Cumbria Renewable Energy Capacity and Deployment Study

Final report to Cumbria County Council – annexes

July 2011

Contents

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Annex A: Review of sub-regional studies

Table A-1: Review of relevant methodologies from Cumbria and elsewhere:

Document	Summary	Detailed resource assessment? If yes then indicate the technologies covered	Geographical scope	Relevance to this study
Allerdale Borough Council Climate Change Strategy and Action Plan 2008-11	The Strategy sets out Allerdale's vision for a lower carbon future. It includes current activities and future plans.	No	Allerdale	Sections on energy, planning and community involvement are of particular relevance
Allerdale Borough Council, 2010. Renewable Energy in Allerdale (not adopted)	This study assessed the potential within Allerdale for renewable energy	Hydro Marine (tidal and wave) Wind (onshore and offshore) Biomass (undermanaged woodland, energy crops, animal biomass, MSW, C&I waste, landfill and sewage gases) Heat pumps Solar (PV, passive solar, solar hot water)	The area of Allerdale excluding the national park. Also covers areas offshore in the Solway Firth which require or may require infrastructure commitment within Allerdale,	This study assessed the possibility of large-scale hydro, unlike previous studies. It will be important to investigate if this is a viable option in the area. Not all of the calculations will be of relevance, for example, the biomass figure which is unrealistically high. Not based on any standard methodology.
Biomass Strategy for England's Northwest	The Biomass Strategy aims to increase biomass electricity and heat generation in England's Northwest from the 2009 level of around 1.5TWh per year to12.3TWh per year by 2020. The strategy analyses the regions current position and includes an action plan to address the key barriers to the deployment of biomass energy	Biomass	Northwest	The strategy focuses on interventions in the following priority sub-sectors where there is the greatest scope for the intervention at regional and sub-regional levels: • process industries • public sector and community buildings

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	through a series of interventions covering information and promotion, finance and funding, business support and public policies and planning. It also proposes the establishment of a Northwest Biomass Forum to coordinate the intervention of the strategy and monitor results			• commercial buildings • domestic boilers. It highlights that the region has substantial biomass fuel resources in the form of wood and organic/general waste, the largest wood processing sector in the UK, significant biomass R&D capabilities at the University of Cumbria, the impending construction of a major biomass and energy from waste plant, a large potential heat demand that could be converted to biomass. It concludes that in the Northwest by 2020 we will need to invest in: • 20 large scale biomass and energy-from-waste plants • 30 Medium/large scale organic waste digestion plants • 2,600 Biomass boilers for commercial and public sector buildings 30,000 domestic biomass boilers.
Carlisle Climate Change Strategy 2008-12	The Climate Change Strategy sets out Carlisle City Council's aims and objectives in terms of climate change targets and actions. Priority actions include reducing the Council's own emissions, ensure that the Council adapts to climate change and using the planning system in pursuit of 'a climate proofed Carlisle'.	No	Carlisle	Energy climate change policy and targets

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Cumbria Climate Change Strategy, 2008-2012	Sub-regional strategy intending to reduce greenhouse gas emissions and enable people, organisations and industry to adapt to unavoidable impacts of climate change. Strategy covers energy generation, housing and buildings, health, industry and commerce, natural environment, procurement, spatial planning, transport, waste and water.	No	Cumbria	Supports Cumbria LAA target to reduce carbon emissions by 210,000 tonnes pa, Current renewable energy generation in Cumbria is very small – 2007 – 81.5 MW of onshore wind operational or with permission to proceed, off shore wind adds another 288 MW (operational or planned), data for 2002 suggests small scale hydro and landfill gas add another 799kW and 3.1MW capacity respectively.
Cumbria Climate Change Action Plan 2009-2014	11 different action plans covering actions for Cumbria CC to undertake in the following areas: • Energy • Housing and Buildings • Health • Industry and Commerce • Natural Environment • Procurement • Spatial Planning • Transport • Water • Leadership and Communication	No	Cumbria	Sections on energy generation, natural environment and spatial planning in Cumbria.
Cumbria Vision 'The scope for renewable energy in Cumbria'.	This scoping study reviewed the various kinds of renewable energy in Cumbria and defined which of these resources were most appropriate in the County. The study assessed the theoretical potential of renewable	This is a guide which includes an examination of technologies, but it does not constitute a resource assessment Wind (onshore and offshore)	Cumbria	This study is relevant due to its examination of technologies, projections and recommendations for the expansion of renewable energy without degrading the

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	energy resource and then considered the geographic distribution, environmental, social, economic and infrastructure-related factors that may influence the utilisation of the resources. It stressed the need to strike a rational balance between the conservation of the Cumbria's assets and the development of renewable energy sources.	Hydropower Marine (tidal and wave) Solar energy Geothermal energy and heat pumps Biomass (municipal, sewage and industrial wastes, anaerobic digestion of farm wastes, woodfuel, energy crops)		environment.
Cumbria Wind Energy Supplementary Planning Document, 2007	The Cumbria Wind Energy SPD guidance is divided into two parts. • Part 1 – guidance on addressing environmental, social and economic effects when preparing wind energy proposals. • Part 2 – technical guidance on landscape capacity, landscape and visual effects and carrying out landscape and visual impact assessments.	No	Cumbria	The SPD includes an overview of the key issues that should be considered by developers when preparing their planning applications. Many of these issues such as the presence of nature conservation designations etc have been included in the proposed exclusion criteria outlined in Table 5.4. In relation to cumulative effects the SPD states that these can only be undertaken on a site by site basis in the light of existing baseline conditions, This Guidance does not stipulate separation distances or the number of schemes that might be accommodated in the County as these are likely to vary depending on the details of a scheme and the issue being considered, such as landscape character or nature conservation interest. The SPD contains guidance on the landscape sensitivity of specified

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				character types within Cumbria to wind energy developments of specified sizes and groupings. This information will be used with the findings of the resource assessment from this study to establish if is possible and appropriate to identify broad areas of search for wind energy developments. The landscape assessment does not cover the National Parks and this is an issue which will need further discussion with the steering group.
Duddon Estuary Tidal Energy Feasibility Study, 2010, Britain's Energy Coast – West Cumbria	An evaluation of the tidal energy potential of the Duddon Estuary to update a previous study commissioned by the DTI in 1994. The study included research on environmental impacts, costs, timeframes, and an appraisal of tidal technologies.	Tidal energy	Duddon Estuary on the West Cumbrian coast	The scale and timescales of the options will be useful for assessing resource in the estuary, especially the middle barrage option (B2) which is seen as the preferred option. Environmental impacts in the study can also be considered.
Economic Implications of Climate Change Legislation for Cumbria, 2008	The study investigates & provides conclusions & recommendations on the following issues: • Review of legislation, policies, regulation re: impact on Cumbria • Evaluation of potential interventions at sub-regional level • Establishes the carbon footprint for Cumbria and future monitoring • Identify economic opportunities from the new situation and	No	Cumbria	Interventions with most potential to meet climate change legislation and create economic impact identified as: • Attract a new nuclear power station and expand the electricity transmission grid capacity • Developing biomass and biogas supply chains based on woody wastes from under-managed woodlands and food and farm wastes • Develop microgeneration and local energy efficiency supply

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	challenges in responding to opportunities.			chains to take advantage of more low carbon buildings • Promote Cumbria as a 'Green Tourism Destination' • Provide more assistance to businesses especially SMEs to reduce their carbon footprints • Develop capacity to serve the emerging wave and tidal renewable sector.
Joule Centre funded research projects - North West Hydro Model. More information and its hydro resource evaluation tool is available at http://www.engineering.lancs.ac.uk/lureg/nwhrm/index.php .	This tool provides a step-by-step guide for users to evaluate the potential viability of a small-scale hydropower scheme based on a number of criteria including an economic assessment, physical characteristics, engineering options, environmental implications and public acceptability. It presents each criterion as a series of questions to explore the viability of a scheme.	The tool provides a detailed guide to evaluating potential at a particular site identified by the user. It does not explore the overall potential for the region or a county. The tool covers hydropower potential.	North West	This tool explores the range of criteria that will influence the viability of a scheme. It is therefore a useful reference source for the types of issues that may affect deployment of schemes beyond the purely technical considerations.
Joule research project - 'Tapping the Tidal Power Potential of the Eastern Irish Sea' further details and links at http://www.joulecentre.org/research/wet_renewables/Burrows%20summary.pdf, 2009	The project is concerned with marine energy in the form of tidal power specifically tidal barrages, and the complementarities of the UK's location for this source of energy. The project has involved examining the effectiveness of the different modes of operation of tidal barrages (flood flow, ebb flow and dual flow) at potential Northwest sites and assessing the performance of alternatives to barrages	Tidal power (tidal barrages)	Northwest, however two of the sites identifies are Solway Firth and Morecombe Bay in Cumbria	The findings of the study showed that the most beneficial mode of operation was ebb flow (delaying the exit of water from the estuary) and that there is the potential to produce 10% of the present UK electricity need, equivalent to 50% of the regions need, from sites in the Northwest via this method. The scheme would also have extensive flood risk benefits for the sub-region. The 0-D model found that the Solway Firth is able to produce 8.44 TWh/year in Ebb mode at a cost of

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				5.83 p/kWh and Morecombe Bay has the potential to produce 5.83 TWh costing 6.04 p/kWh. 2-D model found this to be higher at 9.66 and 5.98 TWh/year respectively
The Lake District National Park Authority hydro studies, 2009/10	An initial scoping study identified 55 potential sites for small-scale hydropower schemes within the LDNP. This desk-based assessment used a number of factors to rank the sites – including a simple payback time calculation. The top 10 sites were taken forward to a pre-feasibility study examining each site in terms of a number of considerations including hydrology, potential power output, cost and access issues, grid connection costs etc. A proforma for each site sets out the merits of each site and is summarised and ranked in terms of payback time.	Yes, although the initial assessment involved no site visits, phase two of the study involved a detailed assessment of the top ten sites in terms of their potential for small-scale hydropower schemes.	Lake District National Park	This study incorporates a number of factors relevant to small-scale hydropower development beyond the technical potential that has been evaluated in the NW study. It is recommended that the results of the EA hydropower study for the LDNP are compared to the detailed results of this study. The NW and proposed Cumbria methodology intend to examine all potential sites rather than the top performing sites, so it will be important to use the EA study findings, but interpret the results alongside the results of this detailed LDNP assessment.
Low Carbon and Environmental Goods and Services (LCEGS) Sector Strategy for England's Northwest, May 2010, NWDA	Strategy developed by the NWDA in partnership with businesses, universities & public sector partners to provide a framework for the development of the LCEGS sector in the region. It identifies the most significant opportunities for growth and defines where and how NWDA and its partners can add real value by promoting innovation and addressing market failure. The strategic framework provides a hierarchy of support based upon the relative level of regional priority with Smart Grids, Solid State Lighting and Tidal Energy being the top 3	No – concerned with economic potential of specific technologies and how best to support these financially and otherwise.	North West but includes sections on Cumbria. Identifies the sub-region's sector expertise as: • Offshore & submarine engineering capabilities important to offshore wind sector. Key ports of Barrow & Workington • Playing an active role in feasibility studies for a number of tidal projects • Promotion of the use of wood fuels and support of the	Relevant context and issues around financial & public sector support will be important in terms of development viability.

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	priorities.		biomass supply chain • Deployment of biomass, specifically focusing on community and off grid applications and realising the potential of Anaerobic Digestion • Cluster of photonics companies developing solid state lighting	
Marine Scotland – Draft Plan for Offshore Wind Energy in Scottish Territorial Waters, May 2010	Scottish targets 25% energy from renewable sources by 2020 & 50% electricity. Scotland contains up to 25% of Europe's offshore wind resource – major opportunity for economic growth. The draft plan (out for consultation) considers the potential of Scottish Territorial Waters (STW) to accommodate offshore wind energy developments from a national perspective with proposals for short/med/long term. Identifies exclusions, potential environmental sensitivities & technical issues in order to identify opportunities. Identifies short/med/ long term options & tests these against SEA objectives	Offshore wind	Scottish Territorial Waters	Over long term horizon, does not take account of wind speed (most of the area acceptable), water depth (new technologies may allow for floating structures in deeper water) or grid connection (various projects ongoing to improve grid connections) Includes Solway Firth (E.ON Climate & Renewables UK Development) & Wigtown Bay (Dong Wind (UK) Ltd) as short term options for offshore wind energy development – have Crown Estates exclusivity agreement.
Morecambe Bay: Innovation for Clean Energy Generation, BHA Annual Conference, Perth, 2007	The assessment of a proposal to construct an 18km bridge across Morecambe Bay (from Heysham in Lancashire to Barrow-in-Furness in Cumbria) which can be used to generate renewable energy.	Assessment of the potential of a 'green bridge' which has the following technologies: • tidal • wind • solar PV	Morecambe bay	The utility of the study for the current research resides in the assessment of potential tidal energy capacity at Morecambe Bay. As this proposal has not much progressed since the feasibility study of 2007, it is questionable whether this bridge could be constructed by

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		• passive tarmac. The study focuses on the tidal element of the green bridge.		2020 as is suggested, especially since economic viability has not been assessed.
Morecambe Bay Wildlife and Woodfuel Project, no date, Forestry Commission England	A feasibility study on the prospects for stimulating woodland management in order to contribute to combating climate change, enhancing biodiversity and providing sustainable opportunities for local business. Key actions were identified in order to stimulate woodland management.	Woodfuel resource from undermanaged woodlands	Morecambe Bay (south of Cumbria extending to the north to Windermere and the Cumbrian Low Fells and south to North Lancashire)	The area and yields for undermanaged woodland will be useful for the resource assessment, along with an estimate of the 'under-managed' woodland in the area.
NWDA Northwest Renewable and Low Carbon Energy Capacity and Deployment	The study involved applying the DECC methodology to quantify the accessible renewable resource. In addition, the impact of deployment constraints and economic viability from the view of the investor were also assessed, with deployment curves for a number of scenarios produced. The study found that Cumbria has a very large commercial scale wind resource (10,399MW or 44% of the Northwest's resource) but also extensive areas of designated land due to their landscape and environmental quality. Cumbria also had the largest sub-regional potential resource in terms of undermanaged woodland (plant biomass), wet organic waste (animal biomass) and small scale hydropower	Onshore wind Biomass (undermanaged woodland, energy crops, waste wood, animal biomass, straw, MSW, C&I waste, landfill and sewage gas, co-firing) Small scale hydropower Microgeneration (PV, solar hot water, ground and air source heat pumps)	North West region	The NW resource assessment is highly relevant, although the assessment for Cumbria will examine the appropriateness of the assumptions used to the Cumbrian context.

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RSPB Biomass and Birds Report 2008	This spatial planning guide identifies potentially sensitive bird species in terms of biomass schemes and highlights the main areas in the North West where they are found. The document is intended to map where further consideration of the ecological impacts for birds is required.	No, this is a guide for potential biomass energy development rather than a resource assessment itself.	North West	This guide is very relevant to the assessment of potential for biomass energy crops in Cumbria. Consideration will be given to the locations that have been identified as sensitive on the alert maps.
RSPB Cumbria bird sensitivity and wind mapping 2007	The output of this report is a series of maps which highlight areas known to support important populations of sensitive species. The maps are designed to be used as a guide to highlight specific areas of Cumbria which are potentially 'bird sensitive areas' in terms of wind farm development.	No, this is a guide for potential wind energy development rather than a resource assessment itself.	Cumbria	This guide is very relevant to the assessment of on-shore wind potential as it spatially identifies areas that are particularly sensitive to wind development that will influence the potential for this type of development in Cumbria.
RSPB Cumbria Peat and Wind Guide 2008	A Spatial Planning guide by RSPB, Natural England and Cumbria County Council to help industry meet renewable energy targets without proposals which would be environmentally damaging. The guide focuses on areas underlain by a deep peat resource which contain fragile habitats and lead to CO_2 releases if disturbed.	No	Cumbria	This guide is very relevant to the assessment of on-shore wind potential as it spatially identifies areas that are particularly sensitive to wind development that will influence the potential for this type of development in Cumbria.
RSPB mapping for birds in England 2009	This study provides mapped and written guidance to enable consideration of bird sensitivity to wind energy development. The study used GIS to assign each 1km grid square in England a sensitivity rating of high, medium or unknown in terms of bird sensitivity based on	No, this is a guide for potential wind energy development rather than a resource assessment itself.	England	This guide is very relevant to the assessment of on-shore wind potential as it spatially identifies areas that are particularly sensitive (in terms of bird species) to wind development that will influence the potential for this type of development

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	a number of criteria using existing mapped data on bird species. Areas of high and medium sensitivity are not identified as 'no-go' areas, rather areas where further discussion and consideration of the impact on bird species is required.			in Cumbria.
Scoping the potential for renewable energy generation on public lands in Northwest England, Forestry Commission	This study undertook an assessment of the potential for generation on the public forest estate as a catalyst to promote renewable energy (wind and hydro power) generation on public lands in England. Two GIS models were developed to estimate the potential wind and hydro capacity that might be generated on public land and these have been 'piloted' on the public forest estate in the North West and elsewhere in the UK.	Yes – onshore wind and hydropower	FC is working with the National Trust, United Utilities and the Lake District National Park to provide estimates on their lands across the north West	The study provides a resource assessment particularly focusing on public land and compares the FC methodology with the SQW DECC methodology. Particularly useful on practical constraints and activities being undertaken by public sector bodies to increase renewable energy generation.
Solway Energy Gateway Feasibility Study, December 2009, Halcrow Group Ltd., Mott MacDonald and RSK Group plc	Options for renewable energy generation on the Solway Firth were assessed for a long list of options. The options identified were developed, in terms of project size, technical specifications and feasibility, location, construction activities required, energy output and impacts on the environment. A financial model for the options was also developed, along with timescales for the delivery of the options. Future work is planned for the refinement of options.	A tidal resource assessment was carried out. The final options assessed included: • four barrage options • two lagoon options • three tidal reef options.	Solway Firth, an estuary forming the border between Cumbria and Dumfries and Galloway in Scotland	The options and their individual capacity will help to inform what practical resource potential Cumbria could have by 2020. The appraisals of the other technologies can also help inform the resource assessment, along with the data sources used, along with the methodologies for establishing energy output for tidal technologies. The environmental impacts mapped out in the study appendix will also be considered.

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South Lakeland District Council Carbon Management Programme – Carbon Reduction Plan	The plan focuses on how South Lakeland DC wishes to reduce its own carbon footprint and become more sustainable. The Council says its aim is to get its "own house in order before working with the wider community to take action on climate change".	No	South Lakeland	Limited relevance to study because of its focus on South Lakeland DC's own impact.
The Yorkshire Dales National Park Authority hydro study 2009	This assessment reviewed the potential at around 50 sites in the YDNP for small-scale hydropower schemes. This assessment identified the top 15 performing sites based on payback time and CO2 offset per year. These 15 sites were further reviewed by YDNP planners and the Environment Agency and a detailed site proforma has been produced for each site. The outcome shows that 13 of the sites have good potential with four of these being more straightforward and nine being more complex to deliver.	Yes, the assessment gives a thorough assessment of the sites identified as having the best potential for small-scale hydropower schemes.	Yorkshire Dales National Park	This study incorporates a number of factors relevant to small-scale hydropower development beyond the technical potential that has been evaluated in the NW study. It is recommended that the results of the EA hydropower study for the YDNP are compared to the detailed results of this study. The NW and proposed Cumbria methodology intend to examine all potential sites rather than the top performing sites, so it will be important to use the EA study findings, but interpret the results alongside the results of this detailed YDNP assessment.
4NW's Towards Broad Areas for Renewable Energy Study	This study undertook an assessment of the existing capacity, broad potential and constraints for renewable energy resources in the North West region. Two sets of estimates were made: a 'theoretical maximum' and a 'pragmatic' scenario. The 'theoretical maximum' scenario represents the upper limit to the potential in the region. It was based on the known resource availability in the region combined with	Biomass Energy from waste Sewage gas and sludge Hydro Onshore Wind Offshore renewables Microgeneration	North West region	The sub-regional assessments will be of most relevance to the current study, including any information on characteristic particular to Cumbria.

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	professional judgement on the significant factors are expected to constrain the deployment in practice. The 'pragmatic' scenario reflects the level of renewable energy generation that may be more likely to come forward in the period to 2020. The estimates were derived by use of GIS data and software.			

Source: SQW and LUC

Annex B: Revised technological assumptions

B.1 Below is the list of technologies, the identified datasets and sources through which to assess these, our assumptions and an explanation on how these differ from the North West study where appropriate.

Table B-1: Assumptions, data sources and data sets for all technologies

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
Onshore commercial-scale wind				
Wind Speed	NOABL	Included area with wind speed 5m/s at 45m above ground level (agl). A wind energy analyst was contracted to review the wind speed threshold assumption and it was concluded that 5m/s is an appropriate cut off point for viability, particularly considering that this study is looking at identifying potential up to 2030.	No divergence from assumptions used in NW Study.	
Turbine size	Local developer input on turbine dimensions.	Assessed potential for: • large- scale turbines (dimensions: tip height 125m, 2.5MW) • medium-scale turbines (dimensions: tip height 90m, 1MW) • small-scale turbines (dimensions: tip height 65m, 0.5MW)	NW methodology assumes a single standard turbine size with specifications: 2.5MW, tip height 135m, rotor diameter 100m, hub height 85m	
Wind turbine density	Steering Group	Assumed different densities for large, medium and small-scale turbines applied within the following zones:	NW study only had one turbine size, and new constraints are being introduced at the local level	
		General assumption in non-constrained	NW study did not specify a density	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		areas: • Large: 4 turbines per km2 • Medium: 10 turbines per km2 • Small: 20 turbines per km2. 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 km2 within protected landscapes. *Peat:* *[Peat data has not been received for this study]* *Areas outside of Protected Landscapes* The Cumbria Wind Energy SPD was used to refine the assumption of wind turbine densities outside of protected landscapes. The SPD rates the capacity of each landscape character area within Cumbria for wind energy in terms of high, medium and low. These ratings were used to inform the density of wind turbines applied to each landscape character area (outside of protected landscapes). A table summarising how the densities were revised from the general assumption in	within Peat areas due to lack of spatial data.	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		non-constrained areas is set out below:		
Wind turbine density	Steering Group	Assumed different densities for large, medium and small-scale turbines applied within the following zones: (All calculations have been undertaken in GIS and it was possible to disaggregate the results to Local Planning Authority level in GIS) *General assumption in non-constrained areas:* • Large: 4 turbines per km2 • Medium: 10 turbines per km2 • Small: 20 turbines per km2 *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 km2 within protected landscapes *Areas outside of Protected Landscapes* The Cumbria Wind Energy SPD was used to refine the assumption of wind turbine densities outside of protected landscapes. The SPD rates the capacity of each landscape character	NW study only had one turbine size, and new constraints are being introduced at the local level NW study did not specify a density within Peat areas due to lack of spatial data.	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		area within Cumbria for wind energy in terms of high, medium and low. These ratings were used to inform the density of wind turbines applied to each landscape character area (outside of protected landscapes). A table summarising how the densities were revised from the general assumption in non-constrained areas is set out below:		

Summary of % reductions to general wind turbines 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%

Non accessible areas	OS Strategi for Roads, OS Meridian for railways and rivers/inland waters, CAA website and additional research for airports, MOD, MasterMap Address Layer 2 for settlements, PRoW and Bridleways from CCC, Transmission lines from national Grid, OS data/developers/manufacturers for slope, Envirolink and RESTATS for existing wind farms	Exclude: -Roads (A, B, motorways) with an additional buffer based on carriage width to approximate the road footprint; -Rivers, canals: with an additional buffer based on size of river to approximate footprint; -Lakes, reservoirs: footprint from OS meridian data; -Airports: Use point data from CAA and internet research to locate airports; -MOD training areas: data requested; -Settlements based on point locations of properties from Address Layer2	For built up areas, the NW study used Urban area polygons with a buffer to exclude settlements. We used the Address Layer 2 database to refine this aspect. There are a number of constraints that are not included in the NW methodology that have been included in this study such as: overhead transmission lines, PROW, bridleways, slope and existing windfarms.	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		database -Transmission lines (including a buffer equal to topple distance +10%) -Public Rights of Way and Bridleways (including a buffer equal to topple distance +10%) -Slope was considered as a technical constraint. Discussions with developers indicated that 15 degree slopes were the maximum limit. It has not been possible to obtain data on the red line boundaries of existing wind farms, only point data exists, therefore this constraint has not been possible to apply.		
Exclusion areas	Natural England for Ancient woodland, English Heritage for historic interest sites, OS Strategi for Roads, OS Meridian for railways and rivers/inland waters, CAA website and additional research for airports, MOD, MasterMap Address Layer 2 for settlements, Consultation with NATS/NERL for Civil Air Traffic Control constraints, Consultation with MOD for training areas and safeguarded areas Conservation Areas, RIGGs from CCC, wildlife sites from County Ecologist	Exclude: -All ancient woodland (ancient semi-natural and PAWS) -National and international nature conservation designations - Local nature reserves, RSPB Nature reserves, Wildlife Trust Nature Reserves -sites of historic interest - Scheduled Monuments, Registered Parks and Gardens, World Heritage Sites (plus buffers), Battlefields, Listed Buildings (including a small buffer around Listed Building point data to generate a footprint to be excluded) -Conservation Areas -5km buffer around all airfields and	Topple distances were varied to match different turbine dimensions. Property buffers were varied according to turbine size and property type. Conservation Area data was not available. MOD/NATS/NERL/CAA data was not available for the NW study Peat GIS data was not available for the NW study Wildlife sites and RIGGs were not included in the NW study.	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		airports (military and civilian) -Consult with NATS/NERL to identify Civil Air Traffic Control constraints (particularly for Allerdale). Although there are still significant issues regarding visibility to the technical infrastructure, NATS/NERL consider 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. -High Priority Low Fly Zones, Safeguarding Zones, Danger Zones (MOD - Electronic Warfare Training Facility not included as the data is under review and may change and MOD advise that this is not a wind farm exclusion zone. Byelaws data not available in GIS.) -Consult with MOD for guidance on MOD constraints -Buffer around rail and roads related to topple distance of small, medium and large turbines (height + 10%) -Buffers around settlement locations (based on a point location for each address) which are varied according to type of address and turbine dimensions Large, medium turbines - 600m for residential buildings, 200m for		

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		commercial buildings and 200m for industrial properties Small turbines - 500m for residential buildings, 200m for commercial buildings and 200m for industrial properties -Wildlife sites (subject to availability from County ecologist); RIGGs County Wildlife Sites Local Nature Reserves RSPB reserves, Woodland Trust Reserves, County Wildlife Trust Reserves RSPB Flyway Conductivity areas, RSPB Goose/Swan/Hen Harrier sensitive areas		
MOD constraints	Consultation with MOD	Consulted MOD to determine constraints associated with their sites/estates/Air Traffic Control/radar/safeguarded areas/danger areas and MOD bylaws High Priority Low Fly Zones, Safeguarding Zones, Danger Zones (MOD - Electronic Warfare Training Facility not included as the data is under review and may change and MOD advise that this is not a wind farm exclusion zone. Byelaws data not available in GIS.)	MOD did not respond during NW study.	
Micro-scale wind				

