benefits packages for future developments will move away from a reliance upon Town and Country Planning legislation and will establish community trust funds outside of the planning system. The partnership with ScottishPower is described in the following concordat:-

Whereas:

a) Argyll and Bute Council ("the Council") have recognised the significant renewable energy resource within the region and wish to see this developed responsibly for the maximum long-term socio-economic benefit of the population of Argyll and Bute.

b) ScottishPower have existing hydro and wind farm interests in Argyll with plans for further expansion in response to demand for renewable energy, and are also the current energy supplier to the Council (including 20% green energy).

Without prejudice to either party's rights and interests, in whatever capacity, Argyll and Bute Council and ScottishPower have agreed to create a Strategic Partnership, which will be expanded to include other utilities and renewable energy companies at the request of such other utilities and renewable energy companies, to ensure that benefit from renewable energy developments are maximised locally through further renewable energy developments and energy efficiency measures. This partnership recognises the long-term relationship, which the Council wishes to have with ScottishPower and such other utilities and companies, ensuring the responsible harvesting of the full range of renewable energy resources in the longer term while maximising benefit to local communities and the local economy.

The Strategic Partnership between Argyll and Bute Council and ScottishPower will in the meantime co-ordinate activities for mutual benefit in the following key areas:

i. The completion of a region-wide Renewable Energy Resource Assessment the remit of which will be drawn up in agreement between the two parties and other relevant partners. The Council will manage the assessment with input from ScottishPower in key areas of expertise.

ii. The completion of a strategic site-selection study for tidal stream power to identify a suitable location for an early demonstration project, recognising the likely significant potential for this technology in the region. This will be led by ScottishPower with input and resources to be agreed from Argyll and Bute Council and other relevant bodies i.e. Scottish Natural Heritage (SNH).

iii. In recognition of the vital role which the Argyll, Lomond and the Islands, Energy Agency (ALI Energy) currently plays in the promotion of renewable energy and energy efficiency, and its future potential role if adequately resourced, funding will be provided from ScottishPower for ALI Energy for an agreed scope of work to include renewable energy education with local communities and other interested stakeholders. Likewise the Council will core fund ALI Energy at the existing level of funding support. Any alterations to this will require the prior authorisation of the Council's Strategic Policy Committee.

iv. The exploration of the potential for an Argyll and Bute -wide fund which will draw resources from large-scale wind farm and other renewable energy developments in order to ensure that the entire community of Argyll and Bute benefits from renewable energy. This fund will help promote additional work through ALI Energy, in particular to facilitate small-scale renewable energy and energy efficiency projects within communities, along with the joint promotion of green energy measures to the domestic and business sectors.

v. The co-ordination of all of the above with ongoing initiatives in sustainable energy in Argyll and Bute.

The above terms are indicative of the parties' intention to work together on renewable energy initiatives in Argyll and Bute in a spirit of partnership. Accordingly the terms shall not be legally binding upon the parties.

The duration of the Strategic Partnership shall be two years from the last date of signing unless terminated by either party giving to the other four weeks written notice of their intent to withdraw. The Partnership's success will be assessed at that time and if it has proven to be of mutual benefit, the partnership will be continued. For the avoidance of doubt, no legally binding partnership is being created.

Ail Wynt

3.12 The following information is taken directly from statements that accompanied a successful planning application to extend the Moel Maelogen Wind Farm in Conwy.

"Ail Wynt is the second co-operative venture to be established by the three hill farming families who originally came together in 1998 to form Cwmni Gwynt Teg, the company which successfully promoted the current Moel Maelogen scheme. Their intention all along has been to find an alternative source of income following the economic crisis which has faced, and continues to face, their industry. Although diversification of agriculture may be successful in lowland farms, the choice of alternative options in an upland area is extremely limited. To use wind power, a natural and plentiful resource in upland areas, is therefore a logical option to consider. In pursuing that option Cwmni Gwynt Teg, and subsequently Ail Wynt, have set out to achieve the following objective:

To develop a wind power project in a way that will retain most of the economic benefit within the local community

Ail Wynt will offer to the general public in Conwy County a minimum of £1 million Bond Issue as an investment in the scheme. This is expected to generate an annual return of some £80,000 to the investors, contingent on satisfactory output from the wind turbines. In addition, Ail Wynt proposes to donate £50,000 per annum towards a programme of energy efficiency in the Upper Conwy Valley. The donation will be eligible for match funding and the total fund will be administered by the Conwy Energy Agency for the benefit of Rural Conwy. Ail Wynt will also donate an annual sum of £15,000 to be shared between the Community Councils of Bro Garmon and Bro Cernyw. The above benefits are in addition to the economic spin-off resulting from the owners of the wind farm residing and operating other businesses locally."

Contacts

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Ail Wynt

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Annex C

Description of Renewable Energy Technologies

1. Introduction

1.1. The main body of the TAN concentrates upon the planning policy considerations of government policy, which seeks to support renewable energy technologies. The technical annex provides background information on the various technologies and is designed to contribute to the development control process. It is not the intention to give a full and technical description of all possible renewable energy generation equipment. This information is not normally needed in order to establish land use planning policy or determine planning applications. Some of the material in this document is based on the technical annex to the Companion Guide to Planning Policy Statement 22 issued by the Office of the Deputy Prime Minister.

2. Wind

Turbine Technology

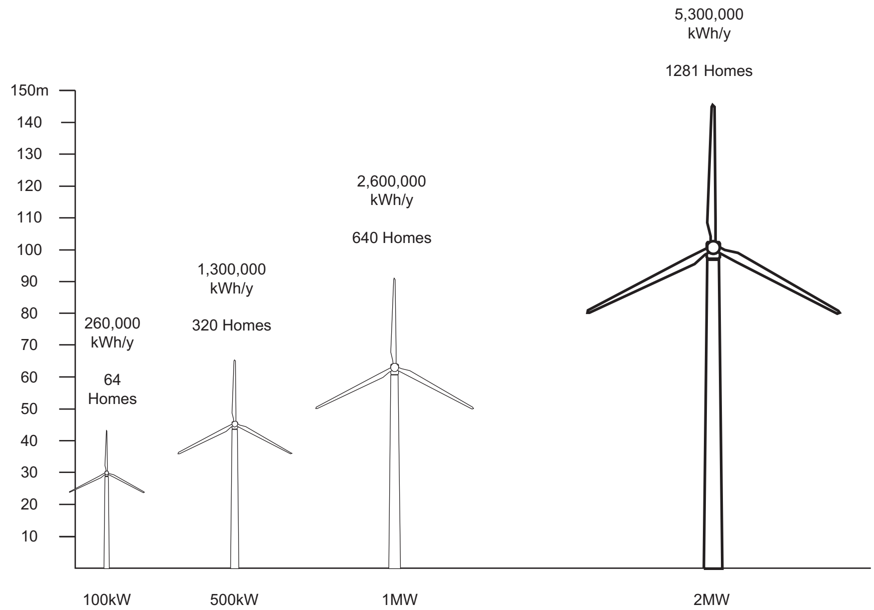
2.1 There are essentially two types of wind turbine,– those that have rotors that rotate about a vertical axis, and horizontal axis machines whose rotating shafts are aligned horizontally. Most wind turbines installed today are of the latter type and this is likely to remain the case for the foreseeable future. The remainder of this section refers primarily to horizontal axis machines.

2.2 Whilst wind turbines are sometimes used to generate mechanical power, particularly for pumping water, this section deals only with the electricity-producing variety. Such wind turbines convert the kinetic energy of the wind that passes through the swept area of the rotor into electrical energy by means of a rotor (generally comprising 3 blades), a mechanical drive train and an electrical generator. The height of the turbine tower is normally at least twice the length of a blade. The blades need to be far enough from the ground or the tops of vegetation to minimise turbulence and to increase the energy capture of the wind turbine. This has particular implications where turbines are sited within areas of trees or shrubs – towers will almost certainly be taller here than on open ground.

2.3 Wind turbines are usually defined by the "rated capacity" which is measured in kilowatts (kW) or megawatts (MW). The "rated capacity" equates to the maximum electrical output. It is worth noting that:

- an increase in the rotor diameter of a wind turbine will result in a greater than proportional change in rated power. See figure 1.
- power output is proportional to the cube of the wind speed, and hence a doubling of wind speed will result in a roughly eight-fold increase in power output. A wind turbine on a site which has an annual mean wind speed of 6 m/s will typically produce only half as much energy as the same machine on a site where the annual mean wind speed is 8 m/s.

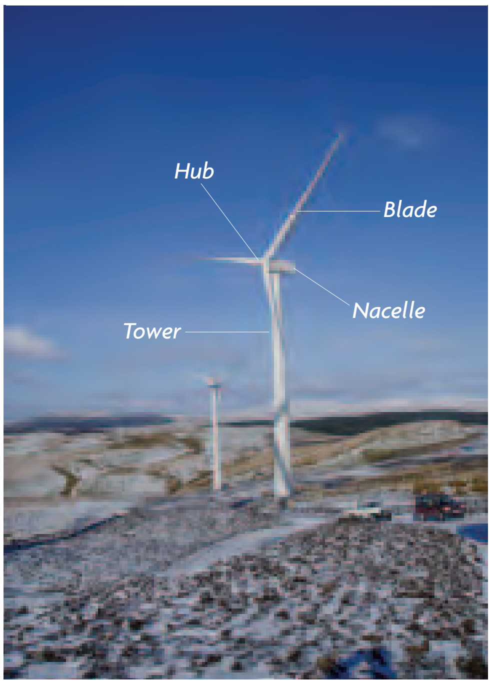
__Figure 1:__ Approximate sizes of typical three-bladed turbines by installed capacity, also showing approximate annual energy output based on an average capacity factor of 0.3, the figure for the number of homes supplied is based on the average UK household consumption of 4100 kWh/year(OFGEM)



2.4 Technological advances have led to a wide range of wind turbine designs. The smallest turbines, some with a rotor diameter of less than one metre, are usually used for charging batteries although recent mains-connected micro-turbines have been introduced to the market. At the other end of the scale turbines with rotor diameters of greater than 100m are now being deployed. The largest machines are most likely for off-shore locations but the current generation of on-shore turbines also often have a rated capacity of several megawatts each. A typical modern wind turbine is shown in figure 2.

