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A Scoping Study on Assessment Practices for Noise Impacts from Renewable Technologies

Final Report for ClimateXChange
Prepared by LUC in association with Cassidy Acoustics
June 2017

climate change

Scotland's centre of expertise connecting climate change research and policy

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Executive Summary

LUC, in association with Cassidy Acoustics, was commissioned by ClimateXChange to undertake a scoping study examining practices for noise impacts from renewable technologies. The aim of the study was to explore the evidence for the need for a review of the way that councils in Scotland are assessing the noise impacts of three renewable technologies: air source heat pumps, hydro, and onshore wind turbines. The study examined policy and practice in relation to planning and environmental health in six local authorities:

- Aberdeenshire;
- East Ayrshire;
- East Renfrewshire;
- Fife;
- Highland;
- West Lothian.

The research stages included:

- Benchmark analysis of noise issues, policies and assessment methods for wind, hydro and ASHP;
- Identification and review of all relevant Environmental Health and local development plan (adopted and proposed, including supplementary guidance) policies on noise;
- Review of a sample of planning applications for each authority, to understand how the identified policies are being applied;
- Analysis and reflection including interviews with the relevant Environmental Health officers and planners within the case study authorities on how noise limits are being set, and why they are being set in this way.

Conclusions and Recommendations

The study concluded that noise issues associated with air source heat pumps and hydro schemes appear to be relatively straightforward and capable of being dealt with by normal development management procedures. By contrast, noise issues associated with wind turbine development are more complex and a far greater challenge for planning authorities.

National policy, advice and guidance require the consideration of noise in development management and refers to the use of ETSU-R-97 as the framework to be used for the measurement of wind farm noise.

Strategic development plans do not play a significant role in relation to setting the planning framework for noise. Local plans contain policies relevant to noise and the need for it to be assessed. Policy detail on the setting of noise limits which development should not exceed is most apparently dealt with within Supplementary Guidance (SG) which forms part of the development plan. Three of the six case study SG include reference to the ETSU-R-97 standards. As noted in the IoA Good Practice Guide to the application of ETSU-R-97, there is recognition that there may be local variations to methodologies or limits. Two examples of non-statutory guidance refer to ETSU and include some local variations on the levels.

The study found that ETSU-R-97 is widely used in the setting of noise limits for wind turbines through planning conditions.

In conclusion, the study did not identify a need to review the way that councils in Scotland assess the noise impacts of air source heat pumps, hydro and onshore wind turbines.

It did, however, identify a number of stakeholder concerns with the framework for assessing noise from wind turbines, in part reflecting concerns about the knowledge and expertise available within local planning authorities, and also with the framework itself.

The study made the following recommendations:

- Greater sharing of information via a **community of practice** focused on wind energy noise issues for EHO and planning officers.
- Preparation of a **lay person's guide** for non-noise specialists to facilitate communication of noise issues in relation to renewable energy.

The study also identified a number of recommendations for further research which include:

- An in depth review of the methodology within ETSU-R-97 and the IOA Good Practice Guide to identify areas where additional detail on interpretation would be required from a planning authority perspective, drawing specifically on the experience of stakeholders.
- Investigation of the value of a detailed local policy framework through a workshop event or similar for environmental health officers and planners. This would provide a forum for structured discussion and sharing good practice on noise policies and in particular, supplementary guidance. This could cover the scope, wording and potential for locally specific limits within policy and guidance. The outcome of this event could be recorded in a summary report to provide a reference source for local authorities addressing noise issues.
- A more detailed investigation of a sample of noise related complaints regarding wind farm developments would allow further conclusions to be drawn on ETSU limits and the nature and occurrence of noise related complaints.

1 Introduction

1.1 LUC, in association with Cassidy Acoustics, was commissioned by ClimateXChange to undertake a scoping study examining practices for noise impacts from renewable technologies.

1.2 The aim of the study was to explore the evidence for the need for a review of the way that councils in Scotland are assessing the noise impacts of three renewable technologies: air source heat pumps (ASHP), hydro, and onshore wind turbines.

1.3 The study examined policy and practice in relation to planning and environmental health in six local authorities which were selected by the project steering group:

- Aberdeenshire;
- East Ayrshire;
- East Renfrewshire;
- Fife;
- Highland;
- West Lothian.

1.4 The research stages included:

- Benchmark analysis of noise issues, policies and assessment methods for wind, hydro and ASHP;
- Identification and review of all relevant Environmental Health and local development plan (adopted and proposed, including supplementary guidance) policies on noise;
- Review of a sample of planning applications for each authority, to understand how the identified policies are being applied;
- Analysis and reflection including interviews with the relevant Environmental Health officers and planners within the case study authorities on how noise limits are being set, and why they are being set in this way.

1.5 A more detailed overview of the methodology is provided in Appendix 1.

2 Benchmark Analysis

2.1 This section of the report provides a summary of:

- The noise issues associated with each of the technologies;
- The best practice / agreed standards in the assessment of noise and setting of noise limits;
- The existing national planning policies, guidance and advice and any relevant environmental health standards for the case study local authorities.

2.2 A more detailed description for the benchmark analysis is provided in Appendix 2.

Summary of noise issues associated with the renewable energy technologies

Air Source Heat Pumps (ASHP)

Overview of the technology

2.3 Air source heat pumps (ASHP) absorb heat from the outside air which can then be used to heat radiators, underfloor heating systems, or warm air convectors and hot water. Air source heat pumps are usually located at ground level immediately adjacent to a building, or at roof level. They are similar in appearance to air conditioning units.

Study scope

2.4 This study includes air source heat pumps requiring planning consent.

Noise sources and characteristics

2.5 Air source heat pumps generate noise during operation, and this is principally associated with compressor and fan. Noise levels vary according to the power level and the character of the noise changes when the unit goes into a defrost cycle.

Potential noise impacts

2.6 Noise impacts may occur where air source heat pumps are located close to noise sensitive buildings such as residential properties.

Planning context

2.7 In Scotland, domestic air source heat pumps systems are classified as a permitted development provided it meets a number of criteria. For example, the air source heat pump must be used to provide domestic heating, and must be the only air source heat pump within the curtilage of the building in question. The installation of the air source heat pumps must also comply with the MCS 020 Planning Standard[1] (or equivalent) which sets out the procedure that installers should follow to ensure that noise effects are acceptable.

2.8 Prior to March 2016, permitted development rights did not apply if the installation was within 100m of another residential building (amongst other requirements). This change means that, as of March 2016, all air source heat pump installations in Scotland are permitted development (with a number of standard exclusions relating to size and cultural heritage[2]), and must comply with the

[1] Department of Energy and Climate Change (DECC) (2008) MCS Planning Standards For permitted development installations of wind turbines and air sour heat pumps on domestic premises. Issue 1.2 Revised 2015. Available at: http://www.microgenerationcertification.org/images/MCS_020_Planning_Standards_Issue_1.2.pdf

[2] Scottish Government (2016) Guidance on Permitted Development Rights. Available at: http://www.gov.scot/Publications/2016/06/2685/8

MCS Planning standards or equivalent standards. It also means that fewer proposals for air source heat pumps are subject to development management processes.

