Cumbria Renewable Energy Capacity and Deployment Study

Final report to Cumbria County Council

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SQW

Contents

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This study has been produced to provide a renewable energy evidence base for Cumbria's Local Development Frameworks.

It has been prepared by SQW for Cumbria County Council, Allerdale Borough Council, Carlisle City Council, Copeland Borough Council, Eden District Council, South Lakeland District Council, the Lake District National Park Authority and for the Yorkshire Dales National Park Authority for the part of Cumbria that lies within its jurisdiction. The study covers the whole of Cumbria.

Photographs are courtesy of Carlisle City Council, Persimmon Homes, Lake District National Park Authority and Cumbria Woodlands.

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Executive Summary

The purpose and scope of the study

1. This study on Renewable Energy Capacity and Deployment in Cumbria provides a comprehensive evidence base for developing appropriate and robust local planning arrangements with regard to renewable energy. It is a technical study only and does not constitute policy for any of the Cumbrian Local Planning Authorities. The work was undertaken by SQW and Land Use Consultants and was overseen by a Steering Group consisting of representatives from Cumbria County Council, Allerdale Borough Council, Carlisle City Council, Copeland Borough Council, Eden District Council, South Lakeland District Council and the Lake District National Park Authority (LDNPA).

2. The study draws on previous work including the *Northwest Renewable and Low Carbon Energy Capacity and Deployment Study (2010)* and the DECC/CLG methodology *Renewable and Low Carbon Capacity Assessment Methodology for the English Regions (2010).*

3. This study has involved a detailed and localised assessment of the amount of resources available that could be used to generate renewable energy up to 2030 – in other words the overall ***potential technical capacity*** (expressed in MW). The resources and technologies investigated include wind, biomass, energy from waste, hydropower, solar and heat pumps. In recognition of the high environmental quality in Cumbria, specific research was undertaken into capacity within Protected Landscapes.

4. The study was also concerned with taking these results a step further and translating them into a level of renewable energy deployment that is realistic to reach by 2030 i.e. the ***deployable capacity***. This involved the analysis of a number of key constraints and opportunities associated with economic viability, supply chain, grid connection/distribution, planning acceptance rates and other factors. It also took into account the amount of renewable energy already installed, and in the pipeline (under/awaiting construction or consented), within each Local Planning Authority (LPA). Scenario testing was undertaken to examine different mixes of renewable energy technologies that could be deployed.

5. The study has been undertaken against a backdrop of a rapidly changing national policy context for planning and energy. Table 1 provides a summary of the key policy developments for renewable energy generally, and specifically in relation to Cumbria.

Table 1: Summary of policy context

Planning policy

- National planning policy: Planning Policy Statement 22 Planning for Renewable Energy and Supplement to PPS1: Planning and Climate Change; national planning system review imminent, Localism Bill intending to shift power from central government back into the hands of individuals, communities and local authorities.
- Regional Spatial Strategies likely to be revoked, but still remain a material considerations although renewable energy targets have little weight.
- All LPAs locally have or are developing renewable energy targets aiming to support the increased deployment of renewable energy. Cumbria's Wind SPD is of particular benefit.

Energy Policy

- Policy on renewable energy capacity is fast moving and changing to take into account emerging technologies and targets at the national and global level.
- Government is committed to furthering deployment of renewable energy.
- Key current policy: UK Renewable Strategy, 2009 (source 15% of energy needs from renewable sources by 2020).
- Key financial incentives:
  - The Renewables Obligation which is the main mechanism for supporting large-scale generation of renewable electricity.
  - Renewable Heat Initiative announcement in March 2011 – phase 1 non-domestic from June 2011, phase 2 domestic from autumn 2012.
  - Premium Payment scheme for domestic renewable heating systems targeted at off gas grid properties starting 1 August 2011.
  - Feed in Tariffs support renewable energy generators with capacity less than 5 MW – currently under review to make efficiency savings due to be complete by end 2011. In June 2011 fast track decisions were announced on changes to the tariffs for anaerobic digestion plants and larger solar projects >50kW.
- Energy Bill 2010 – 3 key measures: The Green Deal, measures to enable low carbon technologies, further provisions including support to the private sector, the Energy Company Obligation and measures to support energy efficiency.
- Electricity Market Review White Paper, 2011, identifies key challenge of meeting electricity demand as 25% of current capacity is removed over the next 10 years due to plant closures and introduces specific measures to attract investment, reduce the impact on consumer bills and create a secure mix of electricity sources including gas, new nuclear, renewables and carbon capture and storage.
- UK Renewable Energy Roadmap, 2011, sets out shared approaches (across England, Wales, Scotland and Northern Ireland) to unlock renewable energy potential by building on existing actions and introducing new measures to promote greater deployment of eight key technologies.
- Emerging legislation: potential revision of Climate change levy; more support to LAs & communities re: ownership of renewable assets.
- Sub-regional energy initiatives such as Britain's Energy Coast and recent EZ submission provide further supportive policy environment.

Source: SQW

What is Cumbria's overall energy demand and how much renewable energy is already generated?

6. Using regional energy consumption statistics from DECC, Cumbria's total energy demand in 2007 was identified as approximately 18,000 GWh (i.e. energy output rather than generation capacity) with demand from Industrial and Commercial sectors being 50% higher than the domestic sector. Road transport demand is substantial and is spatially linked to the path of the M6. Domestic demand is higher in more rural areas probably linked to older and less energy efficient dwellings.

7. To provide a benchmark level for consideration of renewable energy generation potential and policies/targets, projections of Cumbria's energy demand to 2030 have been made. These projections are based on two of DECC's published national energy 'Pathways': the Reference case (no attempt made to de-carbonise or maximise energy generation from renewable sources) and Pathway Alpha which involves a concerted effort to reduce overall energy demand, to increase energy generation from low carbon electricity and to produce and import sustainable bioenergy:

- Reference case – energy demand for Cumbria increases by 7% between 2010 and 2050 driven by a 40% increase in domestic energy demand and a 12% increase in Industrial and Commercial demand, offset by a 28% fall in demand for energy for land transport. Emissions are likely to increase. Energy demand in 2020 and 2030 is projected to decrease slightly to 17,900 GWh and 17,800 GWh respectively.

- Alpha Pathway – energy demand for Cumbria falls by 14% between 2010 and 2050 driven by a 38% fall in energy demand for transport, partly offset by a 13% increase in Industrial and Commercial demand. Domestic demand falls by 6% to 2030 then rises to match 2010 levels by 2050 and emissions decrease. Energy demand in 2020 and 2030 is projected to decrease to 16,000 GWh and 14,200 GWh respectively.

8. Cumbria's current renewable energy installed capacity, plus the projects that are planned and about to be developed (i.e. the "pipeline") was just over 295 MW at April 2011. The analysis indicates that this is provided from just under 400 separate installations. Interestingly, the installed and pipeline capacity exceeds the North West Regional Spatial Strategy target for electricity for Cumbria of 237 MW at 2010 showing that the sub-region is already progressing well in contributing towards the national renewable energy target of meeting 15% of the UK's energy needs from renewable sources by 2030.

Cumbria's potential resource for generating renewable energy

9. The detailed assessment of potential renewable energy resources in Cumbria has been undertaken in relation to 2030 as this fits well with planning horizons and is also realistic in terms of the time it can take for renewable energy developments to be consented and installed. In addition, we have also noted where the identified capacity is likely to increase (or decrease) considerably by 2050 to provide a longer term view. The assessment involved first, identifying the opportunity for harnessing the renewable energy resources on the basis of what is naturally available within the context of the limitations of existing technology solutions. Second, the assessment included addressing the some of the more "fixed" constraints to the deployment of technologies in relation to the physical environment and planning regulatory limitations to identify a more realistic measure of capacity and potential.

10. The total onshore potential technical capacity (i.e. the accessible renewable energy resource) in Cumbria is assessed to be 4,542 MW or 4.5 GW. Table 2 summarises the potential for each technology. The capacity results in italics and red font are not included in the aggregated results because they are provided for context rather than as accurate assessments. Those additional results cover sources such as offshore renewables and solar farms as well as CHP/district heating which are not renewable sources and so are not included in the aggregated total.

Table 2: Potential technical renewable energy resource capacity in Cumbria by technology (at 2030)

Technology group	MW by technology group	Sub Category Level 1	Sub Category Level 2	MW by sub-category
Wind (onshore)	2885.6	Wind - commercial scale	Wind – commercial scale	2858.3
		Wind – small scale	Wind – small scale	27.3
Wind (offshore)	*2900*	Wind (offshore)	Wind (offshore)	*2900*
Tidal	*6200*	Tidal	Tidal	*6200*

Technology group	MW by technology group	Sub Category Level 1	Sub Category Level 2	MW by sub-category
Wave	*500*	Wave	Wave	*500*
Geothermal	---	Geothermal	Geothermal	---
Biomass	212.0[1]	Plant biomass	Unmanaged woodland (electricity)	6.8
			Unmanaged woodland (heat)	41.4
			Energy crops (electricity)	6.2
			Energy crops (heat)	23.6
			Waste wood (electricity)	4.4
			Waste wood (heat)	3.8
			Agricultural arisings	3.0
		Animal biomass (aka EfW)	Wet organic waste	90.0
			Poultry litter	2.8
		Waste	Municipal Solid Waste (MSW)	19.4
			Commercial & Industrial Waste (C&IW)	20.7
		Biogas	Landfill gas	1.8
			Sewage gas	4.9
Hydropower	69.7	Small scale hydropower	Small scale hydropower	69.7
		Commercial scale hydropower	Commercial scale hydropower	0
Microgeneration	1374.7	Solar	Solar Photovoltaics (PV)	150.5
			Solar Water Heating (SWH)	135.4
		Heat pumps	Ground Source Heat Pumps (GSHP)	213.2
			Air Source Heat Pumps (ASHP)	852.7
			Water Source Heat Pumps (WSHP)	22.9
Large scale solar	*326.2*	Solar farms	Solar farms	*326.2*
		Solar infrastructure	Solar infrastructure	0.02
Combined Heat & Power	*126.5*	CHP	CHP	*126.5*
TOTAL	**4542.0**			**4542.0**

Source: SQW and LUC

[1] Unmanaged woodland (Electricity), Energy crops (Electricity) and Waste wood (Heat) have been excluded as heat and energy production for these technologies are mutually exclusive.

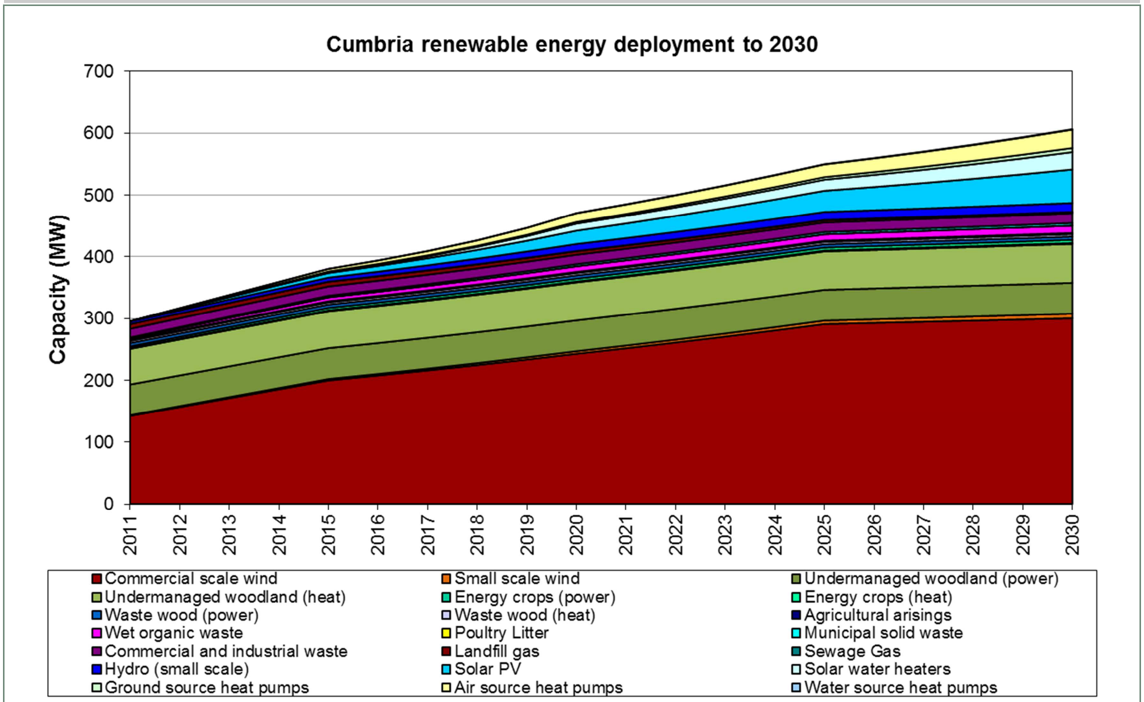
11. Commercial onshore wind provides the largest proportion of the onshore resource at 62% followed by microgeneration – 30% of the total resource. In addition the potential from Solar PV farms could provide an additional 326.2 MW although it is recognised that this assessment is highly caveated due to a number of assumptions being taken into account and the outcome of the recent FIT review resulting in a much reduced financial incentive to develop solar PV farms. Finally, the potential heat demand for combined heat and power (CHP) which could be met through district heating systems is 126.5 MW – this is significant potential and the introduction of the Renewable Heat Incentive combined with technological progress is likely to lead to many more schemes coming forward. Only those resource technologies that contribute to the overall total capacity (i.e. excluding offshore sources, solar PV and CHP) were subject to the deployable resource analysis in the remainder of the study.

How much of that potential resource is realistically deployable?

12. The Deployment Projections prepared in this study have forecast that 606 MW renewable energy could realistically be deployed within Cumbria by 2030 (including that which is already installed or in the pipeline). For all of the technologies except commercial wind, the potential technical capacity figures were used as the reference point or absolute ceiling of the amount of resource. For commercial wind, a reduced ceiling figure of 1,623 MW was used as this takes account of landscape capacity and was therefore considered to be a more realistic limit for Cumbria. The Deployment Projections were generated using SQW's *RE:Deploy* spreadsheet based tool.

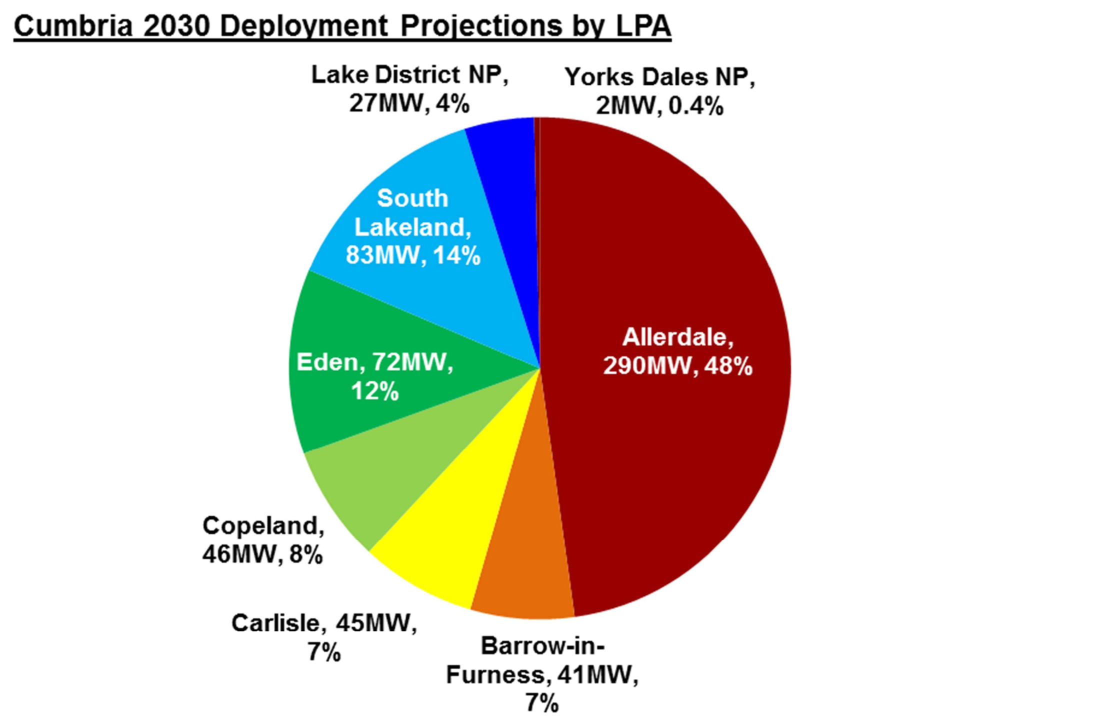
13. Figure 1 shows the deployment curve or "build rates" for the different technologies under the Deployment Projections. Based on locally specific data on the installed/pipeline capacity and potential resources, the anticipated contributions of the eight LPAs to achieve the 606MW for Cumbria are shown in Figure 2.

Figure 1: Cumbria deployment curve to 2030



Source: SQW

Table 3: Local Planning Authority share of deployment at 2030 (NB: total = 606 MW)



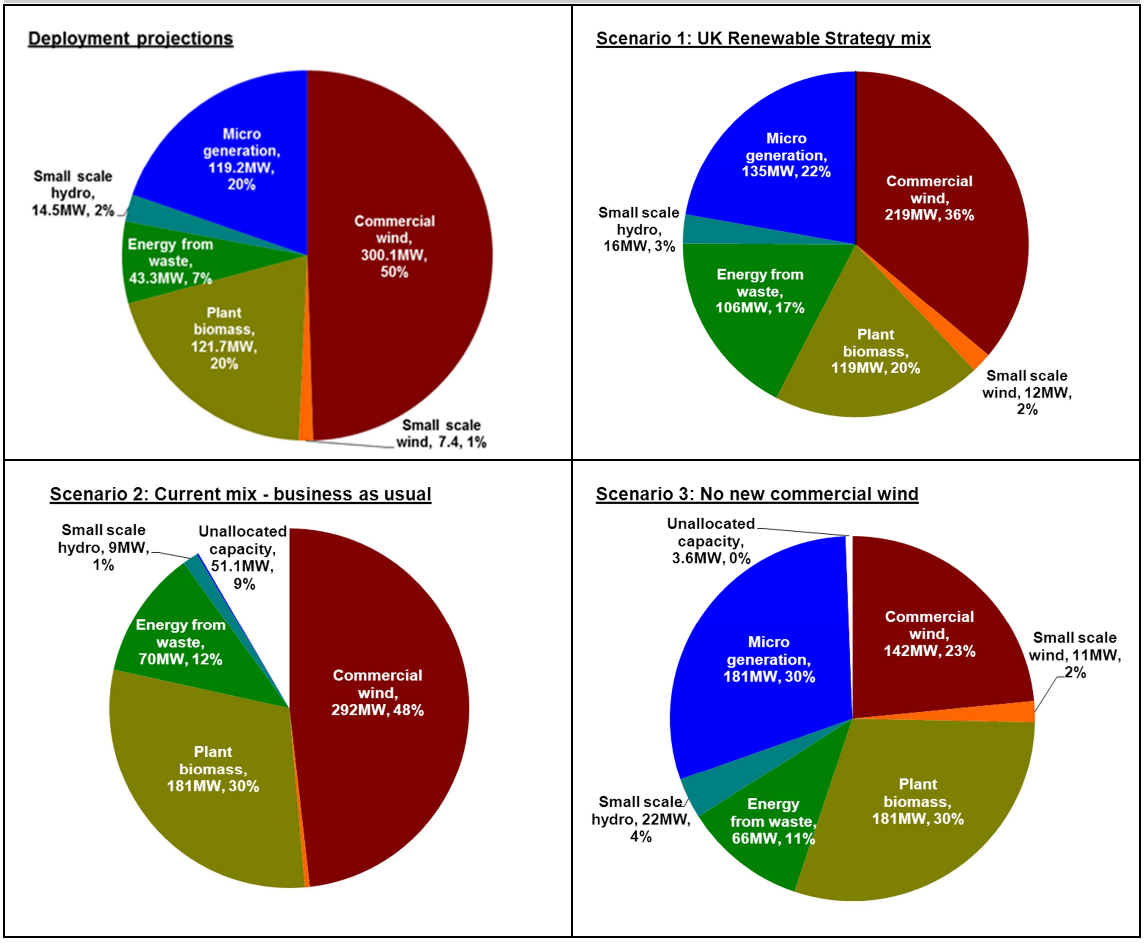
Source: SQW

14. Three further scenarios were investigated to illustrate how Cumbria could achieve the same level of deployment at 2030 by different mixes of technology. The three scenarios were agreed following consultation with the Steering Group and their main features and differences between them are:

- ***Scenario 1: 'UK Renewable Strategy mix'***, which reflects the indicative national technology proportions identified within the UK Renewable Energy Strategy 2009 to obtain 15% of the UK's energy needs from renewables by 2030.
- ***Scenario 2: 'Current mix – business as usual'*** projects forward the current installed capacity mix within each of the Cumbria LPAs (the mix differs between LPAs according to characteristics of current installed capacity).
- ***Scenario 3: 'No new commercial wind'*** assumes that there will be no new commercial wind deployment over and above that which is currently installed, under construction, awaiting construction or consented.

15. Table 4 illustrates the different mixes associated with the Deployment projections and the three further scenarios.

Table 4: Scenario results for Cumbria (NB total = 606 MW)



Source: SQW

Strategic impacts and opportunities associated with increased deployment

16. A **qualitative analysis of risks and opportunities** for Cumbria accompanied the quantitative work on constraints and scenarios. That analysis indicated that in terms of:

17. Economic viability

- Cumbria has the potential to deliver renewable energy on a significant scale if it is made sufficient economic policy priority.
- Continued financial incentives will be important to maximise deployment specifically from commercial scale wind and microgeneration.
- A coordinating group, with dedicated offer support, promoting renewable energy would be beneficial.

18. Supply chain

- The need for skill development in hydropower and biomass installation was highlighted by consultees although experienced engineering and design, and turbine manufacture companies are based in Cumbria. Addressing any skills shortages will be important to reach the uplift in deployment envisaged regardless of the scenario – although these technologies feature most predominantly in the *No new commercial wind scenario.*

- Fuel supply is an issue for biomass, as is the need for sustainable woodland management and known, engaged woodland owners – the potential for significant woodland creation should be maximised as a way of meeting demand within the sub-region, but importing may also be required in future.

19. Planning and political

- More certainty and consistency in planning policy interpretation and decision making should help encourage greater deployment
- Sustained objection to commercial scale wind, albeit by the minority, is an important consideration that needs to be taken into account and managed pro-actively.

20. Technology development

- CHP and heat pumps are two technologies for which there is significant untapped technical capacity. National technological developments are needed for deployment to be fully maximised, and locally there will be opportunities to support firms involved in the associated supply chains (manufacture and installation).
- The large uplift in microgeneration in all scenarios, but particularly for the *No new commercial wind* scenario may prove challenging.

21. Community ownership

- There is limited interest in community ownership of renewables schemes although there are examples of successful projects such as the Bay Wind community initiative. Awareness raising, including visiting other projects such as the Bay Wind Community projects and the development of informed guidance, e.g. 'how to' guide covering technical and financial issues, could help to increase the current uptake which is minimal.

22. Job creation

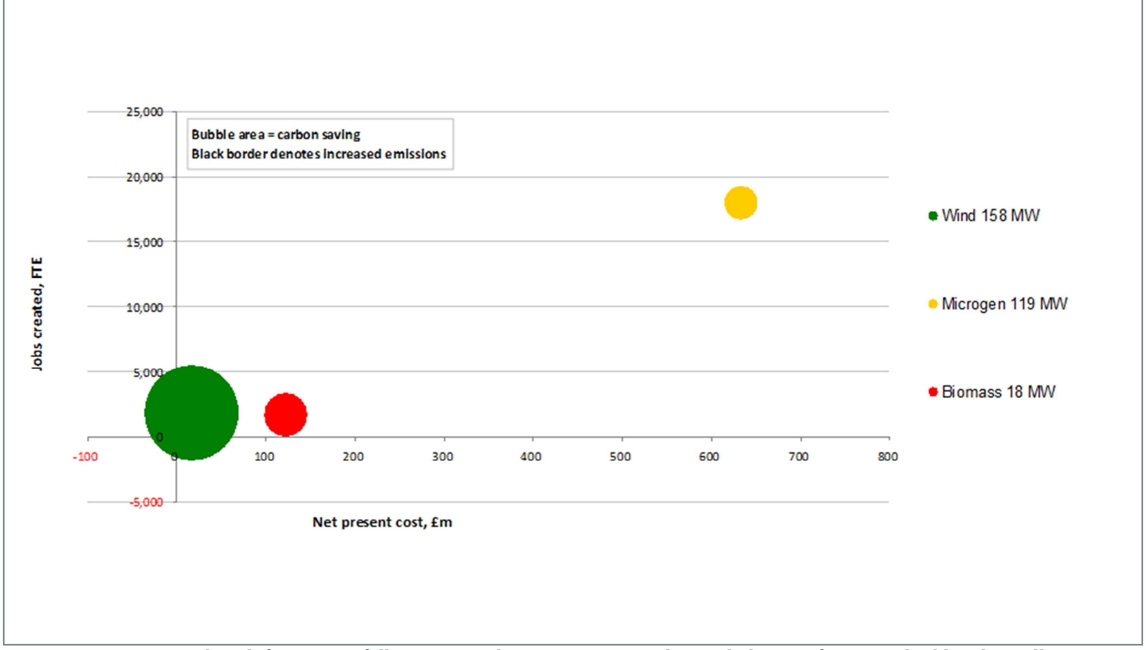
- Positive job creation impacts can be created through the increased deployment of renewable energy, particularly microgeneration which through its individual-property based characteristics is labour intensive.

23. Specific attention was also placed on the anticipated **environmental impacts** associated with the Deployment Projections. Overall, the most significant environmental impacts are likely to result from commercial scale wind, plant biomass and energy from waste. These technologies are prevalent in all scenarios (except the *No Commercial Scale Wind* scenario), and so it is envisaged that each of the deployment scenarios would result in landscape and visual impacts. As such, the cumulative landscape and visual impact resulting from future development of these technologies, combined with the existing deployment, is likely to be of a high

magnitude given the sensitivity of the landscape in Cumbria. Noise is also considered to be a potential impact (both short and long-term) in the case of these technologies. However, this potential is highly dependent on the location of future developments, and is only likely to occur where these technologies become concentrated within a locality, with the magnitude being enhanced where schemes are in proximity to sensitive receptors (e.g. residential development, schools etc.). There are also potential impacts associated with air quality and traffic and transport (both short and long term). Cumulative impacts are likely to arise where biomass and energy from waste plants become concentrated in a specific locality. Depending on the degree of concentration and the scale of individual plants, this would be of a medium-high magnitude.

24. Further analysis was also undertaken to consider the likely **carbon and economic impacts** using the PACE tool[2] which is a transferrable model to compare the impact of various interventions associated with moving towards a low carbon economy. This tool was applied to the Deployment Projections for Cumbria looking specifically at three technologies: commercial scale wind, energy from waste in the form of anaerobic digestion and solar photovoltaics. Figure 2 summarises the impacts analysis through illustrating the costs, jobs and carbon savings all in one chart. It is evident that commercial wind deployment is likely to save the most tonnes of carbon (largest bubble) and cost the least amount of money (furthest to the left). Nevertheless, in employment terms, microgeneration deployment has the potential to create the most new jobs (highest up the y-axis).

Figure 2: Total cost v jobs created (FTE, person years)



Source: SQW Note: The job figures are full-time equivalent person years. They include manufacturing, build and installation jobs for deployment until 2030 and operation and maintenance jobs associated with this deployment.

[2] The PACE (Prioritisation of Actions for low Carbon Economy) tool was developed by SQW for Cornwall Council as part of the EU INTERREG Regions for Sustainable Change programme

Main conclusions from the study

25. This study has provided a wealth of updated evidence and new analysis of the local possibilities for renewable energy across the Local Planning Authorities in Cumbria to 2030 and beyond. The main conclusions arising from the study are that:

- **Cumbria has abundant natural resources for renewable energy, but the deployment of these need to be undertaken in such a way that does not compromise the value and inherent quality of its natural landscapes, many of which are designated. Throughout this study, we have respected the need to ensure that projections for future energy deployment do not detract from Cumbria's outstanding environment. Taking this and a range of other constraints into account it is forecast in this study that Cumbria has deployable onshore renewable energy resources of 606 MW by 2030.** When converted into energy generation (GWh) and taking into account load factors for the various technologies, the potential energy generation figure is 1,861 GWh. This compares with the energy demand projections provided in Chapter 3 which suggest, depending on which pathway is followed, that future energy needs could be between 14,000 and 18,000 GWh at 2030. This suggests that Cumbria could provide between 10 and 13% of its energy requirements from onshore renewables by 2030. The UK Renewable Strategy, 2009, suggests that 15% of total future energy needs (and 30% of electricity) should come from renewable sources by 2020, but it should be noted that this aspiration is not expected to be disaggregated to local areas. Cumbria is currently a net exporter of energy and this is likely to be the case for renewable energy due to the abundance of natural resources.

- Interestingly, the **current installed and pipeline capacity (295 MW) already exceeds the North West Regional Spatial Strategy electricity target for 2010 for Cumbria which was 237 MW**. However it should be noted that this target was based on the North West Sustainable Energy Strategy which was published in 2006 since when there have been considerable advances in technological developments for renewable energy and more financial incentives are now available. In addition, the targets were calculated on a top down basis by identifying projected energy demand for the North West at 2030, calculating 20% of this (as the North West Sustainable Energy Strategy set out for the North West to meet 20% of its energy needs by 2020) and then dividing this amount between Cumbria, Cheshire, Merseyside, Lancashire and Greater Manchester. Cumbria is a net energy exporter and likely to continue to be so, particularly for renewable energy and therefore it is important that targets are developed on a capacity rather than a demand basis capitalising upon the natural resources with which the county is endowed.

- **Cumbria needs to significantly increase its current level of deployment (295 MW) if it is to meet the 606 MW that is considered deployable.** The Deployment Projections provide the most easily achievable mix as they are based on realistic assumptions concerned with economic viability, supply chain, grid constraints and recent planning acceptance. The *UK Renewable Energy Strategy mix scenario* would require a substantial increase in energy from waste which may not be realisable, whilst the *No new commercial wind scenario* which is likely to be more politically acceptable and has the least environmental impacts, requires a substantial uplift in the deployment of microgeneration. Some microgeneration technologies are not yet economically viable on a widespread basis and this target is extremely challenging in terms of the scale of the uplift and viability of deploying this with regards to owner interest, availability of financial incentives, quality of stock and technological development.

- **Microgeneration provides an exciting opportunity in terms of economic benefits and particularly job creation.** The analysis of qualitative aspects revealed that there are a good number of existing microgeneration installers so there is a local labour market benefit that can be achieved. Continued support via Feed in Tariffs, or other financial incentives in the future, plus a supportive local policy environment should help maximise take up. Potential funding sources for wider scale roll-out retrofit and new housing include European funding (already being accessed in Cumbria for retrofit including renewable energy measures), section 106 and the Community Infrastructure Levy. Supportive planning policies are also important particularly those that require more than the minimum Code for Sustainable Homes requirements and Merton type policies where it is specified that a certain proportion of energy should be generated on site.

- **Continued deployment of commercial wind is likely to be required to meet the identified level from the deployment modelling and it is notable that some LPAs with large technical capacity have no existing or planned developments**. An appropriate planning environment, which is in place across Cumbria particularly with the Wind SPD in place, is essential as will be the continuation of financial incentives. Wind also provides the cheapest option as identified through the carbon and economic impact analysis and will achieve the highest carbon saving. Whilst noting the importance of commercial wind in Cumbria's future renewable energy deployment mix, it is important to have cognisance of the cumulative environmental impacts that this can impose. Allerdale for example has a significant installed capacity with regards to commercial wind (at just under 90 MW) yet could realistically deploy a further 60 MW over the next 20 years. This is a fairly significant deployment of commercial wind within one district which would not be without environmental impacts.

Recommendations

26. The key recommendations from the study are summarised below:

- We are aware that Cumbria County Council and the Cumbria Local Planning Authorities are **planning a series of dissemination events**. This is important and should not be restricted to climate change officers or planning officers, but include economic development colleagues due to the important of renewable energy to the Cumbrian economy as recognised through Britain Energy Coast's proposals. Related to this, we are aware that a series of training events have been undertaken throughout 2011 to raise awareness of different types and scale of renewable energy technologies amongst officers and communities. This could be built upon with further awareness sessions for elected members linked to the findings from this report and including site visits to provide first hand experiences of different types and scales of renewable energy developments.

- Individual LPAs may wish to undertake **further work to refine the results** and select the most appropriate scenarios to provide the evidence base to help to take forward their renewable energy ambitions. This could be linked to target setting to set a clear goal and also enable measurement of progress. In addition, further analysis may be important for individual LPAs in relation to economic viability, opportunities, carbon abatement potential and environmental impacts.

- **Increasing the profile of renewable energy to an overarching policy priority** linked to Britain's Energy Coast proposals could provide substantial economic and environmental opportunities for Cumbria in to the future. In addition, the skills opportunities presented through the growth of the sector and its supply chains need to be fully optimised and it is recommended that **supply and demand mapping concerning skills and supply chain** are undertaken for the increased deployment of biomass, hydropower and microgeneration. Whist recognising the significant economic boost that can be provided through capitalising upon renewable energy opportunities, it is important to also acknowledge the importance of tourism to Cumbria's economy and the role of the natural environment in attracting visitors. Therefore cumulative impacts and the consideration of landscape character must be taken into account with regards to the siting of individual developments.

- Related to the above point, there is an identified need to **develop an ongoing co-ordinating group working to raise the profile of renewable energy** and ensure that future deployment is maximised, within environmental constraints, and that its benefits are fed back into local communities via the development of local supply chains, community schemes etc. The Cumbria Renewables Panel could potentially provide the vehicle.

- Whilst there is already a **reasonably well developed planning environment in place** with regards to local policies and the wind SPD, there appear to be some concerns with regards to the **interpretation and delivery of said policy**. Reviewing the consistency of interpretation and implementation of existing policies including the Wind SPD across LPAs will help foster a more supportive environment for the deployment of renewable energy within Cumbria.

- Due to the **landscape quality across Cumbria and prevalence of Protected Landscapes**, we recommend that **further work** is undertaken to fully understand and assess all of the impacts from a significant uplift in renewable energy deployment, particularly commercial scale wind.

- In order to take the **assessment of heat demand and potential for CHP developments** further, **additional research** should be undertaken concerning future development and its heat demand, potential future waste heat sources and a review of existing and planned heat infrastructure across the county.

1: Introduction

1.1 SQW Ltd (SQW) and Land Use Consultants (LUC) were commissioned by Cumbria County Council in September 2010 to prepare a Renewable Energy Capacity and Deployment Study for Cumbria. The study provides a comprehensive evidence base that will facilitate local planning authorities across the region to develop well-founded policies that support renewable energy deployments. It is a technical study only and does not constitute policy for any of the Cumbria Local Planning Authorities. The study was overseen by a Steering Group consisting of representatives from Cumbria County Council, Allerdale Borough Council, Carlisle City Council, Copeland Borough Council, Eden District Council, South Lakeland District Council and the Lake District National Park Authority (LDNPA).

1.2 Cumbria is committed to becoming a low carbon economy and in order to move towards ensuring its contribution towards the UK's target of meeting 15% of its energy needs from renewables by 2020 (as required by the UK Renewable Energy Strategy, 2009), the need for a consistent evidence base across its local authorities was recognised. With the planned revocation of Regional Spatial Strategies, and with them regional (and sub-regional) targets for renewable energy generation, it is important that local areas are proactive in looking to maximise their future renewable energy deployment and in commissioning this study, it is clear that Cumbria takes its responsibilities seriously.

1.3 For this study, potential renewable energy capacity is assessed at 2030. The rationale for this end date is that it aligns well with providing an evidence base for local planning horizons and also provides sufficient time to allow for infrastructure to be put in place in order to realise the deployable capacity. For some technologies, such as wind, future potential capacity will not necessarily increase. However, others which are more related to consumption and development, such as waste and microgeneration which is associated with buildings, may change relatively significantly and this can be factored in based on existing projections; for example as a result of housing growth and development.

1.4 The key objectives of the study are to:

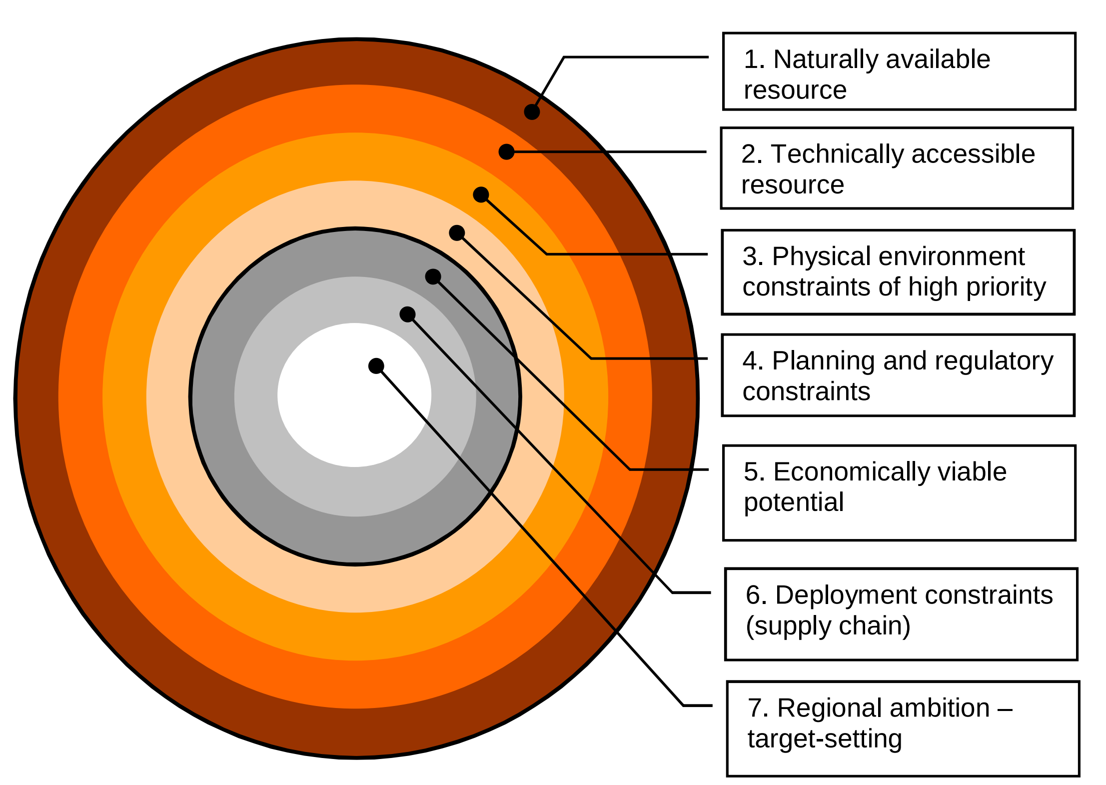
- examine current approaches to renewable electricity generation and renewable heat provision including commercial, community and small scale renewable technologies
- explore the full range of options to optimise renewable energy and combined heat and power, tri-generation and district heating production in the context of a rural sub-region, including exploring whether there can be less of a reliance on onshore commercial scale wind energy schemes
- reflect current government approaches and good practice
- support sub-regional plan making and target setting.

1.5 The study also builds on the Northwest Renewable and Low Carbon Energy Capacity and Deployment Study which SQW and LUC completed last year. That study was undertaken using nationally endorsed DECC and CLG methodology: *Renewable and Low Carbon Capacity Assessment Methodology for the English Regions (2010)* - hereafter referred to as 'the DECC methodology' - also developed by SQW and LUC. The focus of that project was to refresh the evidence base for the potential for renewable energy in the North West. It provided a comprehensive assessment of the potential accessible energy resources at 2020 with the following key finding for Cumbria:

- Cumbria has a very large commercial scale wind resource (10,399MW or 44% of the North West's resource), but also extensive areas of designated land due to its landscape and environmental quality. Cumbria has the largest sub-regional resource in terms of managed woodland (plant biomass) and wet organic waste (animal biomass). Cumbria also has 66% of the North West's small scale hydropower potential accessible resource.

1.6 In this Cumbria-specific study, the task was first to assess the technical renewable energy capacity of the sub-region, within the framework of the DECC methodology (stages 1-4 of the framework in Figure 1-1), but using customised assumptions and data sources reflecting local characteristics.

Figure 1-1: Stages for developing a comprehensive evidence base for renewable energy potential



Source: DECC, Renewable and Low Carbon Energy Capacity Methodology: Methodology for the English Regions, 2010

1.7 This was then translated into the more realistic potential deployable capacity, taking into account key constraints using SQW's *RE: Deploy* tool (stages 5-6 from Figure 1-1). Constraints included economic viability, supply chain, grid connection/distribution and planning acceptance were applied to provide an assessment of the amount of renewable energy that could be realistically deployed by 2030. Scenario testing was then undertaken to examine different mixes of renewable energy technologies that could be deployed to reach this level. Alongside this, an analysis of qualitative risks/opportunities and impacts (including environmental impacts) was undertaken to identify actions required to help Cumbria contribute towards national renewable energy targets.

1.8 Throughout the study, it has been important to maintain a balance between capitalising upon Cumbria's significant assets for renewable energy generation and recognising and protecting its outstanding natural environment. This has required particular consideration of Protected Landscapes and their settings in order to ensure that neither renewable energy nor nature conservation objectives will be compromised.

1.9 We would like to pass on sincere thanks to the Steering Group whose support and advice throughout the study development process has been invaluable.

Status of the report

1.10 This is the final report which supersedes all previous outputs. It is a technical study only and does not constitute policy for any of the Cumbria Local Planning Authorities.

Structure of the report

1.11 The remainder of the report comprises the following:

- Section two sets the scene by providing the wider context, in terms of energy policy and planning policy, for the deployment of renewable energy across Cumbria.
- Section three provides our analysis of energy demand both currently and projected forward to 2030.
- Section four details the scale and location of current installed renewable energy schemes, and those at an earlier stage in the planning process, across Cumbria.
- Section five sets out the results from the technical resource capacity assessments for Cumbria as a whole, and for each of the individual Local Planning Authorities (LPAs).
- Section six provides the results of the deployment modelling and analysis which reduces the technical renewable energy potential to a more realistic forecast of deployable renewable energy by 2030.
- Section seven analyses the implications of deploying this scale of renewable energy in economic, social and environmental terms.
- Section eight details our overall conclusions and recommendations for taking forward the evidence provided in this report and using it to inform future economic, environmental and planning policy development.

1.12 In addition, the evidence base from this study includes 10 annexes, provided in a supporting document, covering:

- a review of sub-regional studies to inform the development of assumptions for assessing technical capacity
- revised technological assumptions detailing how and where these diverge from the DECC methodology
- references and datasets used in the course of the study
- details of organisation that have been consulted throughout the study
- summary of installed and proposed renewable energy developments across Cumbria
- review of protected landscapes
- map access details
- results of the deployment and scenario modelling by Local Planning Authority
- focus group details: programme, attendees and completed SWOTs
- conversion table: to document the conversion factors used (to move between energy capacity in MW and energy output in GWh) and to illustrate the scale of development associated with the overall deployment forecasts.

2: Planning and Energy Policy Context

Introduction

2.1 This chapter provides important context for the Cumbria renewable energy study by summarising the current position and emerging points relating to planning and energy policy in England.

Planning policy

National planning policy

2.2 The Government has announced a programme of radical reforms to the planning system as part of its agenda for devolving greater powers to councils and neighbourhoods. The approach to reforming the planning system is set out in the *Open Source Planning* Green Paper[3], which sets out a wide range of proposals for a new 'open source' planning system. Central to these reforms is a 'simple and consolidated' national planning framework, the details of which are still awaited. The implications of a new national planning framework on specific areas of planning policy, including renewable energy, are still yet to be fully determined.

2.3 In the meantime, current national policy and guidance set out in planning policy statements (PPS) and planning policy guidance (PPG) will continue to apply, and will be a material consideration when determining planning applications for renewable energy developments.

2.4 Planning Policy Statement 22: Renewable Energy (PPS22) and its Companion Guide, both published in 2004 (ODPM), set out the Government's national policies and key principles for planning for renewable energy in England. It states that increased development of renewable energy resources is vital in facilitating the delivery of the Government's commitments on both climate change and renewable energy. The Supplement to PPS1: Planning and Climate Change (ODPM, 2007) also states that local planning authorities should provide a framework that promotes and encourages renewable and low carbon energy generation.

2.5 In March 2010, the former Government commenced consultation on a revised draft PPS: Planning for a Low Carbon Future in a Changing Climate, which was intended to replace the PPS1 supplement and PPS22. The emphasis of this draft statement was that planning should actively support and help drive the delivery of renewables and low carbon energy, and placed particular importance on the role of regional strategies in setting ambitious targets for renewable energy and a clear strategy to support their delivery. It also stated that targets should be based on an assessment of the region's renewable energy resource, following guidance on assessing potential for renewables in the English regions published by the Department of Energy and Climate Change (DECC). In the light of the change in Government, the future of this revised PPS is still uncertain but is likely to be changed.

[3] http://www.conservatives.com/~/media/Files/Green%20Papers/planning-green-paper.ashx

2.6 This year's Budget and Growth Review announced on 24 March 2011 set out proposals aiming to ensure that the planning system better supports economic growth and sustainable development. These measures are intended to complement wider reforms to the planning system including the removal of central targets and encouraging local councils to bring forward more homes through incentives to share in the benefits of growth. The Budget proposals include:

- **A new presumption in favour of sustainable development** – fundamentally a presumption in favour of development except where this would clearly compromise the key sustainable development principles in national planning policy, including protecting National Parks, the Green Belt and Areas of Outstanding Natural Beauty. The presumption is intended to give developers, communities and investors greater certainty about the types of applications that are likely to be approved and should help to speed up the planning process and encourage growth.
    - ➢ The proposed wording was published on 16 June 2011 and is being consulted upon as part of the consultation on the draft National Planning Policy Framework.
    - ➢ The presumption states that Local Planning Authorities (LPAs) should:
        - prepare local plans on the basis that objectively assessed development needs should be met, and with sufficient flexibility to respond to rapid shifts in demand or other economic changes
        - approve development proposals that accord with statutory plans without delay
        - grant permission where the plan is absent, silent, indeterminate or where relevant policies are out of date.
- **A pro-growth national planning policy statement** – the Government intends to combine all national planning policies into one document called the National Planning Policy Framework containing the Government's key economic, social and environmental objectives and planning policies to deliver them. A draft of the Framework was published for consultation on 25 July 2011, with the aim of finalising it by the end of 2011, if possible. Box 2-1 contains an extract from the Draft Framework relating to renewable and low carbon energy.
- **Changes to permitted development rights** – removing the requirement for planning permission for change of use to convert vacant and derelict offices into new homes. The Government will consult on this shortly and also launch an urgent review of the Use Classes Order, which determines how a building can be used.
- **Prioritising growth and jobs** – local authorities are required to prioritise growth in the decisions that they take locally. Councils should ensure that they are not imposing unnecessary burdens in the way of development; where development has stalled, councils should be open to reviewing section 106 agreements at the request of developers, and looking at making possible amendments to get growth underway.

This could benefit and disadvantage renewable energy deployment; increased deployment is likely to create more jobs so development should be promoted, but any reduction in section 106 could impact on the amount of building integrated technologies that can be installed.

- **Extending neighbourhood planning to businesses** – businesses now have the right to initiate Neighbourhood Plans and Neighbourhood Development Orders. This is intended to encourage growth by reducing the need to apply for planning approval in order to develop. Businesses will need to work closely with and win the approval of local communities in order to establish a neighbourhood plan or order.

- **Removal of central targets** – the Government will remove the Whitehall target of specifying the levels of housing development that should take place in previously developed land, but strong policy protection will be maintained for the environment including maintaining the Green Belt, National Parks, Sites of Special Scientific Interest, Areas of Outstanding Natural Beauty and other environmental designations. No information is provided concerning renewable energy targets.

- **Removing bureaucracy from planning applications** – simplifying and speeding up the planning system will include a 12 month guarantee for the processing of all applications, including appeals.

- **New duty for councils to co-operate on planning issues** – the Localism Bill will place a new duty to co-operate on councils to work together to address planning issues that impact beyond local boundaries, such as on transport, housing or infrastructure which could include renewable energy developments.

- **Fast track, democratic system for major infrastructure applications** – the new Major Infrastructure Unit will maintain the stability and speed of the current fast track system for applications, but with decisions made by Ministers rather than officials.

Box 2-1: Extract from the Draft National Planning Policy Framework[4] on "Support the delivery of renewable and low-carbon energy"

152. To help increase the use and supply of renewable and low-carbon energy, local planning authorities should recognise the responsibility on all communities to contribute to energy generation from renewable or low-carbon sources. They should:

- have a positive strategy to promote energy from renewable and low-carbon sources, including deep geothermal energy
- design their policies to maximise renewable and low-carbon energy development while ensuring that adverse impacts are addressed satisfactorily
- consider identifying suitable areas for renewable and low-carbon energy sources, and supporting infrastructure, where this would help secure the development of such sources
- support community-led initiatives for renewable and low carbon energy, including

[4] http://www.communities.gov.uk/planningandbuilding/planningsystem/planningpolicy/planningpolicyframework/

developments outside such areas being taken forward through neighbourhood planning; and

- identify opportunities where development can draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

153. When determining planning applications, local planning authorities should apply the presumption in favour of sustainable development and:

- not require applicants for energy development to demonstrate the overall need for renewable or low-carbon energy and also recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and
- approve the application if its impacts are (or can be made) acceptable. Once opportunity areas for renewable and low-carbon energy have been mapped in plans, local planning authorities should also expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying opportunity areas.

Localism Bill

2.7 The Government's Localism Bill was introduced to Parliament on 13 December 2010. The intention of the Bill is to shift power from central government back into the hands of individuals, communities and local authorities. It is intended that increasingly community groups and local institutions should be given the power to deliver local services and includes a number of important elements:

- decentralisation and strengthening democracy
- non-domestic rates
- community empowerment
- radical re-boot of the planning system including neighbourhood planning
- changes to social housing policies
- devolving powers to the Mayor and London boroughs.

2.8 Whilst proponents of the Bill consider it should accelerate rather than put a break on development, concerns have been voiced that it could lead to increased NIMBYism which can be a significant barrier to the consent of renewable energy developments.

Regional planning policy

2.9 In June 2010, the Coalition Government announced the revocation of Regional Spatial Strategies (RSS) with immediate effect with new ways for LPAs to address strategic planning and infrastructure issues to be introduced in the Decentralisation and Localism Bill. However, in November 2010, Cala Homes (South) Ltd won a case against the Secretary of State for Communities and Local Government, with the outcome being that the latter was not entitled to use the discretionary power to revoke regional strategies contained in s79(6) of the Local Democracy, Economic Development and Construction Act 2009. As a result, RSS remains a material consideration although its revocation is still intended.

2.10 In a letter to chief planning officers (dated 6 June 2010) the Secretary of State stated the following with regards to regional policies on renewable and low carbon energy:

> *'Through their local plans, authorities should contribute to the move to a low carbon economy, cut greenhouse gas emissions, help secure more renewable and low carbon energy to meet national targets, and to adapt to the impacts arising from climate change. In doing so, planning authorities may find it useful to draw on data that was collected by the Regional Local Authority Leaders' Boards (which will be made available) and more recent work, including assessments of the potential for renewable energy.'*

2.11 Policy EM17 of the North West of England Regional Spatial Strategy to 2021 set out renewable energy targets for the region, with the overarching aim of producing at least 10% of the electricity supplied within the region from renewable energy sources by 2010 (rising to at least 15% by 2015 and at least 20% by 2020).

2.12 With the imminent abolition of RSS and the introduction of the localism agenda by the new Government, it will fall to local planning authorities to determine the contribution that they can make towards the challenging national targets. The RSS targets for the deployment of renewable energy in Cumbria by 2020 are set out below:

Table 2-1: North West Regional Spatial Strategy Renewable Energy Targets, 2020

Resource technology	Number of schemes	MW capacity
Commercial wind (onshore)	21 – 27	253.5
Small scale wind	15	0.45
Micro wind	1,500	1.5
Biomass fuelled CHP schemes	4	18
Anaerobic digestion of farm biogas	3	6
Hydropower	8	2.4
Solar Photovoltaics	3,750	7.5
TOTAL	51-57	292.4

Source: North West of England Plan: Regional Spatial Strategy to 2021

Sub-regional planning policy

2.13 In line with the Planning and Compulsory Purchase Act (PCPA) 2004, the Cumbria and Lake District Joint Structure Plan has been replaced by the North West of England RSS. However, on adoption of the RSS, a number of policies in the Joint Structure Plan were extended to supplement RSS policy, meaning they are still a material consideration for planning decision-making purposes. Policy R44 *Renewable Energy Outside the Lake District National Park and AONBs* encourages renewable energy proposals, subject to environmental and amenity considerations, and sets out locational criteria for wind energy, biomass plants and the recovery of energy from agricultural waste and sewage sludge.