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
Address points	OS Mastermap Address Layer 2	Identified all properties from OS masterrmap with greatest potential for small scale wind including: • Community, tourism and government office properties • Commercial and industrial properties • Isolated* residential properties outside of settlement boundaries *A density calculation was undertaken for the County on a 1km grid square basis. Residential properties (outside of settlement boundaries) were only considered if they were in a grid square with a density of five or less properties per square km. (All calculations have been undertaken in GIS and it was possible to disaggregate the results to Local Planning Authority level in GIS)	The assessment was opportunity led and focused on those property types that have the best potential. The NW study evaluated every property in the NW region.	
Wind speed	NOABL	Checked the properties identified as being opportune against minimum wind speed requirements (4.5m/s at 10m agl)	Wind speed was used to filter out unsuitable properties in the NW. It was used in the context of this study as a reality check for individual properties identified.	
Wind turbine size	NW study/DECC methodology	Applied assumption of 6kW per address	No divergence	
Exclusion areas	Conservation Areas from districts, Cultural Heritage designations from English Heritage	Excluded properties that are within Conservation Areas and other cultural heritage designations (both within and outside of protected landscapes)	Not in NW methodology. This is an additional assumption we propose.	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		A Listed Buildings density calculation was undertaken. Only properties that were in a grid square with 20 or less Listed Buildings per km2 have been included (both within and outside of protected landscapes).		
Mean wind speed scaling factor	DEFRA Rural-Definition (Output area level) Wind scaling factor: DECC methodology	Properties were further classified according to the DEFRA Rural-Definition at Output Area level to categorise them as rural, semi-urban and urban. Each suitable address point was assigned a wind speed and a ward type, and wind speed scaled according to ward classification. Include address points where scaled wind speed 4.5 m/s at 10m above ground level (agl). Assume scaling factor of 56% for urban, 67% for suburban, 100% for rural.	Not in NW methodology. This is an additional assumption we have included.	
Offshore commercial scale wind				
Current and potential capacity	Crown Estates European Wind Energy Association DECC 2010 Energy trends DECC Offshore Valuation	Based resource assessment on national studies of potential resource taking into account existing wind farms consented in Rounds 1 and 2: Barrow, Ormonde, Walney and Duddon	Not covered by North West Study	
Wave				
Current and potential capacity	Marine Renewable Energy Resources Atlas DECC and Crown Estates	Based resource assessment on national studies of potential resource	Not covered by North West Study	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
	EMEC (European Marine Energy Centre) Once available, Ernst & Young study 'Cost of & financial support for wave, tidal stream & tidal range generation'			
Tidal stream				
Current and potential capacity	Marine Renewable Energy Resources Atlas DECC and Crown Estates EMEC (European Marine Energy Centre) Once available, Ernst & Young study 'Cost of & financial support for wave, tidal stream & tidal range generation'	Based resource assessment on national studies of potential resource	Not covered by North West Study	
Tidal barrage				
Current and potential capacity	Tidal Power from the Solway Firth: barriers, impacts & capacity - BHA Annual Conference Proceedings (2007) Other tidal barrage studies – to be provided by local authorities if available	Local barrage feasibility studies assess options and their individual capacity helped to inform what practical resource potential Cumbria could have by 2020. The appraisals of the other technologies also helped inform the resource assessment, along with the data sources used, and the methodologies for establishing energy output for tidal technologies. The environmental impacts mapped out in the Solway study were also considered.	Not covered by North West Study	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
Plant biomass – undermanaged woodland				
Existing and potential feedstock	Forestry Commission data Consultation with Forestry Commission and Cumbria Woodlands Natural England Ancient Woodland	Yield classes (4 – broadleaved, 12 – conifers, 6 – mixed woodland) Assumed 1 cubic metre = 1 green tonne and a loss of 50% when converting green tones to oven dried tonnes. Retained NW assumptions regarding woodland under different management (i.e. FC managed – assume constant production for woodfuel, undermanaged and private woodland, assume 100% is potentially available – subject to restrictions listed under constraints) The amount of Ancient Woodland has been identified. (All calculations have been undertaken in GIS and it was possible to disaggregate the results to Local Planning Authority level in GIS)	GIS data were available for this study rather than as a spreadsheet in the NW study. This has enabled a spatial breakdown into protected landscapes and areas outside of protected landscapes. Ancient woodland has been identified in this study.	
Fuel requirement – electricity odt/MW	NW study	6000odt/year = 1MW	No divergence.	
Fuel requirement – heat odt/MW	Biomass Energy Centre and Forestry Commission, local research	18GJ/odt - Discussions with the FC in the NW suggested 18GJ/odt would be a good approximation. Plant conversion efficiency: 80%. Plant availability: 45%. Plant availability (capacity factor): 45% - Previous research has shown that the DECC methodology suggestion of 80% capacity factor is unrealistically high.	Same assumptions as NW study	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		(45% value provided by the Carbon Trust as typical capacity factor for service applications in CT (2009), Biomass heating a practical guide for potential users, pg 43)		
Exclusions of woodfuel potential	Forestry Commission statistics and consultation with Forestry Commission. Integrated Transport Network	Assumed 50% uneconomic to harvest: (it was initially proposed that GIS be used to estimate the accessibility of the resource in relation to the transport network, but it was felt by FC and Cumbria Woodlands, that it would not be possible to refine this assumption). Alternative markets: Assumed 8 % of FC timber will go to woodfuel markets. It was not possible to verify with the Forest District whether this figure was relevant to Cumbria.	The NW study applied necessarily broad assumptions regarding economic exclusion factors. No proposed changes to approach to alternative markets, but the percentage of FC timber going to woodfuel has increased between 2008 and 2009 (most current figure).	
Plant biomass – Energy crops				
Available land	Rural Payments Agency (RPA) or DEFRA Agricultural and Horticultural Census (2007 and/or 2009), DEFRA Energy Crop Opportunity Maps, Natural England	Assumed that energy crops are planted on all abandoned land and pasture, in addition to 10% of land in food production. Used GAEC12 land from the DEFRA Agricultural and Horticultural Census as a proxy for all abandoned land and pasture. Used Defra Agricultural and Horticultural Census for estimate of 10% of land in food production. Given the lack of spatial data, it was not considered appropriate to include	THE NW study also used data from the DEFRA Agricultural and Horticultural Census. The NW study also included a high scenario assuming that all arable land and pasture would be planted with energy crops. It was considered that this is unrealistic and therefore was not considered in Cumbria.	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		all existing energy crops as it was not possible to determine whether they were included in the estimates already. The 2007 National Parks Agricultural and Horticultural Survey has been used to approximate the proportion of the accessible resource that might be found within the two National Park Authorities. This has enabled the data to be disaggregated to Local Planning Authority level.		
Yield	NW study/DECC methodology	2030: -12.1odt/ha SRC -18.15 odt/ha miscanthus	No divergence (but scaled up to 2030)	
Crop type	Natural England	Used existing ratio of miscanthus: SRC from mapped Energy Crop Scheme data available in GIS. 18% miscanthus/82% SRC	Assumed a ratio of 9:1 (miscanthus: SRC) to estimate potential from each crop type	
Fuel requirement - electricity	NW study/DECC methodology	6000odt/year = 1MW	No divergence	
Fuel requirement - heat	NW study	Miscanthus: 17GJ/odt SRC: 18GJ/odt (Natural England: Planting and Growing miscanthus Best Practice Guidelines July 2007) Boiler efficiency: 80% Plant conversion factor: 45%	No divergence	
Exclusion areas	www.magic.gov.uk (Common Land,	-Exclude Common Land, SAC, SPA,	For the NW study, many of the mapped	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
	nature conservation designations and potentially grassland/pasture – see assumptions); Local Authorities (PROW); English Heritage; Field margin calculator (LUC) for generating assumptions for SPS cross-compliance buffers; Natural England (Peat, priority habitats) Cumbria Wildlife Trust	Ramsar, SSSI, NNR, Ancient Woodland, World Heritage Sites, Listed Buildings (with small buffer for point data as per commercial scale wind constraints), Scheduled Monuments, Data limitations meant that it was not possible to remove the exclusion areas (as per the DECC methodology). Discussions with Natural England concluded that a pro-rata reduction to the available land be made based on the level of constraint within the local authority area (eg if 50% of the land in a local authority area is constrained by nature conservation and cultural heritage designations then a 50% reduction would be applied to the available land). The exclusions considered in this percentage reduction included Common Land, SAC, SPA, Ramsar, SSSI, NNR, Ancient Woodland, World Heritage Sites (and buffers), Listed Buildings (with small buffer for point data as per commercial scale wind constraints), Scheduled Monuments, Battlefields, Parks and Gardens, County Wildlife Sites, Woodland Trust Reserves, RSPB Reserves, Wildlife Trust Reserves. No data were available for Limestone Pavement Orders. Protected Species/habitats data has not been included. It has been assumed that the Agricultural and Horticultural Census figure for bare/fallow land excludes all	datasets were not available – including PROW and the Rural Land Register. Peat data were not available.	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		permanent pasture. -PROW and buffers have not been excluded at this stage (PROW data for LDNP not yet available); It was initially proposed to apply a percentage reduction on the total land areas to account for SPS cross-compliance buffers, but due to a lack of spatial data, this reduction has not been applied.		
Competing/ conflicting land use	DEFRA Agricultural and Horticultural Census and Rural Land Register. NE Regional Biomass Active Demand Mapping Project (2007) Agricultural Expert Consultation with Centre of Renewable Energy (CORE), Strawson's Energy	Strawson's Energy was contacted to discuss price volatility and potential impacts and to refine additional areas assumption for land with potential for energy crops, but no further information has been provided to generate this assumption.	Competing/conflicting land use was not considered in the NW study. We propose to consult relevant organisations that were not contacted during NW study to inform the assessment. The NE Regional Biomass Active Demand Mapping Project (2007) will be reviewed for relevance to this assessment.	
Environmental impacts	Consultation with Natural England, Environment Agency, Centre of Renewable Energy (CORE), Strawson's Energy RSPB	RSPB data on energy crops and bird sensitivity for Cumbria was sought, but is only available at a charge, and given the lack of spatial specificity for this assessment, it has not been purchased. Lack of spatial data also meant that it has not been possible to apply any assumptions to the results to account for farmland birds and potential water stressed areas.	NE was not able to provide comments regarding protected areas during the timescale of the NW study. This was also due in part to lack of spatial data to accurately map the potential resource. CORE was not consulted during the NW study. RSPB maps were not considered during MW study.	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
Assumptions for plant biomass – waste wood				
Existing and potential new feedstock	WRAP (2009) Wood Waste Market in the UK	All wood waste used except for MSW which has already been accounted for within other technologies The data were disaggregated to arrive at figures for Local Planning Authorities including National Parks based on the employment numbers in each LPA. For future additional feedstock-apply and increase of the existing feedstock of 1% per year	Regional WRAP data used with the identified assumptions specific to Cumbria The local authority figures were determined using a proxy of employee numbers in each local area to estimate the proportion of the regional waste wood figure in each area.	
Fuel requirement	No Cumbria specific data sources required	Benchmark of 6,000 odt/year per 1MW for electricity. For heat apply standard calorific values	Same assumptions used	
Available feedstock	No Cumbria specific data sources required	Assume 50% of resource is available	Same assumptions used	
Plant biomass – Agricultural arisings (straw)				
Existing feedstock	DEFRA Agricultural and Horticultural Survey (2007 and/or 2009)* Farm Managers Pocket Book	Introduce local factors to reflect local situation: • 3 tonnes per ha of wheat and winter barley; • 2 tonnes per ha of spring barley; • 1.2 tonnes per ha of oil seed rape The 2007 National Parks Agricultural and Horticultural Survey has been used to approximate the proportion of the accessible resource that might be	Biomass Energy Centre factors used in NW study: • 3.5 tonnes per ha of wheat; • 1.5 tonnes per ha of oil seed rape NW used wheat and oilseed rape straw only. Spring barley introduced, but will be discounted due to competing use for animal feed in next stage. It is felt that it is useful to reflect the potential albeit it is discounted due to competing	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		found within the two National Park Authorities. This has enabled the data to be disaggregated to Local Planning Authority level.	demands.	
Fuel requirement	DECC methodology and local research	Electricity only – 6000t of baled straw per 1MW capacity	No divergence	
Available feedstock	DEFRA Agricultural and Horticultural Survey (2007 and/or 2009)*; Local research	Competing demands: • Animal bedding: 1.5 t of straw per annum per head of cattle (or 50% total straw – whichever is the lower figure) • Animal feed – 100% of spring barley used for animal feed Supplement this assessment with local research into competing uses.	Additional local research is proposed to identify additional competing uses.	
Animal biomass - Wet organic waste				
Existing feedstock	DEFRA Agricultural and Horticultural Census (2007 and 2009); Biomass Energy Centre Environment Agency – Northwest Commercial and Industrial Waste Survey, 2009 ONS number of Active Enterprises Local research John Nix Farm Managers Pocketbook Reiver Renewables provided the	Used data on livestock numbers multiplied by manure factor: • Dairy cattle – 19.3t/animal/yr • Beef cattle – 10.6t/animal/yr • Cattle 1-2 yrs – 9t/animal/yr • Calves – 3.7t/animal/yr Assumed cattle are higher yield breeds in Cumbria and will be housed for: • Dairy cattle – 60% of the	NW applied standard manure factor for all cattle. Assumed cattle are higher yield breeds in Cumbria. NW assumptions: Cattle: 9.6t/animal/yr No divergence for pigs NW study did not include grass and silage. Data was verified by local research.	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
	following sources DEFRA Report AET/ENV/R/2104 Scottish Agricultural College "Best Practice" figures DEFRA Project WQ 0133 2009 (dry matter content accepted norm for Big Scale Silage)	year • All others – 50% of the year Investigated number of agricultural businesses and area of agricultural land alongside stock numbers, but did not build this into the assessment. Assumed only breeder and fattener pigs used to derive total slurry produced by pigs, both of which will be housed for 50% of the year. Used data on pig numbers multiplied by manure factor: • Breeder pigs: 2.37t/pig/year • Fattener pigs: 1.1 t/pig/year For food and drink waste: used data for food (the food, drink and tobacco and retail and wholesale sectors, animal and vegetable and non-metallic waste only) Included grass and silage as potential feedstock Reiver Renewables were consulted and have provided a method of estimating grass and silage potential based the assumption that the available grassland can be managed to achieve a level of silage production that will feed every bovine in Cumbria very well - but if the cattle are fed not so well (but enough to remain as productive) the spare silage can be diverted into AD. Used data from Agricultural and Horticultural Census with the following		

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		assumptions: • Dairy cattle: 264 (min)/348 (max) kg/animal;/housed month (housed 8 months) • Beef cattle: 168 (min)/240 (max) kg/animal;/housed month (housed 6 months) • Cattle 1-2yrs: 105 (min)/144 (max) kg/animal;/housed month (housed 6 months) • Calves: 57 (min)/78 (max) kg/animal;/housed month (housed 6 months) 35% Dry matter content The 2007 National Parks Agricultural and Horticultural Survey has been used to approximate the proportion of the accessible resource that might be found within the two National Park Authorities. This has enabled the data to be disaggregated to Local Planning Authority level.		
Biogas yield	UK National Non-Food Crops Centre (NNFCC) (as per DECC methodology)	N/A – biogas yield has not been calculated (although tests were run using the NNFCC/Anderson calculator)	NW applied standard manure factor for all cattle. Assumed cattle are higher yield breeds in Cumbria. NW assumptions: Cattle 25m3/t, Pigs 26m3/t, food and drink 46m3/t NW study did not include grass and silage. Data was verified by local research.	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
Feedstock requirement	NW study/DECC methodology	Applied benchmark of 37,000 tonnes of wet organic waste required per 1MW capacity per year	No divergence	
Limits to extraction	NW study/DECC methodology	Assumed collectable portion of cattle and pig manure is reduced as they are housed for the following percentages of the year: Dairy cattle: 60% Beef cattle: 50% Cattle 1-2yrs: 50% Calves: 50% Breeder pigs: 50% Other pigs: 50%	NW study assumed 80% limit to extraction	
Competing uses	NW study/DECC methodology	For manure and slurry: assumed 100% of resource is available for energy For food and drink: assumed 50% of total resources is available for energy	No divergence	
Hydropower (large scale)				
Current and potential capacity	Cumbria Vision Lancaster University Renewable Energy Group Consultation with energy industry.	Consultation with the Environment Agency regarding existing/proposed schemes & overview of current documentation re: likelihood of deployment	Not covered by North West Study	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
Hydropower (small scale)				
Hydropower opportunities	'Mapping Hydropower Opportunities in England and Wales' (2009) LDNP and YDNP hydropower assessments	Disaggregated hydropower opportunities as defined by the EA hydropower study by County and Local Authority. Barrier opportunities have been presented as those identified as 'win-wins' in the EA study. (All calculations have been undertaken in GIS and it was possible to disaggregate the results to Local Planning Authority level in GIS) For National Parks (where local assessments have been undertaken), the results of both analyses have been considered.	We were advised that the dataset used in the NW study has been revised. This assessment is based on the updated study results. The NW study did not consider the National Park assessments.	
Animal biomass - Poultry litter				
Existing and potential new feedstock	DEFRA Agricultural and Horticultural Census (2007 and/or 2009)*; Biomass Energy Centre LUC Agricultural Expert	Used data on poultry numbers and excreta factor per head of poultry. Undertook research on whether other birds (ie layers) in addition to broiler birds should be included. Concluded that they should not be included as it is uneconomic to obtain litter/ excreta from laying hens. Excreta factor: • 16.5 tonnes per annum per 1000 broiler birds The 2007 National Parks Agricultural and Horticultural Survey has been used to approximate the proportion of the accessible resource that might be found within the two National Park	No divergence	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		Authorities. This has enabled the data to be disaggregated to Local Planning Authority level.		
Feedstock requirement	NW study/DECC methodology	Applied benchmark of 11,000 tonnes of poultry litter required for 1MW capacity per annum	None	
Available feedstock	NW study/DECC methodology	Assumed 100% of the resource is available for energy	None	
Municipal Solid Waste				
Existing and potential new feedstock	Defra WasteDataFlow Local waste management authorities	Use data from waste collection only then assume biodegradable fraction is 68% of total MSW The data were disaggregated to arrive at figures for Local Planning Authorities including National Parks based on the population numbers in each LPA.	The same assumptions were used for existing feedstock.	
Feedstock requirement	No Cumbria specific data sources required	Benchmark of 10 kilo tonnes of MSW required for 1 MW capacity per annum applied.	Same assumptions used	
Commercial and industrial waste				
Existing and potential new feedstock	Environment Agency's North West of England Commercial and Industrial Waste Survey 2009 Local authority data sources?	Animal and vegetable waste and non-metallic waste only are included in the calculation. The data were disaggregated to provide figures for Local Planning Authorities including National Parks based on the employment numbers in	Same data sources and assumptions for the Cumbria-wide assessment.	For more detailed local assessments, other sources will need to be obtained disaggregating C&! waste sources by type

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		each LPA.		
Feedstock requirement	No Cumbria specific data sources required	Apply a benchmark of 10 kilo tonnes required for 1 MW capacity per annum.	Same assumptions used	
Landfill gas				
Available resource	OFGEM RO Register	All 'live' landfill sites in the Cumbria from the OFGEM RO register	Same assumptions used	
Lifetime of resource	Local landfill companies	Future resource based on landfill sites and their age	NW study used general UK assumptions based on BERR waste forecasts.	
Sewage gas				
Available resource	OFGEM RO Register	All 'live' sewage gas sites in the Cumbria from the OFGEM RO register	Same assumptions used	
Potential new resource	DECC (2010) Renewable electricity in Scotland, Wales, Northern Ireland and the regions of England in 2009. Defra (2002) Sewage Treatment in the UK: UK Implementation of the EC Urban Waste Water Treatment Directive. Parliamentary Office of Science and Technology (2007) Postnote: Energy and Sewage.	The assessment was based on population numbers in each district 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 per cent of the total dried solids) can produce 490m3 of biogas in an anaerobic digestion plant. Of this, only the methane in the biogas can be used to generate energy (62.5% was applied - the mean of 60 to 65 per cent of the total biogas). It has been assumed that 11.04kWh of power output can be produced per cubic metre of methane. This was then converted to an energy	The NW assessment was based on the list of accredited stations on the OFGEM Renewable Obligation register. There are currently no accredited stations which generate energy using sewage gas in Cumbria so 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. A new methodology was therefore introduced based on population.	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		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 Local Planning Authorities including National Parks based on the population numbers in each LPA.		
Cofiring				
Current and future available plant	DUKES inventory of coal and oil-fired plants OFGEM RO Register	Assume that no major coal-fired power plant is to be built using co-firing with biomass	Agreement that potential for co-firing unlikely in Cumbria – study does not propose to investigate this further	
Geothermal				
Potential capacity	British Geological Survey and DECC.	Initial review of documentation has not provided much insight – further investigation to be undertaken	Very little information available so assessment inconclusive	
Microgeneration – Solar PV building integrated				
Existing roof space	OS MasterMap Address Layer 2 HEED online database for existing scheme information Met Office/United Kingdom Solar Radiation Map	Assumed 25% of all domestic properties including flats; 40% of commercial properties; 80% of industrial buildings.	None	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		The HEED online was used to explore schemes in Cumbria and the potential based on property type, but the results were inconclusive. (All calculations have been undertaken in GIS and it was possible to disaggregate the results to Local Planning Authority level in GIS)		
Potential new roof space	Local Authority and National Park housing proposals (including dwelling mix)	Assumed NW study assumes 50% new roofs suitable The HEED online was used to explore schemes in Cumbria and the potential based on property type, but the results were inconclusive. It is recognised that the Steering Group feel that this figure is too high.	None	
System capacity	NW study with additional local research based on the EST HEED online database.	Assumed: Domestic properties: 2kW Commercial properties: 5kW Industrial: 10kW The HEED online was used to explore schemes in Cumbria and the potential based on property type, but the results were inconclusive.	No divergence	
Exclusions		Excluded properties within conservation areas A Listed Buildings density calculation was undertaken. Only properties that were in a grid square with 20 or less Listed Buildings per km2 have been included (both within and outside of		

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		protected landscapes).		
Solar PV Farms				
Opportunities	http://re.jrc.ec.europa.eu/pvgis/ OS Panorama data	Solar irradiation threshold (>800 kWh/kWpeak) . It was not possible to do a county wide assessment of this, but based on sample testing, it is assumed that unless constrained by aspect, all areas in Cumbria theoretically receive this amount of solar irradiation, albeit on the very lower limit of viability. Using GIS and Panorama height data, a digital terrain model was built and all slopes facing west through south to east were excluded.	N/A not included in NW study	
Constraints	OS Panorama data Natural England English Heritage *Cowherd, C (1990) Control of Fugutive and Hazardous Dusts (pollution Technology Review, No 192) Noyes Publication Forestry Commission Ordnance Survey DEFRA Cumbria CC National Grid	Using GIS and Panorama height data, a digital terrain model was built and all slopes facing east through north to west were excluded. Excluded all slopes greater than 15 degrees Excluded protected landscapes and heritage and nature conservation designations. Excluded roads and railways, developed areas (settlements) Excluded Grades 1 and 2 Agricultural Land Use Consultants Excluded Flood Risk Zones 2 and 3 Excluded woodland due to shading potential	N/A not included in NW study	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		Excluded minerals sites with a 250m buffer due to shading caused by dust (Research has shown that 98% of airborne dust settles within 250m of the emission source*) Excluded Registered Common Land Research showed that preferred sites would be located within a maximum of 5km from a 33kV substation. No National Grid substations of this voltage were identified in Cumbria and information on substations under other ownership was not available.		
Microgeneration – solar water heating				
Existing roof space	OS MasterMap Address Layer 2 HEED online database for existing scheme information OS Panorama data Met Office/United Kingdom Solar Radiation Map	Included: 25% of all domestic properties including flats The HEED online was used to explore schemes in Cumbria and the potential based on property type, but the results were inconclusive. (All calculations have been undertaken in GIS and it was possible to disaggregate the results to Local Planning Authority level in GIS)	No divergence	
Potential new roof space	Local Authority and National Park housing proposals HEED online database for existing scheme information	Assumed 50% new roofs suitable. The HEED online was used to explore schemes in Cumbria and the potential based on property type, but the results were inconclusive. It is recognised that the Steering Group feel that this figure	No divergence	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
		is too high.		
System capacity	NW study with additional local research based on the EST HEED online database.	Assumed: The HEED online was used to explore schemes in Cumbria and the potential based on property type, but the results were inconclusive.	No divergence	
Microgeneration – Solar PV infrastructure (e.g. motorways)				
Potentially suitable highways	OS motorway data Consultation with Highways Agency (HA) and Mouchel (HA Asset Management)	Consulted HA and Mouchel regarding potentially suitable motorway routes that could accommodate solar PV adjacent to the motorway within Cumbria. Provided with information on noise barriers that may be suitable for solar PV. Assumed that only East/westbound barriers have potential due to orientation. Assumed installed capacity in line with only UK scheme on M27.	Not included in the NW study.	
Heat pumps (air and ground source)				
Existing building stock	Address Layer 2 data allocated to tyoe of use using National Land Use Database (NLUD) codes Off-grid properties – Centre for Sustainable Energy (Identifying and Quantifying the Prevalence of Hard to Treat Homes, 2006)	For domestic 100% of all off-grid properties, for the remaining stock 75% of detached and semi-detached properties, 50% of terraced properties and 25% of flat	Same assumptions used – all data provided	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
	ONS census data and local authorities (for property type data)			
New developments	New housing figures obtained from RSS and consultation with LPAs	50% of all new build domestic properties	Same assumptions used – all data provided	
System capacity	No Cumbria specific data sources required	Domestic -5kw and Commercial - 100kW	Same assumptions used	
Heat pumps (water source)				
Existing building stock	Address Layer 2 data allocated to type of use using National Land Use Database (NLUD) codes Consultation with the Heat Pump Association and manufacturers Ordnance Survey Lakes and rivers/canals	Include all Commercial, Industrial, Community properties that are within 250m of a lake, canal or river. *[GIS data for aquifers was only available after the assessment had been completed and have therefore not been accounted for].* Of these properties, assume 10% might be suitable. Exclude residential properties (this does not imply that the technology is not suited to residential/domestic use, rather that consultation has shown that it is best suited (at the moment) to larger installations) *[Consultation received after the assessment had been completed indicated that some residential properties would have potential and this potential should not be excluded.]* (All calculations have been undertaken in GIS and it was possible to disaggregate the results to Local Planning Authority level in GIS)	No assessment in NW study	

Parameters	Cumbria data sources	Cumbria assumptions	Comments on how Cumbria assumptions differ from assumptions used in North West Study	Additional comments
New developments	New commercial and industrial property projections (SQW)	Of the 10% of new commercial and industrial properties, include a percentage equal to the existing % of properties within 250m of waterbodies	No assessment in NW study	
Exclusions	Consultation with the Heat Pump Association and manufacturers Natural England	Exclude properties within 250m of a waterbody that are additionally within 250m of an SAC/SPA/Ramsar site or SSSI.	No assessment in NW study	
System capacity	Consultation with the Heat Pump Association and manufacturers Renewable Heat Incentive	Commercial and Industrial-100kW	No assessment in NW study	
Combined Heat and Power (large scale)				
Heat demand (current)	National Indicator 185 EPC Register/Display Energy Certificate dataset	Methodology developed based on heat mapping & heat density using sub-national gas consumption statistics	Not covered by North West Study	
Potential heat demand	SHLAA (strategic housing land availability assessment) GIS dataset Non-residential pipleline GIS dataset	GIS data required for LPA owned buildings for heat mapping	Not covered by North West Study – all data provided	
Heat supply	Spatial dataset representing existing district heating systems if available DECC's power station, EU ETS and CHP databases Other local sources?	Existing deployment analysis	Not covered by North West Study	

Annex C: References

C.1 The following documents have been consulted during the course of the study:

- Allerdale Borough Council's draft renewable and low carbon evidence base, 2010
- Allerdale Climate Change Strategy, 2008-11
- Arnside and Silverdale Area of Outstanding Natural Beauty Management Plan (2009)
- Biomass Strategy for England's Northwest, 2009
- Carbon Trust, Biomass Boilers: A practical guide for potential users, 2009
- Carlisle Climate Change Strategy, 2008-12
- Cumbria Biodiversity Evidence Base, 2010, web resource
- Cumbria Climate Change Action Plan, 2009-14
- Cumbria Climate Change Strategy, 2008-12
- Cumbria Historic Landscape Character Assessment (2009) GIS plus guide
- Cumbria Historic Landscape Character Guidance and Toolkit (draft 2010) and GIS
- Cumbria Strategic Housing Land Availability Assessment
- Cumbria Strategic Housing Market Assessment (2009)
- Cumbria Vision 'The scope for renewable energy in Cumbria', 2009
- Cumbria Wind Energy Supplementary Planning document, 2007
- DCLG Household projections by district, England, 1991-2033
- DECC, 2010, Renewable electricity in Scotland, Wales, Northern Ireland and the regions of England in 2009.
- DECC Renewable and Low-carbon Energy Capacity Methodology: methodology for the English regions, 2010
- Defra, 2002, Sewage Treatment in the UK: UK Implementation of the EC Urban Waste Water Treatment Directive.
- Duddon Estuary Tidal Energy Feasibility Study, 2010
- Economic Implications of Climate Change for Cumbria, 2008
- Emerging and adopted Renewable Energy policies for all districts (various)
- Envirolink Northwest and Arup Survey of planning applications for renewable energy in the Northwest, 2010

- Envirolink North West Planning and renewable energy study (to be published November 2010)
- Envirolink Northwest's Biomass Strategy for England's Northwest, Summary Report, 2010.
- Environment Agency (Urban Mines) North West England Commercial & Industrial Waste Arisings Survey 2009
- Forestry Commission A Woodfuel Strategy for England, 2007
- Joule Centre funded research projects – North West Hydro Model, 2008
- Joule research project 'Tapping the Tidal Power Potential of the Eastern Irish Sea', 2008
- The Lake District National Park Authority hydro studies, 2009/10
- LA operations CO_2/NO_2/PM10 emissions, 2008/9
- Low Carbon and Environmental Goods and Services (LCEGS) Sector Strategy for England's Northwest, May 2010, NWDA
- Marine Scotland Offshore Wind Plan, 2010
- Morecambe Bay: Innovation for Clean Energy Generation, 2007
- Morecambe Bay Wildlife and Woodfuel Project (no date specified)
- Natural England Wind Energy Policy Statement, 2009
- North Pennines AONB Building Design Guide (2010)
- North Pennines AONB Planning Guidelines (2010)
- NWDA Low Carbon Goods and Services Strategy, 2010
- NW Renewable and Low Carbon Capacity and Deployment Study, 2010
- ONS Annual Business Inquiry Employee Job estimates, Public/ Private sector by LA, 2003-2008 (excluding employee jobs in farm agriculture), 2009
- ONS 2008-based subnational population projections by sex and quinary age, 2010
- ONS Mid-year population estimates 2009: 24/06/10 (experimental), 2010
- ONS Mid-2009 Population Estimates for National Parks in England and Wales by Quinary Age and Sex.
- ONS 2008-based Subnational Population Projections, 2010
- Ofgem Renewables and CHP Register, Accredited Stations

- Parliamentary Office of Science and Technology (2007) Postnote: Energy and Sewage.
- Potential Future Housing and Employment growth data, Cumbria (various)
- RSPB Biomass and Birds Report, 2008
- RSPB Cumbria Bird sensitivity and wind mapping, 2007
- RSPB Cumbria Peat and Wind Guide, 2008
- RSPB Mapping for birds in England 2009
- Scoping the potential for renewable energy generation on public lands in Northwest England, 2009
- Solway Energy Gateway Feasibility study, 2009
- South Lakeland Carbon Reduction Plan, 2010
- The Management Plan for the Lake District National Park 2010-2015 (2010)
- The Solway Coast Area of Outstanding Natural Beauty Management Plan 2010-2015 (2010)
- The Yorkshire Dales National Park Authority hydro study, 2009
- The Yorkshire Dales Today and Tomorrow 2007-2012: Yorkshire Dales National Park Management Plan (2007)
- Waste Data Flow, Municipal Waste Statistics - Local Authority data 2008/09
- WRAP Wood Waste Market in the UK, 2009
- 4NW's Towards Broad Areas for Renewable Energy Study, 2008

Annex D: Consultees

D.1 Representatives from the following organisations were consulted in the course of this study. We are extremely grateful to all who have provided information, advice and guidance.