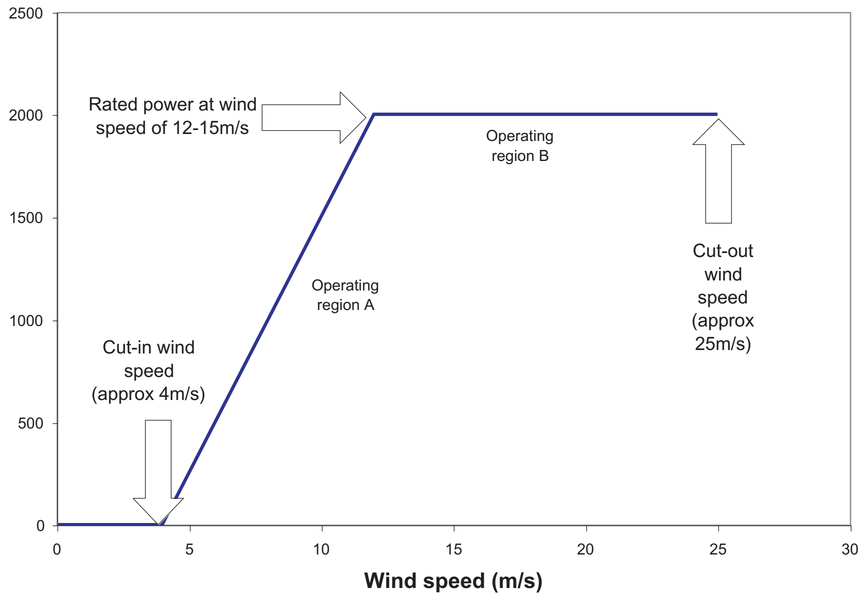
2.5 The blades are generally the largest single item that is transported to a wind farm during construction as they are manufactured in one piece, unlike the towers which are usually sectional. The blades are attached to the hub, which in turn is attached to the main shaft that drives the generator, usually but not always via a gearbox. The generator, any gear box and a yaw drive are housed within the nacelle. The yaw drive turns the rotor to face the wind. The nacelle is mounted on the tower, which for larger turbines is of tubular steel construction. Whilst there are variations on the above description, it is typical of most larger turbines currently being erected in the UK.

Figure 2: *Main components of a wind turbine*



2.6 The operating regime of a typical wind turbine is shown on figure 3 which shows the relationship between the wind speed and power output.

Figure 3: *Representation of a wind turbine operating regime*



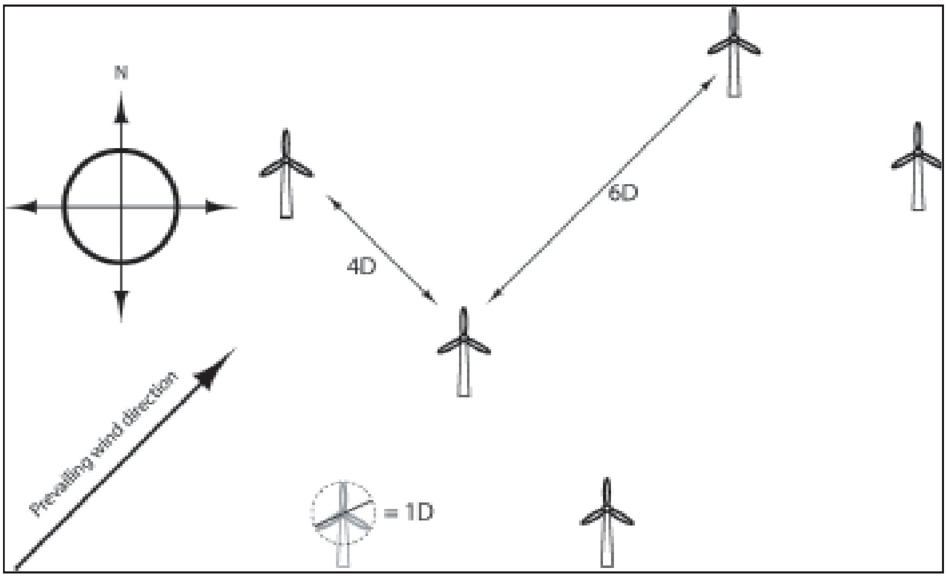
Below a certain wind speed, (the cut-in speed) there is insufficient energy in the wind for the turbine to generate electricity. Between cut-in and the rated wind speed – operating region A, the blades of the turbine will be positioned such as to capture as much energy as possible. Once the rated capacity has been reached ie within operating region B, the angle of the blades will be adjusted to limit the energy capture from the wind, such that the rated power is not exceeded. Above the cut-out wind speed the turbine must stop and park the rotor in order to protect itself. All of this is controlled by its own computer system which also continuously monitors its own performance. If atypical vibrations caused by component imbalances are detected, or if connection is lost to the electricity grid infrastructure, all turbines must undergo emergency stops.

2.7 A typical modern wind turbine in an upland location in Wales might operate for 80% of its time in operating regions A and B ie the blades are only stationary for 20% of the time.

Spacing of Turbines

2.8 Wind turbines need to be positioned so that the distance between them are around 3-10 rotor diameters (this would equate to 180-600m for a development using 60m diameter rotors, 1.3 MW turbines). This spacing represents a compromise between compactness, which minimises capital cost, and the need for adequate separations to lessen energy loss through wind shadowing from upstream machines. Figure 4 shows a possible layout for a Welsh site with a typical south westerly prevailing wind direction.

Figure 4: *Example turbine spacing in a wind farm with a South Westerly prevailing wind direction*



Other Infrastructure

2.9 In addition to wind turbines, the required infrastructure of a wind farm consists of adequate road access, on-site tracks, turbine foundations, crane hard-standings, one or more anemometer masts, a construction compound, electrical cabling and an electricity sub-station and control building. The construction compound can be removed once the development is completed. On-site tracks can often be reduced in width and crane hard-standings covered over but they must always be capable of being re-instated in order to accommodate cranes or long delivery vehicles in the case of major component failure. Anemometer masts are needed as part of the project planning and design process but they are also needed post-construction in order to provide control information. Such masts are usually 25-60m tall and are slender structures with guy support.

2.10 The concrete foundation pad for each turbine is likely to be square or hexagonal in shape and 7-20m across although the base of the tower is only likely to be 2-5m.

Connection to the Electricity Grid

2.11 Small transformers are required to change the generating voltage (likely to be 690V) to a common site voltage which is likely to be 11, 33 or 66 kV. These transformers are usually housed in the base of the turbine tower but might, particularly with smaller turbines, need a separate housing alongside. The output from the individual turbines is normally connected to a sub-station via underground cables.

2.12 Responsibility for the routing of electrical cabling onwards from the sub-station to the nearest suitable point of the electricity distribution network is the responsibility of the District Network Operator (DNO). This will be achieved either by a standard 3-wire system on wooden poles or by underground lines. It should be noted, however, that laying high voltage cables underground is usually 6-20 times more expensive than a pole-mounted system and would be likely to be justified for only limited lengths and/or in special circumstances. Whilst the routing of such lines by the DNO is usually dealt with separate to the planning application for the wind farm, developers are encouraged to provide details of likely routes.

Grid Capacity in Wales

2.13 There is currently very restricted capacity for further wind-power developments in North and Mid Wales (Scottish Power/Manweb network) and the re-enforcement of the network through the construction of new high voltage distribution and transmission lines is vital to the realisation of any significant additional generating capacity as well as providing a stronger, more reliable network for electricity users in the western mid Wales area. The Assembly Government strongly supports the principle of this scheme. The situation in south and west Wales is somewhat different with there currently being some significant spare capacity in the distribution and transmission systems that are operated by Western Power Distribution and NGT.

Noise

2.14 Well designed wind farms should be located so that increases in ambient noise levels around noise-sensitive developments are kept to acceptable levels with relation to existing background noise. This will normally be achieved through good design of the turbines and through allowing sufficient distance between the turbines and any existing noise-sensitive development. Noise levels from turbines are generally low and, under most operating conditions, it is likely that turbine noise would be completely masked by wind-generated background noise. There are two quite distinct types of noise source within a wind turbine - the mechanical noise produced by the gearbox, generator and other parts of the drive train and the aerodynamic noise produced by the passage of the blades through the air. There has been a significant reduction in mechanical noise since the early 1990's so the latest generation of wind turbines are much quieter than those first installed in Wales. Aerodynamic noise from wind turbines is generally unobtrusive – it is broad-band in nature and in this respect is similar to, for example, the noise of wind in trees.

2.15 Wind-generated background noise increases with wind speed, and at a faster rate than the turbine noise increases. The noise of the wind farm is therefore more likely to be noticeable at low wind speeds. Varying the speed of the turbines in such conditions can, if necessary, reduce the sound output from modern turbines.