2.14 A Supplementary Planning Document (SPD) on wind energy was produced by Cumbria County Council to interpret and provide guidance on planning policies dealing with the development of onshore wind turbines and their associated landscape impact. The SPD has been adopted by each of the local authorities in Cumbria, except Barrow, and forms part of each council's Local Development Framework. Cumbria County Council also intends to prepare a Waste to Energy SPD.

2.15 Cumbria County Council has also provided its core strategy, site allocation (currently under review) and development control policies concerning Waste to Energy contained within the Cumbria Minerals and Waste LDP. This Plan applies to all local authorities in Cumbria and is a material consideration in the determining of planning decisions. Core Strategy Policy 1 *Sustainable Location and Design* requires that:

> *'all proposed waste management developments with gross floor space of over 1000 square metres should gain at least 10% of energy supply, annually or over the design life of the development, from decentralised and renewable or low carbon energy supplies'*

It also requires that energy management, environmental performance and carbon reduction are all taken into account in the design of facilities.

2.16 Core Strategy Policy 9 is concerned with waste capacity, the development of an integrated network and the provision of waste facilities. It states the amount of waste capacity that should be provided for managing and treating municipal waste, and commercial and industrial waste, and landfill capacity. The policy requires that sufficient sites should be identified for an integrated network providing a range of waste management facilities with preference given to sites that can accommodate more than one type of facility. Finally the policy details the number and type of sites required to provide sufficient waste capacity and enable the development of an integrated network. These include two sites of between 2 and 4.5 ha for Energy from Waste incinerators.

2.17 Site Allocations Policy 3 *Energy from waste plants (sites of around 2 to 4.5 ha)* with the first preference sites to be identified as:

- AL 3 Oldside, Workington
- AL 8 Lillyhall Waste Treatment Centre, Workington
- AL 18 Port of Workington
- CA 31 Kingmoor Park East, Carlisle

2.18 Development Control Policies DC 4 *Criteria for Waste Management Facilities* states that combined heat and power providers will be given preference as will proposals located on an industrial site or premises where the waste arises or heat can be used.

Local planning policy

2.19 The Planning and Compulsory Purchase Act (PCPA) 2004 introduced fundamental changes to the plan making system. County Structure Plans were replaced by Local Development Frameworks (LDFs). The Core Strategy is the most important suite of documents that comprise the LDF, as its sets out the overall vision and policies, at a strategic level, to guide the direction of future development. However, owing to the anticipated timings of the preparation and adoption of the LDF, the Act has allowed policies in existing local plans to be 'saved' until they can be superseded by adopted LDF policy.

2.20 Until recently, targets for the delivery of renewable energy developments in Cumbria were set out in RSS policy (see above). Given the timing of the revocation of RSSs, and current uncertainty regarding responsibility for strategic planning functions previously undertaken at the regional level, local planning authorities in Cumbria have not yet revised local planning policies relating to renewable energy deployment. Rather, 'saved' policies in local plans and emerging policies in LDF documents set out the criteria against which planning applications for renewable energy development will be considered.

2.21 **Allerdale Borough Council** is currently in the early stages of production of their LDF, and is due to consult on the Cope Strategy Options early in 2012. The preferred option will contain a Core Strategy policy covering renewable energy generation.

2.22 **Barrow-in-Furness Borough Council** is currently at a very early stage in the preparation of their LDF and has not yet commenced production of their Core Strategy DPD. A number of policies relating to renewable energy in the Barrow-in-Furness Local Plan Review 1996-2006 (adopted August 2001) have therefore been 'saved' until superseded. Policy D45 seeks to encourage proposals for energy generation projects where they meet best practice criteria and minimise environmental impacts. Policies D46 and D47 seek to control the location of wind turbines and set out a number of criteria against which proposals for wind energy installations will be considered. Policies D48 and D49 seek to control the location, scale and design of energy and heat from farm waste, solar and PV, whilst Policy D50 seeks to improve energy conservation and efficiency in new developments.

2.23 The **Carlisle City** Revised Local Plan (adopted in 2008) is a transitional document until the Carlisle LDF is sufficiently advanced. Carlisle City Council is currently at the early stages of production of their LDF, although it is envisaged that key elements of the revised Local Plan will be transferable to the Core Strategy. In the meantime, Local Plan Policy CP8 *Renewable Energy* seeks to encourage proposals for renewable energy developments subject to consideration of a number of land use impacts. Policy CP9 *Development, Energy Conservation and Efficiency* seeks to encourage developers to consider the incorporation of photovoltaic cells, solar panels and other small-scale sources of renewable energy in new developments. Carlisle City Council adopted its Energy Efficiency SPD in Spring 2010.

2.24 **Copeland Borough Council** consulted on its Preferred Options Core Strategy and Development Management Policies DPD between May and July 2010, which sets out preferred policy options for a number of strategic policy issues. With regards to renewable energy, Preferred Option Policy ER2 *Planning for the Renewable Energy Sector* seeks to support and facilitate new renewable energy generation at locations which best maximise renewable resources and minimise environmental and amenity impacts. Criteria on the location and impact of renewable energy development are set out in Preferred Option Policy DM2 *Renewable Energy Generation in the Borough*. There are also a number of 'saved' policies on renewable energy in the Copeland Local Plan. 'Saved' policies EGY2 to EGY6 encourage the development of wind energy, solar energy, hydroelectric schemes, tidal energy, waste and biofuels subject to a number of criteria relating to environmental and amenity impacts (Policy EGY1). Policy EGY7 *Energy Conservation & Efficiency* requires developers to make provision for energy production on-site from renewable energy sources.

2.25 **Eden District Council's** Core Strategy DPD (formally adopted in May 2010) supports renewable energy proposals, subject to no significant unacceptable effects, particularly where they contribute towards meeting and exceeding the minimum renewable energy targets set out in the RSS (Policy CS20). With regard to the use of renewable energy in new developments, Policy CS19 *Energy Conservation, Efficiency and Production in New Developments* states that the thresholds and targets set out in RSS policy EM18 should be adhered to.

2.26 **South Lakeland District Council's** Core Strategy DPD (formally adopted October 2010) states that the Council will be undertaking a study on renewable energy potential and viability, with a view to including targets for energy for renewable and decentralised energy within a review of the Core Strategy or a subsequent DPD (Policy CS8.7 *Sustainable Construction, Energy Efficiency and Renewable Energy*). It is anticipated that this Cumbria Renewable Energy Capacity and Deployment Study (Commissioned by Cumbria County Council) will fulfil this policy objective. There are also a number of 'saved' policies relating to renewable energy in the South Lakeland Local Plan. 'Saved' policies C26 to C30 encourage the development of wind energy, hydroelectric schemes, slurries and solar power subject to a number of criteria relating to environmental and amenity impacts. SLDC is looking towards a greater degree of action on the topics of renewable energy and climate change with an increase in both elected member and Management Team support for these issues.

2.27 **The Lake District National Park's** Core Strategy DPD (formally adopted in October 2010) supports renewable energy developments, including and additional buildings or infrastructure, as long as landscape character or the special qualities of the National Park are not adversely affected (Policy CS16 *Generating Renewable & Low Carbon Energy*). Policy also requires all new housing developments and other developments with 200sqm or more of floorspace to generate energy from decentralised, renewable or low-carbon sources to reduce predicted CO_2 emissions by 10% or more. This target should be exceeded where feasible. With regards to wind energy developments, Policy CS16 states that these will be assessed in accordance with the Cumbria Wind Energy SPD.

2.28 The **Yorkshire Dales National Park** Local Plan has only recently been adopted (2006) and so the production of a Core Strategy as part of their LDF is not currently a priority. Saved Policy U6 *Small-Scale Renewable Energy Developments* of the Local Plan supports small-scale proposals that meet local energy needs subject to a set of criteria against which proposals will be assessed. Policy U5 *Large-Scale Renewable Housing Developments* has not been saved. The National Park also has a draft Housing Development Plan policy, which will form their version of the 'Merton rule' in relation to new housing. The Yorkshire Dales

National Park Authority has recently adopted an SPD '*The Guide to Energy Production in the Yorkshire Dales National Park*' to help guide renewable energy development.

Marine planning

2.29 The Marine Management Organisation (MMO) was established in 2010, incorporating the work of the Marine and Fisheries Agency and has several roles; principally marine planning plus other marine related powers and specific functions previously associated with DECC and the Department for Transport (DfT).

2.30 The key role of the MMO is to implement a new marine planning system designed to integrate social requirements, economic potential and environmental imperatives related to the UK's seas. It has an important role with regards to the deployment of offshore renewable energy as it is responsible for licensing offshore generating stations including wind farms, wave and tidal devises with a capacity of 1-100 MW. Larger capacity generating stations qualify as nationally significant infrastructure and are therefore subject to a different form of consent from central Government.

Concluding comments on the planning policy environment

2.31 It is hard to judge the implications of the Government's proposed planning reforms given the current uncertainty regarding the scale of reform. However, in the absence of regional policy setting out renewable energy capacity targets, greater emphasis is likely to be placed on the need for local authorities to encourage the development of renewable and low carbon energy through local policies alongside the guidance in the national planning policy framework.

2.32 The Cumbria Wind Energy SPD provides a strong policy steer for the deployment of wind energy and the Cumbria LPAs are all looking to include policies promoting the deployment of renewable energy as they proceed through the plan-making process. This provides a positive policy environment and the development of criteria-based policies will enable planning officers, developers and local communities to fully understand the requirements that must be addressed in developing and implementing renewable energy schemes.

Energy policy

National policy

2.33 Policy on renewable energy capacity is fast moving and changing to take in to account emerging technologies and targets at the national and global level. During the five years from the end of 2004 through to 2009, worldwide renewable energy capacity grew at rates of 10-60% annually for many technologies. For wind power and many other renewable technologies, growth accelerated in 2009 relative to the previous four years[5]. Currently, UK policy is in a state of flux with new Coalition Government policy emerging through 2011. The 2010 Comprehensive Spending Review confirmed the current Government's commitment to investing in this area and to pressing ahead with the UK's competitive

[5] REN21 Global Status Report http://www.ren21.net/globalstatusreport/REN21_GSR_2010_full.pdf

advantage in the green economy. DECC is the only department that will see its Capital Budget rise over the Spend Review Period; a 59% increase is planned by 2014-15.

2.34 The UK's current policy stance is to dramatically increase its use of renewable energy (including renewable electricity generation, renewable heat and renewable energy/fuels for transport). Underpinned by an EU-wide commitment to increase the use of renewable energy, the UK has committed to sourcing 15% of its energy from renewable sources by 2020.

2.35 The threat of potentially dangerous climate change means there is an urgent need to reduce UK emissions of carbon dioxide and other greenhouse gases. Renewables will help the UK to recover some of its energy self-sufficiency, while ensuring that more imported energy comes from reliable sources. Globally, there is an on-going transition to a new, low-carbon future, and the UK can make the most of economic opportunities in this sector by getting ahead on the renewables agenda as quickly as possible.

Renewable Energy Strategy

2.36 The current Renewable Energy Strategy for the UK was put in place by the former Government to help tackle climate change, by reducing the UK's emission of carbon dioxide by over 750 million tonnes between now and 2030. It also promotes the security of the national energy supply by reducing overall fossil fuel demand by around 10% and gas imports by 20-30% against what they would have been in 2020. The strategy also has the aim of creating up to half a million more jobs in the UK renewable energy sector resulting from around £100 billion of new investment. Alongside energy saving, nuclear and carbon capture and storage, the strategy is a key element of an overall transition plan for the UK to achieve a low-carbon, sustainable future that helps address climate change.

Government priorities

2.37 Last year's Spending Review revealed the Government's plans on renewables and how it intended to take forward the low carbon agenda. Although the Renewable Energy Strategy is still in place, the Spending Review, plus the Business Plan for DECC published in November 2010, set out Government thinking and proposed action on the topic with reform priorities as summarised in Table 2-2 below:

Table 2-2: Compulsory Spending Review highlights

Structural Reform Priorities

- Save energy with the Green Deal and support vulnerable consumers.
- Reduce energy use by households, businesses and the public sector, and help to protect the fuel poor
- Deliver secure energy on the way to a low carbon energy future
- Reform the energy market to ensure that the UK has a diverse, safe, secure and affordable energy system and incentivise low carbon investment and deployment
- Drive ambitious action on climate change at home and abroad
- Work for international action to tackle climate change, and work with other government departments to ensure that we meet UK carbon budgets efficiently and effectively
- Manage our energy legacy responsibly and cost-effectively
- Ensure public safety and value for money in the way we manage our nuclear, coal and other energy liabilities.

Source: DECC Business Plan 2011-2015

2.38 The Government has retained the commitment to obtain 15% of energy from renewables by 2020 by supporting the roll out of large and small scale technologies and will aim for a 34% reduction in greenhouse gas emissions by 2020 compared to 1990 levels.

2.39 As a result of the Spending Review, DECC will no longer fund technologies unless it is confident that they are the most critical to meeting long-term de-carbonisation and energy security objectives. Nor will it contribute to funding the establishment of the National Nuclear Centre of Excellence or provide the same scale of funding to deal with the overseas nuclear legacy once current commitments are met. The Government's key needs for technical advice and related support on nuclear non-proliferation issues will instead be met by new cross-government arrangements that were announced in the Strategic Defence and Security Review. There will be an end to voluntary contributions to international energy and climate organizations; instead contribution to international low carbon technology efforts will be channelled through the Official Development Assistance Budget. There will also no longer be funding for any of the economic development activities previously funded by the Regional Development Agencies[6].

Renewable Heat Incentive

2.40 On 10 March 2011, the Government announced the details of the Renewable Heat Incentive policy to change the way heat is generated and used in buildings and homes. The RHI will provide support for a range of technologies and fuel uses including solid and gaseous biomass, solar thermal, ground and water source heat pumps, on-site biogas, deep geothermal, energy from waste and injection of biomethane into the grid.

2.41 The RHI is the first financial support scheme for renewable heat of its kind in the world. The RHI will represent over £850 million investment over the spending review period, driving a more-than-tenfold increase of renewable heat over the coming decade and moving renewable heat into the mainstream, whilst achieving efficiency savings of 20% or £105 million a year by 2013-15.

2.42 The scheme will be introduced in two phases. In the first phase, long-term tariff support will be targeted in the non-domestic sectors, at the big heat users – the industrial, business and public sector – which contribute 38% of the UK's carbon emissions. Under this phase there will also be support of around £15 million for households through the Renewable Heat Premium Payment. This will come into force in September 2011.

2.43 The second phase of the RHI scheme will see households moved to the same form of long-term tariff support offered to the non-domestic sector in the first phase. This transition will be timed to align with the Green Deal which is intended to be introduced in October 2012. In the meantime, a Premium Payment scheme for domestic renewable heating systems targeted at off-gas grid properties has been launched.

[6] DECC Business Plan 2011-2015 http://www.decc.gov.uk/assets/decc/About%20us/decc-business-plan-2011-2015.pdf

Feed-in Tariffs

2.44 Feed-in-Tariffs (FITs) are a financial incentive for renewable generators with an installed capacity below 5MW. The initiative was developed by DECC and was designed to encourage individuals and businesses in the UK to generate renewable energy. FITs aim to make renewable generation more financially viable by guaranteeing generators a long term fixed price for the renewable energy they produce. This will help the UK reach its 2020 target of generating 15% of the UK's energy from renewable sources. They are particularly designed for 'first time' generators and will consist of two tariffs: a Generation Tariff and an Export Tariff:

- **Generation Tariff** – a fixed rate that a generator will receive for every kilowatt of renewable energy generated regardless of where the energy is used. To measure the generation there must be an Ofgem approved total generation meter connected to the installation.
- **Export Tariff** – a fixed 3p/kWh rate for the surplus amount of energy which is sent back to the electricity grid. This is measured by an export meter onsite and will initially be estimated for smaller installations. Generators will receive the export tariff in addition to the generation tariff.

2.45 On 7 February 2011, the Energy Minister, Chris Huhne announced the start of the first review of the FITs scheme to be completed by the end of the year. As confirmed at the Spending Review, the FIT review will determine how the efficiency of FITs will be improved to deliver £40 million of savings, around 10% in 2014/15. The review will be completed by the end of 2011, with tariffs remaining unchanged until April 2012 – unless the review reveals a need for greater urgency. Changes proposed include the following:

- indexation of all tariffs by Retail Price Index (RPI) in future years
- support for electricity generation from biomass (other than anaerobic digestion) will not be provided by FITs, but will be continued to be supported through Renewable Obligation Certificates instead
- a pilot programme for support of domestic scale micro-combined heat and power (CHP) through FITs
- changes to the banding structure for anaerobic digestion (AD), hydropower and wind
- deferral of the start of degression of tariffs by one year with a steeper profile thereafter.

2.46 As part of the FIT scheme review, a fast-track review was initiated by DECC in relation to the tariffs for large scale and stand-alone solar photovoltaics (PV) projects (over 50kW); for example, so called solar farms, and farm-scale anaerobic digestion of up to 500 kilowatts. A consultation on the fast track review was held between March and May 2011. The outcome of this fast track review was announced on 9 June 2011. This confirmed the Government's proposed tariff reductions for solar PV larger than 50 kilowatts and all stand-alone PV installations and increases for farm scale anaerobic digestion (up to and including 500 kilowatts).

Green Investment Bank and Finance for Overseas Development

2.47 The Spending Review also included a commitment of providing £1 billion of funding to capitalise a UK-wide Green Investment Bank (GIB). Subject to final design, this will aim to provide financial interventions to unlock significant new private investment in green infrastructure projects. Government ministers have said they want to '*create an enduring institution which can re-invest the proceeds from its investments*' and expect the GIB to support risk that the market currently cannot afford. On 29 June 2011, the GIB Commission published its recommendations for the initial design and focus of the Bank in its report *Unlocking investment to deliver Britain's low carbon future*[7].

2.48 Spending on overseas development assistance (ODA) was also protected, providing £2.9 billion of international climate finance to help developing countries.

Carbon Capture and Storage

2.49 The Spending Review revealed that there will be up to £1 billion of investment to create one of the world's first commercial scale carbon capture and storage (CSS) demonstration plants and there is an additional commitment to providing public funding for four CCS demonstration plants in coming years.

Carbon Reduction

2.50 The CRC Energy Efficiency scheme (formerly known as the Carbon Reduction Commitment) will be maintained but reformed with the first allowance sales for 2011-12 emissions now taking place in 2012 rather than 2011. The scheme is a mandatory scheme aimed at improving energy efficiency and cutting emissions in large public and private sector organisations. These organisations are responsible for around 10% of the UK's emissions. The scheme is designed to tackle CO_2 emissions not already covered by Climate Change Agreements (CCAs) and the EU Emissions Trading Scheme. Following the Spending Review, revenues from allowance sales in the scheme, totalling £1 billion a year by 2014-15 will be used to support the public finances, including spending on the environment, rather than recycled to participants.

Energy Legacy

2.51 The legacy of UK energy will be managed responsibly in a new way that protects public safety. The Department will continue to manage capital funding for the Nuclear Decommissioning Authority (NDA) and spending on the highest hazards at sites such as Sellafield are protected.

Energy Bill (December 2010)

2.52 The Energy Bill has been designed to provide for a step change in the provision of energy efficiency measure to homes and businesses, and make improvements to our framework to enable and secure, low carbon energy supplies and fair competition in the energy markets.

[7] http://www.climatechangecapital.com/media/108890/unlocking%20investment%20to%20deliver%20britain%27s%20low%20carbon%20future%20-%20green%20investment%20bank%20commission%20report%20-%20final%20-%20june%202010.pdf

The Bill seeks to provide for some of the key elements of the Coalition's Programme for Government and its first Annual Energy Statement. It is a first step in the legislative programme and further legislation will be sought to implement, for example, the findings of the Electricity Market Reform Programme.

2.53 The Energy Bill has three principal objectives: tackling barriers to investment in energy efficiency; enhancing energy security; and enabling investment in low carbon energy supplies. In summary, the Bill seeks provisions for:

- The Green Deal
- Measures to enable low carbon technologies
- Further provisions including support to the private sector, the Energy Company Obligation and measures to support energy efficiency.

The Green Deal

2.54 The Green Deal is the Government's initiative to support the implementation of energy efficiency measures to households and businesses without needing to meet any upfront costs. The programme will be backed with a totally new finance mechanism designed around the needs of people and business. The Queen's Speech in May 2010 set out a provisional timetable to put in place the legal framework needed for the Green Deal. It is anticipated that the Green Deal will be launched in autumn 2012.

2.55 The Green Deal has provision:

- To create a new financing framework to enable the provision of fixed improvements to the energy efficiency of households and non-domestic properties, funded by a charge on energy bills that avoids the need for consumers to pay upfront costs. This framework will include:
  - powers to set parameters around the use of this facility to ensure consumer protection from both the originator of the work and subsequent occupiers
  - powers to limit access to the financial mechanism in the framework to the installation of measures that are expected to deliver savings exceeding the level of the charge
  - an obligation on energy companies to administer the charges and pass monies to the appropriate party.
- To exempt energy suppliers from the Consumer Credit Act requirement to gain a credit licence when they collect Green Deal payments. Exempt Green Deal Providers from the requirement to hold a consumer credit licence in respect of Green Deal Finance offered to smaller businesses, to avoid segmenting the non-domestic market.
- In November 2010, DECC announced that the Energy Bill would create powers to allow any tenants asking for 'reasonable energy efficiency improvements' to receive them from 2015 onwards. It was also announced that local authorities would be given

powers to insist that landlords improve the worst performing homes. Local authority action would focus on homes with an Energy Performance Certificate Rating (EPC) of F and G.

Measures to enable low carbon technologies

2.56 These measures will firstly involve extending existing Secretary of State powers in the Energy Act 2004 (that expired on 18 December 2010) and also extend existing Ofgem powers in the Electricity Act 1989 to enable the implementation of an enduring offshore electricity transmission regime beyond 2010. Secondly, they will require amending existing powers in the Energy Act 2008 that enable Secretary of State to modify a nuclear operator’s Funded Decommissioning Programme; to ensure that there is an appropriate balance between the Secretary of State’s powers to protect the taxpayer and the operator’s need for clarity over how those powers will be exercised.

Other provisions in the Energy Bill

2.57 Other provisions in the Energy Bill include:

- **Private Rented Sector:** establishing powers for the Secretary of State, which would, in the event of continued poor energy efficiency performance in the Private Rented Sector, prevent private residential landlords from refusing tenants’ reasonable request for energy efficiency improvements to be undertaken in their properties, where a finance package is available. It would also require private landlords in the domestic and non-domestic sector to improve some of the least energy efficient properties where finance is available. The earliest date regulations could be made is April 2015.
- **Energy Company Obligation:** amend existing powers in the Gas Act 1986, Electricity Act 1989 and the Utilities Act 2000 to enable the Secretary of State to create a new Energy Company Obligation to take over from the existing obligations to reduce carbon emissions (the Carbon Emissions Reduction Target (CERT) and Community Energy Saving Programme (CESP)), which expire at the end of 2012, and to work alongside the Green Deal finance offer by targeting appropriate measures at those households which are likely to need additional support, in particular those containing vulnerable people on low incomes and those in hard to treat housing.
- Further measures to improve energy efficiency including:
  - amending the smart meters powers in Energy Act 2008 to allow Government to direct the approach to the roll-out of Smart Meters until 2018 and to enable the Secretary of State to make changes to transmission licences to ensure the effective introduction of the new central communications arrangements to support all Smart Meters.
  - amending the Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007, to enable the removal of unnecessary restrictions on access to data.
- a series of measures to improve energy security

- a measure extending the role of the Coal Authority
- Repeal of the Home Energy Conservation Act 1995 (HECA) in England, Scotland and Wales.

Electricity Market Reform and Renewables Roadmap, July 2011

2.58 In December 2010, DECC and HM Treasury together launched consultations on fundamental reforms to the electricity market to ensure that the UK can meet its climate goals and have a secure, affordable supply of energy in the long term. The key proposals included:

- four reforms to provide long-term certainty for electricity investors
- a new market to have a built-in level playing field for low carbon
- rules for existing investments protected
- long term impact on household electricity bills lower than under the current market.

2.59 Following the consultations, the Electricity Market Reform (EMR) White Paper *'Planning our electric future: a White Paper for secure, affordable and low-carbon electricity'*[8] was published on 12 July 2011. This paper sets out the Government's commitment to transform the UK's electricity system to ensure that future electricity is secure, low carbon and affordable. It identifies the key challenges as: security of supply as existing plants close with around a quarter (around 20 GW capacity) of existing generation likely to be lost over the next 10 years as older or more polluting plants are closed, which if not replaced could result in increasing, expensive blackouts. Other challenges identified are the need to decarbonise electricity generation to achieve the 2020 target of meeting 15% electricity needs from renewable energy, a projected increase in demand for electricity despite improvements in energy efficiency and an increase in electricity costs.

2.60 The White Paper sets out key measures to attract investment, reduce the impact on consumer bills and create a secure mix of electricity sources including gas, new nuclear, renewables and carbon capture and storage. Key elements include:

- A Carbon Price Floor to reduce investor uncertainty, putting a fair price on carbon and providing a stronger incentive to invest in low-carbon generation.
- The introduction of new long-term contracts (Feed-in Tariff with Contracts for Difference) to provide stable financial incentives to invest in all forms of low-carbon electricity generation. A Contract for Difference approach has been chosen over a less cost-effective premium feed-in tariff.
- An Emissions Performance Standard set at 450_g CO_2/KWh to reinforce the requirement that no new coal-fired power stations are built without carbon capture and storage, but also to ensure that necessary short-term investment in gas can take place.

[8] http://www.decc.gov.uk/en/content/cms/legislation/white_papers/emr_wp_2011/emr_wp_2011.aspx

- A Capacity Mechanism including demand response as well as generation, which is needed to ensure future security of electricity supply. Further views will be sought on the type of mechanism required.

2.61 The White Paper was accompanied by the publication of the *UK Renewables Roadmap*[9]. The Roadmap is intended to set out a comprehensive action plan to accelerate the UK's deployment and use of renewable energy, in order to achieve the 2020 target, while driving down the cost of renewable energy over time.

2.62 The study has strong resonance with the Roadmap and, along with its precursor – the North West Renewable Energy and Deployment Study – is highlighted within the document as an example of how to take forward sub-national renewable energy capacity and deployment assessments.

2.63 The UK Renewables Roadmap identifies the eight technologies that have either the greatest potential to help the UK meet the 2020 target in a cost-effective and sustainable way, or offer great potential for decades to come. These are: offshore wind, onshore wind, marine energy, biomass heat, ground source heat pumps, air source heat pumps and renewable transport.

2.64 Energy from wind, biomass and heat pumps are identified as the leading contributors, including offshore wind – where the UK has abundant natural resource and is already the world's largest market. The remaining energy necessary to meet the 2020 target is expected to come from technologies such as hydropower, solar PV, and deep geothermal heat and power.

Emerging energy legislation and policy

2.65 Consultation on the reform of the Climate Change Levy to provide support to the carbon price was undertaken in spring 2011 with plans to publish on the consultation by November. The Government will decide whether to introduce a levy on electricity supplies from CCS or to fund future demonstrations from general public spending from this consultation.

2.66 There are also particular implications for local authorities and communities from the Coalition's commitment to maximising renewable energy generation. In August 2010, the ban on local authorities selling renewable energy generated from their own estates was overturned. According to a letter from Chris Huhne to all local authorities, they '*should assume their rightful place leading a local power revolution*'. This will open new sources of income including the full benefit of the FIT and it is estimated could generate up to £100 million a year in income for local authorities across England and Wales.

2.67 In addition more support is to be given to community ownership of renewable assets. The Coalition's Programme for Government[10] stated that it would '*…encourage community-owned renewable energy schemes where local people benefit from the power produced. We will also allow communities that host renewable energy projects to keep the additional business rates they generate*'. Further details of how this will operate in England are expected in the coming months.

[9] http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/renewable-energy/2167-uk-renewable-energy-roadmap.pdf
[10] HM Government 2010 – The Coalition's Programme for Government.

2.68 Overall, there are still important national policy decisions being made in this area which will impact on the Cumbria authorities' approaches to renewable energy. It is important that LPAs keep abreast of unfolding policy developments to ensure that their policies and practices align with national policy and legislation.

Regional energy policy

2.69 Regional policy is in a similar state of flux as at the national level – the Government's move to scrap Regional Development Agencies and allocate Regional Growth Fund spending at Local Enterprise Partnership level raises questions over the extent to which regional strategy will play in to policymaking going forwards; it is likely that there will be a greater emphasis on sub-regional developments.

2.70 Both the North West Sustainable Energy Strategy and the North West's Climate Change Strategy and Action Plan date back to 2006 meaning that they are both now quite dated. However, the 'Future Northwest: Our Shared Priorities' document from August 2010 states that to '*develop our low carbon energy offer*' is a key priority for the North West over the next decade. The following three objectives for the region are set out to contribute towards tackling climate change:

- Make the North West a world-class place for nuclear technologies, accelerate the deployment of renewable energy and exploit opportunities in other low carbon and environmental goods and services.
- Ensure the North West understands and adapts to the implications of unavoidable climate change.
- Stimulate key sectors, including housing, transport and industry, to develop low carbon and resource efficient solutions and alternatives.

2.71 On renewable energy, the document states that:

> '*Currently we generate around 5% of our electricity from renewable sources, with even lower proportions for transport and heat. We need to step this up if the North West is to make an effective contribution to the UK target of generating 15% of tour energy from renewables by 2020. Our extensive rural areas, coastline and other assets provide potentially significant opportunities to develop wind, marine, energy from waste and other renewable energy technologies. These are supplemented by a strong research base at our universities and research/innovation centres. However, the electricity network will require considerable upgrading if it is to support our low carbon energy aspirations*.'[11]

2.72 Cumbria is clearly a key area to which this aim applies.

Local energy policy

2.73 Due to its advanced position with in the sector Cumbria already has its strategic direction on renewable energy set out to a certain extent.

[11] NWDA – 'Future Northwest: Our Shared Priorities'
http://www.4nw.org.uk/downloads/documents/aug_10/4nw_1281965953_FINAL_Future_NW_main_doc1.pdf

2.74 As the Furness Enterprise Partnership points out without exaggeration, *'Nowhere within the UK is there a more strategically important area than the West Coast of England, and in particular for energy generation, the Furness Peninsula and its offshore coastline west of Barrow-in-Furness. Barrow is the Gateway to Britain's Energy Coast'*[12].

2.75 'Britain's Energy Coast – A Masterplan for West Cumbria' focuses on the nuclear assets that the county has as well as the internationally competitive expertise and skills in a range of related activities, including environmental remediation, engineering and decommissioning. Employment in Research and Development is double the regional average.

2.76 The document sets out the importance of the sub-region to the UK contribution to European energy policy. Noting that West Cumbria can provide a unique contribution to the UK's short and long term policy goals, transforming its own economy in the process. The Vision for West Cumbria is based on this unique relationship between local economic assets and transformation and national policy priorities.

2.77 On renewables more specifically, Cumbria Vision's 'The scope for renewable energy in Cumbria' document is a 2009 study which indicates that the likely locations and distribution of renewable production within the county. The study does not provide an in-depth evidence base on the potential renewable energy resources and technologies but suggests an indicative timeline for the development of renewable energy set out in Table 2-3 below.

Table 2-3: Findings from the Cumbria Vision Renewable Energy Scoping Study

In 2010

- It is expected that Cumbria will have only some 380MW of installed renewable capacity, almost all of it as electricity from wind, two thirds of that offshore. Most of the jobs are however likely to be associated with small-scale hydro and energy from landfill, sewage gas and fuel wood.

By 2020

- the offshore wind sector is expected to have expanded dramatically and the county's total capacity, again mostly for electricity production, to have risen to around 2500MW – 2.5GW – which is in theory sufficient to meet almost all of Cumbria's needs if operating continuously.
- the study is cautious about tidal power, projecting only 150MW of development, equivalent to either a small Solway Barrage or the Bridge Across Morecambe Bay, which would combine the attractions of a new communications link for West Cumbria with both wind and tidal stream turbines; small-scale hydro, solar, geothermal and biomass sources are all expected to have advanced and to be important sectors of employment, with a total of about 2500 jobs in the renewable energy sector by this period.

By 2050

- onshore wind is expected to have reached a ceiling because the sensible sites have been taken up and it is assumed that the internationally acclaimed Cumbrian landscape, source of so much tourist income, will be safeguarded;
- offshore wind could however be a very big player indeed;
- tidal power could well have expanded a great deal, possibly using tidal stream turbines, some in association with wind farms;
- wave energy may have become a contributor, though potential in the land-locked Irish Sea is relatively limited;
- solar systems could have taken off, impelled by feed-in-tariffs and the Government commitment to a zero carbon standard for all new homes built after 2016;
- ground and air sourced heat pumps are also predicted to gain popularity, replacing domestic heating oil.

Source:http://www.cumbriavision.co.uk/files/documents/The%20Scope%20for%20Renewable%20Energy%20in%20Cumbria%20FINAL.pdf

[12] http://www.furnessenterprise.co.uk/

2.78 The Cumbria Local Enterprise Partnership (LEP) was established in 2010, with the vision '*To create one of the fastest growing economies in the UK, in an energised and healthy environment*'. The LEP has recently submitted a bid to Government for the development of an Enterprise Zone (EZ) focused on low carbon and renewable energy development: Britain's Energy Coast Low Carbon/Energy Enterprise Zone comprised of two sites at Barrow Waterfront and Lillyhall in West Cumbria. The two sites are proposed in order to target opportunities in different growth sectors of the energy market: Lillyhall for nuclear and low carbon related technologies, and Barrow Waterfront for offshore renewable energy generation and gas storage. It is intended that EZ status will allow for better targeting of inward investment opportunities, exploiting Cumbria's competitive advantage by building up clusters of existing specialist companies thus attracting and developing new business in a national growth sector.

Summary of energy policy environment

2.79 Clearly, the broader energy policy context is promoting and encouraging the increased deployment of renewable energy, both offshore and onshore, through both national and local policy imperatives and financial incentives. Cumbria is taking advantage of these and together with its low carbon assets, through Britain's Energy Coast is ensuring that the sub-region maximises its continued competitive advantage in this national growth area.

3: Energy demand

Introduction

3.1 In this chapter we describe current energy usage in Cumbria and explore projections of energy demand to 2020, 2030 and 2050 for use within this study. It should be noted that in this chapter, analysis is provided at the ***local authority*** rather than the ***local planning authority*** level, that is specific figures are not provided for the Lake District and Yorkshire Dales National Parks, as energy consumption and demand projections are not available at these levels.

3.2 Total energy demand is analysed including transport; however, it is important to specify that the study as a whole is focused on the capacity and deployment of renewable energy for electricity and heat production, i.e. it does not provide forecasts for renewable energy used to directly fuel transport nor does it encompass low carbon technologies such as nuclear.

Current energy consumption in Cumbria

3.3 Regional energy consumption data is available from DECC[13]. This is derived from a number of sources, including meter point data from electricity and gas supply companies and benchmark figures developed for the National Atmospheric Emissions Inventory[14]. There are a number of points to note with regard to this data set:

- Figures are available at the local authority (LA) and MLSOA (middle layer super output area) levels. For this study we have used the LA datasets.
- Fuels consumed for electricity generation are not included in these figures, which relate to **final** energy consumption (FEC), while electricity generation involves the **transformation** of one form of energy to another.
- Large industrial consumers are excluded from the data for reasons of commercial confidentiality. This only occurs in cases where these consumers account for a significant proportion of the local energy demand, which limits the utility of this data as a measure of **total** energy consumption at the LA level (however coverage for non-industrial sectors should be better). Gas consumption figures have been 'weather adjusted' by DECC to smooth out the impact of temperatures higher of lower than the regional average. The other fuel consumption figures have not been adjusted in this way.
- The split between 'domestic' and 'industrial and commercial' consumption for electricity and gas has been made on the basis of a number of factors including: the type of meter; the level of annual metered demand; and company address registration data. Given the methodology adopted, it is likely that the majority of public sector demand will be included in the 'industrial and commercial' figure.

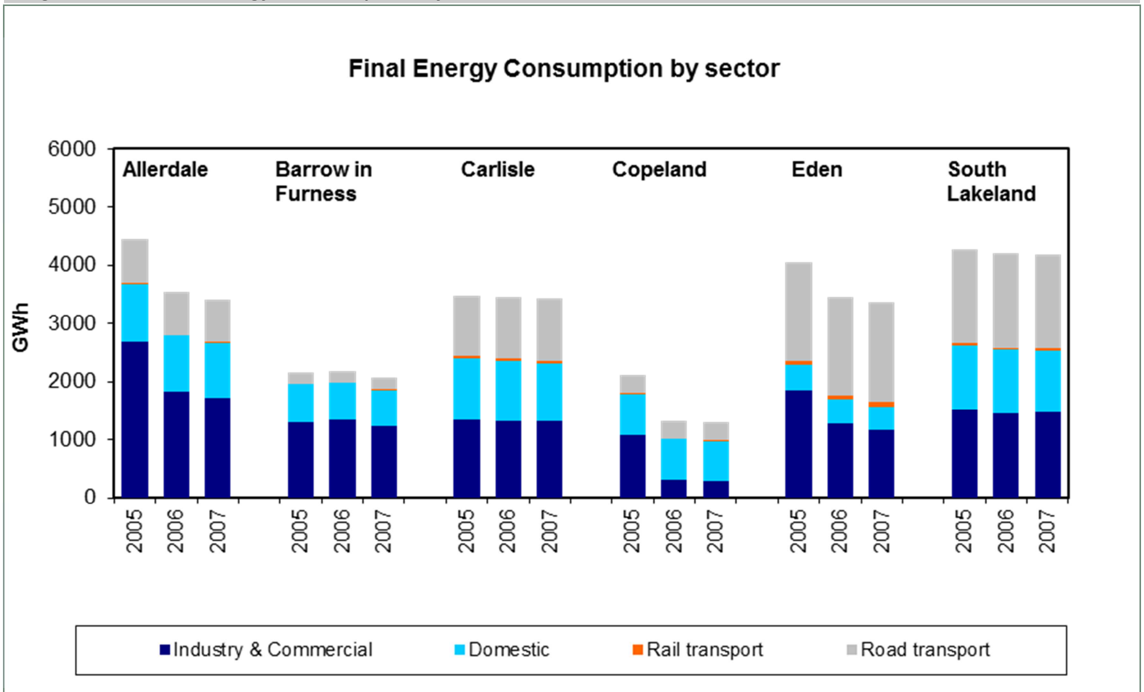
[13] http://www.decc.gov.uk/en/content/cms/statistics/regional.aspx
[14] http://www.naei.org.uk/

3.4 Energy consumption data is available at the individual LA (not disaggregated to LPA including the National Parks) level, but the focus of this section is on current and projected energy demand for Cumbria as a whole.

3.5 Figure 3-1 shows FEC by sector for the six Cumbrian LAs. Key observations are:

- The large fall in industrial and commercial (I&C) production in some areas between 2005 and 2006 is probably due to the removal of large gas consumers from the database for commercial reasons, as noted above.
- Road transport is included in this figure for comparison, although energy used for transport will not be covered by this study. The size of transport energy demand is closely correlated with the area of each LA and the path of the M6. Diesel fuel used in rail transport is also included.
- Official government statistics are only available from DECC at a regional level for 2005 onwards (electricity and gas for 2005-08, other fuels 2005-07). Experimental statistics are available for earlier years, with the caveat that they use a different methodology so should not be directly compared to the official figures. In addition, we consider it possible that the economic recession, introduction of renewable tariffs and potentially the Green Deal could have a significant impact on energy consumption which may bring into question the validity of projection based on previous years.
- This short time period covered by the data set makes it unsuitable for use as a firm basis for the identification of trends although it can be seen that energy demand in each county fell between 2006 and 2007 (pre-dating the onset of recession).
- Across Cumbria as a whole, I&C demand is 50% greater than domestic demand.

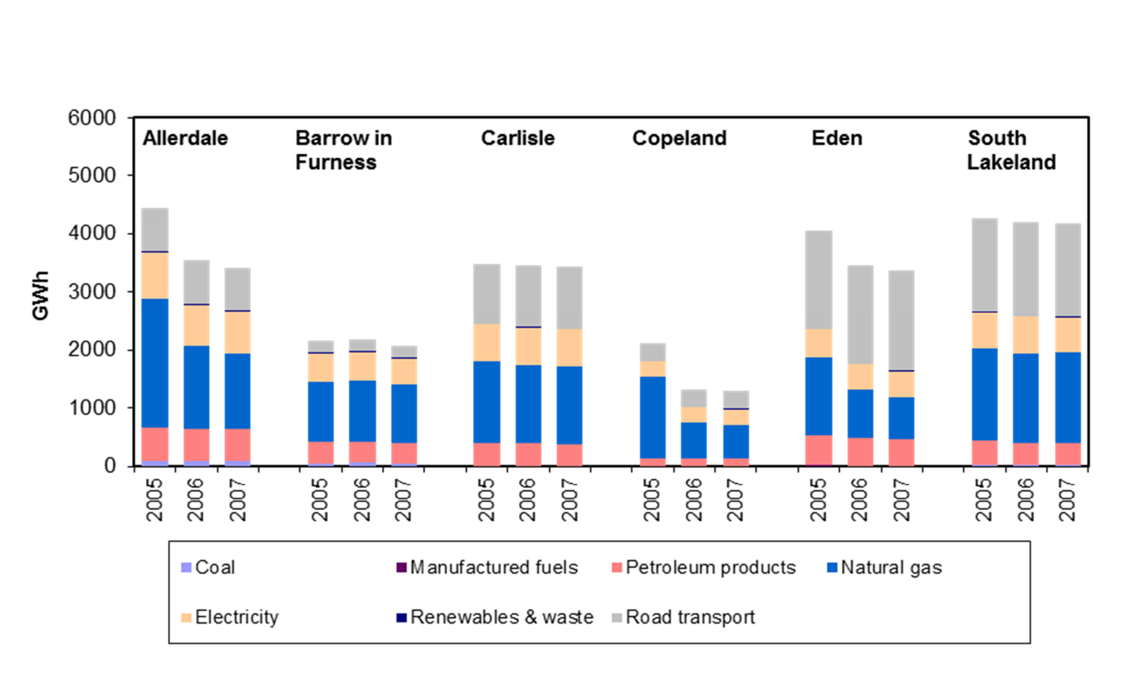
Figure 3-1: Final energy consumption by sector



Source: SQW from DECC data

3.6 Figure 3-2 provides more detail on the fuels consumed in each LA from 2005 to 2007.

Figure 3-2: Final Energy Consumption by type[15]



Source: SQW from DECC data

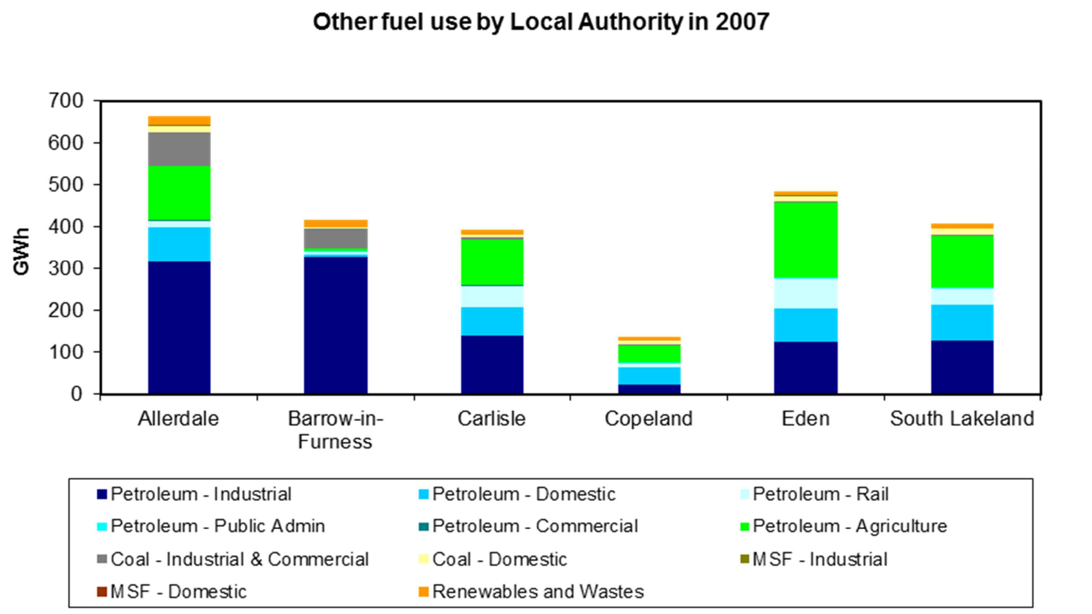
3.7 The large fall in consumption noted previously in Allerdale, Copeland and Eden can be traced to a fall in gas consumption, possibly related to the removal of large scale consumers between 2005 and 2006.

3.8 In each LA (excluding road transport) gas[16] meets the largest proportion of demand (~55%), followed by electricity (~25%) and petroleum products (~18%). Other fuels play very little part in I&C or domestic demand.

3.9 Figure 3-3 shows demand for 'other' fuels (not gas or electricity) in 2007. Approximately 80% of petroleum demand (other than for road transport) is accounted for by the agricultural and industrial sectors. The remaining demand is largely accounted for by the domestic and rail sectors, with some industrial coal use remaining in Allerdale and Barrow-in-Furness. 2.5% of current energy demand is satisfied by energy generated from renewables and wastes. Figure 3-3 also highlights the significant differences in energy consumption profile between different Cumbrian LAs, reflecting the rural/urban split and the specific industrial makeup within each LA area. In addition, there are significant differences in the amount of energy consumed for transport which relates to the route of the M6 across the sub-region.

[15] The new nuclear new build site is likely to have a potential output of 3.2 GW or 3.6 GW depending on the type of reactor type that is developed
[16] The Steering Group requested clarification as to whether the figure for gas includes bottled gas. We have not been able to obtain a definitive answer, but assume that as this is not identified as an explicit separate gas category it is included within the overall figure.

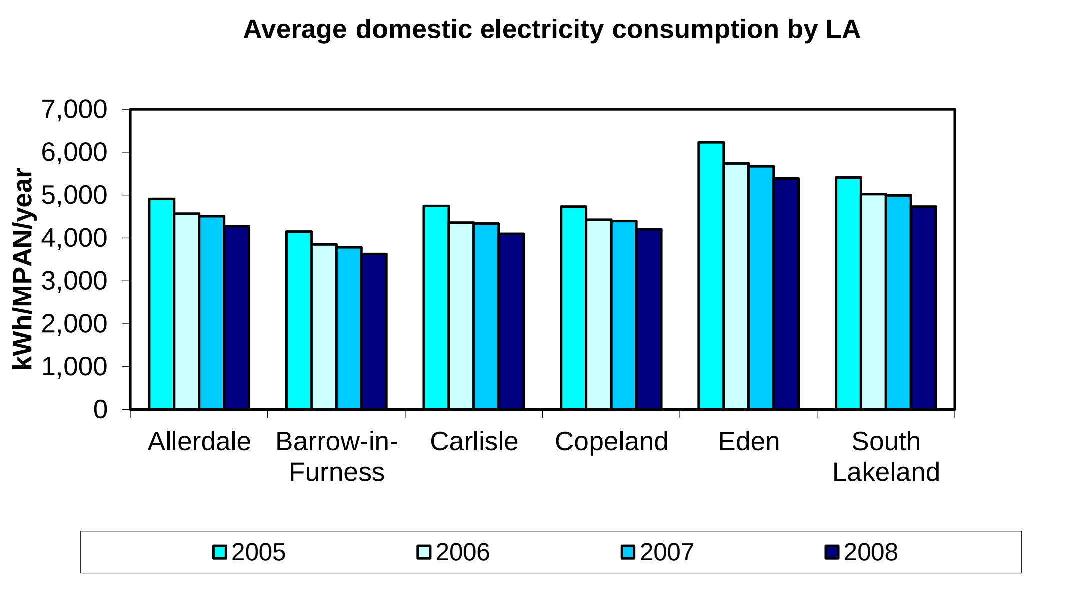
Figure 3-3: Other fuels used by local authority in Cumbria in 2007



Source: SQW from DECC data

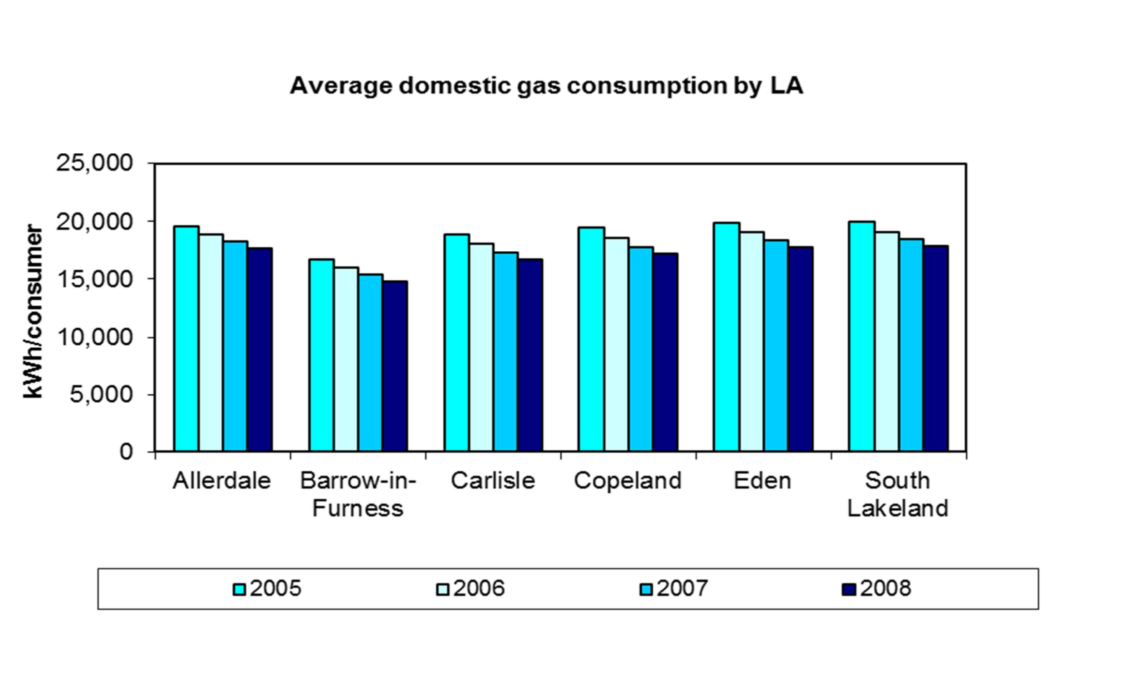
3.10 Figure 3-4 and Figure 3-5 show that domestic electricity and gas consumption are on a downward trend in each LA in Cumbria. Demand is noticeably higher in rural areas, probably due to larger, older and less energy efficient housing stock.