Table D-1:

Consultee organisation	Issues consulted upon
Allerdale Borough Council	All as member of Steering Group plus specifically on qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership. Attendance at focus group and specific guidance on Protected Landscapes.
Arnside and Silverdale AONB	Attendance at focus group and specific guidance on Protected Landscapes.
Britain's Energy Coast	Energy demand
Carlisle City Council	All as member of Steering Group plus specifically on qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership. Attendance at focus group.
Copeland Borough Council	All as member of Steering Group plus specifically on qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership. Attendance at focus group.
Country Landowners' Association	Attendance at focus group.
Coriolis Energy	Windspeed and slope considerations for commercial-scale wind
Cumbria County Council	Client – consulted on all elements throughout the study.
Cumbria Woodlands	Plant biomass constraints and opportunities. Attendance at focus group.
Cumbria Wildlife Trust	Local wildlife and nature conservation considerations for a range of technologies. Attendance at focus group.
Eden District Council	All as member of Steering Group plus specifically on qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership. Attendance at focus group.
Electricity North West	Grid/transmission constraints
Envirolink	Qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership. Attendance at focus group.
Environment Agency	Qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership. Attendance at focus group.
Eon	Qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership
Fells Wind Group	Attendance at focus group.
Forestry Commission	Plant biomass constraints and opportunities
Friends of the Lake District	Specific guidance on Protected Landscapes
Heat Pump Association members	Advice on issues associated with water source heat pumps
Highways Agency and Mouchel	Advice on solar PV infrastructure

Consultee organisation	Issues consulted upon
Hyperion Associates LLP	Advice on issues associated with Solar PV farms
Invest Cumbria	Energy demand and biomass industry
Lake District National Park Authority	All as member of Steering Group plus specifically on qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership. Specific guidance on Protected Landscapes.
Lightsource Renewables	Advice on issues associated with Solar PV farms
MOD	Aviation and military considerations for wind development
National Farmers Union	Advice on poultry litter considerations
NATS/NERL	Aviation and radar considerations for wind development
Natural England	Nature conservation considerations for a range of technologies and specific guidance on Protected Landscapes.
Npower Renewables	Qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership
Persimmon Homes	Qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership
Reiver Renewables	Provided expertise in developing the methodology used to calculate potential from Anaerobic Digestion
Renewable Energy Systems	Qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership
Renewable UK	Qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership
RSPB	Attendance at focus group
Shanks	Qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership
South Lakeland District Council	All as member of Steering Group plus specifically on qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership. Specific guidance on Protected Landscapes.
Story Homes	Attendance at focus group
Sunrise Renewables Barrow Dock	Qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership
Thomas Armstrong	Qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership
Trotters Quarry	Qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership
United Utilities	Qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership
Upland AD	Qualitative constraints – economic, supply chain, technological, grid constraints, planning, political, community ownership
West Lakes Engineering	Attendance at focus group.
Yorkshire Dales National Park	Specific guidance on Protected Landscapes

Source: SQW and LUC

Annex E: Installed and pipeline renewable energy capacity in Cumbria

E.1 The following table provides a summary of installed renewable energy capacity, plus that which is "in the pipeline" (in MW capacity) in Cumbria by LPA. This information has been obtained from the following sources:

- Renewable Energy Planning Database (REPD)
- Renewable UK database on windfarms
- British Hydropower Association
- Envirolink Survey of Planning Applications for Renewable Energy in the North West
- Ofgem Register – Feed In Tariff Central FIT register
- Cumbria County Council, Allerdale Borough Council, Carlisle City Council, Copeland Borough Council, Eden District Council and South Lakeland District Council, Lake District National Park, Yorkshire Dales National Park

Tables E1 - E8 provide a summary of existing renewable energy deployment categorised by technology type. There are other small-scale wind, solar hot water, PV and ground and air source pumps operational within the county. However, there is a lack of information available on these schemes, as many are deemed permitted development and thus do not require planning permission. Therefore, it is likely that there are additional microgeneration installations, over and above those captured by the FIT register.

The data for installed and potential renewable energy capacity was correct at 31 March 2011.

Commercial scale wind (onshore)

Table E-1: Commercial wind (onshore):

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
Oldside Wind Farm	5.4	Oldside Wind Farm, Workington	Allerdale	Operational	REPD / RenewableUK
Lowca Wind Farm	4.7	Lowca, Near Workington, Cumbria	Copeland	Operational	REPD
Haverigg Repowering (Haverigg II)	2.4	Kirksanton Airfield, Haverigg, Millom	Copeland	Operational	REPD / RenewableUK
Haverigg III	3.4		Copeland	Operational	RenewableUK
Far Old Park Farm Wind Farm	4.6	Land North East of Far Old Park Farm, Ireleth, Askam-in-Furness	Barrow-in-Furness	Operational	REPD
Siddick Wind Farm	4.2	Siddick Wind Farm, Siddick, Workington	Allerdale	Operational	REPD
Great Orton and Great Orton Wind Farm (Extension)	4.0	Great Orton Airfield, near Wiggonby, Carlisle	Allerdale	Operational	REPD / RenewableUK
Eastman Chemicals, Workington	4	Eastman Chemical Workington Ltd, Siddick, Workington, CA14 1LG	Allerdale	Operational	REPD
Lambrigg Wind Farm	6.5	Lambrigg Fell, Off A684, Roan Edge	South Lakeland	Operational	REPD / RenewableUK
Winscales Moor	9.1	Winscales Moor	Allerdale	Operational	REPD
Harlock Hill Wind Farm	2.5	Harlock Hill Wind Farm, Pennington, Near Ulverston	South Lakeland	Operational	REPD
Wharrels Hill Wind Farm	10.4	Wharrels Hill, Bothel	Allerdale	Operational	REPD
Kirkby Moor	4.8	approximately 4km from Ulverston	South Lakeland	Operational	REPD
Winscales Phase I and II	8.8	Winscales, Workington	Allerdale	Operational	REPD

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
High Pow Farm	3.9	High Pow Farm, Boltons Low Houses, Nr. Wigton	Allerdale	Operational	REPD
Fairfield Farm	6.5	Fairfield Farm, Pica, Distington	Copeland	Under Construction	REPD
Hellrigg Wind farm	10	Park Head Farm, Silloth, Carlisle	Allerdale	Under Construction	REPD
Armistead Wind Farm	15	Land to the east of Crosslands Farm, Kendal South Lakeland, LA6 2QJ	South Lakeland	Awaiting Construction	REPD
Land at Flimby Hall Farm	9.5	Flimby, Maryport, Cumbria	Allerdale	Awaiting Construction	REPD
Pirelli	3.0		Carlisle	Consented	Renewable UK
Tallentire Hill	12	Hill Farm, Cockermouth, CA13 0PY	Allerdale	Consented	Cumbria CC
Broughton Lodge	6	Great Broughton, Cockermouth, CA13 0LD	Allerdale	Application Submitted	REPD
Westnewton Wind	7.5		Allerdale	Consented	Cumbria CC
Warwick Hall Farm		Warwick Hall Farm, Westnewton	Allerdale	Withdrawn	Envirolink
Beck Burn Peat Works	18	Springfield, Longtown	Carlisle	Application submitted	Cumbria CC

Source: LUC

Small scale wind (onshore)

Table E-2: Small scale/micro wind:

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
Carlisle HGVTS Brunthill Road	0.006	Brunthill Road, Kingstown Industrial Estate	Carlisle	Consented	Envirolink

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
Springfield House	0.02	Springfield House, Moor Row	Allerdale	Consented	Envirolink
Lonning	0.02	Lonning, Farm Roans Bank, Tallentire	Allerdale	Consented	Envirolink
Longcroft	0.0018	Longcroft, Kirkbride	Allerdale	Consented	Envirolink
Wigton RUFC Lowmoor Road	0.005	Wigton RUFC Lowmoor Road	Allerdale	Consented	Envirolink
BCMS Curwen Road	0.25	BCMS Curwen Road, Derwent Howe, Derwent Howe Industrial Estate	Allerdale	Consented	Envirolink
Richard Rose Morton Academy Wigton Road	0.011	Richard Rose Morton Academy Wigton Road	Carlisle	Consented	Envirolink
Greenlands	0.011	Greenlands, Wreay	Carlisle	Consented	Envirolink
Intake	0.01	Intake, Newbiggin-on-Lune	Eden	Consented	Envirolink
Wormpotts	0.006	Wormpotts, Kings Meaburn	Eden	Consented	Envirolink
23 Brunstock Close	0.02	23 Brunstock Close, Lowry Hill	Carlisle	Consented	Envirolink
Bonny Hill	0.011	Bonny Hill, Bridekirk	Allerdale	Consented	Envirolink
Airigg Cottage	0.006	Airigg Cottage, Thurstonfield	Carlisle	Consented	Envirolink
Hay Close	0.006	Hay Close, Calthwaite	Eden	Consented	Envirolink
St Cuthbert's Church	0.02	St Cuthbert's Church, Cliburn	Eden	Consented	Envirolink
Garden House	0.001	Garden House, Garrigill	Eden	Consented	Envirolink
Weasdale Nurseries	0.02	Weasdale Nurseries, Newbiggin-on-Lune	Eden	Consented	Envirolink
Flitholme Farm	0.06	Flitholme Farm, Warcop	Eden	Consented	Envirolink

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
Stepping Stones Farm	0.006	Stepping Stones Farm, Southerfield, Abbey Town	Allerdale	Consented	Envirolink
Pennington C Of E School	0.02	Pennington C Of E School, Pennington	South Lakeland	Consented	Envirolink
Carrock House	0.015	Carrock House, Hutton Roof	Eden	Consented	Envirolink
E22 Range Warcop Training Area	0.02	E22 Range Warcop Training Area, Warcop	Eden	Consented	Envirolink
Stonecross Rigg	0.06	Stonecross Rigg, (Road from West Hall jun.), Walton	Carlisle	Consented	Envirolink
Beech Tree Farm	0.02	Beech Tree Farm, Reagill	Eden	Consented	Envirolink
Pirelli Tyres Limited Dalston Road	0.02	Pirelli Tyres Limited Dalston Road	Carlisle	Consented	Envirolink
Furrow Green Farm	0.015	Furrow Green Farm, Wharton	Eden	Consented	Envirolink
Applegarth	0.02	Applegarth, Middleton	South Lakeland	Consented	Envirolink
Roswain Farm	0.011	Roswain Farm, Rosewain	Allerdale	Consented	Envirolink
Wallace Lane Farm	0.015	Wallace Lane Farm, Brocklebank	Allerdale	Consented	Envirolink
Causey Wood Bungalow	0.02	Causey Wood Bungalow, Great Urswick	South Lakeland	Consented	Envirolink
Meadowbank Business Park Shap Road	0.002	Meadowbank Business Park Shap Road, (Cox & Allen (Kendal) Ltd)	South Lakeland	Consented	Envirolink
Simgill Farm	0.006	Simgill Farm, Grayrigg	South Lakeland	Consented	Envirolink
BAE Systems Bridge Road	0.006	BAE Systems Bridge Road, Michaelson Road	Barrow-in-Furness	Consented	Envirolink
Westwood	0.0334	Westwood, Orton Grange	Carlisle	Consented	Envirolink

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
Rylands Farm	0.006	Rylands Farm, Welton	Allerdale	Consented	Envirolink
Nunwick Hall	0.005	Nunwick Hall, Great Salkeld	Eden	Consented	Envirolink
Reservoir Cottage	0.0014	Reservoir Cottage, Kentmere, Staveley	LDNPA	Consented	Envirolink
Qd Building Glaxo North Lonsdale Road	0.02	Qd Building Glaxo North Lonsdale Road	South Lakeland	Consented	Envirolink
Gate Heads	0.02	Gate Heads, Casterton	South Lakeland	Consented	Envirolink
High Fellside	0.001	High Fellside, Middleton	South Lakeland	Consented	Envirolink
Clinty Brow Farm	0.02	Clinty Brow Farm, Blagill	Eden	Consented	Envirolink
Birchfield Farm	0.006	Birchfield Farm, Lowgill	South Lakeland	Consented	Envirolink
P Kingmoor Park Road	0.012	P Kingmoor Park Road, Kingmoor Park Central	Carlisle	Consented	Envirolink
Beech House	0.02	Beech House, Winskill	Eden	Consented	Envirolink
Grizebeck Village Hall	0.2	Grizebeck, Kirby-in-Furness, LA17 7XJ	South Lakeland	Under Construction	REPD
Stoneraise School	0.005	Stoneraise School, Stoneraise, Durdar	Carlisle	Application Submitted	Envirolink
Brayton Park	0.3	Brayton, Aspatria, Wigton, CA7 3SX	Allerdale	Application Submitted	REPD
Howgill Farm	0.011	Carleton, Near Carlisle, CA4 0BS	Carlisle	Application submitted	Cumbria CC
Seascale School	0.015	CA20 1LZ	Copeland	Consented	Cumbria CC
Netherhall School	0.006	Maryport, CA15 6NT	Allerdale	Consented	Cumbria CC
Beacon Hill School	0.011	Aspatria, CA7 3EZ	Allerdale	Consented	Cumbria CC
Overwater Hall Hotel	0.015	Overwater Hall Hotel, Ireby, Wigton,	LDNPA	Operational	LDNPA

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
		CA7 1HH			
Old Park Farm	0.001	Old Park Farm, Matterdale, Penrith, CA11 0LE	LDNPA	Operational	LDNPA
Thornflatt Farm, Holmrook	0.006	Thornflatt Farm, Carleton, Holmrook, CA19 1YT	LDNPA	Operational	LDNPA
Bell Cottage	0.006	Bell Cottage, Glenridding, Penrith, CA11 0QR	LDNPA	Operational	LDNPA
Laverick Howe Ponsonby	0.001	Laverick Howe Ponsonby, Seascale	LDNPA	Operational	LDNPA
Fiddlers Cottage	0.011	Fiddlers Cottage, Nenthead	Eden	Operational	Envirolink
Broomhills	0.01		Carlisle	Consented	Carlisle City Council
Greenbank Farm	0.011	Greenbank, Whitehaven, Cumbria	Copeland	Awaiting Construction	REPD
Lambrigg Farm	0.015	Lambrigg Farm, South Lakeland, LA8 0DL	South Lakeland	Operational	Cumbria County Council
Micro wind	0.025	Allerdale	Allerdale	Consented	Ofgem microgeneration data[1]
Micro wind	0.02	Carlisle	Carlisle	Consented	Ofgem microgeneration data
Micro wind	0.011	Copeland	Copeland	Consented	Ofgem microgeneration data
Micro wind	0.029	Eden	Eden	Consented	Ofgem microgeneration data
Micro wind	0.011	South Lakeland	South Lakeland	Consented	Ofgem microgeneration data

Source: LUC

[1] Schemes that have applied for Feed-in-Tariff accreditation up to 31 December 2010 (NB; data only available by LA, not LPA so no National Park split). This data has not been mapped due to the very small scale of the schemes and because it was accessed very late in the study development process.

Biomass

Table E-3: Biomass

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
Dryholme Farm (type unknown)	1.2	Dryholme Farm Silloth Wigton Cumbria CA7 4PZ	Allerdale	Awaiting Construction	REPD
Veterinary Laboratories Agency (type unknown)		Penrith, Cumbria, CA11 9RR	Eden	Consented	Envirolink
Land North of Anchor Basin (type unknown)	9	Barrow Port, Barrow-in-Furness	Barrow-in-Furness	Consented	Cumbria CC
Iggesund CHP (type unknown)	50 electricity 50 renewable heat		Allerdale	Consented	Allerdale Borough Council
Energy Plant (biomass powerplant) – combined heat and power powerplant on an existing boardmill site.	9		Barrow-in-Furness	Consented	Cumbria CC
Croppers Steam Raising Plant – energy from waste, wood, waste paper, and papermaking effluent cake	6.2		South Lakeland	Consented	Cumbria CC
Hespin Wood, Carlisle (biomass boiler - MBT)	37,500 tonnes solid recovered fuel		Carlisle	Consented	Cumbria CC
Sowerby Wood, Barrow (biomass boiler – MBT plant)	37,500 tonnes of solid recovered fuel		Barrow-in-Furness	Consented	Cumbria CC

Source: LUC

Anaerobic digestion

Table E-4: Anaerobic digestion

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
Kirkbride Industrial Estate	0.5	CA7 5HW	Allerdale	Consented	Cumbria CC
Blackdyke Farm, Silloth (farm waste)	1	CA7 4PZ	Allerdale	Consented	Cumbria CC
Stone House (farm waste)	0.25	Little Brampton, Wigton, CA7 0JQ	Allerdale	Consented	Cumbria CC
Linstock Castle AD Scheme	1	Alisatir Wannop, Linstock Castle, Linstock, Carlisle, CA6 4PZ	Carlisle	Operational	Steering Group

Source: LUC

Landfill Gas

Table E-5: Landfill Gas:

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
Bennett Bank Landfill Site	2.2	Thwaite Flat, Burrow in Furness LA14 4QU	Barrow-in-Furness	Operational	REPD
Kendal Fell Landfill Site	0.33	Boundary Bank Lane, Kendal, Cumbria	LDNPA	Operational	REPD
Flusco	0.97	Newbiggin, Penrith, Cumbria	Eden	Operational	REPD
Todhills Power	0.3	Hespin Wood Landfill Site, Rockliffe, Carlisle	Carlisle	Operational	REPD
Shearman Field	1.9	Joseph Noble Road, Lillyhall, Workington, Cumbria	Allerdale	Operational	REPD
Distington Landfill	1.77	Pitwood Road, Lillyhall Industrial	Allerdale	Operational	REPD

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
		Estate, Workington, Cumbria			
South Walney Landfill	0.18	South Walney, Barrow in Furness	Barrow-in-Furness	Under Construction	REPD

Source: LUC

Small scale hydropower

Table E-6: Small-scale hydro:

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
Backbarrow	0.32	River Leven, Back Barrow, Cumbria	LDNPA	Operational	REPD
Church Beck	0.3	Church Beck, Coniston	LDNPA	Operational	REPD
Swiss Lodore Hotel Hydro Scheme	0.21	Swiss Lodore Hotel, Derwent Water, Borrowdale, Keswick, Cumbria	LDNPA	Operational	REPD
Staveley Mill Yard	0.1	Staveley, Kendal, Cumbria LA8 9LS	LDNPA	Operational	BHA
Nenthead Mines	0.4	Nenthead Mines Heritage Centre, Nenthead, Alston, Cumbria CA9 3PD	Eden	Operational	BHA
Colwith	0.01	Low Hacket, Little Langdale, Cumbria LA22 9NU	LDNPA	Operational	BHA
Rydal Hall	0.14	Carlisle Church House, Rydal Hall, Ambleside, Cumbria LA22 9LX	LDNPA	Operational	BHA
Kilnstones	0.025	Longsleddale, Kendal, Cumbria (LA8 9BB)	LDNPA	Operational	BHA
Glenridding	0.5	Gillside Farm, Penrith (CA11 0QQ)	LDNPA	Operational	BHA

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
Beck Foot Farm	0.45	Duddon Bridge, Broughton in Furness, Cumbria	LDNPA	Awaiting Construction	REPD
Kentmere	0.31	Kentmere, Cumbria	LDNPA	Awaiting Construction	REPD
Heron Corn Mill	0.1	Beetham, Milnthorpe, Cumbria (LA7 7PQ)	South Lakeland	Awaiting Construction	BHA
Thirlmere Lake, Draw-Off Tower	0.17	Thirlmere Lake, near Keswick, Cumbria	LDNPA	Application Submitted	REPD
Docker Nook	0.015	Longsleddale, Kendal, Cumbria, LA8 9BB	LDNPA	Operational	Cumbria CC
Low Wood	0.71	Low Wood, Haverthwaite, Cumbria	LDNPA	Operational	Cumbria CC
Low Gillerthwaite Field Centre, Ennerdale	0.008		LDNPA	Consented	
Barrow Beck	0.008		LDNPA	Consented	
High Gillerthwaite, Ennerdale	0.0043 kW/hr		LDNPA	Consented	
Rattelbeck Bridge, Glenridding	0.5		LDNPA	Consented	
Micro-hydro scheme	0.007	Allerdale	Allerdale	Operational	Ofgem microgeneration data
Micro-hydro scheme	0.006	Copeland	Copeland	Operational	Ofgem microgeneration data
Micro-hydro scheme	0.002	Eden	Eden	Operational	Ofgem microgeneration data
Micro-hydro scheme	0.032	South Lakeland	South Lakeland	Operational	Ofgem microgeneration data

Source: LUC

Microgeneration

Solar Photovoltaics

Table E-7: Solar PV

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
189 Ainslie Street	0.006	189 Ainslie Street	Barrow-in-Furness	Consented	Envirolink
Former Roa Island Hotel Piel Street	0.006	Former Roa Island Hotel Piel Street, Roa Island	Barrow-in-Furness	Consented	Envirolink
Holme Stinted Pasture Clawthorpe Lane	0.006	Holme Stinted Pasture Clawthorpe Lane, Holme	South Lakeland	Consented	Envirolink
Solar PV schemes	0.094	Allerdale	Allerdale	Operational	Ofgem microgeneration data
Solar PV schemes	0.002	Barrow-in-Furness	Barrow-in-Furness	Operational	Ofgem microgeneration data
Solar PV schemes	0.042	Carlisle	Carlisle	Operational	Ofgem microgeneration data
Solar PV schemes	0.041	Copeland	Copeland	Operational	Ofgem microgeneration data
Solar PV schemes	0.051	Eden	Eden	Operational	Ofgem microgeneration data
Solar PV schemes	0.186	South Lakeland	South Lakeland	Operational	Ofgem microgeneration data

Source: LUC

Table E-8: Solar Water Heating

Name	Capacity (MW)	Location	Local Planning Authority	Status	Source
Old Rectory	0.006	Old Rectory, Aldingham	South Lakeland	Consented	Envirolink

Source: LUC

Annex F: Review of Protected Landscapes' special qualities

1.2 The following annex sets out the results of the review of the special qualities of the National Parks and AONBs within Cumbria. A review of the special qualities of the Lake District to Dales extension is also included. The first table provides a short summary of the special qualities for each protected landscape. The second table summarises this information in a different format so the special qualities can be cross-compared. This information has been used to inform the assessment of renewable energy potential within the protected landscapes of Cumbria. From this review it was concluded that commercial scale wind, large scale solar PV farms and energy crops may have the potential to compromise the special qualities of the protected landscapes. As a result it has been assumed that there is no potential for commercial scale wind or solar PV farms within these areas. Whilst it is acknowledged that biomass energy crops may have the potential to compromise the special qualities, the assumptions for the assessment of potential have not been changed at this stage.

1.3 For the remaining technologies, it was felt that the assumptions for the assessment of potential do not need to be revised although it is acknowledged that the suitability of these schemes within the protected landscapes will depend on their scale, design and site specific constraints. Nevertheless, the use of large-scale plants is unlikely to be suitable within the protected landscapes. The resource assessment currently makes no assumptions about the individual scale of the technologies and their associated development plants – it simply identifies the total accessible potential from various natural resources – i.e. biomass, solar, water etc.