Noise assessment and standards

2.9 As noted previously, the MCS 020 Planning Standard provides the principal means of ensuring that the noise impacts of air source heat pumps are acceptable.

Hydro

Overview of the technology

2.10 Recent years have seen a notable increase in the number of hydro-electric schemes proposed and implemented in Scotland. Most recent developments are of a small scale, with installed capacity which tends to be between 1 and 2 MW.

Study scope

2.11 This study covers operational noise issues associated with smaller scale hydro schemes.

Noise sources and characteristics

2.12 Noise impacts associated with small scale hydro schemes generally focus on the mechanical noise (hum or whine) from the turbine itself, with secondary effects including the hum from any transformers and the sound from the tail race as water is returned to the river. Construction noise will depend on the scheme itself and the extent of engineering works. Operational noise is usually controlled through conditioned noise limits and occasionally by restrictions on the hours of operation. Where turbines are housed within buildings there is usually potential for mitigation in the form of noise insulation.

Potential noise impacts

2.13 Potential noise impacts may occur where hydro turbines are located close to noise-sensitive buildings such as residential properties.

Planning context

2.14 Scottish Planning Policy (2014)[3] requires planning authorities to identify in their development plans areas capable of accommodating hydro schemes related to river or tidal flows. Noise Impact Assessments can be required either as part of an EIA or separately as requested by the planning authority. The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011 identify hydro schemes with an installed capacity of more than 0.5MW as potentially requiring Environmental Impact Assessment (EIA) dependent on factors including potential for cumulative impacts, the generation of nuisance and the sensitivity of the proposed location. The location of a proposed hydro scheme close to residential property could therefore trigger the requirement for noise assessment as part of an EIA.

Noise assessments and standards

2.15 Specific guidance for the noise assessment of hydro-electric schemes does not exist, however PAN 1/2011[4] promotes the principles of good design to ensure that quality of life is not unreasonably affected. Consequently, for industrial environmental noise, authorities typically request a full noise assessment based on BS4142 Methods for Rating and Assessing Industrial and Commercial sound, and the World Health Organisation (WHO) Guidance for Community Noise. BS8233 is occasionally referenced as a noise limit, and this contains recommended internal noise levels which are in line with those presented in the WHO guidance. Other noise limits associated with hydro-electric schemes include planning conditions set to Noise Rating (NR) curves within the nearest residential properties.

[3] Scottish Government (2014) Scottish Planning Policy. Available at: http://www.gov.scot/Resource/0045/00453827.pdf

[4] Scottish Government (2011) Planning Advice Note 1/2011 Planning and Noise. Available at: http://www.gov.scot/resource/doc/343210/0114180.pdf

Wind

Overview of the technology

2.16 Wind energy schemes currently account for around 70% of the total renewable energy installed capacity in Scotland. Schemes range in size from single turbines or small groups of turbines to large wind farms compromising well over a hundred turbines.

Study scope

2.17 This study covers noise issues associated with all sizes of wind turbine, with the exception of domestic turbines mounted on buildings.

Noise sources and characteristics

2.18 A number of noise issues are associated with the operation of wind turbines, which includes 'aerodynamic noise' caused by the movement of blades and 'mechanical noise' brought about by the turbine gearbox and transmission, taking the form of a hum or low whine. An additional characteristic of wind turbine noise is amplitude modulation (AM). AM characteristics are commonly perceived as sounds that could be described as 'swish', or less frequently as 'thump'[5]. Awareness of AM has increased in recent years, including recent research reports commissioned by the former Department of Energy and Climate Change in 2015[6].

Potential noise impacts

2.19 Generally, the severity of impacts from wind turbines will depend on a number of factors, including:

- the characteristics of the noise in question (e.g. aerodynamic 'swish' or mechanical whine);
- any variations in noise over time, as well as the frequency with which the noise occurs;
- prevailing weather conditions including wind speed and direction;
- whether receptors are present and what they are doing; and
- Personal circumstances and attitudes towards the source of noise.

Planning context

2.20 Scottish Planning Policy requires planning authorities to identify where there is strategic capacity for wind farms, including those areas with greatest potential for wind development.

2.21 The following sources of information are relevant to the assessment of noise from wind turbines:

- The Assessment and Rating of Noise from Wind Farms (ETSU-R-97)[7]; and
- Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise by the Institute of Acoustics (IoA)[8].

2.22 The ETSU-R-97 and IoA guidance are specifically referenced within Scottish Government policy and guidance, such as the online guidance on Onshore Wind Turbines, PAN 1/2011 and Technical Advice Note (TAN): Assessment of Noise.

2.23 ETSU-R-97 provides a framework for the approach to the measurement of wind farm noise, and also provides indicative noise levels. In this sense it is both a guidance document and a methodology and the limits within the document are widely used as the accepted standard.

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[5] WSP, Parsons Brinckerhoff (2016) Wind Turbine AM Review Phase 2 Report. Department of Energy and Climate Change. Available from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/562186/Phase_2_Report_-_Wind_Turbine_AM_Review_Issue_3__FINAL_.pdf

[6] https://www.gov.uk/government/publications/review-of-the-evidence-on-the-response-to-amplitude-modulation-from-wind-turbines

[7] The Working Group on Noise from Wind Turbines (1996) The Assessment and Rating of Noise from Wind Farms Available at: http://webarchive.nationalarchives.gov.uk/20090609003228/http://www.berr.gov.uk/energy/sources/renewables/explained/wind/onshore/page21743.html

[8] Institute of Acoustics (2013) A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise: Available at: http://www.ioa.org.uk/sites/default/files/IOA%20Good%20Practice%20Guide%20on%20Wind%20Turbine%20Noise%20-%20May%202013.pdf

Noise assessment and standards

2.24 Noise is often critical to the development management decision, while noise limits are usually embodied with conditions attached to a planning consent.

2.25 ETSU-R-97 sets out a noise assessment methodology for all wind turbine development. This approach comprises six steps:

- Prediction of noise from all turbines at the nearest receptors;
- Determine the study area;
- Identify potentially affected properties;
- Measure background noise at affected properties;
- Analyse data to derive noise limits for the scheme;
- Update noise predictions and access compliance with noise limits for candidate turbines.