2.16 The report "The Assessment and Rating of Noise from Wind Farms" (ETSU-R-97), describes a framework for the measurement of wind farm noise and gives indicative noise levels calculated to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development or adding unduly to the costs and administrative burdens on wind farm developers or planning authorities. The report presents the findings of a cross-interest Noise Working Group and makes a series of recommendations that can be regarded as relevant guidance on good practice.

Low Frequency Noise

2.17 There is no evidence that ground transmitted low frequency noise from wind turbines is at a sufficient level to be harmful to human health. A comprehensive study of vibration in the vicinity of a modern wind farm was undertaken in the UK in 1997 by ETSU for the DTI (ETSU W/13/00392/REP). Measurements were taken on site and up to 1km away – in a wide range of wind speeds and direction.

2.18 The study found that:

- Vibration levels 100m from the nearest turbine were a factor of 10 less than those recommended for human exposure in critical buildings (ie laboratories for precision measurement).
- Tones above 3.0 Hz were found to attenuate rapidly with distance - the higher frequencies attenuating at a progressively increasing rate.

Safety

2.19 Experience indicates that properly designed, erected and maintained wind turbines are a safe technology. The very few accidents that have occurred involving injury to humans have been caused by failure to observe manufacturers' and operators' instructions for the operation of the machines. There has been no example of injury to a member of the public.

2.20 The minimum desirable distance between wind turbines and occupied buildings calculated on the basis of expected noise levels and visual impact will usually be greater than that required to meet safety requirements.

Landscape and Visual Impact

2.21 See Annex D.

Ecology and Ornithology

2.22 TAN 5, Nature Conservation and Planning, gives advice that should be taken into account when considering any development of land. The development of a wind farm is often a major civil engineering project and thus there are potentially very serious implications for bio-diversity. The major ecological impacts are most likely to be associated with site infrastructure rather than the turbines themselves and the advice contained with TAN 5 should cover all aspects of the development - other than the impact of the moving blades upon birds and bats. With such extensive application sites there will very often be opportunities for developers to mitigate for any potential ecological damage and preferably enhance current wildlife habitats.

2.23 The impact of the moving blades upon birds and bats is a common concern but in most cases will not lead to significant numbers of deaths or injuries. "Bird strike" is most likely to occur if a wind turbine is erected directly in a migration path or where there are high concentrations of a particular species for feeding. Early consultations with the Countryside Council for Wales and RSPB is essential and most large sites are likely to require a breeding bird survey in the spring and a winter survey as a minimum requirement.

Archaeology

2.24 Welsh Office circular 60/96, Archaeology and Planning gives advice on issues relating to archaeology. Care should be taken to ensure that relevant procedures are followed in preparing planning submissions, dealing with applications and pre/during construction.

Proximity to Highways and Railways

2.25 It is advisable to set back all wind turbines a minimum distance, equivalent to the height of the blade tip, from the edge of any public highway (road or other public right of way) or railway line.

2.26 There is no evidence that motor vehicle accidents have been caused as a result of drivers being distracted by the movement of wind turbine blades. Wind turbines should not be treated any differently from other distractions faced by a driver.

2.27 The British Horse Society, following internal consultations, has suggested a 200m exclusion zone either side of public bridle ways in order to avoid wind turbines frightening horses. This is not a statutory requirement and the circumstances pertaining at any particular site should be taken into account.

Proximity to Power Lines

2.28 Wind Turbines should be separated from overhead power lines in accordance with the Electricity Council Standard 44-8 "Overhead Line Clearances".

Electromagnetic Production and Interference

2.29 A wind turbine can interfere with the electromagnetic transmission in two ways – by emitting an electromagnetic signal itself, and by interfering with other electromagnetic signals. The very low level of electromagnetic radiation produced by the turbine itself poses no greater threat to health than do most domestic appliances.

2.30 Provided careful attention is paid to siting, wind turbines should not cause any significant adverse effects on communication systems which use electromagnetic waves as the transmission medium (eg television, radio and microwave links). Specialist organisations responsible for the operation of the electromagnetic links typically require a 100m clearance either side of a line of sight link from the swept area of turbine blades, though individual consultations would be necessary to identify each organisation's safeguarding distance.

2.31 The Office of Communications (OFCOM) holds a central register of all civil radio communications operators in the UK and acts as a central point of contact for identifying specific consultees relevant to a site. Applicants and local planning authorities cannot rely wholly upon the OFCOM consultations and are also advised to contact those organisations listed at the end of this section. It may also be necessary to consult the local utility companies and emergency services.

Shadow Flicker and Reflected Light

2.32 Under particular circumstances the sun may pass behind the rotors of a wind turbine and cast a shadow over neighbouring properties. The shadow flicks on and off as the blades rotate. This can be disturbing for the affected residents or even have the potential of being a health problem for people who are photo-sensitive epileptics. The problem is seasonal and only lasts for a few hours per day, but needs to be investigated where any potential exists. Developers should provide an analysis of the potential for shadow flicker impacting upon any nearby properties.

2.33 Turbines can also cause flashes of reflected light, which can be visible for some distance. It is possible to ameliorate the flashing but it is not possible to eliminate it. Careful choice of blade colour and surface finish can help reduce the effect. See "The Influence of Colour on the Aesthetics of Wind Turbine Generators" – ETSU W/14/00533/00/00 for detailed advice.

Icing

2.34 The build-up of ice on turbine blades is unlikely to present problems on the majority of sites in Wales. Even where icing does occur the turbines' own vibration sensors are likely to detect the imbalance and inhibit the operation of the machines.

Protecting Aviation Interests

2.35 Developments within a specified radius of major airports and aerodromes are subject to mandatory consultation with the Civil Aviation Authority (CAA) and/or the Ministry of Defence (MoD) under the Town and Country Planning (Aerodromes and Technical Sites) Directive 1992. The CAA will inform the applicant of any civilian airfields that are likely to be affected, but it is the responsibility of the applicant/planning authority to consult the airfield management at the airfield in question.

2.36 Lights are only required on structures that are over 150m high. There are currently no turbines of this height in the UK.

2.37 The MoD uses a large tract of Mid Wales for low flying training and consultation with the Ministry will be required for any proposals lying within what is known as the Tactical Training Area.

2.38 Any large structure is liable to show up on radar, but wind turbines can present a particular problem as they can be interpreted by radar as a moving object, which is only intermittently seen (as the nacelle rotates to face the wind). There is a consultation zone and an advisory zone around every civilian and military air traffic radar but objections may sometimes be raised in respect of developments further afield. Consultations are also required in respect of other defence and meteorological radar. Developers will need to closely consult over aviation and other radar issues and the British Wind Energy Association web site gives details of how this can be achieved. Local planning authorities should be aware of the statutory consultees applicable to their particular area. Preliminary discussions with the National Air Traffic Service have indicated that there are no significant problems likely for wind farm development in the SSAs.

2.39 Consultees (in addition to statutory consultees)

Ministry of Defence: Defence Estates, Kingston Road, Sutton Coldfield, West Midlands, B75 7RL.

Civil Aviation Authority: Directorate of Airspace Policy, CAA House, 45-49 Kingsway, London, WC2B 6TE.

National Air Traffic Services: Navigation, Spectrum and Surveillance, Spectrum House, Gatwick, West Sussex, RH6 0LG.

OFCOM: Wind Farm Site Clearances, Operations-Licensing, Desk 02-49, Ofcom, Riverside House, 2a Southwark Bridge Road, London, SE1 9HA.

BT Wholesale, Radio Solutions Unit: Post Point 500, Angel Centre, 403 St John Street, London, EC1V 4PL.

BBC: BBC Research Dept, Spectrum Planning, Kingswood Warren, Tadworth, Surrey, KT20 6NP.

NTL: Crawley Court, Winchester, Hampshire, SO21 2QA.

Orange: St James Court, Great Park Road, Almondsbury, Bristol, BS32 4QJ.

Cable and Wireless: 49 Waterside House, Longshot Lane, Bracknell, RG12 1XL.

T-Mobile UK: Hatfield Business Park, Hatfield, Herts, AL10 9BW.

O2: Acquisition Development Group, The Stafford Taylor Building A, 1 Leeds City Office Park, Meadow Lane, Leeds, LS11 5BD.

Crown Castle UK: PO Box 98, Warwick, CV34 6TN.

Joint Radio Company: Suite 108, The Blackfriars Foundry, 156 Blackfriars Road, London, SE1 8EN.

CSS Spectrum Management Services Ltd: Canvin Court, Somerton Business Park, Somerton, Somerset TA11 6SB.

2.40 For coastal or marine sites:

Trinity House: Engineering Dept, Trinity House Depot, East Cowes, Isle of Wight, PO32 6RE.

Department of Transport: Marine Directorate Navigation and Communication, Official Post Branch, Room 653, Sunley House, 90-93 High Holborn, London,WC1V 6LP.

Maritime and Coastguard Agency: Bay 2/25, Spring Place, 105 Commercial Road, Southampton, SO15 1EG.

3. Woodfuel

3.1 Small diameter timber, largely from conifer plantations, is a fuel source that is readily and currently available. Thinning and felling operations will produce some timber that is too small in diameter for construction purposes but suitable for paper manufacture, fencing stakes/posts, raw product for fibre board or woodfuel. Forestry Commission Wales has established the Wood Energy Business Scheme (WEBS) that utilises EU Objective 1 and 2 funding and seeks to support small and medium sized enterprises to become established and expand into the provision of energy from woodfuel.