Table F-1: Special qualities

Special Qualities	**Lake District to Dales extension**	**Lake District National Park**	**Yorkshire Dales National Park**	**Solway Coast AONB**	**Arneside and Silverdale AONB**	**North Pennines AONB**
Landform and scale						
World renowned geology resulting in dramatic landforms						■
Complex geology and geomorphology		■				
Sand and mud flats, salt marshes, sand dunes and raised mires with agricultural land on glacial till and boulder clay				■		
Small scale hills					■	
Rare and distinctive Carboniferous limestone and associated features with clear evidence of glacial erosion and depositional processes	■				■	
Best examples in Britain of classic limestone (Karst) scenery	■		■			
Stunning glacial forms	■					
Limestone scenery of pavements, cliffs, screes, potholes and gorges with the largest cave system in Britain	■					
Prevalence of glacial features notably drumlin fields, erractics and post glacial lakes			■			
Stirking northern landscape of distinctive steep profiles resulting from weathering			■			
Spectacular waterfalls			■			
Important rivers						■
Landscape of contrasts, most notably between the deep, sheltered dales and the open, exposed, sweeping fells above	■		■			
Open large scale coastal landscape contrasts with intimate scale but complex undulated wooded hills					■	
Diverse landscape from mountain to coast		■				
Dynamic and continually changing coastline				■	■	
Dynamic coastline						
Landcover pattern and presence of human scale features						
A long and historic land use seen in the field patterns, such as exposed ridge and furrows and remains of towers					■	
Unique mosaic of coastal and pastoral landscapes with sequence and contrasting scale of different landscape types				■		

Special Qualities	**Lake District to Dales extension**	**Lake District National Park**	**Yorkshire Dales National Park**	**Solway Coast AONB**	**Arneside and Silverdale AONB**	**North Pennines AONB**
Small ancient often unimproved pasture fields - predominately for livestock farming			■			
Tracks and transport patterns						
Narrow lanes and tracks between meandering dry stone walls or hedgerows			■			
On higher ground unfenced roads cross open moorland			■			
Field pattern and scale						
Small hedge bound fields with sunken lanes and narrow roads				■		
Drystone walls impose a strong pattern on the landscape						■
Intricate network of drystone walls create a patchwork enclosure			■			
Unique farmed landscape and concentration of common land		■				
Settlement pattern						
Numerous scattered farmsteads as well as small, attractive and compact villages and hamlets			■			
Settlement pattern retains a very traditional and intimate atmosphere			■			
Historic villages			■			
Strong vernacular traditions expressed in the design, construction and detailing of individual buildings, and in the form and layout of villages and hamlets, which often reflect their historical origins					■	
Distinctive areas and settlement character		■				
Buildings materials/design						
Distinctive traditional Dales architecture and building materials linked to geology			■			
Traditional stone-built field barns, the density of which is unique			■			
Buildings and settlements are an integral part of the landscape, reflecting underlying geology and complimenting the stone field walls and surrounding countryside						■
Intervisibility						
Panoramic views	■					
Open and dramatic views from high ground over the Bay with views of scenery within the Lake District, Yorkshire Dales and the Forest of Bowland					■	
High degree of intervisiblity across high ground						■

Special Qualities	**Lake District to Dales extension**	**Lake District National Park**	**Yorkshire Dales National Park**	**Solway Coast AONB**	**Arneside and Silverdale AONB**	**North Pennines AONB**
Vast unbroken dramatic views across the estuary to Scotland				■		
Skylines						
Visual openness of the landscape						■
Open nature of the fells		■				
Open fells and numerous valleys offers expansive views			■			
Low levels of light intrusion			■			
Ever-changing light, seasonal change and occasional severe weather creates visual drama and contrast			■			
Open skies that create an ever-changing backdrop to the landscape					■	
The sky is a dominant feature				■		
Perceptual qualities						
Impressive, majestic, wild, high, and unfriendly						■
Strong sense of wildnerness and remoteness	■					■
Opportunities for quiet enjoyment		■				
Deeply rural creating a strong sense of remoteness and isolation				■		
Views are deeply influenced by the weather				■		
Extensive areas retain a true sense of tranquillity, remoteness and solitude			■			
Windswept and invigorating					■	
Small-scale but complex nature of the landforms gives rise to a range of feelings and impressions					■	
Exposed and open landscape on the coast					■	
Small scale, undulating and often wooded hills and valleys create an enclosed and intimate landscape					■	
Strong sense of tranquillity	■			■		
Cultural heritage sensitivity						
Celebrated social and cultural heritage		■				
Rich archaeology		■				
Clear evidence of early patterns of cultivation - prehistoric Iron Age/Romano-British fields and stepped medieval lynchets			■			
Exceptional range, importance and condition of archaeology			■			
Many features including individual buildings, settlements and field system have a strong "time depth" within the landscape					■	

Special Qualities	**Lake District to Dales extension**	**Lake District National Park**	**Yorkshire Dales National Park**	**Solway Coast AONB**	**Arneside and Silverdale AONB**	**North Pennines AONB**
Legacy of former rural industries - minerals extraction and processing and water mills			■			
Large estates and religious houses			■			
Rich heritage of mining remains						■
Rich archaeological and historical heritage illustrating a time depth - from the Stone Age, to Roman remains associated with Hadrian's Wall to the airfields of WWII				■		
Multi layered archaeology	■					
Well preserved historic field patterns	■					
Strong cultural links with the 19th century picturesque movement	■					
Views recognised and celebrated by writers and artists	■					
Significant natural heritage - Sizergh Castle and Levens Hall	■					
Semi natural habitats						
Important upland heath	■					
Nationally important mosaic of lakes, tarns and rivers and coast		■				
Wealth of habitats and wildlife		■				
Extensive semi-natural woodlands		■				
Distinctive native woodlands following rivers or narrow gills						■
Nationally renowned flower-rich hay meadows and pastures			■			
Rich hay meadows	■					
Internationally important hay meadows						■
Internationally important limestone habitats			■			
Ancient woodlands	■					
Small woodlands and ancient woodland of high biodiversity value			■			
High concentration of internationally and nationally important conservation sites and areas						■
Outstanding range of internationally valued and protected wildlife resources	■			■	■	
Socio economic						
Extensive access land and recreational opportunities	■					
Important cultural, natural and recreational resource			■			
History of tourism and outdoor activities		■				
Farming and forestry play an important role in landscape management						■

Table F-2: Special qualities

Special Qualities	Lake District to Dales extension	Lake District National Park	Yorkshire Dales National Park	Solway Coast AONB	Arneside and Silverdale AONB	North Pennines AONB
Landform and scale	Rare and distinctive Carboniferous limestone and associated features	Diverse landscape from mountain to coast	Best examples in Britain of classic limestone (Karst) scenery	Dynamic coastline	Small scale hills	World renowned geology resulting in dramatic landforms
	Stunning glacial forms	Complex geology and geomorphology	Prevalence of glacial features notably drumlin fields, erractics and post glacial lakes	Sand and mud flats, salt marshes, sand dunes and raised mires with agricultural land on glacial till and boulder clay	Rare and distinctive Carboniferous limestone and associated features with clear evidence of glacial erosion and depositional processes	Important rivers
	Limestone scenery of pavements, cliffs, screes, potholes and gorges with the largest cave system in Britain		Stirking northern landscape of distinctive steep profiles resulting from weathering		Open large scale coastal landscape contrasts with intimate scale but complex undulated wooded hills	
	Landscape of contrasts, most notably between the deep, sheltered dales and the open, exposed, sweeping fells above		Spectacular waterfalls		Dynamic and continually changing coastline	
			Landscape of contrasts, most notably between the deep, sheltered dales and the open, exposed, sweeping fells above			
Landcover pattern and			Small ancient often	Unique mosaic of coastal	A long and historic land use	

Special Qualities	Lake District to Dales extension	Lake District National Park	Yorkshire Dales National Park	Solway Coast AONB	Arneside and Silverdale AONB	North Pennines AONB
presence of human scale features			unimproved pasture fields - predominately for livestock farming	and pastoral landscapes with sequence and contrasting scale of different landscape types	seen in the field patterns, such as exposed ridge and furrows and remains of towers	
Tracks and transport patterns			Narrow lanes and tracks between meandering dry stone walls or hedgerows			
			On higher ground unfenced roads cross open moorland			
Field pattern and scale		Unique farmed landscape and concentration of common land	Intricate network of drystone walls create a patchwork enclosure	Small hedge bound fields with sunken lanes and narrow roads		Drystone walls impose a strong pattern on the landscape
Settlement pattern		Distinctive areas and settlement character	Numerous scattered farmsteads as well as small, attractive and compact villages and hamlets		Strong vernacular traditions expressed in the design, construction and detailing of individual buildings, and in the form and layout of villages and hamlets, which often reflect their historical origins	
			Settlement pattern retains a very traditional and intimate atmosphere			
			Historic villages			

Special Qualities	Lake District to Dales extension	Lake District National Park	Yorkshire Dales National Park	Solway Coast AONB	Arneside and Silverdale AONB	North Pennines AONB
Buildings materials/design			Distinctive traditional Dales architecture and building materials linked to geology			Buildings and settlements are an integral part of the landscape, reflecting underlying geology and complimenting the stone field walls and surrounding countryside
			Traditional stone-built field barns, the density of which is unique			
Intervisibility	Panoramic views			Vast unbroken dramatic views across the estuary to Scotland	Open and dramatic views from high ground over the Bay with views of scenery within the Lake District, Yorkshire Dales and the Forest of Bowland	High degree of intervisiblity across high ground
Skylines		Open nature of the fells	Open fells and numerous valleys offers expansive views	The sky is a dominant feature	Open skies that create an ever-changing backdrop to the landscape	Visual openness of the landscape
			Low levels of light intrusion			
			Ever-changing light, seasonal change and occasional severe weather creates visual drama and contrast			

Special Qualities	Lake District to Dales extension	Lake District National Park	Yorkshire Dales National Park	Solway Coast AONB	Arneside and Silverdale AONB	North Pennines AONB
Perceptual qualities	Strong sense of tranquillity	Opportunities for quiet enjoyment	Extensive areas retain a true sense of tranquillity, remoteness and solitude	Deeply rural creating a strong sense of remoteness and isolation	Windswept and invigorating	Impressive, majestic, wild, high, and unfriendly
	Strong sense of wildnerness and remoteness			Views are deeply influenced by the weather	Small-scale but complex nature of the landforms gives rise to a range of feelings and impressions	Strong sense of wildnerness and remoteness
				Strong sense of tranquillity	Exposed and open landscape on the coast	
					Small scale, undulating and often wooded hills and valleys create an enclosed and intimate landscape	
Cultural heritage sensitivity	Rich archaeological and historical heritage illustrating a time depth	Celebrated social and cultural heritage	Clear evidence of early patterns of cultivation - prehistoric Iron Age/Romano-British fields and stepped medieval lynchets	Rich archaeological and historical heritage illustrating a time depth - from the Stone Age, to Roman remains associated with Hadrian's Wall to the airfields of WWII	Many features including individual buildings, settlements and field system have a strong "time depth" within the landscape	Rich heritage of mining remains
	Well preserved historic field patterns					
	Strong cultural links with the 19th century picturesque movement	Rich archaeology	Exceptional range, importance and condition of archaeology			

Special Qualities	Lake District to Dales extension	Lake District National Park	Yorkshire Dales National Park	Solway Coast AONB	Arneside and Silverdale AONB	North Pennines AONB
	Views recognised and celebrated by writers and artists		Legacy of former rural industries - minerals extraction and processing and water mills			
	Significant natural heritage - Sizergh Castle and Levens Hall		Large estates and religious houses			
Semi natural habitats	Important upland heath	Nationally important mosaic of lakes, tarns and rivers and coast	Nationally renowned flower-rich hay meadows and pastures	Outstanding range of internationally valued and protected wildlife resources	Outstanding range of internationally valued and protected wildlife resources	Distinctive native woodlands following rivers or narrow gills
	Rich hay meadows					
	Ancient woodland	Wealth of habitats and wildlife	Internationally important limestone habitats			Internationally important hay meadows
	Outstanding range of internationally valued and protected wildlife resources	Extensive semi-natural woodlands	Small woodlands and ancient woodland of high biodiversity value			High concentration of internationally and nationally important conservation sites and areas
Socio economic	Extensive access land and recreational opportunities	History of tourism and outdoor activities	Important cultural, natural and recreational resource			Farming and forestry play an important role in landscape management

Annex G: Maps

G.1 GIS maps have been produced to support this study. Due to the size of the files, these are available separately from Cumbria County Council's website. The full set of maps are listed below:

Map 1: Existing renewable energy and low carbon deployment

Map 2: Landscape and nature conservation designations

Map 3: Windspeed at 45m above ground level (agl)

Map 4: Bird sensitive areas and landscape capacity for wind

Map 5: Constraints for commercial-scale wind (excluding nature conservation and cultural heritage constraints) - Based on large turbines

Map 6: Nature conservation and cultural heritage constraints for commercial-scale wind

Map 7: Results of the technical assessment for commercial-scale wind

Map 8: Landscape Character Type capacity

Map 9: Results of the technical assessment for commercial-scale wind incorporating landscape capacity

Map 10: Results of the technical assessment for small-scale wind

Map 11: Woodland included in the assessment by type

Map 12: Woodland included in the assessment by management

Map 13: Energy crop mapped constraints

Map 14: Small-scale hydropower opportunities

Map 15: Mapped constraints for solar farms

Map 16 Total domestic and non-domestic heat density

Map 17: Domestic heat density

Map 18: Non-domestic heat density

Annex H: Deployment projections and scenario results by LPA

H.1 Annex H provides summary analysis of the Deployment Projections and scenario modelling for each of the Cumbria LPAs other than those parts of the Yorkshire Dales National Park. The latter has been excluded as due to the small area of land involved, the capacity for the deployment of renewable energy is very limited.

Allerdale

H.2 The current installed capacity and pipeline capacity (operational, under construction, awaiting construction and consented) for renewable energy in Allerdale is set out below alongside the result of the Deployment Projections at 2030 and the additional amount that this represents over and above the current level. The final column shows the technical capacity identified from the earlier resource assessments.

Wind

Table H-1: Allerdale wind deployment projections, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource[2]
Commercial wind	88.8	59.9	148.7	493.5
Small scale wind	0.4	1.5	1.9	5.7
Total	**89.2**	**61.4**	**150.5**	**499.2**

Source: SQW

Biomass

Table H-2: Allerdale plant biomass deployment projections, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource[3]
Plant Biomass				
Undermanaged woodland (electricity)	46.0	0.0	46.0	0.4
Undermanaged woodland (heat)	54.0	0.3	54.3	2.1
Energy crops (electricity)	0.0	0.1	0.1	1.7
Energy crops (heat)	0.0	0.6	0.6	6.5
Waste wood	0.0	0.0	0.0	0.6

[2] excluding protected landscapes
[3] excluding protected landscapes

(electricity)				
Waste wood (heat)	0.0	0.1	0.1	0.5
Agricultural arisings	0.0	0.0	0.0	0.8
Total plant biomass	**100.0**	**1.2**	**101.2**	**12.6**
Animal biomass				
Wet organic waste	1.8	3.3	5.1	18.5
Poultry litter	0.0	0.0	0.0	0.2
Total animal biomass	**1.8**	**3.4**	**5.1**	**18.7**
Waste				
Municipal solid waste	0.0	0.3	0.3	3.6
Commercial & Industrial	12.5	0.0	12.5	2.9
Total waste	**12.5**	**0.3**	**12.8**	**6.5**
Biogas				
Landfill gas	3.7	-2.9	0.7	0.8
Sewage gas	0.0	0.1	0.1	0.8
Total biogas	**3.7**	**-2.8**	**0.9**	**1.6**
Total biomass	**117.9**	**2.0**	**120.0**	**39.3**

Source: SQW

Hydropower

Table H-3: Allerdale small scale hydropower deployment, 2030 (MW)

Technology	Installed and pipeline capacity at 2030	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Small scale hydropower	0.0	0.2	0.2	2.1
Total	**0.0**	**0.2**	**0.2**	**2.1**

Source: SQW

Microgeneration

Table H-4: Allerdale microgeneration deployment, 2030 (MW)

Technology	Installed and pipeline capacity at 2030	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Solar				
Solar photovoltaics	0.1	8.4	8.5	23.7

Technology	Installed and pipeline capacity at 2030	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Solar water heating	0.0	4.4	4.4	21.1
Total solar	**0.1**	**12.8**	**12.9**	**44.8**
Heat pumps				
Ground source heat pumps	0.0	1.1	1.1	34.8
Air source heat pumps	0.0	4.8	4.8	139.0
Water source heat pumps	0.0	0.1	0.1	4.8
Total heat pumps	**0.0**	**6.1**	**6.1**	**178.6**
Total Microgeneration	**0.1**	**18.9**	**19.0**	**223.4**

Source: SQW

Totals

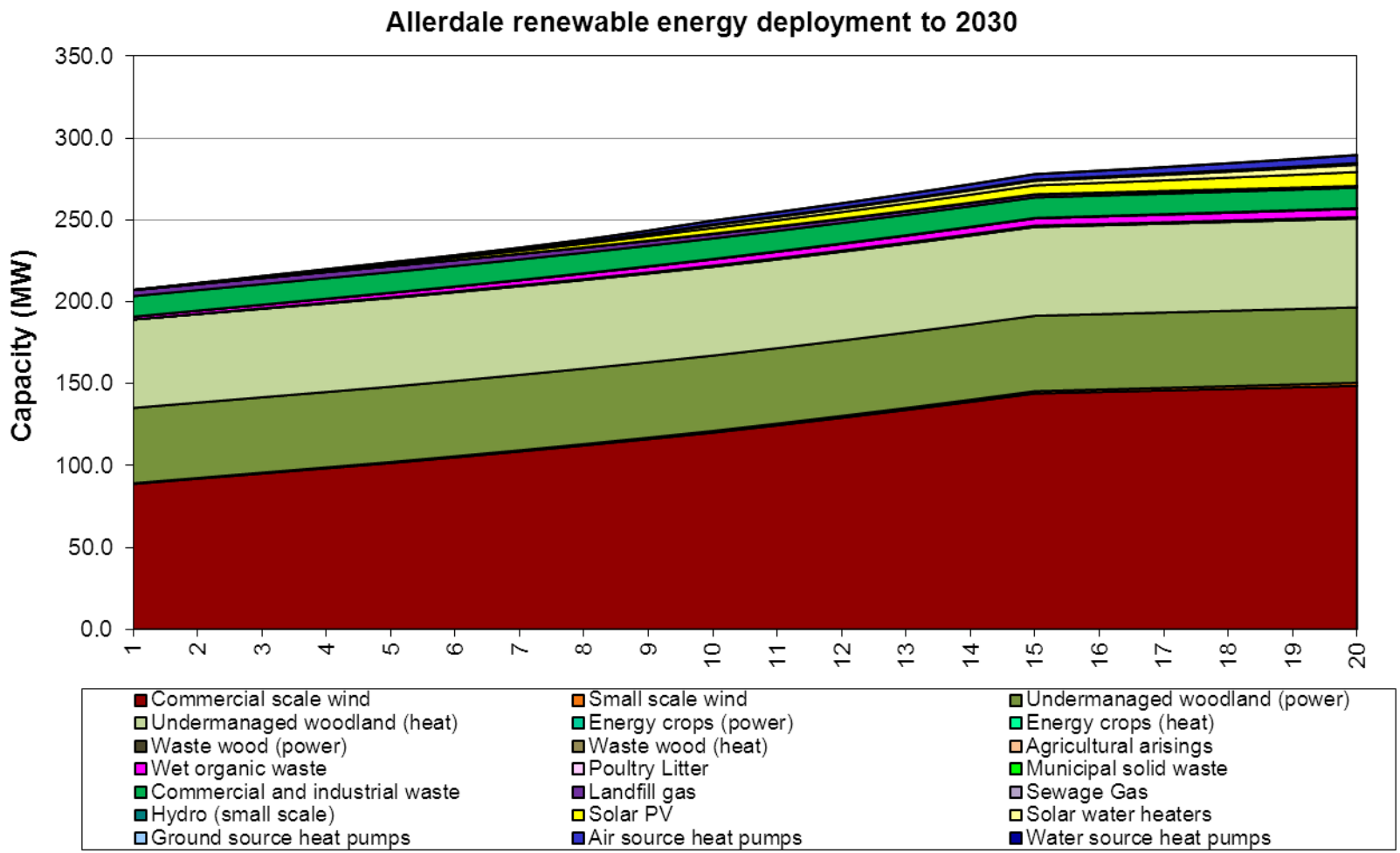
Table H-5: Total deployment projections for Allerdale, 2030 (MW)

Technology	Installed and pipeline capacity at 2030	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
ALL	207	83	290	764

Source: SQW

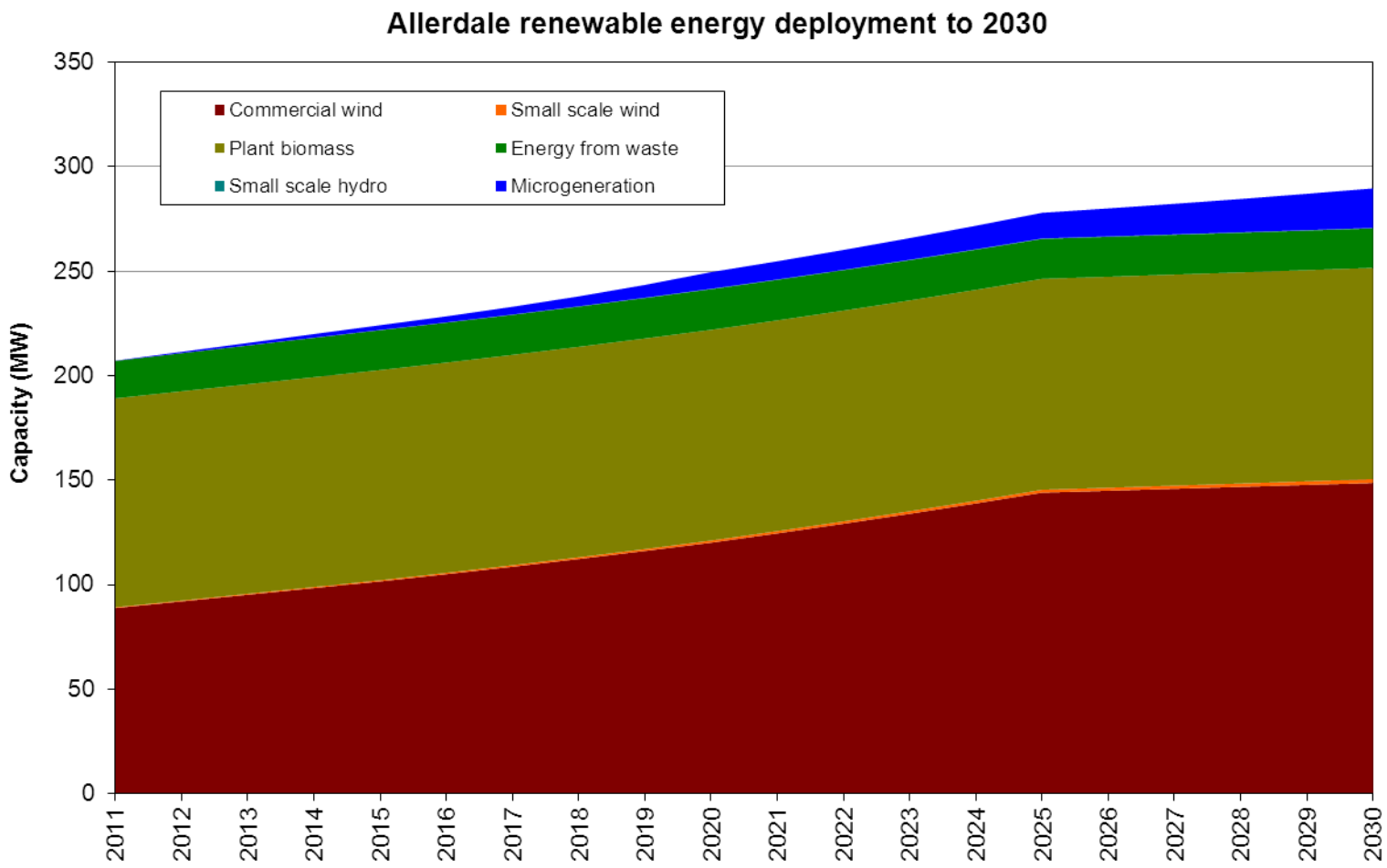
H.3 Overall the tables show the biggest absolute resource and the biggest proportional increase in resource is commercial scale wind. This is reflected in the deployment curves displayed in the following figures:

Figure H-1: Allerdale renewable energy deployment curve to 2030



Source: SQW

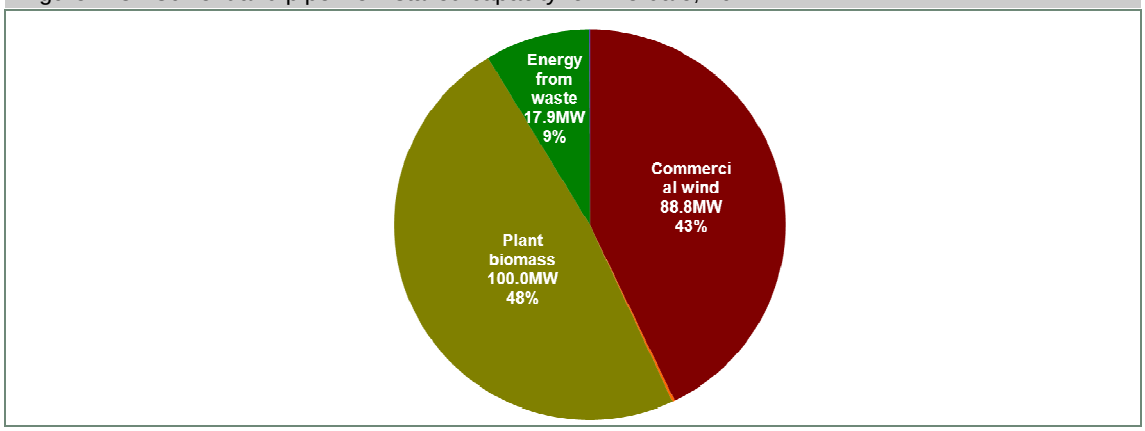
Figure H-2: Allerdale renewable energy deployment curve to 2030 - simplified



Source: SQW

Figure H-3 shows how the current and pipeline installed capacity is distributed in Allerdale.

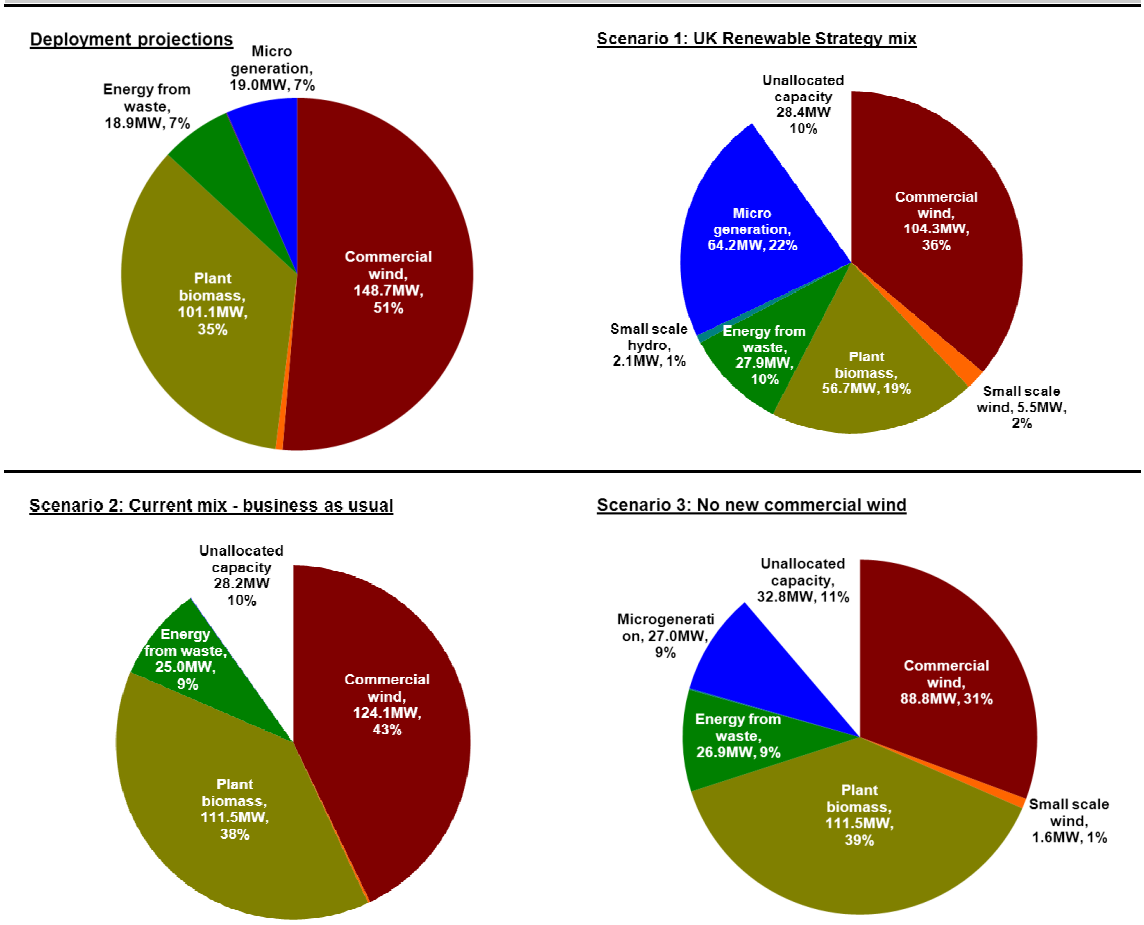
Figure H-3: Current and pipeline installed capacity for Allerdale, 2011



Source: SQW

H.4 Table H-2 provides an overview of the scenario results for Allerdale. This reveals a potential capacity shortfall of 28.4MW for the UK Renewable Strategy mix, 28.4MW for the Current mix – business as usual and 32.8MW for the No New Commercial Wind scenario because in the various cases the plant biomass, energy from waste and small scale hydropower projections have exceeded the identified technical resource capacity.