2.26 Under this methodology, noise limits are set with reference to ambient or background noise levels prevailing at the nearest noise sensitive property before the scheme is developed, rather than defining a standard noise level that is deemed acceptable in any location or context, except where a development is far enough away and a 35dB(A) limit is applicable. In low noise environments ETSU recommends setting day time level of the L_{A90} wind farm noise to an absolute level between 35-40dB(A), and night time level of 43dB(A). Ensuring that the noise limit is correctly defined, reflected in planning conditions, monitored and enforced are evidently critical to the approach.

Noise standards and guidance

2.27 In addition to the planning policy framework, there are a number of other general standards and guidance which are used for assessing noise for the three renewable technologies wind, air source heat pump, and hydro. A summary of these is provided in Table 2.1 below, and further details are included in Appendix 3.

Table 2.1 Summary of Standards and Guidance on Assessing Noise

Standard or guidance	Air source heat pump	Hydro	Onshore wind	Comment
IEMA Guidelines for Environmental Noise Impact Assessment	X	X	X	The IEMA guidelines are applicable to noise impact assessment for any scale of development proposal, and provide advice on the issues that need to be considered in a noise impact assessment i.e. the appropriateness of the noise parameters, the reference time period used, the nature of the noise sources, and the relation between predicted noise levels and relevant standards and guidelines.
BS 7445-1:2003	X	X	X	BS 7445-1:2003 provides details of the instrumentation and measurement techniques to be used when assessing environmental noise. Background noise assessments are typically undertaken in accordance with BS 7445-1:2003.
Environmental Protection Act 1990	X	X	X	The Environmental Protection Act 1990 provides powers for a local authority, to serve a noise Abatement Notice, in order to demand that an individual or company, who the local authority believes to be generating unnecessary and objectionable noise, refrains from causing a nuisance in the future.
World Health Organisation	X	X	X	The World Health Organisation (WHO) Guidelines for Community Noise state that in dwellings, the critical effects of noise are on sleep, annoyance and speech interference. To this end, different night-time criteria are presented, based on the type of space, health effects, noise levels and duration.
BS 4142:2014	X	X		BS 4142:2014 presents methods for rating and assessing

Standard or guidance	Air source heat pump	Hydro	Onshore wind	Comment
				industrial and commercial sound affecting mixed residential and industrial areas. Though originally used to develop ETSU-R-97, the 2014 version of BS 4142 makes specific reference to not being applicable to "other sources falling within the scopes of other standards or guidance". Noise assessments are undertaken in accordance with BS 4142:2014, which refers to the following assessment of impact: *A difference of around +10dB or more is likely to be an indication of a significant adverse impact.* *A difference of around +5dB is likely to be an indication of an adverse impact* An objective method for penalties, and rating uncertainty have been included in the latest version of the standard.
ETSU-R-97			X	ETSU-R-97 sets out a UK noise assessment methodology for all wind turbine developments, and noise limits Noise from the wind farm is limited to 5dB above background for both day and night-time, subject to a lower limit of 35 to 40 dB during the day and 43 dB at night up to wind speeds of 10m/s at 10m height,. In low noise environments, the day-time level of the $L_{A90,10min}$ of the wind farm noise is limited to an absolute level within the range of 35-40dBA, and this depends on the number of nearby dwelling, effect on generation, and the duration and level of exposure.
IoA Good Practice Guide (2013)			X	The IoA Good Practice Guide is a guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise. It describes methods for background noise data collection, data analysis, noise limit derivation and noise predictions. It also includes an example planning condition with attached guidance notes.
BS 8233:2014	X	X		BS 8233:2014 provides guidance for the control of noise in and around buildings.
Noise Rating (NR) Curves	X	X		Noise curves are a common way to measure and specify audio noise in buildings and occupied spaces. Their purpose is to produce a single number rating for the background noise spectrum in a space.
BS 5228-1:2009+A1:2014		X	X	BS 5228-1:2009+A1:2014 is a code of practice for noise and vibration control on construction and open sites. The standard does not give noise limits for construction sites, but emphasis is placed on ensuring that best practical means are adapted to control noise on site.
Control of Pollution Act 1974	X	X	X	The aim of the Control of Pollution Act 1974 is to deal with a variety of environmental issues, including noise pollution. It sets out the process for dealing with excess noise and noise from construction sites.
MCS Planning Standards MCS 020	X		X	The MCS Planning Standards set out the standard which must be complied with for domestic installations to be permitted development. It includes a calculation procedure designed to confirm whether the permitted development noise limit of 42dB $L_{Aeq,5\ mins}$ (at the assessment position) would be met.
Permitted Development Rights: Domestic Wind Turbines and Air Source Heat Pumps	X		X	The 'Permitted Development Rights' was a study to identify and evaluate the benefits and impacts associated with both Domestic Wind Turbines (DWT) and air source heat pumps. The study provides evidence for appropriate recommendations to Scottish Ministers on the granting of Permitted Development Rights in planning legislation to the two technologies.

3 Policy and national standards

3.1 This section of the report sets out the key findings from the review of policy for the sample planning authorities. The findings are presented as overall observations and with reference to the specific technology type where this is appropriate.

3.2 A review of the relevant Environmental Health and Local Development Plan policies on noise, particularly those specific to noise from wind turbines, hydro schemes and air source heat pumps was undertaken, and this is summarised in this chapter.

National Policy and guidance

NPF and SPP

3.3 National Planning Framework 3 (2014)[9] does not make reference to noise within the context of general amenity or renewable energy. Scottish Planning Policy (2014)[10] makes generic reference to the consideration of noise in development management, specifically in relation to rural development, and energy infrastructure development.

PAN 1/2011 Planning and Noise

3.4 Planning Advice Note (PAN) 1/2011[11] outlines how noise should be addressed in development planning and development management. PAN 1/2011 outlines a range of generic measures which can be implemented though planning conditions. It cross refers to the Addendum to Circular 4 1998 which sets out some model conditions relating to noise issues. With specific respect to noise from wind turbines, the PAN refers back to the Scottish Government online guidance on Onshore Wind Turbines and the ETSU-R-97 guidance.

TAN Planning and Noise

3.5 Technical Advice Note (TAN) Planning and Noise[12] provides guidance which assists in the technical evaluation of noise assessment for various common situations. It provides detailed guidance which aims to assist in assessing the significance of the impact. TAN Planning and Noise makes reference to PAN 1/2011, which provides advice on the role of the statutory planning system in helping to prevent and limit the adverse effects of noise. TAN Planning and Noise provides a framework for assessing the noise impacts that could potentially arise when a 'noise generating development' (NGD) is consented or when a 'noise sensitive development' (NSD) is planned.