Figure 3-4: Average domestic electricity consumption by authority



Source: SQW from DECC data

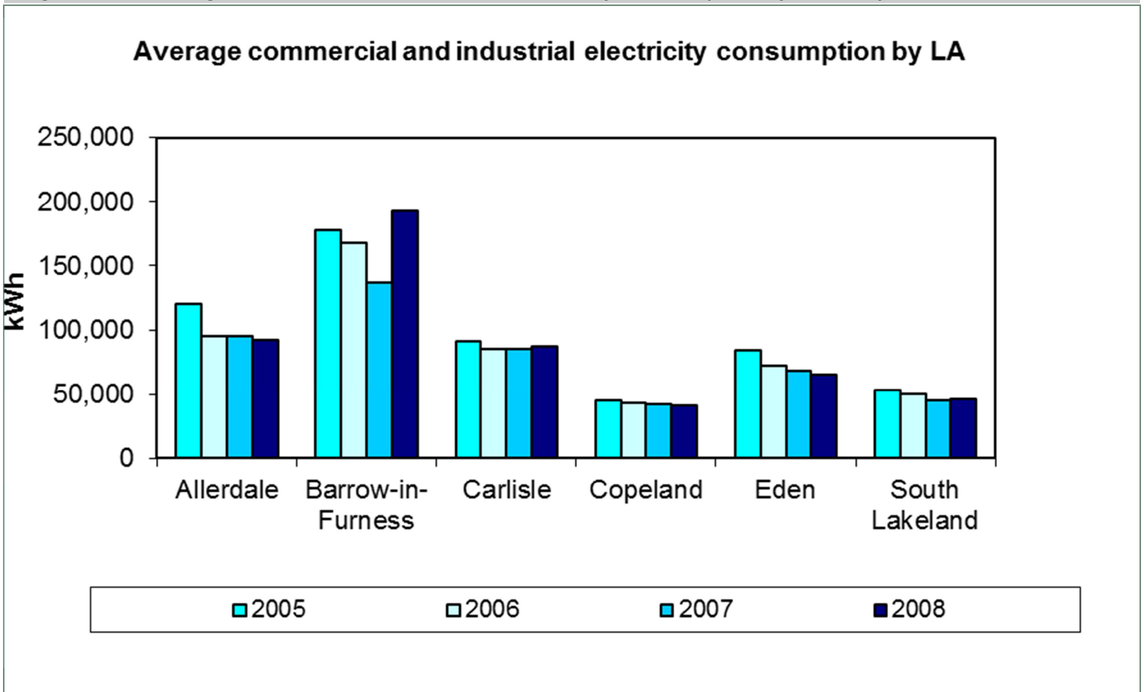
Figure 3-5: Average domestic gas consumption by authority



Source: SQW from DECC data

3.11 Figure 3-6 shows that average consumption in the I&C sector is also falling, with the notable exception of Barrow-in-Furness, where demand rose in 2008. While this could be explained by the opening (or re-opening) of an industrial facility, we cannot be completely certain as it could also relate to a change in methodology to assess energy demand.

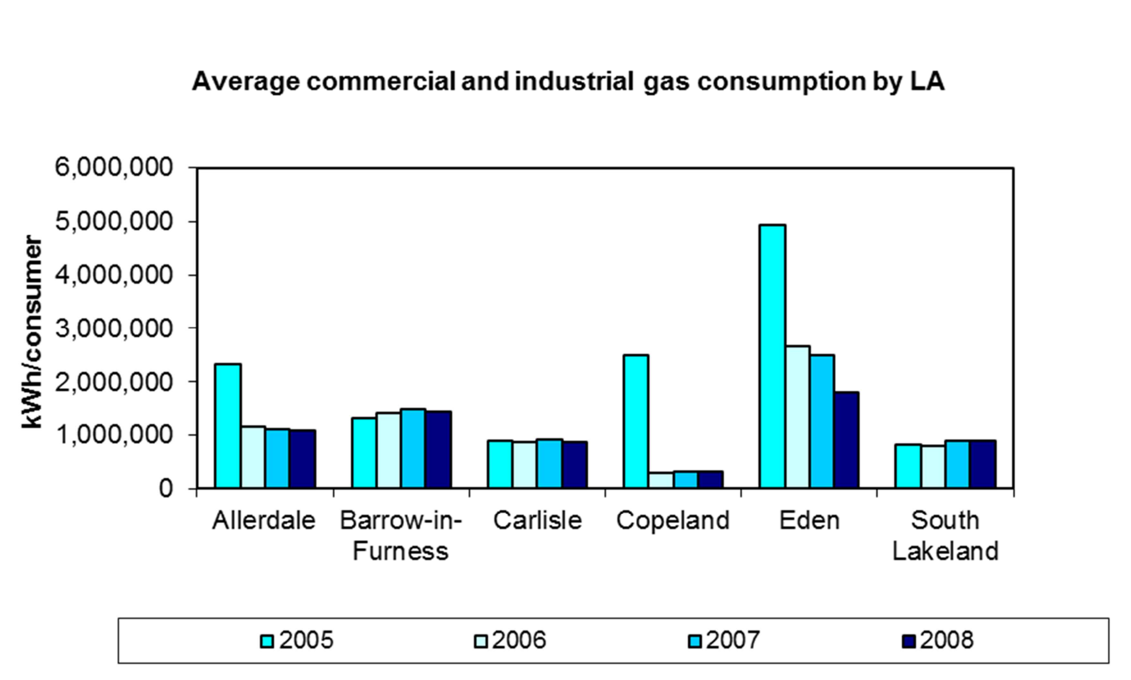
Figure 3-6: Average commercial and industrial electricity consumption by authority



Source: SQW from DECC data

3.12 Figure 3-7 for average I&C gas consumption, illustrates the impact of the (presumed) removal of a small number of large consumers from the Allerdale, Copeland and Eden data sets in 2006.

Figure 3-7: Average commercial and industrial gas consumption by authority



Source: SQW from DECC data

Other sources of evidence

3.13 Due to identified limitations with regards to the removal of large industrial users energy consumption data, we have briefly investigated this issue to identify if any approaches can be undertaken to 'fill the gap' in intelligence. The Steering Group recommended we consider the data which informed the Cumbria 'Mini Stern Review'[17] conducted in 2008. The data was sourced from NI 186: Per capita reduction in CO_2 emissions in local authority areas. It was suggested that this could be traced back to energy consumption for large I&C consumers. However, this data also excludes energy consumption from large users on the basis of disclosure rules. These rules are in place to ensure that it is not possible to work out the consumption of individual companies using national statistics in order to protect commercial sensitivity.

3.14 Within Cumbria, there are probably around 10 sites (such as the Gypsum plant at Kirby Thore and the Corus works at Shap) excluded from the data and we would have to identify the specific businesses and request them to provide data on their energy use to provide a fully robust dataset. We have explored the potential of obtaining electricity consumption statistics from large industrial consumers supported by Invest Cumbria and Britain's Energy Coast. However, it has not been possible to rectify this without potentially double-counting as there is no way of identifying which consumers are excluded as the disclosure rules prevent DECC from doing so.

3.15 The Cumbria Climate Change Strategy[18] provides no additional information as this refers to 2005 baseline data which has been used to establish energy use and carbon dioxide equivalent

[17] Regeneris, 2008, Economic implications of climate change legislation for Cumbria
[18] Cumbria County Council, Cumbria Climate Change Strategy, 2008-2012

emissions across all sectors, but does not identify the source of the data. We assume that this also is referring to the DECC regional energy consumptions used in this report.

Energy demand projections

Methodology

3.16 The trajectory of future energy demand in Cumbria will depend on a wide range of interconnected factors, including: economic growth rate, demographic changes, fuel prices, fuel switching, changing modes of transport, policy measures, consumer preferences and efficiency improvements. Rather than attempt to model all of these factors for Cumbria we have built on the work done by DECC in their 2050 Pathways analysis[19]. This approach will strengthen the work presented in the Northwest Renewable and Low Carbon Energy Study that drew on DECC figures and projected a decline in electricity demand of 2.8% between 2008 and 2020. The benefits of the new approach relate to enabling projections to be made beyond 2020 (up to 2050) and allowing different scenarios to be considered.

3.17 The DECC study describes a set of internally consistent, quantitative and distinct scenarios for UK energy supply and demand in the period to 2050. It is accompanied by a tool that allows users to construct their own pathways by choosing 'trajectories' for 40 separate energy supply and demand sectors. Two examples are given for supply and demand sectors below:

- Energy supply – nuclear power. Trajectories:

  1: No new nuclear power installed; estimated closure of final plant in 2035

  2: ~13 3GW power stations delivering ~280 TWh/yr in 2050

  3: ~30 3GW power stations delivering ~630 TWh/yr in 2050

  4: ~50 3GW power stations delivering ~1030 TWh/yr in 2050

- Energy demand – domestic lighting, appliances and cooking. Trajectories:

  1: Energy demand for domestic lights and appliances increases by 20% by 2050 (relative to 2007)

  2: Energy demand for domestic lights and appliances is stable to 2050

  3: Energy demand for domestic lights and appliances decreases by 40% by 2050

  4: Energy demand for domestic lights and appliances decreases by 60% by 2050

3.18 We have sought to apply the trajectories defined in the DECC Pathways study to present day energy demand in Cumbria in order to create demand projections to 2020, 2030 and 2050. Since the DECC analysis operates at a UK level it is important to note that this approach does not allow tailored projections taking into account of the specific circumstances in Cumbria.

[19] http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/2050/2050.aspx

3.19 Given that this task is focused on energy demand rather than supply (and not concerned with transport demand) the specific DECC trajectories selected on which Cumbrian energy demand projections are based are shown in Table 3-1.

Table 3-1: Relevant parameters from the DECC trajectories

Sector	Level 1	Level 2	Level 3	Level 4
Domestic space heating and hot water				
(i) Heating / cooling comfort level	Average room temperature increases to 20℃ (a 2.5℃ increase on 2007)	Average room temperature increases to 18℃ (a 0.5℃ increase on 2007)	Average room temperature decreases to 17℃ (a 0.5℃ decrease on 2007)	Average room temperature decreases to 16℃ (a 1.5℃ decrease on 2007)
(ii) Housing thermal efficiency	Average thermal leakiness (Watts/℃) of UK dwellings decreases by 25%	Average thermal leakiness (Watts/℃) of UK dwellings decreases by 33%	Average thermal leakiness (Watts/℃) of UK dwellings decreases by 40%	Average thermal leakiness (Watts/℃) of UK dwellings decreases by 50%
(iii) Electrification level	The proportion of domestic heat supplied using electricity is 0-10%, as today	The proportion of domestic heat supplied using electricity is 20%	The proportion of domestic heat supplied using electricity is 30-60%	The proportion of domestic heat supplied using electricity is 80-100%
(iv) Non-electric fuel direction	The dominant non-electric heat source is gas (biogas if available)	The dominant non-electric heat source is coal (biomass if available)	The dominant non-electric heat source is waste heat from power stations	A mixture of gas/biogas; coal/biomass; and heat from power stations
Commercial heating and cooling				
(i) Heat / cooling demand	Space heating demand increases by 50%, hot water demand by 60%, cooling demand by 250%	Space heating demand increases by 30%, hot water demand by 50%, cooling demand by 60%	Space heating demand stable, hot water demand increases by 25%, cooling demand stable	Space heating demand drops by 25%, hot water demand by 10%, cooling demand by 60%
(ii) Electrification level	The proportion of non-domestic heat supplied using electricity is 0-10%, as today	The proportion of non-domestic heat supplied using electricity is 20%	The proportion of non-domestic heat supplied using electricity is 30-60%	The proportion of non-domestic heat supplied using electricity is 80-100%
(iii) Non-electric fuel direction	The dominant non-electric heat source is gas (biogas if available)	The dominant non-electric heating fuel is coal (biomass if available)	The dominant non-electric heat source is heat from power stations	A mixture of gas/biogas, coal/biomass, and heat from power stations
Domestic lighting, appliances, and cooking				
(i) Demand / Efficiency	Energy demand for domestic lights and appliances increases by 20% (relative to 2007)	Energy demand for domestic lights and appliances is stable	Energy demand for domestic lights and appliances decreases by 40%	Energy demand for domestic lights and appliances decreases by 60%

(ii)Technology pathway	Energy used for domestic cooking remains at 63% electricity and 37% gas	100% electric	As for 2	As for 2
Commercial lighting, appliances, and catering				
(i) Demand / Efficiency	Energy demand for lights & appliances increases by 33%. Energy for cooking is stable	Energy demand for lights & appliances increases by 15%; decreases by 5% for cooking	Energy demand for lights & appliances decreases by 5%; decreases by 20% for cooking	Energy demand for lights & appliances decreases by 30%; decreases by 25% for cooking
(ii)Technology pathway	60% electricity and 40% gas (no change from 2007)	100% electric	As for 2	As for 2
Industrial processes	UK industrial sector is the same size and carbon intensity in 2050 (relative to 2007)	UK industrial sector same size with lower carbon intensity in 2050 (relative to 2007)	UK industrial sector large with much lower carbon intensity in 2050 (relative to 2007)	UK industrial sector small with much lower carbon intensity in 2050 (relative to 2007)

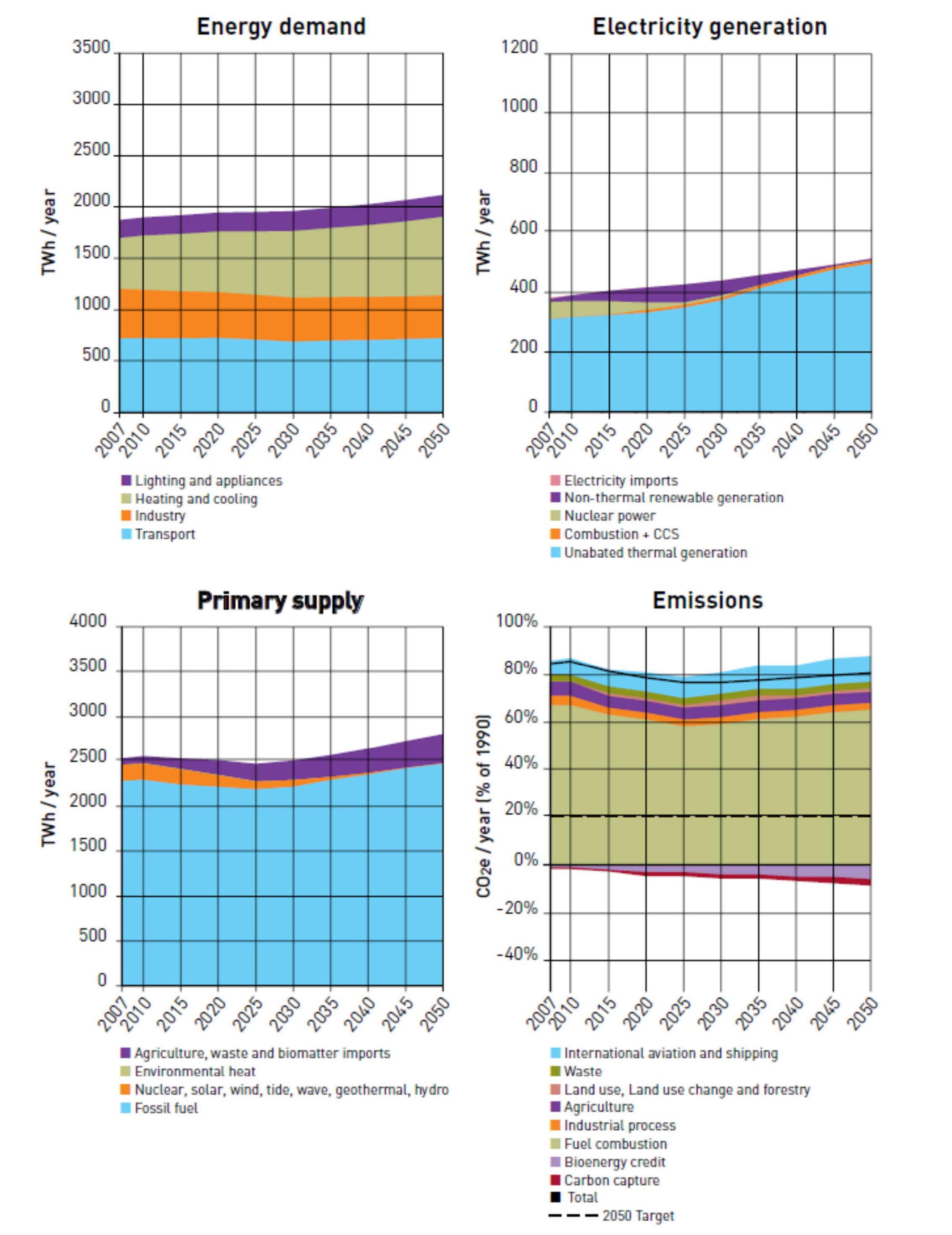
Source: SQW

3.20 A pathway is based on the selection of a set of options for energy supply and demand scenarios to 2050. The DECC study provides seven example pathways, from which we have selected two to use in this analysis:

- **The Reference Case:** this pathway assumes that there is little or no attempt to decarbonise, and that new technologies do not materialise. This pathway does not meet emissions targets and would not ensure that a reliable and diverse source of energy was available to meet demand – it would leave us very vulnerable to energy security of supply shocks.
- **Pathway Alpha** illustrates a pathway with largely balanced effort across all sectors, based on physical and technical ambition. In this pathway, there would be a concerted effort to reduce overall energy demand; an equivalent level of effort from three large scale sources of low carbon electricity (renewables, nuclear, and fossil fuel power stations with carbon capture and storage); and a concerted effort to produce and import sustainable bioenergy.

3.21 The charts in Figure 3-8 summarise the UK energy supply and demand picture to 2050 under the reference case: energy demand continues to rise but little effort is made to decarbonise and no significant new technologies are deployed at scale; fossil fuels increase their dominance of electricity generation and primary energy supply; carbon emissions remain relatively flat.

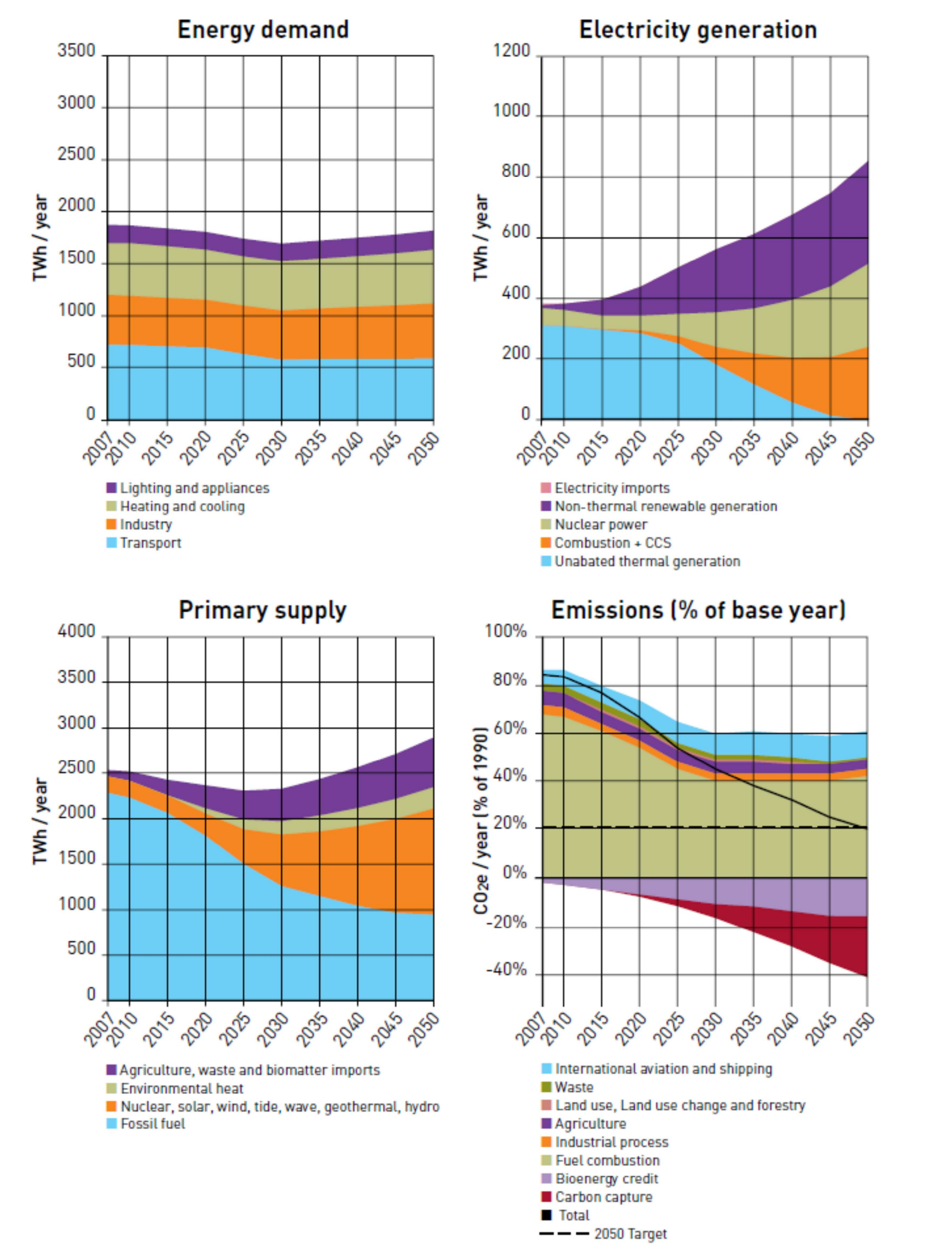
Figure 3-8: UK energy projections under the Reference case



Source: DECC pathways study

3.22 UK energy supply and demand projections under the Alpha pathway are shown below: energy demand stays relatively flat; rising electricity consumption from renewables, nuclear and CCS is accompanied by a sharp reduction in fossil fuel use as electricity use displaces fossil fuels in transport, industry and heating; building standards improve considerably; up to 60% of domestic heat comes from electricity and most of the remainder from district heating; 10% of UK land would be devoted to energy crops; 60% of mileage is covered in electric vehicles and 20% by fuel cell vehicles; road freight moves to rail and water. This is depicted in Figure 3-9.

Figure 3-9: UK energy projections under the Alpha pathway



Source: DECC pathways study

3.23 These pathways have been selected since they describe two extremes of effort as regards energy demand: little effort in the reference case and considerable effort under pathway Alpha. The other example pathways are as follows:

- Pathway Beta looks at what could happen if we were not able to generate electricity using carbon capture and storage technology.
- Path way Gamma looks at what could happen if no nuclear plant were built.
- Pathway Delta looks at what could happen if only minimal new renewable electricity capacity were built.
- Pathway Epsilon looks at what could happen if supplies of bioenergy were limited.
- Pathway Zeta looks at what could happen if there were little behaviour change on the part of consumers and businesses.

3.24 These scenarios illustrate the wide range of possible future energy landscapes it is possible to envisage for the UK in 2050, underlining the fact that projecting energy demand to 2050 is a very uncertain business.

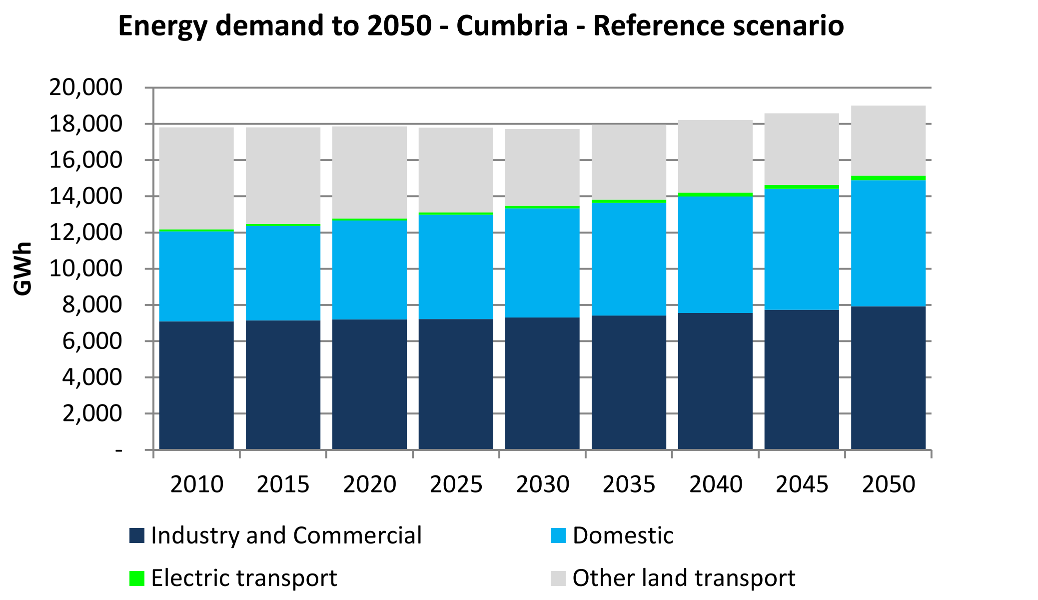
Energy projection results

3.25 The following methodology was used to map the DECC projections onto the data available for energy demand in Cumbria:

- DECC data for total local energy demand in 2007 was used as a starting point for the projections.
- **Domestic** energy demand was assumed to change in proportion with the UK average under each scenario. This is a reasonable assumption, although it fails to reflect differences between local and regional demographic changes.
- **Industrial and Commercial** energy demand was also assumed to change in proportion with the UK average under each scenario. In reality the particular industrial makeup within Cumbria could lead to significant differences between energy demand at a local and national level, however it is difficult to predict the evolution of the local industrial base with any confidence.
- **Transport** energy demand was also assumed to follow national patterns. In particular, the share of electricity in meeting transport demand was assumed to follow the UK average. However, note that there could be significant regional differences if, for example, demand for electric cars (and the associated infrastructure) rises initially for short journeys in urban areas and develops more slowly for long journeys and rural areas. Aviation and shipping demand were excluded since these sources of demand are not covered by DECC regional datasets (as there are difficulties in allocating these sources to specific Local Authorities).

3.26 The chart shown in Figure 3-10 shows projected energy demand by sector in Cumbria to 2050 in the Reference case. Under this scenario, total energy demand remains almost the same in 2020, with a slight dip by 2030, but overall rises 7% between 2010 and 2050. Energy demand at 2020 is projected as 17,900 GWh and 17,800 GWh in 2030. The rise between 2010 and 2050 is driven by a 40% increase in domestic energy demand and a 12% increase in I&C demand, offset by a 28% fall in demand for energy for land transport. The latter is largely the result of an assumed improvement in the efficiency of internal combustion engines (e.g. through the use of hybrid drives and lightweight vehicle design). Electricity used for transport increases by 154%, from 2% to 6% of total transport demand.

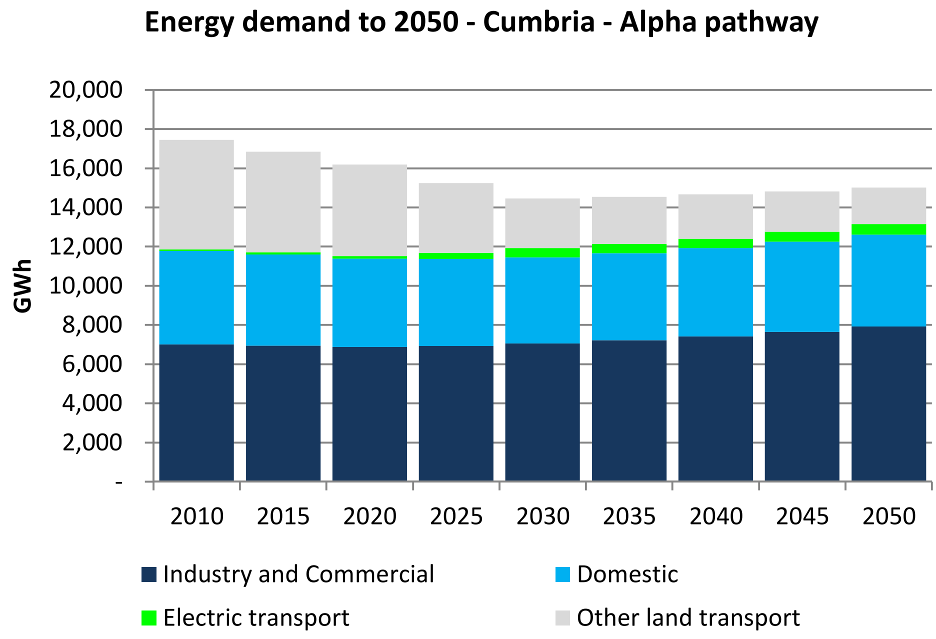
Figure 3-10: Cumbria energy demand projections under the Reference case



Source: SQW, based on DECC data

3.27 Figure 3-11 shows projected energy demand by sector in Cumbria to 2050 in the Alpha pathway. Under this scenario, total energy falls by 14% between 2010 and 2050, with a reduction between 2010 and 2020 of 9% and then a further reduction to 2030 of 11%. Energy demand is projected to be 17,500 GWh in 2020 and 16,000 GWh in 2030. The overall reduction is largely driven by a 38% fall in energy demand for transport, partly offset by a 13% increase in I&C demand. Domestic demand falls by 6% to 2030 then rises to match 2010 levels by 2050; the initial fall is a result of improved energy efficiency, but this trend is eventually reversed by rising household numbers and increased demand for air conditioning as summer temperatures rise. The fall in transport demand is the result of the technological improvements mentioned above, coupled with a modal shift from cars to buses, trains and bikes for domestic transport. Electricity increases its share of land transport demand from 2% to 23%.

Figure 3-11: Cumbria energy demand projections under the Alpha pathway



Source: SQW, based on DECC data

Potential impact of planned major developments

3.28 Clearly using trend-based projections does not allow for the impact of any planned major developments which may have a significant impact on energy demand over the next 20, 30 or 40 years. The following table, Table 3-2 identifies some of the immediate major developments that are planned within Cumbria. We have not built these into projections but provide a brief commentary below on how these may impact on future energy demand.

Table 3-2: Planned major developments in Cumbria

Local Planning Authority	Name of scheme	Type	Size	Location
GENERAL				
Carlisle CC	Crindledyke	Housing	850 units	Carlisle
	Carlisle Airport	Commercial		East of Carlisle
	Morton	Housing	800 units	
Copeland BC	Sellafield Nuclear Power Station	Energy production	Potential nuclear new build site – 2GW?	Sellafield
	Albion Square	Office, retail & leisure	11,000 m^2	
Eden DC	New Squares	Retail	90,000sqft	Penrith
South Lakes DC	Kendal Canal Head AAP	Mixed use		Kendal

HOUSING ALLOCATIONS (dwellings)				
Allerdale BC	Not yet developed	Housing	267 pa (RSS)	N?A
Barrow DC	Not yet developed	Housing	150 (RSS)	N/A
Carlisle CC	Not yet developed	Housing	637pa (Economic Strategy for Carlisle)	N/A
Copeland BC	Not yet developed	Housing	300pa (LDF Core options)	N/A
Eden BC	Not yet developed	Housing	127 2010/11 150 2012/13 200 2014/15 (LDF Core Strategy)	N/A
South Lakeland BC	Not yet developed	Housing	400pa (Core Strategy Development plan Document)	N/A
LDNPA	Not yet developed	Housing	60pa (Core Strategy Development Plan Document)	N/A

Source: SQW

3.29 From an initial review of the above, the proposed development requiring the most substantial amount of energy will be the new nuclear power station at Sellafield. Proposed additional housing figures will only increase the existing housing stock (using 2008 household projections as a proxy for existing stock) by around 1% annually and new housing will be more energy efficient than the existing stock so whilst this will result in additional energy demand, it is not expected to be substantial.

Summary

3.30 This section has provided an overview of current and projected future energy demand within Cumbria. Using regional energy consumption statistics from DECC, Cumbria's total energy demand in 2007 was approximately 18,000 GWh with demand from Industrial and Commercial sectors being 50% higher than the domestic sector. Road transport demand is substantial and is spatially linked to the path of the M6. Domestic demand is higher in more rural areas probably linked to older and less energy efficient dwellings.

3.31 The projections are based on a range of scenarios or 'Pathways' being applied. The DECC projections methodology uses eight Pathways, we have analysed projections for two for Cumbria: the Reference case (no attempt made to de-carbonise or maximise energy generation from renewable sources) and Pathway Alpha which involves a concerted effort to reduce overall energy demand, to increase energy generation from low carbon electricity and to produce and import sustainable bioenergy. The outcomes from these two scenarios show:

- Reference case – energy demand for Cumbria increases by 7% between 2010 and 2050 driven by a 40% increase in domestic energy demand and a 12% increase in

I&C demand, offset by a 28% fall in demand for energy for land transport. Emissions are likely to increase. Energy demand in 2020 and 2030 is projected to decrease slightly to 17,900 GWh and 17,800 GWh respectively.

- Alpha Pathway – energy demand for Cumbria falls by 14% between 2010 and 2050 driven by a 38% fall in energy demand for transport, partly offset by a 13% increase in I&C demand. Domestic demand falls by 6% to 2030 then rises to match 2010 levels by 2050 and emissions decrease. Energy demand in 2020 and 2030 is projected to decrease to 16,000 GWh and 14,200 GWh respectively.

3.32 The findings are caveated as the available data on current energy consumption excludes major commercial users of gas which are protected through disclosure rules. In addition, the projections into the future are based on proportions of national projections rather than being customised for Cumbria. However, we consider that these provide a useful basis for this study; that is, to provide a benchmark level for consideration of renewable energy generation potential and policies/targets.

4: Existing renewable energy deployment

Introduction

4.1 This chapter provides an overview of existing renewable energy schemes and the overall installed capacity in Cumbria.

Methodology

4.2 Information on the type, capacity, location and status (i.e. application submitted, consented, under construction, operational etc) of renewable energy projects throughout the county has been obtained from the following sources:

- Renewable Energy Planning Database (REPD): A national database run by AEA Technology on behalf of DECC
- RenewableUK (formerly BWEA): Detailed UK-wide information on windfarms
- British Hydropower Association
- Envirolink 'Survey of Planning Applications for Renewable Energy in the North West' dataset
- Ofgem Central Feed In Tariff Register, which provides details of all accredited microgeneration installations producing electricity.
- Review of existing renewable energy studies covering the area
- Information on schemes provided directly by the Cumbria Renewable Energy Capacity and Deployment Study Steering Group.

Existing deployment

4.3 Table 4-1 below provides a summary of existing renewable energy deployment in Cumbria. Further detail concerning individual schemes is provided in Annex E.

Table 4-1: Summary of number and capacity of existing renewable energy schemes in Cumbria

Technology	Number of Schemes	Capacity (MW)
Commercial On-shore Wind (Operational)	15	78.7
Commercial On-shore Wind (Consented/Under Construction)	7	63.5
Small-Scale/Micro Wind (Operational)	7	0.06
Small-Scale/Micro Wind (Consented/Under Construction)	71	1.14

Technology	Number of Schemes	Capacity (MW)
Biomass (Consented)[20]	8 (including Iggesund)	63 power, 64 heat
Anaerobic digestion (Consented)	4	2.75
Landfill Gas (Operational)	6	7.47
Landfill Gas (Under Construction)	1	0.18
Small-scale/Micro Hydro (Operational)	19	2.73
Small-scale/Micro Hydro (Consented)	7	1.38
Building integrated PV (Operational)	228	0.42
Building Integrated PV (Consented)	3	0.02
Solar Water Heating (Consented)	1	0.01

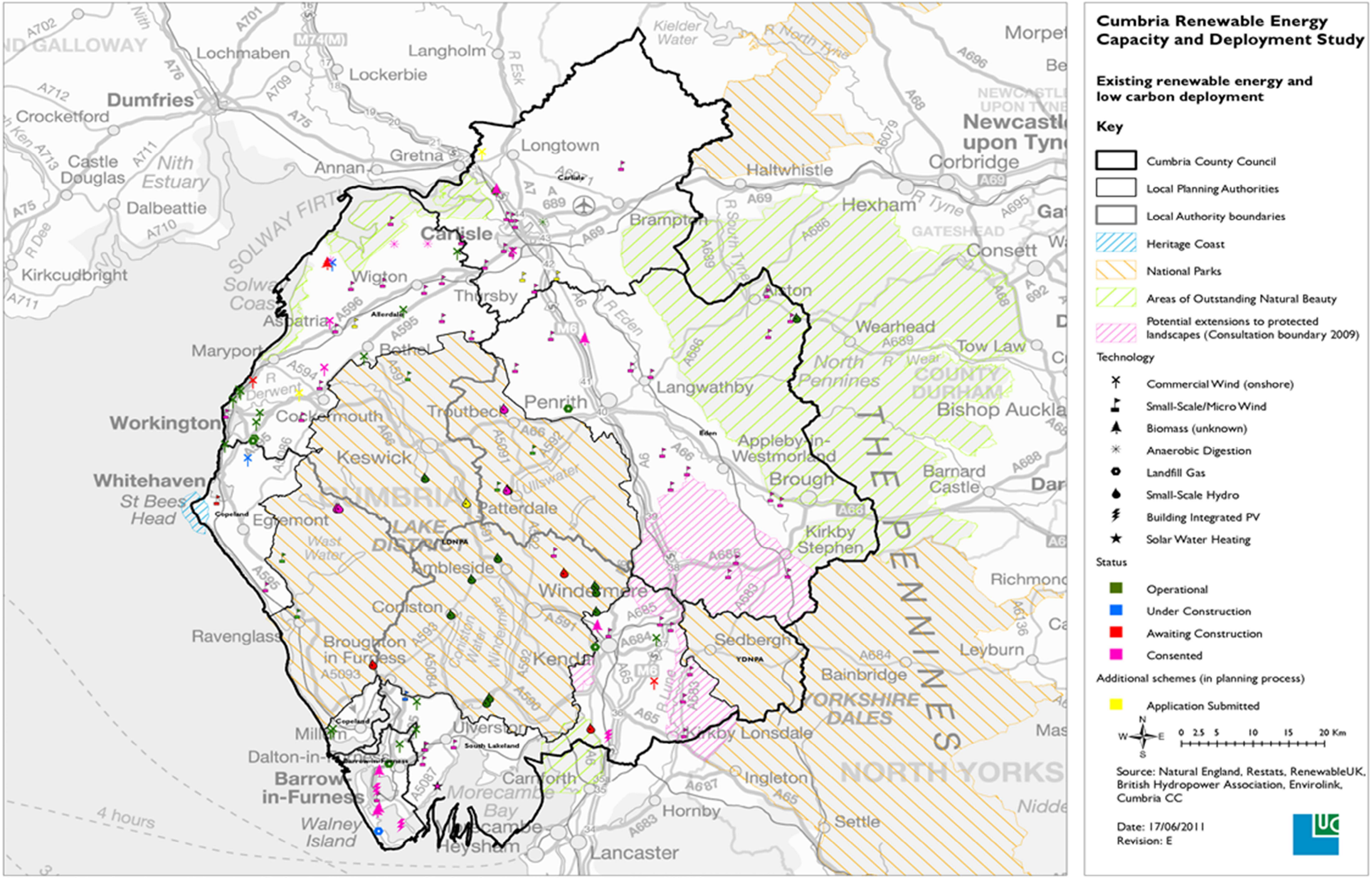
Source: LUC and SQW, April 2011[21]

4.4 A map indicating the location of these schemes is shown overleaf – this can also be downloaded from Cumbria County Council's website (labelled Map 1).

4.5 It is important to note that in some cases the energy capacity (MW) that is contributed by existing sites could change over time. In particular the older operational commercial wind schemes that were installed in the 1990's may at some point become subject to proposals to be "repowered" – i.e. to replace the turbines with more efficient technology.

[20] It is likely that there are many more individual small-scale biomass boilers in use that have not been captured through the data collation exercise

[21] It is likely that microgeneration installations such as biomass boilers, solar PV, solar thermal in place before the FITS were introduced will not have been identified through this assessment and therefore the overall figure for microgeneration is likely to be higher than that stated



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5: Technical renewable energy resource capacity results

Introduction

5.1 As outlined in Chapter 1, developing the sub-regional evidence base for the capacity and deployment of renewable energy across Cumbria has involved a sequential process. In this chapter, we cover the results of the potential accessible renewable energy resource, Stages 1-4 as defined in the national DECC methodology. We have provided results for 2030 as this fits well with planning horizons and is also realistic in terms of the time it can take for renewable energy developments to be consented and installed. In addition, we have also noted where the identified capacity is likely to increase (or decrease) considerably by 2050 to provide a longer term view.

5.2 The starting point in determining the potential for renewable energy in Cumbria was the methodology used in the 2010 North West study which in turn is in line with the original DECC methodology. However, this Cumbria study also takes into account previous and ongoing studies (where appropriate) that have been carried out in the sub-region as well as local information/priorities (e.g. with respect to rural settlements and protected landscapes). This has resulted in an adapted methodology for assessing the capacity and practical potential across the chosen range of technologies that are listed in Table 5-1. As indicated in Table 5-1 at the request of the Forestry Commission the term “undermanaged woodland” is used in relation to woodland energy resources throughout this study as opposed to the term “managed woodland” used in the DECC methodology.

Table 5-1: Summary of technologies

Category	Technology	Category	Technology
Wind (onshore)	Commercial scale Small scale	Offshore	Commercial scale wind Wave & Tidal
Plant Biomass	Undermanaged woodland Energy crops Waste wood Agricultural arisings (straw)	Geothermal	Deep geothermal
		Hydro	Hydro – small scale Hydro – commercial
		CHP	Large scale Small scale (including fuel cells)
Animal biomass	Wet organic waste Poultry litter		
Waste	Municipal Solid Waste C&I Waste Landfill gas	Solar	Building integrated PV Solar PV farms Solar Water Heating (SWH) Solar PV – infrastructure (e.g. motorways)
		Heat pumps	Heat pumps

Category	Technology	Category	Technology
	Sewage gas		
	Co-firing of biomass		

Source: SQW

5.3 Figure 1-1 sets out the key stages which the DECC methodology identifies are required to develop a comprehensive evidence base for regional renewable energy potential. The DECC methodology provides guidance on how to undertake the Stages 1 to 4 of this process. The technical assessment, which follows in this Chapter, covers these stages whilst the assessment of deployable capacity covers Stages 5 and 6 and is detailed in Chapter 6. The Steering Group did not require the study to proceed to the final stage of target-setting.

5.4 Table 5-2 (below) provides a summary of the DECC methodology assessment process for technical renewable energy potential. This was initially developed for use by regions, but is also relevant and applicable to sub-regions and local planning authorities (LPAs). The stages cover:

- Identifying the opportunity for harnessing the renewable energy resources on the basis of what is naturally available within the context of the limitations of existing technology solutions (Stages 1-2)
- Addressing the constraints (Stages 3-4) to the deployment of technologies in relation to the physical environment and planning regulatory limitations to identify a more realistic measure of capacity and potential.

Table 5-2: DECC methodology

Main element	Stage and description
Opportunity analysis	
Stage 1: Naturally available resource	Regions need to explore and quantify the naturally available renewable energy resource within their geographical boundary. This will be based on data and information analysis including resource maps and inventories
Stage 2: Technically accessible resource	Regions need to estimate how much of the natural resource can be harnessed using commercialised technology (currently available or expected to reach the market by 2030)
Constraints analysis	
Stage 3: Physical environment constraints	Regions need to explore the physical barriers to deployment such as areas where renewables schemes cannot practically be built – e.g. large scale wind turbines on roads and rivers etc. This layer of constraints will reduce the overall deployment opportunity. The analysis will be based on GIS maps and various relevant regional inventories
Stage 4: Planning and regulatory constraints	Regions need to apply a set of constraints relevant to each renewable technology that reflects the current planning and regulatory framework, such as excluding from the assessment areas and resources which cannot be developed due to e.g. health and safety, air/water quality, environmental protection etc.

Source: SQW

5.5 For both the opportunity and constraints analyses, the methodology sets out a list of parameters and key data sources which must be used. However, there are problems adhering to the guidance set out in the DECC methodology for some of the technology assessments, as the data sources suggested within the guidance are no longer available in practice. It is also important to note that the DECC methodology was designed to identify the potential for renewable energy at a regional level as opposed to at a county or LPA level, therefore, some of the data sources and assumptions proposed within the DECC methodology have had to be amended/refined to take account of the requirements of this study and the need to disaggregate the results down to the local level. More localised assumptions were developed through reviewing sub-regional and more local studies and strategies[22] and undertaking consultations with key experts and stakeholders such as Natural England, the Forestry Commission and Britain's Energy Coast West Cumbria.

5.6 Annex B contains the final list of assumptions used to undertake the resource assessments for Cumbria detailing where these have changed from the standard DECC methodology and the 2010 North West Renewable Energy Capacity and Deployment Study.

Protected Landscapes

5.7 Cumbria has a very high quality environment containing a wide range of internationally important nature conservation sites designated as Special Protection Areas and Special Areas of Conservation, a very rich cultural heritage and a diverse landscape from coastal plain and rich river valleys to dramatic upland moorland and fell. Over half of Cumbria is covered by national landscape designations, including the Lake District National Park, parts of the Yorkshire Dales National Park and the possible National Park extensions, as well as the Solway Coast, St Bees Heritage Coast, parts of the Arnside and Silverdale and the North Pennines Areas of Outstanding Natural Beauty (AONBs) and a number of Sites of Special Scientific Interest (SSSIs). An accompanying map of the key landscape and nature conservation designations is downloadable from Cumbria County Council's website (see Annex G for a list of all supporting maps).

5.8 Clearly the quality of the landscape and other special characteristics, such as cultural heritage, place constraints on the type, scale and location of renewables that can be accommodated within Cumbria. A clear understanding of the landscape character of the area has therefore been a key component of this study to determine the best mix of renewable energy deployment. However, it is important to acknowledge that the designated areas of Cumbria, with their dispersed settlement pattern and strong sustainability objectives, have the potential to pro-actively promote community renewable schemes that greatly increase the energy self-sufficiency of individual localities. Designated areas therefore are not no-go areas for renewable development, but those renewable that are promoted should not compromise the purposes or integrity of the individual designations. In considering the different types of renewable energy technology that could be accommodated within the designated areas of Cumbria, it has been helpful to consider a hierarchy of three distinct categories:

- Those technologies that operate in symbiosis with the objectives of designated areas (for example, as expressed in their statutory management plans) and help support the existing rural economy, as in anaerobic digestion of farm and tourism wastes and aspects of biomass linked to the management of existing woodland and the extension of semi-natural woodland within National Parks and AONBs and the use of former mill sites to generate hydro power.

[22] The outcome of this review is provided in Annex A in the accompanying annexes document.

- Those technologies that have no or limited impact on the environment and have the potential to make significant renewable energy contributions to individual households and communities, such as ground and air source heat pumps; building integrated solar technologies associated with individual premises; woodfuel boilers/burners; and small scale hydropower.

- Those technologies that can have an impact on the environment, but nonetheless can make a significant contribution to energy generation – such as larger scale biomass plants and large scale wind energy developments. It is this category of renewables that will be most problematic within designated areas and their deployment is not generally supported; for example, the LDNP Core Strategy (supporting text for Policy CS16 concerning renewable energy) states that large scale wind energy proposals are inappropriate within the National Park.

5.9 Careful consideration has been given in this study to the assumptions that should be applied to the assessment of renewable energy potential within the protected landscapes of Cumbria. To date these areas have only been given partial consideration in previous studies, particularly with regard to wind energy. For example, Protected Landscapes were not considered in the Axis study – Renewable Energy Development in Cumbria – Identifying the Potential (2003). In terms of the technical resource potential, there is no reason why most renewable energy technologies should not be considered within protected landscapes, the key issue is the scale of the development that is appropriate. Single small scale turbines of below 25m in height are acceptable in some locations even within protected landscapes associated with individual developments, but large commercial wind turbines are likely to be inappropriate.

5.10 The DECC methodology includes a requirement that separate assessments should be undertaken of the potential for renewable energy deployment within international and national landscape and nature conservation designations. The methodology sets out a five step approach that seeks to ensure that the deployment of renewable and low carbon technologies does not compromise the purposes or integrity of the designations. However, subsequent to the preparation of the DECC methodology. Natural England stated that for broad assessments of renewable energy potential, nature conservation areas should be excluded. Natural England has since made it clear that designated landscapes should no longer be seen as ‘no-go’ areas and that an assessment of their potential should be undertaken. There is an opportunity for renewable energy projects in these landscapes to demonstrate sustainable development in sensitive areas.

5.11 For the purposes of this study, a meeting was held with the relevant protected landscape officers representing the National Parks and AONBs, Natural England and Friends of the Lake District to agree a suitable approach to the assessment of renewable potential within the protected landscapes. Agreement was reached on the following approach:

- A review was undertaken to identify the special qualities of the protected landscapes based on information obtained from the protected landscape officers, and their relevant Management Plans (see Annex F).

- A headline analysis was carried out of the different technologies that may be unacceptable within the protected landscapes because of their adverse effect on their purposes or special qualities – i.e. commercial scale wind, and large-scale solar PV plants.

- If a technology was not considered to have the potential for significant adverse effects on the purposes and special qualities of designated areas, then the standard methodology as used for non-protected landscapes was used to calculate potential within the designated areas.

- For those technologies which could potentially have an adverse effect on the purposes or special qualities, an assessment of potential within designated areas was undertaken using revised assumptions which were agreed with the National Park Authorities, AONB Units and Natural England.

5.12 The assumptions used and results of the assessment of technical potential within the protected landscapes are set out in the remainder of this chapter, along with the assessment results across all areas of Cumbria[23].

Potential accessible resource results

5.13 Table 5-3 lists the potential accessible resource of each technology for the Cumbria sub-region. The technology capacity results in italics and red font are not included in the aggregated results because they are provided for context rather than as accurate assessments (such as the offshore sources and solar farms) or in the case of CHP/district heating are not renewable sources and so are not included.

Table 5-3: Potential accessible renewable energy resource in Cumbria by technology (at 2030)

Technology group	MW by technology group	Sub Category Level 1	Sub Category Level 2	MW by sub-category
Wind (onshore)	2885.6	Wind - commercial scale	Wind – commercial scale	2858.3
		Wind – small scale	Wind – small scale	27.3
Wind (offshore)	*2900*	Wind (offshore)	Wind (offshore)	*2900*
Tidal	*6200*	Tidal	Tidal	*6200*
Wave	*500*	Wave	Wave	*500*
Geothermal	---	Geothermal	Geothermal	---
Biomass	212.0[24]	Plant biomass	Undermanaged woodland (electricity)	6.8
			Undermanaged woodland (heat)	41.4
			Energy crops (electricity)	6.2

[23] It should be noted that whilst constraints have been applied to reflect current local challenges, these may change over time and different circumstances may apply at a local level which could lead to greater deployment in some instances.

[24] Undermanaged woodland (Electricity), Energy crops (Electricity) and Waste wood (Heat) have been excluded as heat and energy production for these technologies are mutually exclusive.

Technology group	MW by technology group	Sub Category Level 1	Sub Category Level 2	MW by sub-category
			Energy crops (heat)	23.6
			Waste wood (electricity)	4.4
			Waste wood (heat)	3.8
			Agricultural arisings	3.0
		Animal biomass (aka EfW)	Wet organic waste	90.0
			Poultry litter	2.8
		Waste	Municipal Solid Waste (MSW)	19.4
			Commercial & Industrial Waste (C&IW)	20.7
		Biogas	Landfill gas	1.8
			Sewage gas	4.9
Hydropower	69.7	Small scale hydropower	Small scale hydropower	69.7
		Commercial scale hydropower	Commercial scale hydropower	0
Microgeneration	1374.7	Solar	Solar Photovoltaics (PV)	150.5
			Solar Water Heating (SWH)	135.4
		Heat pumps	Ground Source Heat Pumps (GSHP)	213.2
			Air Source Heat Pumps (ASHP)	852.7
			Water Source Heat Pumps (WSHP)	22.9
Large scale solar	*326.2*	Solar farms	Solar farms	*326.2*
		Solar infrastructure	Solar infrastructure	0.02
Combined Heat & Power	*126.5*	CHP	CHP	*126.5*
TOTAL	**4542.0**			**4542.0**

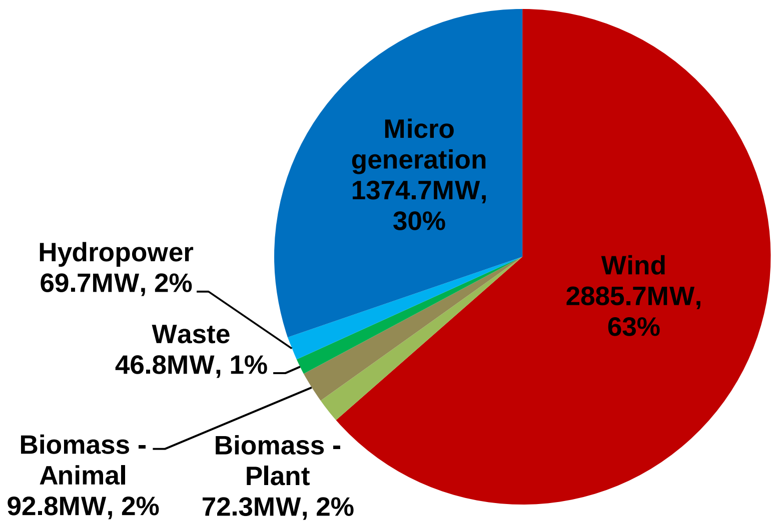
Source: SQW and LUC

5.14 The above table shows that the total onshore potential accessible renewable energy resource in Cumbria is 4542 MW or 4.5 GW. The offshore contribution has been considered through secondary sources and is not part of the detailed resource assessment; however, taking into account just offshore wind and tidal (wave and tidal are to a large degree mutually exclusive) provides an additional resource capacity figure of 9.1 GW by 2030.