Table H-6: Scenario results for Allerdale (total = 290 MW)



Source: SQW

Barrow-in-Furness

H.5 The current installed and pipeline capacity (operational, under construction, awaiting construction and consented) for renewable energy in Barrow-in-Furness is set out below alongside result of the Deployment Projections at 2030 and the additional amount that this represents over and above the current level. The final column shows the technical capacity identified from the earlier resource assessments.

Wind

Table H-7: Barrow-in-Furness wind deployment projections, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource[4]
Commercial wind	4.6	2.1	6.7	15.4
Small scale wind	0.0	0.1	0.1	0.5
Total	**4.6**	**2.2**	**6.8**	**15.9**

Source: SQW

Biomass

Table H-8: Barrow-in-Furness plant biomass deployment projections, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource[5]
Plant Biomass				
Undermanaged woodland (electricity)	3.5	0.0	3.5	0.0
Undermanaged woodland (heat)	3.5	0.0	3.5	0.1
Energy crops (electricity)	1.3	0.0	1.3	0.1
Energy crops (heat)	1.3	0.0	1.3	0.4
Waste wood (electricity)	3.5	0.0	3.5	0.6
Waste wood (heat)	3.5	0.0	3.5	0.5
Agricultural arisings	1.3	0.0	1.3	0.0
Total plant biomass	**18.0**	**0.0**	**18.0**	**1.**
Animal biomass				
Wet organic waste	0.0	0.1	0.1	0.8
Poultry litter	0.0	0.0	0.0	0.2

[4] excluding protected landscapes
[5] excluding protected landscapes

Total animal biomass	**0.0**	**0.1**	**0.1**	**1.0**
Waste				
Municipal solid waste	0.0	0.2	0.2	2.3
Commercial & Industrial	0.0	0.2	0.2	2.7
Total waste	**0.0**	**0.4**	**0.4**	**5.0**
Biogas				
Landfill gas	2.4	-1.9	0.5	0.5
Sewage gas	0.0	0.1	0.1	0.7
Total biogas	**2.4**	**-1.8**	**0.6**	**1.2**
Total biomass	**20.4**	**-1.3**	**19.0**	**8.8**

Source: SQW

Hydropower

Table H-9: Barrow-in-Furness small scale hydropower deployment, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Small scale hydropower	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**0.0**	**0.0**

Source: SQW

Microgeneration

Table H-10: Barrow-in-Furness microgeneration deployment, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Solar				
Solar photovoltaics	0.0	6.8	6.9	19.0
Solar water heating	0.0	3.6	3.6	17.2
Total solar	**0.0**	**10.4**	**10.4**	**36.2**
Heat pumps				
Ground source heat pumps	0.0	0.8	0.8	25.1
Air source heat pumps	0.0	3.5	3.5	100.4
Water source heat pumps	0.0	0.0	0.0	1.1

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Total heat pumps	**0.0**	**4.3**	**4.3**	**126.6**
Total Microgeneration	**0.0**	**14.7**	**14.7**	**162.8**

Source: SQW

Totals

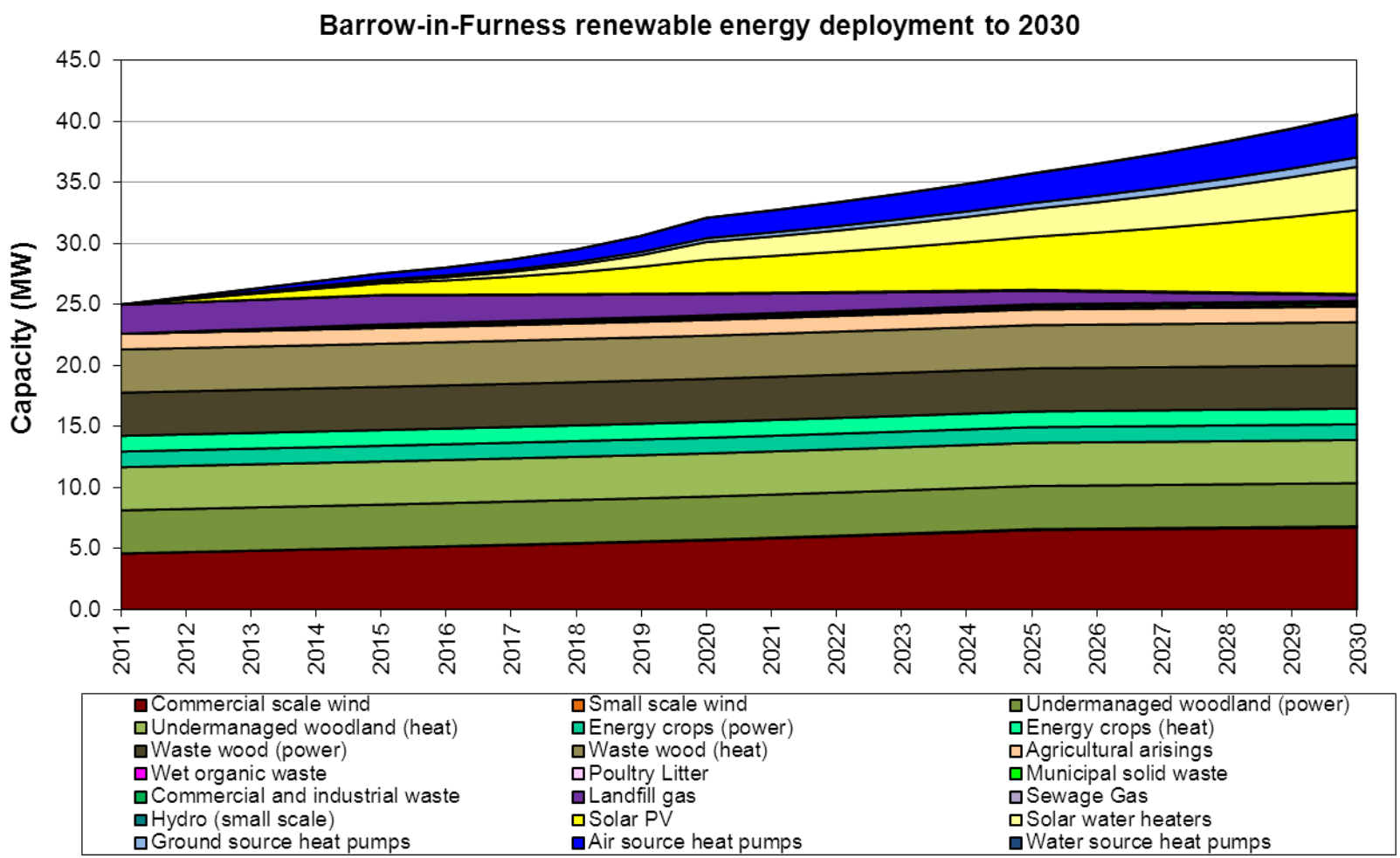
Table H-11: Total deployment projections for Barrow in Furness, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
ALL	25	16	41	188

Source: SQW

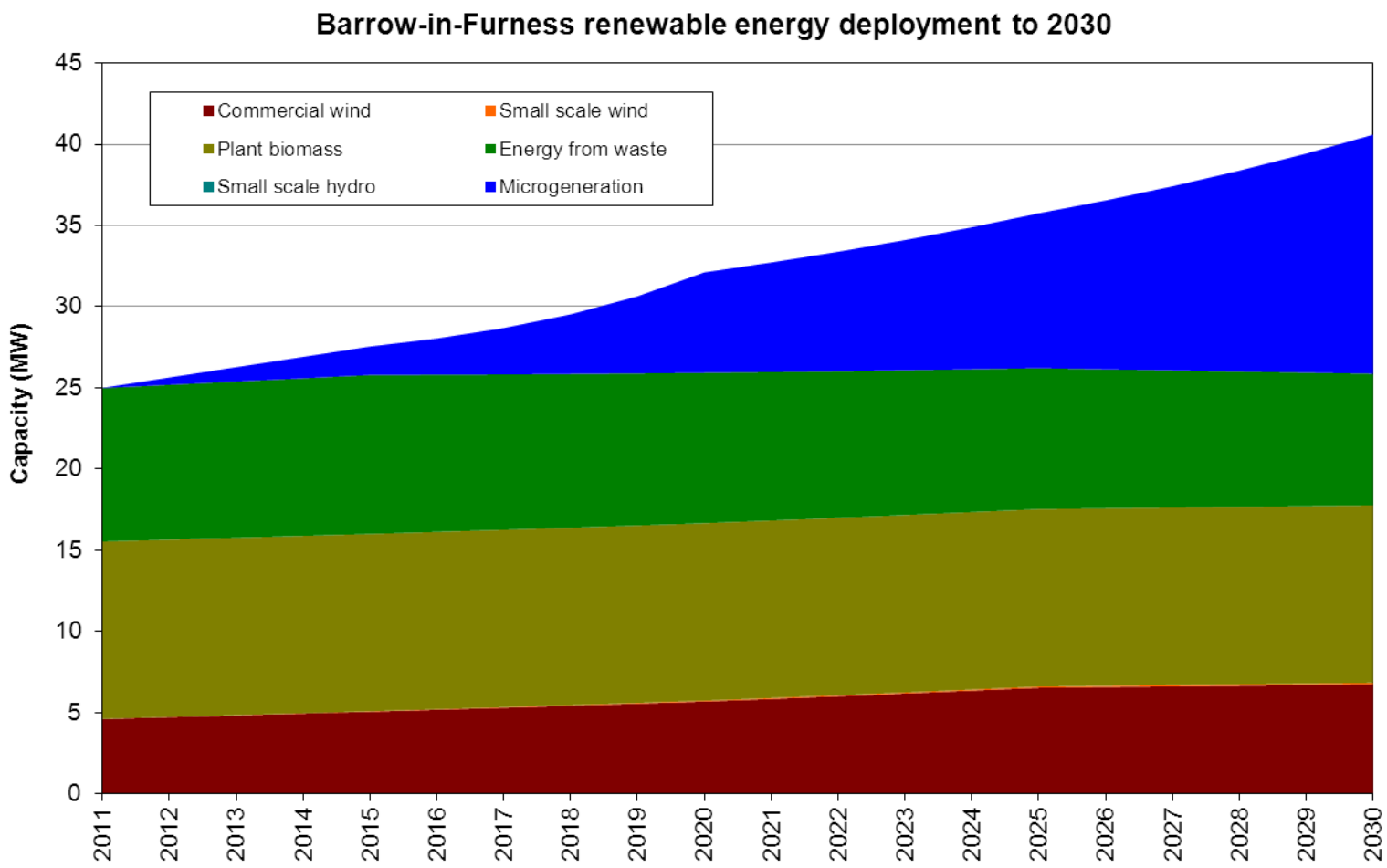
H.6 Overall the tables show the biggest absolute resource and the biggest proportional increase in resource is solar microgeneration. This is reflected in the deployment curves displayed in the following figures:

Figure H-4: Barrow-in-Furness renewable energy deployment curve to 2030



Source: SQW

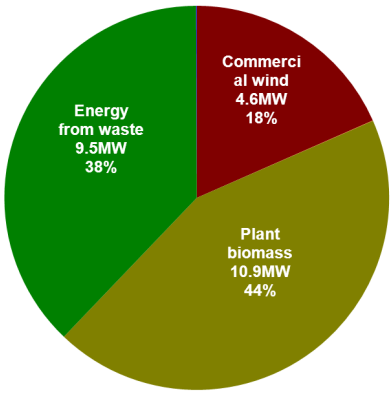
Figure H-5: Barrow-in-Furness renewable energy deployment curve to 2030 - simplified



Source: SQW

Figure H-3 shows how the installed and pipeline capacity is distributed in Barrow-in-Furness.

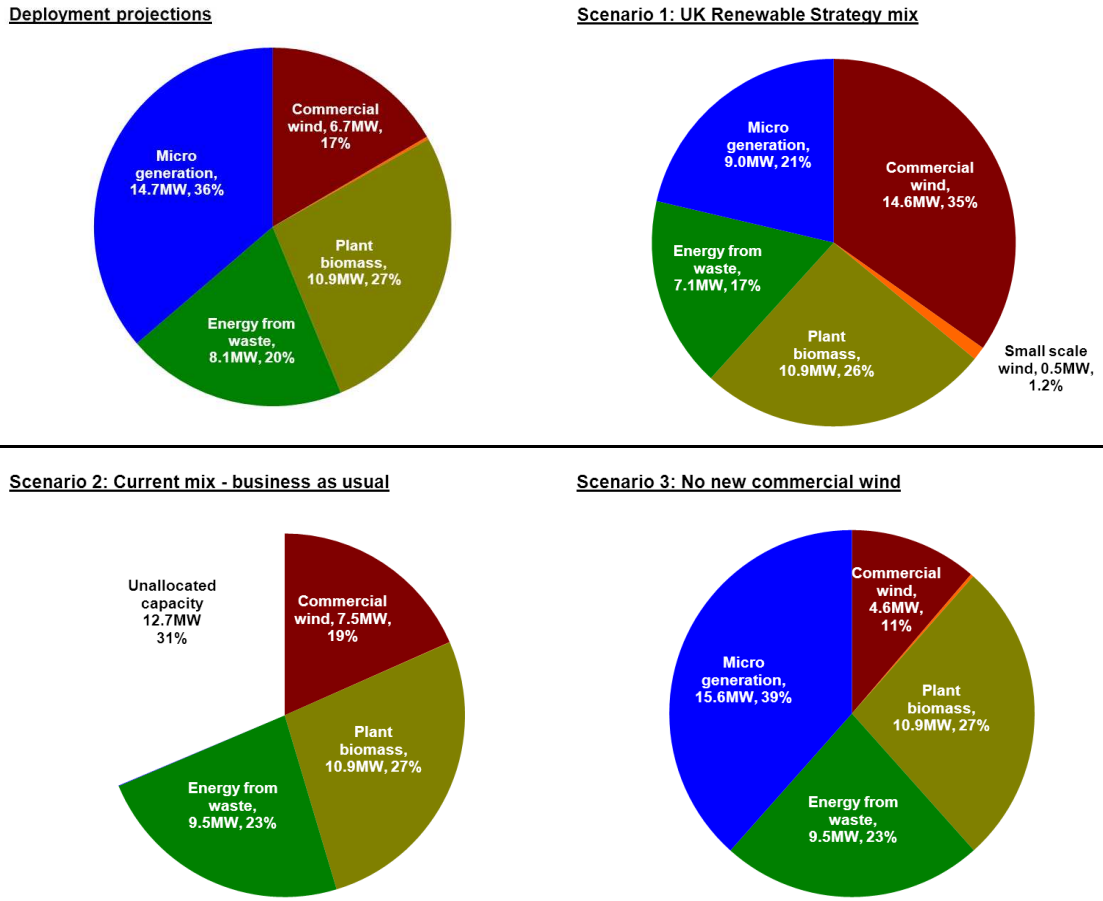
Figure H-6: Current installed and pipeline capacity in Barrow-in-Furness, 2011



Source: SQW

H.7 Table H-2 provides an overview of the scenario results for Barrow-in-Furness. This reveals a potential capacity shortfall of 12.7MW for the Current mix – business as usual scenario because plant biomass, energy from waste and small scale hydropower have exceeded the identified technical resource capacity.

Table H-12: Scenario results for Barrow-in-Furness (total = 41 MW)



Source: SQW

Carlisle

H.8 The current installed and pipeline potential capacity (operational, under construction, awaiting construction and consented) for renewable energy in Carlisle is set out below alongside result of the Deployment Projections at 2030 and the additional amount that this represents over and above the current level. The final column shows the technical capacity identified from the earlier resource assessments.

Wind

Table H-13: Carlisle wind deployment projections, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource[6]
Commercial wind	3.0	8.2	11.2	140.6
Small scale wind	0.2	1.1	1.3	6.1
Total	**3.2**	**9.3**	**12.5**	**146.7**

Source: SQW

Biomass

Table H-14: Carlisle plant biomass deployment projections, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource[7]
Plant Biomass				
Undermanaged woodland (electricity)	0.0	0.1	0.1	1.7
Undermanaged woodland (heat)	0.0	1.4	1.4	10.4
Energy crops (electricity)	0.0	0.1	0.1	1.5
Energy crops (heat)	0.0	0.6	0.6	5.7
Waste wood (electricity)	0.0	0.1	0.1	1.1
Waste wood (heat)	0.0	0.1	0.1	1.0
Agricultural arisings	0.5	0.1	0.6	0.8
Total plant biomass	**0.5**	**2.4**	**2.9**	**22.0**
Animal biomass				
Wet organic waste	0.5	1.3	1.8	18.9
Poultry litter	0.0	0.0	0.0	0.3

[6] excluding protected landscapes
[7] excluding protected landscapes

Total animal biomass	**0.5**	**1.3**	**1.8**	**19.2**
Waste				
Municipal solid waste	0.0	0.3	0.3	4.0
Commercial & Industrial	0.0	0.3	0.3	5.2
Total waste	**0.0**	**0.7**	**0.7**	**9.2**
Biogas				
Landfill gas	0.3	-0.2	0.1	0.3
Sewage gas	0.0	0.2	0.2	1.1
Total biogas	**0.3**	**-0.1**	**0.2**	**1.4**
Total biomass	**1.3**	**4.3**	**5.6**	**51.8**

Source: SQW

Hydropower

Table H-15: Carlisle small scale hydropower deployment, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Small scale hydropower	0.0	0.2	0.2	1.5
Total	**0.0**	**0.2**	**0.2**	**1.5**

Source: SQW

Microgeneration

Table H-16: Carlisle microgeneration deployment, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Solar				
Solar photovoltaics	0.0	12.4	12.5	34.6
Solar water heating	0.0	6.6	6.6	32.0
Total solar	**0.0**	**19.1**	**19.1**	**66.6**
Heat pumps				
Ground source heat pumps	0.0	1.4	1.4	45.1
Air source heat pumps	0.0	6.3	6.3	180.5
Water source heat pumps	0.0	0.1	0.1	2.8

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Total heat pumps	**0.0**	**7.8**	**7.8**	**228.4**
Total microgeneration	**0.0**	**26.8**	**26.9**	**295.0**

Source: SQW

Totals

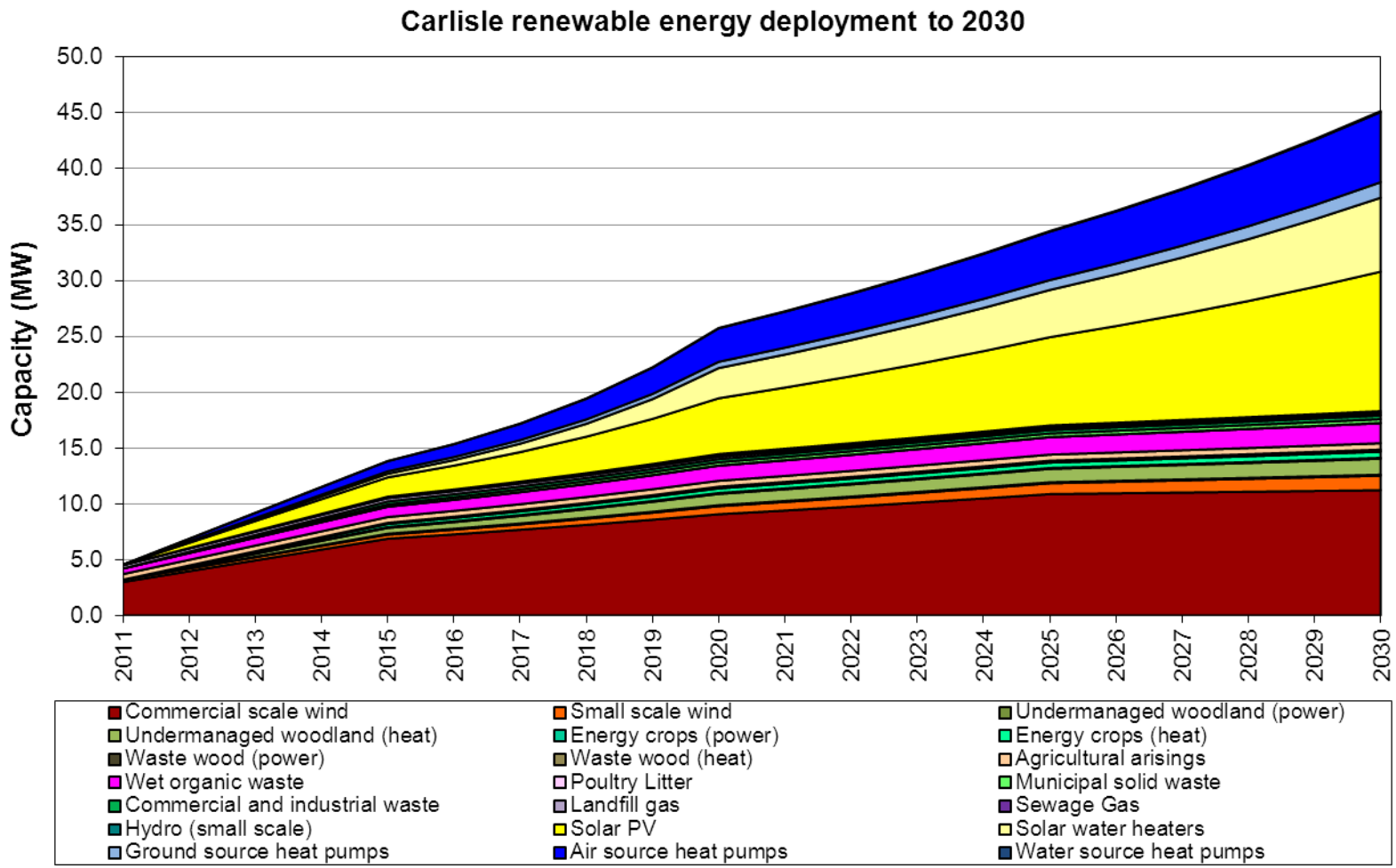
Table H-17: Total deployment projections for Carlisle, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
ALL	5	40	45	495

Source: SQW

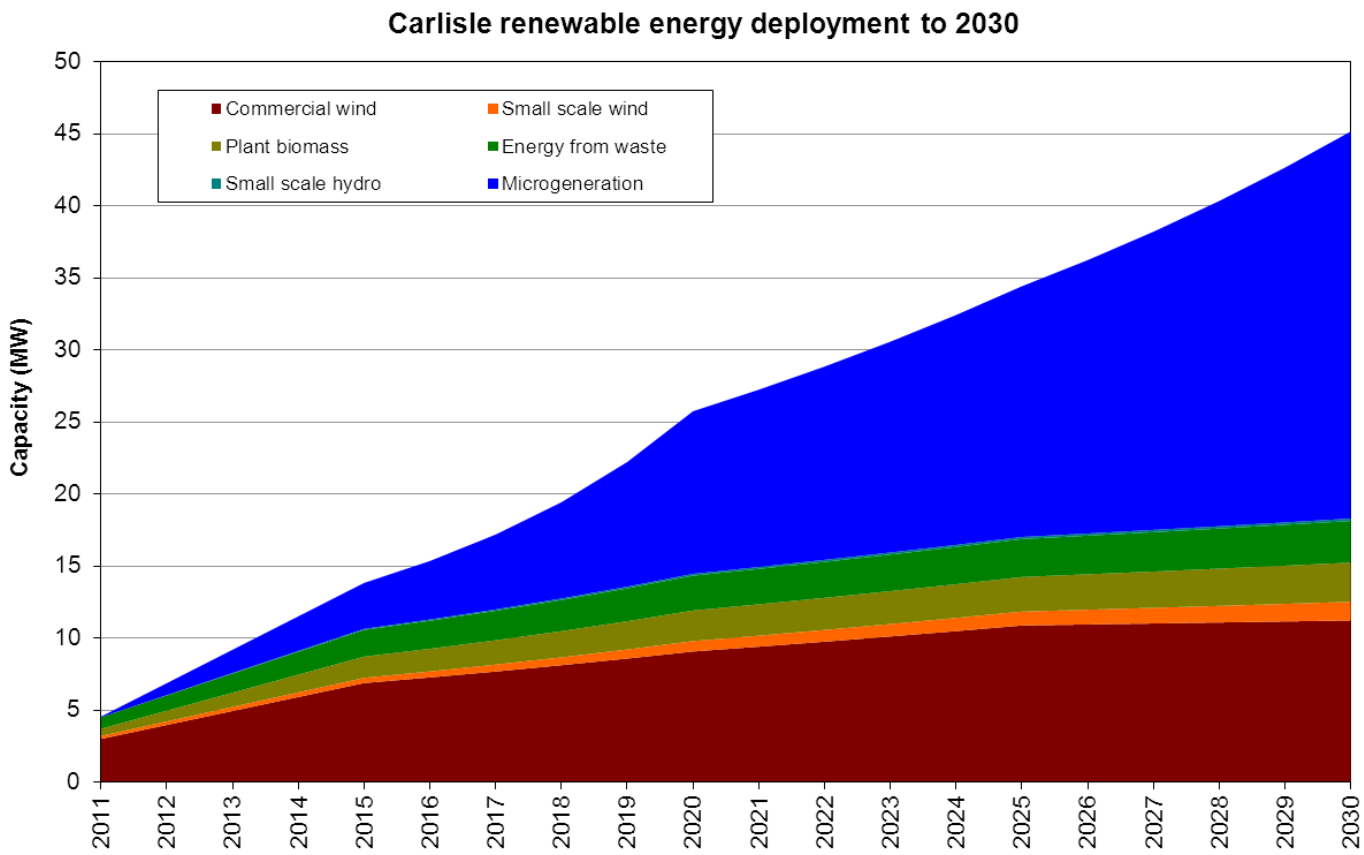
H.9 Overall the table shows the biggest absolute resource and the biggest proportional increase in resource is solar photovoltaic followed by commercial scale wind. This is reflected in the deployment curves displayed in the following figures:

Figure H-7: Carlisle renewable energy deployment curve to 2030



Source: SQW

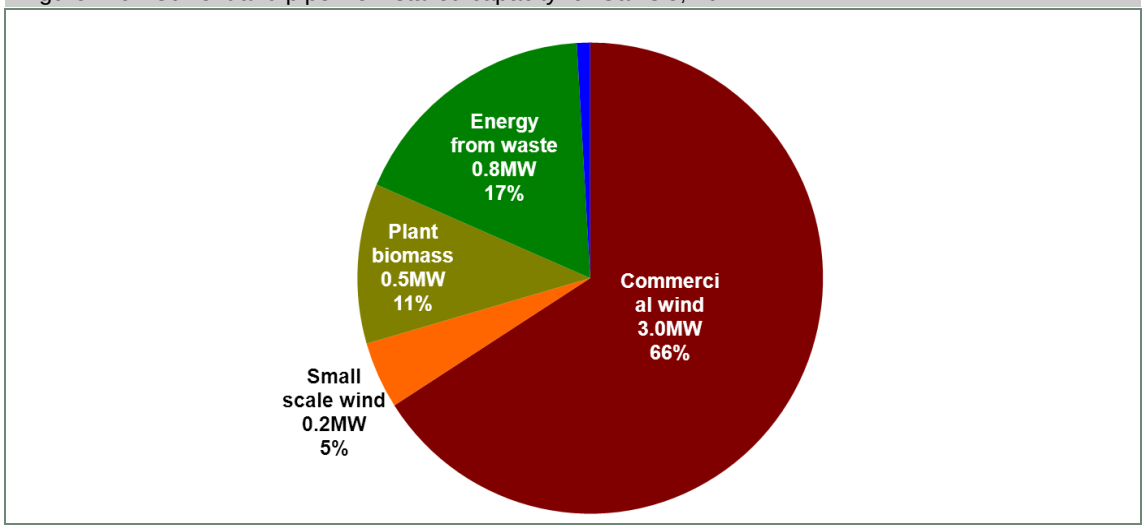
Figure H-8: Carlisle renewable energy deployment curve to 2030 - simplified



Source: SQW

Figure H-3 shows how the current and pipeline installed capacity is distributed in Carlisle.