Strategic Development Plans

3.6 Three of the planning authorities discussed in the case studies are also covered by Strategic Development Plans (SDP). The SDP were reviewed in order to identify how noise issues were considered at this level. The policy review identified only generic references to the importance of renewable energy, and broad references to the need to consider wider impacts. Only one SDP policy specifically requires the consideration of renewable energy noise impacts, requiring that proposals for energy schemes should consider the '*anticipated effects of construction and operation on air quality, emissions, noise, odour, surface and ground water pollution, drainage,*

[9] Scottish Government (2014) National Planning Framework 3. Available at: http://www.gov.scot/Resource/0045/00453683.pdf
[10] Scottish Government (2014) Scottish Planning Policy. Available at: http://www.gov.scot/Resource/0045/00453827.pdf
[11] Scottish Government (2011) Planning Advice Note 1/2011 Planning and Noise. Available at: http://www.gov.scot/resource/doc/343210/0114180.pdf. Available at: http://www.gov.scot/resource/doc/343210/0114180.pdf
[12] Scottish Government (2011) Technical Advice Note Planning and Noise. Available at: http://www.gov.scot/Resource/Doc/343341/0114220.pdf

waste disposal, radar installations and flight paths, and, of nuisance impacts on off-site properties'.

Local Development Plans, Supplementary Guidance and other planning advice

3.7 As stated in PAN 1/2011 unwanted noise can have a significant impact upon environmental quality, public health and amenity. The approach to addressing the issue of noise from renewables within the case study Local Development Plans takes a number of varied approaches. Table 3.1 below summarises the different approaches to the coverage of noise and renewable energy within the case study plans.

Table 3.1 Overview of Local Development Plan, Supplementary Guidance and other planning guidance by planning authority references to noise

Local Development Plan	A	B	C	D	E	F
General noise policy /reference to amenity	Overarching **noise** policy which also refers to SG on noise	Overarching policy on **pollution** refers to noise	**Amenity** policy refers to **noise** from all types of development	Strategic policy on Assessment of Development Proposals and policy on detailed guidance for all development refers to impacts on **amenity,** but does not specify noise issues.	Overarching environmental protection policy which covers **noise** pollution and requirement for a noise impact assessment.	Policy refers to impacts on **amenity** of dwellings, but does not specify noise issues
General renewable energy policy	The policy on 'Other Renewable energy technologies' refers to '**significant adverse impacts** on local communities' (without specific reference to amenity or noise).	Renewable energy policy refers specifically to **noise** from all renewable energy types. Makes reference to consideration of cumulative impacts.	Low carbon policy refers to **noise** from 'low carbon energy schemes', which captures all low carbon and renewable energy developments.	Policy on renewable energy refers to paragraph 169 of SPP (which refers to **noise**)	Specific reference to wind energy proposals and **noise** within the generic 'renewable energy assessment criteria'	Renewables policy makes no explicit mention of noise refers to the need to avoid **unacceptable environmental effects** taking **cumulative** effects of existing and consented wind farms into account. Also makes reference to avoiding unacceptable significant adverse effects on the amenity of dwelling houses.
Wind energy policy	Refers to '**significant adverse impacts** on local communities' and the criteria in the Wind Energy SG.	-	-	-	Refers to **noise** impacts from wind energy and refers to **amenity**.	-
Statutory Guidance on noise / renewables	Draft Supplementary Guidance on planning and **noise** and Draft Interim SG **Wind** Energy Development	Onshore **Wind** Supplementary Guidance	Supplementary Guidance for **Wind** Energy	Supplementary Planning Guidance **Renewable** Energy	Draft Supplementary Guidance on **wind** energy	Supplementary Guidance (combined document of all SG)
Reference to noise	Identifies noise from wind turbines as potential nuisance for noise sensitive users.	The SG notes that the council consider noise is a particularly sensitive issue.	The SG identifies that wind turbines have the potential to affect the residential amenity of communities.	The SG makes reference to the requirement for noise assessments to be submitted with Environmental Impact Assessments. Applicants will be required to demonstrate no	Sets out requirement for noise impact assessment in line with ETSU and IOA Good Practice Guide for proposals of turbines over 50m height.	Notes the potential for impacts of wind farms and wind turbines to have significant adverse effects on the amenity of dwelling houses and for other renewable energy developments to have potential for impacts of noise

				adverse impacts on residential amenity, including noise impacts.		on neighbouring properties.
Reference to noise limits	No – cross refers to non statutory guidance below.	Yes, refers to ETSU-R-97 as acknowledged best practice, and that noise assessment should be undertaken in accordance with ETSU and the IoA Good Practice Guide. For smaller turbines it refers to the British Wind Energy Association Small Wind Turbine performance and Safety Standard	Yes, refers to the use of the ETSU-R-97 standards until new standards are introduced by the Scottish Government, and the IoA Good Practice Guide	No	Yes, refers to assessment of noise impacts in accordance with ETSU-R-97 and the IoA Good Practice Guide.	No
Non statutory guidance	Assessment of **Wind** Turbine **Noise** (Advice Note)	**-**	-	-	-	Planning Advice on **Wind** Energy
Reference to ETSU	Yes					Yes
Reference to noise limits	Sets out specific noise levels for different size turbines at different wind speeds with specific reference to ETSU and sets out adjusted night time limit of 40dB.					Yes - sets out noise limits including adjusted night time limit of 38dB and refers to ETSU derived limits.

3.8 The following text summarises the approaches to the issue of noise and amenity from renewable and wind energy development within local development plans, supplementary guidance and non-statutory guidance. Supplementary Guidance once adopted and issued will form part of the development plan. Planning authorities may also issue non-statutory planning guidance, which does not form part of the development plan, but may be a material consideration.

3.9 In the LDP, planning authority A has an overarching noise policy, a policy for wind energy and a policy for other renewable energy technologies. There is no direct reference to noise in either the renewable energy or wind energy policy, although 'significant adverse impacts' are referred to. It also has draft SG on noise, and draft Interim Supplementary Guidance on wind energy. The draft SG on planning and noise only makes one reference to wind energy. It states that these sites are governed by specific detailed guidance and therefore beyond the scope of the guide, and it also refers to the council guidance document on noise assessments for wind farms and individual turbine development. The draft interim Supplementary Guidance for wind energy development includes a link to further non-statutory planning guidance on the Assessment of Wind Turbine Noise. This guidance document makes specific reference to noise limits at noise sensitive receptors, referring to ETSU standards, but including an adjusted night time limit of 40dB $L_{A90(10\ min)}$.

3.10 Planning authority B refers to noise within an overarching LDP pollution policy and also within the renewable energy policy. It has Onshore Wind Energy Supplementary Guidance which refers to ETSU-R-97 as being accepted as best practice in terms of assessment of noise from wind turbines and the IoA Good Practice Guide and supplementary guidance notes. The text sets out the planning authority's focus on achieving noise limits at the lower end of the range indicated in national guidance, reflecting the lower background noise levels across the area in question. It also refers to the locations for background noise monitoring, cumulative impact and consideration of amplitude modulation. Planning authority B also has the non-statutory Renewable Energy Strategy and Planning Guidelines which refer to the approach to background noise assessment and noise limits in relation to ETSU-R-97 for wind energy. It includes reference to hydro-electricity and, in relation to noise, notes that developers will need to provide details of noise levels, but also that turbine noise can be mitigated relatively easily.