5.15 Commercial onshore wind provides the largest proportion of the onshore resource at 63% followed by microgeneration – 30% of the total resource. In addition the potential from Solar PV farms could provide an additional 326.2 MW although it is recognised (and detailed further later in the Chapter) that this assessment is highly caveated due to a number of assumptions being taken into account and the outcome of the recent FIT review resulting in a much reduced financial incentive to develop solar PV farms. Finally, the potential heat demand for combined heat and power (CHP) which could be met through district heating systems is 126.5 MW – this is significant potential and the introduction of the Renewable Heat Incentive combined with technological progress is likely to lead to many more schemes coming forward. Only those resource technologies that contribute to the overall total capacity (i.e. excluding offshore sources, solar PV and CHP) have been subject to the deployment analysis in the following chapters.

5.16 Figure 5-1 shows how the accessible resource within Cumbria is split by technology.

Figure 5-1: Potential accessible renewable energy resource in Cumbria by technology at 2030



Source: SQW and LUC

Cumbria Accessible Resource Results – by local planning authority (LPA)

5.17 Table 5-4 and Table 5-5 detail the potential accessible resource for each of the LPAs in Cumbria by technology and display the geographic split (in MW capacity) of the total capacity displayed in Table 5-3 above.

5.18 Figure 5-2 illustrates how the share of the potential accessible renewable energy (electrical and heat) is distributed across the eight LPAs. Based on the potential accessible renewable energy resource, Eden has the greatest potential with 30% of the total. This is primarily due to the extensive onshore wind resource in the district.

Table 5-4: Accessible energy resource for various technologies by local planning authority at 2030 (MW)

	Onshore wind		Offshore			Hydropower		Microgeneration					Commercial Solar	
LPA	**Large scale**	**Small scale**	**Wind**	**Tidal**	**Wave**	**Large scale**	**Small scale**	**PV**	**SWH**	**GSHP**	**ASHP**	**WSHP**	**Solar farms**	**Solar infra-structure**
Allerdale	834.8	5.7	---	---	---	---	2.1	23.7	21.1	34.8	139	4.8	---	0
Barrow-in-Furness	20.4	0.5	---	---	---	---	0	19	17.2	25.1	100.4	1.1	---	0
Carlisle	213.1	6.1	---	---	---	---	1.5	34.6	32	45.1	180.5	2.8	---	0
Copeland	152.4	2.1	---	---	---	---	0	21.2	19.8	25.7	102.7	1.7	---	0
Eden	1180.5	4.6	---	---	---	---	4.4	13	11.3	24.7	98.8	1.9	---	0.02
South Lakeland	457.2	2.9	---	---	---	---	6.6	24.7	22.4	34.6	138.6	3.6	---	0
LDNP	0	5.2	---	---	---	---	42.5	13.6	11	21.6	86.4	6.6	---	0
YDNP	0	0.2	---	---	---	---	12.6	0.7	0.6	1.6	6.3	0.4	---	0
Cumbria total	**2858.3**	**27.3**	**---**	**---**	**---**	**---**	**69.7**	**150.5**	**135.4**	**213.2**	**852.7**	**22.9**	**---**	**0.02**

Source: SQW and LUC

Table 5-5: Accessible energy resource for biomass, geothermal and CHP by local planning authority at 2030 (MW)

LPA	Under managed woodland (E)	Under managed woodland (H)	Energy crops (E)	Energy crops (H)	Waste wood (E)	Waste wood (H)	Agric arisings (straw)	Wet organic waste	Poultry litter	MSW	C&IW	Landfill gas	Sewage gas	Co-firing	Geo thermal
Allerdale	0.4	2.1	1.7	6.5	0.6	0.5	0.8	18.5	0.2	3.6	2.9	0.8	0.8	---	---
Barrow	0	0.1	0.1	0.4	0.6	0.5	0.04	0.8	0.2	2.3	2.7	0.5	0.7	---	---
Carlisle	1.7	10.4	1.5	5.7	1.1	1	0.8	18.9	0.3	4	5.2	0.3	1.1	---	---
Copeland	0.2	1	0.4	1.4	0.5	0.5	0.1	6	0.2	2.2	2.4	0	0.6	---	---
Eden	1.4	8.7	2	7.7	0.5	0.4	1.1	20.1	1.4	1.9	2	0.1	0.5	---	---
South Lakeland	0.4	2.3	0.3	1.1	0.7	0.6	0.1	11.5	0.3	3.2	3	0	0.7	---	---
LDNP	2.6	16.0	0.3	0.9	0.5	0.5	0.1	14	0.2	2	2.4	0.1	0.5	**---**	
YDNP	0.2	1	0	0	0	0	0	0.2	0	0.2	0.1	0	0	**---**	
Cumbria total	**6.8**	**41.4**	**6.2**	**23.6**	**4.4**	**3.8**	**3.0**	**90.0**	**2.8**	**19.4**	**20.7**	**1.8**	**4.9**	**---**	**---**

Source: SQW and LUC

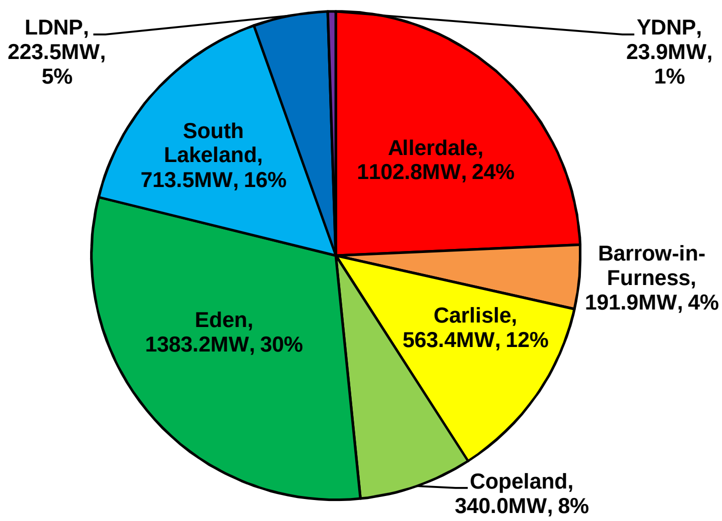
5.19 Taking the totals from each table provides the following overall total of accessible energy resource within each LPA which is also shown as a proportion of the county total (Table 5-6 and Figure 5-2). It should be noted throughout this section that analysis has been undertaken at the level of the LPA with no double counting. That is, Allerdale, Copeland, Eden and South Lakeland LPAs refer to those areas of each of the local authorities that sit outside the Lake District and Yorkshire Dales National Parks.

Table 5-6: Total amounts of accessible renewable energy resource by local planning authority at 2030 (MW)

LPA	Electricity	Heat	Total	Percentage of Cumbria's total
Allerdale	896.5	208.8	1102.8	24
Barrow-in-Furness	47.8	144.8	191.9	4
Carlisle	290.1	277.4	563.4	12
Copeland	188.2	152.8	340.0	8
Eden	1233.5	153.4	1383.2	30
South Lakeland	511.6	203.1	713.5	16
LDNP	83.9	142.9	223.5	5
YDNP	14.2	9.9	23.9	1
Cumbria total	**3265.8**	**1292.9**	**4542.0**	**100**

Source: SQW and LUC (numbers may not total due to rounding)

Figure 5-2: Renewable energy resource by local planning authority



Source: SQW and LUC

5.20 The following sections provide further detail on the technology resource analysis including sub-regional and LPA results, maps, commentary and key assumptions. Each technology is analysed in terms of:

- definition and scope (for broad technology categories)
- main assumptions
- results – all of which relate to a forecast of the potential accessible resource for renewable energy production in 2030
- conclusion.

Technology by technology assessment

Onshore wind

Commercial scale wind

DEFINITION AND SCOPE

Wind power uses energy from the wind to turn a rotor connected to an electrical generator.

The natural energy of the wind can be harnessed to drive a generator that produces electricity.

Commercial scale wind refers to on-shore wind farm developments (with capacity of over 100 KW) for commercial energy generation and supply. Most such developments are connected to the national grid, however private-wire schemes are also an option and some already exist. Configurations of groups of wind turbines or individual turbines are used.

Assessing the resource potential and the deployment opportunities relates primarily to the wind speeds available within the region and the ability of current technology to harness this resource in terms of turbine design (size, efficiency) and installation requirements.

Source: DECC/CLG, 2010

Assumptions

5.21 The detailed assumptions made to assess the accessible resource for Commercial Wind are given in Annex B. The headline wind turbine assumptions are set out below:

- three turbine sizes (large 2.5 MW, medium 1 MW and small 0.5 MW)
- 5 m/s wind speed
- different densities per km2 based on level of landscape capacity, bird sensitivity and turbine size
- non-accessible areas (including roads, railways, rivers, steep slopes, water bodies etc)
- exclusion areas (international, national and county nature conservation designations, cultural heritage designations etc.)

5.22 In consultation with the Steering Group, several additional constraints that had not been included in the North West study were considered in this study. These considerations are detailed in Annex B. Most importantly, this study assesses the potential for three turbine sizes instead of one large model turbine (as in the DECC methodology):

- Large: at 125 m to tip
- Medium: at 90 m to tip
- Small: at 65 m to tip

5.23 Another significant deviation from the North West study (and therefore the DECC methodology) was the assessment of settlement buffers based on individual properties rather than settlement boundaries. This is seen as a refinement of the method that gives a more realistic idea of the amount of land constrained by being in very close proximity to a property.

5.24 During the North West study, it was not possible to consult National Air Traffic Services (NATS) regarding regional level aviation constraints. It was highlighted early on in this study that Allerdale was subject to some severe aviation restrictions. NATS was consulted to obtain the current position regarding air traffic control constraints. Although there are still significant issues regarding visibility to the technical infrastructure, NATS considers that it would be too restrictive to apply a blanket constraint at this stage given that this study looks to 2030 and there is a chance that research and development projects may mean that mitigation in the future is possible.

5.25 As a requirement of the DECC methodology, the Ministry of Defence (MOD) was consulted regarding MOD constraints. MOD constraints have the effect of reducing the potentially available land (and by inference, the potentially available resource) in the north and west of Cumbria and further consultation with the MOD is essential when undertaking more detailed analysis such as for individual sites.

Protected landscape assumptions

5.26 It was agreed that within the protected landscapes (including National Parks, AONBs, Heritage Coast and potential extensions to the National Park), due to the scale of the turbines, commercial scale wind energy developments have the potential to have a significant impact on the special qualities listed in Annex F. It was therefore assumed that there is no potential for commercial scale wind (i.e. above 25 m to blade tip) within these areas.

5.27 In order to take account of the setting of the National Parks, AONBs and other nationally designated areas, it was agreed that within areas outside of the protected landscapes, the assumptions regarding the density of turbines per km^2 should reflect the findings of the landscape capacity assessment for wind energy contained within the Cumbria Wind Energy Supplementary Planning Document (2007). The SPD indicates the capacity of each landscape character type within Cumbria for wind energy in terms of high/moderate, moderate, moderate/low and low. These indications were used to inform the density of wind turbines applied to each landscape character area. More details on these assumptions are contained within Annex B.

Results

5.28 All maps referred to in this section are downloadable from Cumbria County Council's website (see Annex G for details of all maps).

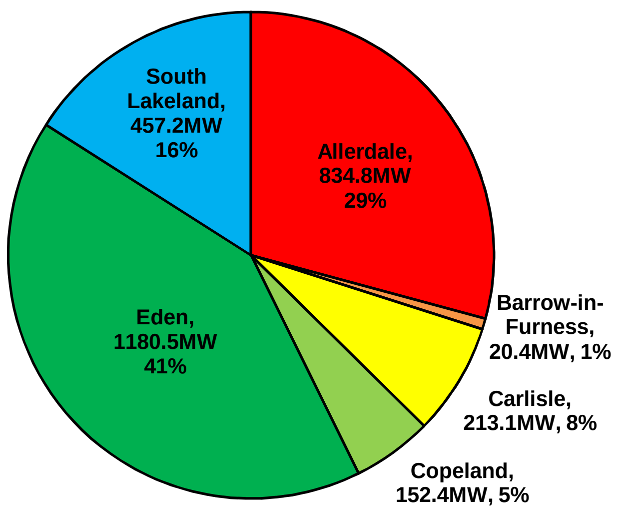
5.29 It can be seen from Table 5-7 that the absolute maximum technical potential for Cumbria is 2858.3 MW, made up of a mixture of small, medium and large turbines. Commercial wind therefore accounts for almost 63% of the total accessible potential renewable resource and will be critical to the overall onshore renewables mix. The figures in Table 5-6 represent the potential outside of all protected landscapes and the areas of the proposed National Park extension. These results reflect the results of the assessment before protected landscape setting (and the results of the Cumbria Wind Energy SPD) are taken into account.

Table 5-7: Potential Accessible Commercial Wind Resource by local planning authority at 2030

LPA	MW capacity by turbine size			Total Electricity (MW Capacity)	Percentage of Total (%)
	Large	Medium	Small		
Allerdale	471.2	25.9	337.7	834.8	29
Barrow-in-Furness	9.3	1.3	9.7	20.4	1
Carlisle	108.7	5.3	99.1	213.1	7
Copeland	86.6	6	59.8	152.4	5
Eden	697.3	39.1	444.2	1180.5	41
South Lakeland	255.6	27.5	174.1	457.2	16
LDNP	0	0	0	0	0
YDNP	0	0	0	0	0
Cumbria total	**1628.7**	**105.1**	**1124.5**	**2858.3**	**100**

Source: LUC (figures may not total due to rounding)

Figure 5-3: Potential Accessible Commercial Wind Resource at 2030 by local planning authority



Source: LUC

Conclusions

5.30 Wind proved to be the largest single resource in Cumbria with Eden being the LPA with the largest capacity. Allerdale also has a significant amount of potential. Due to the importance of ensuring that commercial wind does not impact detrimentally on the setting of Cumbria's protected landscapes, further analysis has been undertaken taking into account the requirements of the Cumbria Wind SPD.

Commercial-scale wind: Results of incorporating Cumbria wind SPD

5.31 Following the overall assessment of capacity, it was considered important that this was then considered taking account of the capacity of the landscape to accommodate commercial-scale wind turbines. The results from this analysis, whilst not included in the headline capacity results (detailed at the beginning of this Chapter) were used as the starting point to inform the deployment stage as they are more realistic in terms of constraints.

Assumptions

Within protected landscapes

5.32 It was agreed that within the protected landscapes, due to the scale of the turbines, commercial scale wind energy developments have the potential to have a significant impact on their special qualities. It was therefore assumed that there is no potential for commercial scale wind (i.e. above 25 m to blade tip) within these areas. This includes all National Parks, AONBs, potential National Park extensions and Heritage Coasts.

Protected landscapes setting

5.33 In order to take account of the setting of the National Parks and AONBs, it was agreed that within areas outside of the protected landscapes, the assumptions regarding the density of turbines per km^2 should reflect the findings of the landscape capacity assessment for wind energy contained within the Cumbria Wind Energy SPD. The SPD rates the capacity of each landscape character type within Cumbria for wind energy in terms of high/moderate, moderate, low/moderate and low. Map 8 (which can be accessed from the maps folder on Cumbria CC's website) illustrates these capacity ratings. These ratings were used to inform the density of wind turbines applied to each landscape character type.

Density of turbines (resource assessment potential)

5.34 The technical resource assessment uses the following turbine density assumptions:

- General assumption in non-constrained areas:
  - Large: 4 turbines per km^2
  - Medium: 10 turbines per km^2
  - Small: 20 turbines per km^2
- High Bird Sensitive Areas:

    - 75% reduction of (general assumption) above

- Medium Bird Sensitive Areas:
    - 50% reduction of (general assumption) above

- Protected Landscapes Assumption:
    - Zero turbines per km^2 within protected landscapes.

Density of turbines (incorporating landscape capacity)

5.35 In order to consider the setting of the protected landscapes, a further set of density assumptions have been applied. Table 5-8 sets out the % reductions to general wind turbine densities that have been applied in this analysis.

Table 5-8: Summary of % reductions to general wind turbine densities related to the Wind Energy SPD Capacity Assessment and scale of turbine

SPD Wind energy capacity rating	Large turbines (125m to blade tip)	Medium turbines (90m to blade tip)	Small turbines (65m to blade tip
Low	100%	100%	75%
Low/Moderate	75%	50%	50%
Moderate	50%	25%	0%
Moderate/High	25%	0%	0%

Source: LUC

5.36 Where there are different sensitivities in terms of birds and landscape capacity, the highest sensitivity has always been applied (e.g. a moderate/high landscape capacity with high bird sensitivity will defer to the density assumptions for bird sensitivity).

5.37 It has been assumed that the largest size turbines will be accommodated (as per the technical assessment) even if a smaller turbine in the same location would yield a higher MW output. Cumbria County Council advised that this is in line with their current position which is aimed at reducing cumulative impacts.

5.38 The exception to this rule is where landscape capacity is low. In cases where the technical assessment has highlighted an area as having potential for large, medium or small turbines, but it is in an LCT with low landscape capacity for turbines, it has been assumed that small turbines will be accommodated in these areas (with a 75% reduction in density). If, as per the general rule, the largest turbine was assumed, then there would be a 100% density reduction and the area would show no potential, whereas the capacity assessment has shown that it would be suitable for a small amount of turbines.

Results

5.39 The results of the technical resource assessment for commercial-scale wind are set out in Map 7 (within the maps folder that can be downloaded from Cumbria County Council's website) and shown in Table 5-9.

Table 5-9: Results of technical resource assessment for commercial-scale wind

LPA	Large (MW)	Medium (MW)	Small (MW)	Total (MW)	% of total
Allerdale	471.2	25.9	337.7	834.8	29
Barrow-in-Furness	9.3	1.3	9.7	20.4	1
Carlisle	108.7	5.3	99.1	213.1	7
Copeland	86.6	6.0	59.8	152.4	5
Eden	697.3	39.1	444.2	1,180.5	41
South Lakeland	255.6	27.5	174.1	457.2	16
YDNP	0	0	0	0	0
LDNP	0	0	0	0	0
Cumbria	**1,628.7**	**105.1**	**1,124.5**	**2.858.3**	**100**

Source: LUC (figures may not total due to rounding)

5.40 The results of the resource assessment after landscape capacity has been considered are shown in Table 5-10 and illustrated in Map 9 (within the maps folder that can be downloaded from Cumbria County Council's website).

Table 5-10: Results of technical resource assessment for commercial scale wind incorporating landscape capacity

LPA	Large (MW)	Medium (MW)	Small (MW)	Total (MW)	% of total
Allerdale	188.3	16.6	288.6	493.5	30
Barrow-in-Furness	6.5	0.9	8.0	15.4	1
Carlisle	47.2	3.9	89.5	140.6	9
Copeland	35.6	4.0	42.3	81.8	5
Eden	272.2	24.8	359.5	656.5	40
South Lakeland	105.6	16.0	124.3	246.0	15
YDNP	0	0	0	0	0
LDNP	0	0	0	0	0
Cumbria	**655.3**	**66.3**	**912.1**	**1,633.8**	**100**

Source: LUC (figures may not total due to rounding)

5.41 Table 5-11 shows the resultant percentage reduction that has occurred when taking landscape capacity into consideration. As expected, this is highest for the large turbines. (T) is the technical potential and (C) is the potential once landscape capacity and wider landscape character has been considered.

5.42 The methodology used is intended to reflect the potential constraints of settings of protected landscapes rather than being a detailed assessment of this constraint.

Table 5-11: Resultant reductions in overall MW capacity when considering landscape capacity

LPA	Large (T) (MW)	Large(C) (MW)	% large	Medium (T) MW)	Medium (C) (MW)	% Medium	Small (T) (MW)	Small (C) (MW)	% Small	Total (T) (MW)	Total (C) MW)	% of total
Allerdale	471.2	188.3	40	25.9	16.6	64	337.7	288.6	86	834.8	493.5	59
Barrow-in-Furness	9.3	6.5	69	1.3	0.9	70	9.7	8.0	82	20.4	15.4	75
Carlisle	108.7	47.2	43	5.3	3.9	74	99.1	89.5	90	213.1	140.6	66
Copeland	86.6	35.6	41	6.0	4.0	67	59.8	42.3	71	152.4	81.8	54
Eden	697.3	272.2	39	39.1	24.8	64	444.2	359.5	81	1,180.5	656.5	56
South Lakeland	255.6	105.6	41	27.5	16.0	58	174.1	124.3	71	457.2	246.0	54
YDNP	0	0	0	0	0	0	0	0	0	0	0	0
LDNP	0	0	0	0	0	0	0	0	0	0	0	0
Cumbria	1,628.7	655.3	40	105.1	66.3	63	1.124.5	912.1	81	2,858.3	1,622.8	57

Source: LUC (figures may not total due to rounding)

5.43 In the final recommendations contained within Chapter 8, we set out how a further detailed assessment of the capacity for renewable energy development, specifically wind energy, within the potential setting of a protected landscape could be undertaken.

Small scale wind

DEFINITION AND SCOPE

A sub-category of onshore wind is the small scale wind installations which can be defined as having capacity of less than 100 kW and typically comprises single turbines. Small scale wind schemes have different characteristics to large scale developments.

The majority of small scale wind installations are ground-based developments, with only few that are building integrated (on top roofs). Small scale ground-based turbines, by their nature have lower hub/tip heights of about 15 m above ground level and are viable at lower wind speeds (4.5 m/s at 10m above ground level).

They are usually installed on-site and supply the on-site demand first before feeding the excess to the grid.

Source: DECC/CLG, 2010

Main assumptions

5.44 In contrast to the DECC methodology, the assessment of small scale wind potential has been opportunity led, rather than constraints led. In the North West study every property was evaluated for its potential, however this study has sought to identify those properties that offer the best potential for small scale wind. The assessment identified:

- community and tourism properties
- commercial and industrial properties
- isolated residential properties outside of settlement boundaries

5.45 Identified properties were then evaluated in terms of their location (urban/rural) and their wind speed. Properties within Conservation Areas and other cultural heritage designations were excluded from the assessment. Properties located in areas with a high density of Listed Buildings were also excluded. Further details of the assumptions used can be found in Annex B.

Protected landscape assumptions

5.46 The same assumptions as outlined above were applied for small scale wind within the protected landscapes. As the assessment has been undertaken in GIS, it has been possible to accurately identify the number of properties within and outside of protected landscapes.

Results

5.47 Table 5-12 details the potential accessible resource of small scale wind for each LPA. It can be seen that Cumbria has a technical potential resource of 27.3 MW. Carlisle has the highest potential at just over a fifth of the total resource due to its urban nature.

5.48 It is noticeable that whilst the total potential is higher outside of protected landscapes, the Lake District National Park has the potential to make a significant contribution in terms of small-scale wind.

Table 5-12: Potential accessible small scale wind resource by local planning authority at 2030

LPA	Electricity (MW Capacity)	Percentage of Total (%)
Allerdale	5.7	21
Barrow-in-Furness	0.5	2
Carlisle	6.1	22
Copeland	2.1	8
Eden	4.6	17
South Lakeland	2.9	11
LDNP	5.2	19
YDNP	0.2	1
Cumbria total	**27.3**	**100**

Source: LUC (figures may not total due to rounding)

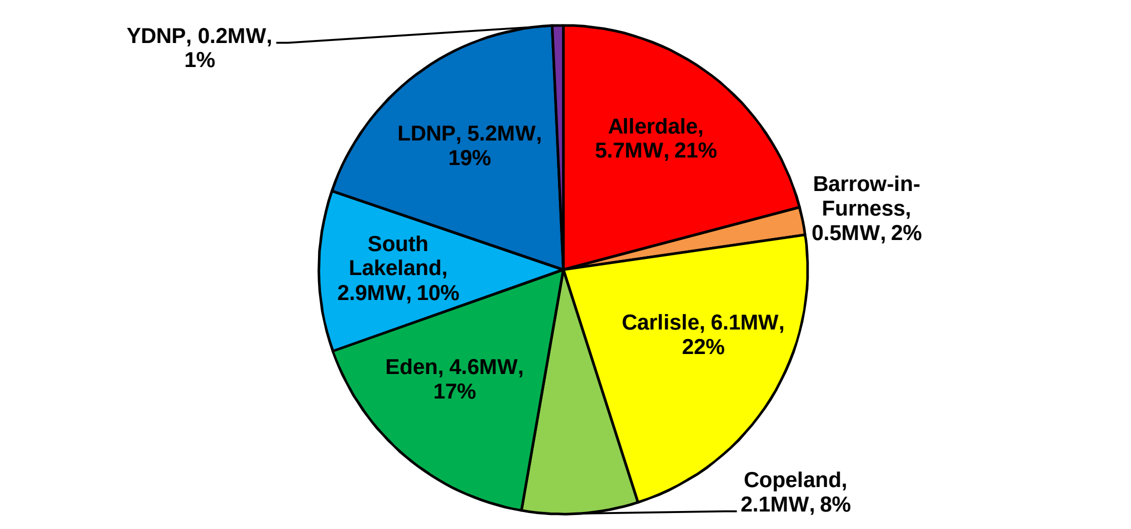
Table 5-13: Potential accessible small scale wind resourced by protected landscape at 2030

Protected landscape	Number of properties identified	Electricity (MW Capacity)	Percentage of protected landscapes Total (%)
Arnside & Silverdale AONB	45	0.3	4
Lake District NP	868	5.2	67
North Pennines AONB	101	0.6	8
Solway Coast AONB	98	0.6	7
Yorkshire Dales NP	36	0.2	3
Potential extensions	140	0.8	11
Protected Landscapes total	1288	7.7	100

Source: LUC (figures may not total due to rounding)

5.49 Figure 5-4 illustrates the proportion of the small scale wind resource in each LPA.

Figure 5-4: Potential accessible small scale wind resource by local planning authority at 2030 (including Protected Landscapes)



Source: LUC

Conclusion

5.50 This assessment has focussed on the potential resource linked to properties with potential for community schemes, commercial and industrial properties and isolated residential properties. The overall small-scale wind resource is 27.3 MW. 28% of this potential is within protected landscapes or potential extensions of these designated areas.

Offshore resources

5.51 Overall, by 2030 Cumbria has a combined (wind and tidal) offshore potential of 9.1 GW, 6.2 GW of which is derived from tidal energy and the remaining 2.9 GW from wind sources. However, these figures particularly the tidal energy capacity, have a high degree of uncertainty given technological development and other factors. Capacity from wave technologies is not included in the overall assessment as to a large degree tidal and wave energy generation can be considered mutually exclusive, which is explained below.

5.52 LPA areas do not extend out to sea beyond low sea level, so there is no agreed method for apportioning offshore resources on this basis. Legally offshore resources fall within the remit of Crown Estates. For this study, we have apportioned offshore resources to Cumbria where they are closer to Cumbria County than the adjacent areas of Lancashire and Scotland.

Offshore wind

DEFINITION AND SCOPE

Offshore wind turbines are based on the same technology as those used onshore but on larger scale.

Source: SQW derived from Solway Energy Gateway Feasibility Study, Halcrow, 2010

Assumptions

5.53 Offshore wind is not included within the DECC methodology and therefore we have relied upon existing reports and studies concerning the potential resource capacity of the Cumbrian coast. The key assumptions used to identify the potential capacity for offshore wind (which are taken from local studies of relevance) are as follows:

- wind farms must be located at least 10 km from the shoreline
- they cannot be located in waters deeper than 25-30 m
- they need to be a minimum of 500 m apart
- each turbine has the capacity to produce 5 MW; however, the industry load factor is only 30% due to down time (no wind) and transmission losses.

Results

5.54 Existing sites and those under development include the following:

- Robin Rigg – site began full generation in April 2010 and currently produces 180 MW; and is currently able to provide enough electricity to power around 117,000 homes25.
- Barrow – covers an area of 10 km2, contains 30 turbines with an output capacity of 90 MW. Its anticipated annual production is 305 GWh supplying 65,000 homes26.
- Ormonde – currently under construction (commenced May 2010 due to finish 2011, it is located 10 km off Barrow-in-Furness and will cover an area of 8.7 km2, it will contain 30 turbines producing 150 MW with the potential to supply 100,000 homes pa27.
- Walney – is located 15 km from the coastline of Walney Island and will cover 73 km2 once fully complete. It is being built in 2 Phases. Phase 1 was completed in January 2011 and contains 51 turbines (3.6 MW capacity each). Phase 2 will contain a further 51 turbines (due to be completed by the end of 2011). The total capacity of the site will be 367.2 MW28. A further extension to the west and north west of the site has a license from the Crown Estates for between 109 and 209 turbines with the capacity to generate between 572 MW and 768 MW of installed capacity provided.
- West Duddon – has been consented and has the potential to produce 500 MW29.
- Irish Sea – as part of round three of the Crown Estates portfolio a further site has been identified with the potential for a number of windfarms. The site is triangular in shape covering an area approximately 2,200 km2 between Anglesey, the Isle of Man and the Cumbrian Coast. The potential capacity of the site is over 4 GW, capable of supplying around 3 million homes. However, not all of the site will be developed due to a number of constraints including water depth, shipping, fishing, oil and gas, aviation and connection to the grid. The first site is unlikely to be identified before 2013 after careful consideration of the aforementioned constraints, although it is anticipated that generation from this site will be occurring in time to contribute to the 2020 renewable energy targets.

Conclusions

5.55 Overall, the existing installed capacity for offshore wind is **0.8 GW**. The capacity of existing wind farms together with those with consents and licenses stands at **1.9 GW** (excluding the Irish Sea development, for which the sizes of individual sites are yet to be confirmed).

[25] Eon-uk.com
[26] Renewable UK website
[27] Renewable UK website
[28] Renewable UK website
[29] Duddon Estuary Tidal Energy Feasibility Study, Parsons Brinckerhoff Ltd, 2010.

Tidal

DEFINITION AND SCOPE

Energy from tidal power can be developed in two ways, barrages and turbines.

Tidal barrages are effectively dams which are built across a river estuary which raise the water level on one side of the dam until it is high enough to drive a turbine which is built in the dam. Barrages can operate in three different modes, flood flow, ebb flow and dual flow which is a combination of both. Flood flow generation is where the entry of rising tidal levels into the estuary is delayed in order to raise the water level and ebb flow generation is where the exit of tidal water from the estuary is delayed.

Turbines work in a similar way to that of wind turbines albeit producing power on a more consistent basis.

Source: SQW derived from Joules research project, 'Tapping the Tidal Power Potential of the Eastern Irish Sea, 2009

Main assumptions

5.56 Tidal power is not covered by the DECC methodology; this has been addressed by analysing secondary research in the form of studies previously undertaken regarding the potential for tidal barrages off the coast of Cumbria.

5.57 The Solway Firth and Morecambe Bay have been identified as suitable locations for tidal energy. As dual flow barrages capture energy from both ebb and flows, these harness the maximum capacity.

5.58 There are numerous different studies covering the overall tidal potential of the Irish Sea (Cumbria Vision, 2009 and the Joule Centre, 2008) and the feasibility of specific barrages (notably at Morecambe Bay, Duddon Estuary and the Solway Firth). These all use different assumptions and focus on different technologies and are therefore not directly comparable. We have considered it most appropriate to use the results from Solway Firth Feasibility Study, but also make reference to other individual feasibility studies below.

Results

5.59 A detailed feasibility study on the potential capacity of the Solway Firth was carried out in 2009. The study looked at several options and potential projects involving barrage, lagoon and reef technology. The results of the study are displayed below, the greatest energy generation potential identified was through a barrage project located between Workington and Abbey Head (**5,891 MW**). It must be noted that the construction phase for all of these projects is nominally anticipated to begin mid-2015, with smaller scale projects likely to be operational by 2017 and larger scale projects by 2022.

Table 5-14: Potential tidal projects identified for the Solway Firth

Project	Location	Constructed length (km)	Installed capacity (MW)	Annual Energy Production (GWh)	Comment
Barrage Projects					
B1	Workington to Abbey Head	28.4	5891	11500	Largest scheme with greatest environmental impact
B2	Southerness Point to Beckfoot	11.5	2703	3800	Intermediate barrage, still with substantial environmental impact
B3	Bowness to Annan	1.9	316	320	Reduced environmental impact with lower energy output
B4	Morecambe Bay	2.6	113	120	Lowest energy output but removed from main estuary
Lagoon Projects					
L1	Rascarrel to Southerness	20.5	692	900	Larger lagoon on North side
L2	Maryport to Beckfoot	11.5	535	2070	Mid-range solution in terms of energy and environmental impact
Reef Projects					
R1	Workington to Abbey Head	28.4	1318	3800	Largest scheme to retain scale generation with lower impact
R2	Southerness Point to Beckfoot	11.5	535	2070	Mid-range solution in terms of energy and environmental impact
R3	Bowness to Annan	1.9	88	170	Low output due to shallow bathymetry of location

Source: Solway Firth Feasibility Study, 2009

5.60 Last year, an individual feasibility study was also carried out to identify the potential of the Duddon Estuary. The study concluded that the barrage located at Sandscale Haws could have the potential to produce 160 MW of energy from tidal power. However, the study recommends that a period of two years is allowed for further studies to reduce uncertainties around environmental impacts which would then be followed by a further three years for design, consent and procurement and a further four years for construction of the barrage; therefore no renewable energy would be generated until 2019 at the earliest[30].

5.61 Further contextual information produced, but not adopted by Allerdale Borough Council in 2010 [31] states that proposals have also been developed to attach 500 kW tidal turbines to the base of offshore wind turbines such as Robin Rigg which has 30 turbines, with the potential to

[30] Duddon Estuary Tidal Energy Feasibility Study, Parsons Brinckerhoff, 2010
[31] Renewable Energy in Allerdale Study, Allerdale Borough Council, 2010

provide an additional 15 MW of capacity. There is the potential that this could be extended to up to 300 turbines providing an additional 150 MW.

5.62 In addition to the tidal technologies displayed above, other tidal technologies are currently in development such as the Venturi Fence, known as the Spectral Marine Energy Converter (SMEC) which is about to be tested in Cumbria and is considered suitable as it does not require the same depth of water as a tidal stream device. The device is thought to have a potential installed capacity of 100 MW given a 20% load factor. However, it is likely to be another 12 years before this technology becomes a reality[32].

Conclusions

5.63 Considerable tidal energy capacity has been identified which potentially could be as high as **6.2 GW** by 2022. However, tidal barrages take considerable time to proceed to development – the Duddon Estuary study, for example, suggests a further two years of research before the deployment stage can be realistically start to be planned and considered – which must be taken into account in looking forward to the deployable renewable energy mix for the sub-region and could constrain the actual potential for tidal energy in these areas.

5.64 The Solway Firth, Morecambe Bay and Drigg Coast are designated for their internationally important ecological value. The studies which inform this section have acknowledged these designations but not assessed in detail what the impacts of such designations would be on the overall potential accessible resource. It is important that this is acknowledged in identifying the potential resource as the technology is new and its ecological impacts on individual sites is not known in detail. In addition, much more detailed studies on the environmental, social and economic issues will be needed before deployment which may take up to a decade to be realised.

[32] Evidence base for the Provision of Renewable Energy in Allerdale, Allerdale Borough Council, 2010

Wave

DEFINITION AND SCOPE

Wave energy conversion devices are generally categorized by the method used to capture the energy of the waves. They can also be categorized by location and power take-off system. Method types are:

- point absorber or buoy; surfacing following or attenuator
- terminator, lining perpendicular to wave propagation
- oscillating water column
- overtopping.

Locations are shoreline, nearshore and offshore. They involve different types of power take-off including hydraulic ram, elastomeric hose pump, pump-to-shore, hydroelectric turbine, air turbine and linear electrical generator. Some of these designs incorporate parabolic reflectors as a means of increasing the wave energy at the point of capture. These capture systems use the rise and fall motion of waves to capture energy.

Source: SQW derived from Solway Energy Gateway Feasibility Study, Halcrow, 2009

Main assumptions

5.65 Wave and tidal barrage energy production are not mutually compatible as waves need large distances to propagate which barrages can prevent. Therefore the potential for wave and tidal need to be considered together as development of one would prevent the other. Only 25% of wave energy is deliverable as this resource is inconsistent and unpredictable. Wave energy for Cumbria may be limited because the main Atlantic swell does not penetrate the land locked Irish Sea and the Isle of Man inhibits wave development.

Results

5.66 The Atlas of UK Marine Renewable Energy Resources identifies wave energy in the Solway Firth to be about 2.5 kW/m equating to a potential energy value of 84.5 MW, compared to around 6,000 MW that could be generated by a tidal barrage. Of the 84.5 MW only 21 MW is actually deliverable due to the inefficiencies mentioned above.

5.67 The Cumbria Vision Scope for Renewable Energy report states that the total wave energy capacity for Cumbria is 500 MW based on 500 Anaconda devices with a capacity of 1 MW each which requires 80,000 km^2. However, this does not take into account the potential conflict with tidal wave barrage development.

Conclusion

5.68 Overall, wave power does not represent a substantial resource particularly when compared with the potential identified for tidal barrages. As the two are potentially mutually exclusive, only the tidal capacity is considered within the overall resource assessment.

Geothermal

DEFINITION AND SCOPE

Geothermal power is power extracted from heat stored in the earth. This geothermal energy originates from the original formation of the planet, from radioactive decay of minerals, and from solar energy absorbed at the surface. This heat can be captured to power turbines or as a direct heat source.

The technology involves drilling vertical boreholes up to 3000 m and connecting them by hydraulically fracturing the rock between them. Water is injected into one hole and is heated as it percolates through the rock and returns to the surface up the other holes releasing steam that is used to drive a turbine. However, there is a danger of triggering seismic activity through this technology.

Ground source heat pumps are also another method of extracting low grade heat from near-surface soil, another method is to extract the low grade heat from the air using air source heat pumps, both are covered under the Microgeneration section of this report.

Source: SQW derived from The Scope for Renewable Energy in Cumbria, Cumbria Vision

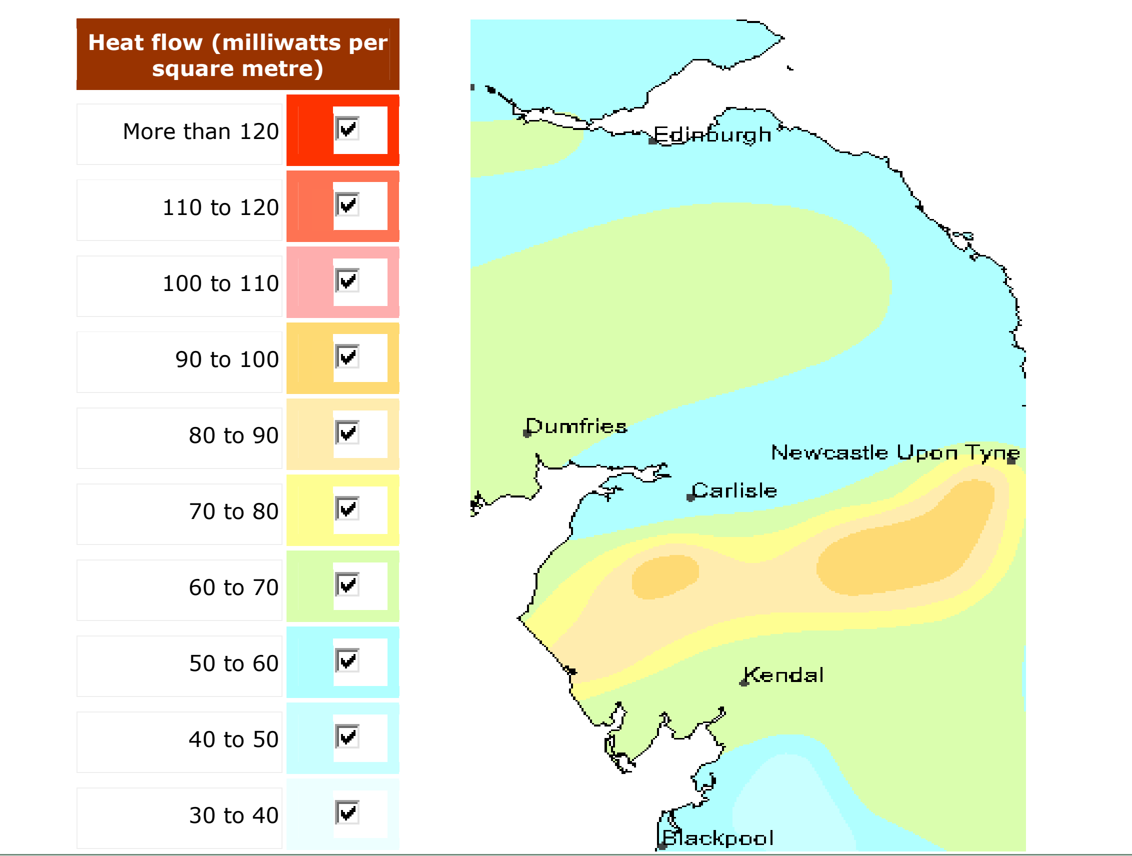
5.69 Geothermal potential was not considered within the DECC Methodology and therefore we have again looked to secondary sources in terms of the British Geological Survey (BGS) and local research to help identify the potential capacity. The BGS shows that parts of Cumbria (as indicated in Figure 5-5 in dark yellow) have geothermal gradients (the rate at which the Earth's temperature increases with depth) that are significantly higher than the UK average (26°C per km) due to the presence of granite and have potential for geothermal power generation.

5.70 Some initial geothermal schemes have been considered in Cumbria and it has been suggested that a development could be constructed in the Lake District; although there may be an issue of incompatibility with nuclear waste storage proposals.

5.71 Recently, it was reported that a geothermal resource had been found in the north east of England[33] and that the relevant rock seam appeared to run right through to Carlisle. This resource would therefore be available to settlements right along the rock seam, including Carlisle, providing significant potential via heat pumps.

[33] http://www.bbc.co.uk/news/uk-england-tyne-13914718 http://www.theengineer.co.uk/news/drilling-to-begin-on-newcastle-geothermal-energy-scheme/1007203.article

Figure 5-5: Heat flow per square metre of Northern England and Southern Scotland



Source: British Geological Survey

Conclusions

5.72 Overall, the study team has been unable to identify conclusive evidence regarding the geothermal potential of Cumbria. However, from the map evidence above and the fact that schemes are currently being considered, it is clear that there is resource potential to be capitalised. We consider that a more detailed study would be required to quantify this.

Biomass

DEFINITION AND SCOPE

Biomass is a diverse category with regard to the type of available fuels, fuel conversion technology and type of energy output.

Fuels – different fuel categories have been used in the literature and a single agreed categorisation is still difficult to identify. The EU Renewable Energy Directive and the UK Biomass Strategy, however, provide more comprehensive (and legally binding) definitions for biomass fuels. Generally, biomass fuel can arise from plants (woody or grassy), animals (manure, slurry) and human activity (industrial and municipal waste). All of these options are considered in the guidance. In most cases, the useful fuel is in a solid or gaseous form. Bioliquids (i.e. liquid fuel for energy purposes other than for transport) are also available and varied, however they are not directly included in this guidance as (1), they compete with the other biomass fuel categories for natural resource (productive land or bio waste) and therefore are not an additional resource, and (2) they often need to be imported to meet commercial scale demand (e.g. palm seed oil), for which regional resource assessment in not appropriate. Biofuels (e.g. biodiesel and bio-ethanol) are those fuels used for transport purposes and are not included in this study.

Conversion technology – three main processes are currently available and used: (1) direct combustion of solid biomass, (2) pyrolysis and gasification of solid biomass and (3) anaerobic digestion of solid or liquid biomass. Biomass fuels are in principle suitable for use in combined heat and power (CHP) plants, however, its use has not been exploited to its full potential in the UK. Assessing the capacity potential for biomass CHP however will not change the total outcome for the regional biomass opportunity and therefore is not required.

Energy output – this can be in the form of electricity or heat.

Source: DECC/CLG, 2010

Plant biomass

Main Assumptions

5.73 Plant biomass consists of undermanaged woodland, energy crops, waste wood and agricultural arisings (straw) for the generation of electricity and woodland and energy crops for heat. Each of these resources is detailed individually under its own heading in the following sections.

5.74 The assumptions made for plant biomass are as per the DECC methodology. Assumptions about individual technologies/resources are given in the sections for each technology/resource. A detailed list of the assumptions made for all the technologies can be found in Annex B.

Results

5.75 It can be seen from Table 5-15 that the Plant Biomass potential of Cumbria is 20.3 MW (electrical) and 68.7 (thermal). Carlisle provides the single largest potential for plant biomass with 25% of the sub-region's electrical potential and potential plant biomass heat provision.

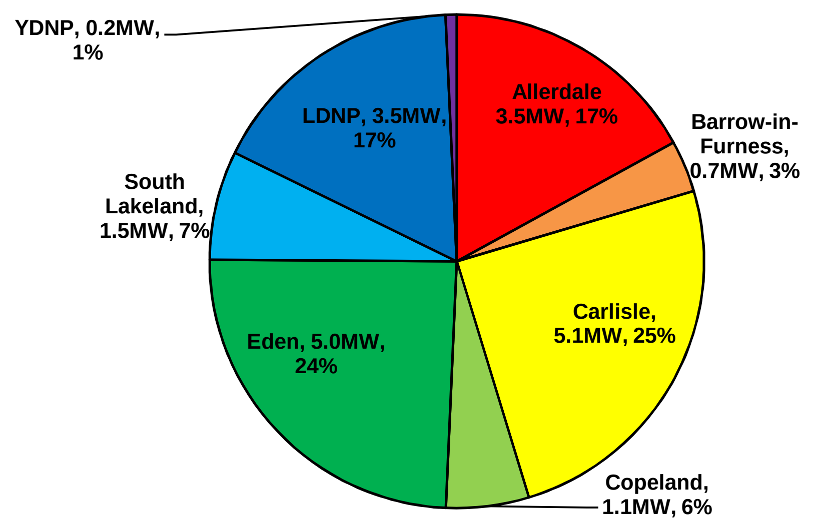
Table 5-15: Potential accessible plant biomass resource by local planning authority at 2030

LPA	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Allerdale	3.5	17	9.1	13
Barrow-in-Furness	0.7	3	1.0	1
Carlisle	5.1	25	17.0	25
Copeland	1.1	5	2.9	4
Eden	5.0	24	16.7	24
South Lakeland	1.5	7	3.9	6
LDNP	3.5	17	17.3	25
YDNP	0.2	1	1.0	1
Cumbria total	**20.3**	**100**	**68.7**	**100**

Source: SQW and LUC

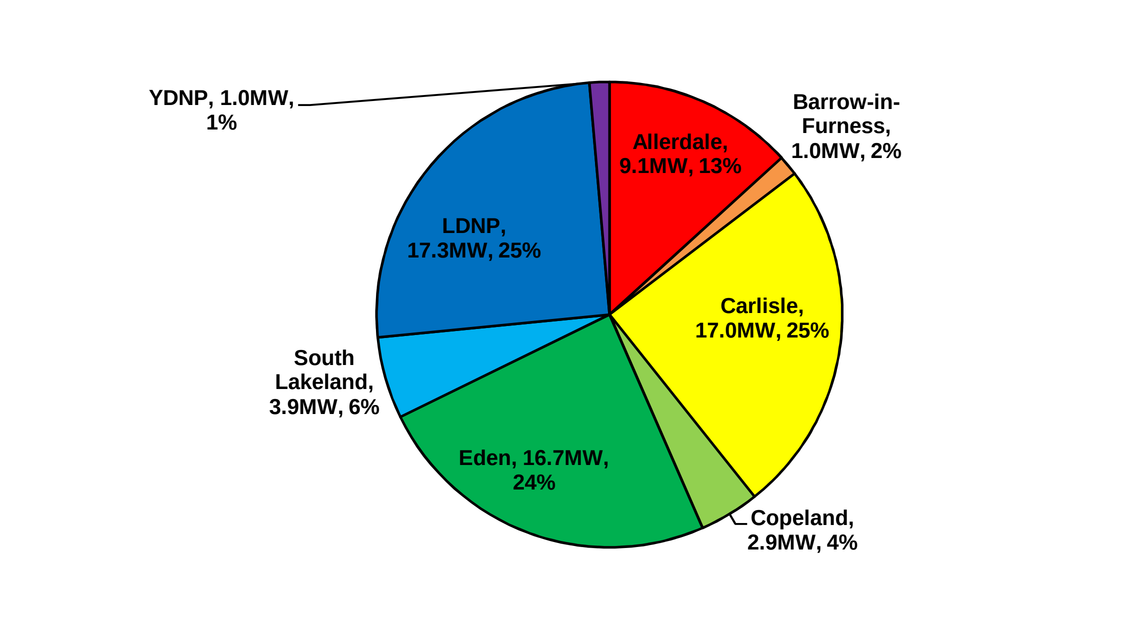
5.76 Figure 5-6 and Figure 5-7 illustrate the proportion of Plant Biomass potential for each LPA.

Figure 5-6: Potential accessible plant biomass (for electricity production) by local planning authority



Source: SQW and LUC

Figure 5-7: Potential accessible plant biomass (for heat production) by local planning authority



Source: LUC and SQW

Conclusions

5.77 Plant biomass only accounts for a small proportion of the overall renewable resource in Cumbria (2%). Most forms of plant biomass lend themselves to storage and can be easily transported. As such, it can be easily harnessed, managed and play an important role in local energy production.

Undermanaged Woodland

5.78 Undermanaged woodland is referred to as ‘managed woodland’ within the DECC methodology and the North West study and this term was originally used within this Cumbria study. However, it has been clarified by the Forestry Commission that the majority of the resource used is in currently undermanaged woodland and this is the phrase more commonly used when referring to woodfuel resource. Therefore, the undermanaged woodland referred to in this report represents the same resource as the managed woodland identified in the DECC methodology and the North West study.

Main Assumptions

5.79 The Forestry Commission was consulted in the development of the methodology for the assessment of woodland in the North West study, and has been consulted again for this study to refine the methodology to make it more tailored to Cumbria. In addition, Cumbria Woodlands was consulted. As per the North West study, the assessment has been a ‘bottom-up’ assessment starting with GIS data on woodland locations. Tree yield classes have been applied in this assessment in line with those applied in the North West study. A calorific value of 18 GJ/odt of wood (equivalent of stemwood) was used to calculate the resource value. It was then assumed that 50% of the available woodland was uneconomic to harvest (due to factors such as lack of physical access, owner perceptions etc). Although relatively crude, this assumption is in line with the Forestry Commission's Woodfuel Strategy (2007). Competition from alternative markets was also taken into account.

5.80 Consideration was given to including an estimate for woodland creation to 2030, but the Forestry Commission advised us not to include an aspirational figure. This is due to the difficulties in predicting the amounts that may be planted in the future. In addition, if trees are to be planted in 2011, it will likely take up to 20 years to start being able to thin the woodland on a substantial enough scale for woodland, which would be beyond the timescale of this study.

5.81 The assessment uses data from the National Inventory of Woods and Trees which was last produced in 1999. Since the analysis was undertaken, the results of the latest survey have just been made available and show an increase in the amount of woodland in Cumbria by 3461ha[34] - representing an overall increase from 9.4% woodland cover to 9.9%. Some of the increase will be due to better mapping technology and some will be due to new planting, but this would not produce biomass in the 20 year timeframe.

5.82 A more detailed list of assumptions for undermanaged woodland can be found in Annex B.

Protected landscape assumptions

5.83 The same assumptions as outlined above were applied to assess the potential for biomass from undermanaged woodland within protected landscapes. The protected landscape officers were consulted to identify the percentage woodland that it may be appropriate to bring back under management within the protected landscapes, however it was not possible to identify these figures for this study. As outlined above, a standard assumption of 50% was applied to estimate the percentage of woodland that is economic to harvest. The assessment has been undertaken in GIS and it has been possible to identify the potential within protected landscapes.

Results

5.84 The accompanying maps (available for download from Cumbria County Council's website – see Annex G for full list of maps) show the location of woodland considered in this assessment by tree type and by management type. The amount of woodland considered in this assessment is shown in Table 5-16. The information on woodland distribution provided by the Forestry Commission was cross-compared with the distribution of ancient woodland across the county. There are 17,066 ha of ancient woodland in Cumbria. Of this, all but 1,009 ha were included in the Forestry Commission dataset; this is because the Forestry Commission dataset resulted from a survey undertaken by English Nature which only recorded woodlands over 2 ha. It has been assumed that this remaining ancient woodland resource is undermanaged and that all ancient semi-natural woodland (ASNW) is broadleaved woodland and all ancient replanted woodland (PAWS) are coniferous woodland. Table 5-16 also shows the amount of woodland that is designated as ancient woodland.