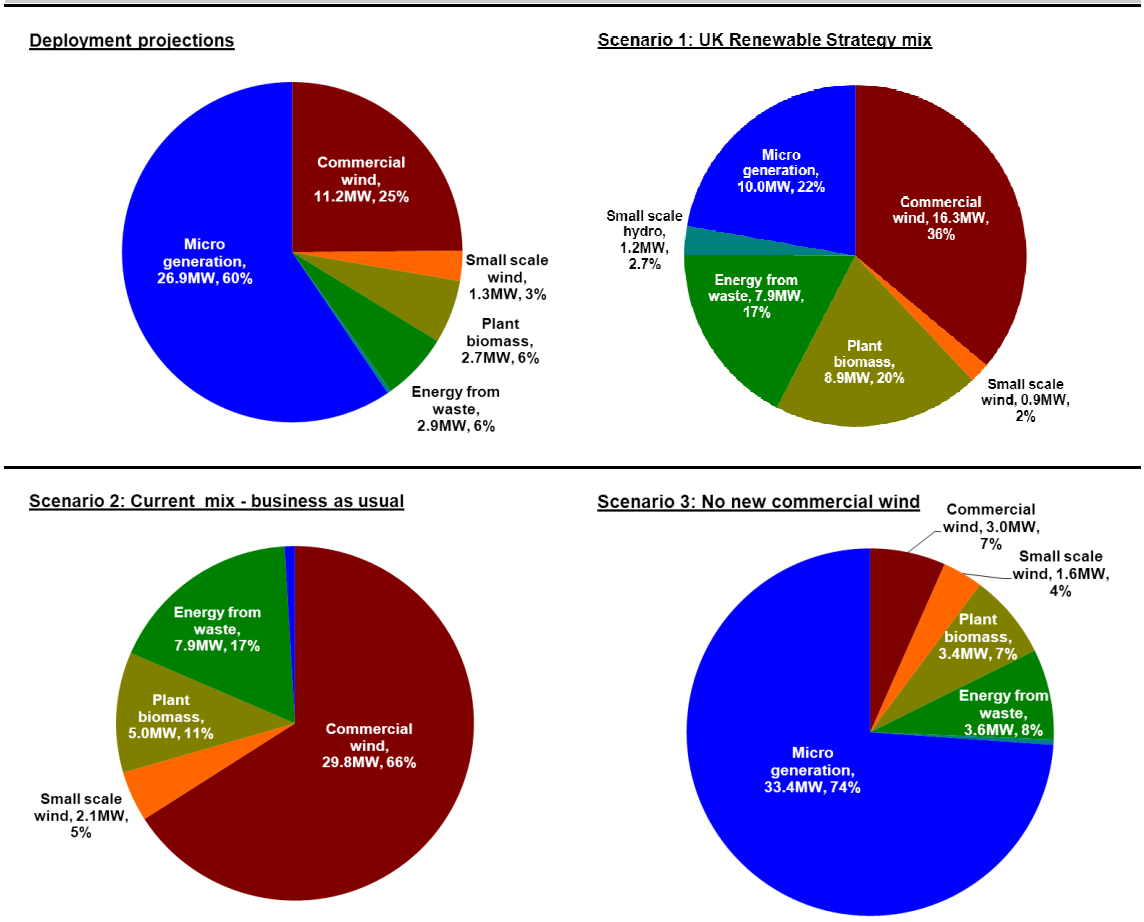
Figure H-9: Current and pipeline installed capacity for Carlisle, 2011



Source: SQW

H.10 Table H-15 provides an overview of the scenario results for Carlisle.

Table H-18: Scenario results for Carlisle (total = 45 MW)



Source: SQW

Copeland

H.11 The current installed and pipeline capacity (operational, under construction, awaiting construction and consented) for renewable energy in Copeland is set out below alongside result of the Deployment Projections at 2030 and the additional amount that this represents over and above the current level. The final column shows the technical capacity identified from the earlier resource assessments.

Wind

Table H-19: Copeland wind deployment projections, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource[8]
Commercial wind	17.0	10.7	27.7	81.8
Small scale wind	0.0	0.4	0.4	2.1
Total	**17.0**	**11.1**	**28.1**	**83.9**

Source: SQW

Biomass

Table H-20: Copeland plant biomass deployment projections, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource[9]
Plant Biomass				
Undermanaged woodland (electricity)	0.0	0.0	0.0	0.2
Undermanaged woodland (heat)	0.0	0.1	0.1	1.0
Energy crops (electricity)	0.0	0.0	0.0	0.4
Energy crops (heat)	0.0	0.1	0.1	1.4
Waste wood (electricity)	0.0	0.0	0.0	0.5
Waste wood (heat)	0.0	0.1	0.1	0.5
Agricultural arisings	0.0	0.0	0.0	0.1
Total plant biomass	**0.0**	**0.4**	**0.4**	**4.0**
Animal biomass				
Wet organic waste	0.0	0.6	0.6	6.0
Poultry litter	0.0	0.0	0.0	0.2

[8] excluding protected landscapes
[9] excluding protected landscapes

Total animal biomass	**0.0**	**0.6**	**0.6**	**6.2**
Waste				
Municipal solid waste	0.0	0.2	0.2	2.2
Commercial & Industrial	0.0	0.1	0.1	2.4
Total waste	**0.0**	**0.3**	**0.3**	**4.6**
Biogas				
Landfill gas	0.0	0.0	0.0	0.0
Sewage gas	0.0	0.1	0.1	0.6
Total biogas	**0.0**	**0.1**	**0.1**	**0.6**
Total biomass	**0.0**	**1.4**	**1.4**	**15.4**

Source: SQW

Hydropower

Table H-21: Copeland small scale hydropower deployment, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Small scale hydropower	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**0.0**	**0.0**

Source: SQW

Microgeneration

Table H-22: Copeland microgeneration deployment, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Solar				
Solar photovoltaics	0.0	7.6	7.6	21.2
Solar water heating	0.0	4.1	4.1	19.8
Total solar	**0.0**	**11.7**	**11.7**	**41.0**
Heat pumps				
Ground source heat pumps	0.0	0.8	0.8	25.7
Air source heat pumps	0.0	3.6	3.6	102.7
Water source heat pumps	0.0	0.1	0.1	1.7

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Total heat pumps	**0.0**	**4.4**	**4.4**	**130.1**
Total microgeneration	**0.0**	**16.1**	**16.2**	**171.1**

Source: SQW

Totals

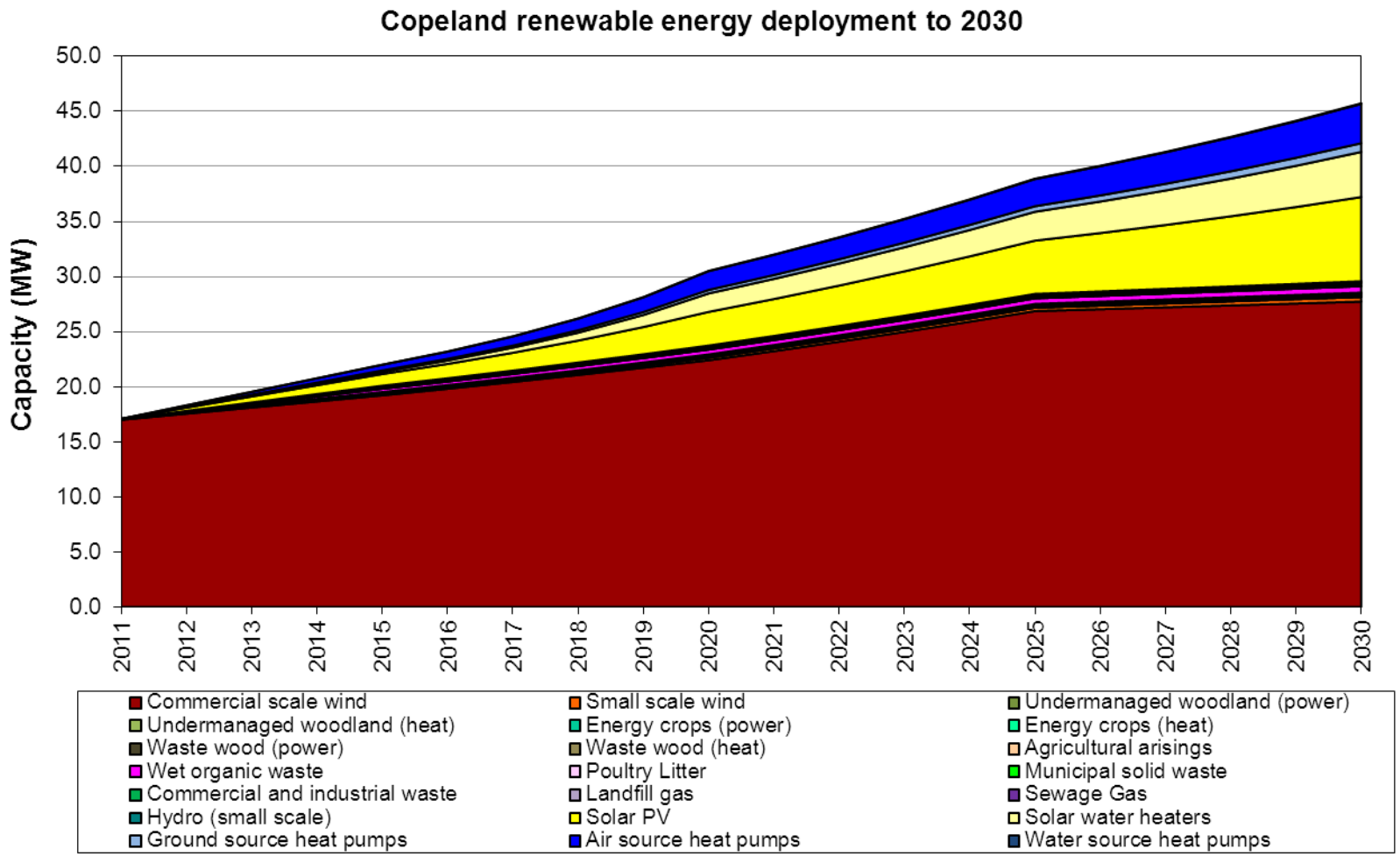
Table H-23:

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
ALL	17	29	46	270

Source: SQW

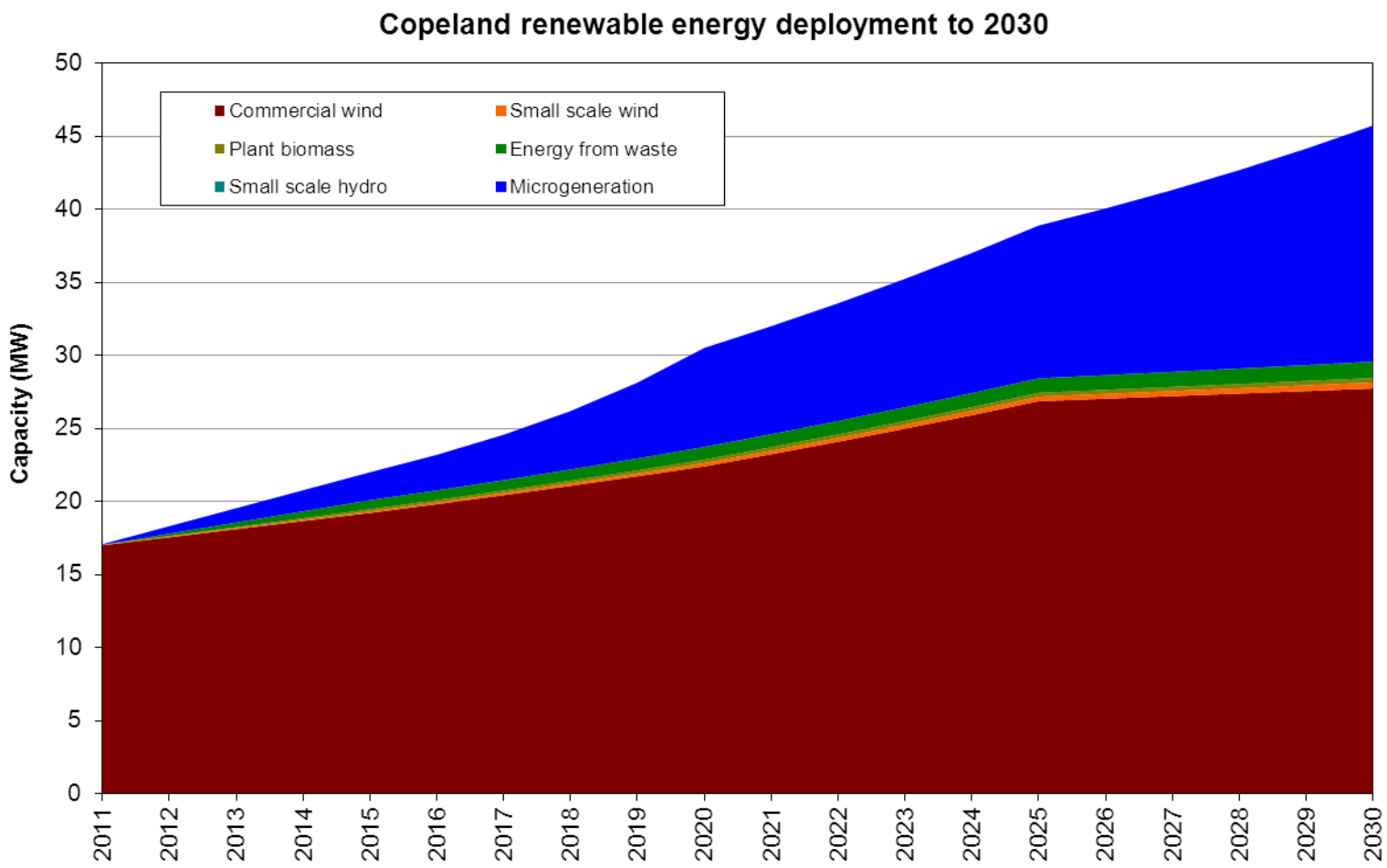
H.12 Overall, the tables show the biggest absolute resource is commercial scale wind and the biggest proportional increase in resource is solar microgeneration. This is reflected in the deployment curves displayed in the following figures:

Figure H-10: Copeland renewable energy deployment curve to 2030



Source: SQW

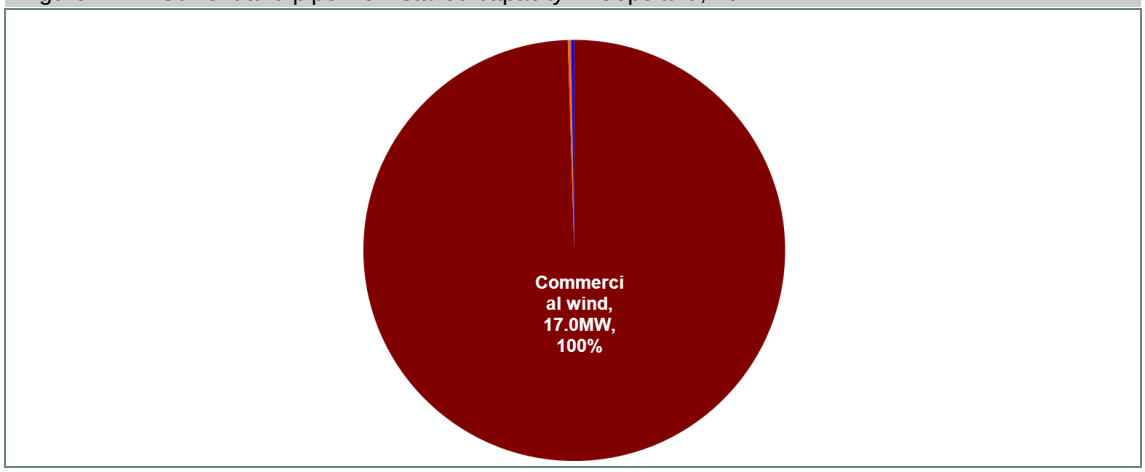
Figure H-11: Copeland renewable energy deployment curve to 2030 - simplified



Source: SQW

H.13 Figure H-3 shows how the installed and pipeline capacity is distributed in Copeland.

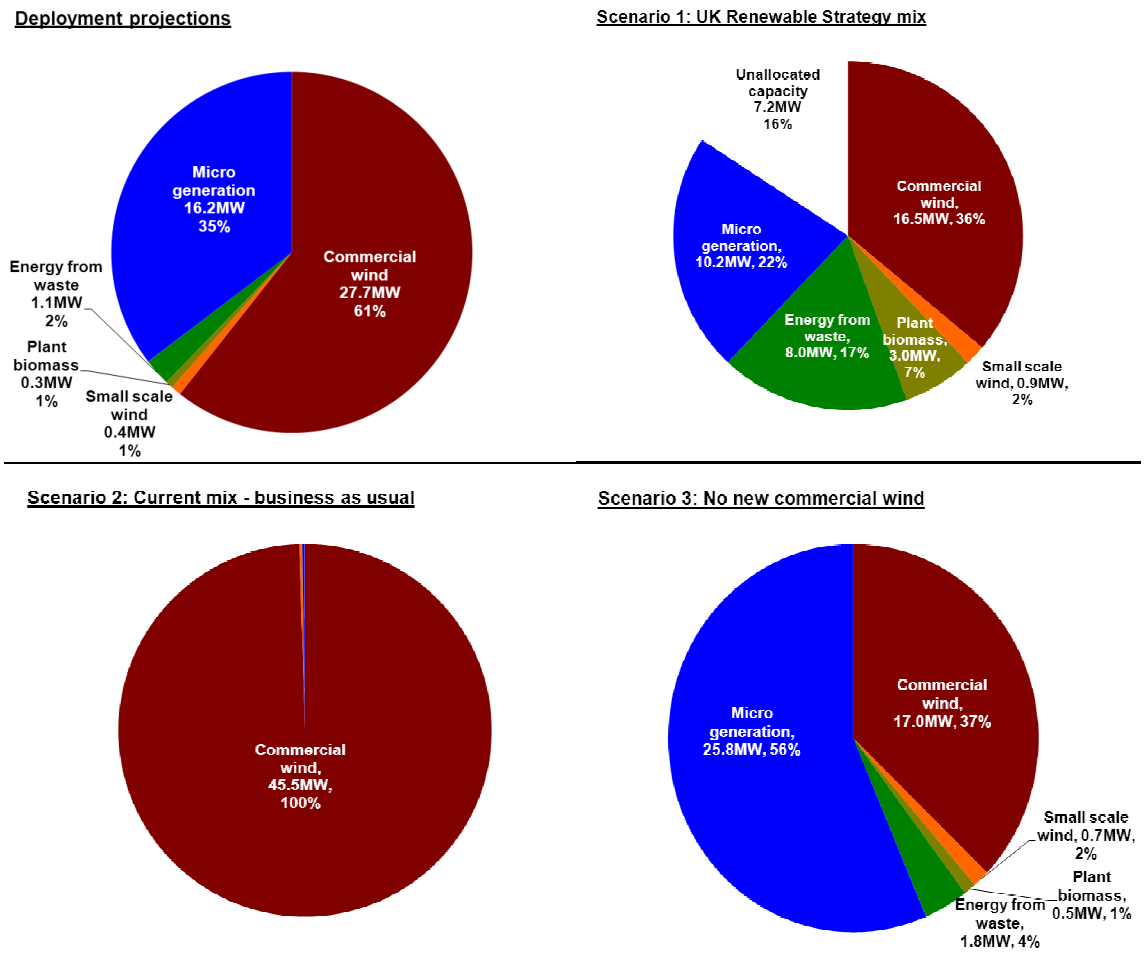
Figure H-12: Current and pipeline installed capacity in Copeland, 2011



Source: SQW

H.14 Table H-2 provides an overview of the scenario results for Copeland. This reveals a potential capacity shortfall of 7.2 MW for the UK Renewable Strategy mix scenario because technical resource capacities for plant biomass and small scale hydropower have been exceeded.

Table H-24: Scenario results for Copeland (total = 46MW)



Source: SQW

Eden

H.15 The current installed and pipeline capacity (operational, under construction, awaiting construction and consented) for renewable energy in Eden is set out below alongside the result of the Deployment Projections at 2030 and the additional amount that this represents over and above the current level. The final column shows the technical capacity identified from the earlier resource assessments.

Wind

Table H-25: Eden wind deployment projections, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource[10]
Commercial wind	0.0	53.6	53.6	656.5
Small scale wind	0.3	1.1	1.4	4.6
Total	**0.3**	**54.7**	**55.0**	**661.1**

Source: SQW

Biomass

Table H-26: Eden plant biomass deployment projections, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource[11]
Plant Biomass				
Undermanaged woodland (electricity)	0.0	0.1	0.1	1.4
Undermanaged woodland (heat)	0.0	1.2	1.2	8.7
Energy crops (electricity)	0.0	0.1	0.1	2.0
Energy crops (heat)	0.0	0.8	0.8	7.7
Waste wood (electricity)	0.0	0.0	0.0	0.5
Waste wood (heat)	0.0	0.0	0.0	0.4
Agricultural arisings	0.0	0.1	0.1	1.1
Total plant biomass	**0.0**	**2.3**	**2.3**	**21.7**
Animal biomass				
Wet organic waste	0.0	2.0	2.0	20.1
Poultry litter	0.0	0.1	0.1	1.4

[10] excluding protected landscapes
[11] excluding protected landscapes

Total animal biomass	**0.0**	**2.0**	**2.0**	**21.5**
Waste				
Municipal solid waste	0.0	0.2	0.2	1.9
Commercial & Industrial	0.0	0.1	0.1	2.0
Total waste	**0.0**	**0.3**	**0.3**	**3.9**
Biogas				
Landfill gas	1.0	-0.8	0.2	0.2
Sewage gas	0.0	0.1	0.1	0.5
Total biogas	**1.0**	**-0.7**	**0.3**	**0.7**
Total biomass	**1.0**	**3.9**	**4.9**	**47.7**

Source: SQW

Hydropower

Table H-27: Eden small scale hydropower deployment, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Small scale hydropower	0.4	0.8	1.2	4.4
Total	**0.4**	**0.8**	**1.2**	**4.4**

Source: SQW

Microgeneration

Table H-28: Eden microgeneration deployment, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Solar				
Solar photovoltaics	0.1	4.6	4.7	13.0
Solar water heating	0.0	2.3	2.3	11.3
Total solar	**0.1**	**7.0**	**7.0**	**24.3**
Heat pumps				
Ground source heat pumps	0.0	0.8	0.8	24.7
Air source heat pumps	0.0	3.4	3.4	98.8
Water source heat pumps	0.0	0.1	0.1	1.9

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Total heat pumps	**0.0**	**4.3**	**4.3**	**125.4**
Total microgeneration	**0.1**	**11.2**	**11.3**	**149.7**

Source: SQW

Totals

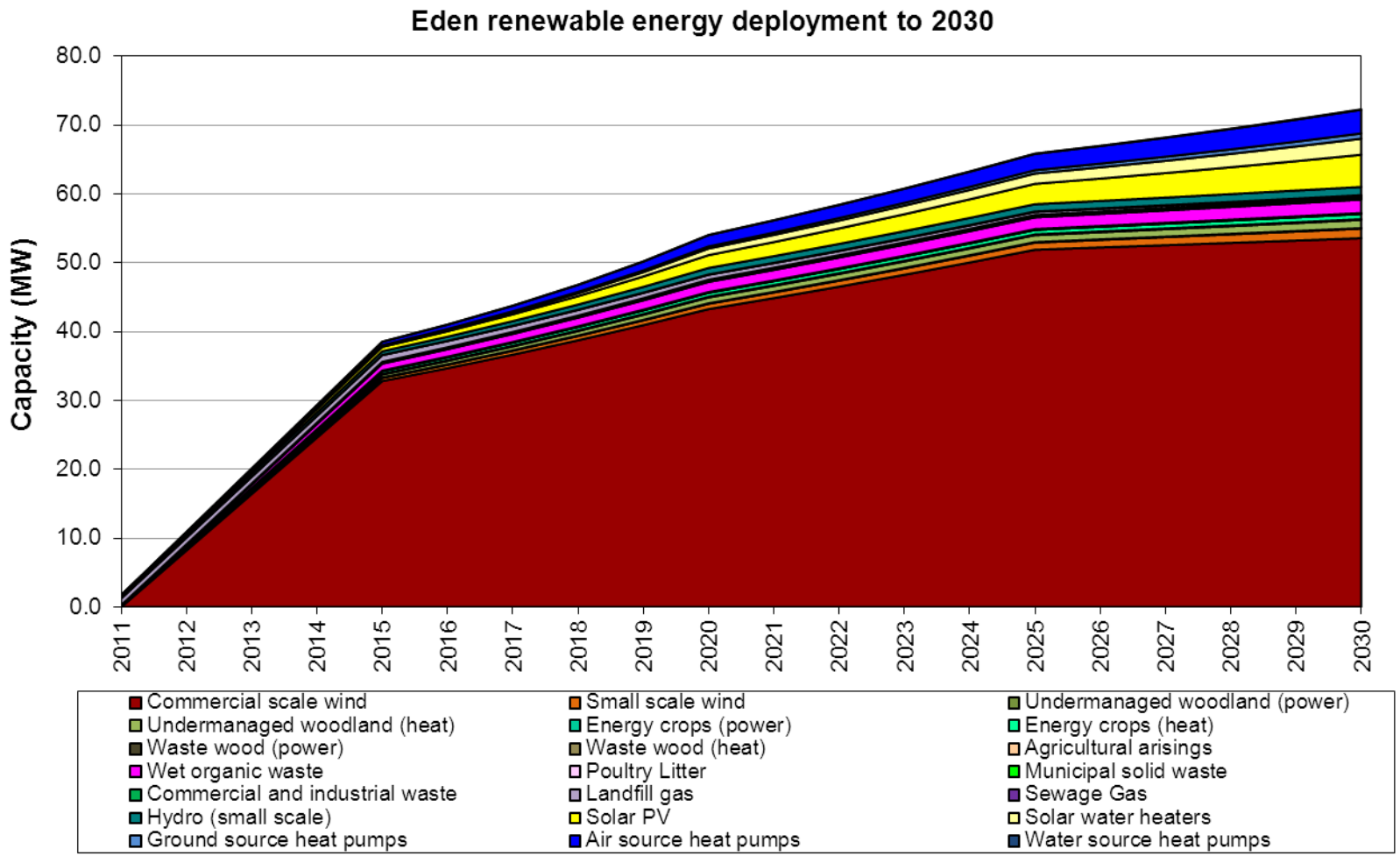
Table H-29: Total deployment projections for Eden, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
ALL	2	71	72	863

Source: SQW

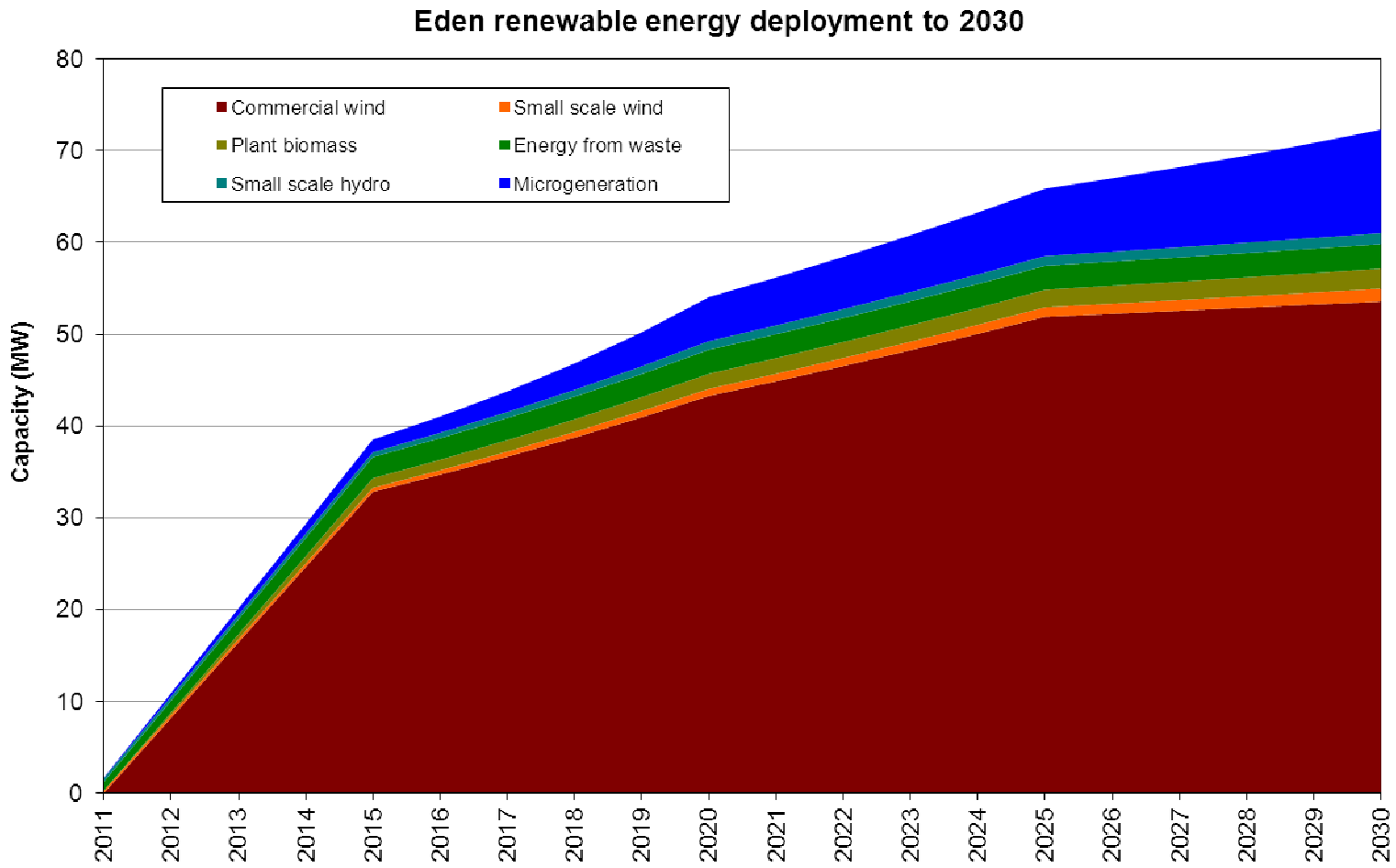
H.16 Overall the tables show the biggest absolute resource and the biggest proportional increase in resource is commercial scale wind. This is reflected in the deployment curves displayed in the following figures:

Figure H-13: Eden renewable energy deployment curve to 2030



Source: SQW

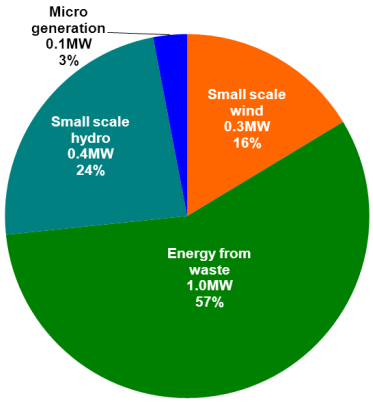
Figure H-14: Eden renewable energy deployment curve to 2030 - simplified



Source: SQW

H.17 Figure H-3 shows how the installed and pipeline capacity is distributed in Eden.