3.2 Willow and poplar species grown and harvested under a short-rotation coppice regime produce very good yields and this is probably the most likely system for the production of specifically grown woodfuel in the near future. These crops would supplement the existing timber resource.

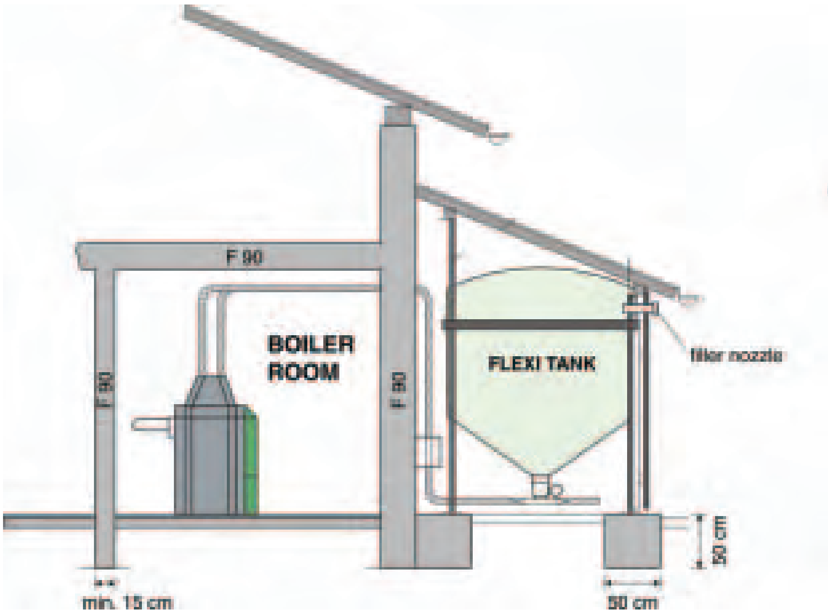
3.3 The technologies involved in combusting small diameter timber in an automated plant usually involve an initial chipping or shredding process. The comminuted timber may then be burnt directly or put through a gasification or pyrolysis process first. For domestic and smaller scale systems, pelletised wood waste may be an alternative and attractive option.

3.4 Gasification and pyrolysis technologies convert the timber into combustible gas or oil, which can then be used to fuel an engine providing power and heat. Technological improvements in engines, gas and steam turbines have, and will, probably, continue to increase the range over which electricity from woodfuel and other biomass crops can be generated practically and economically. It is the availability of fuel at a reasonable distance from the plant, rather than the available technology that is likely to limit electricity generation units to little more than 10MW in the next decade or so. With this scale of operation there should be an expectation that waste heat from any electricity generation scheme should be productively used. The emissions even from larger plant should be of such a limited impact as to allow siting on the edge of, or within, an urban area. The scale of the development and the anticipated impacts are such that only rarely will EIA be required. It is clearly critical that adequate consideration is given to likely sources of fuel and the impacts associated with the necessary vehicle movements. There are no examples of larger scale electricity generation from woodfuel yet in the UK other than co-firing at existing coal-fired power stations.

3.5 By far the most common form of woodfuel system will deliver heat only. Log stoves are already reasonably common in rural areas. Automated stove and boiler systems are available with logs, wood chips or pellets as their feedstock. Wood pellets are manufactured from clean dry wood waste and represent a convenient and easy fuel to use. The only current manufacturing facility in Wales is at Bridgend. Wood pellets represent a particularly clean fuel that will be burnt to a very high level efficiency in modern boiler systems. Woodchip is likely to have a much higher moisture content than pellets and the emissions are therefore likely to be much more visible due to steam content, particularly during start-up, but modern boilers are very efficient and emissions should not represent any sort of pollution or amenity problem.

3.6 Even domestic scale woodfuel installations will usually require quite large fuel storage facilities. Fuel bunkers in small extensions or outbuildings will often be required. These might well constitute permitted development. The fuel storage facility for a large woodchip boiler heating large or multiple buildings could be quite extensive . It will sometimes be more appropriate to have a relatively small fuel store next to the boiler but frequent deliveries from a larger store or fuel supplier. Where there is a choice, local planning authorities might wish to consider the balance of advantages and steer a developer in a particular direction.

***Figure 5:** Woodfuel. One possible layout for a domestic wood pellet boiler installation. A textile "flexi-tank" fuel store housed within a lean-to extension*



(Source: Okofen Ltd)

4. Other Fuel Crops

4.1 It is possible that other crops (*Miscanthus* spp. (a tropical grass) for example) will be grown specifically for electricity or heat generation systems but these will be less important than timber in the short term. It is also possible that solid biofuels, particularly agricultural wastes or by-products, may be used. The planning implications of the processing and combustion plant are similar to those described under "woodfuel" and the utilisation of land currently in agricultural or forestry use for the growing of fuel crops does not require planning consent. It is also possible that agricultural crops will be utilised to manufacture vehicle fuels.

5. "Co-Firing" of biomass at Existing Fossil Fuel Power Stations

5.1 Under current arrangements for the Renewables Obligation the co-firing of biomass with fossil fuels at established power stations is eligible for renewable obligation certificates on a phased basis until the 31st March 2016. From the 1st April 2009 25% of the biomass product must come from energy crops and this proportion increases to 50% in April 2010 and to 75% from April 2011 until the termination of the eligibility of co-firing from ROCs on 31st March 2016. It is likely that co-firing with woodfuel and other biomass will occur at Welsh coal-fired power stations.

6. Utilising Methane

6.1 Methane is a powerful greenhouse gas (approximately 20 times more effective than carbon dioxide) but it is also an excellent fuel. Utilising methane that is produced naturally when bacteria decompose organic waste in the absence of oxygen (anaerobically) is often of considerable value in environmental protection terms. At landfill sites for instance, methane is usually the main gas that arises through the anaerobic decomposition process. Although methane itself is odourless, landfill gas is often offensive in smell and in public health and amenity terms as well as climate change considerations, it is highly desirable that it is burnt at high temperature. That burning either occurs in a flare where the energy is simply wasted or it is utilised as a fuel, usually in an engine that is used to generate electricity. Whilst landfill gas is not considered to truly constitute renewable energy, it is eligible for Renewable Obligation Certificates and it is very much encouraged where feasible. It is not, of course, a justification for poor waste management practice but should be utilised where landfill gas is being produced and needs to be burnt.

Figure 6: *Generator utilising landfill gas*

(Source: Evans Logistics Ltd)

6.2 Methane is present within coal seams and this is capable of being safely removed from underground mines and used for electricity/heat generation. Methane extracted from Tower Colliery working areas is productively used for energy generation. There are, however, also significant opportunities for pumping of methane out of coal beds that are not necessarily being worked. Whilst this gas would not be seen as being a renewable resource, it may well be of significant environmental benefit to productively utilise it if the alternative is that it is likely to find its way into the atmosphere through cracks and fissures.

7. Anaerobic Digestion (Biogas)

7.1 Animal wastes and/or vegetable matter can be deliberately decomposed or fermented under anaerobic conditions in order to produce methane, or possibly, in the future, hydrogen. This technology has a potentially wide range of applications with human and animal wastes being the most common feedstock to date but food wastes from kitchens and restaurants are likely to feature in the near future. The outputs from an anaerobic digester are gas – utilised as a fuel for heating, electricity production and/or vehicles, liquids – an excellent agricultural fertiliser, and a solid fraction – that can sometimes be used as a soil conditioner. Up to 60% of the digestible solids are converted to biogas.

7.2 The digestion process takes place in a sealed airless container (the digester) and needs to be warmed and mixed thoroughly to create the ideal conditions for the bacteria to convert the complex organic molecules into biogas. There are two types of AD process:

- Mesophilic digestion. The digester is heated to 30-35^0 C and the feedstock remains in the digester typically for 15-35 days. Mesophilic digestion tends to be more robust and tolerant than the thermophilic process, but gas production is less. Larger digestion tanks are required and sterilisation, if required, is a separate process stage.
- Thermophilic digestion. The digester is heated to 55^{0}C and the residence time is typically for 12-14 days. Thermophilic digestion systems offer higher methane production, faster throughput, and better pathogen "kill", but require more expensive technology, greater energy input and a higher degree of operational skill and monitoring.

7.3 A typical AD plant will comprise waste pre-treatment equipment, digester tank or tanks, buildings to house ancillary equipment such as a generator, a biogas storage tank, a flare stack and associated pipework. If municipal waste is the feedstock then the pre-treatment equipment will separate organic from inorganic waste but the strong preference in Wales is for source segregated waste only to be used.

Figure 7: *Combined heat and power generator utilising biogas at a sewage treatment works*

(Source: Dwr Cymru/Welsh Water Ltd)

7.4 The planning implications will vary tremendously between individual proposals, depending upon the scale of operations and the type and source/s of feedstock. Locational requirements will be similarly varied although, in some cases, such as those associated with sewage treatment plants, they will be tied to particular sites.

8. Solar Photo-Voltaic (PV)

8.1 PV systems exploit the direct conversion of daylight into electricity in a semi-conductor device with the most common form being a number of semi conductor cells which are interconnected and encapsulated to form a solar panel or module. There is considerable variation in appearance, but many solar modules are dark in colour and have low reflective properties. Solar modules are typically 0.5 to 1 sq m with a peak electrical output of 70 to 160 watts. A number of modules are usually connected together in an array, the area of which can vary from a few sq metres to several hundred sq metres. A typical array on a domestic property might have an area of 9 to 18 sq m, and would produce 1 to 2 kW peak output. In most cases such arrays are mounted on a roof either on a low support structure above the existing roof or integrated into it (ie replacing the conventional roofing material).