3.11 Planning authority C has an LDP amenity policy which makes specific reference to noise, and a low carbon policy which also makes reference to noise. It also has Supplementary Guidance for wind energy which refers to noise in terms of impact on communities, issues relating to the proximity of wind turbines to properties and other sensitive installations, and residential amenity. The SG refers to the use of ETSU-R-97 standards, and the current policy framework. There is no additional non-statutory guidance.

3.12 Planning authority D has LDP policies on the criteria against which developments will be assessed and refers to amenity, but not explicitly to noise. The policy on renewable energy cross refers to the relevant paragraph of SPP which mentions noise. The Supplementary Planning Guidance on renewable energy refers to the consideration of noise impacts in relation to residential amenity and the requirement for noise assessment to be submitted with Environmental Impact Assessments. It does not refer to noise limits or ETSU. There is no additional non-statutory guidance.

3.13 Planning authority E refers to noise within an overarching LDP environmental protection policy, to noise issues in relation to the assessment of renewable energy proposals, and noise and amenity impacts from wind turbines. The Supplementary Guidance for wind energy refers to noise in relation to residential amenity. It refers explicitly to the consideration by the planning authority of any required shutdown on the efficiency of operation of the technology. It also refers to consideration of cumulative impacts of noise. It describes the need for noise assessment in line with ETSU-R-97 standards, but not explicitly to the limits. There is no additional non-statutory guidance.

3.14 In the case of planning authority F there is an overarching LDP policy which refers to amenity impacts on dwellings, but not explicitly to noise. Significant detail is provided in the Supplementary Guidance which is presented as a combined document of the whole suite of supplementary guidance for the Local Development Plan. It includes specific guidance on wind farms and medium to large wind turbines, and other renewable energy developments, and includes mention of noise in the reasoned justification. There is no specific reference to noise

limits, although it notes that thresholds can be found in separate non-statutory *Planning Advice* and that thresholds could be varied, depending on the specific local circumstances. The planning advice on wind energy includes reference to noise limits, including lower night time noise limits than those within ETSU.

3.15 In summary the review of plans and policies found:

- Development plan policies covering the issue of noise or amenity in general:
  - All of the plans examined had general policies which cover noise, or amenity in relation to noise.
- Development plan policies covering noise in relation to renewable energy:
  - Five of the plans had renewable energy policies which referred to the impacts of these types of development, and three made direct reference to noise. The other policies referred indirectly to noise or significant impacts on local communities.
  - Two of the plans also included wind energy specific policies which referred directly or indirectly to noise.
- All of the six case study authorities have statutory supplementary guidance (SG) on wind energy or renewable energy and all of these referred to noise issues from these technologies, however there is some variation in how they refer to noise standards. One case study authority also had supplementary guidance on noise.
- Three SG state they will use ETSU standards for assessment, but do not refer directly to the levels within ETSU.
- Two planning authorities have non-statutory guidance specifically for wind energy which refer to ETSU standards and adjusted night time levels.
- LDP policy references to noise tend to make few references to national policy, assessment methods or the setting of limits, however this detail is provided in three of the case study SG. The detail within these SG contrasts with the other three case study plans which do not provide detail on assessment of noise or limits within supplementary guidance;
- Overall, the statutory supplementary guidance documents were principally focused on wind energy, and only one makes brief reference to hydro.
- There is inconsistent coverage of cumulative noise issues within the LDPs. Some policies include specific reference to cumulative landscape and visual but not noise issues, some cover a wider range of issues (including or excluding noise), while others include no reference to any kind of cumulative effects. Where SG refer to the consideration of cumulative effects, they typically do not provide guidance on how this is required to be assessed. Only one case study PA provides some additional detail on noise limits in relation to cumulative effects.

Environmental Health policies and guidance

3.16 A review of relevant environmental health policies and guidance was undertaken. Only one planning authority was identified as having a publically available environmental health document specifically relating to the assessment of noise impact of proposed new development. This document sets out noise standards, the requirements for noise reports and the process of conducting noise measurements and monitoring for all types of development. The document does not cover wind turbine noise, which is within a separate environmental health submission guidance note. The Wind Turbine Guidance Note sets out noise limits for all relevant noise sensitive receptors, differentiating between single turbines, wind farms with large separation distances to noise sensitive receptors, day time and night time hours, and background noise levels.

Conclusions

3.17 In summary the following conclusions can be drawn in relation to the policy review:

- National policies provide a clear framework requiring the assessment of noise from renewable energy development and guidance provides a clear framework in relation to wind energy. At a national level noise is often considered as a more general or amenity issue, without reference to specific types of development.
- Strategic and local development plan policies do not make specific reference to noise limits, and references to ETSU and IOA methodologies are made within Supplementary Guidance, with local variations to ETSU within non-statutory guidance. There is partial and inconsistent treatment of cumulative effects.
- In most cases, noise issues are covered by a combination of general policy references within LDPs and more detailed reference to noise issues, including in some references to the setting of noise limits, within supplementary guidance. Together, these ensure that the need for noise issues to be considered is triggered and that renewable energy developers are provided with guidance on the assessment process that is required and the council's expectations regarding the setting of noise limits. The six case studies ranged from an authority where the LDP included overarching policies on noise, on noise from renewables and specifically from wind turbines, backed by Supplementary Guidance on wind energy to another where there was more limited reference to noise within the local development plan (including supplementary guidance) with specific reference confined to a non-statutory guidance document.
- There are two examples of local variation in relation to lower night time limits than included within ETSU. This means that there is limited tailoring of guidance and limits to local circumstances.
- Only one of the case study authorities' Environmental Health departments had published guidance on the coverage of noise issues in relation to planning applications.

3.18 Overall, all of the planning authorities have a policy that requires the consideration of noise issues from development. This policy may cover amenity, noise in general, in terms of renewables, or specific to types of renewable energy development. Supplementary Guidance, which forms part of the development plan provides further detail on noise assessment, and three of the SG make reference to the ETSU-R-97 standards. A further two non-statutory guidance documents include detail on noise limits, meaning that, when taken as a whole, most authorities have relatively comprehensive policy and advice.

3.19 Variations in the way that noise issues are covered in policy and statutory and non-statutory guidance may reflect the complexity of the subject, the lack of specialist skills within authorities and a perception that local policies or guidance would simply replicate that already published at a national level.