[34] http://www.forestry.gov.uk/website/forestry.nsf/byunique/INFD-8EYJWF

Table 5-16: Woodland assessed for potential

LPA/Protected Landscape	Area Woodland in FC dataset (ha)	Amount of woodland in FC dataset that is Ancient Woodland (ha)	Additional Ancient Woodland (not in FC dataset) (ha)
Allerdale (outside of protected landscapes)	2,497.9	561.6	35.5
Barrow-in-Furness (outside of protected landscapes)	148.9	42.9	7.3
Carlisle (outside of protected landscapes)	18,412.0	1,475.6	70.8
Copeland (outside of protected landscapes)	1,443.1	210.7	25.2
Eden (outside of protected landscapes)	6,484.7	1,572.1	58.0
South Lakeland (outside of protected landscapes)	2,156.9	700.1	45.7
Arnside & Silverdale AONB	753.6	384.4	6.3
Lake District NP	26,443.7	9,680.1	638.1
North Pennines AONB	1,725.4	278.7	52.4
Solway Coast AONB	124.2	--	--
Yorkshire Dales NP	738.8	54.4	30.9
Potential extensions	1,299.1	488.7	39.2
Cumbria total	**62,228.2**	**15,449.4**	**1,009.5**

Source: SQW and LUC (figures many not total due to rounding)

5.85 Table 5-17 shows the potentially accessible undermanaged woodland resource for both electricity generation (6.8 MW) and heat generation (41.4 MW) respectively from Cumbria. Within Cumbria, over a third of the potential resource lies within the Lake District National Park Authority. Carlisle and Eden also have a significant portion of the potential resource due to the amount of woodland coverage.

Table 5-17: Potential accessible undermanaged woodland resource for electricity and heat generation at 2030 by local planning authority

LPA	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Allerdale	0.4	5	2.1	5
Barrow-in-Furness	0.0	0.2	0.1	0.2
Carlisle	1.7	25	10.4	25
Copeland	0.2	2	1.0	2
Eden	1.4	21	8.7	21

LPA	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
South Lakeland	0.4	6	2.3	6
LDNP	2.6	39	16.0	39
YDNP	0.2	2	1.0	2
Cumbria total	**6.8**	**100**	**41.4**	**100**

Source: LUC (figures may not total due to rounding)

5.86 Table 5-18 shows the potentially accessible resource for each of the protected landscapes.

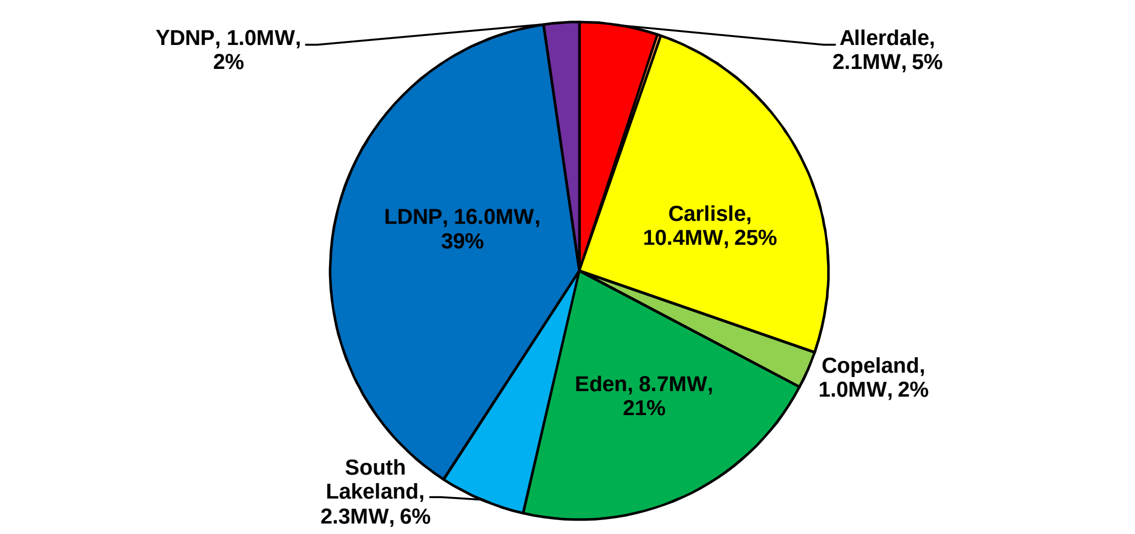
Table 5-18: Potential accessible undermanaged woodland resource for electricity and heat generation at 2030 by protected landscape

Protected Landscape	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Arnside & Silverdale AONB	0.1	2	0.8	2
Lake District NP	5.2	79	31.9	79
North Pennines AONB	0.5	8	3.2	8
Solway Coast AONB	0.02	0.4	0.1	0.4
Yorkshire Dales NP	0.3	5	1.9	5
Potential extensions	0.4	6	2.3	6
Protected Landscapes total	**6.6**	**100**	**40.2**	**100**

Source: (LUC)

5.87 If all ancient woodland is included, an additional resource of 0.22 MWe and 1.3 MWth could be made available. The majority of this extra resource is found within the Lake District National Park. Figure 5-8 illustrates the proportion of undermanaged woodland accessible resource for electricity generation by 2030 in each local authority.

Figure 5-8: Potential accessible undermanaged woodland resource at 2030 (heat generation) by local planning authority



Source: LUC

Conclusions

5.88 The potentially accessible undermanaged woodland resource for both electricity generation (6.8 MW) and heat generation (41.4 MW) respectively from Cumbria. The majority of this resource (39%) is found within the Lake District National Park Authority. This accounts for almost 80% of the resource in protected landscapes. Carlisle and Eden have a further 46% of the resource. Undermanaged woodland only accounts for around 1% of the accessible renewable electricity generation in Cumbria. Whilst more sophisticated models to estimate woodland yields exist, the yield classes used are in line with those used in the North West study and the assumptions about availability are in line with the Forestry Commission national study into woodfuel. In Chapter 7, we identify some of the key challenges that can be encountered in realising this potential.

Energy Crops

Main Assumptions

5.89 The DECC methodology requires the generation of estimates for heat and electricity from biomass energy crops under three scenarios – high, medium and low as follows:

- High – assumes that all available arable land and pasture will be planted with energy crops
- Medium – assumes that all abandoned land and pasture will be planted with energy crops
- Low – assumes that new crops will only be planted to the extent of submitted applications to the Energy Crop Scheme.

5.90 The Steering Group felt that there was little merit in evaluating the high and low scenarios as the results would be either a considerable overestimate or underestimate of potential. Instead, it was decided that a 'refined' version of the medium scenario would be evaluated. The refinement included the addition of a further 10% of land in food production to the estimate of all abandoned land and pasture. GIS data were not available to spatially map the extent of 'all abandoned land and pasture'. Through discussions with Natural England and the Steering Group, it was decided that the best proxy data was the amount of bare/fallow land from the DEFRA Agricultural and Horticultural Census. Similarly, the estimate of 10% of land in food production was calculated based on data from the DEFRA Agricultural and Horticultural Census.

5.91 In order to estimate potential for SRC and miscanthus, mapped existing Energy Crop Scheme data was used. The GIS data layer produced by Natural England shows that currently there are 14 ha of miscanthus and 63 ha of SRC in Cumbria. This equates to 18% miscanthus / 82% SRC and this breakdown has been used to estimate potential for each crop at 2030.

5.92 Data limitations meant that it was not possible to remove the exclusion areas (as per the DECC methodology) and through discussions with Natural England, it was decided that a pro rata reduction to the available land be made based on the level of constraint within the county (e.g. 36% of the county is constrained by nature conservation and cultural heritage designations, so a 36% reduction has been applied to the available land). An accompanying map (downloadable from Cumbria County Council's website – see Annex G for details) illustrates the distribution of these constraints. Further details of the assumptions used in the calculations can be found in Annex B.

Protected landscape assumptions

5.93 The same assumptions as outlined above were used to assess the potential for biomass from energy crops within the protected landscapes. Discussions with Natural England and the protected landscape officers did; however, note that the planting of energy crops within protected landscapes could have the potential to compromise the special qualities of these areas. It was decided that whilst the assumptions used would be the same, the data would be disaggregated as far as possible into protected landscapes and areas outside protected landscapes.

5.94 For the Lake District and Yorkshire Dales National Park Authorities, the 2007 National Parks Agricultural and Horticultural Survey has been used to approximate the proportion of the accessible resource that might be found within these two authorities. The calculations have been based on the amount of crops and bare/fallow land in each of the Cumbria LPAs and the Lake District National Park in 2007. For the Yorkshire Dales, 12% of the figure reported for the whole National Park has been used to approximate the amount of the Park within Cumbria. For the other protected landscapes and potential extensions, the calculations have been based on the land areas due to lack of data at this spatial scale.

Results

5.95 Table 5-19 shows the total potential resource for each LPA. It can be seen that Cumbria has an accessible energy crop resource of 6.2 MW for electricity generation and 23.6 MW for heat. Whilst Eden has the greatest potential resource, Allerdale also has a significant portion.

Table 5-19: Potential accessible energy crops resource for electricity and heat generation by local planning authority at 2030

LPA	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Allerdale	1.7	28	6.5	28
Barrow-in-Furness	0.1	2	0.4	1
Carlisle	1.5	24	5.7	24
Copeland	0.4	6	1.4	6
Eden	2.0	33	7.7	33
South Lakeland	0.3	5	1.1	4
LDNP	0.3	4	0.9	4
YDNP	0.0	0	0.0	0
Cumbria total	**6.2**	**100**	**23.6**	**100**

Source: LUC

5.96 Barrow-in-Furness, Copeland, South Lakeland and the two National Park Authorities have considerably less potential. In the case of Barrow-in-Furness, this is due to the more urban nature of the LPA.

5.97 Table 5-20 shows the contributions made by each of the protected landscapes.

Table 5-20: Potential accessible energy crop resource for electricity and heat generation by protected landscape at 2030

Protected Landscape	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Arnside & Silverdale AONB	0.0	1	0.1	1
Lake District NP	0.5	14	1.8	14
North Pennines AONB	1.6	46	6.1	46
Solway Coast AONB	0.5	14	1.9	14
Yorkshire Dales NP	0.0	0	0.0	0
Potential extensions	0.9	26	3.4	26
Protected Landscapes total	**3.4**	**100**	**13.3**	**100**

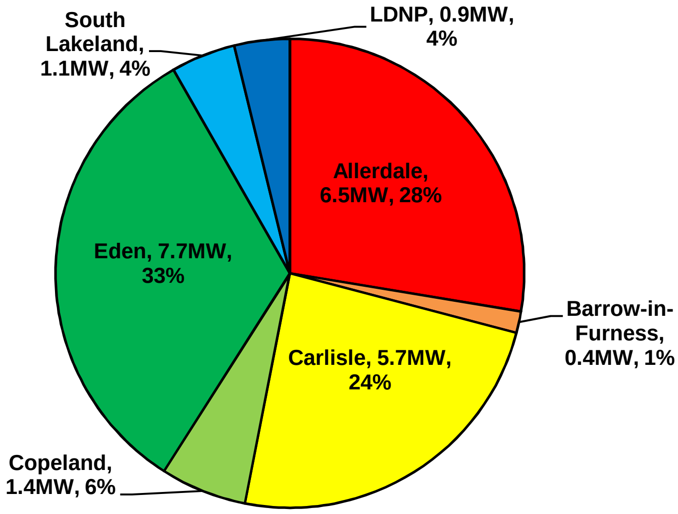
Source: LUC

5.98 Although only an estimate based on land areas for the AONBs and potential extensions, the North Pennines AONB shows significant potential.

5.99 The energy crops accessible resource potential of Cumbria accounts less than 1% of its potential renewable electricity generation and around 2% of the country's renewable heat.

Figure 5-9 shows the proportion of Cumbria's energy crops potential for electricity generation and heat contributed by each of the LPAs.

Figure 5-9: Potential accessible energy crops resource at 2030 (heat generation) by local planning authority



Source: LUC

Conclusion

5.100 Cumbria has an accessible energy crop resource of 6.2 MW for electricity generation and 23.6 MW for heat. Although energy crops are a relatively small part of the overall renewable energy resource in Cumbria, they offer a potential opportunity for exploitation in Eden, Allerdale and Carlisle.

Waste Wood

Main Assumptions

5.101 To ensure consistency of figures for each LPA, the WRAP Report 'Wood Waste Market in the UK' from August 2009 was used as a basis for the resource assessment as this gave the most comprehensive and up to date information on waste wood in the North West as a whole. The figures were then disaggregated to a local level based on employee numbers in each area. Findings could be further refined through consultation with local waste wood producers on a local area basis.

5.102 All the waste wood categories from the WRAP report were included in the assessment except for Municipal Solid Waste wood to avoid double counting with the MSW resource assessment. It was assumed that waste wood was converted to useful energy using direct combustion. A benchmark of 6,000 oven dried tonnes per year for each MW of electricity was then applied for the electricity capacity assessment. For the heat assessment, a benchmark of 12.5 GJ per tonne of wood waste was applied along with a fuel conversion efficiency of 80% and a capacity factor of 45%. Since the capacity factor for the heat assessment is highly dependent on the type of application of the biomass boiler[35], further refinement could be undertaken on a local area basis as biomass boilers installed across Cumbria will vary in terms of their capacity.

5.103 The resource was then assumed to increase by 1% per annum to 2030 in line with the DECC/CLG methodology (and this benchmark would likely remain until 2050).

Results

5.104 Table 5-21 shows the potential accessible resource for waste wood in Cumbria. It can be seen that Cumbria has almost 4.4 MW of waste wood potential (converting to electricity) and 3.8 MW (converting to heat) with significant levels of resource in both Carlisle and South Lakeland in particular.

Table 5-21: Potential accessible waste wood resource by local planning authority

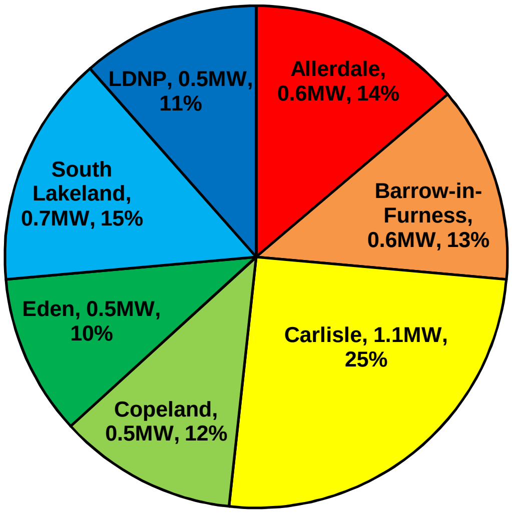
LPA	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Allerdale	0.6	14	0.5	13
Barrow-in-Furness	0.6	13	0.5	13
Carlisle	1.1	25	1.0	25
Copeland	0.5	11	0.5	12
Eden	0.5	10	0.4	9
South Lakeland	0.7	15	0.6	15
LDNPA	0.5	11	0.5	12
YDNPA	0.0	0	0.0	0
Cumbria total	**4.4**	**100**	**3.8**	**100**

Source: SQW (NB: numbers may not total due to rounding)

5.105 Waste wood accounts for less than 1% of the renewable energy resource in Cumbria. Figure 5-10 illustrates the proportion of the waste wood resource in each LPA.

[35] For example, general occupancy systems which are only in use during working hours have a capacity factor of around 20% while service applications such as swimming pools or hospitals use the systems for longer periods and thus have a capacity figure of 45% (Carbon Trust, 2009, *Biomass Heating: A Practical Guide*).

Figure 5-10: Potential accessible waste wood by local planning authority



Source: SQW

Conclusion

5.106 Cumbria has 4.4 MW of waste wood renewable potential (converting to electricity).

Agricultural Arisings (straw)

Main Assumptions

5.107 The assumptions and data sources for agricultural arisings (straw) were in line with the DECC methodology, with some refinements to yield and feedstock assumptions to better reflect local circumstances in Cumbria. Most notably, winter barley has been included as a potential feedstock source. Full details of the assumptions can be found in Annex B.

Protected landscape assumptions

5.108 For the Lake District and Yorkshire Dales National Park Authorities, the 2007 National Parks Agricultural and Horticultural Survey has been used to approximate the proportion of the accessible resource that might be found within these two authorities. The calculations have been based on the total amount of cereals in the National Parks and other LPAs in 2007. For the Yorkshire Dales, 12% of the figure reported for the whole National Park has been used to approximate the amount of the Park within Cumbria. No approximation has been made for the AONBs or potential extensions.

Results

5.109 Table 5-22 shows the accessible resource for agricultural arisings (straw) with a total renewable electricity resource of 3.0 MW. Eden has the largest proportion of the straw resource with 36% of Cumbria's total capacity.

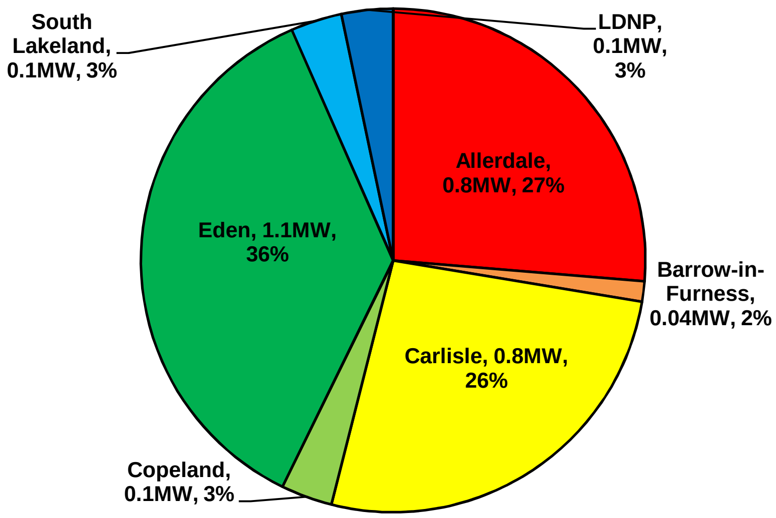
Table 5-22: Potential accessible agricultural arising (straw) resource at 2030

LPA	Electricity (MW Capacity)	Percentage of Total (%)
Allerdale	0.8	26
Barrow-in-Furness	0.04	1
Carlisle	0.8	26
Copeland	0.1	3
Eden	1.1	36
South Lakeland	0.1	3
LDNP	0.1	3
YDNP	0.00	0
Cumbria total	**3.0**	**100**

Source: LUC (data may not sum due to rounding)

5.110 Figure 5-11 shows the proportion of the straw resource potential by LPA.

Figure 5-11: Potential accessible agricultural arisings (straw) by local planning authority at 2030



Source: LUC

5.111 Although the agricultural arisings resource represents less that 0.1% of the total renewable electricity resource for the region, it constitutes an easily accessible resource that is already well managed. However, by its nature, straw production is very seasonal and is relatively expensive to store and transport due to its comparatively bulky nature and low calorific value. In addition, straw prices fluctuate considerably due to competing uses and depend on seasonal weather. As such, straw is only likely to supplement other biomass source plants.

Conclusion

5.112 Agricultural arisings (straw) has regional resource potential of 3.0 MW with Eden, Carlisle and Allerdale providing over 85% of the county's potential.

Animal Biomass

Main Assumptions

5.113 The potential renewable resources in the animal biomass category of the DECC methodology consist of wet organic waste and poultry litter. Each of these resources is detailed individually under its own heading in the following sections.

5.114 The assumptions made for animal biomass are largely consistent with the DECC methodology, but some important amendments have been made to better reflect the situation in Cumbria. Assumptions about individual technologies/resources are given in the sections for each technology/resource. A detailed list of the assumptions made for all the technologies can be found in Annex B.

Results

5.115 Both potential resources are used to produce electricity and account for 92.7 MW of electricity generation capacity. The majority of this (97%) comes from wet organic waste.

5.116 Table 5-23 details the results for each LPA. It can be seen that Eden has the biggest animal biomass resource with over 23% of the entire county's capacity. Allerdale and Carlisle also have a significant percentage of the overall county resource.

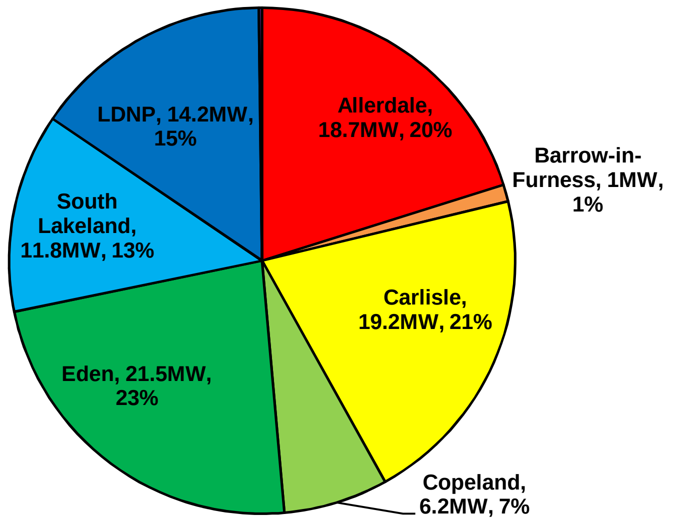
Table 5-23: Potential accessible animal biomass resource at 2030

LPA	Electricity (MW Capacity)	Percentage of Total (%)
Allerdale	18.7	20
Barrow-in-Furness	1	1
Carlisle	19.2	21
Copeland	6.2	7
Eden	21.5	23
South Lakeland	11.8	13
LDNP	14.2	15
YDNP	0.2	0
Cumbria total	**92.8**	**100**

Source: LUC

5.117 Figure 5-12 illustrates the proportion of animal biomass resource in each LPA.

Figure 5-12: Potential accessible animal biomass resource at 2030 by LPA



Source: LUC

Conclusion

5.118 Animal biomass accounts for 92.8 MW of potential renewable electricity generation in Cumbria, of which almost a quarter is located in Eden.

Wet Organic Waste

Main Assumptions

5.119 The DECC methodology suggests that the use of ADAS Manure Management Database, but these data are only available at a cost and it was felt that good results could be obtained by using the DEFRA Agricultural and Horticultural Census to get the number of livestock in each local authority. Data at LPA level are only available for 2007. The percentage contributions for each LPA have been applied to the 2009 census figures in order to try and bring the figures ‘up to date’. This was then multiplied by a standard animal waste factor obtained from the Biomass Energy Centre and supplied by the Reiver Renewables (based on DEFRA Report AET/ENV/R/2104). For food and drink waste data the Environment Agency report ‘Northwest Commercial and Industrial Waste Survey 2009’ was used. Figures in this report are stated for the whole of Cumbria, but we have been advised that a good approximation of the figures at an LPA level can be obtained pro-rating the figures in line with the number of active enterprises in each LPA based on the Office of National Statistics (ONS) data.

5.120 In addition to cattle, pigs and food/drinks waste, this study has included a small contribution for grass and silage to be diverted to anaerobic digestion to reflect current trends in the county. Reiver Renewables was consulted and provided a robust methodology for estimating input from grass and silage. The method considers the amount of grass/silage that will remain after all the livestock in the county have been fed to a satisfactory level. More detailed information about the assumptions can be found in Annex B.

Protected landscape assumptions

5.121 For the Lake District and Yorkshire Dales National Park Authorities, the 2007 National Parks Agricultural and Horticultural Survey has been used to approximate the proportion of the accessible resource that might be found within these two authorities. The calculations have been based on the total cattle numbers in the National Parks and other LPAs in 2007. For the Yorkshire Dales, 12% of the figure reported for the whole National Park has been used to approximate the amount of the Park within Cumbria. No approximation has been made for the AONBs or potential extensions.

Results

5.122 Table 5-24 shows the results for wet organic waste for Cumbria broken down by LPA.

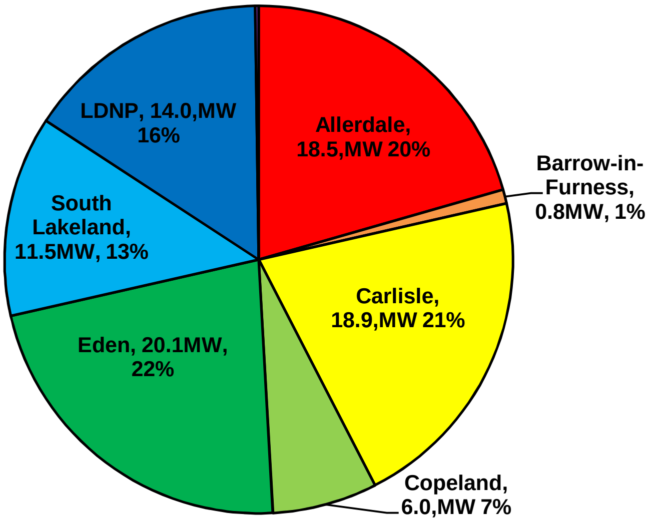
Table 5-24: Potential accessible wet organic waste resource at 2030

LPA	Electricity (MW Capacity)	Percentage of Total (%)
Allerdale	18.5	21
Barrow-in-Furness	0.8	1
Carlisle	18.9	21
Copeland	6.0	7
Eden	20.1	22
South Lakeland	11.5	13
LDNP	14.0	16
YDNP	0.2	0.2
Cumbria total	**90.0**	**100**

Source: SQW (Numbers may not sum due to rounding)

5.123 Cumbria has 90 MW of wet organic waste potential resource with Eden accounting for 22% of this. Allerdale and Carlisle also have a significant proportion of the remaining potential with Barrow-in-Furness and Yorkshire Dales NP with the lowest potential. Figure 5-13 below illustrates the proportion of wet organic waste potential in each of the LPAs.

Figure 5-13: Potential accessible wet organic waste by local planning authority at 2030



Source: LUC

Conclusion

5.124 Wet organic waste accounts for 90 MW of potential renewable electricity generation in Cumbria, of which around 22% is located in Eden.

Poultry Litter

Main Assumptions

5.125 The assumptions made for poultry litter were based on those in the DECC methodology. Through consultation with poultry specialists at the National Farmers Union (NFU), it has been confirmed that it is theoretically possible to collect litter for energy from non-broiler birds (chicken layers and turkeys). However, further discussions with EPRL (who manage the litter sourcing for the UK's largest poultry litter fuelled power station) and the Biomass Energy Centre have highlighted that it is the bedding rather than the litter itself that is the best energy source and the shallower depth of the bedding used for non-broilers limits the amount of litter that can viably be collected from non-broilers.

5.126 The 2007 DEFRA Agricultural and Horticultural Census is the most recent census to present data at local authority level. The percentage contribution for each LA in the 2007 census was applied to the 2009 census data to try and bring these figures 'up to date'. It must be noted that gaps exist in the LA figures due to confidentiality issues. Where gaps exist, it has been necessary to split the total between the LAs equally. The total number of broilers (table chickens) has decreased between 2007 and 2009.

Protected landscape assumptions

5.127 For the Lake District and Yorkshire Dales National Park Authorities, the 2007 National Parks Agricultural and Horticultural Survey has been used to approximate the proportion of the accessible resource that might be found within these two authorities. The calculations have been based on the total poultry numbers in the National Parks and Local Authorities in 2007.

For the Yorkshire Dales, 12% of the figure reported for the whole National Park has been used to approximate the amount of the Park within Cumbria. No approximation has been made for the AONBs or potential extensions.

Results

5.128 Table 5-25 details the potential accessible renewable capacity for poultry litter in Cumbria by LPA; the total potential is 2.8 MW.

Table 5-25: Potential accessible poultry litter resource at 2030

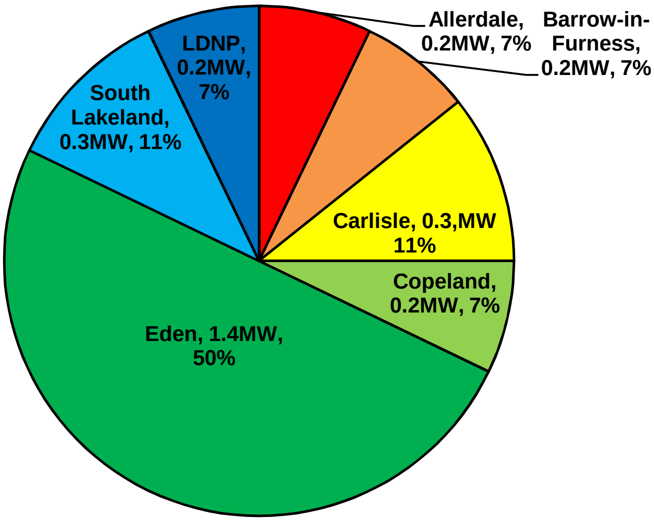
LPA	Electricity (MW Capacity)	Percentage of Total (%)
Allerdale	0.2	7
Barrow-in-Furness	0.2	7
Carlisle	0.3	11
Copeland	0.2	7
Eden	1.4	50
South Lakeland	0.3	11
LDNP	0.2	7
YDNP	0.0	0
Cumbria total	**2.8**	**100**

Source: LUC (figures may not total due to rounding)

5.129 As expected, the more rural the LPA the greater the potential for this type of resource. Although this is a very small potential capacity, poultry litter is a mature and well established technology. Westfield Power Station currently utilises litter from Cumbria. Discussions with the NFU highlighted that the use of poultry litter at a domestic scale is currently limited due to prohibitive legislation (Waste Framework Directive), which requires controls on emissions which are only affordable for large-scale commercial operations. NFU are lobbying DEFRA and the EA for de-classification of poultry litter when used for energy, with some success. This would be enacted through the 'End of Waste Protocol' whereby the treatment of the 'waste' product through a process (in this case burning for energy) exempts it from being classed as 'waste'.

5.130 Figure 5-14 below illustrates the proportion of the total poultry litter resource for each LPA.

Figure 5-14: Potential accessible poultry litter resource at 2030 by local planning authority



Source: LUC

Conclusion

5.131 Poultry litter offers a potential renewable resource of 2.8 MW in Cumbria located primarily in Eden.

Municipal Solid Waste

Main Assumptions

5.132 The potential for Municipal Solid Waste (MSW) was assessed assuming direct combustion of the resource. Local authority data for Cumbria were used from DEFRA's WasteDataFlow[36] database for the latest available year (2008/09). A benchmark of 10 kilo tonnes of MSW for 1 MW of electricity capacity was applied. The Biodegradable Municipal Waste (BMW) portion of the municipal waste was assumed to be 68% of the total MSW amount[37]. The remainder of the resource was excluded, reflecting the DECC/CLG methodology. The data were disaggregated to arrive at figures for LPAs including National Parks based on the population numbers in each LPA. More details on the assumptions made can be found in Annex B.

5.133 In terms of the assumptions to 2030, it was assumed that waste would rise in line with the household growth in each LPA (based on sub national household projections available from CLG), but that the amount of waste per household would remain constant. It is likely that the technical potential of MSW in 2050 will have increased from 2030 as household numbers are expected to rise.

[36] http://www.wastedataflow.org/
[37] This is the deemed percentage of municipal waste which is biodegradable according to Defra, 2006, Guidance on the Landfill Allowance Schemes: Municipal Waste.

Results

5.134 Table 5-26 details the MSW potential resource in Cumbria and its LPAs. It can be seen that the total for the county is 19.4 MW with the proportions for each of the LPAs broadly in line with their population.

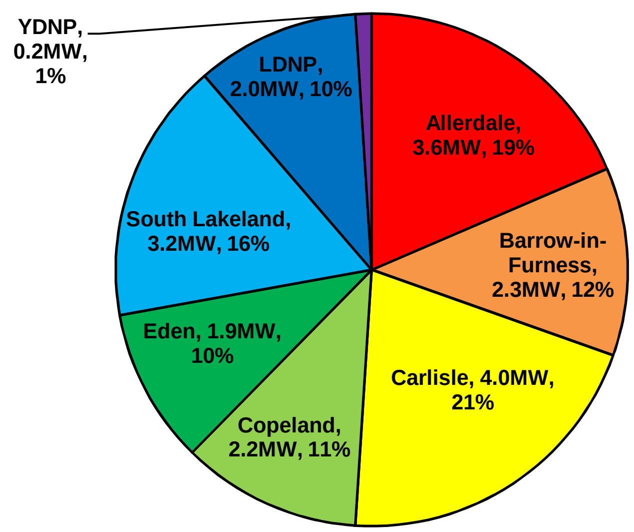
Table 5-26: Potential accessible Municipal Solid Waste resource by LPA

LPA	Electricity (MW Capacity)	Percentage of Elec. Total (%)
Allerdale	3.6	19
Barrow-in-Furness	2.3	12
Carlisle	4.0	21
Copeland	2.2	11
Eden	1.9	10
South Lakeland	3.2	16
LDNP	2.0	10
YDNP	0.2	1
Cumbria total	**19.4**	**100**

Source: SQW (figures may not total due to rounding)

5.135 Figure 5-15 illustrates the proportion of MSW potential resource in each LPA. Carlisle has the greatest potential followed by Allerdale and South Lakeland.

Figure 5-15: Potential accessible municipal solid waste resource by local planning authority



Source: SQW

Conclusion

5.136 Cumbria has a potential MSW renewable energy resource of 19.4 MW.

Commercial and Industrial Waste

Main Assumptions

5.137 The potential for Commercial and Industrial (C&I) waste was assessed assuming direct combustion of the resource (as stipulated by the DECC methodology), using similar assumptions to the Municipal Solid Waste (MSW) assessment. For example, a benchmark of 10 kilo tonnes of C&I is assumed to generate 1 MW of electricity capacity per annum. The main source of data was the Environment Agency's 2009 'North West of England Commercial and Industrial Waste Survey Report'. Only the waste streams that had a high organic content (animal and vegetable waste and non-metallic waste) that were not accounted for in any of the other resource categories were used. In order to derive figures for each local authority in Cumbria (only county or unitary authority figures were available from the Environment Agency report) employee numbers were used as a proxy, as used for the industrial waste wood assessment. The data were disaggregated further to arrive at figures for LPAs including National Parks based on the employment numbers in each LPA. The resource assessment for this study was undertaken as follows:

- It included animal and vegetable waste and non-metallic waste only (for the animal and vegetable waste fraction; food, drink and tobacco and retail and wholesale was excluded to avoid double counting as this is already included in the wet organic waste assessment).
- It excluded other categories of waste, such as mineral waste, which are unable to produce energy.
- It assumed growth in number of employees to 2030 of 0.5% per annum (based on a UK-wide UK Commission for Employment and Skills report).
- the LPA figures were calculated by using their employee numbers to attribute C&I waste to each LPA – including the required apportionment of capacity to National Parks.

5.138 Several other studies were considered, but did not provide the data required for the following reasons:

- Jacobs (2010) Commercial and Industrial Waste Survey, although more recent than the Environment Agency report, only includes estimates of C&I waste quantities by type of waste and by sector separately and it does not include figures disaggregated for both at the same time (e.g. the animal and vegetable fraction of food, drink and tobacco waste for Cumbria). Also, the Environment Agency Study uses data disaggregated to the county and unitary authority level whilst the Jacobs study only includes data for the North West as a whole.
- A study undertaken by ADAS (2009) – National Study into Commercial and Industrial Waste Arisings – is more recent than the Environment Agency report, but unfortunately excludes the North West from its analysis (although it covers all other regions).

- Entec (2007) Cumbria County Council and Cheshire County Council Analysis of BVPI 84a report has a section on estimating trade waste volumes in relation to the Best Value Performance Indicator 84a. It shows the recalculations at LPA level, but only where they were required (i.e. where a dedicated vehicle had not been used). Therefore, it does not provide figures for all the LPAs within Cumbria. In addition, this report only covers waste collected by LPAs (not all C&I waste) and it does not show the biodegradable fraction required for this study.

- North West Regional Advisory Body (2003), 2nd Waste Management Monitoring Report found that the North West produced 8.3 million tonnes of C&I waste in 2003, this had fallen by 13% since 1998/99. The survey results estimated that 359,000 tonnes were disposed of by thermal treatment, including export from the region. In Cumbria, although 30% of C&I waste was recycled and reused, the majority was sent to landfill and over a third the treatment option was unrecorded. This data source was not used for the current assessment as the data were not disaggregated to LPA level and more recent data at the county level were available.

Results

5.139 Table 5-27 below details the C&IW potential resource in Cumbria and its constituent authorities. As shown below, the total for the region is approximately 20.7 MW with Carlisle accounting for a quarter of the potential resource.

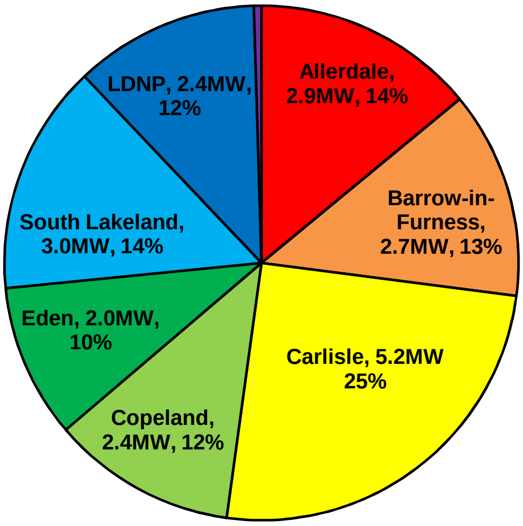
Table 5-27: Potential accessible Commercial & Industrial Waste resource

LPA	Electricity (MW Capacity)	Percentage of Elec. Total (%)
Allerdale	2.9	14
Barrow-in-Furness	2.7	13
Carlisle	5.2	25
Copeland	2.4	12
Eden	2.0	10
South Lakeland	3.0	14
LDNP	2.4	12
YDNP	0.1	0
Cumbria total	**20.7**	**100**

Source: SQW (figures may not total due to rounding)

5.140 Figure 5-16 illustrates the proportion of the resource available in each LPA.

Figure 5-16: Potential accessible commercial & industrial waste resource by local planning authority



Source: SQW

Conclusion

5.141 Cumbria has a potential renewable resource from commercial & industrial waste of 20.7 MW.

Biogas

Main Assumption

5.142 The potential renewable resources in the biogas category of the DECC methodology consist of landfill gas and sewage gas. Each of these resources is detailed individually under its own heading in the following sections.

5.143 A detailed list of the assumptions made for all the resources can be found in Annex B.

Results

5.144 Table 5-28 details the potential accessible resource for biogas for Cumbria. Both the biogas resources have a combined potential resource capacity of 6.7 MW.

Table 5-28: Potential accessible biogas resource

LPA	Electricity (MW Capacity)	Percentage of Elec. Total (%)
Allerdale	1.6	24
Barrow-in-Furness	1.2	18
Carlisle	1.4	21
Copeland	0.6	9
Eden	0.7	10
South Lakeland	0.8	12
LDNP	0.5	8

LPA	Electricity (MW Capacity)	Percentage of Elec. Total (%)
YDNP	0.0	0
Cumbria total	**6.7**	**100**

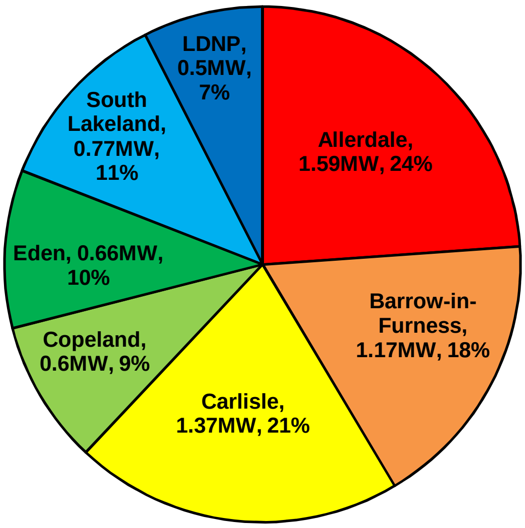
Source: SQW (figures may not total due to rounding)

5.145 Figure 5-17 illustrates the proportion of the biogas potential in each LPA. Allerdale has the largest potential with 24% of the total. Copeland has limited potential resource according to the preliminary assessment as there are no accredited landfill gas sites in the area.

Conclusion

5.146 Cumbria has a potential for accessible resource for biogas of 6.7 MW.

Figure 5-17: Potential accessible biogas resource by local planning authority



Source: SQW

Landfill Gas

Main Assumptions

5.147 The existing capacity of landfill gas was extracted from the OFGEM Renewable Obligation register and the potential accessible landfill gas resource calculated for the year 2030. The current assessment is based on UK-wide forecasts of landfill gas capacity (it was assumed that the present day landfill capacity will continue flat for 5 years to 2015, then there will be a straight line reduction until the capacity in 2030 is 20% of today's capacity).

5.148 Even taking local plans into account, the amount of landfill gas in 2030 and 2050 is likely to be substantially lower than current capacity. This is because the EU Landfill Directive and waste management legislation meant that the amount of waste sent to landfill will decrease significantly over the next two decades, albeit with the landfill gas resource lagging behind waste sent to landfill due to decomposition timescales. It was assumed that there would be no new significant landfill sites opened over the period of this analysis. More detail on the assumptions made can be found in Annex B.

Results

5.149 Table 5-29 details the potential landfill gas resource in 2030 given the above assumption. Cumbria has a landfill gas potential of 1.8 MW. It can be seen that Allerdale has the greatest resource with almost half of all the landfill gas potential.

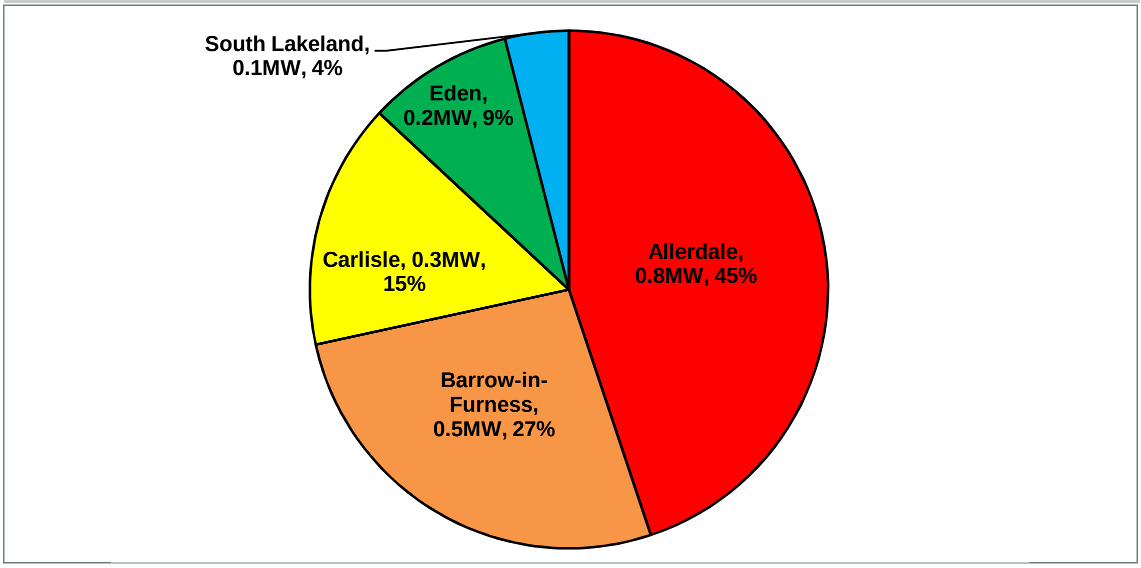
Table 5-29: Potential accessible landfill gas resource

LPA	Electricity (MW Capacity)	Percentage of Elec. Total (%)
Allerdale	0.8	45
Barrow-in-Furness	0.5	27
Carlisle	0.3	15
Copeland	0.0	0
Eden	0.2	9
South Lakeland	0.1	4
LDNP	0.0	0
YDNP	0.0	0
Cumbria total	**1.8**	**100**

Source: SQW (figures may not total due to rounding)

5.150 Figure 5-18 illustrates the share of the county's landfill gas potential in each of the LPAs. Copeland, the Lake District and Yorkshire Dales National Parks have no current technical potential for landfill gas as there are no accredited landfill gas sites in the area.

Figure 5-18: Potential accessible landfill gas by local planning authority



Source: SQW

Conclusion

5.151 The likely potential accessible landfill gas resource for Cumbria is 1.8 MW.

Sewage Gas

Main Assumptions

5.152 The original preliminary assessment was based on the list of accredited stations on the OFGEM Renewable Obligation register. However, there are currently no accredited stations which generate energy using sewage gas in Cumbria and thus this methodology clearly did not reflect the real technical potential for sewage gas energy sites in the county. This is especially the case since it is thought that smaller sites will become more viable for sewage gas production in the future as technology improves. For example, United Utilities, the water utility company for much of the North West, is currently installing an advanced digestion plant to produce electricity at a site in Lancashire (Davyhulme Wastewater Treatment Works) and if successful this technology could potentially be rolled out to their wastewater treatment works in Cumbria.

5.153 The updated assessment, in contrast, is based on population numbers in each LPA and the average amount of sewage that is produced per person (20kg per year when dried, according to Defra, 2002). It has been assumed that each tonne of organic dried sewage sludge (80% of the total dried solids) can produce 490 m^3 of biogas in an aerobic digestion plant. Of this, only the methane in the biogas can be used to generate electricity (62.5% was applied – the mean of 60 to 65% of the total biogas). It has been assumed that 11.04 kWh of power output can be produced per cubic metre of methane. This has then been converted to an energy capacity figure based on the number of hours in a year and a sewage gas load factor for the North West from DECC (2010). The data were then disaggregated to arrive at figures for LPAs including National Parks based on the population numbers in each LPA. The results have been projected forward to 2030 using the most recent ONS population projections for each district.

5.154 Table 5-30 details the results of the sewage gas assessment for 2030.

Table 5-30: Potential accessible sewage gas resource

LPA	Electricity (MW Capacity)	Percentage of Elec. Total (%)
Allerdale	0.8	16
Barrow-in-Furness	0.7	14
Carlisle	1.1	22
Copeland	0.6	12
Eden	0.5	10
South Lakeland	0.7	14
LDNP	0.5	10
YDNP	0.0	0
Cumbria total	**4.9**	**100**

Source: SQW

5.155 The overall potential for generating electricity from sewage gas is 4.9 MW. The greatest potential can be found in Carlisle, Allerdale, Barrow-in-Furness and South Lakeland, the areas with greatest populations, which all have around 1 MW of potential. It is thought that in 2050 the capacity is likely to be higher due to further forecast population increases. This could rise even further if increases to efficiency of sewage gas generation facilities occur and with the introduction of more advanced anaerobic digestion technologies and the addition of other organic materials such as food waste which can increase gas yields (Parliamentary Office of Science and Technology, 2007).

Conclusion

5.156 Compared to landfill gas (1.8 MW capacity), sewage gas has a higher potential in Cumbria as a whole (and also in the long term as sewage gas will not be depleted in the same way as landfill gas).

5.157 This assessment has not considered where sewage gas production could be located (as it is based on population numbers) and this may impact on the potential, as treatment works catering for the county may be located elsewhere. Alternatively, Cumbria may be able to treat the sewage sludge (and therefore could capture resultant gas) of populous neighbouring areas. However, this is true of a number of the resource assessments; for example, biomass which could be treated outside of Cumbria, and Cumbria could treat biomass from neighbouring areas.

5.158 The assessment has only calculated the potential for generating electricity in line with the DECC methodology. In addition to this, there is the potential to exploit waste heat that is produced as a by-product of combustion, using combined heat and power (CHP). The ability to make use of this heat is dependent on whether there is a heat demand nearby. Since the generation plant needs to be on/near-site to the wastewater treatment facility and many facilities are located in areas remote from significant populations, this potential would need to be assessed on a site specific basis.

Co-firing

Main Assumptions

5.159 The assessment was based on the number of solid or liquid fuel power plants in Cumbria (from DECC's Digest of UK Energy Statistics).

Results

5.160 There are currently no coal or oil-fired power plants in Cumbria and it is assumed that this will remain the case to 2030 (and likely 2050). Thus, there is no technical potential for co-firing of biomass with a fossil fuel in Cumbria.

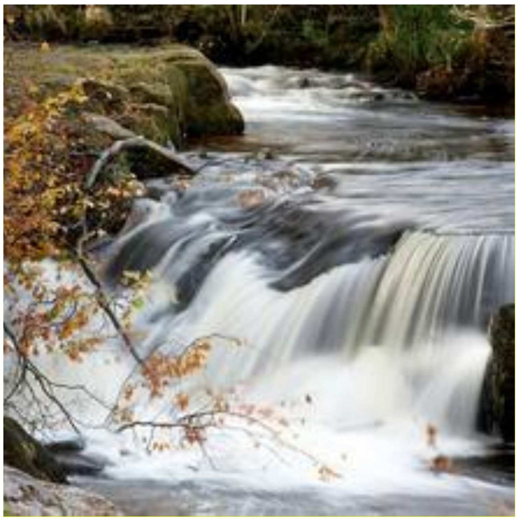
Hydropower

Small scale hydropower

DEFINITION AND SCOPE

Hydro power involves harnessing the power of flowing or falling water through a turbine in order to produce electricity. The parameters determining the amount of electricity produced include the turbine generating capacity, the turbine discharge flow (the volume of water passing through the turbine at any given time, which will change depending on the time of year) and available head (the vertical distance between the point where the water is highest and the turbine). The larger the head, the more gravitational energy can be converted to electrical energy. Hydropower can also be combined with storage (pumped storage), by pumping water from a low elevation to a high elevation at times of plentiful supply of electricity for release when needed.

For the purposes of assessing the hydropower resource, small-scale hydro power (under 20 MW) is considered because opportunities for large-scale hydro (e.g. large dams) are becoming more and more limited. This is because most of the major sites for hydro have already been used along with environmental concerns over the adverse impact of large-scale hydro on local ecosystems and habitats and changes to the natural river flow and intensity. In contrast, small-scale hydro installations can be sited at small rivers and streams with little adverse impact on the river's ecology, for example, on fish migration patterns.



Source: DECC/CLG, 2010

Main Assumptions

5.161 The DECC methodology recommends the use of the results of the Environment Agency's report 'Mapping Hydropower Opportunities in England and Wales' (2009) to identify the total regional resource and the portion of that resource which is accessible and viable.

5.162 GIS data from the Environment Agency study was obtained and was divided up spatially into local authorities. The Environment Agency study is the first phase in a wider programme of work and subsequent phases will refine and ground truth the data, consider environmental sensitivities in more detail and apply the analysis at river catchment scale. Despite being based on the same data as the North West study, the results will differ as the dataset has undergone a review in the period between the two studies.

5.163 Opportunities identified in the Environment Agency study were classified according to an environmental sensitivity-hydropower potential matrix. In a separate exercise, a subset of the barriers (barrier is the term used to identify a site where there is sufficient height in river level to provide a hydropower opportunity) were identified as potential sites which include those barriers which have the potential to provide a good hydropower opportunity (over 10 kW) as well as increasing the status of the associated fish population (e.g. by improving fish passage). These 'win-wins' are all located in Heavily Modified Water Bodies. More detailed information can be found in Annex B.

Protected landscape assumptions

5.164 The findings of Environment Agency's report as outlined above were used to identify the potential for hydropower within the protected landscapes as the data locates each barrier in GIS. However, the findings of two feasibility studies undertaken in the Lake District NP and Yorkshire Dales NP have been included for further context.

Results

5.165 Table 5-31 details the potential accessible resource for small scale hydropower. These are those barriers identified as 'win-wins' in the EA study. The table represents the potential in each local authority including the protected landscapes.

Table 5-31: Potential accessible small scale hydropower resource at 2030 by local authority

LPA	Electricity (MW Capacity)	Percentage of Total (%)
Allerdale	2.1	3
Barrow-in-Furness	0.0	0
Carlisle	1.5	2
Copeland	0.0	0
Eden	4.4	6
South Lakeland	6.6	9
LDNP	42.5	61
YDNP	12.6	18
Cumbria total	**69.7**	**100**

Source: LUC (figures may not total due to rounding)

5.166 Cumbria has a potential resource of 69.7 MW with 80% of this potential identified within protected landscapes. The potential hydropower resource outside of protected landscapes is summarised in Table 5-32 below.

Table 5-32: Potential accessible small scale hydropower resource at 2030 outside of protected landscapes

LPA	Electricity (MW Capacity)	Percentage of Total (%)
Allerdale	2.1	30
Barrow-in-Furness	0	0
Carlisle	1.3	18
Copeland	0	0
Eden	1.2	17
South Lakeland	2.4	35
Cumbria total	**6.9**	**100**

Source LUC (figures may not total due to rounding)

5.167 Table 5-33 shows the results for protected landscapes. We have also investigated two feasibility studies undertaken in the National Parks; these identified 10.8 MW potential in the

Lake District NP and 0.2 MW in those parts of the Yorkshire Dales NP located within Cumbria. Whilst this study was limited in its scope and did not set out to capture the entire capacity of the NPs, the results do suggest that the realisable capacity could be somewhat reduced from that identified in the Environment Agency report.