Figure 8: *PV array retro-fitted to office complex*

(Source: Powys County Council)

8.2 Other forms of solar PV technology are becoming more common in the UK, such as solar tiles/slates, which can be integrated into new buildings or refurbishments alongside conventional roofing products. They are designed to be similar in appearance to the conventional tiles and slates and undertake the same water-proofing role as well as generating electricity.

Figure 9: *PV roof tiles*

(Source: Dulas Ltd and Marley Ltd)

8.3 For best performance, PV modules need to be inclined at an angle of approximately 35 degrees and orientated to face due south. In practice the array is usually at the inclination of the roof and situated on the roof slope closest to south. This is clearly at the expense of optimum performance but the panels will perform reasonably well at an inclination of between 10 and 60 degrees and an orientation within 90 degrees of south.

8.4 Modules can also be mounted on the sides of buildings, or on free-standing support structures on the ground. In some cases, particularly on institutional or commercial buildings, PV wall cladding can be an architectural feature, water-proof skin and a supply of electricity. Other building integrated uses include sun shading for office windows (bris-solaires) and atrium roofs.

9. Solar Thermal

9.1 Solar thermal is a proven technology capable of providing significant environmental benefits through the displacement of fossil fuels. Most buildings in Wales are suitable for solar thermal and installations can make a valuable contribution to the hot water demands of homes, hospitals and a wide range of other buildings. Solar water heating can be an ideal companion to other renewable technologies such as woodfuel heating or photovoltaics. Solar collectors, commonly referred to as "solar panels", adsorb solar radiation and transfer thermal energy to a useful application – usually a hot water store. A typical domestic system will utilise a solar collector mounted on a south facing roof of the house or ancillary building in order to pre-heat water for use in the home. Whilst there are solar thermal systems designed to heat air and aid ventilation it is currently unusual for solar thermal to contribute to space heating in the UK.

9.2 There are two main types of solar thermal collector in the UK:

- Flat Plate collectors comprise a water filled metal "envelope" with a black coating which improves absorption of solar energy and heat transfer. This is housed in a glazed, insulated box and is connected to the hot water system of the building in a similar way to a conventional boiler, usually using an indirect coil in the hot water cylinder. Water is circulated through the system when the temperature of the collector is at least a few degrees higher than the water around the coil in the hot water tank.

***Figure 10:** Flat-plate solar collectors*

(Source: Awel Aman Tawe)

- Evacuated tube collectors comprise a number of vacuum tubes, typically around 100mm in diameter, and 2 metres in length containing a finned metal collector tube. Each tube is filled with a heat transfer fluid and the upper ends of individual tubes are connected to a manifold heat exchanger, which is connected to the hot water system of the building as in the case of flat plate collectors.

Figure 11: *Evacuated tube collectors that have had to be sited other than on the roof in order to face south*

(Source: Welsh Assembly Government)

10. Hydro-Power

10.1 The technology for harnessing waterpower is well established. Water flowing from a higher to a lower level is used to drive a turbine, which produces mechanical energy. This mechanical energy is usually turned into electrical energy by a generator, or more rarely to drive a useful mechanical device.

10.2 The energy produced is directly proportional to the volume of water and the vertical distance through which it falls. The majority of schemes will be “run of river” where water is taken from a river from behind a low weir, with no facility for water storage, and returned to the same watercourse after passing through the turbine. There is some limited potential to install small turbines at existing reservoirs in Wales.

10.3 Pumped storage schemes utilise off-peak electricity to pump water from a low level to a higher level reservoir in order that it can be released into the hydro system when peaks in electricity demand need to be satisfied. The major schemes in Wales have thus far utilised base load conventional electricity production as their source of off-peak electricity but the same principles could be used to store intermittent renewable electricity production.

10.4 The essential elements of a run of river hydro scheme are:-

- A source of water that will provide a reasonably constant supply. Sufficient depth of water is required at the point of abstraction and this is achieved by building a low weir (typically around 2m high) across the watercourse. This is known as the “intake”.

- A pipeline, often known as a penstock, to connect the intake to the turbine.
- A building housing the turbine, generator and ancillary equipment.
- A "tailrace" returning the water to the watercourse, and
- A link to the electricity network or the user's premises.

10.5 The intake comprises a concrete or stone weir that incorporates a spillway that ensures that the downstream watercourse is never deprived of some flow. A screen or trashrack prevents floating debris or fish from entering the pipeline.

Figure 12: *Intake weir on small run-of-river hydro scheme*

(Source: Ecodyfi and Dulas Ltd)

10.6 The visual impacts of the scheme itself is likely to be limited and not particularly difficult to predict but there will be occasions that the absence of water from a particular length of river may be significant in landscape terms – where there are rapids or waterfalls for instance

10.7 The most likely source of concern from a hydro scheme relates to ecological issues and this appears to be particularly true of the clean mountain streams of Wales with their associated ecosystems. The impacts of water abstraction upon, for instance, communities of bryophytes, is currently being researched in order that the issue be better understood. The developers of all proposed schemes and the LPA will need to liase closely with the Environment Agency and the Countryside Council for Wales for almost all applications in Wales.

10.8 Migratory fish may sometimes be an issue but this can usually be resolved through the incorporation of appropriate passes. Adverse ecological impacts arising out of the laying of the pipeline may well also need to be carefully controlled and monitored.

10.9 The noise of the turbine will generally be well contained within the turbine house and it would rarely be an issue.

Figure 13: *Turbine house on hydro scheme at Figure 12*

(Source: Ecodyfi and Dulas Ltd)

11. Tidal and Wave Energy

11.1 There is potential for extracting energy from tidal flows and waves. The notion of constructing a tidal barrage across the Severn Estuary was first debated many years ago and such a scheme has never been ruled out in the long term. The capital cost of such a scheme would be large and the environmental impacts, both positive and negative, would be very significant. Alternatives in theory to a barrage across an estuary could be huge enclosures (tidal lagoons) out at sea. Energy would be captured as the tides fill and empty the enclosure.

11.2 Trials are underway for the development of underwater tidal stream turbines (not forming part of a barrage or other enclosure) to extract energy from tidal flows and this technology appears to raise fewer environmental issues than the barrage type options. The electricity generating potential of such schemes may be very large but, as with any marine operations, the engineering challenges associated with developing this technology to its full potential are significant and LPAs should not rely upon it to provide any significant contribution to 2010 renewable energy targets.

11.3 Wave power machines also lie within the category of developments that show great promise but, as with tidal stream technologies, cannot be relied upon to deliver very significant contributions to the nation's power supply by 2010.

12. Heat Pumps

12.1 Heat pumps are able to extract heat from soil, rock, air or water by a process that is similar to the operation of a refrigerator. The heat source could be a large area of ground or a river, stream, lake, the sea or body of groundwater. They require electricity from another source to operate but will extract much more energy than is input. There are occasions when heat pumps are an appropriate carbon saving technology but applications need to be carefully selected. Heat pumps work best where heat can be applied evenly and consistently (eg underfloor heating systems).

***Figure 14:** Domestic heat pump arrangement with buffer tank*

(Source: John Cantor Heat Pumps Ltd)

12.2 Heat pump technology has been utilised to extract energy from water that accumulates in abandoned coal mines, sometimes under circumstances where the water has to be pumped to the surface for safety reasons. There may well be significant opportunities of this sort in Wales and these should be investigated further.

12.3 Although heat pumps may well provide excellent opportunities for carbon reduction programmes in Wales, there are unlikely to be significant implications for planning policy or development control. The most significant opportunities would probably come in combination with community heating networks installed as part of new residential or mixed use developments.

13 Geothermal

13.1 Energy is sometimes practically and economically available from natural sources of heat from below the Earth's crust. Whilst common-place in some parts of the world (there are well-known examples in Iceland and New Zealand) this opportunity is certainly less obvious in the UK. There are no significant geothermal energy plants in Wales at present and it is likely that any such plant in the future would involve drilling to some considerable depth if high temperatures are to be reached.

13.2 The possibilities in the longer-term should not be ignored.

14. Energy from Waste

14.1 The Renewables Obligation 2002 states that only electricity derived from "biomass" will be eligible for Renewable Obligation Certificates (ROCs). "Biomass" is defined here as a fuel of which at least 98% of the energy content is derived from plant or animal matter or substances derived directly or indirectly therefrom (whether or not such matter or substances are waste) and includes agricultural, forestry or wood wastes or residues, sewage and energy crops.

14.2 A generating station which is fired wholly or partly from waste is excluded from receiving ROCs unless:

- The only fuel is biomass in accordance with the above definition; or
- Advanced conversion technologies (eg pyrolysis and gasification) are used to produce a fuel gas, in which case ROCs can be claimed for the biomass fraction of the fuel.

The Renewables Obligation is currently under review.

14.3 The Assembly Government considers that a plant to recover energy from waste is acceptable only if:

- It forms part of an integrated approach and that it only recovers energy from residual waste that remains after as much recyclable and compostable material as practically possible has been removed;
- The need for it has been established as part of the development of the Municipal Waste Management Strategy and/or Regional Waste Plan which has been consulted upon with local communities at an early stage when all options can be considered;
- It represents the Best Practical Environmental Option for residual waste, taking into account transportation;
- It has been designed so as not to inhibit increasing recycling and composting rates at a later date (in expectation that the Assembly Government increases the targets further);
- It includes combined heat and power wherever practicable.