4 Practice

Introduction

4.1 This section of the report is based on the detailed analysis of the sample of 87 ASHP, hydro and wind energy planning applications for the six case study authorities.

4.2 This chapter summarises:

- Approaches to the noise levels specified in the planning conditions for each technology and the policy framework for that planning authority;
- The standards / thresholds being used.

4.3 In most cases, noise limits and associated planning conditions were defined as a result of dialogue between development management officers and their counterparts within the relevant environmental health departments.

4.4 The findings are presented in relation to each renewable technology type.

Air Source Heat Pumps

4.5 The review of 30 planning applications and decisions found:

- Differences in level of scrutiny between planning authorities, with some authorities frequently applying noise related planning conditions and others rarely raising noise issues;
- A wide range of approaches to the setting of noise limits for air source heat pumps both between planning authorities and within the same local authority;
- Reference to a range of standards:
  - Use of both variable dB limits and noise rating curves NR20 and NR25 (dB limits related to the frequency (Hz) of the sound), sometimes also BS4142 (which includes measurement of background noise).
  - Different locations used in relation to the setting of noise limits, e.g. at boundary with noise sensitive property, or 1m from doors or windows.
  - Variations in the specificity of planning conditions, with some very specific and others less enforceable. Conditions covered issues including use of safeguarding limits and requirement for detailed assessment, noise enclosures and acoustic fences.
- No issues were identified through the scoping study with regard to the range of approaches to setting noise limits from air source heat pumps by different planning authorities. However there was a limited sample size included in the study. Only a very small proportion of the case study air source heat pump planning applications were decided after March 2016, when there was a change to permitted development rights in relation to ASHP. It is noted that other standards such as BS4142 are more prescriptive than MCS and therefore there could continue to be a range of approaches used to noise assessment for air source heat pumps.

Hydro

4.6 The review of planning applications identified proposals for small scale hydro schemes only within one of the case study authorities, for which a total of 11 planning applications were reviewed. This revealed a consistent approach to the setting of noise limits. BS4142 – NR20 was used at noise sensitive properties with windows open and less than 5dB(A) above background 3.5 m from façade of noise sensitive property to guide the setting of noise limits.

Wind turbines

4.7 The review of 46 planning applications and decisions found:

- Noise limits: ETSU-R-97 most frequently referred to, with the 35dB(A) limit most frequently set, sometimes with 5dB(A) above background.
- Some examples of decisions where the derivation of noise limits was not clear, or there is a lack of clarity in conditions and the calculations on which they were based.
- Day and night noise limits: Most case study examples included just one limit, though some examples of different daytime and night time limits. Examples include alignment with the ETSU night time limits and a small number of examples of night time limits of 38dB (below the ETSU limit).
- Most examples used noise levels at wind speeds of up to 10m/s, though one planning authority referred to 12m/s.
- Some reference to BS61400 (by applicant) and BS4142 and NR20, NR25 and NR35 limits (for construction noise).
- Some examples of where noise limits are based on predictions in noise impact assessment.
- For smaller schemes, conditions were sometimes based on the noise levels specified by the manufacturer, backed by a warranty stating that the noise output will not be exceeded.
- Variation in the conditions being used, although some use of the Institute of Acoustics Good Practice Guide (2013) example conditions, particularly in more recent applications.
- Very limited examples of dealing with cumulative impacts – leaving headroom for other schemes by setting lower noise limits or in some cases revising noise limits for existing developments downwards to allow for other developments.
- Reports of handling made relatively few references to local development plan policies or supplementary guidance on noise, confirming the finding that these policies tend to be general in nature. There is greater reliance on national guidance and approved methodologies such as ETSU-R-97, based on advice from Environmental Health officers.

Conclusions

4.8 In summary the following conclusions can be drawn in relation to the review of practice:

- There does not appear to be a consistent approach to the setting of noise limits with regard to air source heat pumps, though the extension of permitted development rights in 2016, with the requirement for installers to comply with a common standard (including with respect to noise) may result in greater consistency (although the case studies do not provide sufficient examples to test this through the review of planning applications);
- The setting of noise limits for small scale hydro appears to be consistent, though based on cases from only one authority;
- Noise limits for wind energy developments are most commonly set in the conditions with reference to the 35dB(A) limit derived from ETSU-R-97. The values predicted within applicants' noise impact assessments were sometimes transposed into noise limits.
- Information from Reports of Handling suggests some reference to local development plan policies, with the inclusion of policy matrices, but limited reference to noise and greater reliance on national guidance and the specialist advice from Environmental Health Officers.

5 Stakeholder feedback

5.1 This chapter summarises the issues identified from discussion with development management staff and environmental health officers for the six case study planning authorities.

5.2 The responses tend to focus on wind energy, identifying it as a more complex area than air source heat pumps and hydro schemes. Air source heat pumps have been described as much more akin to air-conditioning units and hydro schemes are often planned in sparsely populated areas. The noise issues from these technologies are described by respondents as being less complex than those for wind energy. It was noted that if required, mitigation for these technologies can be easily achieved through changes in design or the provision of a sound insulation hood. Hence, a case-by-case approach is usually taken for these technologies.

5.3 This section therefore deals mainly with issues in relation to wind turbine developments. The specific issues identified from the discussions are presented in the following sections:

- Policy guidance and training;
- Noise limits;
- Amplitude modulation; and
- Enforcement and monitoring.

Policy guidance and training

Access to training

5.4 The stakeholders suggested that there are varying levels of skills in relation to noise from Environmental Health officers, with typically one self-taught 'specialist' within the planning authority who deals with wind farm noise who is sometimes isolated from the wider acoustic community. This was seen as contrasting with the better resourced development interests who are often able to employ acoustic specialists. The respondents felt there is a need to share knowledge, and access to training was identified as an issue in most local authorities. However, one planning authority identified they have a training programme in place.

Review of ETSU

5.5 A number of stakeholders described a need to update ETSU-R-97, whilst recognising the value of the IoA Good Practice Guide. General observations included that the document is twenty years old, and wind turbines are very different in terms of scale and extent than at the time ETSU was written.

5.6 Concern was expressed by two respondents over the range of noise levels which can be used within ETSU. One respondent noted that a local authority could wish to work to the lower end of the scale, but a developer may push for the upper end of the scale.

5.7 Two respondents specifically highlighted that the ETSU-R-97 night-time limit is considered too high as it is based on outdated WHO guidelines, which have since been revised downward, and that ETSU should be updated accordingly.