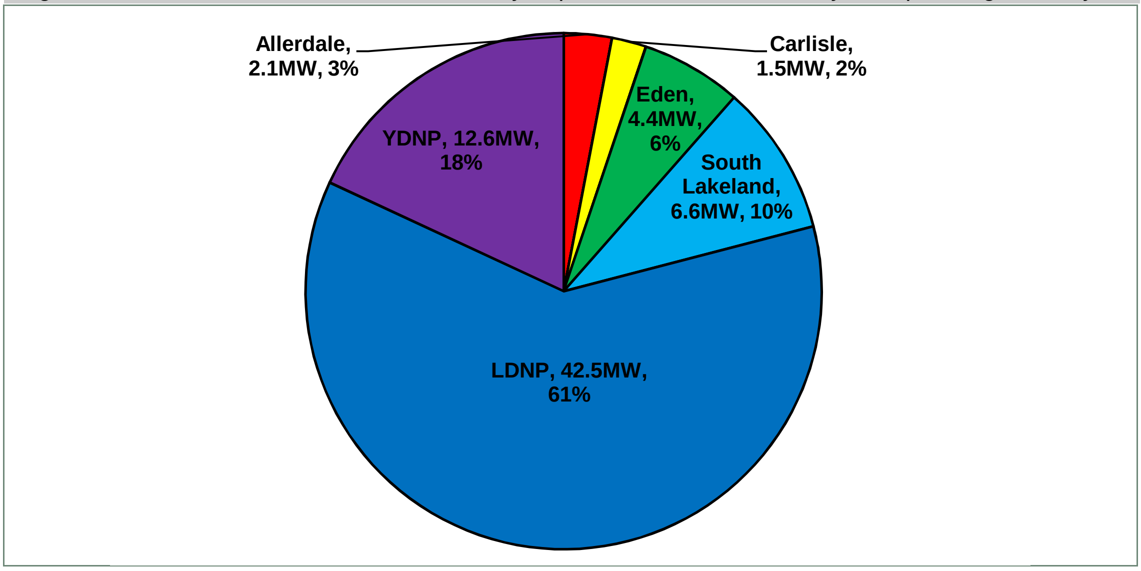
Table 5-33: Potential accessible small scale hydropower resource at 2030 within protected landscapes

Protected Landscape	Electricity (MW Capacity)	Percentage of Total (%) (based on Environment Agency 'win-wins' only)
Arnside & Silverdale AONB	0.2	0.4
Lake District NP	42.5	68
North Pennines AONB	1.0	2
Northumberland NP	0.1	0.1
Solway Coast AONB	0.0	0.0
Yorkshire Dales NP	12.6	20
Potential extensions	6.3	10
Protected Landscapes total	**62.8**	**100**

Source: LUC

5.168 Figure 5-19 illustrates the proportion of small scale hydropower in each LPA (including protected landscapes).

Figure 5-19: Potential accessible small scale hydropower resource at 2030 by local planning authority



Source: LUC

Conclusion

5.169 Cumbria has a potential accessible resource of Small Scale Hydropower of 69.7 MW. According to the Environment Agency study, the majority of this potential is found within the Lake District National Park.

Large scale hydropower

DEFINITION AND SCOPE

Hydroelectric power is a widely used form of renewable energy. It exploits the gravitational force of falling water, converting it into mechanical power via a turbine which produces electricity by driving a generator. Large scale hydropower involves large dams and reservoirs.

Electricity can also be generated on a commercial scale via the construction of pumped storage schemes that move water between reservoirs located at different elevations. Such schemes are not carbon neutral as electricity from the grid is used to pump the water uphill. The main benefit of this technology is to generate electricity at peak demand times using water that has been pumped uphill at times of lower demand.

Source: Environment Agency and Tradelinksolutions.com

5.170 Commercial scale hydropower is not considered as part of the DECC methodology. From discussions with the Environment Agency, we are aware that there are currently no large hydropower schemes operational in Cumbria nor are any schemes proposed. According to the Cumbria Vision document, 'The Scope for Renewable Energy in Cumbria', 2009 (p21):

> *'it is inconceivable that large-scale hydro-power schemes involving the damming of valleys and submergence of cultural landscapes could be contemplated in the Lake District National Park or other areas of prized Cumbrian scenery. Environmental considerations are almost certain to concentrate attention on small scale developments with minimal scenic and ecological impact'.*

Microgeneration

DEFINITION AND SCOPE

Microgeneration typically refers to renewable energy systems that can be integrated into buildings to primarily serve the on-site energy demand. They are applicable to both domestic and non-domestic buildings and can be connected to the grid although this is not required as most of the output is used on-site. Thus microgeneration systems are typically designed and sized either in relation to the on-site demand or in proportion to the physical constraints on-site such as available space, whichever is more appropriate.

Microgeneration technologies cover the full range of renewable energy categories: wind, solar, biomass, hydropower and heat pumps. Technologies that directly depend on the built environment capacity to take microgeneration systems are solar – solar water heating (thermal) and solar photovoltaics (electric) – and heat pumps – ground source heat pumps and air source heat pumps.

In terms of assessing the regional opportunities and constraints for deployment, the microgeneration wind, biomass and hydropower categories are captured elsewhere in this report.

Source: DECC/CLG

Microgeneration – solar

5.171 The assumptions made for solar microgeneration were largely consistent with the DECC methodology. As with the North West study, it was necessary to make some additional assumptions for the average unit capacity for industrial properties. In this case it was assumed that the average size for solar was 10 kW for industrial properties. More details on the assumptions can be found in Annex B.

5.172 A number of DECC/North West assumptions were checked for relevance to Cumbria as part of this study. In particular, the Steering Group felt that the 50% assumption for suitable new rooms from new housing was too high. The Energy Savings Trust Homes Efficiency Database (HEED online) was checked, but no figures were found to challenge to refine this assumption for Cumbria. Additionally, the introduction of a solar irradiation constraint was considered. Although data exists showing solar PV potential at property level based on available sunlight and roof orientation, this data was too expensive to purchase for a county scale assessment.

5.173 Therefore, in line with the DECC methodology and the North West study, this assessment considers the potential based on number of residential, commercial and industrial properties as well as new housing that will be built up to 2030 (for PV) and residential (existing and planned) with a very small contribution from commercial properties for solar thermal.

5.174 Properties within Conservation Areas were excluded and a reduction was applied in locations which have a high density of Listed Buildings. Further details on the assumptions used are contained in Annex B.

Protected landscape assumptions

5.175 The same assumptions as outlined above were applied to assess the potential for solar within the protected landscapes. As the assessment has been undertaken in GIS, it has been possible to estimate potential in each of the protected landscapes.

Results

5.176 Table 5-34 details the electrical potential of solar photovoltaics (PV) and the heat potential of solar thermal technology for each LPA.

Table 5-34: Potential accessible solar microgeneration resource at 2030

LPA	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Allerdale	23.7	16	21.1	16
Barrow-in-Furness	19.0	13	17.2	13
Carlisle	34.6	23	32.0	24
Copeland	21.2	14	19.8	15
Eden	13.0	9	11.3	8
South Lakeland	24.7	16	22.4	17
LDNP	13.6	9	11.0	8
YDNP	0.7	1	0.6	0.4
Cumbria total	**150.5**	**100**	**135.4**	**100**

Source: LUC (figures may not total due to rounding)

5.177 Carlisle has the largest potential resource of both microgeneration solar PV and solar thermal energy. It can be seen that Cumbria has a potential of 150.5 MW of Solar PV and 135.4 MW of solar thermal. The greatest potential can be found in the built environments of LPAs with the largest populations. Table 5-35 details the electrical potential of solar PV and the heat potential of solar thermal technology for areas outside of protected landscapes.

Table 5-35: Potential accessible solar microgeneration resource outside of protected landscapes at 2030

LPA	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Allerdale	23.1	18	20.6	17
Barrow-in-Furness	19.0	14	17.2	14
Carlisle	34.1	26	31.6	27
Copeland	21.2	16	19.8	17
Eden	11.3	9	9.8	8
South Lakeland	22.6	17	20.5	17
Cumbria total	**131.3**	**100**	**119.4**	**100**

Source: LUC (figures may not total due to rounding)

5.178 Carlisle has the most significant resource outside of protected landscapes.

5.179 Table 5-36 shows the potential within each of the protected landscapes and potential extensions. It can be seen that the Lake District National Park has the most significant resource within protected landscapes as it has the largest number of properties.

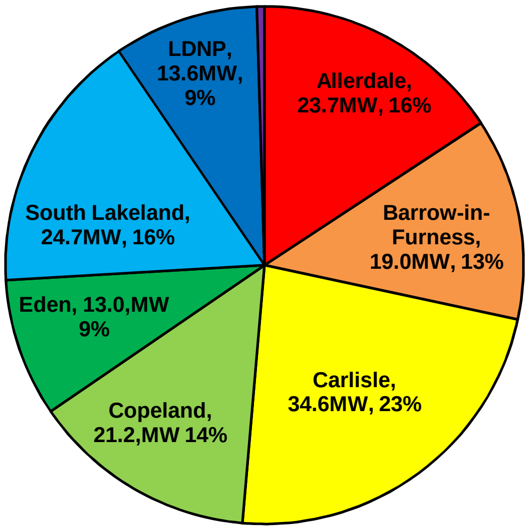
Table 5-36: Potential accessible solar microgeneration resource within protected landscapes at 2030

Protected Landscape	Electricity (MW Capacity)	Percentage of Elec. Total (%)	Heat (MW Capacity)	Percentage of Heat Total (%)
Arnside & Silverdale AONB	1.6	8	1.4	9
Lake District NP	13.6	71	11.0	69
North Pennines AONB	1.4	7	1.2	8
Solway Coast AONB	0.7	4	0.7	4
Yorkshire Dales NP	0.7	4	0.6	4
Potential extensions	1.2	6	1.0	7
Protected Landscapes total	**19.1**	**100**	**15.9**	**100**

Source: LUC

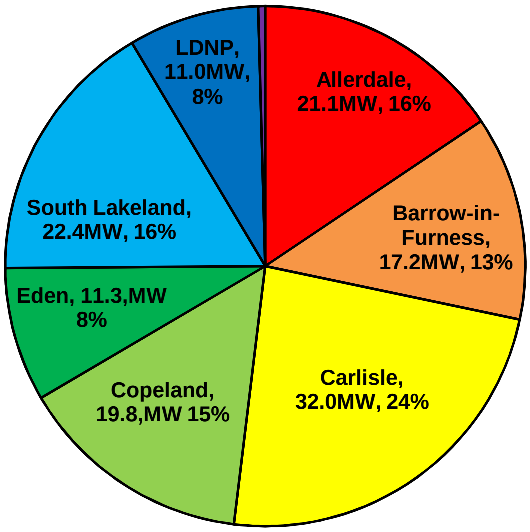
5.180 Figure 5-20 and Figure 5-21 show the proportion of solar PV and solar thermal microgeneration available resource in each of the LPAs.

Figure 5-20: Potential accessible microgeneration solar resource (for electricity production) at 2030



Source: LUC (NB: unlabelled segment refers to Yorkshire Dales National Park)

Figure 5-21: Potential accessible microgeneration solar resource (for heat production) at 2030



Source: LUC (NB: unlabelled segment refers to Yorkshire Dales National Park)

Conclusion

5.181 Cumbria has a potential resource of 150.5 MW for Solar PV and 135.4 MW for solar thermal from microgeneration.

Microgeneration – heat pumps

Main Assumptions

5.182 The potential renewable resources in the microgeneration heat pumps category of the DECC methodology consist of Ground Source Heat Pumps (GSHP) and Air Source Heat Pumps (ASHP). Each of these resources is detailed individually under its own heading in the following sections. In addition, an assessment of potential for Water Source Heat Pumps (WSHP) has been undertaken.

5.183 The assumptions made for microgeneration heat pumps (GSHP/ASHP) are largely consistent with the DECC methodology and a detailed list of the assumptions made for each of the technologies can be found in Annex B. A methodology for WSHP has been developed and is detailed in Annex B. The same data sources were used as for solar microgeneration and the number of off-grid properties were sourced from the Centre for Sustainable Energy's report 'Identifying and Quantifying the Prevalence of Hard to Treat Homes' (2006).

5.184 It has been assumed that the same proportion of heat pumps can be deployed within protected landscapes.

Results

5.185 Table 5-37 details the potential accessible microgeneration heat pump resource (GSHP and ASHP) for Cumbria and its LPAs. It can be seen that Cumbria has potential resource of 1066 MW of heat. Carlisle has the largest resource, due to its relatively large population.

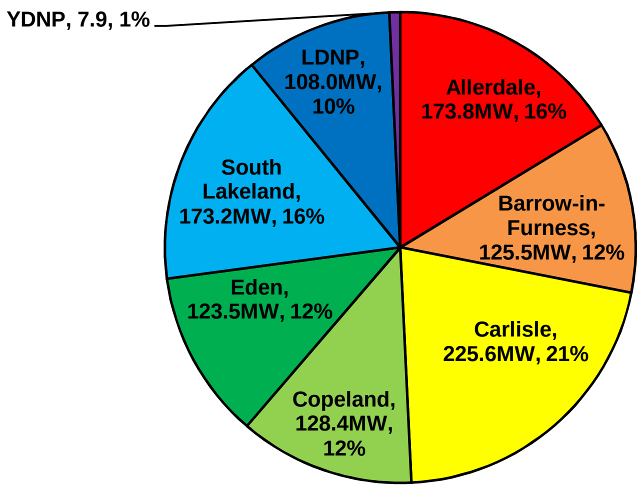
Table 5-37: Potential accessible microgeneration heat pump resource at 2030

LPA	Heat (MW Capacity)	Percentage of Total (%)
Allerdale	173.8	16
Barrow-in-Furness	125.5	12
Carlisle	225.6	21
Copeland	128.4	12
Eden	123.5	12
South Lakeland	173.2	16
Lake District NP	108.0	10
Yorkshire Dales NP	7.9	1
Cumbria total	**1065.9**	**100**

Source: SQW

5.186 Figure 5-22 illustrates the proportion of the heat pump resource in each of the LPAs.

Figure 5-22: Potential accessible microgeneration heat pump resource (for heat production) at 2030



Source: SQW

Conclusion

5.187 Cumbria has potential accessible microgeneration heat pump resource of 1065.9 MW.

Ground Source Heat Pumps

Main Assumptions

5.188 The assumptions made from microgeneration GSHPs are consistent with DECC methodology. However, the DECC methodology was unclear as to what assumption should be made for the percentage of commercial properties with potential for heat pumps. In this case it was assumed that 10% of commercial properties were suitable. The split between GSHPs and ASHPs was assumed to be 80% ASHP and 20% GSHP. The reasons for this are that ASHPs are suitable for installation in more properties and cause less disruption when installing; hence making them more attractive to potential customers. In addition GSHPs require a large area of open land and whilst the assessment has not been based on the exact amount of land available, the 80:20 split is considered appropriate to address this. A detailed list of the assumptions made for each of the technologies can be found in Annex B.

Results

5.189 Table 5-38 details the potential accessible heat resource from microgeneration GSHPs. The potential capacity for Cumbria is 213.2 MW with Carlisle providing the single biggest potential resource with just under a quarter of the total.

Table 5-38: Potential accessible microgeneration GSHP resource at 2030

LPA	Heat (MW Capacity)	Percentage of Total (%)
Allerdale	34.8	16
Barrow-in-Furness	25.1	12
Carlisle	45.1	21
Copeland	25.7	12
Eden	24.7	12
South Lakeland	34.6	16
Lake District NP	21.6	10
Yorkshire Dales NP	1.6	1
Cumbria total	**213.2**	**100**

Source: SQW

Conclusion

5.190 Cumbria has a potential accessible GSHP resource of 213.2 MW.

Air Source Heat Pumps

Main Assumptions

5.191 The assumptions made for microgeneration ASHPs are consistent with the DECC methodology. However, the DECC/CLG methodology was unclear as to what assumption should be made for the percentage of commercial properties with potential for heat pumps. In this case it was assumed that 10% of commercial properties were suitable. The split between GSHPs and ASHPs was assumed to be 80% ASHP and 20% GSHP. The reasons for this are that ASHPs are suitable for installation in more properties and cause less disruption when installing, hence they are more attractive to potential customers. A detailed list of assumptions made for each of the technologies can be found in Annex B.

Results

5.192 Table 5-39 details the potential accessible microgeneration ASHP resource for Cumbria and its LPAs. The potential heat resource is 852.8 MW for the region.

Table 5-39: Potential accessible microgeneration ASHP resource at 2030

LPA	Heat (MW Capacity)	Percentage of Total (%)
Allerdale	139.0	16
Barrow-in-Furness	100.4	12
Carlisle	180.5	21
Copeland	102.7	12
Eden	98.8	12
South Lakeland	138.6	16
Lake District NP	86.4	10
Yorkshire Dales NP	6.3	1
Cumbria total	**852.8**	**100**

Source: SQW

Conclusion

5.193 Cumbria has a potential accessible ASHP resource of 852.8 MW.

Water Source Heat Pumps

Main Assumptions

5.194 No standard methodology exists for estimating potential from WSHPs. A number of organisations were approached to define parameters, but suitability is largely evaluated on a case-by-case basis. There is broad agreement that the parameters that need to be considered are:

- proximity of properties to water
- location of aquifers
- type of waterbody
- sensitivity of waterbody.

5.195 Whilst it is known that the further the water needs to be pumped, the less cost-effective the system becomes, it was not possible to exactly define this distance. For the purposes of this assessment, a distance of 250 m has been used.

5.196 It has not been possible to obtain a GIS map of aquifer locations in Cumbria, although it is recognised that this is an important consideration for water source heat pumps. In the absence of detailed GIS data, all lakes and rivers (as defined by the Ordnance Survey) have been used to identify properties within close proximity to waterbodies.

5.197 A further consideration is the sensitivity of the waterbody. Data were not available to show whether a waterbody was designated. The location of all Special Areas of Conservation (SAC), Special Protection Areas (SPA), Ramsar sites and Sites of Special Scientific Interest

(SSSI) are known. Properties identified as having potential due to their proximity to waterbodies that are additionally within 250 m of an SAC/SSSI/SPA/Ramsar site have been eliminated as a precautionary measure. A licence from the Environment Agency is required prior to installing a WSHP. The technology is better suited to larger commercial-scale projects. A detailed list of the assumptions made for each of the technologies can be found in Annex B.

Results

5.198 Table 5-40 details the potential accessible heat resource from microgeneration WSHPs. The potential capacity for Cumbria is 22.9 MW with the Lake District National Park providing the highest potential resource with almost 30% of the total.

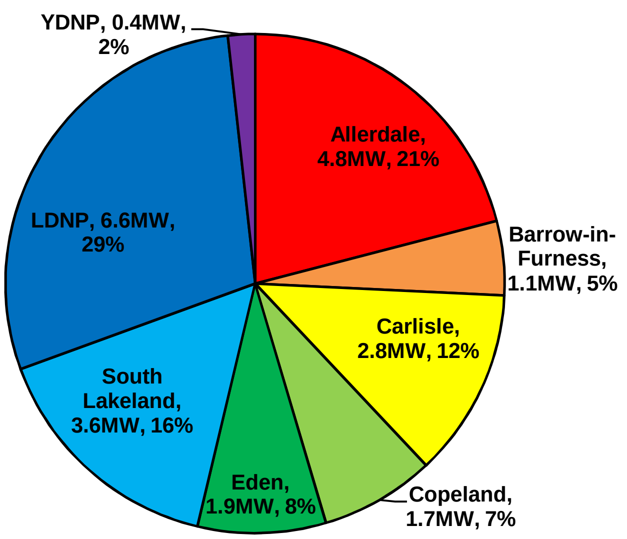
Table 5-40: Potential accessible microgeneration WSHP resource at 2030

LPA	Heat (MW Capacity)	Percentage of Total (%)
Allerdale	4.8	21
Barrow-in-Furness	1.1	5
Carlisle	2.8	12
Copeland	1.7	7
Eden	1.9	8
South Lakeland	3.6	16
LDNP	6.6	29
YDNP	0.4	2
Cumbria total	**22.9**	**100**

Source: SQW

5.199 Figure 5-23 shows the distribution of WSHP potential across the LPAs.

Figure 5-23: Potential accessible microgeneration WSHP resource by local planning authority at 2030



Source: SQW

Conclusion

5.200 Cumbria has a potential accessible WSHP resource of 22.9 MW.

Large scale solar

DEFINITION AND SCOPE

Commercial scale solar PV farms are an emerging development in the UK, although well established in other parts of the world. They consist of freestanding arrays of solar panels mounted on fixed frames or systems that track the sun and which feed their electricity into the national grid.

The Solar PV panels are arranged in groups or 'arrays' of up to 50 panels mounted on a static metal stand, ideally facing due south and angled 20-45 degrees from the horizontal to maximize exposure to sunlight. The height of the rear edge of each stand will depend on the size of individual panels, their angle and the number of panels stacked above each other in the array.

The main technical constraints for solar PV plants are the availability of sufficient land on which to build them, the solar radiation received by the site and its proximity to a grid connection.

Source: LUC derived from DECC

Solar farms

Main assumptions

5.201 Solar farms are not included in the DECC methodology. Through discussions with solar developers and developers undertaking assessments (sensitivity and site suitability) for solar farms, an opportunities and constraints based assessment was undertaken.

5.202 It was established that the most suitable locations for solar farms are on gentle, south facing slopes within close proximity to existing sub stations. When searching for new sites, it is preferable to avoid:

- areas of low solar radiation
- the steepest slopes
- unfavourable aspects
- best and most versatile agricultural land
- peat (no data available)
- areas at risk of flooding
- direct loss of nature conservation or cultural heritage assets
- shading (trees, dust from operational quarries)

- road and rail infrastructure.

5.203 Using these criteria, an opportunities and constraints methodology was generated.

Protected landscape assumptions

5.204 The Steering Group and Natural England agreed that due to the special qualities of the protected landscapes in Cumbria large-scale solar PV developments are not likely to be appropriate within these areas and they have therefore not been assessed as part of this study. It is recognised, however, that there may be exceptions to this rule.

Results

5.205 The constraints to solar farm development are illustrated in maps which are downloadable from Cumbria County Council's website (see Annex G for details).

5.206 Table 5-41 details the potential accessible solar farm resource for Cumbria and its local authorities outside of protected landscapes.

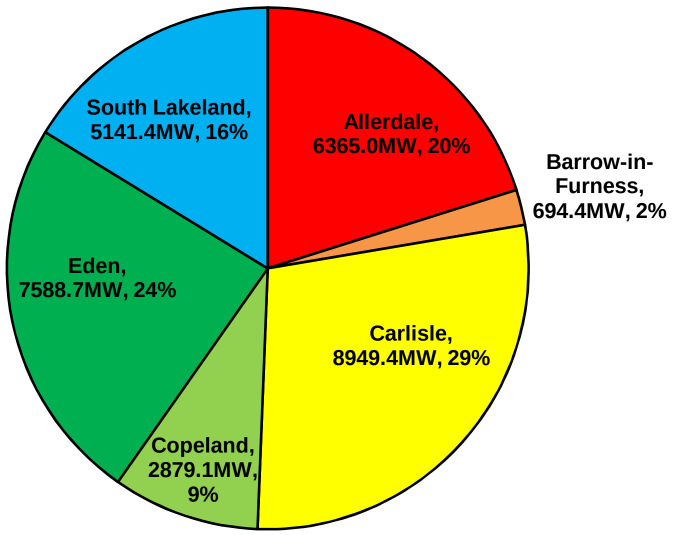
Table 5-41: Potential accessible solar farm resource at 2030

LPA	Electricity (MW Capacity)	Percentage of Total (%)
Allerdale	6,365.0	20
Barrow-in-Furness	694.4	2
Carlisle	8,949.4	28
Copeland	2,879.1	9
Eden	7,588.7	24
South Lakeland	5,141.4	16
LDNP	0	0
YDNP	0	0
Cumbria total	**31,618.0**	**100**

Source: LUC (figures may not total due to rounding)

5.207 Figure 5-24 illustrates the share of solar farm potential of each of the LPAs. Carlisle has the largest potential resource with 29% of the county's potential.

Figure 5-24: Potential accessible solar farm resource by local planning authority at 2030



Source: LUC

Conclusion

5.208 It is clear that the initial method for assessing potential has grossly overestimated the potential within Cumbria for large scale solar energy development. In reality, although a large amount of land exists that could be considered favourable for this type of development, the northern latitude of Cumbria means that the solar radiation received is at the lower limit of viability for developers. Although technically possible to harness solar energy based on the peak solar radiation received in Cumbria, the county is subject to severe constraints in terms of having a high horizon and is unlikely to generate much interest from the developer community. In addition, the results from the FIT review undertaken earlier this year means there are reduced financial incentives available to support the development of solar farms. The results of the solar farm assessment have not therefore been included in the total accessible potential for Cumbria.

Solar infrastructure associated with highways

Main assumptions

5.209 Highway embankments and existing infrastructure such as noise barriers provide opportunities to collect solar energy. The DECC methodology does not provide a methodology for assessing this technology. Discussions with the Highways Agency have provided a GIS dataset locating noise barriers in Cumbria. In this assessment, we have just focused on noise barriers and not included free standing panels adjacent to motorways.

5.210 There is little data available on the potential solar PV energy that can be generated from installing solar panels along noise barriers. It has been necessary to look to Europe for examples of working photovoltaic noise barriers.

5.211 In the UK, the Highways Agency has undertaken a full-scale trial of photovoltaic barriers on the M27. Two barriers 54 m long and about 2 m high were installed and their performance was monitored. The photovoltaic system commenced generation in April 2004 and the AC energy exported to the local grid over a period of one year was monitored as 6.4 MWh. SEE-Stats records the installed capacity as 10.2 kW for the 20 modules. It has therefore been assumed that:

- each panel is 5.4 m long by 2 m high and has an installed capacity of 0.51 kW
- for each metre length, if south facing, 0.1 kW can be installed.

Protected landscape assumptions

5.212 There are no noise barriers located in protected landscapes.

Results

5.213 Three roads in the county have noise barriers:

- A66 (Eastbound) in Eden – 167 m
- A595 (North and Southbound) in Copeland and Allerdale – 1071 m
- M6 (North and Southbound) in Carlisle – 2247 m.

5.214 The total length of noise barriers in the county is 3.5 km. Only the A66 is suitably orientated (eastbound). Table 5-42 details the potential accessible solar infrastructure resource for Cumbria and its local authorities – 100% of the resource is likely to be available in Eden.

Table 5-42: Potential accessible solar infrastructure resource at 2030

LPA	Electricity (MW Capacity)	Percentage of Total (%)
Allerdale	0	0
Barrow-in-Furness	0	0
Carlisle	0	0
Copeland	0	0
Eden	0.02	100
South Lakeland	0	0
LDNP	0	0
YDNP	0	0
Cumbria total	**0.02**	**100**

Source: LUC

CHP/district heating energy potential

Methodology

5.215 Unlike most of the renewable energy categories, which are assessed on the basis of supply side in terms of resource availability, low carbon opportunities referred to in the DECC methodology are a function of available heat demand.

5.216 The CHP/district heating capacity of an area cannot be calculated solely by assessing the heat demand of its properties, since the viability of CHP or district heating is dependent not only on the viability of heat, but the density of that heat demand. This is because the cost of pipe required to transport heat is very high and there are heat losses through transportation, which also means that the plant used for generating CHP/district heating energy needs to be situated in close proximity to the source of its demand.

5.217 In order to assess the viability of an area for CHP or district heating, the DECC methodology introduces the concept of 'heat density'. This is defined as the annual heat demand, divided by the number of hours in a year, which is then divided by an area in km^2. Higher density urban areas will have a higher heat demand per km^2 and hence would be expected to have lower district heating costs and greater potential for cost effective schemes. The DECC methodology states that if the heat density exceeds 3,000 kW/km^2, the heat density is considered to be high and district heating is likely to be economically viable in a high proportion of buildings, such as flats.

Developing a Heat Map

5.218 For this study, a new heat map has been developed, calculating the heat densities across Cumbria. The map is based on DECC's Middle Level Super Output Area (MLSOA) gas consumption statistics[38]. A boiler efficiency of 80%[39] was used as an assumption to convert gas consumption to heat demand (it should be noted that this assumption is more robust for converting domestic usage, than commercial and industrial usage, as industrial processes may consume gas for uses other than heat production). Heat demand met by other fuels such as coal and oil are not accounted for as data at MLSOA level is not available. Once the annual heat demand for the MLSOAs was calculated, it was converted into heat density by dividing in by the area of the MLSOA. The developed heat map produced results similar to the DECC Heat Map[40]. The customised Cumbria map was used to assess where the separate and combined domestic, commercial and industrial overall heat demand is sufficient to exceed the DECC heat density threshold. Three maps are available from Cumbria County Council's website, Map 16, 17 AND 18 illustrating total domestic and non-domestic heat density, domestic heat density and non-domestic heat density respectively.

5.219 To assess the low carbon energy potential for Cumbria, the heat map developed for this study was utilised. Each MLSOA in the county was examined and where the total heat density

[38] http://www.decc.gov.uk/en/content/cms/statistics/regional/mlsoa_2008/mlso_2008.aspx
[39] *Industry standard quoted by DECC – see* http://www.decc.gov.uk/en/content/com/what_we_do/uk_supply/energy_mix/distributed_en_heat/chp/chp.aspx
[40] http://chp.decc.gov.uk/heatmap/

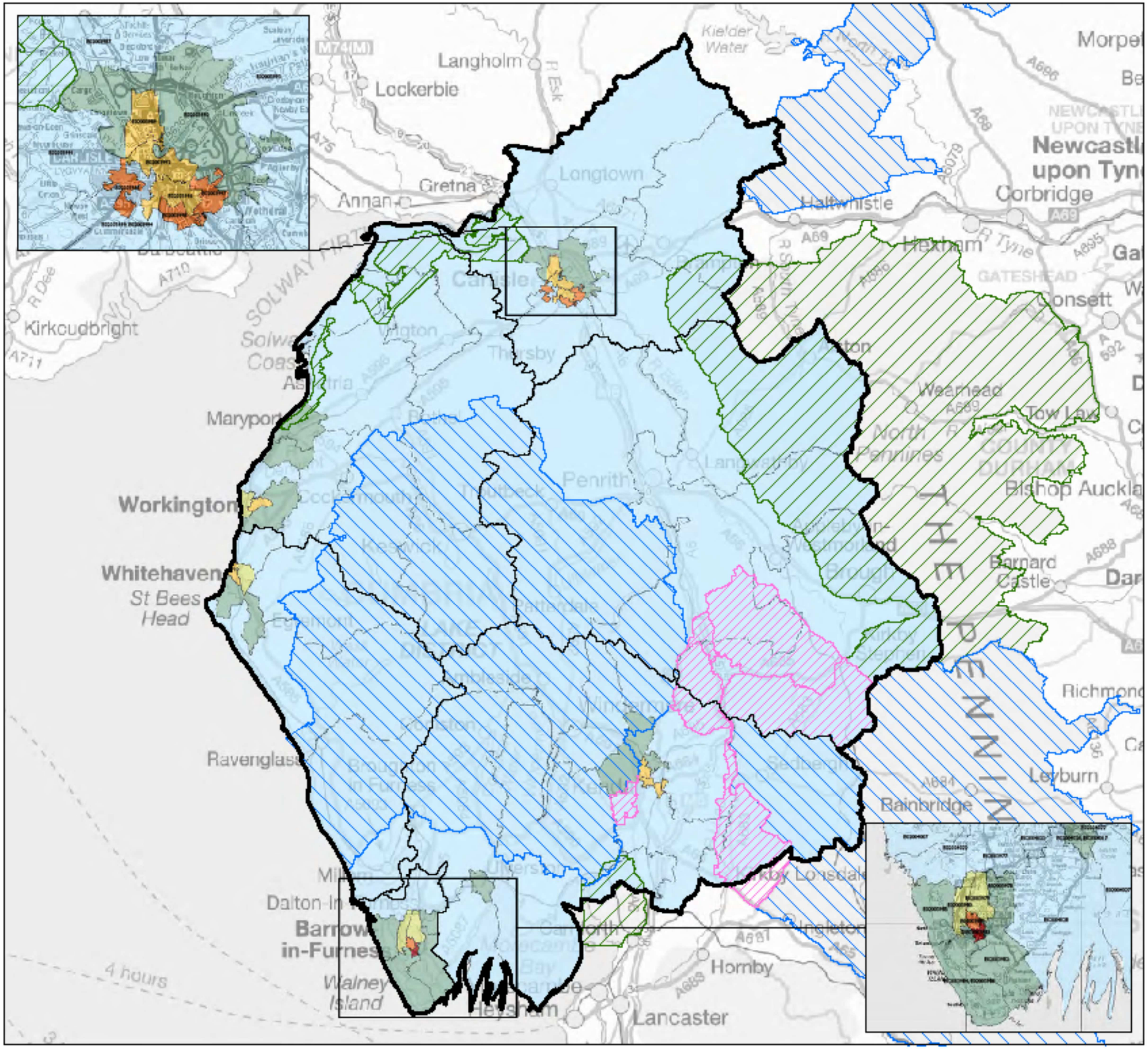
exceeded 3,000 kW/km^2, an area was judged to be a candidate for one of the low carbon technologies, such as district heating or CHP.

Results

5.220 The following maps and Table 5-43 provide the results from the low carbon assessment[41]. Unsurprisingly, all of the areas identified as exceeding the heat threshold are in the more populous LPAs, with the majority in Carlisle (11 areas are identified: six are in Carlisle, two in Barrow, and one each in Allerdale, Copeland and South Lakeland).

5.221 The total demand in these areas is 126,535 kW which equates to approximately 1,108 GWh/yr. This represents a substantial resource, but must be viewed as theoretical potential for low carbon energy development. The amount that could be harnessed in reality would be dependent on a more detailed assessment of the candidate sites with economic and engineering surveys carried out to evaluate individual site suitability. The feasibility of district heating schemes may increase if they are in close proximity to energy recovery facilities, large thermal power stations, CHP plants or large point heat loads.

[41] IT should be noted that the study used the boundaries for potential National Park extension consulted upon in 2010. Since then further changes have been proposed, but the additional proposed 2011 extension is small and therefore unlikely to have a significant impact on the study findings if all areas are designated as national park in the future.



Cumbria Renewable and Low Carbon Energy Capacity and Deployment Study

Domestic heat density

Key

Cumbria County Council

Cumbria Local Authority boundaries

National Parks

Areas of Outstanding Natural Beauty

Potential extensions to protected landscapes (Consultation boundary 2009)

Domestic heat density (by MLSOA)

Heat demand (kW)/square km

0 - 250.0

250.1 - 1,000.0

1,000.1 - 2,000.0

2,000.1 - 3,000.0

3,000.1 - 5,000.0

5,000.1+

Please note that some MLSOA have had to be aggregated to reflect the DECC consumption statistics

0 2.5 5 10 15 20 Km

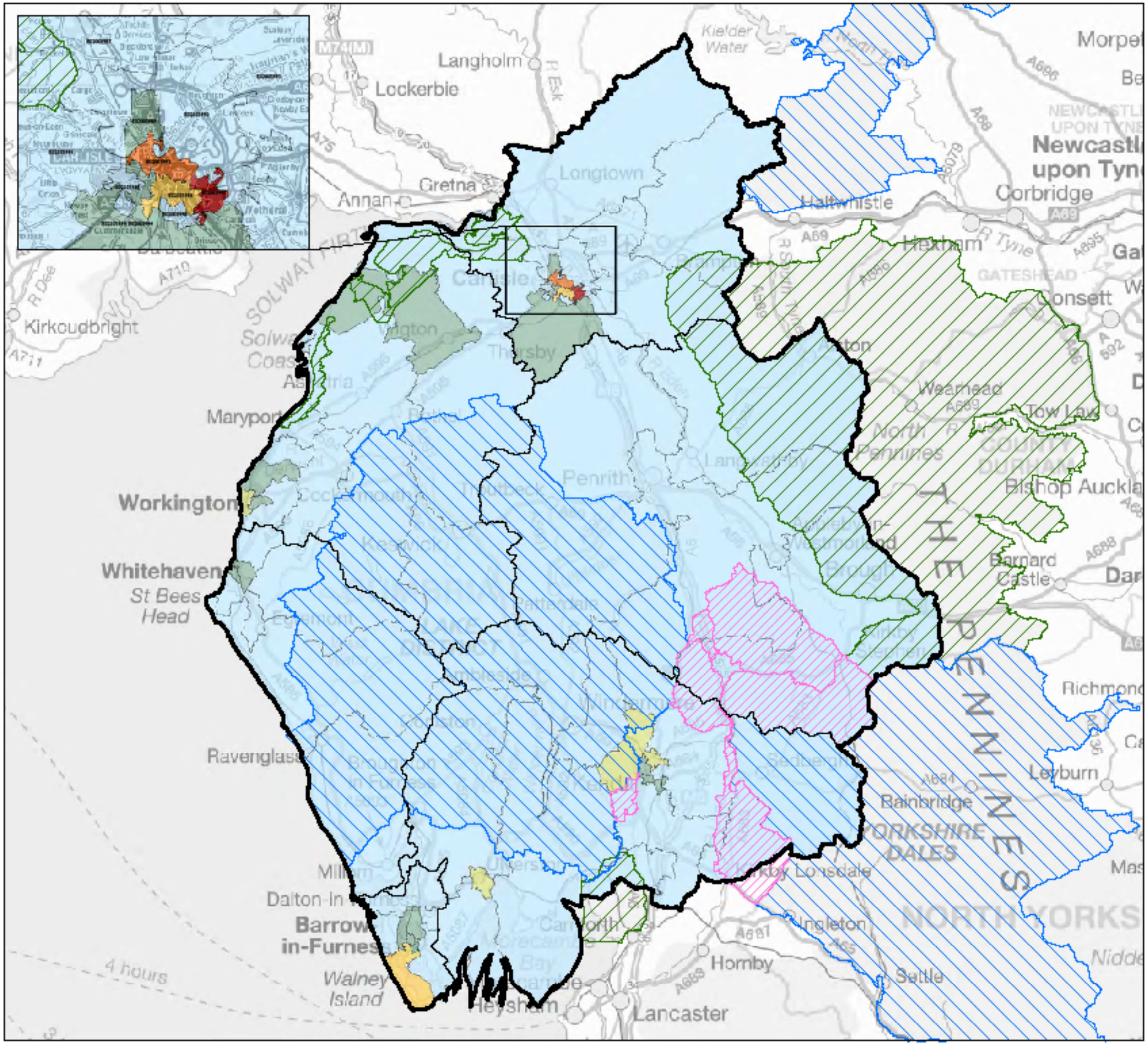
DRAFT

Source: DECC Middle Layer Super Output Area (MLSOA) domestic gas estimates 2008, Natural England

Date: 11/03/2011

Revision:

File: S:\5000\5016 Cumbria CC Renewables\B Project Working\GIS\Themes\ArcGIS9\5016-01_032_Domestic_heat_density.mxd



Cumbria Renewable and Low Carbon Energy Capacity and Deployment Study

Non-domestic heat density

Key

- Cumbria County Council
- Cumbria Local Authority boundaries
- National Parks
- Areas of Outstanding Natural Beauty
- Potential extensions to protected landscapes (Consultation boundary 2009)

Domestic heat density (by MLSOA)

Heat demand (kW)/square km

- 0.0 - 250.0
- 250.1 - 1,000.0
- 1,000.1 - 2,000.0
- 2,000.1 - 3,000.0
- 3,000.1 - 5,000.0
- 5,000.1+

Please note that some MLSOA have had to be aggregated to reflect the DECC consumption statistics

0 2.5 5 10 15 20 Km

DRAFT

Source: DECC Middle Layer Super Output Area (MLSOA) non-domestic gas estimates 2008, Natural England

Date: 11/03/2011
Revision:

File: S:\5000\5016 Cumbria CC Renewables\B Project Working\GIS\Themes\ArcGIS9\5016-01_033_Non_Domestic_heat_density.mxd

Table 5-43: Areas with sufficient heat demand to support low carbon developments

LPA	MLSOA Code	Nearby settlements	Area (km2)	Non-domestic consumption (kWh)	Domestic consumption (kWh)	Non-domestic demand (kW)	Domestic demand (kW)	Total demand (kW)	Domestic heat density (kW/km2)	Non-domestic heat density (kW/km2)	Total heat density (kW/km2)
Allerdale	E02003973	Mossbay, Westfield and Salterbeck	4.63	46,900,156	62,972,315	6,692	8,986	15,678	1,943	1,447	3,390
Barrow-in-Furness	E02003981	Between Newbarns and South Newbarns	1.48	8,072,428	49,627,904	1,152	7,082	8,233	4,799	781	5,580
Barrow-in-Furness	E02003983	Abbotsmead and Salthouse	1.25	2,735,542	45,424,426	390	6,482	6,872	5,191	313	5,504
Carlisle	E02003997	Between Harraby and Botcherby	2.41	84,862,984	57,822,830	12,109	8,251	20,360	3,419	5,018	8,437
Carlisle	E02003992	Carlisle	3.80	91,478,777	67,651,054	13,053	9,653	22,707	2,540	3,435	5,975
Carlisle	E02003996	North East Currock and East Denton Holme	3.24	63,587,865	64,944,094	9,074	9,267	18,341	2,859	2,799	5,658
Carlisle	E02003998	Upperby and Currock	1.57	2,688,991	44,120,883	384	6,296	6,679	4,000	244	4,244
Carlisle	E02003995	Morton, Raffles and Newtown	2.23	2,482,354	62,107,457	354	8,862	9,217	3,975	159	4,134
Copeland	E02004001	Brantsy, Whitehaven and Corcickle	2.58	16,540,519	43,442,656	2,360	6,199	8,559	2,403	915	3,318
South Lakeland	E02004018	Kendal including Kirkbarrow and Hallgarth	2.85	15,423,499	53,880,310	2,201	7,688	9,889	2,701	773	3,475

Source: LUC

Conclusion

5.222 The CHP/district heating assessment has identified eleven areas which have sufficient demand (as defined by the DECC heat threshold) to be viable for CHP developments or district heating with a total potential of 1,108 GWh/yr. This is a large, untapped energy source for potential exploitation. As such, this is an energy source that clearly warrants further detailed investigation. Currently, the high cost of developing such schemes means that few across the UK have been realised. It would require a step change in uptake to utilise a significant proportion of this available resource.

5.223 DECC's 2050 Pathways Analysis[42] shows that to 2050, heating and cooling usage may increase by 75% or could decrease by 60%. The range in prediction is a function of the changes in energy efficiency and usage assumptions that are made for the different 'pathways'. In addition to the difficulties in estimating overall change in heat demand, predicting the location and thus density of this demand presents another level of uncertainty which would limit the utility of any predictions in the change in low carbon energy potential to the 2050 horizon. This means that no projections of the resource available in 2030 or 2050 have been made.

[42] http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/2050/2050.aspx

6: Renewable energy deployment constraints and scenarios to 2030

Translating technical capacity to deployable capacity - introduction

6.1 The resource assessment results detailed in Chapter 5 provide a view of the overall ***potential technical*** capacity for renewable energy generation across Cumbria to 2030. They do not provide an indication of ***what could or should be deployed***. The remainder of the report details the findings of taking these technical capacity results a step further and translating them into a more realistic capacity that is capable of being deployed bearing in mind a range of constraints.

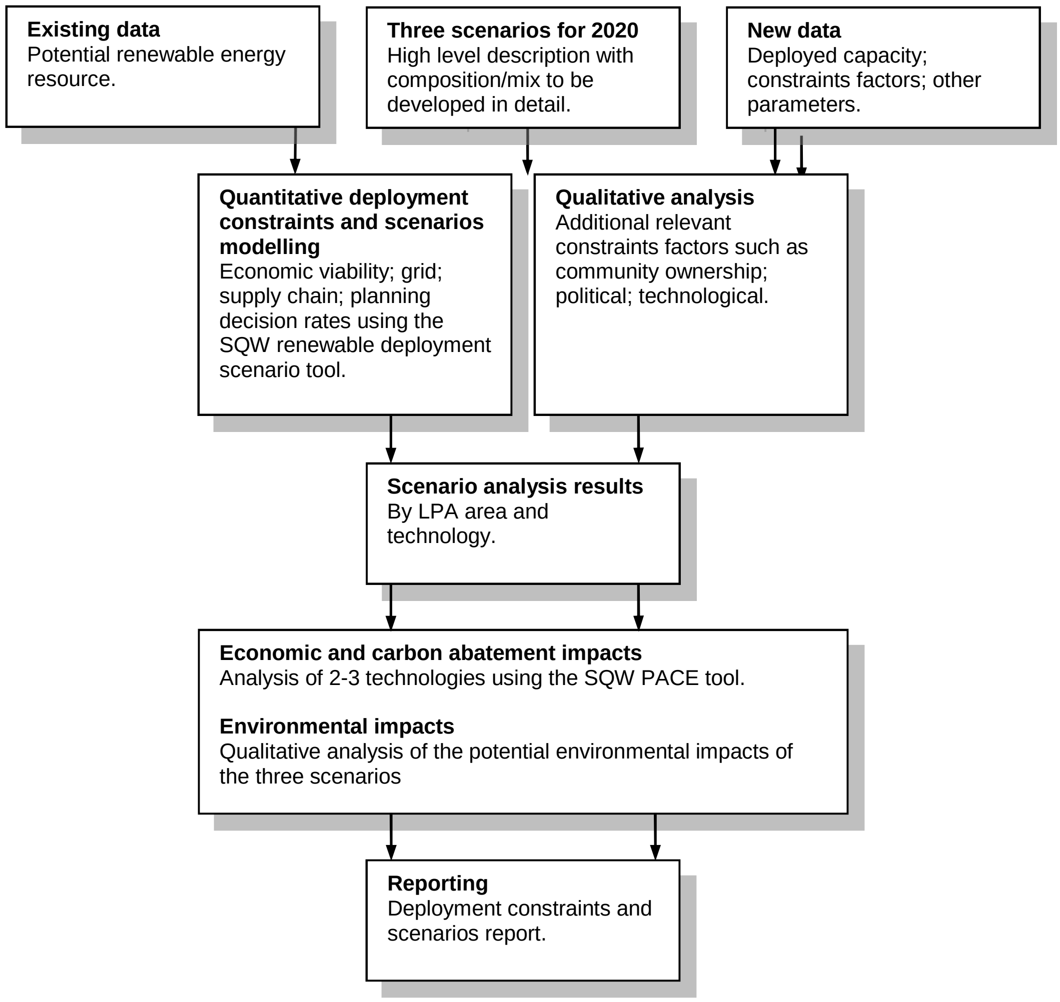
6.2 This assessment of deployable capacity is a more robust evidence base for local plan making and the development of target-setting on an LPA or Cumbria-wide basis if it is decided to take this route in the future.

6.3 This Chapter explains the modeling utilised to analyse and apply constraints to assess a realistic level of renewable energy that could be deployed by 2030. It then presents the results of that analysis alongside three further scenarios of different technology mixes (agreed in advance with the Steering Group) that could be adopted in order to reach this level of renewable energy generation over the next 20 years.

6.4 The starting point for this analysis was provided by the results from the renewable energy resource assessments detailed in Chapter 5. For every assessment except commercial wind, the total capacity figures provided in Table 5-4 were used as the total amount of resource that could possibly be deployed. For commercial wind, the figure in Table 5-11 (1,623 MW) rather than the 2,858 MW in Table 5-4 was used as this takes into account landscape capacity and was therefore considered to be a more realistic level of potential.

6.5 Figure 6-1 provides an overview of the methodology used for the deployment analysis and scenario testing which is explained in further detail below.

Figure 6-1: Deployment constraints, scenarios and impacts methodology overview



Source: SQW

6.6 This phase of the study has included consultation with stakeholders via an email survey and attendance at a focus group on 10 May 2011 (the proceedings and outputs from which are provided in Annex I.

6.7 The results of the constraints modelling and the different technology mix scenarios are provided at the level of the Cumbria sub-region and for each of its constituent LPAs, with further detail at the LPA level provided in Annex H. Further analysis of upside opportunities and downside risks informed through qualitative analysis is provided in Chapter 7 along with environmental impacts, economic and carbon abatement impacts.

Constraints and deployment scenarios methodology

Deployment modelling tool

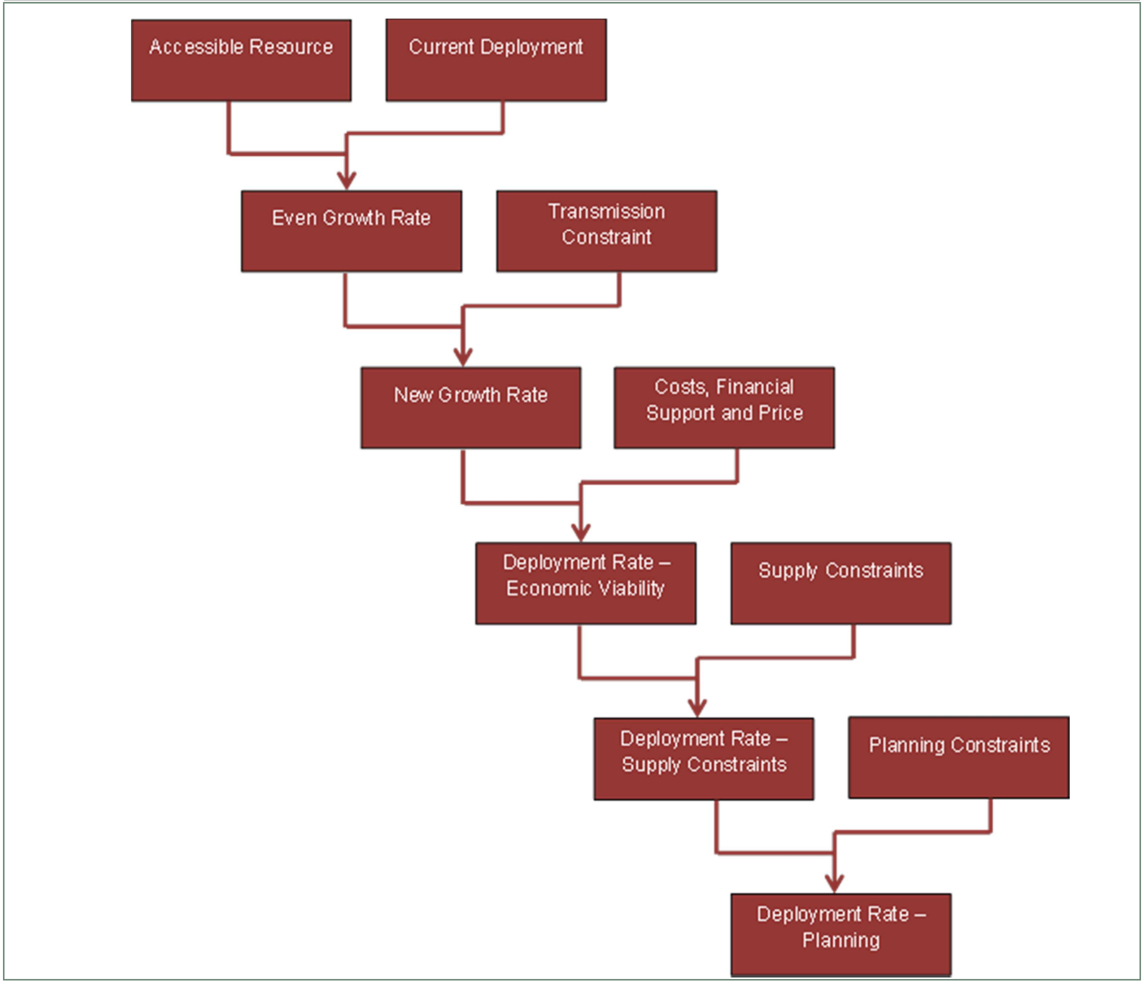
6.8 The deployment modelling was supported by SQW's *RE: Deploy* tool for local authority scale analysis, which was developed in Microsoft Excel. A schematic of design of the tool is provided in Figure 6-2 showing how the four constraints (economic viability, transmission, supply chain and planning) were applied to illustrate different assumptions and scenarios for the deployment/growth of each renewable energy technology.

6.9 The overall process for identifying the potential deployable capacity by 2030 involved the following steps:

- Identification of current installed capacity and pipeline capacity with planning consent – summarised in Chapter 4. Annex E includes the full list of sites which are operational, under construction, have consent or awaiting planning consideration which have been included in this baseline.
- Calculation of the difference between the current installed and consented capacity, and the technical available resource[43] identified earlier in the study on an LA basis.
- Identification of LA specific growth rates to reach the technical capacity constrained by economic factors (using national benchmarks), transmission constraints (using the intelligence gained from stakeholder consultations), supply chain constraints (using national benchmarks) and planning acceptance rates (using the evidence from the Envirolink study and RESTATS data).
- Projecting forward from the current installed capacity (or 5% of the technical capacity if there were no current installations) using the constrained growth rate over the next 20 years on an individual LA basis.
- Aggregation of the LA results to provide a deployable capacity figure for Cumbria as a whole.

[43] For all technologies the technical resource identified in Section 5 of the Part 1 report was used, other than for commercial scale wind which used the technical capacity, taking into account landscape character using the Cumbria Wind SPD, as the starting point.