15. Combined Heat and Power

15.1 Where electricity is produced through thermal processes the efficiency of conversion is often only something like 35% ie 65% of the energy input is wasted through heat that is released into the atmosphere or a body of water. Combined heat and power plant allow that "waste" heat to be put to valuable use thus providing an opportunity for significant savings in carbon emissions and increased efficiencies. Such plant clearly needs to be carefully sited adjacent to a suitably matched heat load but CHP technology, for gas in particular, exists at a huge variety of scales. CHP units are now available down to the scale of the individual home and have been appropriate to locations such as public swimming pools for a number of years. The planning system can do much to assist in the feasibility of larger CHP systems by planning for community heating (see below).

16. Community (or District) Heating

16.1 The most efficient way of utilising renewable heating fuels (eg woodchips) is utilising one or more centralised boilers and a heat distribution network. This might be in a block of flats, a hospital complex or perhaps an estate of houses or small community. The ideal heat-load for a community heating network would include a variety of users with a good spread of demand throughout the day and week. A combination of residential, leisure and commercial/industrial users would be excellent. Such networks can also provide energy for cooling and this is a valuable summer load displacing energy intensive alternatives.

17. Bio-Fuels for Vehicles

17.1 The energy used for transportation purposes is not only very significant in terms of carbon emissions, very little of it currently comes from any source other than mineral oil derived products. The Bio-Fuels Directive of the European Union has set targets for the use of such transport fuels and products such as bio-diesel will be produced at very different scales. At one level bio-diesel is already produced from used vegetable oil in relatively small industrial units. This process produces no significant emissions, including noise and can fit perfectly well with into a standard industrial location.

18. Hydrogen

18.1 There is considerable research and development activity based upon the potential of hydrogen as a transport fuel. If there were to be a break-through in fuel cell technology the demand for hydrogen from non-carbon sources would be likely to be very significant, particularly as a transport fuel. It can be produced by various means including biological and electrolytic processes.

19. Passive Solar Design

19.1 The objective in passive solar design (PSD) is to maximise solar heat and light by using simple design approaches which intentionally enable buildings to function more effectively and provide a comfortable environment for living or working. Not all aspects of PSD are of direct concern to Development Control, for example the use of dense materials to store heat and the details of internal layout and use of natural ventilation.

19.2 An important distinction must be drawn between the use of PSD in housing and commercial buildings. In housing, the primary objectives are the capture of light and heat. In the case of commercial buildings light is also important but generally excess heat is a problem during periods of high solar gain, making the main purpose of PSD the removal of excess heat whilst avoiding the use of air conditioning.

19.3 The key issues to taken into account in PSD are:-

- Orientation. Solar gain will be maximised by orientating the main glazed elevation of a building within 30 degrees of south. Orientation is important for housing and schools, which can make effective use of solar heating and lighting. Using dense materials in construction will enable the building to absorb heat during the day and release it slowly at night.
- Room layout. Placing rooms used for living and working in the south facing part of the building, and locating storage, kitchens, bathrooms, toilets, stairways and the main entrance on the north side will make most effective use of solar heat and light.
- Avoidance of overshadowing. Careful spacing of buildings should seek to minimise overshadowing of southern elevations, particularly during the winter when the sun is low. On sloping and wooded sites careful consideration must be given to siting in order to maximise solar gain.
- Window sizing and position. In housing, smaller windows should generally be used in north facing elevations. On the south elevation whilst larger windows increase solar gain this has to be weighed against greater heat losses in the winter and a risk of overheating in the summer. Sloping roof lights facing the sun will increase the solar radiation received. The greatest emphasis should be in reducing to a minimum the area of glazing in north elevations.
- Conservatories and Atria. Carefully designed conservatories and atria can contribute to the management of solar heat and ventilation. To avoid problems of excessive heat gains and losses they should be designed and used as intermediate spaces located between the building and the external environment. They can be designed to assist natural ventilation in the summer by drawing hot air upward to roof vents. During the spring and autumn they are valuable heat collectors but the net thermal benefits of conservatories will however be lost if they are heated for use during the winter.
- Natural Ventilation. Atria and internal ventilation stacks can be used to naturally vent offices, schools and similar buildings. Technologies that avoid the need for air conditioning should be encouraged – air conditioning units account for significant electricity use in the summer.
- Lighting. In offices and similar buildings, the avoidance of deep-plan internal layouts and the use of atria, roof lights, reflective solar tubes (eg “Sunpipes”) and reflecting surfaces can help reduce the need for artificial lighting.
- Landscaping. Landscaping measures, including the use of earth bunds, is often used as part of an overall PSD approach providing a buffer against prevailing cold winds and shading for summer cooling.

19.4 It is probably the housing sector that provides the greatest potential for energy capture and saving through PSD and residential developments should be planned to permit good solar access to as many dwellings as possible. This clearly necessitates careful design of the overall layout in order to integrate the principles outlined above.

20. Microgeneration

20.1 Microgeneration refers to the ability to generate heat and electricity on a small scale (houses, small commercial premises) at the point of use. The Energy Act 2004 defines microgeneration as methods of generating heat (under 45Kw) and electricity (under 50Kw) that reduce carbon emissions.

20.2 Microgeneration technologies comprise air source heat pumps, ground source heat pumps, fuel cells, micro-CHP, micro-hydro, micro-wind, biomass and solar thermal. As part of its Sustainable Development duty, the Assembly Government is committed to encouraging the development of an indigenous microgeneration renewables industry in Wales, with particular focus on opportunities for small and medium sized enterprises. An Action Plan for the use of microgeneration technologies in Wales will be developed by summer 2006.

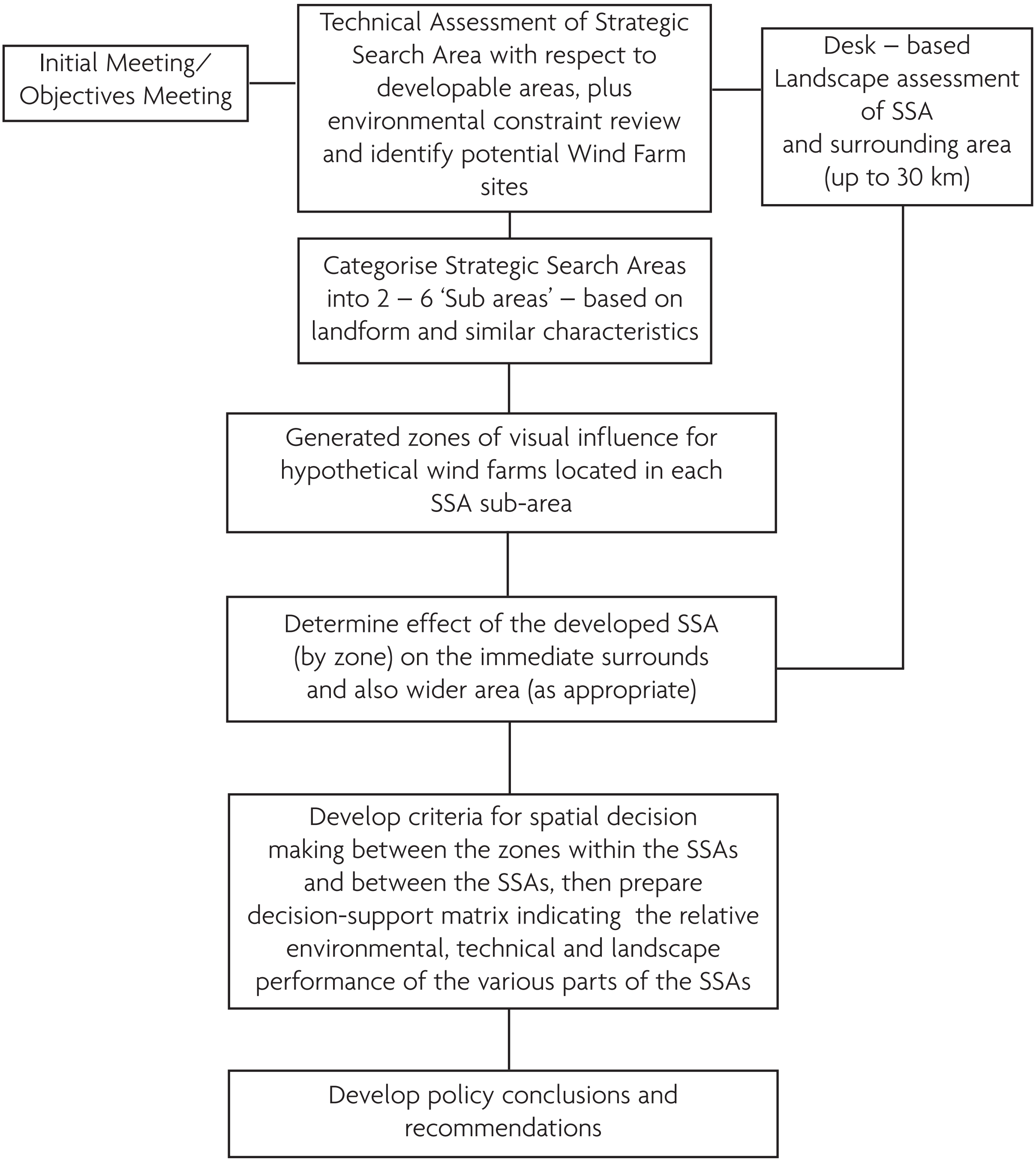
20.3 The update of microgeneration will also be facilitated by an internet Portal that will guide users to relevant advice and services in Wales. This will be available from summer 2005 at www.energysavingswales.org.uk.