5.8 The WHO Night Noise guidelines for Europe (2009)[13] present recommended criteria for health and sleep disturbance in terms of $L_{night, outside}$, which is equivalent to a yearly average of night noise levels outside at the facade. These levels are based on new studies which became available since ETSU was published and recommend the population should not be exposed to night noise

[13] World Health Organisation Europe (2009) Night Noise Guidelines for Europe. Available at: http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf

levels greater than 40 dB of $L_{night, outside}$. This reflects the identification of adverse health effects for exposure levels ($L_{night, outside}$) in excess of this.[14]

5.9 Three of the respondents specifically noted that ETSU-R-97 does not adequately deal with certain potential noise impacts of windfarms such as amplitude modulation as it is focused on average noise levels rather than changes in the nature of noise such as a 'swish' or 'thump'. Although the issue of amplitude modulation has been investigated and reported on more recently[15], the stakeholders identified that there was a need for a clear link between the ETSU noise limits and the nature or character of noise.

5.10 Five respondents specifically noted that gaps in the interpretation of ETSU-R-97 remain. Although there is recognition that the Institution of Acoustics Good Practice Guidance has helped with the interpretation of specifics, two stakeholders suggested that there is a need for more guidance (either within ETSU or guidance on applying ETSU) on judging the significance of effect, and another identified the need for more definition of headroom in relation to potential cumulative noise effects. There is also a view that ETSU and the IoA Good Practice Guidance contain terminology which forms a considerable barrier for application by non-specialists.

Working relationship

5.11 The stakeholders indicated that the working relationship between environmental health and development management is generally good. Environmental health officers are noted as the first port of call for evaluating processes and procedures. Development management staff do not usually have the training to deal with complex environmental issues such as noise impacts. They heavily rely on the noise expertise within the environmental health department. It is important, however, to recognise that EHOs are primarily concerned with protecting public health rather than considering issues such as development 'headroom' which fall within the remit of planners.

5.12 The respondents also noted that pre-application discussions are identified as an important part of the process.

Noise limits

Lower limits

5.13 The project steering group requested exploring the issue of different local limits based on a more qualitative approach with the stakeholders. The respondents identified the various challenges which this would raise in terms of consistency, and defensibility, and the significant resource required to develop this.

5.14 Two stakeholders indicated that it would be desirable to set noise limits at the lower end of the ETSU scale, to reflect the lower background noise levels found in some parts of the country. This for example could be achieved through the approach of using fixed limits at the lower ends of the ETSU range for daytime noise, and lower night time limits than within ETSU. There have been challenges to this approach from developers, because of the scope within ETSU to apply the range of fixed daytime noise limits. There is a lack of guidance in ETSU on how the factors affecting the choice of value should be applied, and therefore this can be interpreted differently by developers and local planning authorities when considering amenity or limiting restrictions to development.

5.15 One authority attempted to reflect lower noise limits within statutory Supplementary Guidance, but was met with significant resistance from developers. A stakeholder suggested that there is a need for a guidance framework which allows local authorities with lower background noise to set tighter limits. ETSU recommends that generally noise limits should be set relative to the existing background noise at the nearest noise sensitive properties, and concludes "*that it is not necessary to use a margin above background approach in such low noise environments*", adding that it "*would be unduly restrictive on developments which are recognised as having wider national and global benefits*".

[14] It should be noted that the WHO guidelines are based on the measurement of noise as a yearly average, but the ETSU limits are based on shorter term exposure to noise. Although the WHO Night Noise Guidelines are based on transportation noise, the guidance states that the recommendations are for night noise in general.

[15] Department for Business, Energy and Industrial Strategy (2016) Review of the evidence on the response to Amplitude Modulation (AM) from wind turbines with recommendations on control through the use of a planning condition https://www.gov.uk/government/publications/review-of-the-evidence-on-the-response-to-amplitude-modulation-from-wind-turbines

5.16 The respondents suggested that compliance with ETSU-R-97 standards is invariably the bottom line from a developer's perspective, which makes it difficult for environmental health officers or development management planners to defend lower limits using qualitative arguments. In the absence of definitive or prescriptive local policy, the precedent set by planning inquiries can be seen as important in defining an acceptable approach to setting noise limits.

Background noise surveys

5.17 The stakeholders felt that the lack of specialist skills within local authorities means that it is often difficult to challenge developers' noise surveys. Background noise surveys in particular are inherently variable and difficult to challenge. Environmental health officers often do not have sufficient expertise or equipment to undertake their own baseline noise monitoring nor the budget to employ a consultant. Adding to this issue, manufacturer's specifications do not tend to follow a standard format, making it hard for environmental health officers to use the data they contain to determine whether noise effects are likely to be acceptable.

Cumulative impacts

The respondents indicated that authorities have learnt to reserve headroom for future developments, however, the assessment of cumulative impacts is considered to be one of the most difficult stages of the application process. There are issues with historic applications, as noise data for previously consented schemes is often not well documented. It is also difficult to anticipate whether additional proposals are likely to come forward in an area in the future, making it difficult to strike a balance between setting reasonable noise limits whilst not ruling out future development. Undertaking cumulative noise assessment is regarded as a complex process involving a large number of variables, again raising the concerns about local authorities' resourcing and expertise noted previously.

Technological improvements

5.18 It was recognised by the stakeholders that technological improvements mean that modern wind turbines are quieter and noise is becoming less of a constraint. From a developer's perspective, larger and more efficient turbines are often identified as the most cost-effective solution, particularly as subsidies and support for renewable energy schemes are reduced.

Amplitude modulation

5.19 Amplitude modulation (AM) is the name given to the distinctive acoustic character of wind turbines often described as a 'swish'. Recent evidence suggests that, under certain weather conditions, this 'swish' can become more of a pronounced 'thump', leading to complaints from residents of properties neighbouring wind farms.

Levels of experience

5.20 Amplitude modulation is a relatively recent issue associated with larger turbines. Most environmental health officers and development management staff are aware of issues related to amplitude modulation, but have variable experience of this as an issue.

Assessment

5.21 The stakeholders identified that amplitude modulation is technically complex and hard to predict, with occurrence related to specific weather conditions and topographic characteristics. Cold weather, frost and high winds were identified as possible causes of amplitude modulation. This makes it particularly difficult to prove the occurrence of amplitude modulation at a particular point of time as weather conditions constantly change.

Enforcement and monitoring

Number of noise-related complaints

5.22 The interview findings suggested that, although the number of complaints varies with each authority, the levels are generally low. There is uncertainty whether the low levels of complaints in most authorities reflect the tight standards applied, or if there is an issue with complaints not being seen as valid where noise levels are within approved limits. Although there is some variation between authorities in the number of noise complaints, the procedure for dealing with them is generally the same. ETSU-R-97 limits are used as a benchmark for processing noise

complaints. Detailed exploration of the issues associated with complaints was not within the scope of the study.