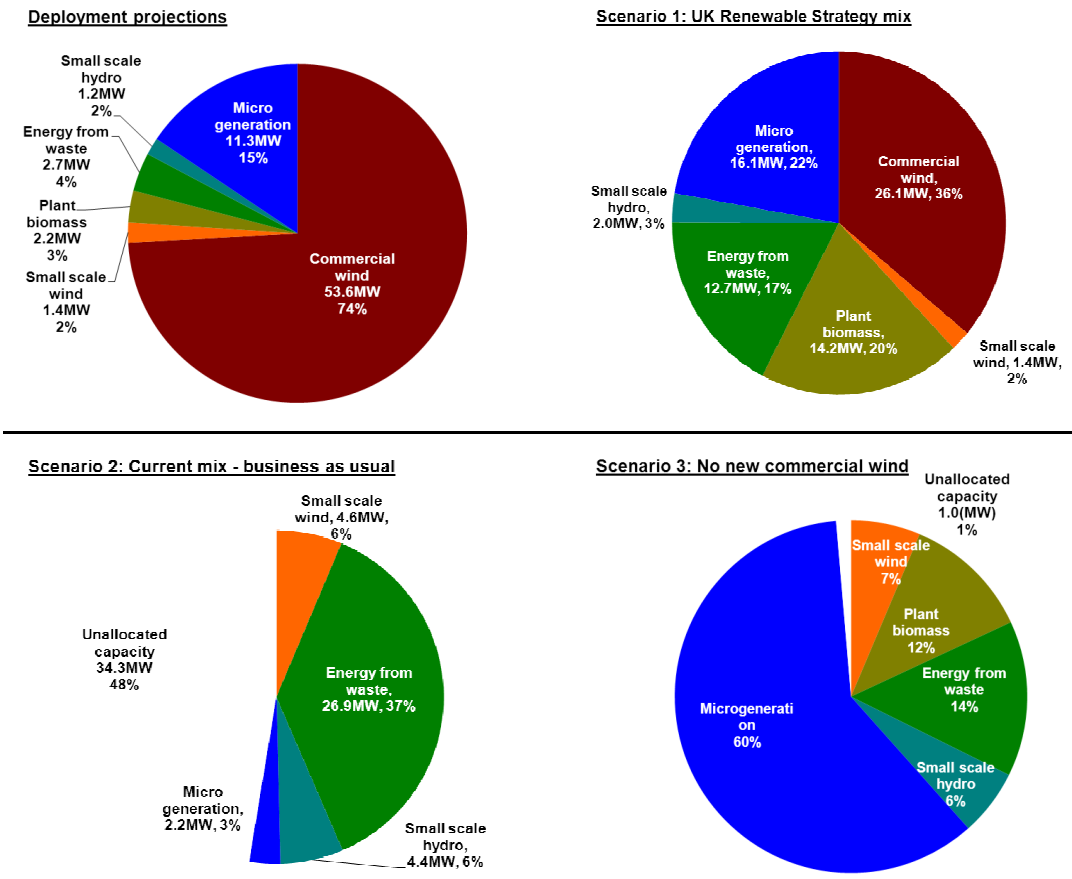
Figure H-15: Current and pipeline installed capacity in Eden, 2011



Source: SQW

H.18 Table H-25 provides an overview of the scenario results for Eden. This reveals a potential capacity shortfall of 34.3 MW for the Current mix – business as usual scenario because the projections for small scale wind, energy from waste and small scale hydropower have exceeded the identified technical resource capacity. There is also a small capacity shortfall for the No new commercial wind scenario as the technical capacities for small scale wind and small scale hydropower have been reached.

Table H-30: Scenario results for Eden (total = 72 MW)



Source: SQW

South Lakeland

H.19 The current installed and pipeline capacity (operational, under construction, awaiting construction and consented) for renewable energy in South Lakeland is set out below alongside result of the Deployment Projections at 2030 and the additional amount that this represents over and above the current level. The final column shows the technical capacity identified from the earlier resource assessments.

Wind

Table H-31: South Lakeland wind deployment projections, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource[12]
Commercial wind	28.8	23.4	52.2	246.0
Small scale wind	0.3	1.0	1.3	2.9
Total	**29.1**	**24.3**	**53.5**	**248.9**

Source: SQW

Biomass

Table H-32: South Lakeland plant biomass deployment projections, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource[13]
Plant Biomass				
Undermanaged woodland (electricity)	0.0	0.0	0.0	0.4
Undermanaged woodland (heat)	0.0	0.3	0.3	2.3
Energy crops (electricity)	0.0	0.0	0.0	0.3
Energy crops (heat)	1.6	0.0	1.6	1.1
Waste wood (electricity)	1.6	0.0	1.6	0.7
Waste wood (heat)	0.0	0.1	0.1	0.6
Agricultural arisings	0.0	0.0	0.0	0.1
Total plant biomass	**3.1**	**0.4**	**3.5**	**5.4**
Animal biomass				
Wet organic waste	0.0	1.1	1.1	11.5
Poultry litter	0.0	0.0	0.0	0.3

[12] excluding protected landscapes
[13] excluding protected landscapes

Total animal biomass	**0.0**	**1.1**	**1.1**	**11.8**
Waste				
Municipal solid waste	1.6	1.0	2.6	3.2
Commercial & Industrial	1.6	0.7	2.2	3.0
Total waste	**3.1**	**1.7**	**4.8**	**6.2**
Biogas				
Landfill gas	0.0	0.0	0.0	0.1
Sewage gas	0.0	0.1	0.1	0.7
Total biogas	**0.0**	**0.1**	**0.1**	**0.8**
Total biomass	**6.2**	**3.4**	**9.6**	**24.1**

Source: SQW

Hydropower

Table H-33: South Lakeland small scale hydropower deployment, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Small scale hydropower	0.1	0.6	0.7	6.6
Total	**0.1**	**0.6**	**0.7**	**6.6**

Source: SQW

Microgeneration

Table H-34: South Lakeland microgeneration deployment, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Solar				
Solar photovoltaics	0.2	8.7	8.9	24.7
Solar water heating	0.0	4.6	4.6	22.4
Total solar	**0.2**	**13.3**	**13.5**	**47.1**
Heat pumps				
Ground source heat pumps	0.0	1.1	1.1	34.6
Air source heat pumps	0.0	4.8	4.8	138.6
Water source heat pumps	0.0	0.1	0.1	3.6

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Total heat pumps	**0.0**	**6.0**	**6.0**	**176.8**
Total microgeneration	**0.2**	**19.3**	**19.5**	**223.9**

Source: SQW

Totals

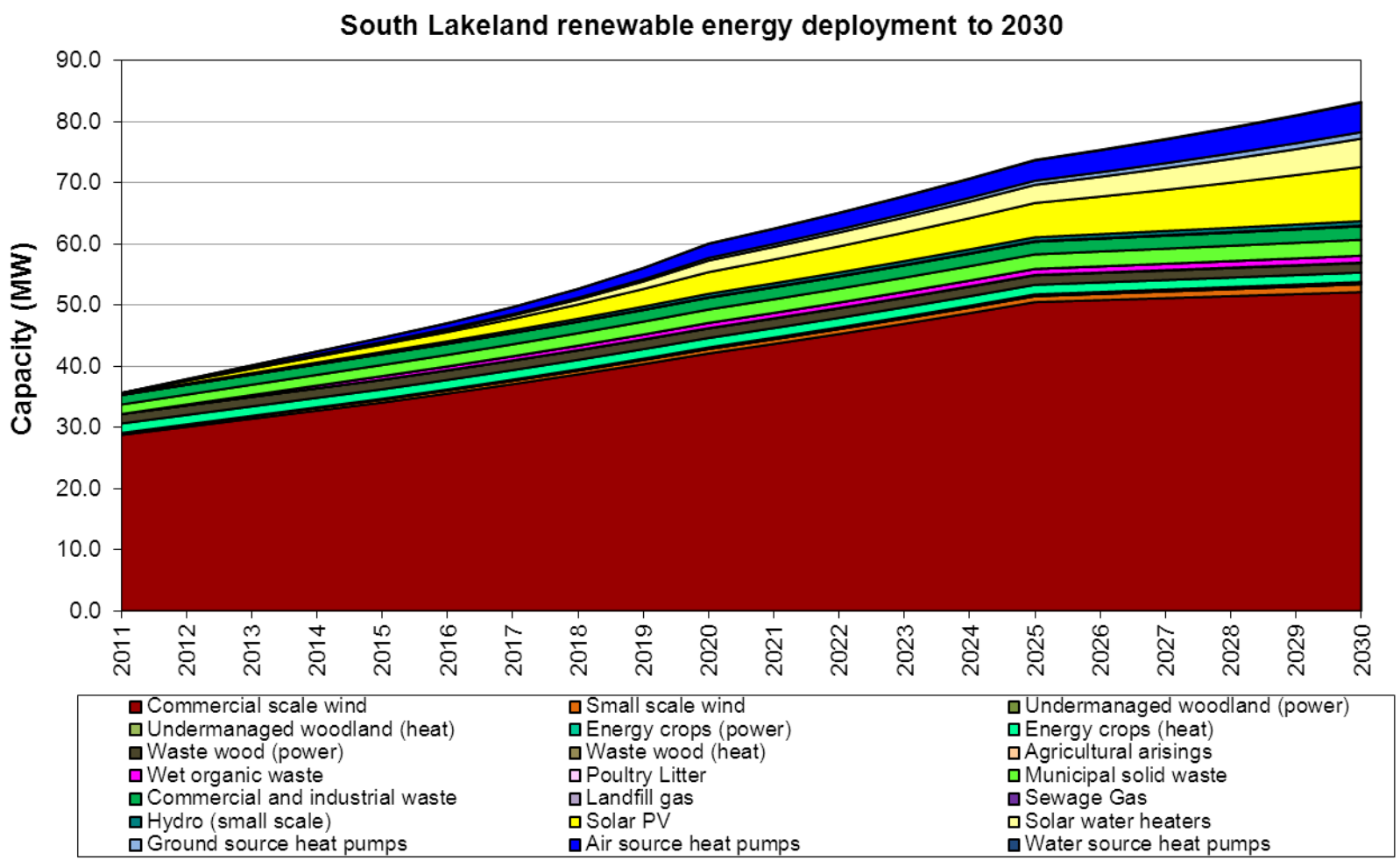
Table H-35: Total deployment projections for South Lakeland (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
ALL	36	47	83	504

Source: SQW

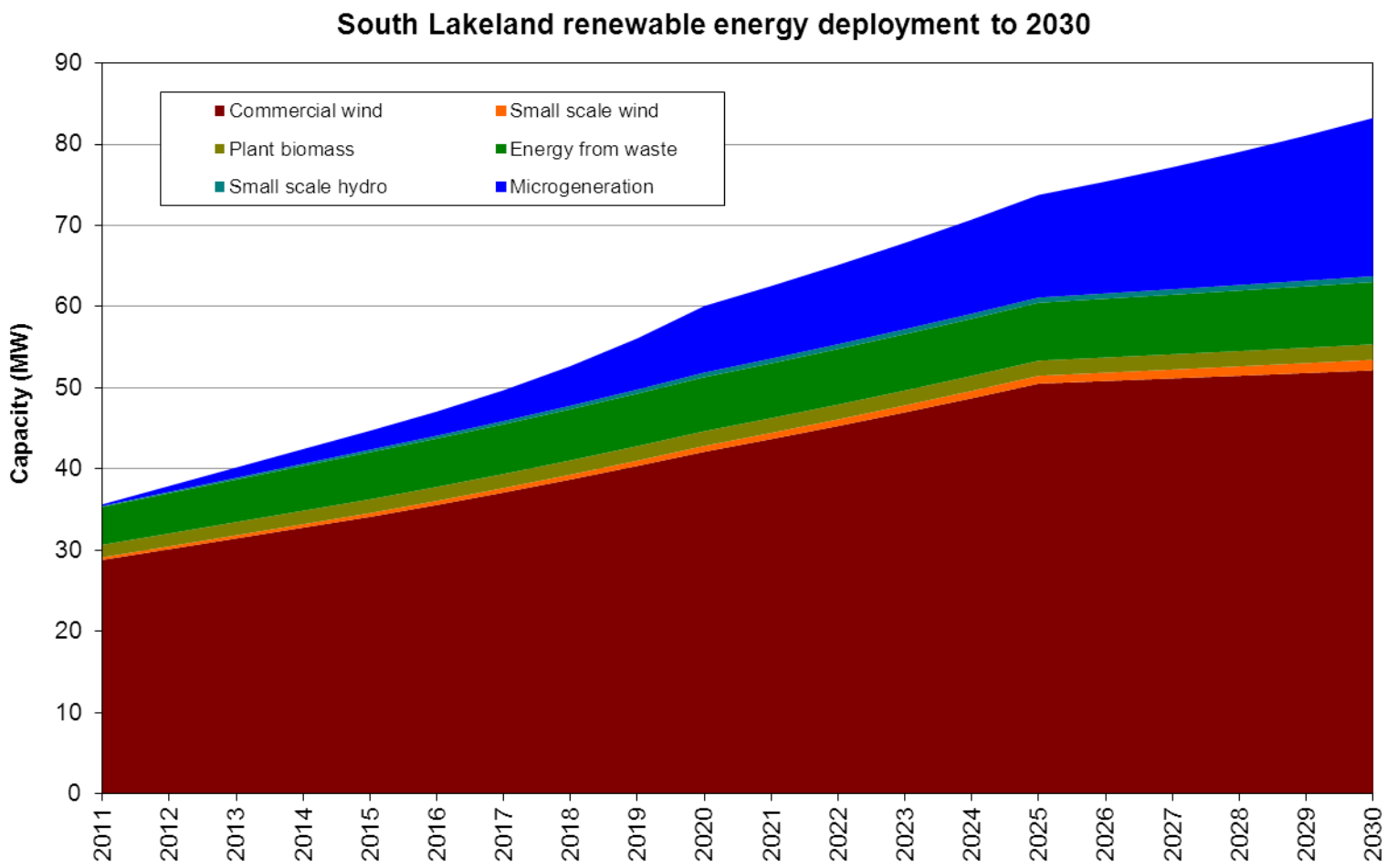
H.20 Overall the tables show the biggest absolute resource is commercial wind and the biggest proportional increase in resource is solar photovoltaics. This is reflected in the deployment curves displayed in the following figures:

Figure H-16: South Lakeland renewable energy deployment curve to 2030



Source: SQW

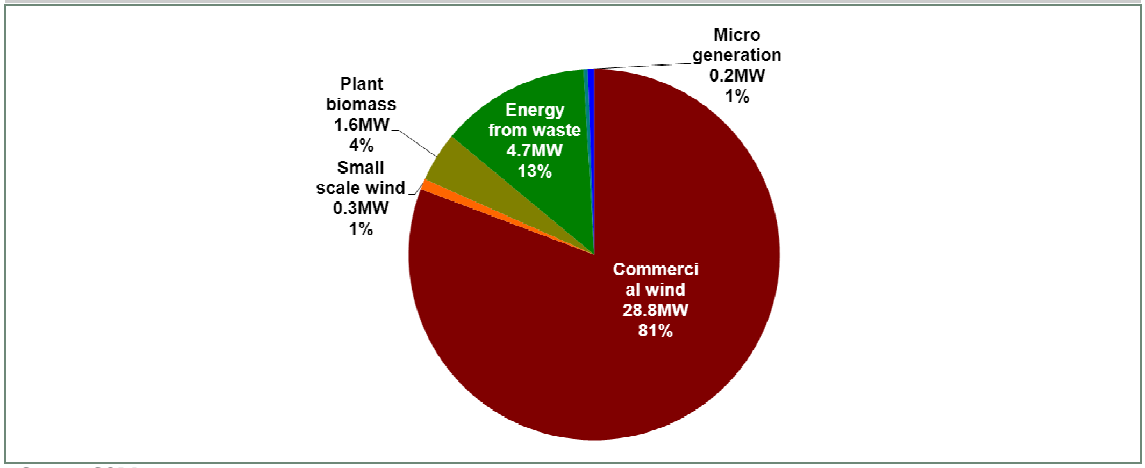
Figure H-17: South Lakeland renewable energy deployment curve to 2030 - simplified



Source: SQW

H.21 Figure H-3 shows how the current installed and pipeline capacity is distributed in South Lakeland.

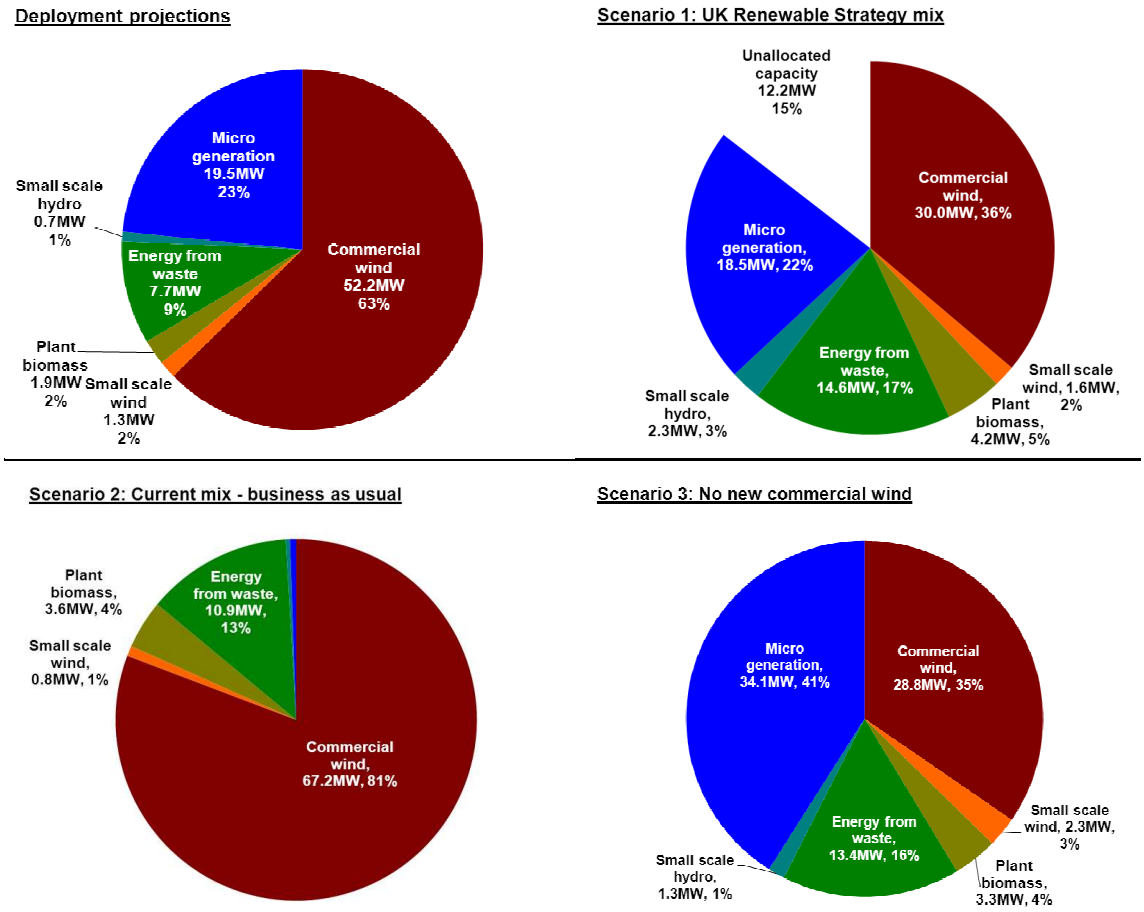
Figure H-18: Current installed and pipeline capacity in South Lakeland, 2011



Source: SQW

H.22 Table H-19 provides an overview of the scenario results for South Lakeland. This reveals a potential capacity shortfall of 12.2 MW for the UK Renewable Strategy mix scenario because plant biomass has exceeded the identified technical resource capacity.

Table H-36: Scenario results for South Lakeland (total = 83 MW)



Source: SQW

Lake District National Park

H.23 The current installed and pipeline capacity (operational, under construction, awaiting construction and consented) for renewable energy in the Lake District National Park (Lake District NP) is set out below alongside result of the Deployment Projections at 2030 and the additional amount that this represents over and above the current level. The final column shows the technical capacity identified from the earlier resource assessments.