Annex D

Potential Methodology for Local Planning Authorities with Strategic Search Areas (excerpts from Review of Final Report, Arup 2005)

1. Introduction

1.1 A typical approach for undertaking a local authority-led study of any of the Strategic Search Areas is set out in the flow chart below and is described in the sections which follow.



1.2 The purpose of the local planning exercise is to achieve a finer grain of development allocation within the SSA, taking into account landscape, visual and cumulative impacts. It is not intended for use in the negotiation of the SSA capacities indicated in the Final TAN 8; since this would risk the achievement of renewable energy target delivery.

1.3 It is anticipated, however, that the Final TAN 8 will allow the local planning authorities to make minor adjustments to the SSA boundaries when translated into their local planning documents. This will facilitate the inclusion of development on the margins of SSAs where local conditions recommend.

2. Study Area

Visual/landscape and cumulative issues

2.1 An overall study area of some 40km radius, from the centre of each SSA is recommended, to allow consideration of cumulative landscape and visual issues associated with development in the SSA and existing or proposed wind turbines in the wider area.

Technically feasible areas

2.2 An overall study area of some 5km radius from the margins of each SSA is recommended to allow consideration of technically feasible areas for possible wind turbines.

3. Identify "technically feasible areas"

3.1 The following factors should typically be reviewed for the study in order to identify "technically feasible areas" for the development of onshore wind energy schemes, broadly in the order outlined below.

Wind speed/topography

3.2 Using the NOABL[21] dataset, the distribution of existing wind speeds across the area should be determined. Areas with wind speeds greater or equal to 7ms-1 at 35m above ground level should be considered suitable for taking forward for further analysis. It should be noted however that whilst the distribution of such wind speeds is typically the starting point for developers, some flexibility should be allowed as detailed wind resource modelling would be undertaken of the SSAs by most developers which inevitably will show slightly different results to the NOABL data.

3.3 A digital terrain model should be used to identify those areas with slopes steeper than 15 degrees; these should be also eliminated.

[21]**NOABL -UK Wind Speed Database -Background Information** -The data is the result of an air flow model that estimates the effect of topography on wind speed. There is no allowance for the effect of local thermally driven winds such as sea breezes or mountain/valley breezes. The model has a 1km square resolution and takes no account of topography on a small scale or local surface roughness (such as tall crops, stone walls, or trees), both of which may have a considerable effect on the wind speed. The data can only be used as a guide and should be followed by on-site measurements for a proper assessment. Each value stored in the database is the estimated average for a 1km square at either 10m, 25m or 45m above ground level (agl). Available via www.britishwindenergy.co.uk)

Proximity to residential dwellings

3.4 Using a Geographic information system established for the project, Ordnance Survey Address –point data should be loaded and displayed for the Strategic Area. Address-point allows the display of any dwelling that currently has a postcode. The data should be buffered by 500 (i.e. a 500 m radius drawn). 500m is currently considered a typical separation distance between a wind turbine and residential property to avoid unacceptable noise impacts, however when applied in a rigid manner it can lead to conservative results and so some flexibility is again advised.

Cultural Heritage

3.5 Digital data representing the locations of scheduled ancient monuments (SAM) should be used. SAMs are represented by point features in the available dataset from Cadw; consultation should therefore be undertaken with the local Archaeological trust if any archaeological features appear to present a particular constraint to any one site.

Land ownership/Forestry

3.6 The extent of land in the holdings of the Forestry Commission (FC) or other landowners should be determined via Ordnance survey data or via consultation. A copy of the Design Management plan for the FC estates in the area could be obtained and opportunities explored for the phasing and development of wind turbines in and around forestry clearance operations. If other information is not available the study should assume only 25-50% at maximum of the afforested areas would be available for wind energy development over the next 5 years due to operation and environmental constraints

Existing wind turbines and consented developments

3.7 The locations of existing wind turbines/wind turbines within the study area should be mapped, together with locations of consented developments and those proposals currently within the planning system.

4. Review of environmental and landscape constraints/factors

4.1 The TAN 8 research and strategic sieve process should have ensured that the SSA is free of a range of International and National environmental constraints. This next exercise should consider a range of environmental data not considered/considered in detail as part of the TAN 8 research, namely local and ecological factors.

Nature conservation

4.2 In liaison with the County Wildlife officer, all statutory and non-statutory nature conservation sites should be mapped (and/or digitised for the area if required). Consultation should be undertaken with Countryside Council for Wales and the RSPB and relevant factors noted.

Landscape character and value

4.3 The landscape value of an area is an important criterion in judging its suitability for wind turbines development. It is a factor that applies to a particular area rather than a generic landscape type.

4.4 Existing information available on the landscape value within the SSA and its surroundings should be collated and mapped. Consultation should be undertaken with the county landscape officers and any existing LANDMAP information obtained and reviewed. If possible, GIS data for the LANDMAP aspect layers should be mapped. Historic Landscape data from the CADW Registers of Landscapes of Special/Outstanding Interest in Wales should also be obtained and mapped.

4.5 For each existing LANDMAP aspect or character area the criteria of the influence and presence of other conservation interests such special cultural associations, perceptual landscape characteristics such as tranquillity, wildness, sense of remoteness, scenic beauty and the existence of a consensus about importance, either nationally or locally should be applied. These judgements should be kept separate from the more objective criteria of landscape and visual sensitivity (considered below) to present a more transparent assessment.

5. Classify areas within the SSA

5.1 The SSAs should be reviewed for major areas with similar landform characteristics and sub-aread accordingly. Between 5 and 10 sub-areas per SSA is likely to be a sensible maximum. Any sub-areas not including a "technically feasible area" could be discounted from further analysis.

6. Cumulative landscape and visual assessment (supplemental information at item 8)

6.1 The potential for cumulative landscape and visual effects is recognised as a matter to be included in Environmental Impact Assessment under the terms of the EIA regulations 1999. Consideration of cumulative and synergistic effects is also a requirement under the Strategic Environmental Assessment Directive which is required for development plans.

6.2 A cumulative landscape and visual impact assessment (CLVIA) will normally form part of an Environmental Statement for wind turbine proposals. Good practice guidance on how to undertake such as assessments is available (such as a recent publication by Scottish Natural Heritage[22]). Expertise of such assessments is now also well established amongst developers and their consultants within the UK. However, development-specific assessments are unlikely to consider the effects of a fully developed SSA. In particular:

a) it would be unreasonable for a developer to consider the effects of other wind turbines within those (as yet) undeveloped parts of an SSA and,

[22]Appendix 5 - Guidance on the cumulative effect of wind farms (2005), Scottish Natural Heritage

b) taken in isolation, developer-specific CLVIAs are unlikely to provide the objective data to allow the local planning authority to consider which parts of an SSA can best be developed whilst minimising landscape change.

6.3 In order that cumulative landscape and visual issues are appropriately assessed, the SSA and its immediate surroundings should be subjected to a more detailed landscape value and visual sensitivity assessment. The assessment should consider all landscape aspect/character areas adjacent (or likely to be influenced by) development in a technically feasible area.

Visibility Analysis

6.4 The visibility assessment should be computer based, using a Geographical Information System (GIS) and an Ordnance Survey Digital Elevation model. The analysis should have two several separate but interlinked elements:-

- The relative visibility from outside the SSA of the different sub-areas within the SSA. The inter-visibility of the area within a 20-30km radius should be mapped using a GIS. The visibility information should be prepared for the likely size of wind turbines rather than be undertaken at ground level; wind turbines of a minimum of 110m in height should be assumed. The visibility of existing and consented proposals should also be considered and mapped.
- The identification of landscape and visual sensitive receptors, typically key viewing points from which visibility of wind turbines will be assessed e.g. roads, National Trails, National Parks/AONBs, areas of settlement, key viewing points or visitor sites. Typically 6 view points would be used, the locations for which would be agreed in conjunction with the appropriate local authority officers.

Landscape and visual sensitivity assessment

6.5 A landscape and visual sensitivity assessment should be undertaken of the SSA, its immediate environs and the sub-areas within the SSA. Landscape sensitivity criteria which are particularly relevant to wind turbine development include landform character, scale and height, skyline character, pattern and grain of landcover, openness/enclosure, character of vertical elements, manmade features, settlement/circulation patterns, time depth and condition. Some of this should already be in any LANDMAP assessment, but this should be developed further during fieldwork.

6.6 Building upon the results of the work above, the results of the visibility analysis should be combined with the boundaries of the aspect areas for the landscape assessment.

7. Overall Analysis and Reporting

7.1 There are various methods available for bringing together various spatial datasets to arrive at a picture of cumulative constraints and thus areas most suitable for development for wind turbines. These include multi-criteria analysis, whereby each constraint layer is assigned a score, and the scores are added together to arrive at an overall environmental performance. The scores for each environmental layer can also be weighted, to reflect the differing importance of the factors in the decision-making process. Whilst the rigour of multi-criteria analysis is often desirable, it pre-supposes that:

a) all the relevant datasets are available digitally;

b) all parties to the decision making agree on any scores/weightings to be used.

7.2 It is envisaged that due to the data and resource limitation associated with this study, expert judgement should be used to bring the various factors together.