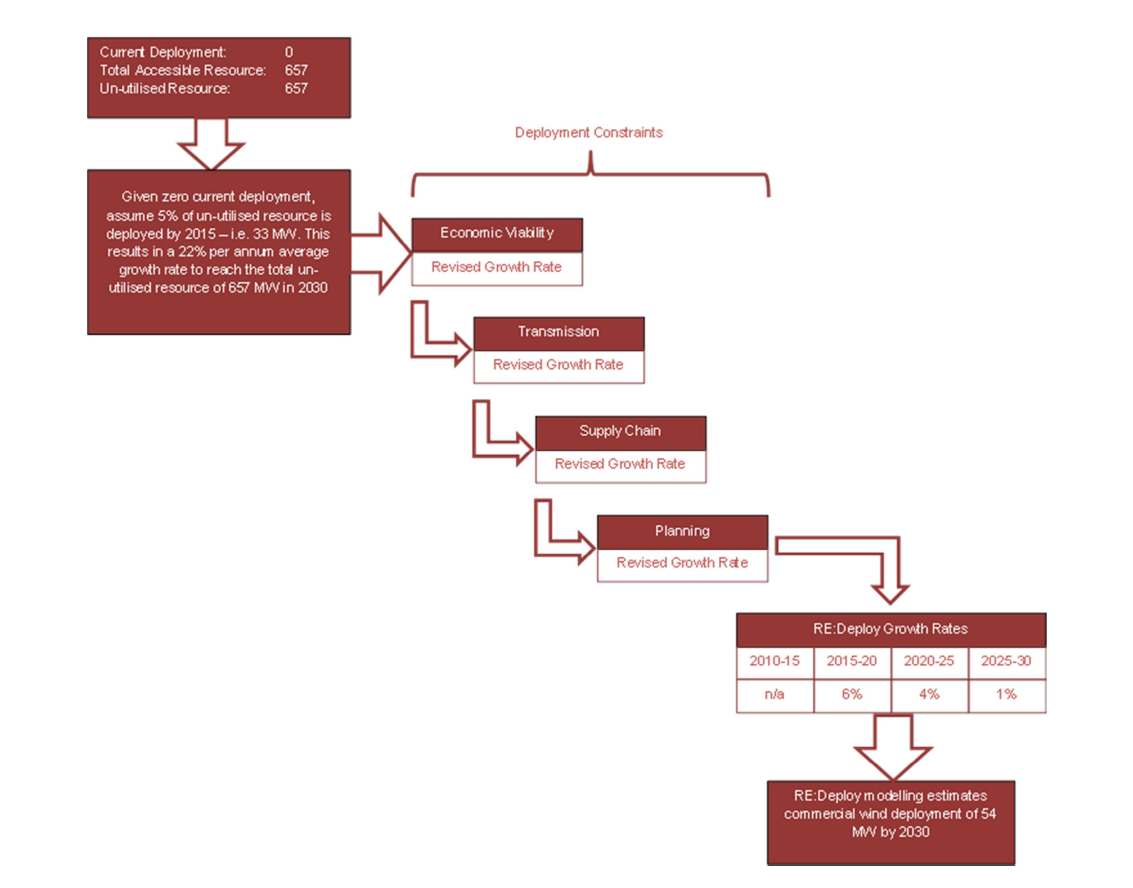
Figure 6-2: Schematic for the deployment modelling tool



Source: SQW

6.10 Figure 6-3 provides a worked example of how the deployment modelling was undertaken – in this case to produce the assessment of deployable commercial wind capacity in Eden at 2030.

Figure 6-3: Worked example of deployment modelling for commercial wind in Eden



Source: SQW

Explanation of the individual constraints

6.11 The purpose of the constraints and scenario analysis is to investigate the most significant areas of constraint on the growth rates of different renewable energy technologies (towards the potential technical capacity identified through the resource assessments in Chapter 5) and apply these constraints to the potential growth rates to provide quantitative forecasts of possible deployment pathways to 2030. The focus of the analysis is upon constraints that are likely to have a material impact on the potential deployment of renewable energy sources at 2030 rather than minor constraints that might have temporary and/or localised effects but little overall impact. The constraints and scenario analysis has been carried out using the SQW *RE: Deploy* tool that has been designed for LPA scale analysis and was customised for this Cumbria study.

6.12 The analysis is based around four types of constraint as indicated below. These are the same kinds of constraints that were investigated in the North West Renewable Energy Capacity and Deployment Study.

- economic viability
- transmission constraints
- supply chain constraints

- planning constraints.

Economic viability

6.13 Given that many renewable energy technologies are relatively new and still undergoing significant innovation, economic viability varies between them and is of key importance. The economic viability of each technology has a significant effect on the probability of its deployment and we have utilised the findings from a number of recent studies to inform our analysis. These include:

- Committee on Climate Change (2011), *Achieving deployment of renewable heat*, undertaken by Element Energy and NERA Economic Consulting
- Committee in Climate Change (2011), *Cost of low carbon generation technologies*, undertaken by Mott Macdonald
- Element Energy (2008), *The growth potential for Microgeneration in England, Wales and Scotland.*

Transmission constraints

6.14 The electricity transmission system can constrain the deployment of large scale (transmission connected) new renewable energy capacity. This is most likely to occur if a proposed site for a renewable energy project is a long distance from the existing electricity transmission grid or if the grid is already at or near full capacity. In these situations, access to the grid will be granted and in the context of the period 2010-2020, time delays to provide the connection can be seen as temporary. However, significant investment may also be required to provide connection to the grid. Under the agreed charging schemes[44] these up front investments can render particular renewable energy projects as uneconomic.

6.15 We were aware of grid constraints in Cumbria following the North West study and therefore consulted Electricity North West for this Cumbria study. Currently there are constraints on grid transmission for larger scale (over 10 MW) commercial wind farms which should be addressed through the proposed North West Coast Connections initiative[45]. Potential connection routes (Strategic Routes Options) to support the proposals within the Britain's Energy Coast Masterplan (£2bn package of regeneration projects that hope to establish West Cumbria as a major national hub for low carbon and renewable energy generation) will be consulted on later this year. It is assumed that additional capacity will be provided from 2020 and therefore grid constraints are only applied until then.

Supply chain constraints

6.16 Given that many renewable energy technologies are relatively new and still undergoing significant innovation, supply chains for producing and installing some technologies may be constrained. As supply chains for some of the renewable technologies are global, consideration is needed of what is happening outside of the UK as well as any likely regional

[44] http://www.nationalgrid.com/uk/Electricity/Charges/
[45] http://www.nationalgrid.com/uk/Electricity/MajorProjects/NorthWestCoastConnections/

variations. Clearly the picture will also change over time with new supply chains established in response to committed demand and as regional, national and international support initiatives help to tackle initial bottlenecks. The investigation of supply chain constraints has utilised the findings from a number of recent studies conducted in this area, in particular a study on *Supply Chain Constraints on the Deployment of Renewable Electricity Technologies* (BERR, 2008).

Planning constraints

6.17 The planning system can have a major influence on the deployment rate of new renewable energy projects where planning consent is required. The key parameters are the approval rate for planning applications and the duration and delays to planning decisions for different technologies and types of project. Recent historic data has been used as the starting point for the analysis of planning constraints, largely drawing upon a study of planning approvals for renewable energy projects in the North West region between 2004 and 2009 (Envirolink Northwest, 2010) and also publicly available data from RESTATS.

6.18 Table 6-1 shows how each of these constraints have reduced the overall growth rate to move from current installed capacity towards the technically available capacity as identified by the renewable energy resource assessments in Chapter 5.

Table 6-1: Constraints by technology

Technology	Description of constraints
Commercial scale wind	Economic viability constraints increase over the full period, with annual growth capped at 16% to 2020, then dropping to 9% and 2% in 2020-25 and 2025-30 respectively. Commercial scale wind is thought to be the only technology facing transmission constraints. These are likely to reduce annual growth rates by 16% per annum until 2020. Planning constraints reduce the annual growth rate by a further 57% per annum. No supply chain constraints are expected.
Small scale wind	Economic viability constraints increase over the full period, with annual growth capped at 42% to 2015, then dropping to 23% in 2015-20 and 8% in 2020-30. Planning constraints reduce the annual growth rate by a further 24% per annum. No transmission or supply chain constraints are expected.
Undermanaged woodland (power)	Significant economic viability constraints throughout whole period, as dictated by Committee on Climate Change that warns of a cautious approach to biomass power. Minimal 1% growth per annum assumed. Supply chain constraints are expected to impact on certain biomass categories. This reduces the growth rate by 14% between 2010-15 and 35% post 2015. Planning constraints reduce the annual growth rate by a further 6% per annum. No transmission constraints are expected.
Undermanaged woodland (heat)	Economic viability constraints increase post 2020, with annual growth rate declining from 24% to 6%. Supply chain constraints are expected to impact on certain biomass categories. This reduces the growth rate by 14% between 2010-15 and 35% post 2015. Planning constraints reduce the annual growth rate by a further 6% per annum. No transmission constraints are expected.
Energy crops (power)	Significant economic viability constraints throughout whole period, as dictated by Committee on Climate Change that warns of a cautious approach to biomass power. Minimal 1% growth per annum assumed. Supply chain constraints are expected to impact on certain biomass categories. This reduces the growth rate by 14% between 2010-15 and 35% post 2015. Planning constraints reduce the annual growth rate by a further 6% per annum. No transmission constraints are expected.
Energy crops	Economic viability constraints increase post 2020, with the annual growth rate declining from 13% to 5%. Supply chain constraints are expected to impact on certain biomass categories. This

Technology	Description of constraints
(heat)	reduces the growth rate by 14% between 2010-15 and 35% post 2015. Planning constraints reduce the annual growth rate by a further 6% per annum. No transmission constraints are expected.
Waste wood (power)	Significant economic viability constraints throughout whole period, as dictated by Committee on Climate Change that warns of a cautious approach to biomass power. Minimal 1% growth per annum assumed. Supply chain constraints are expected to impact on certain biomass categories. This reduces the growth rate by 14% between 2010-15 and 35% post 2015. Planning constraints reduce the annual growth rate by a further 6% per annum. No transmission constraints are expected.
Waste wood (heat)	Economic viability constraints increase post 2020, with the annual growth rate declining from 24% to 6%. Supply chain constraints are expected to impact on certain biomass categories. This reduces the growth rate by 14% between 2010-15 and 35% post 2015. Planning constraints reduce the annual growth rate by a further 6% per annum. No transmission constraints are expected.
Agricultural arisings	Significant economic viability constraints throughout whole period, as dictated by Committee on Climate Change that warns of a cautious approach to biomass power. Minimal 1% growth per annum assumed. Supply chain constraints are expected to impact on certain biomass categories. This reduces the growth rate by 14% between 2010-15 and 35% post 2015. Planning constraints reduce the annual growth rate by a further 6% per annum. No transmission constraints are expected.
Wet organic waste	Economic viability constraints increase post 2020, with annual growth rate declining from 8% to 2%. Supply chain constraints are expected to impact on certain biomass categories. This reduces the growth rate by 14% between 2010-15 and 35% post 2015. Planning constraints reduce the annual growth rate by a further 6% per annum. No transmission constraints are expected.
Poultry Litter	Significant economic viability constraints throughout whole period, as dictated by Committee on Climate Change that warns of a cautious approach to biomass power. Minimal 1% growth per annum assumed. Supply chain constraints are expected to impact on certain biomass categories. This reduces the growth rate by 14% between 2010-15 and 35% post 2015. Planning constraints reduce the annual growth rate by a further 6% per annum. No transmission constraints are expected.
Municipal solid waste	Economic viability constraints increase post 2020, with the annual growth rate declining from 8% to 2%. No transmission, supply chain or planning constraints are expected.
Commercial and industrial waste	Economic viability constraints expected to increase over the period. Annual growth rate likely to drop from 11% in 2010-15, to 2% in 2015-20 and just over 1% post 2020. No transmission, supply chain or planning constraints are expected.
Landfill gas	In line with DECC methodology landfill gas capacity is expected to remain flat until 2015 and decline to 20% of existing capacity by 2030.
Sewage Gas	Economic viability constraints increasing post 2020; annual growth rate declining from 13% to 5%. No transmission, supply chain or planning constraints are expected.
Hydro (small scale)	Economic viability constraints fall in the short term, suggesting that annual growth rates could rise from 8% in 2010-15 to 13% in 2015-20. Post 2020, annual growth rates expected to drop to 5%. Planning constraints reduce the annual growth rate by a further 7% per annum. No transmission or supply chain constraints are expected.
Solar PV	Economic viability constraints increasing post 2020; annual growth rate declining from 24% to 10%. No transmission, supply chain or planning constraints are expected.
Solar water heaters	Economic viability constraints fall in the short term, suggesting that annual growth rates could rise from 36% in 2010-15 to 53% in 2015-20. Post 2020, annual growth rates expected to drop to 10%.

Technology	Description of constraints
	No transmission, supply chain or planning constraints are expected.
Ground source heat pumps	Economic viability constraints fall in the short term, suggesting that annual growth rates could rise from 17% in 2010-15 to 20% in 2015-20. Post 2020, annual growth rates expected to drop to 10%. No transmission, supply chain or planning constraints are expected.
Air source heat pumps	Economic viability constraints increasing over the full period; annual growth capped at 50% in 2010-15 20, then dropping to 27% in 2015-20 and 8% post 2020. No transmission, supply chain or planning constraints are expected.
Water source heat pumps	Economic viability constraints fall in the short term, suggesting that annual growth rates could rise from 17% in 2010-15 to 20% in 2015-20. Post 2020, annual growth rates expected to drop to 10%. No transmission, supply chain or planning constraints are expected.

Renewable energy scenarios to 2030

6.19 The *RE: Deploy* modelling provides the results of the constraints and deployment modelling taking the current installed and pipeline capacity as the starting point. These results are referred to hereafter as the 'Deployment Projections'. The modelling generates a bespoke technology mix and level of renewable energy deployment to 2030 within Cumbria. The three additional scenarios then illustrate different technology mixes and pathways for meeting the same level of deployment by 2030 as the Deployment Projections.

6.20 Three scenarios were agreed following consultation with the Steering Group. The main features of the scenarios and the differences between them are described below:

6.21 ***Scenario 1: 'UK Renewable Strategy mix'***, which reflects the indicative national technology proportions identified within the UK Renewable Energy Strategy 2009 to obtain 15% of the UK's energy needs from renewables by 2030. This provides overall proportions of:

- 35% commercial scale wind
- 2% small scale wind
- 20% plant biomass (energy crops, undermanaged woodland, waste wood, agricultural arisings)
- 18% energy from waste (wet organic waste, poultry waste, municipal solid waste, commercial and industrial waste, landfill gas and sewage gas)
- 3% small scale hydropower
- 22% microgeneration (solar photovoltaics, solar water heating, ground source and air source heat pumps).

6.22 ***Scenario 2: 'Current mix – business as usual'*** projects forward the current installed and pipeline capacity mix within each of the Cumbria LPAs (the mix differs between LPAs according to characteristics of current installed capacity).

6.23 ***Scenario 3: 'No new commercial wind'*** assumes that there will be no new commercial wind deployment over and above that which is currently installed, under construction, awaiting construction or consented.

6.24 Before moving on to presenting the Deployment Projections and scenario modelling results, there are a number of issues that need to be highlighted and taken into account in considering the results.

- The Deployment Projections treat Cumbria as a 'closed system'. In line with the DECC renewable energy capacity assessment methodology, the projections are based on potential growth rates to move towards deploying the available naturally occurring resources available within Cumbria and therefore current facilities which generate energy from imported material distort the results. The Iggesund Plant in Allerdale is a planned major biomass plant which will import wood, as well as utilising local sources, via the port of Workington and is expected to have a capacity of around 50 MW heat and 50 MW electricity as a 'windfall'. Although it will use locally sourced timber in addition to imports, the capacity has been removed from the modelling projections to avoid skewing the resulting growth rates, but added back into the final Allerdale and Cumbria 2030 Deployment Projections.

- Reflecting the above point, in the 2030 Deployment Projections, all projections are capped at whichever is the highest figure of (a) technical capacity or (b) current deployment. That is, the deployment of any specific resource technology cannot grow beyond the technical capacity or current installed capacity if this is larger than technical capacity. The latter situation only arises in relation to biomass where a considerable amount of imports are expected to sustain the Iggesund Plant in Allerdale.

- Throughout the study, the generation of heat and electricity for undermanaged woodland, energy crops and waste wood is considered mutually exclusive – i.e. the identified capacity (from within Cumbria) can be used for one or the other, not both. In the technical capacity assessments, it was decided to select the larger capacity identified (for either heat or electricity) and disregard the other, as the resource assessments reflect that maximum technical capacity. Within the Deployment Projections, where installed or potential capacity does not identify the proportions (of heat or electricity generated from biomass) we have assumed 50% for each and similarly it is assumed that 50% of the technical capacity of each can be reached.

- Only those technologies, for which robust assessments of technical capacity were made in Chapter 5, have been included. The modelling therefore excludes offshore sources, combined heat and power, solar farms and solar infrastructure – all of which have a significant contribution to make.

- An additional safeguard has been included to ensure that projections for technologies with very low (or no) existing deployment in specific LPAs are not overly constrained by the current state of play. This safeguard takes into account the technical capacity and the market maturity of each technology so that the level of current deployment is a weaker determinant of the 2030 modelling results. In most cases, this means that where installed capacity is very low or zero, 5% of potential capacity (as identified by the resource assessments) is taken as the starting point[46].

- To better reflect reality and the technical capacity assessment, the level of deployment that can be reached in each of the three comparative scenarios is limited by the highest figure of (a) technical capacity or (b) installed capacity (if the latter is larger than technical capacity – this situation only arises for biomass in Allerdale). As a consequence, in some scenarios there is a 'capacity shortfall' whereby limits on the growth of some technologies have led to a reduced overall capacity. This means that the level of deployment envisaged by the Deployment Projections cannot be reached by the other scenario mixes in some LPAs.
- Landfill gas 2030 modelling has been amended in line with DECC guidance (with regard to the future implications of EU landfill legislation) so that the 2030 capacity declines to just 20% of current levels.

Deployment constraints and scenario modelling results

6.25 The first step, as previously identified was to use the baseline of installed and pipeline capacity (which covers developments which are operational, under construction, awaiting construction and consented) discussed in Chapter 4 and further detailed in Annex E.

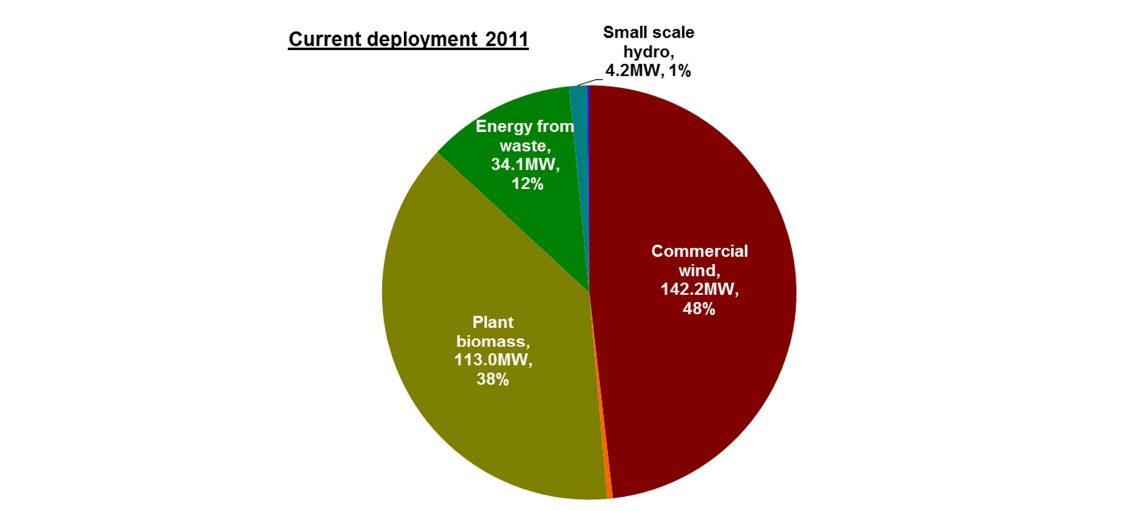
6.26 The proportion of installed and pipeline capacity across technology types is depicted in Figure 6-4. Some technology types have been combined to provide a clearer overview for analysis. The following describes the basis for this aggregation:

- Plant biomass = undermanaged woodland, energy crops, waste wood and agricultural arisings
- Energy from waste = animal biomass (wet organic waste and poultry litter), waste (Municipal Solid Waste and Commercial and Industrial Waste) and biogas (landfill gas and sewage gas)
- Microgeneration = solar photovoltaics, solar water heating and heat pumps (ground, source, air source and water source).

6.27 The current deployment mix shows that almost half of installed and pipeline capacity is commercial wind (142 MW out of a total of 295 MW). However, it should be noted that of the total for plant biomass (113 MW), 100 MW can be accounted for by the Iggesund plant. Taking this figure out of the mix, identifies a far greater reliance on commercial wind (73% of the total). Energy from waste provides 12% of the total, which is largely comprised from Commercial and Industrial waste and landfill gas, whilst the proportions for small scale wind and microgeneration contribute less than 1 MW each and small scale hydropower, just over 4 MW.

[46] For all technologies, other than solar water heaters and heat pumps, the technologies (and the market for them) are considered to be relatively mature and 5% of the potential capacity has been taken as a starting point. In the case of solar water heaters 1% of potential capacity has been used and for the three heat pump technologies 0.5% of potential capacity has been used. This reflects the fact that these latter technologies are relatively immature and therefore initial deployment is expected to be slightly slower.

Figure 6-4: Existing deployment share 2011 (total 295 MW)



Source: SQW

6.28 Following the modelling, the Deployment Projections for Cumbria and for each LPA are provided in Table 6-2. The results are provided in greater detail for each LPA in Annex H.

6.29 Overall the projections suggest that 606 MW renewable energy could be deployed by 2030. From these results, it can be seen that Allerdale could deploy the most renewable energy – this is based on it having a large technical capacity and also the largest (by a significant margin) amount of renewable energy currently installed or in the pipeline. Eden's capacity is expected to increase the most, due to it having the largest technical capacity at 863 MW and starting from a very low base; a step change, particularly in the deployment of commercial wind, would be required over the next 20 years to reach this.

Table 6-2: Deployment projections to 2030 by local planning authority

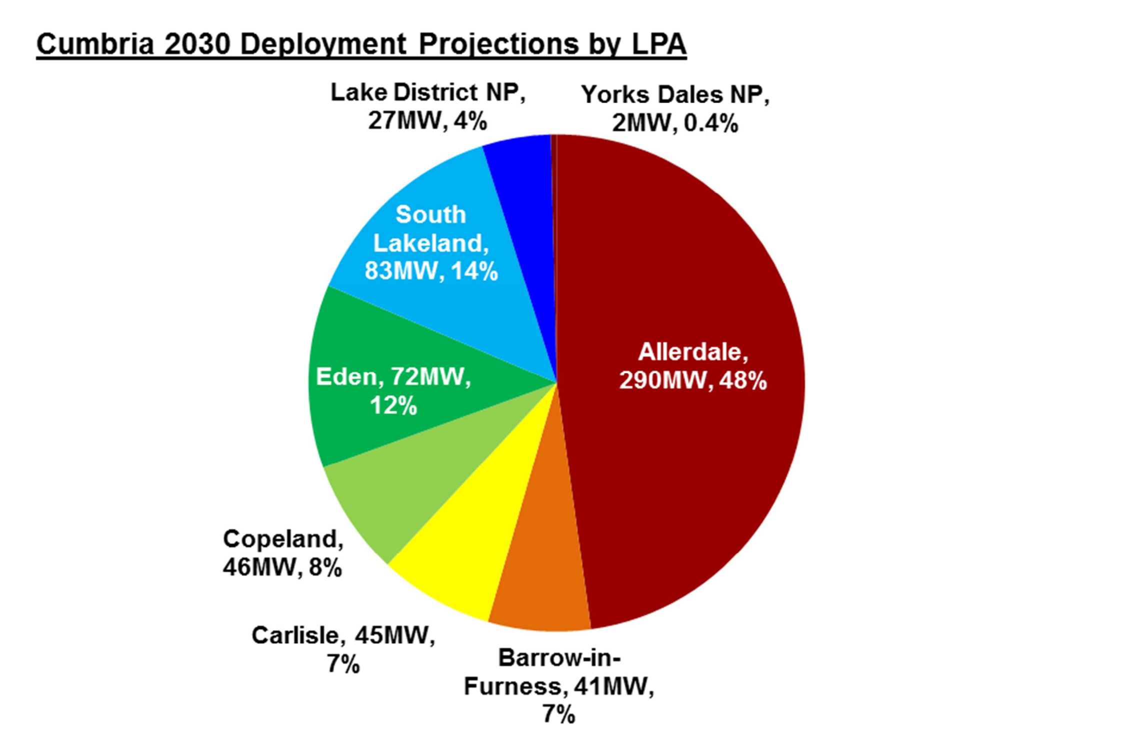
Local Planning Authority	Current Deployment 2011 (MW)	Additional projected deployment to 2030 (MW)	Total deployment 2030 (MW)	Total accessible resource (MW)[47]
Allerdale	207	83	290	764
Barrow-in-Furness	25	16	41	188
Carlisle	5	40	45	495
Copeland	17	29	46	270
Eden	2	71	72	863
South Lakeland	36	47	83	504
Lake District National Park	4	23	27	227
Yorkshire Dales National Park	0	2	2	24
Total	**295**	**311**	**606**	**3334**

Source: SQW (figures may not total due to rounding)

6.30 This proportion is split between the LPAs as shown in Figure 6-5.

[47] excluding protected landscapes

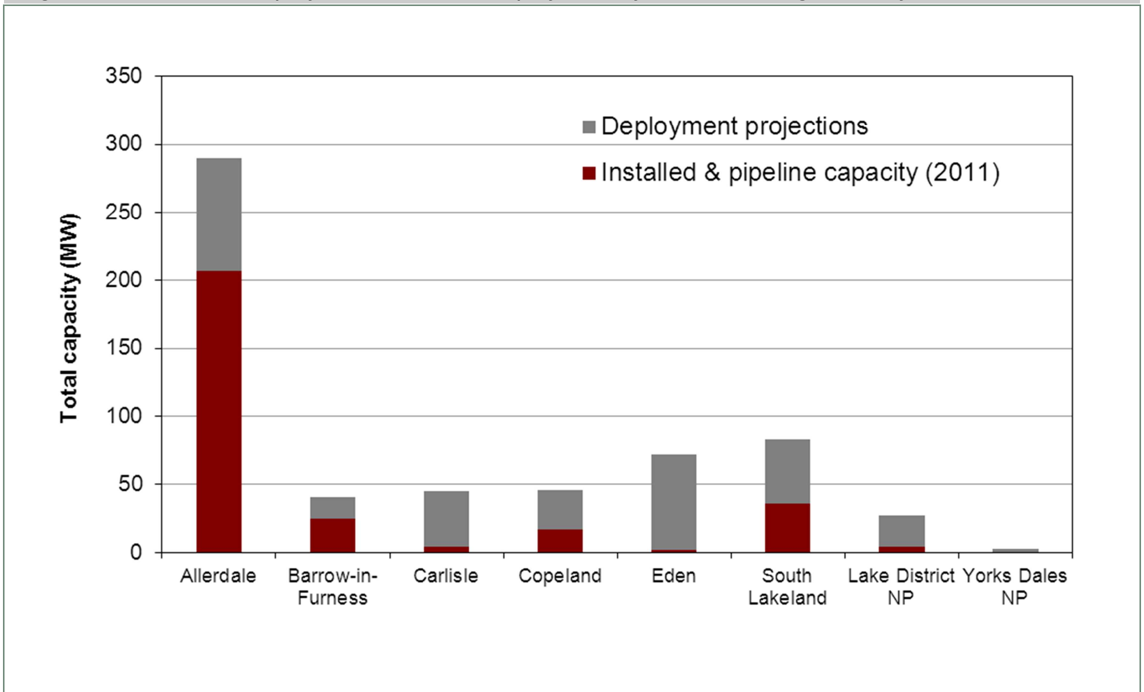
Figure 6-5: Local Planning Authority share of deployment at 2030 (NB: total = 606 MW)



Source: SQW

6.31 The additional amount that each LPA is expected to deploy is shown in Figure 6-6.

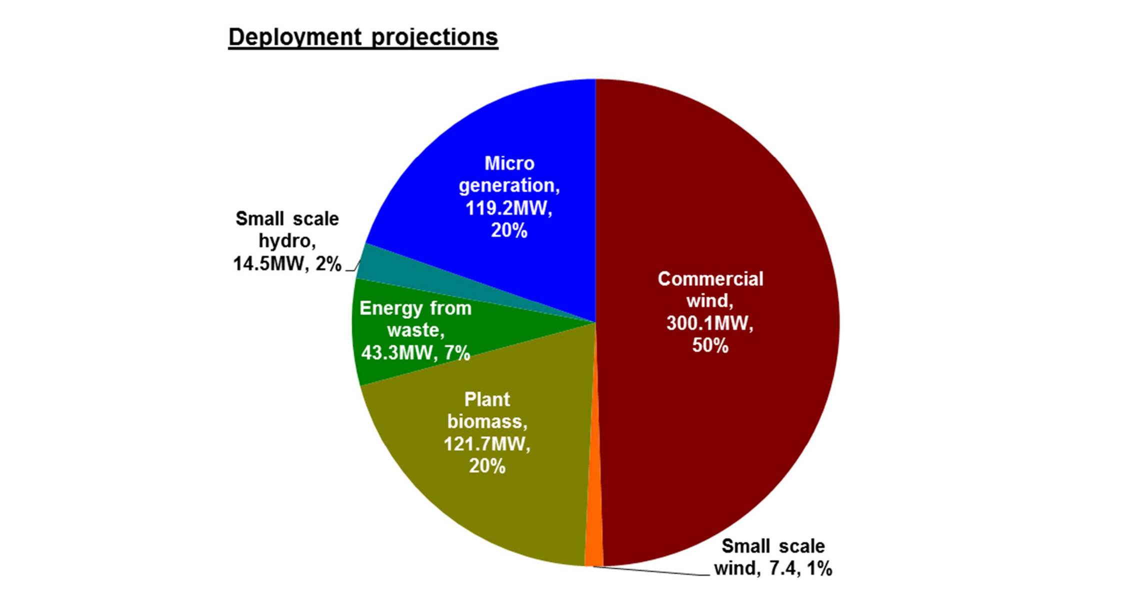
Figure 6-6: Current and projected additional deployment by Local Planning Authority



Source: SQW

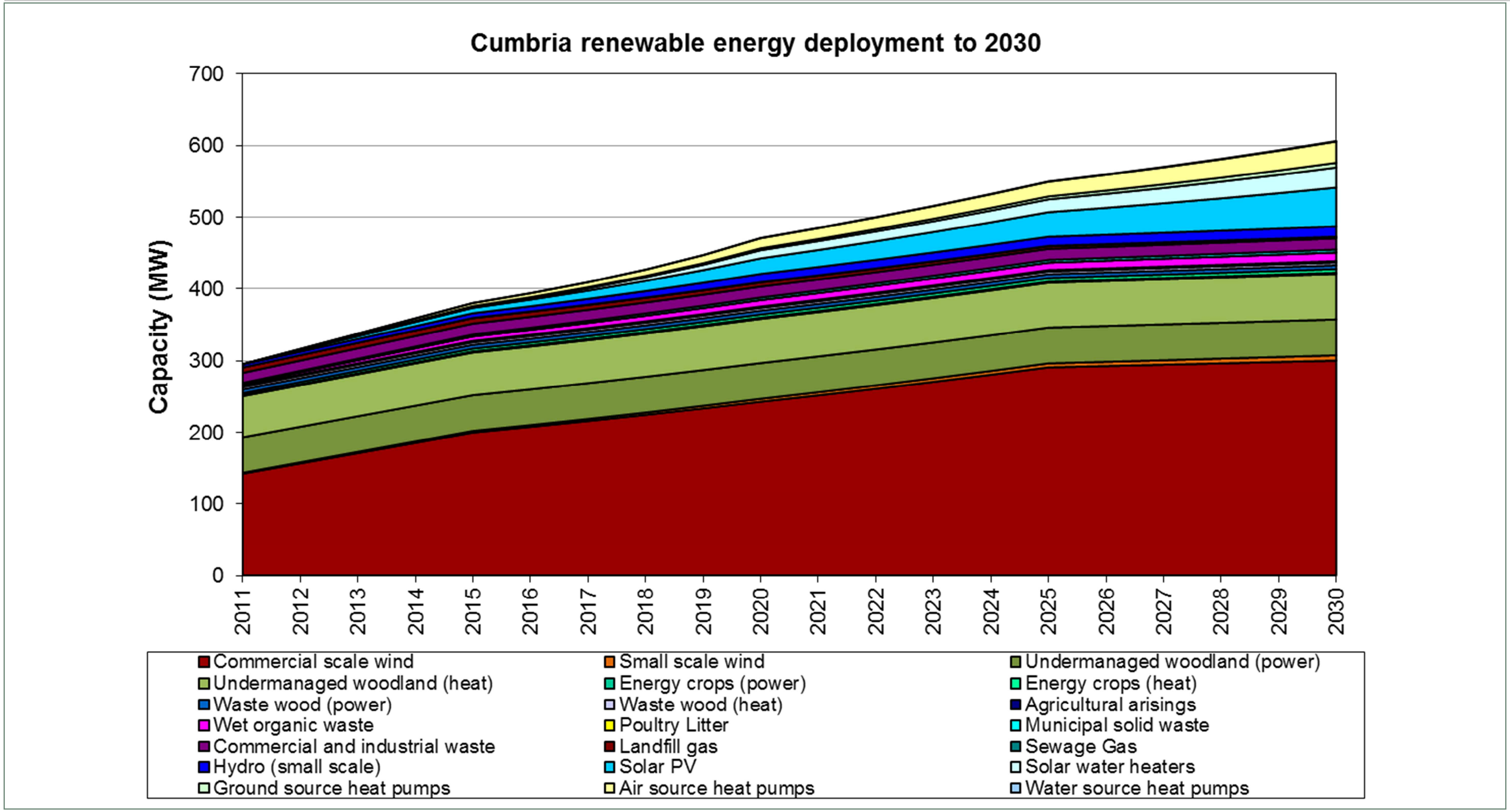
6.32 Deployment projections by technology at 2030 are shown in Figure 6-7 below and then depicted in two deployment curves showing how each technology is projected to grow in Figure 6-8 and Figure 6-9.

Figure 6-7: Deployment projections at 2030 by technology (total 606 MW)



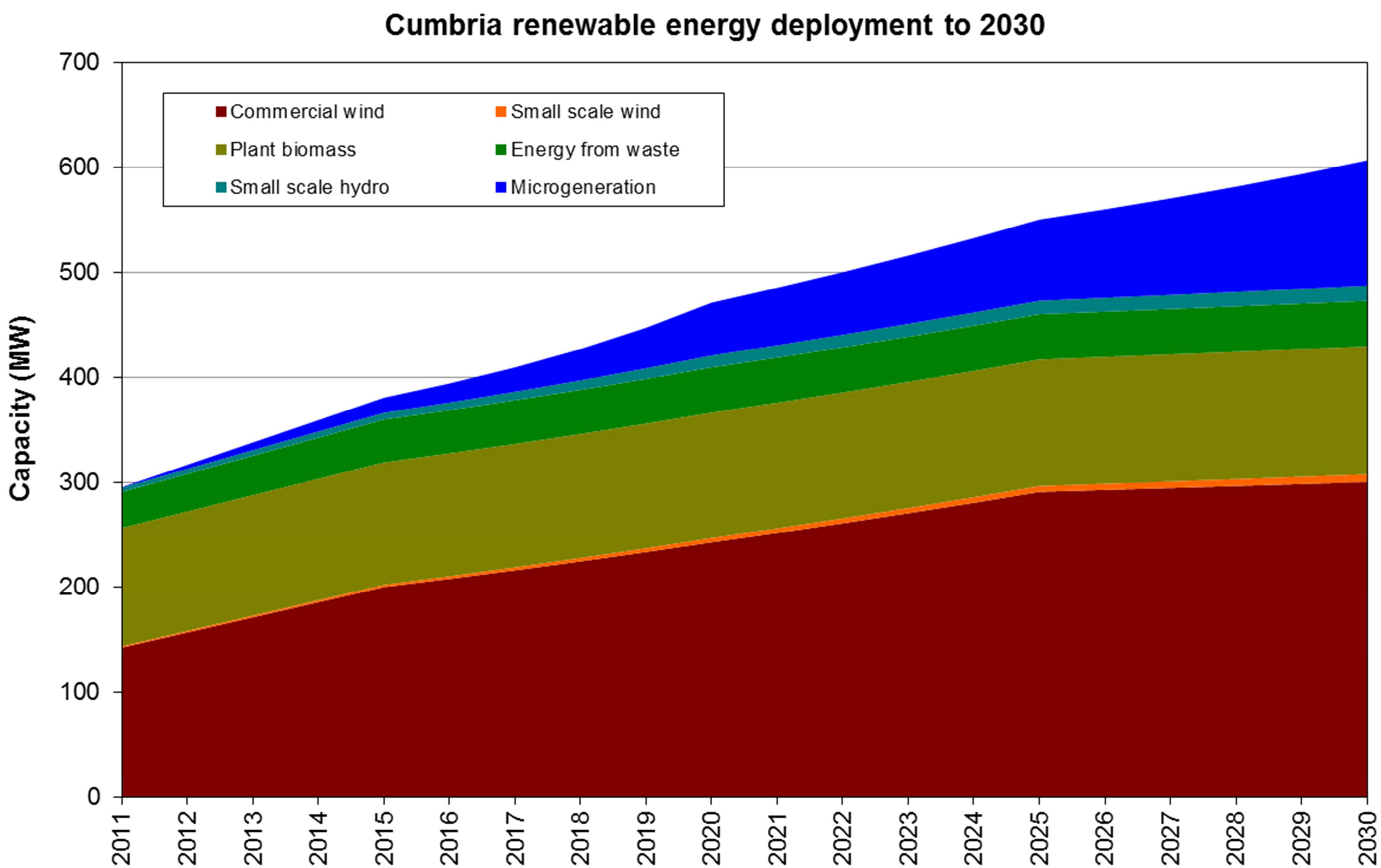
Source: SQW

Figure 6-8: Cumbria renewable energy deployment curve (i.e. build rates) to 2030



Source: SQW

Figure 6-9: Cumbria renewable energy deployment curve (i.e. build rates) to 2030 - simplified

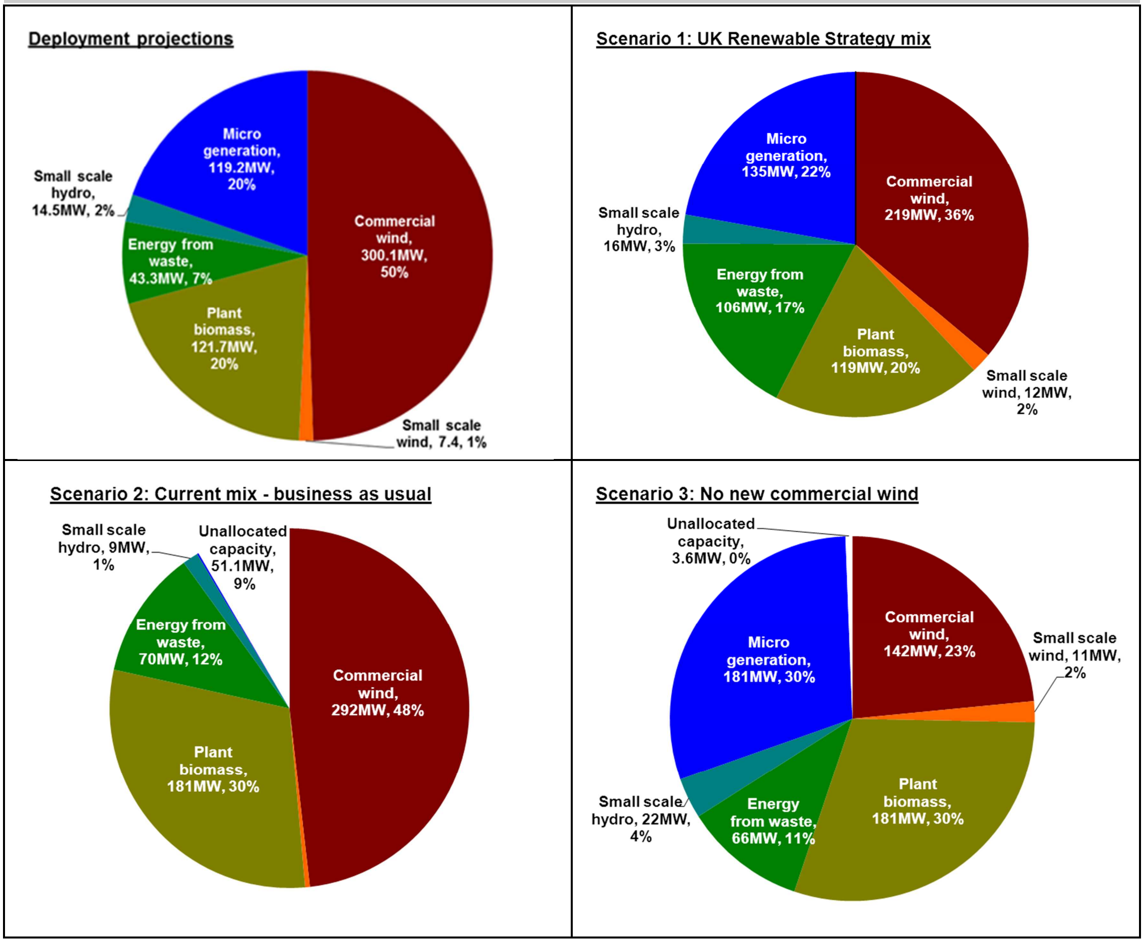


Source: SQW

6.33 From the preceding deployment curves or ‘build rates’, it can be seen that the Deployment Projections show less of a reliance on commercial wind than the current pattern. This is partly due to the grid constraint on larger installations (over 10 MW); this constraint is likely to be in place until 2020. Commercial wind does continue to grow in absolute terms; in fact it doubles, from 142 to 300 MW. Plant biomass is projected to continue growing to a deployable capacity of 127 MW in 2030. All other resources are expected to grow with microgeneration showing a particularly large increase from 0.4 MW currently to 119 MW in 2030.

6.34 Table 6-3 provides an overview of the scenario results for the whole of Cumbria.

Table 6-3: Scenario results for Cumbria (NB total = 606 MW)



Source: SQW

6.35 The *UK Renewable Strategy Mix* scenario reflects the total share of technologies expected to contribute nationally to reaching the UK Renewable Energy Strategy targets at 2020. In this scenario, the reliance on commercial wind is expected to reduce with a greater proportion of energy expected to be deployed from energy from waste, small scale wind and small scale hydropower. A slightly larger proportion is expected to be generated from microgeneration. This scenario is achievable in terms of the technical capacity although energy from waste is almost to the limit of technical capacity, which may prove difficult to deploy in practical terms.

6.36 If the *Current mix-business as usual* scenario were followed; that is, the current pattern continues into the future, a shortfall in capacity would be reached. The full 606 MW could not be deployed with this mix as the technical capacity from plant biomass would be reached. Therefore further biomass would need to be imported, or the shortfall would have to be made up from deployment of an alternative resource to reach the same overall level of deployment.

6.37 In the final scenario *No new commercial wind*, the proportion of wind deployed at 2030 would reduce to 23% of the total as this would only consist of commercial wind currently deployed. It would also require a substantial uplift in microgeneration to 181 MW which would be extremely challenging considering the very low base in terms of current deployment (0.4 MW). There would also be a small shortfall in capacity (of 1%) due to the technical capacity for plant biomass being exceeded.

6.38 Annex H provides the full deployment and scenario modelling results for each local planning authority, these together with some headline implications for each LPA are provided in Table 6-4.

Summary of Local Planning Authority level analysis

6.39 The following analysis highlights a number of important issues for the Cumbria LPAs that need to be given considered attention regarding the future deployment of renewable energy. Central to these findings are the following key points (continued after the tabular analysis):

- There is substantial capacity for commercial scale wind; however, some authorities with large technical capacities, particularly Eden (with technical capacity of 657 MW) currently have very small, or no installed or pipeline capacity. In addition, it is suggested that Allerdale, which already has 207 MW installed/pipeline capacity, could deploy an additional 83 MW – cumulative impacts will clearly be an important consideration. Whilst there are a number of constraints to the deployment of commercial wind, not least grid constraints which are built into the modelling, and the technical capacity was strongly caveated in line with the DECC methodology; the Deployment Projections suggests that a total of 300 MW of commercial scale wind could be deployed by 2030 and this is just 18% of the identified technical capacity. In order to increase the deployment of commercial wind in specific authorities, a supportive planning environment will be required along with continued financial incentives. It should also be noted that following earlier work concerning Protected Landscapes and landscape character assessment based on the Cumbria Wind SPD, the starting point for commercial wind assumes that there will be no deployment in the National Parks, AONBs and on the Heritage Coast – Natural England has suggested that there should not be a blanket exclusion and therefore it is possible that some sensitive deployment could occur within these areas.

- The *UK Renewable Strategy mix* is not relevant in many cases due to the low technical capacity of hydropower being reached within the specific LPAs and the high expected contribution from plant biomass. This means that other technologies would have to deploy a larger share in order to make up this shortfall to meet a level of around 606 MW.

- If future deployment reflected the current mix as in the *Current mix – business as usual scenario*, but with larger absolute amounts, a capacity shortfall would result due to the technical capacity for plant biomass being exceeded (NB: this does not take into account the Iggesund plant). The same situation would result from the *No new commercial wind scenario.*

- In the Deployment Projections and the *UK Renewable Strategy mix* scenario, a significant uplift in the deployment of microgeneration is envisaged – to 119 MW and 134 MW respectively. This amount would increase even further for the *No new commercial wind* scenario with a total deployable capacity of 181 MW forecast. Current deployment of microgeneration is just 0.4 MW across the whole of Cumbria and therefore reaching these amounts would be extremely challenging. Registered Social Landlord (RSL) and local authority stock within the more urban areas of Carlisle and Barrow, in particular, provide opportunities for retrofit programmes providing financial support can be obtained. More widely, financial incentives such as Feed in Tariffs would need to be sustained or possibly increased to support this significant uplift in the deployment of microgeneration.

- The modelling has not taken into account current or planned waste resource facilities that will manufacture Solid Recovered Fuel (SRF). This is because the waste source for these facilities are already taken into account within the Municipal Solid Waste and Commercial and Industrial Waste technical assessments (in line with the DECC methodology) and the deployment modelling. Adding the outputs from these, in terms of the fuel created and potential energy that this could generate, to the existing technical and deployable capacity figures would constitute double counting. As a result of these waste facilities being constructed, it is likely that the full potential of waste deployment will be met.

- The Iggesund plant has raised important and interesting questions concerning the treatment of Cumbria as a ‘closed system’. Whilst not treating it as such would create an overly complex modelling approach, recognising that there are currently imports (and exports) of biomass and potentially energy from waste which will continue to exist into the future and may increase or decrease, adds another factor to the issues that LPAs may consider in planning their own overall renewable energy deployment mix.

Table 6-4: Results and implications of the scenarios for each Local Planning Authority/ NPA

LA	Deployment Projections	UK Renewable Strategy mix	Current mix – business as usual	No new commercial wind mix
Allerdale LPA Deployment at 2030 = 290 MW Additional deployment to 2030[48] = 83 MW	Allerdale's existing deployment is dominated by commercial wind and plant biomass (largely from the Iggesund Plant). The Deployment Projections suggest a less balanced mix in 2030 as commercial wind is envisaged to grow whereas growth in plant biomass) was restricted in the modelling due to the amount likely to be imported to support the Iggesund Plant in addition to the utilisation of local sources. Microgeneration is also expected to grow significantly.	Capacity shortfall of 10% due to technical capacities for plant biomass and small scale hydropower being exceeded.	The current mix projected forwards suggests considerable growth in commercial scale wind and energy from waste. Plant biomass is capped due to technical capacities and microgeneration remains at a very low level.	This scenario suggests the need for significant growth in microgeneration. The combination of no new commercial wind, and very little increase in plant biomass (due to technical capacity being exceeded) leads to a capacity shortfall of 11%.
Barrow-in-Furness LPA Deployment at 2030 = 41 MW Additional deployment to 2030 = 16 MW	Barrow's existing deployment is dominated by plant biomass and energy from waste. The Deployment Projections suggest that Barrow's large technical capacity in microgeneration could drive new deployment for these technologies.	A mix reflecting the UK Renewable Strategy suggests major growth in commercial scale wind.	Capacity shortfall of 32% due to technical capacities for plant biomass, energy from waste and small scale hydropower being exceeded.	No new commercial wind is not too dissimilar from the Deployment Projections. Future deployment is dominated by microgeneration due to plant biomass, energy from waste and small scale hydropower exceeding technical capacity.
Carlisle LPA Deployment at 2030 = 45 MW Additional deployment to 2030 = 40 MW	Current renewable energy deployment in Carlisle is limited in terms of total MW capacity and dominated by commercial wind. The Deployment Projections suggest future deployment will be dominated by microgeneration technologies – which are driven by the large technical capacity for these in Carlisle.	To reflect the UK Renewable Strategy mix, Carlisle must significantly increase the amount of plant biomass and energy from waste deployment.	The business as usual scenario would see the continued dominance of Carlisle's commercial wind deployment – which is likely to grow from 3 MW in 2011 to 30 MW in 2030.	With no new commercial wind in Carlisle, this scenario suggests a major increase in microgeneration deployment. Overall, this scenario is not too dissimilar from the Deployment Projections.
Copeland LPA Deployment at 2030 = 46 MW Additional deployment to 2030 = 29 MW	Current deployment in Copeland is almost entirely composed of commercial scale wind. The Deployment Projections suggest there is likely to be further deployment of commercial wind combined with a major increase in the deployment of microgeneration technologies.	Capacity shortfall of 16% due to technical capacities for plant biomass and small scale hydropower being exceeded.	The business as usual scenario would see Copeland's commercial wind deployment grow from 17 MW in 2011 to 46 MW in 2030.	With restrictions placed on the deployment of extra commercial wind, this scenario suggests a significant increase in microgeneration: a growth of over 25 MW between 2011 and 2030.

[48] This represents the difference between current installed capacity and projected deployment at 2020

LA	Deployment Projections	UK Renewable Strategy mix	Current mix – business as usual	No new commercial wind mix
Eden LPA Deployment at 2030 = 72 MW Additional deployment to 2030 = 71 MW	Eden currently has very low levels of all renewable energy technologies. Due to the large technical capacity, the Deployment Projections suggest a large increase in commercial scale wind in Eden, complemented by more modest increases in microgeneration, plant biomass and energy from waste technologies.	This scenario suggests less commercial wind compared to the Deployment Projections, but significant deployment of microgeneration, plant biomass and energy from waste technologies.	The business as usual scenario leads to a capacity shortfall of 48%. This is driven by small scale wind, energy from waste and small scale hydropower exceeding technical capacity.	This scenario envisages a huge increase in the deployment of microgeneration – from 0.1 MW in 2011 to 44 MW in 2030 – complemented by smaller increases in the deployment of the remaining technologies.
South Lakeland LPA Deployment at 2030 = 83 MW Additional deployment to 2030 = 47 MW	Current deployment in South Lakeland is dominated (81%) by commercial wind. Although the total capacity is expected to increase, the Deployment Projections suggest a more balanced mix in 2030 with microgeneration technologies growing in size to reduce the share currently accounted by commercial wind.	Capacity shortfall of 15% due to technical capacity for plant biomass being exceeded.	The business as usual scenario reflects the dominant role that commercial wind deployment currently plays in South Lakeland. Under this scenario commercial wind deployment is projected to grow from 29 MW in 2011 to 67 MW in 2030.	The no new commercial wind scenario suggests a major role for the deployment of microgeneration technologies in South Lakeland. The share of microgeneration in South Lakeland's energy mix must grow from below 1% in 2011 to 40% by 2030.
Lake District NPA Deployment at 2030 = 27 MW Additional deployment to 2030 = 23 MW	Current renewable energy deployment in the Lake District NP is small and dominated by small scale hydropower. The Deployment Projections suggest that small scale hydropower, together with microgeneration, are likely to dominate future growth in the area's renewable energy generation.	Capacity shortfall of 35% due to technical capacity for commercial wind being exceeded.	The business as usual scenario reflects growth in small scale hydropower – the current dominant technology current deployed in the area.	Due to the lack of any technical capacity for commercial scale wind in the National Park, this scenario is the same as the Deployment Projections which also suggest no new commercial wind and a modest increase in small scale hydropower and microgeneration technologies.
Yorkshire Dales NPA[49] Deployment at 2030 = 2 MW Additional deployment to 2030 = 2 MW	There is currently no deployment of renewable energy in the Cumbrian part of the Yorkshire Dales National Park. The Deployment Projections suggest that a modest deployment (totalling 2 MW) of small scale hydropower and microgeneration could be possible by 2030.	Capacity shortfall of 35% due to technical capacity for commercial wind being exceeded.	Due to zero current deployment, the business as usual scenario suggests zero deployment by 2030.	Due to the lack of any technical capacity for commercial scale wind in the National Park, this scenario is the same as the Deployment Projections which also suggest no new commercial wind and a modest increase in small scale hydropower and microgeneration technologies.