Wind

Table H-37: Lake District NP wind deployment projections, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource[14]
Commercial wind	0.0	0.0	0.0	0.0
Small scale wind	0.0	1.0	1.0	5.2
Total	**0.0**	**1.0**	**1.0**	**5.2**

Source: SQW

Biomass

Table H-38: Lake District NP plant biomass deployment projections, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource[15]
Plant Biomass				
Undermanaged woodland (electricity)	0.0	0.1	0.1	2.6
Undermanaged woodland (heat)	0.0	2.2	2.2	16.0
Energy crops (electricity)	0.0	0.0	0.0	0.3
Energy crops (heat)	0.0	0.1	0.1	0.9
Waste wood (electricity)	0.0	0.0	0.0	0.5
Waste wood (heat)	0.0	0.1	0.1	0.5
Agricultural arisings	0.0	0.0	0.0	0.1
Total plant biomass	**0.0**	**2.5**	**2.5**	**20.8**
Animal biomass				
Wet organic waste	0.0	1.4	1.4	14.0
Poultry litter	0.0	0.0	0.0	0.2

[14] excluding protected landscapes
[15] excluding protected landscapes

Total animal biomass	**0.0**	**1.4**	**1.4**	**14.2**
Waste				
Municipal solid waste	0.0	0.2	0.2	2.0
Commercial & Industrial	0.0	0.1	0.1	2.4
Total waste	**0.0**	**0.3**	**0.3**	**4.4**
Biogas				
Landfill gas	0.3	-0.3	0.1	0.0
Sewage gas	0.0	0.1	0.1	0.5
Total biogas	**0.3**	**-0.2**	**0.1**	**0.5**
Total biomass	**0.3**	**4.0**	**4.4**	**39.9**

Source: SQW

Hydropower

Table H-39: Lake District NP small scale hydropower deployment, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Small scale hydropower	3.6	7.1	10.7	42.5
Total	**3.6**	**7.1**	**10.7**	**42.5**

Source: SQW

Microgeneration

Table H-40: Lake District NP microgeneration deployment, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Solar				
Solar photovoltaics	0.0	4.9	4.9	13.6
Solar water heating	0.0	2.3	2.3	11.0
Total solar	**0.0**	**7.2**	**7.2**	**24.6**
Heat pumps				
Ground source heat pumps	0.0	0.7	0.7	21.6
Air source heat pumps	0.0	3.0	3.0	86.4
Water source heat pumps	0.0	0.2	0.2	6.6

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
Total heat pumps	**0.0**	**3.9**	**3.9**	**114.6**
Total Microgeneration	**0.0**	**11.1**	**11.1**	**139.2**

Source: SQW

Totals

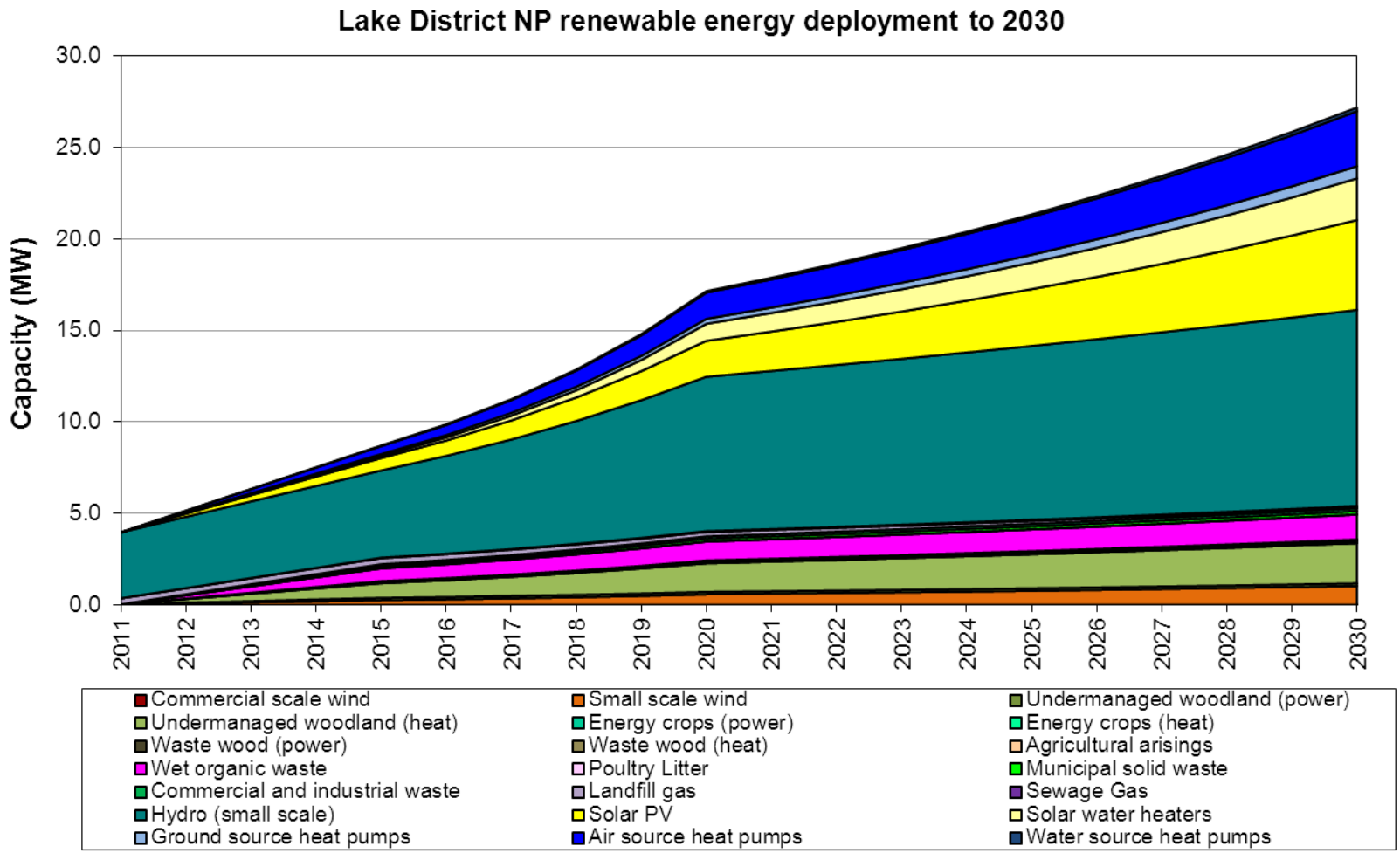
Table H-41: Total deployment projections for Lake District NP, 2030 (MW)

Technology	Installed and pipeline capacity at 2011	Additional deployment to 2030	Total deployment at 2030	Total accessible resource
ALL	4	23	27	227

Source: SQW

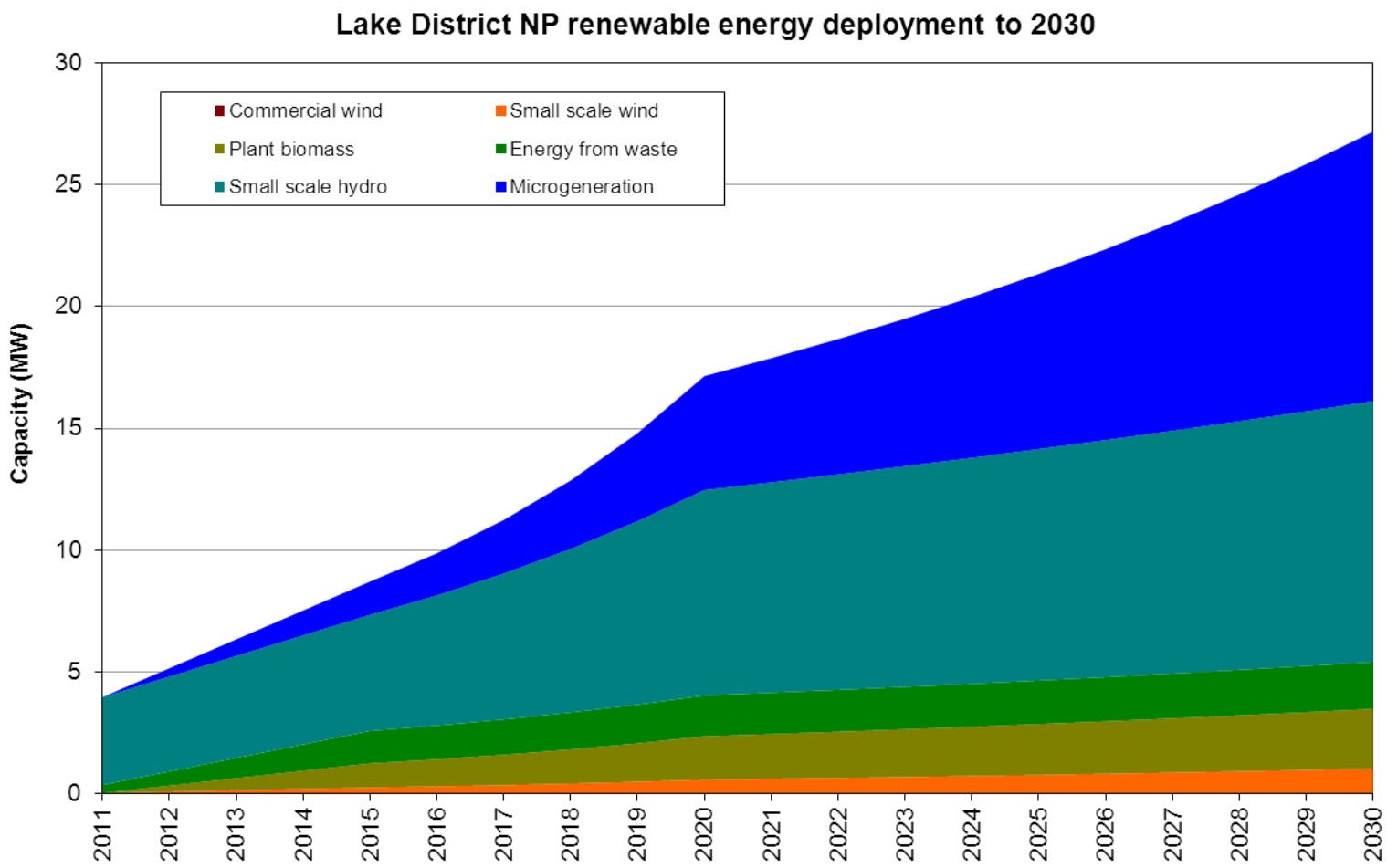
H.24 Overall the tables show the biggest absolute resource and the biggest proportional increase in resource is solar photovoltaics. This is reflected in the deployment curves displayed in the following figures:

Figure H-19: Lake District NP renewable energy deployment curve to 2030



Source: SQW

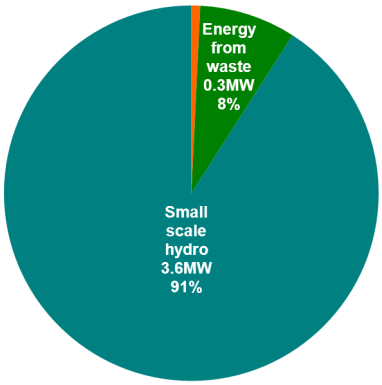
Figure H-20: Lake District NP renewable energy deployment curve to 2030 - simplified



Source: SQW

Figure H-3 shows how the current installed and pipeline capacity is distributed in Lake District NP.

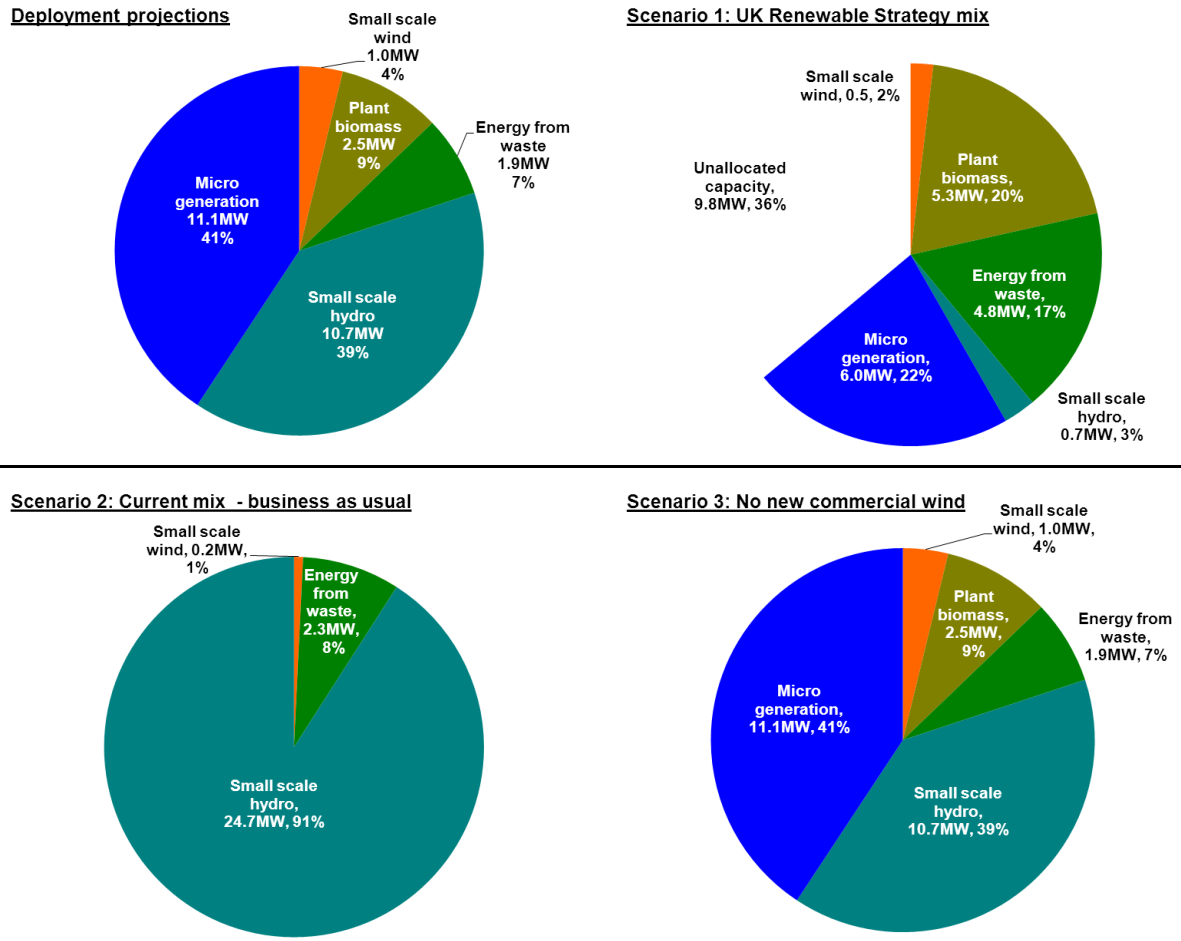
Figure H-21: Current installed and pipeline capacity in Lake District NP, 2030



Source: SQW

H.25 Table H-35 provides an overview of the scenario results for Lake District NP. This reveals a potential capacity shortfall of 9.8 MW for the UK Renewable Strategy mix scenario because commercial wind has exceeded the identified technical resource capacity.

Table H-42: Scenario results for Lake District NP (total = 27 MW)



Source: SQW

Annex I: Focus group details

I.1 This Annex provides the briefing note and programme for the Focus Group that held on 10 May 2011 to inform the qualitative analysis regarding upside opportunities and downside risks for the deployment of renewable energy across Cumbria. This is then followed by the key outcomes from the focus group in the form of SWOT (strengths, weaknesses, opportunities and threats) tables.

Focus group briefing

I.2 SQW and Land Use Consultants were commissioned by Cumbria County Council in September 2010 to prepare a Renewable Energy Capacity and Deployment Study for Cumbria. The study will provide a comprehensive evidence base that will facilitate local planning authorities across the sub-region to develop well-founded policies that support renewable energy deployment, where appropriate.

I.3 The first stage of the study, completed in mid-April 2011, was to undertake an assessment of the technical potential for renewable energy generation within Cumbria which took into account high level constraints such as landscape designations, but did not incorporate other constraints such as those related to transmission to the grid, economic viability, supply chain and planning policy.

I.4 The consultancy team has developed a deployment model, which will be used to refine the resource assessment results to provide a more realistic and deployable figure for the county. This is the main task for the second stage of the study. Initial views on likely constraints, and opportunities, have been sought from a range of stakeholders (via email and follow-up calls where appropriate).

I.5 The purpose of this focus group is first, for the consultancy team to provide further information on the study, results to date and next steps; and second, to seek views from participants on the issues likely to be faced for the deployment of renewable energy across Cumbria to influence the overall assessment of deployable potential. We very much appreciate the time you have taken to attend, look forward to hearing your views and hope you have an interesting and enjoyable afternoon.

Focus group programme

1:30 Welcome, introduction and housekeeping - Cumbria County Council

1:35 Purpose of the focus group and the study, overview of technical capacity findings - SQW

1:50 Translating technical to deployable capacity - SQW

- Overview of the deployment model
- Feedback on local evidence

2:15 Break out groups (3 or 4 depending on numbers) facilitated by SQW & LUC. These will be focused on undertaking SWOT (Strengths, Weaknesses, Opportunities & Threats) analyses concerning the deployment of renewable energy across Cumbria in relation to the following issues:

- Technological
- Supply Chain
- Planning
- Politics (national and local)
- Community Ownership

(A tea break will be held during the break out group session at 3:00).

3:45 Round up of key opportunities & constraints highlighted by each group

4:15 Next steps – SQW & Cumbria County Council

4:30 Close

Focus group outcome: SWOT tables

Table I-1: Technology

STRENGTHS & OPPORTUNITIES	WEAKNESSES & THREATS
• Potential for new PV technologies e.g. thin film (encouraged by FITs). • RHI could stimulate further innovation in heat. • Electricity from infra-red light. • A D.C.supergrid would be much more efficient way of moving electricity from best places to generate to consumption e.g. East coast of Scotland pilot. • Combinations of technologies e.g. trenches for electricity used fuel GSHP (ground source heat pump). • New super-grid connection to Sellafield from Gretna should provide an opportunity but no decision has been made on this yet and it won't be realised or have an impact on distribution until after 2020.	• Grid connectivity (due to rural geography) for micro-hydro and all technologies but not heat technologies or AD. • Hydro – low head sites especially outside N.P – Appleby pilot will present opportunity. • Heat pumps aren't practical to retrofit to existing building – domestic but could be added to community buildings as part of major refurb? e.g. Brigsteer Village Hall. • Technological development is reliant on government support .

Source: SQW & LUC

Table I-2: Supply chain and economics

STRENGTHS	WEAKNESSES
• Local businesses working on farm scale AD and solar PV • Re-use of existing (old tech) energy infrastructure and knowledge e.g. domestic heating converted to biomass boiler • Solway basin / Eden Valley well suited to farm-scale AD – large-scale dairy farms but potential long term decline in dairying due to climate change. • Two large waste biological treatment plants in construction.	• Wood heat and wind – poor levels of delivery of training and standards including AD and waste. • Microgeneration technologies need high fittings and maintenance compared to large scale wind. • Grid is currently not diverse enough to connect to but need to make most of local distribution network.
OPPORTUNITIES	**THREATS**
• MCS accreditations onerous - need a lower cost way in for small contractors. • Solar and heat pump training for installers • Public benefits of keeping money in local economy – could be used as a planning test. Micro creates opportunities for local businesses long term. • Re-use of old mill and hydro sites - less EA regulatory concern e.g. Church beck, Glen riding Beatham old mill site and Stavely Mill and Iggesund 50 MW plants on paper mill. • Opportunity for re-use of railway viaducts for small-scale tidal barrages e.g. Arnside Duddon and Ulverston.	• Ofgem MCS accreditation killing the DIY culture • Large scale technologies attractive to existing companies outside Cumbria (e.g. Germany) but short term work. • Wood fuel – we need to look at FC woodfuel strategy which covers in some detail constraints and opportunities.

Source: SQW and LUC

Table I-3: Planning and regulation

STRENGTHS

- Solar PV on buildings supported by the system e.g. recent appeal on a listed building
- Cumbria Wind Energy SPD
- Cumbria's studies/analysis ahead of the game, investment in feasibility e.g. as evidenced by commissioning this study
- SPD and MAPS/DATA - SPD alert evidence/data and MAPS (RSPB, Biomass)
- Aim for balance between environment and acceptability issues.
- Adoption of policies requiring renewables – LDNP on new build.
- Permitted development rights - small-scale solar / wind, scope for broadening in new bill
- Waste water/directories remain the same but EA implementation is evolving.
- Landfill tax increasing – encouraging re-use of waste.

WEAKNESSES

- Councillors and public perceptions re: scale of renewable energy developments
- Planning system reform - state of flux e.g. RSS targets, Localism Bill – Act, Planning legislation and guidance.
- SPD "not working well in all areas" – out of date.
- Some new developments missing any on-site renewables.
- Inconsistent LPA response e.g. requirements for microgeneration
- Decision making process – TIME e.g. Up to 3-4 years for large scale wind turbine.
- Inconsistency between planning and building control e.g. need for building regulations versus P.D
- Danger to birds from very limited sites without protection.
- Poor/bad applications. Can planning system protect environment if there is a change of use? e.g. change to energy crops and impacts on wildlife/birds .
- Inconsistency of planning inspectors' decisions e.g. Armistead and Silfield wind farms.

OPPORTUNITIES

- New Environment Agency single process for hydro - 2010 guide.
- LEPs/Enterprise zones getting more involved in planning (LEP chair or CCC contact - follow up).
- Localism is a "relative" concept when applying it to different situation e.g. Greenfield versus Brownfield sites.
- Up to date core strategy / planning policies
- Policies to promote particular technologies e.g. Allerdale Options Review, and Yorkshire Dales NP hydro policy
- Planners trained in renewables recently via the CLASP programme
- Universities to play a role in knowledge e.g. Newcastle University on AD. Cumbria University ongoing
- Harnessing the Enterprise Zone - Barrow and Lillyhall enterprise zone, "Fuelling the Future"
- Renewables Strategy – opportunity for pro-active Policy.
- Localism provides opportunity for local evidence to feed in in replacing regional/RSS type things.
- National Park revisions.
- Streamline requirements needed for go ahead (standard mitigation packages) e.g. RSPB giving advice on what is needed for mitigation.
- Opportunity (through SPDs) to improve planners knowledge.
- Code for sustainable homes (6) (ex BREAMM) should stimulate adoption of district heading, AD

THREATS

- Local community view e.g. on windfarms and small scale developments
- Various wind projects – refusals / appeals
- Localism - could be equally negative amongst negative communities. Large scale wind often suffers.
- Defra's current review of Sustainable Development in relation to National Park Authorities – could affect grants for
- Environment Agency and Natural England functions in state of flux.
- Separation Distance Bill (Turbine to Houses) - Second reading in parliament.
- National and Local Policy inconsistency - RSS etc.
- Local resistance to applications e.g. wind.
- National Park revisions.
- Losing sign of "proportionality"- different requirements for 15 m and 50m turbines.
- Cumulative impact - growth in deployment of impact e.g. birds/turbines.
- Although scope of broadening in the new Bill, there is a lack of clarity. Planners must be consulted.
- Lack of knowledge and experience in LPAs – planners and members.
- Code for sustainable home (6) – but ministerial statement has watered this down. Bonfire of red tape.
- National Policy Framework – equivalent negatives could lead to more NIMBY policies.

etc. • Localism and neighbourhood plans could enable enthusiastic communities to bring forward RE e.g. wood fuel. • National Policy Framework could free up LPAs to adopt locally relevant policies. • Community Infrastructure Levy could be used to encourage RE – but lots of competing demands for CIL. • If science (ongoing research) proves low impacts, could be an opportunity. • Renewables UK have suggested a voluntary developer contribution of £1k per installed MW per year. • National Infrastructure Planning Commission may free up large scale applications. More up-front consultation.	• Lots of waste regulation • Time taken for large scale applications to go through is growing. • Birds and Habitats Directive – ongoing research (scientific uncertainty) about the nature of impacts on birds/bats etc. • Planning system is opaque. Small businesses may be put off by red tape.

Source: SQW

Table I-4: Politics

STRENGTHS	WEAKNESSES
• Feed in Tariff. • Renewable Heat Incentive. • Independence of planning inspectorate.	• ROCS, FITs etc = artificial market. • Renewables may be undermining industrial competitiveness in the UK due to high energy prices e.g. Inneos Chlor feedback and Energy Intensive Users Group report 2010.
OPPORTUNITIES	**THREATS**
• "Greenest government ever". • Inward investment into Cumbria • CCC function to help this e.g. Vestas 2,000 jobs. • Lobbying capacity to change political direction. • Continuous process / engagement with local politicians and officers. • Localism agenda - local politicians engaging with this • CCC/Copeland view – no more wind. • EU finding – but awareness, availability, perceived capacity, motivation.	• Lack of match funding for grants (local MEP comment in the news) • UK might pull away from EU targets? • Economists views on job creation benefits of renewables v more positive potential from traditional energy sources • Continuous progress - CCC/Copeland view – no more wind. • Governance review of National Park authorities • Defra review – decisions due soon. • Post 2014 structural funds for Cumbria or not?

Source: SQW

Table I-5: Community ownership and buy in

STRENGTHS

- Multiple benefits e.g. AD=Heat for social housing and electricity
- Existing experience in and around Cumbria - some groups existing for long term / multiple issues. E.g. a pub scheme raised funds via shares (settle scheme went through learning). Crosby / Ravensworth project (early planning). Harlock Hill wind farm.
- Keenness – in general including the National Park
- Expertise of local people.
- Harlock Hill was UK's first community owned commercial scale wind project.
- Kentmere have plans for community hydro.
- Arnside and Silverdale AONB have a community interest company looking at small scale wind and PV.
- Invest directly in community buildings (and take the FITt to reinvest.

WEAKNESSES

- Local people need to be educated to make informed decisions.
- Loss of economies of scale without coordination of grassroots community groups/schemes.
- Source of truly independent advice (sales driven).
- Ability to access key info e.g. grid intelligence.
- Costs specific to Cumbria e.g. grid connection.
- Accessing funding to begin with e.g hydro needs initial feasibility £5-10k.
- Lots of objections
- Funding holes in project life cycles.

OPPORTUNITIES

- Promoting good practice – raise ambition.
- Public service Reform Bill - Summer 2011?
- Exemplars e.g. Thirlmere Village Hall, various hydro (some Yorks – NPA North Yorkshire feasibility study funding).
- Enable knowledge sharing e.g. Eden community groups – workshops on RE (2011) (CCC/CLASP).
- Networking between community energy projects at the Cumbria Action for Sustainability fortnight in Sept 2011 (CCC/CLASP funded); and the conference in May.
- Links with 'Big Society'.
- Money available to promote technical advice.
- Volunteer time / local knowledge.
- Opportunity to spread factsheet data / intelligence / process guidance.

THREATS

- Companies coming in with weak offer to communities i.e. need "ownership".
- Government change could threaten finances and local political support.
- Recession and public spending affecting grant availability.
- Private sector investment.
- Uncertain funding. Uncertain regulation e.g. tax.
- No trusted advice.
- Need planning / surveys.
- Technical advice can sometimes be generic.
- Cost and grid connection.

Source: SQW

Annex J: Conversion table

J.1 The following table has been produced to help contextualise the results from the Deployment Projections. For each technology we have identified the load factor (amount of theoretical maximum outputs likely to be generated from a renewable energy source), the MW capacity from a typical plant, the generating potential of the plant (MWh output per typical plant capacity) and the MWh output per MW capacity. This is then followed by an analysis of the Deployment Projections from this study in order to understand the number of additional plants that would need to be installed to reach the additional deployment projected and the number of houses these plants could serve. For commercial wind and biomass, it should be noted that each of the sub-categories meets the overall additional deployment identified separately. So, for commercial wind, the additional 157.9 MW capacity can be provided from 63 single large turbines OR 158 single medium turbines OR 315 single small turbines.

Table J-1:

Technology	Load factor	Source	Typical plant capacity			Deployment projections from this study			
			MW	MWh output per typical plant capacity	MWh output per MW capacity	Additional MW required to 2030	Additional MWh output to 2030	Number of additional homes served	Number of additional installations required
Commercial scale wind (single large turbine)	29.5%	DECC RESTATS (NW Regional Load Factors 2009) 'Wind'	2.5	6,461	2,584	157.9	408,045	104,815	63
Commercial scale wind (single medium turbine)	29.5%	DECC RESTATS (NW Regional Load Factors 2009) 'Wind'	1.0	2,584	2,584				158
Commercial scale wind (single small turbine)	29.5%	DECC RESTATS (NW Regional Load Factors 2009) 'Wind'	0.5	1,292	2,584				316

Technology	Load factor	Source	Typical plant capacity			Deployment projections from this study			
			MW	MWh output per typical plant capacity	MWh output per MW capacity	Additional MW required to 2030	Additional MWh output to 2030	Number of additional homes served	Number of additional installations required
Commercial scale wind (small farm with large turbines)	29.5%	DECC RESTATS (NW Regional Load Factors 2009) 'Wind'	10.0	25,842	2,584				16
Small scale wind	29.5%	DECC RESTATS (NW Regional Load Factors 2009) 'Wind'	0.006	16	2,584	6.1	15,764	4,049	1,017
Large biomass (electricity)	86.0%	Ofgem Renewables Register June 2010	100	753,360	7,534	8.7	65,542	16,836	0
Medium biomass (electricity)	86.0%	Ofgem Renewables Register June 2010	50	376,680	7,534				0
Large biomass plant boilers (heat)	45.0%	Carbon Trust (2009), Biomass heating a practical guide for potential users	3	11,826	3,942		34,295	1,947	3
Small biomass plant boilers (heat)	45.0%	Carbon Trust (2009), Biomass heating a practical guide for potential users	0.2	788	3,942				44

Technology	Load factor	Source	Typical plant capacity			Deployment projections from this study			
			MW	MWh output per typical plant capacity	MWh output per MW capacity	Additional MW required to 2030	Additional MWh output to 2030	Number of additional homes served	Number of additional installations required
Municipal solid waste	60.0%	DECC DUKES	11	57,816	5,256	2.4	12,614	3,240	0
Commercial and industrial waste	60.0%	DECC DUKES	11	57,816	5,256	1.6	8,410	2,160	0
Landfill gas	53.4%	DECC RESTATS (NW Regional Load Factors 2009) 'Landfil gas'	3	14,034	4,678	-6.1	-28,535	-7,330	-2
Sewage Gas	67.4%	DECC RESTATS (NW Regional Load Factors 2009) 'Sewage gas'	0.1	590	5,904	0.7	4,133	1,062	7
Hydro (small scale)	32.9%	DECC RESTATS (NW Regional Load Factors 2009) 'Hydro'	0.2	576	2,882	10.3	29,685	7,625	52
Solar PV (domestic)	8.0%	Renewable Energy Foundation 'FiT Performance in First Year' (Average load factor of 0 - 5MW installations)	0.001	1	701	53.8	37,703	9,685	53,800
Solar water	7.3%	Element Energy (2011)	0.0025	2	639	28	17,905	1,016	11,200

Technology	Load factor	Source	Typical plant capacity			Deployment projections from this study			
			MW	MWh output per typical plant capacity	MWh output per MW capacity	Additional MW required to 2030	Additional MWh output to 2030	Number of additional homes served	Number of additional installations required
heaters		'Achieving deployment of renewable heat'. Average of figures presented.							
Ground source heat pumps (domestic)	22.8%	Element Energy (2011) 'Achieving deployment of renewable heat'. Average of figures presented.	0.005	10	1,997	6.6	13,182	748	1,320
Air source heat pumps (domestic)	22.8%	Element Energy (2011) 'Achieving deployment of renewable heat'. Average of figures presented.	0.005	10	1,997	29.7	59,319	3,367	5,940
Water source heat pumps (non-domestic)	22.8%	as for other heat pumps	0.1	200	1,997	0.7	1,398	79	7

Source: LUC

J.2 The above assumes average household consumption (elec) 3.9 MWh (ONS Local Profiles tool (average for Cumbria 2007)) and average household consumption (gas) 17.6 MWh (ONS Local Profiles tool (average for Cumbria 2007)