7.3 A matrix should be developed containing details of all the feasible 'sub-areas' within the SSAs. The technical, landscape and environmental performance of each of these sub-areas should be assessed and presented in the matrix. Precise criteria for environmental performance should be developed as part of the study in conjunction with the appropriate local authority officers but could include the landscape sensitivity and the degree to which any likely Sub-area of Visual influence from proposals located within such a sub-area would affect sensitive visual receptors.

7.4 The areas should be ranked as a result of the matrix analysis.

An example matrix is shown below.

Table A.1 -Example summary matrix: environmental performance of SSA Sub-areas

Sub-area	Nature conservation constraint	Historic landscape constraint	Landscape character sensitivity	Landscape Value	Visual sensitivity [to settlements/ roads etc]	Visual sensitivity [to sensitive landscapes/ recreational rece[tprs]	Overall sensitivity	Overall capacity/ranking	Potential capacity
Sub-area 1									
Sub-area 2									
Sub-area 3									
Sub-area 4									
Sub-area 5									
Sub-area 6									
Sub-area 7									
Sub-area 8									
Sub-area 9									
Sub-area 10									

* Landscape value derived from combined LANDMAP ratings with weighting towards Visual and Sensory scores.

8. Supplemental information on cumulative landscape and visual impact

8.1 The issue of cumulative landscape and visual effects in the derivation of the 7 SSAs should also be reviewed and consideration given to the effects upon adjacent local authority areas.

8.2 Cumulative effects are those which occur, or may occur, as a result of more than one wind farm project being constructed. The degree of cumulative impact is a product of the number of and distance between individual wind farms, the inter-relationship between their Sub-areas of Visual Influence (ZVI), the overall character of the landscape and its sensitivity to wind farms, and the siting and design of the wind farms themselves. It is important to recognise that cumulative effects consist of both those upon visual amenity as well as effects on the landscape. The degree of cumulative impact also gives rise to the notion of thresholds, beyond which impacts may not be acceptable.

8.3 In order to justify a threshold based on natural heritage factors, there needs to be clarity over natural heritage objectives. Without such clarity, there is little value in seeking a cumulative impact assessment in the first place. Thus, for example, in relation to cumulative landscape impacts, one needs to be clear whether the landscape objective in the area is:

- to maintain the integrity and quality of the landscape (as may be appropriate within a designated landscape);
- to maintain the landscape character; or
- to accept landscape change.

8.4 There is an implicit objective in TAN 8 *to maintain the integrity and quality of the landscape* within the National Parks/AONBs of Wales i.e. no change in landscape character from wind turbine development.

In the rest of Wales outside the SSAs, the implicit objective is to maintain the landscape character i.e. no significant change in landscape character from wind turbine development.

Within (and immediately adjacent) to the SSAs, the implicit objective is to accept landscape change i.e. a significant change in landscape character from wind turbine development.

8.5 TAN 8 (and the work on which it is based), therefore, considered cumulative landscape and visual impacts at the all-Wales level. The strategy adopted is a means of concentrating the impact of wind turbines in a relatively small proportion of the country in areas that are, on balance, technically, practically and environmentally better able to accommodate such impacts than other parts of Wales.

8.6 At the local level, accepted thresholds of change, having regard to nationally developed energy capacity targets, can be established by more detailed assessments.

Annex E

Glossary of Terms

Bio-fuels – fuels that derive from biomass.

Biomass – any material that derives from recent animal or vegetable sources (ie does not include fossil fuels).

Biosphere Reserve – an ecological designation of the United Nations. The "core area" is the area of particular ecological interest.

Capacity Factor – the theoretical output over a year divided by the actual output and then usually expressed as a percentage. For example a 1 MW turbine would have a theoretical annual output of 1 x 24 x 365.25 = 8,766 MWh. Its actual output might be 2,630 MWh. The capacity factor is 2630/8766x100=30%.

Clearfell – the cutting down of all trees on an area of woodland (typically greater than 0.25 hectares) in a single operation.

Climate Change – the recognised phenomenon whereby the climate of the Earth is changing due to rising average temperatures.

Co-firing – the utilisation of more than one fuel type at the same time in the same plant.

Distribution Network – the system of wires, switches and transformers that serve homes and businesses. It operates at 132 kV, 33kV, 11kV and below. The wires are usually carried on wooden poles.

Fossil Fuels – fuels that arise from organic matter but over geological timescales.

Gigawatt (GW) – 1,000 megawatt.

Global Warming – the recognised phenomenon leading to the rise in average temperatures across the Earth (often used inter-changeably with "Climate Change").

Greenhouse Effect – the trapping of reflected solar radiation in the Earth's atmosphere leading to a rise in global temperature.

Greenhouse Gases – the gases that are responsible for trapping the solar radiation - the greenhouse effect. The most significant impact comes from carbon dioxide and methane.

Grid Capacity – the technical/physical ability of any electricity transmission or distribution network to accommodate new electricity generation or usage.

Installed Capacity – the theoretical instantaneous output of electrical power if all generators were working at full capacity.

Kilowatt (kW) – 1,000 watts.

Kilowatt hour (kWh) – 1 kW output over one hour (this is the "unit" of electricity on the standard electricity bill).

kW (e) – a measure of electrical power.

kW(th) – a measure of thermal power.

Megawatt (MW) – 1,000 kilowatts.

Natura 2000 sites – areas of land that have designated as being of international importance for wildlife conservation.

OFGEM – Office of Gas and Electricity Markets: the energy regulator for the GB gas and electricity sectors.

Pumped Storage - a facility designed to generate electricity during peak periods with a hydroelectric plant utilizing water pumped into a storage reservoir during off-peak periods.

Rated output or capacity – another term for installed capacity but usually applied to one generator.

Renewable Energy – the term used to cover those energy flows that occur naturally and repeatedly in the environment. It includes all energy derived from the sun (solar, wind, tidal, wave, hydro and biomass) and geothermal sources.

Renewables Obligation – an obligation on all electricity suppliers to obtain a proportion of their power from renewable sources. A supplier can either buy renewable electricity, buy ROCs (see below) from other suppliers or can pay OFGEM an agreed fee for the unmet obligation.

ROC – Renewables Obligation Certificate – ROCs are the means by which a supplier of electricity demonstrates compliance with the Renewables Obligation. The certificates are tradable.

Strategic Search Area - an area that has been identified at a strategic level as having the general characteristics that lend themselves to the accommodation of large wind farms.

Terawatt (TW) – 1,000 gigawatts.

TWh – Terawatt- hour. One terawatt over one hour.

Transmission Network – the electricity transmission system operating at voltages above 132kV – usually wires carried on steel lattice towers.

Watt (W) – unit of power output (instantaneous measurement) – the rate of doing work.

World Heritage Site – a United Nations designation relating to land of particular historical or cultural importance on an international level. In the case of Blaenafon this relates to its key importance to the industrial revolution.

Annex F

Contacts

Useful Contacts and Sources of Information

Welsh Development Agency, South West Wales Division, Llys-y-Ddraig, Penllergaer Business Park, Swansea, SA4 9HL.
www.wda.co.uk

Carbon Trust Wales, Albion House Oxford Street, Nantgarw, Cardiff, CF15 7TR.
www.thecarbontrust.co.uk

Energy Saving Trust, 21 Dartmouth Street, London SW1H 9BP
www.est.org.uk.

British Wind Energy Association, Renewable Energy House, 1 Aztec Row, Berners Road, London, N1 0PW.
www.britishwindenergy.co.uk

British Biogen, Ambassador House, Brigstock Road, Thornton Heath, Surrey CR7 7JG.
www.britishbiogen.co.uk

Combined Heat and Power Association, Grosvenor Gardens House, 35/37 Grosvenor Gardens, London SW1W 0BS.
www.chpa.co.uk

Mid Wales Energy Agency, Unit 7 Dyfi Eco Park, Machynlleth SY20 8AX.
www.mwea.org.uk

Conwy Energy Agency, Conwy Energy Agency, The Old Sawmill, Bodnant Estate, Tal-y-Cafn, Colwyn Bay LL28 5RD.
www.conwyenergyagency.co.uk

Carmarthenshire Energy Agency, Unit 10 St Clears Business Park, Tenby Road, St Clears SA33 4JW.
www.ynnisirgar.org.uk

Awel Aman Tawe, Gwaun Cae Gurwen School, New Road, Gwaun Cae Gurwen, Ammanford SA18 1UN.
www.awelamantawe.co.uk

West Wales Eco Centre, Lower St. Mary Street, Newport, Pembrokeshire, SA42 0TS.
www.ecocentre.org.uk

Severn Wye Energy Agency, Unit 6/15 The Mews, Brook Street, Mitcheldean, Gloucestershire, GL17 0SL.

Centre for Alternative Technology, Machynlleth, SY20 9AZ.
www.cat.org.uk

Renewable Energy Investment Club, c/o Dulas Ltd, Unit 1 Dyfi Eco Park, Machynlleth SY20 8AX.
www.reic.co.uk

North Wales Energy Efficiency Advice Centre, The Town Hall, Earl Road, Mold, Flintshire, CH7 1AB.
nwal@eeac.net

South East Wales Energy Efficiency Advice Centre, Suite 3, Floor 6 Clarence House, Clarence Place, Newport, NP19 7AA.
sewa@eeac.net

Swansea Energy Efficiency Advice Centre, 13 Craddock Street Swansea, SA13 1XX.
Pam.Walters@swansea.gov.uk

Managenergy (European Union level website with valuable case studies).
www.managenergy.net