Source: SQW

[49] Only a very small proportion of the Yorkshire Dales NP is within Cumbria – hence the very low figures for current deployment and very small technical capacity for additional projected deployment

6.40 In order to assist LPAs and others with contextualising these results, we have provided a conversion table in Annex J which identifies the load factor for each technology, typical plant capacity, the number of additional plants that would be required and the number of homes that could be served if the Deployment projections were realised.

6.41 These results are provided below for Cumbria as a whole in Table 6-5. For commercial wind and biomass, there are several sub-categories; in each case the full capacity for the category could be reached by any one of the sub-categories. So, in the case of commercial wind, the Deployment Projections result of 158 MW could be provided by 63 single large turbines ***OR*** 158 medium turbines ***OR*** 316 small turbines.

6.42 In order to realise the full capacity identified by the Deployment Projections, the following number of plants would be required:

- Commercial scale wind: 63 large turbines or 158 medium turbines or 316 small turbines (or a combination of the three)
- 1, 017 small scale wind turbines
- 3 large biomass boilers or 44 small biomass boilers (or a combination of the two)
- No new Municipal Solid Waste plants
- No new Commercial and Industrial Waste plants
- 2 less landfill gas plants than are currently in existence
- 7 sewage gas plants
- 52 small-scale hydropower turbines
- 53,800 solar photovoltaic panels
- 11,200 solar water heaters
- 1,320 ground source heat pumps
- 5,940 air source heat pumps
- 7 non-domestic water source heat pumps.

Table 6-5: Plants required and numbers of homes that could be served by Deployment Projections

Technology	MW per plant	Deployment projections (MW)	No of plants required	No of additional homes served
Commercial scale wind (single large turbine)	2.5	157.9	63	104,815
Commercial scale wind (single medium turbine)	1		158	
Commercial scale wind (single small turbine)	0.5		316	

Technology	MW per plant	Deployment projections (MW)	No of plants required	No of additional homes served
Small scale wind	0.006	6.1	1,017	4,049
Large biomass (electricity)	100	8.7	0	16,836
Medium biomass (electricity)	50		0	
Large biomass plant boilers (heat)	3		3	1,947
Small biomass plant boilers (heat)	0.2		44	
Municipal Solid Waste	11	2.4	0	3,240
Commercial and industrial waste	11	1.6	0	2,160
Landfill gas	3	-6.1	-2	-7,330
Sewage gas	0.1	0.7	7	1,062
Hydro (small scale)	0.2	10.3	52	7,625
Solar PV (domestic)	0.001	53.8	53,800	9,685
Solar water heaters	0.0025	28	11,200	1,016
Ground source heat pumps	0.005	6.6	1,320	748
Air source heat pumps	0.005	29.7	5,940	3,367
Water source heat pumps (non-domestic)	0.1	0.7	7	79

Source: SQW

7: Other impacts and opportunities associated with increasing renewable energy deployment

7.1 Further to the deployment and scenario modelling reported in Chapter 6, it is important to consider the practical aspects of deploying renewable energy and the impacts, both positive and negative, that these may cause. This Chapter commences with a review of the upside opportunities and downside risks of each of the scenarios undertaken through further qualitative analysis, informed by consultations with stakeholders and the focus group held in May 2011. Then, recognising the value of Cumbria's natural environment, the Chapter proceeds to provide the results from a review of the environmental impacts of each scenario before moving to look at economic and carbon abatement impacts.

Qualitative analysis – upside opportunities and downside risks

7.2 The deployment constraints and scenario analysis stage of this study involved utilising and customising the *Re: Deploy* model for Cumbria in order to translate the technical capacity identified in the first stage of the study into a more realistic assessment of the deployable capacity. However, not all constraints, or opportunities can be modelled quantitatively and therefore the model's findings are further refined using qualitative analysis of the key implementation risks and success factors for deployment related to each of the three scenarios. These issues cannot be modelled either because they cannot be quantified (e.g. local politics and the potential for community ownership), their specificity meaning they are not of relevance to entire LPAs or resource technologies (e.g. matters pertaining to farm use of anaerobic digestion) or their impacts are not yet known (such as some technological developments).

7.3 This qualitative analysis has provided the opportunity to explore and capture the key implementation risks and upside opportunities to achieve successful deployment – i.e. things that may be significant for planning policy making but that might not be readily quantifiable at this time. For example, the risks and opportunities associated with deployment of community scale renewables has been investigated as part of this task as this is an important and fast emerging aspect to UK renewable energy deployment in relation to small and micro scale technologies.

7.4 The key factors analysed cover economic viability, supply chain, technology developments, planning and political factors and the potential for community ownership. These issues have been analysed from the intelligence and feedback gained during the course of the study, including consultation with key stakeholders in Cumbria via an email survey and also through a focus group held in May 2011.

7.5 In conducting the qualitative analysis a series of indicators have been identified for each of the factors and an assessment undertaken of downside risks and upside opportunities in relation to how these indicators may impact on deployment. These are summarised in Table 7-1 and then explored further in the text below.

Table 7-1: Qualitative analysis matrix

Factor	**Indicator** i.e. the particular aspect of this factor that will have a bearing on whether the scenario can be achieved.	**Downside Risk** i.e. how this could jeopardise deployment	**Upside Opportunity** i.e. how the scenario/target level could be exceeded	**Relevance to specific scenarios**
1. Economic viability	a. Cumbria has the potential to become a net renewable energy exporter and build economic policy around this thus harnessing greater deployment	No action in promoting this opportunity likely to result in deployment being undertaken at continued rate rather than a step increase.	Clear political and private sector support through LAs, LEP etc could lead to a substantial increase in deployment.	All – concerned with general uplift in deployment
	b. Financial incentives such as ROC, FITs and RHI promoting renewable energy deployment	Reduction in incentives could result in reduced deployment. Incentives focusing on specific technologies at expense of others could lead to imbalanced technology mix that does not necessarily capitalise upon the natural resources available	Continuation/increase in financial incentives should lead to increased deployment across all technologies	Particularly important for commercial wind – Deployment Projections & Current Mix scenario, and microgeneration – all scenarios
	c. Presence of a single organisation promoting renewable energy deployment, encouraging collaboration and sharing learning	Lack of presence could significantly reduce uptake – currently several organisations exist but all timebound to around 2014.	Establishment of a single organisation could ensure greater synergy and coherence to the sector which should lead to increased deployment	All – concerned with general uplift in deployment
	d. Economics of small slurry based AD v centralised AD plants run using very little silage and more energy crop material. 20% herd reduction projection likely to lead to diversion of plant biomass to maximise income streams	Opportunities for both are large but the mix could be more heavily skewed towards AD using plant rather than animal biomass.	Policy support for both small and centralised AD schemes should enable much greater deployment of this resource – as the scale of deployment increases so should investor confidence facilitating an upward spiral.	Relates to biomass which is prevalent in the Current mix and No new commercial wind
2. Supply chain	a. Strong supply chain for microgeneration, especially PV and heat pumps as a result of plumbers and electricians diversifying, but skilled labour is a problem with hydro and biomass installers	Lack of appropriately trained installers could impact on overall levels of deployment and the balance of renewable energy resources deployed	Increase in trained installers should lead to an increase in deployment	Relates to hydropower and biomass which is particularly important for the No new commercial wind scenario but relevant to all
	b. Availability of fuel supply especially for biomass and anaerobic digestion	Lack of fuel supply will impact negatively on commercial scale installations (NB: most timber exported to Lockerbie where	Guaranteed fuel supply will have a positive impact on deployment – potential	Relevant to plant biomass – Current mix and No new commercial wind scenarios

Factor	**Indicator** i.e. the particular aspect of this factor that will have a bearing on whether the scenario can be achieved.	**Downside Risk** i.e. how this could jeopardise deployment	**Upside Opportunity** i.e. how the scenario/target level could be exceeded	**Relevance to specific scenarios**
3. Planning and political		demand still exceeds supply)	for import?	
	a. Reports of unpredictable and inconsistent outcomes, perceptions by some of 'extreme restraint' in the National Parks plus length of time taken to obtain decisions. Also reports of inconsistency between planning and building control	Planning by appeal will have a detrimental impact on uptake. However, this largely impacts on commercial wind which is not promoted in all scenarios. Building control/planning inconsistency could impact on microgeneration take up.	More certain planning context would assist to maximise deployment. Planning situation is not generally a problem for AD which provides a major opportunity for increased deployment.	All – concerned with general uplift in deployment
	b. Other regulatory constraints such as MOD and seismic	Overly restrictive constraints could have potential to substantially limit deployment in Allerdale and Carlisle	Sensible application and recognition that not all installations will impact on radar and seismic issues should have a positive impact on deployment	Relevant to commercial wind – Deployment Projections and Current Mix scenarios
	c. Skills and knowledge level of planning especially development control	Lack of technical understanding could lead to inconsistent policy application and frustration for developers leading to less deployment	Increased skills, confidence & competence through programmes such as CLASP should lead to a more positive environment for renewable energy deployment	All - concerned with general uplift in deployment
	d. Community Infrastructure Levy	Competing demands –unlikely to secure a great deal to support deployment of renewable energy	Provides an opportunity to increase funding support for renewable energy	All – concerned with general uplift in deployment
	e. Current national policy flux including localism	State of flux, lack of targets and potential for localism to be used to promote anti-renewable energy views could have a detrimental impact on deployment	Communities positive about renewable energy could harness localism policies such as neighbourhood plans to provide more support and certainty for renewable energy applications – potential for AD	All – concerned with general uplift in deployment
	f. Very significant local opposition – several hundred letters in relation to one application is common	Local community support/objection will have detrimental impact on take up	Community awareness raising programme combined with successful community schemes could harness support	All – concerned with general uplift in deployment
	g. National policy including financial incentives	'Greenest' Government to date likely to continue providing financial incentives and promoting renewable energy	Support needs to be consistent and long term to provide stability within the industry – clear national policy around targets and implications for local	All – concerned with general uplift in deployment

Factor	**Indicator** i.e. the particular aspect of this factor that will have a bearing on whether the scenario can be achieved.	**Downside Risk** i.e. how this could jeopardise deployment	**Upside Opportunity** i.e. how the scenario/target level could be exceeded	**Relevance to specific scenarios**
4. Technology			authorities would harness a lot of the current work being undertaken into feasibility etc to maximise deployment within Cumbria	
	a. Woodfuel much easier and more straightforward at smaller scale – numerous difficulties with large scale CHP. Small scale retrofit particular opportunity for off grid properties – substantial proportion in Cumbria	If difficulties with large scale CHP not overcome, and retrofitting not taken up on a large scale this would represent a considerable missed opportunity and deployment in this area will remain low with scenario projections not reached	Technical developments in CHP and improved grid connection would have a positive impact on deployment enabling scenario projections and mix to be reached	All – general uplift in deployment
	b. Technical issues with all types of heat pumps will impact on take up	Lack of technical advancement with all will mean scenario projections and mix unlikely to be achieved	Technical advancement at a higher level than expected could mean scenarios exceeded	Particular relevance to No new commercial wind, but relevant for all
	c. Overall improvements in technology should reduce costs especially if government support continued	Lack of advancement and withdrawal of government support will mean scenarios not met	Higher level of advancement supported by government incentives could reduce costs more than expected which have a positive impact on take up	All – general uplift in deployment
	d. Capacity to maximise potential of woodfuel impacted by a number of factors identified within the Forestry Commission's 'A Woodfuel Strategy for England Report'	Woodfuel cannot be maximised if: • Woodland owners are not known or engaged • Woodlands are unmanaged • Supply chain is not sustainable • End users not engaged, aware or have access to fuel or maintenance expertise	Woodfuel can be maximised if: • Known and engaged woodland owners • Sustainably managed woodlands • Sustainable supply chain with access to research and data, sufficient demand, skills, competent & well equipped workforce • End users are able to make informed choices, have sufficient supply and are able to call on local	All – general uplift in deployment

Factor	**Indicator** i.e. the particular aspect of this factor that will have a bearing on whether the scenario can be achieved.	**Downside Risk** i.e. how this could jeopardise deployment	**Upside Opportunity** i.e. how the scenario/target level could be exceeded	**Relevance to specific scenarios**
			maintenance expertise	
5. Community ownership	a. Interest and take up – policy environment, funding and community skills & knowledge	Uncertain policy, funding and lack of knowledge acting as a continued constraint will inhibit take up	Harnessing of local support, financial incentives and improvement of local skills/knowledge could substantially increase take up	All – general uplift in deployment
6. Job creation	a. Job creation potential for all of the technologies envisaged and within all of the scenarios. The Britain's Energy Coast initiative aims to maximise economic growth and job creation potential from all low carbon and renewable energy sources.	• Potential negative impact on jobs re: grazing and arable farming around commercial wind turbines • Possible negative impact on tourism if visual impact from commercial wind turbines (and biomass plants) has detrimental effect on landscape quality	• Potential identified for microgeneration, particularly installation as well as manufacture • Development of biomass plants likely to have a positive impact through provision of long-term income for farmers, forestry owners and transport operators resulting from the supply of biomass fuel	Negative impacts associated with commercial wind deployment most likely to result from Deployment Projections Positive impacts associated with microgeneration and biomass likely to result from *No new commercial wind scenario.*

Source: SQW

7.6 From the qualitative analysis table, the following key issues have been identified:

- Economic viability
  - Cumbria has the potential to deliver renewable energy on a significant scale if it is made sufficient economic policy priority.
  - Continued financial incentives will be important to maximise deployment specifically from commercial scale wind and microgeneration.
  - A coordinating group, with dedicated offer support, promoting renewable energy would be beneficial.
- Supply chain
  - The need for skill development in hydropower and biomass installation was highlighted by consultees although experienced engineering and design, and turbine manufacture companies are based in Cumbria. Addressing any skills shortages will be important to reach the uplift in deployment envisaged regardless of the scenario – although these technologies feature most predominantly in the *No new commercial wind scenario.*
  - Fuel supply is an issue for biomass, as is the need for sustainable woodland management and known, engaged woodland owners – the potential for significant woodland creation should be maximised as a way of meeting demand within the sub-region, but importing may also be required in future.
- Planning and political
  - More certainty and consistency in planning policy interpretation and decision making should help encourage greater deployment
  - Sustained objection to commercial scale wind, albeit by the minority, is an important consideration that needs to be taken into account and managed pro-actively.
- Technology development
  - CHP and heat pumps are two technologies for which there is significant untapped technical capacity. National technological developments are needed for deployment to be fully maximised, and locally there will be opportunities to support firms involved in the associated supply chains (manufacture and installation).
  - The large uplift in microgeneration in all scenarios, but particularly for the *No new commercial wind* scenario may prove challenging.
- Community ownership

- Awareness raising including visiting other projects such as the Bay Wind Community projects and the development of informed guidance, e.g. 'how to' guide covering technical and financial issues, could help to increase the current uptake which is minimal.

- Job creation
  - Positive job creation impacts can be created through the increased deployment of renewable energy, particularly microgeneration which through its individual-property based characteristics is labour intensive.

Environmental Impacts

7.7 Detailed below are the environmental impacts that may arise as a result of the technology deployments associated with the deployment scenarios. Impacts have been highlighted that are of greatest likelihood and/or magnitude. These environmental impacts are more qualitative and detailed than those investigated as part of the technical capacity resource constraints, which focused on overall landscape impacts in terms of the Protected Landscapes and their settings. Many of the technologies, including commercial wind, biomass and anaerobic digestion plants have associated *possible* impacts relating to ecology, ornithology and heritage. Table 7-2 provides a summary of the key impacts associated with each of the onshore resource technologies investigated within the study.

Table 7-2: Environmental impacts summary

Technology	Environmental Impacts	Mitigating Actions
Commercial scale wind	**Landscape and Visual** • On site: loss of landscape features, change in character of the site and adjacent landscapes, change to views from settlements and viewpoints as a result of turbines	• Undertake landscape restoration works at the end of the construction period • Use appropriate colour coating for tower, nacelle and turbine blades • Incorporate off-site screen planting in key locations • Ensure site restoration upon decommissioning
	Noise • Mechanical noise from the generator and gearbox and aerodynamic from the turbine blades - aerodynamic is usually at a higher level than mechanical • During construction and decommissioning	• Ensure chosen wind farm layout and predicted operational noise levels fall within established limits of ETSU-R-97 • Restrict working hours during construction and decommissioning
	Air Quality • Related predominantly to emissions generated during the construction so short term	• Switch off engines when not in use • Minimise delivery movements
	Hydrology • Impacts to local watercourses, water bodies, groundwater and water supplies due to pollution, erosion, sedimentation and impediments to flow resulting from construction activity	• Prepare Environmental Management Plan (including use of silt traps, buffer zones from watercourses etc.)
Biomass (Electricity and CHP plants)	**Landscape and Visual** • On site: loss of landscape features, change in character of the site and adjacent landscapes, change to views from settlements and viewpoints as a result of industrial buildings	• Minimise extent of disturbance to ground • Undertake landscape restoration works at the end of the construction period • Ensure careful site layout design and siting of plant • Incorporate off-site screen planting in key locations • Appropriate colour treatment of plant
	Noise • Long-term impacts relating to vehicle noise (e.g. deliveries, loading etc.) and	• Ensure appropriate site layout design and siting of particularly noisy pieces of

Technology	Environmental Impacts	Mitigating Actions
	engine/pump noise during plant operation	plant such as the air cooled condenser (e.g. located away from sensitive site boundaries) • Incorporate noise attenuation features (e.g. within roof and walls) to reduce noise break-out
	Air Quality	
	• Stack and particulate emissions from operational procedures • Odour deriving from sources of biomass fuels (e.g. agricultural residues and waste streams)	• Incorporate proprietary air pollution control systems into scheme design • Apply chemical deodorants to minimise external odours • Avoid retention of large volumes of waste
	Traffic and Transport	
	• Increase in vehicle movements to and from the site during operation for the transport of biomass fuel by-products	• Prepare Traffic Management Plan to include measures for vehicle sharing, avoidance of HGV deliveries during peak periods etc.
	Hydrology	
	• Impacts relating to operational procedures on local watercourses/groundwater • leaching of liquids from the storage of large wood chip piles	• Prepare Environmental Management Plan (including use of silt traps, buffer zones from watercourses etc.) • Incorporate collection dish around storage area to minimise runoff
Anaerobic digestion	**Landscape and Visual**	
	• On site: loss of landscape features, change in character of the site and adjacent landscapes, change to views from settlements and viewpoints as a result of industrial buildings and storage tanks	• Minimise extent of disturbance to ground • Undertake landscape restoration works at the end of the construction period • Ensure careful site layout design and siting of plant (i.e. digesters can be partially buried to minimise visual impacts) • Incorporate screening measures to minimise potential adverse impact • Incorporate off-site screen planting in key locations • Appropriate colour treatment of plant
	Noise	
	• Long-term impacts relating to vehicle noise (e.g. deliveries, loading etc.) and	• Appropriate site layout design and siting of particularly noisy pieces of plant

Technology	Environmental Impacts	Mitigating Actions
	engine/pump noise during plant operation	(e.g. located away from sensitive site boundaries) • Set noise limits at site boundaries or at sensitive receptors • Incorporate noise attenuation features (e.g. within roof and walls) to reduce noise break-out
	Air Quality	
	• Vehicle emissions during construction (short term) and operation (long term) • Odour deriving from the storage of feedstock and the digestion process	• Appropriate siting of the facility along with effective site and plant management to minimise odour impacts • Incorporate negative ventilation systems fitted with biofilters to control and contain odours within buildings
	Traffic and Transport	
	• Increase in vehicle movements to and from the site during operation for the transport of delivery feedstock	• Prepare Traffic Management Plan to include measures for vehicle sharing, avoidance of HGV deliveries during peak periods etc.
Landfill gas	**Landscape and Visual**	
	• Visual impact may be relatively insignificant if co-located with other activities such as waste disposal • Short term visual impacts may be incurred during land restoration after extraction and landfill have ended	• Design (including colour and appearance) and siting of Landfill gas plant to minimise visual impacts
	Air Quality	
	• Vehicle emissions during operation • Use of a combustion-based energy recovery technology, depending on its type (e.g. boiler, gas turbine, internal combustion engine), may result in increased emissions	• The emissions from typical L Landfill gas plant are not currently regulated. This is currently under review by the Environment Agency and landfill gas fuelled generators may be regulated under EU stationary engines regulations in the near future. This is expected to result in a tightening of emissions limits
Small-scale hydro	**Landscape and Visual**	
	• On site: loss of landscape features, change in character of the site and adjacent landscapes, change to views from settlements and viewpoints as a result of turbine houses and associated power lines	• Incorporate screen planting (of an appropriate species) to conceal turbine house • Design built elements to be as small as possible • Ensure colour and materials of built elements are in keeping with local

Technology	Environmental Impacts	Mitigating Actions
		landscape features • Bury pipeline and restore pipeline route after construction
	Noise • Increase in noise levels at nearby residences during operation (e.g. noise emitted from the turbine and generator)	• Design of turbine house to incorporate acoustic insulation materials • Set limits on noise emissions through planning conditions
	Hydrology • Alteration to existing hydrological regimes of a river, resulting in impacts on aquatic ecosystems dependent on hydrological regimes • Construction impacts resulting in pollution, erosion and sedimentation	• Prepare Environmental Management Plan (including use of silt traps)
Micro-generation	**Landscape and Visual** • Modernising effect on landscape and settlement character when located on the principal elevation of a property (micro turbines and roof-mounted solar panels)	• Position turbines sympathetically to surrounding built forms, as far as possible • Choose sympathetic paint and finishes for tower/mast, nacelle and turbine blades • Use screening (e.g. planting) to minimise unsympathetic views where appropriate • Design (including colour and appearance) and siting of panels to minimise visual impacts
	Noise • Increase in noise levels at nearby residences during operation from outdoor pump during operation (air source heat pumps) • Increase in noise levels at nearby residences during operation due to mechanical and/or aerodynamic noise during operation (micro turbines)	• Design scheme to incorporate anti vibration mountings and acoustic insulation of outdoor pump • Site turbines to minimise impact on neighbouring properties • Adopt good practice measures for reducing noise in line with British Standards guidance
	Air Quality • Emissions from operational procedures, such as nitrogen and sulphurous oxides and carbon dioxide emissions from biomass fuel combustion (biomass boilers)	• Incorporate proprietary air pollution control systems into scheme design

Technology	Environmental Impacts	Mitigating Actions
	Cultural Heritage	
	• Direct visual impact on the character of a building or site of historical value (micro turbines, roof-mounted solar panels)	• Wall mounted micro turbines should be installed on unobtrusive areas of a roof or walls if possible
	• Indirect visual impacts on the setting of heritage features (micro turbines, roof-mounted solar panels, air source heat pumps)	• Design (including colour and appearance) and siting of solar panels to minimise visual impacts on character and appearance of heritage features
		• If possible, solar panels should be installed on unobtrusive areas of a roof, such as the inner slopes of a roof valley, or where a flat roof is obscured by a parapet
		• External heat pump units should be installed to the rear of a property, in service areas or on flat roofs where they will be hidden from view
		• Appropriate materials and colour treatment should also be used if any housing for heat pump unit is required
		• Consult relevant heritage stakeholder
	Hydrology	
	• Pollution of groundwater from leakage of additive chemicals (water source heat pumps)	• Ensure equipment used is of high quality and meets Environment Agency (EA) standards - seek advice of EA
	• Abstraction of water (water source heat pumps)	• Ensure abstraction rates meet do not exceed EA requirements (an abstraction license from the EA will be required)

Source: LUC

Summary of environmental impacts by scenario

7.8 Overall, the most significant environmental impacts are likely to result from commercial scale wind, plant biomass and energy from waste. These technologies are prevalent in all scenarios (except the *No Commercial Scale Wind* scenario), and so it is envisaged that each of the deployment scenarios would result in landscape and visual impacts. As such, the cumulative landscape and visual impact resulting from future development of these technologies, combined with the existing deployment, is likely to be of a high magnitude given the sensitivity of the landscape in Cumbria. Noise is also considered to be a potential impact (both short and long-term) in the case of these technologies. However, this potential is highly dependent on the location of future developments, and is only likely to occur where these technologies become concentrated within a locality, with the magnitude being enhanced where schemes are in proximity to sensitive receptors (e.g. residential development, schools etc.). There are also potential impacts associated with air quality and traffic and transport (both short and long term). Cumulative impacts are likely to arise where biomass and energy from waste plants become concentrated in a specific locality. Depending on the degree of concentration and the scale of individual plants, this would be of a medium-high magnitude.

7.9 The *No New Commercial Scale Wind* scenario would see the maximum micro-generation, which would give rise to significant impacts on landscape and settlement character, as technologies such as micro turbines and roof-mounted solar panels have a 'modernising' effect on townscape character, particularly if they are located on the principal elevation of a property. Given the very high level of micro-generation required to be deployed to meet this scenario, the cumulative visual impact would be of a high magnitude. Similarly, the development of such technologies can have a negative impact on cultural heritage through both direct visual impacts on the character of a building or site of historical value and indirect impacts on the setting of heritage features. However, given the relatively small scale of micro-generation technologies, such impacts could be largely mitigated through sensitive siting and design.

7.10 In conclusion it is clear that all renewable energy technologies will have some degree of environmental impact; with visual impact mainly a feature of the larger scale technologies, particularly commercial wind turbines and large biomass plants, noise and transport impacts being associated with the construction of all types of installations (other than microgeneration) and commercial wind, biomass and hydropower all having potentially detrimental impacts on hydrology. Mitigating actions have been identified for each of the environmental impacts – the degree to which these can overcome the impacts will largely depend on density and cumulative impact. Therefore, it is important that individual site analysis within the perspective of developments elsewhere is undertaken thoroughly.

Analysis of carbon and economic impacts

PACE tool: purpose and approach

7.11 The SQW PACE tool[50] is a transferrable model which robustly and consistently compares the impact of various mechanisms required to move towards a low carbon economy. The tool compares the **cost effectiveness** of these mechanisms, the **carbon impacts** (the carbon savings, taking into consideration the production emissions associated with delivering the measure as well as the savings it will ultimately achieve) and the **job creation impact** (the extent to which the measure will create jobs and therefore could contribute to an area's economic objectives).

7.12 All three of these impacts can be considered at a local level, i.e. only the jobs created within Cumbria, or at a total level, i.e. all jobs created. Note that when considering costs, the 'local' costs are those that are borne by the local authority in that area.

7.13 For the purposes of this analysis, the cost, carbon and job impacts refer to the *net* impacts of deploying the various renewable technologies. This means the costs, carbon emissions and jobs associated with renewable energy deployment minus the costs, carbon emissions and jobs which would have occurred anyway (i.e. the reference case) if the energy was generated using more conventional power generation. The PACE calculations are absolute costs and assume zero subsidies (FiTs, ROCs, or any others).

Selection of technologies for impact analysis

7.14 Using the results from the Deployment Projections (further scenario analysis has not been undertaken), we selected three key renewable technologies for the impact analysis. These technologies were chosen because of the significant deployable potential that they have in Cumbria to 2030. The Deployment Projections suggest that commercial scale wind is likely to account for the largest share of future deployment at around an additional 158 MW by 2030. Slightly less microgeneration capacity (119 MW) is expected, followed by a relatively small amount of additional biomass capacity (18 MW).

- **Commercial-scale onshore wind** – the additional deployment of 158 MW of onshore wind in Cumbria by 2030.
- **Plant biomass and energy from waste (specifically focusing on anaerobic digestion)** – the additional deployment of 18 MW capacity plants in Cumbria by 2030.
- **Microgeneration (specifically focusing on domestic solar photovoltaics (PV))** – the additional deployment of 119 MW[51] of microgeneration in Cumbria by 2030.

[50] The PACE (Prioritisation of Actions for low Carbon Economy) tool was developed by SQW for Cornwall Council as part of the EU INTERREG Regions for Sustainable Change programme
[51] The 119 MW of microgeneration equates to 42,357 individual solar PV installations (assuming a capacity of 2.8 kW per installation, which according to the Ofgem Feed-in Tariff data (April 2010 to March 2011) is the current average for the Northwest region).

Overall results

Total and local net impacts summary

7.15 Table 7-3 and Table 7-4 show the **total** net impacts and the **local** Cumbrian net impacts of renewable energy deployment. Note that in Table 7-4 – at the local level – we have assumed no contribution towards the costs from Cumbrian local authorities.

Table 7-3: Total cost, carbon and employment impacts

Renewable technology	Net cost – NPV (£m)	Net carbon savings (tCO_2)	Cost of carbon (£/tCO_2)	Net jobs created (FTE job years)	Cost per job (£/FTE)
Commercial wind	£16m	2,278	£7	1,856	£8,670
Biomass	£122m	479	£254	1,668	£73,087
Microgeneration	£633m	289	£2,190	17,996	£35,184

Source: SQW

Table 7-4: Local Cumbrian cost, carbon and employment impacts

Renewable technology	Net cost – NPV (£m)	Net carbon savings ($ktCO_2$)	Cost of carbon (£/tCO_2)	Net jobs created (FTE job years)	Cost per job (£/FTE)
Commercial wind	£0m	2,289	£0	1,427	£0
Biomass	£0m	493	£0	1,468	£0
Microgeneration	£0m	329	£0	14,865	£0

Source: SQW

7.16 Table 7-3 and Table 7-4 provide some interesting findings which are explored further in the charts and text below. Due to the assumed lack of local authority cost contributions, there is a limited level of 'cost-effectiveness' analysis that can be done purely at the local Cumbrian level. Nevertheless, it is clear through comparing the two tables that a significant proportion of the total carbon savings and jobs created are likely to be experienced within Cumbria.

Carbon impacts

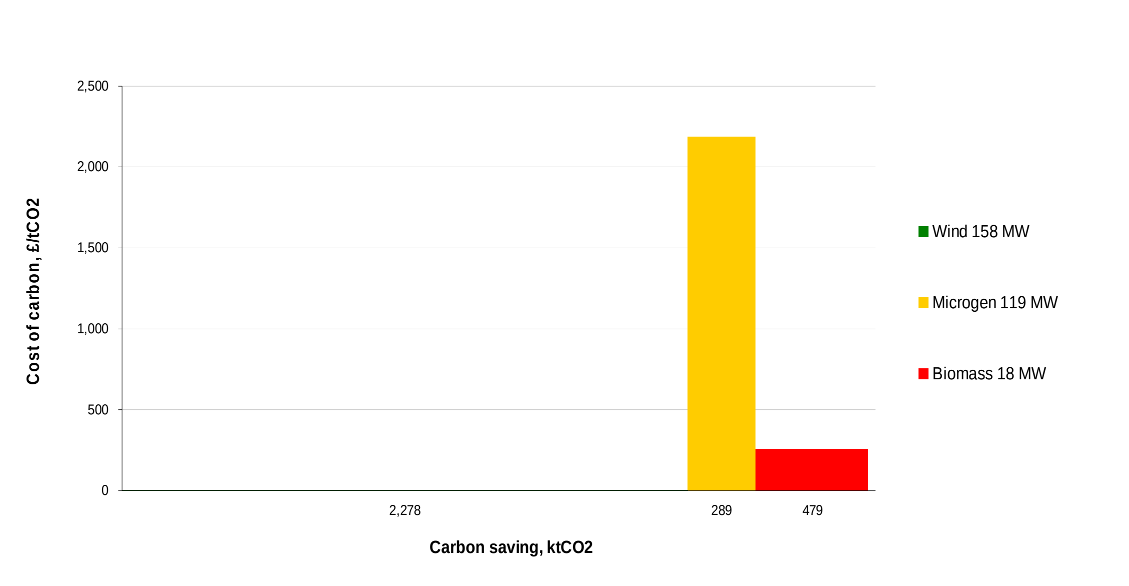
7.17 Of all three technologies, the deployment of 158 MW of commercial scale wind is expected to lead to the largest total amount of carbon savings. This is partly explained by the fact that commercial wind accounts for the largest amount of new capacity and also due to the relatively high load factor[52] of commercial wind technology compared to solar photovoltaic technology (Annex J contains a summary of load factors for each technology type),

7.18 Commercial wind is also the most cost effective in terms of the costs associated with achieving carbon savings. The PACE tool assessment estimates that each tonne of carbon saved through deploying commercial wind costs approximately £7. In comparison, carbon saved through the deployment of biomass technologies is expected to cost around £250 per tonne and over £2,000 per tonne for solar PV technologies.

[52] A load factor is a measure of the *actual output* of an energy generating technology compared to the *maximum capacity* it could theoretically produce.

7.19 These dynamics are illustrated in Figure 7-1. The width of each bar represents the total carbon savings and the height of each bar reflects the cost for each tonne of carbon saved. The commercial wind bar is therefore very wide- it stretches from the y-axis (i.e. a large total amount of carbon saved) and very short – cost is so low that it does not show up (i.e. a low cost per each tonne of carbon saved) in comparison to the other bars.

Figure 7-1: Total cost v carbon savings



Source: SQW

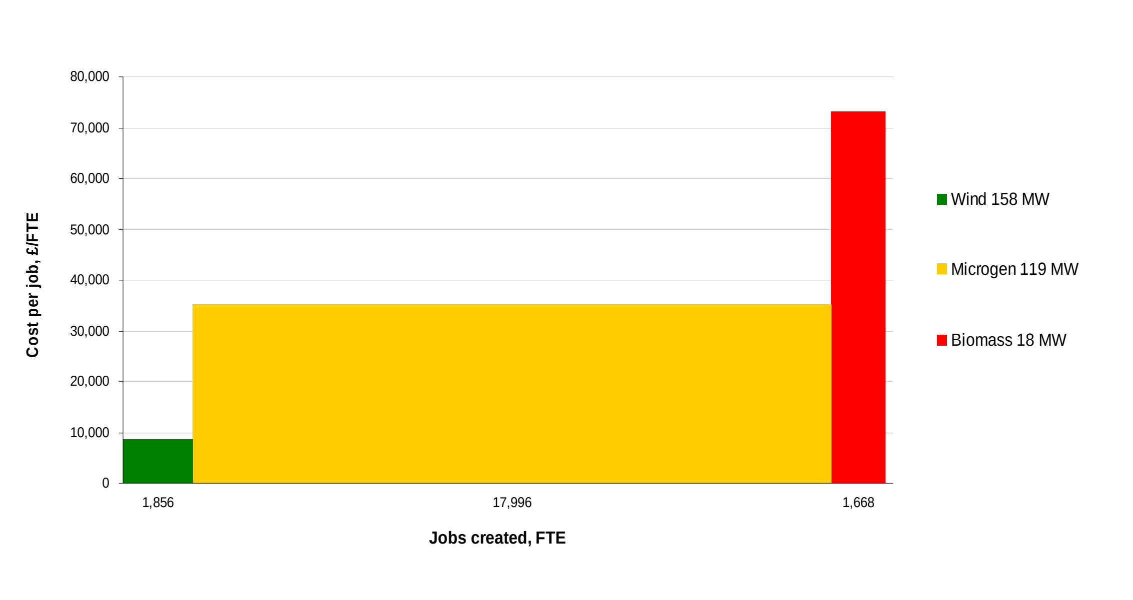
Job creation impacts

7.20 It is also possible to frame the analysis in terms of job creation (full-time equivalent, person years), rather than carbon savings. In this respect, the PACE analysis suggests that the microgeneration deployment is likely to generate the most new jobs – almost 18,000 person years over the next four decades. Given the small-scale decentralised nature of microgeneration, the bulk of these jobs are created through the build and installation of the microgeneration energy systems which are relatively labour intensive in terms of jobs per MW. For example, in installed capacity terms, a single 2 MW commercial wind turbine is equivalent to over 700 average sized solar PV installations.

7.21 When considering the costs of these impacts, again commercial wind appears to be the most economical technology. Although the 158 MW of commercial wind is expected to generate around 1,850 jobs, much fewer than microgeneration, the average cost associated with each of these jobs is under £9,000 per job. (Cost per job is a simple ratio of the net full cost (NPV) of the measure/intervention divided by the net number of jobs associated with that measure). In comparison, the average cost associated with each job created through microgeneration is around £35,000 and for biomass the figure is around £73,000 per job created.

7.22 Figure 7-2 illustrates these points. Although the microgeneration bar is the widest (indicating the largest total number of new jobs created), the commercial wind bar is the shortest (indicating the most economical cost per job created).

Figure 7-2: Total cost v jobs created (FTE, person years)



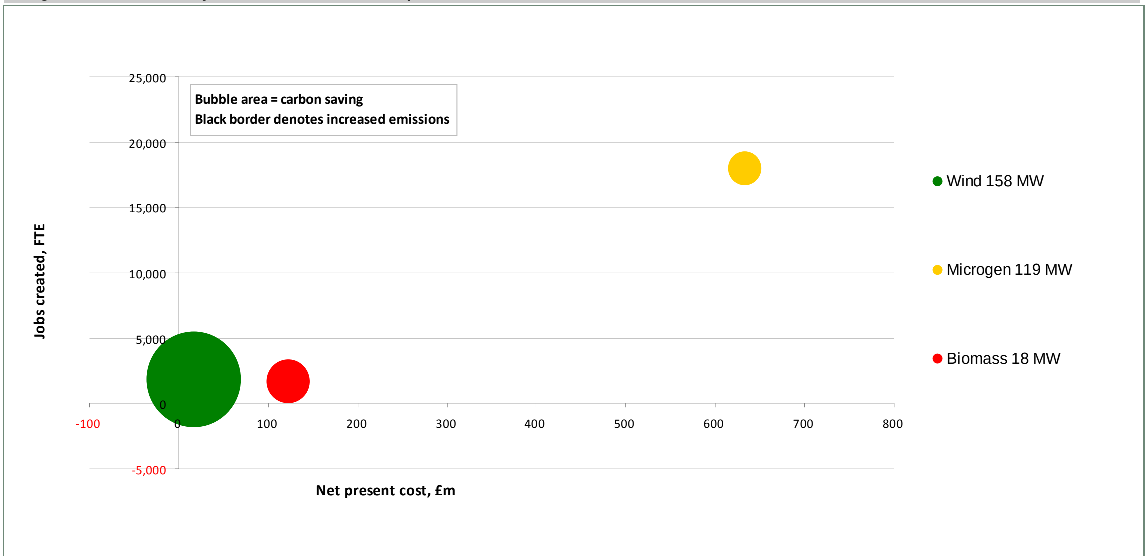
Source: SQW Note: The job figures are full-time equivalent person years. They include manufacturing, build and installation jobs for deployment until 2030 and operation and maintenance jobs associated with this deployment.

Costs, jobs and carbon impacts - summary

7.23 Figure 7-3 summarises the impacts analysis through illustrating the costs, jobs and carbon impacts all in one chart. The higher up the y-axis, the greater the number of jobs created. Bubbles to the left are less expensive than those to the right. And finally, larger bubbles indicates a larger carbon saving.

7.24 It is evident from Figure 7-3 that commercial wind deployment (at the scale defined) is likely to save the most tonnes of carbon (largest bubble) and cost the least amount of money (furthest to the left). Nevertheless, in employment terms, microgeneration deployment has the potential to create the most new jobs (highest up the y-axis).

Figure 7-3: Cost, jobs and carbon impacts



Source: SQW

8: Conclusions and recommendations

Overview

8.1 This study has produced a comprehensive assessment of the potential accessible energy resources across LPAs in Cumbria and explored the constraints and deployment scenarios for significantly growing their contribution to 2030. The LPA specific renewable energy resource assessments have also provided an initial assessment of low carbon energy potential (i.e. combined heat and power or tri-generation (to include cooling) and district heating schemes) as well as assessing offshore resources to provide wider context.

8.2 The project's evidence base is highly relevant for use at the local scale in planning policy development. The evidence can be used to assist LPAs in considering the contribution of renewable energy and low carbon initiatives (i.e. opportunities for climate change mitigation) noting that energy consumption is a material planning consideration. The evidence base from this project has the specific advantages of being disaggregated down from the sub-regional scale to individual LPAs taking their specific opportunities and challenges into account.

8.3 The key implications arising from the findings of the study are summarised in Table 8-1. The overall conclusions and recommendations for LPAs in Cumbria follow.

Table 8-1: Summary of key implications

Scenario implications for LPAs

- There is substantial capacity for commercial scale wind; however, some authorities with large technical capacities, particularly Eden (with technical capacity of 657 MW) currently have very small, or no installed capacity. The Deployment Projections suggest that a total of 300 MW of commercial scale wind could be deployed by 2030 which is just 18% of the identified technical capacity. The increase in commercial wind projected for Allerdale, in addition to current installed capacity, needs careful consideration as regards cumulative impacts.
- The *UK Renewable Strategy mix* cannot realistically be deployed in several LPAs due to the low technical capacity of hydropower in specific LPAs, and high expected contribution from plant biomass. This means that other technologies would have to deploy a larger share in order to make up this shortfall to meet a level of around 605 MW.
- If future deployment reflected the current mix as in the *Current mix – business as usual scenario,* but with larger absolute amounts, a capacity shortfall would result due to the technical capacity for plant biomass being exceeded (NB: this does not take into account the Iggesund plant). The same situation would result from the *No new commercial wind scenario.*
- The Deployment Projections and *UK Renewable Strategy mix scenario* project a significant uplift in the deployment of microgeneration – to 119 MW and 134 MW respectively. This amount would increase even further for the *No new* commercial *wind* scenario with a total deployable capacity of 181 MW projected. Current deployment of microgeneration is just 0.4 MW across the whole of Cumbria and therefore reaching these amounts would be extremely challenging in terms of implementation scale even with a supportive planning environment and the availability of financial incentives.
- The modelling has not taken into account current or planned waste resource facilities that will manufacture Solid Recovered Fuel (SRF). This is because these facilities are already taken into account within the Municipal Solid Waste and Commercial and Industrial Waste technical assessments and deployable modelling
- The Iggesund plant has raised important and interesting questions concerning the treatment of Cumbria as a 'closed system'. Whilst not treating it as such would create an overly complex modelling approach, recognising that there are currently imports (and exports) of biomass and potentially energy from waste which will continue to exist into the future and may increase or decrease, adds another factor to the issues that LPAs may consider in planning their own overall renewable energy deployment mix.

Conclusions from the analysis of upside risks and downside opportunities

- Economic viability: Cumbria has the potential to deliver renewable energy on a significant scale if it is made sufficient economic policy priority, continued financial incentives are important, and a coordinating group promoting renewable energy would be beneficial.
- Supply chain - skill development in hydropower and biomass installation will be important to reach the uplift in deployment envisaged regardless of the scenario, fuel supply is an issue for biomass – importing may be required in future.
- Planning and political - more certainty and consistency in planning policy content and implementation should help encourage greater deployment, wide-scale objection to commercial scale wind is an important consideration that needs to be taken into account.
- Technology development - CHP and heat pumps are two technologies for which there is significant untapped technical capacity. National technological developments are needed for deployment to be fully maximised, and locally there will be opportunities to support firms involved in the associated supply chains
- The large uplift in microgeneration in all scenarios, but particularly for the *No new commercial wind scenario* may prove challenging.
- Community ownership - awareness raising and potentially the development of a standardised framework for initiating and running such schemes is needed to increase the current uptake which is minimal.

Environmental impacts

- Overall the biggest environmental impacts are likely to result from commercial scale wind, plant biomass and energy from waste. These technologies are prevalent in all scenarios other than *No New Commercial Scale Wind*. However, the very high level of microgeneration that needs to be deployed to meet this scenario makes it extremely challenging to meet and may have localised cumulative impacts.

Carbon and economic impacts from key technologies

- From analysis of three technologies: commercial wind, energy from waste and microgeneration, key findings are that onshore wind is the cheapest (in unit cost terms) technology to deploy and will achieve the highest carbon savings
- Wind is also most cost-effective in terms of job creation (i.e. cost per job) but microgeneration would create more jobs (18,000 compared with 1,850 for commercial scale wind).

Source: SQW

Overall conclusions

8.4 The main conclusions arising from the study are that:

- **Cumbria has abundant natural resources for renewable energy, but the deployment of these need to be undertaken in such a way that does not compromise the value and inherent quality of its natural landscapes, many of which are designated. Throughout this study, we have respected the need to ensure that projections for future energy deployment do not detract from Cumbria's outstanding environment. Taking this and a range of other constraints into account it is forecast in this study that Cumbria has deployable onshore renewable energy resources of 606 MW by 2030.** When converted into energy generation (GWh) and taking into account load factors for the various technologies, the potential energy generation figure is 1,861 GWh. This compares with the energy demand projections provided in Chapter 3 which suggest, depending on which pathway is followed, that future energy needs could be between 14,000 and 18,000 GWh at 2030. This suggests that Cumbria could provide between 10 and 13% of its energy requirements from onshore renewables by 2030. The UK Renewable Strategy, 2009, suggests that 15% of total future energy needs (and 30% of electricity) should come from renewable sources by 2020, but it should be noted that this aspiration is not expected to be disaggregated to local areas. Cumbria is currently a net exporter of energy and this is likely to be the case for renewable energy due to the abundance of natural resources.

- Interestingly, the **current installed and pipeline capacity (295 MW) already exceeds the North West Regional Spatial Strategy electricity target for 2010 for Cumbria which was 237 MW**. However it should be noted that this target was based on the North West Sustainable Energy Strategy which was published in 2006 since when there have been considerable advances in technological developments for renewable energy and more financial incentives are now available. In addition, the targets were calculated on a top down basis by identifying projected energy demand for the North West at 2030, calculating 20% of this (as the North West Sustainable Energy Strategy set out for the North West to meet 20% of its energy needs by 2020) and then dividing this amount between Cumbria, Cheshire, Merseyside, Lancashire and Greater Manchester. Cumbria is a net energy exporter and likely to continue to be so, particularly for renewable energy and therefore it is important that targets are developed on a capacity rather than a demand basis capitalising upon the natural resources with which the county is endowed.

- **Cumbria needs to significantly increase its current level of deployment (295 MW current installed and pipeline capacity) if it is to meet the 606 MW that is considered deployable.** The Deployment Projections provide the most easily achievable mix as they are based on realistic assumptions concerned with economic viability, supply chain, grid constraints and recent planning acceptance. The *UK Renewable Energy Strategy mix scenario* would require a substantial increase in energy from waste which may not be realisable, whilst the *No new commercial wind scenario* which is likely to be more politically acceptable and has the least environmental impacts, requires a substantial uplift in the deployment of microgeneration. Some microgeneration technologies are not yet economically viable on a widespread basis and this target is extremely challenging in terms of the scale of the uplift and viability of deploying this with regards to owner interest, availability of financial incentives, quality of stock and technological development.

- **Microgeneration provides an exciting opportunity in terms of economic benefits and particularly job creation.** The analysis of qualitative aspects revealed that there are a good number of existing microgeneration installers so there is a local labour market benefit that can be achieved. Continued support via Feed in Tariffs, or other financial incentives in the future, plus a supportive local policy environment should help maximise take up. Potential funding sources for wider scale roll-out retrofit and new housing include European funding (already being accessed in Cumbria for retrofit including renewable energy measures), section 106 and the Community Infrastructure Levy. Supportive planning policies are also important particularly those that require more than the minimum Code for Sustainable Homes requirements and Merton type policies where it is specified that a certain proportion of energy should be generated on site.

- **Continued deployment of commercial wind is likely to be required to meet the identified level from the deployment modelling and it is notable that some Local Planning Authorities with large technical capacity have no existing or planned developments**. An appropriate planning environment, which is in place across Cumbria particularly with the Wind SPD in place, is essential as will be the continuation of financial incentives. Wind also provides the cheapest option as identified through the carbon and economic impact analysis and will achieve the highest carbon saving. Whilst noting the importance of commercial wind in Cumbria's future renewable energy deployment mix, it is important to have cognisance of the cumulative environmental impacts that this can impose. Allerdale for example has a significant installed capacity with regards to commercial wind (at just under 90 MW) yet could realistically deploy a further 60 MW over the next 20 years. This is a fairly significant deployment of commercial wind within one district which would not be without environmental impacts.

Recommendations

8.5 We are aware that Cumbria County Council and the Cumbria Local Planning Authorities are **planning a series of dissemination events**. This is important and should not be restricted to climate change officers or planning officers, but include economic development colleagues due to the important of renewable energy to the Cumbrian economy as recognised through Britain Energy Coast's proposals. Related to this, we are aware that a series of training events have been undertaken throughout 2011 to raise awareness of different types and scale of renewable energy technologies amongst officers and communities. This could be built upon with further awareness sessions for elected members linked to the findings from this report and including site visits to provide first hand experiences of different types and scales of renewable energy developments.

8.6 Individual LPAs may wish to undertake **further work to refine the results** and select the most appropriate scenarios to provide the evidence base to help to take forward their renewable energy ambitions. This could be linked to target setting to set a clear goal and also enable measurement of progress. In addition, further analysis may be important for individual LPAs in relation to economic viability, opportunities, carbon abatement potential and environmental impacts.

8.7 It is important that climate change and planning officers work closely with economic development colleagues to ensure that maximisation of renewable energy development is seen as central importance to the economy and communities. Win-win solutions can be developed providing there is ongoing communication and an appreciation of each other's policy goals and aspirations. **Increasing the profile of renewable energy to an overarching policy priority** linked to Britain's Energy Coast proposals could provide substantial economic and environmental opportunities for Cumbria in to the future. In addition, the skills opportunities presented through the growth of the sector and its supply chains need to be fully optimised and it is recommended that **supply and demand mapping concerning skills and supply chain** are undertaken for the increased deployment of biomass, hydropower and microgeneration. Whist recognising the significant economic boost that can be provided through capitalising upon renewable energy opportunities, it is important to also acknowledge the importance of tourism to Cumrbia's economy and the role of the natural environment in attracting visitors. Therefore cumulative impacts and the consideration of landscape character must be taken into account with regards to the siting of individual developments.

8.8 Related to the above point, there is an identified **need to develop an ongoing co-ordinating group** working to raise the profile of renewable energy and ensure that future deployment is maximised, within environmental constraints, and that its benefits are fed back into local communities via the development of local supply chains, community schemes etc. The Cumbria Renewables Panel could potentially provide the vehicle.

8.9 Whilst there is already a **reasonably well developed planning environment** in place with regards to local policies and the wind SPD, there appear to be some concerns with regards to the interpretation and delivery of said policy. Reviewing the **consistency of interpretation and implementation of existing policies** including the Wind SPD across LPAs will help foster a more supportive environment for the deployment of renewable energy within Cumbria.

8.10 Due to the **landscape quality across Cumbria and prevalence of Protected Landscapes, we recommend that further work is undertaken** to fully understand and assess all of the impacts from a significant uplift in renewable energy deployment, particularly commercial scale wind:

- Identification of those special qualities of the Protected Landscapes that are likely to be particularly susceptible to the siting of wind energy developments within their setting. In this context, the most important of these special qualities are likely to relate to:
    - ➢ perceptions of tranquillity, remoteness and naturalness with turbines introducing uncharacteristic features into the landscape
    - ➢ important skylines where the backdrop to that skyline lines outside the Protected Landscape
    - ➢ small-scale landscapes, such as small-scale enclosures where large-scale developments could dominate the scale of the landscape.
- Identification of the Zone of Theoretical Visibility (ZTV) from locations within the setting of the Protected Landscape. Using a topographical model, the ZTV will identify where wind turbines of a set height within the setting of the Protected Landscape might be visible from the Protected Landscape, thereby identifying where the special qualities of the Protected Landscape might be affected.
- Assuming that there would be no commercial-scale wind (large, medium or small-scale turbines) in those parts of the setting where there is a likelihood that the special qualities of the Protected Landscape might be affected.

8.11 In order to **take the assessment of heat demand and potential for CHP developments further**, the following issues should be addressed:

- a review of new development in the region and its potential impact on CHP/low carbon development; that is, those sites which meet the defined threshold and would be most suited for the installation of CHP developments or district heating schemes
- a review of potential major waste heat sources in the area that could be captured to provide heat for other uses
- a review of potential anchor loads (defined as buildings or users with relatively large and constant head demand).
- a review of existing heat distribution infrastructure and any planned district heating systems in the county.