Restrictions on wind farm development

5.23 Local authorities aim to ensure a reasonable degree of protection to receptors without placing unreasonable restrictions on wind farm development. In this perspective, targets for wind energy set by the Scottish Government are referred to as a key driver. Environmental health officers and development management staff are supportive of wind energy, but some suggested that ETSU-R-97 can favour development by setting noise limits which are too high and which make it difficult to set locally derived limits. As a result, stop notices are rarely issued and tend to be of short duration.

Scottish training sessions

5.24 The Scottish Government ran training sessions on the assessment of noise from wind turbines in 2016. Although attendance was limited amongst the interviewees, most development management officers are aware of the Scottish training sessions. They – and their colleagues – generally value the training sessions as an opportunity to get a better understanding of the technicalities behind noise impacts and the development of updated planning conditions.

Conclusions

5.25 Discussions with stakeholders focused on noise issues associated with wind turbines since noise from air source heat pumps and small scale hydro installations is generally less contentious, more straightforward to assess and mitigate.

5.26 A key finding relates to the level of knowledge and expertise on noise issues within authorities' planning and environmental health departments. The interviews identified that there tends to be a reliance on 'self taught' specialists who may not have a detailed understanding of issues such as amplitude modulation. This contrasts with developers' use of specialist noise consultants. As a result, planning authorities are often unable or reluctant to corroborate or challenge the content of noise impact assessments, for example by undertaking independent noise monitoring or setting different noise limits.

5.27 Discussion with stakeholders suggests that ETSU-R-97 guidance is seen as being complex, in places out of date, lacking clarity in some areas and sometimes viewed as favouring developers. Some of the interviewees identified a desire use noise levels at the lower end of the ETSU scale, but that they could not defend this against challenge from developers. Authorities appear to lack confidence to set lower noise limits within ETSU, and tailored to local circumstances, due to the challenges of defending this against the developer interpretation of ETSU. Complaints are assessed in relation to accordance with noise limits set in planning conditions based on ETSU limits.

6 Conclusions and Recommendations

Conclusions

6.1 The aim of the study was to explore the evidence for the need for a review of the way that councils in Scotland are assessing the noise impacts of three renewable technologies: air source heat pumps (ASHP), hydro, and onshore wind turbines.

6.2 Noise issues associated with air source heat pumps and hydro schemes appear to be relatively straightforward and capable of being dealt with by normal development management procedures, although there is some variation in the approach to noise limits for air source heat pumps. By contrast, noise issues associated with wind turbine development are more complex and present a far greater challenge for planning authorities. The more detailed conclusions are presented under the relevant headings below.

Policy, advice and guidance

National policy, advice and guidance

6.3 Scottish Planning Policy (2014) requires the consideration of noise in development management, and PAN 1/2011 Planning and Noise and the Scottish Government online guidance on Onshore Wind Turbines refer to the use of ETSU-R-97 as the framework to be used for the measurement of wind farm noise.

6.4 Further detail on the application of ETSU-R-97 is given through the IoA Good Practice Guide to the application of ETSU-R-97. This recognises that there may be local variations to methodologies or limits. From the case studies examined there are limited examples within the case studies of local authority guidance (non-statutory planning advice or environmental health guidance) providing for a more locally specific approach.

Strategic and local policy and guidance

6.5 Strategic development plans do not play a significant role in relation to setting the planning framework for noise, and local development plans contain policies relevant to noise and the need for it to be assessed. Policy detail on the setting of noise limits which development should not exceed is most apparently dealt with within Supplementary Guidance (SG). All of the case study local planning authorities have SG on wind, renewable energy or noise, setting out policy detail, with half of the SG including reference to the ETSU-R-97 standards.

Non-statutory local advice and guidance

6.6 A further two of the case study planning authorities, which do not refer to ETSU-R-97 within their supplementary guidance, include reference to ETSU-R-97 and make specific reference to noise limits, including some variation from ETSU within non-statutory advice or guidance.

Development management

6.7 The development management process appears to make little reference to the local noise policy framework and instead has an indirect reliance on national policy and guidance through the references to the need to consider noise generally, and the policy framework is effective in triggering the requirement for noise issues to be considered.

ETSU-R-97 is widely used in the setting of noise limits for wind turbines in planning conditions, though there is some variation in the application of some of the subtleties (e.g. the case review identified variation in the distinction between night and day time limits, setting noise limits at different wind speeds and use of background noise monitoring), with a reliance on the 35dB(A) standard. Stakeholder comments on noise assessment and the application of ETSU-R-97

6.8 Discussion with stakeholders indicates a major differential in expertise and resources between planning authorities and development interests, with most 'specialists' within planning authorities being self-taught and sometimes isolated from the wider acoustic community. This lack of expertise makes it difficult for planning authorities to deal with complex noise issues such as amplitude modulation, to challenge the findings of noise impact assessments or carry out their own assessment or monitoring.

6.9 The stakeholders identified that ETSU-R-97 is often regarded as complex, over-technical, out of date and sometimes as favouring development interests with an apparent tension between some authorities who would like to set limits at the lower end of the range defined within ETSU in order to protect residents' amenity and developers who, whilst meeting the requirements of ETSU may favour a noise limit at the upper end of the range. However, despite the complexity of noise issues associated with wind energy, no issues were specifically raised through the study about the impact of this on the planning outcome, although a detailed review of complaints was not a component of the research.

Conclusion

6.10 In conclusion, the scoping study did not identify a need to review the way that councils in Scotland assess the noise impacts of air source heat pumps, hydro and onshore wind turbines. The study did not find that the outcomes of decisions were affected by the differences in the level of detail on noise issues within the national and local planning framework. However in relation to wind turbines concerns were raised by stakeholders about ETSU-R-97 and the skills and resources of the planning authority in addressing noise from wind turbines.

Recommendations

Information sharing

6.11 A clear recommendation to emerge from the study was the need for greater **sharing of information** on changes in policy and practice, and examples of best practice via a community of practice focused on wind energy noise issues for EHO and planning officers. This could possibly be facilitated by partnership working on the part of professional institutes including the Royal Environmental Health Institute of Scotland, the Royal Town Planning Institute and Institute of Acoustics. This community of practice could play a role in leading **further training in noise issues** relating to wind energy developments.

Simplified guide to ETSU

6.12 In response to concerns around the technical nature of ETSU-R-97 guidance, it is recommended that a **lay person's guide** for non-noise specialists should be prepared. This would provide clarity and consistency in the use of ETSU and cover the assessment of noise effects, the use of mitigation measures, monitoring and control through planning conditions. The guide should cover the setting of noise limits, the use of day and night limits, issues relating to background noise levels, cumulative effects and preservation of headroom, amplitude modulation and the presentation of noise data.

Recommendations for further research

6.13 As noted above, the purpose of the study was to identify if there was a need to review the way that councils in Scotland are assessing the noise impacts of three renewable technologies. A number of other issues were identified through the course of the study, in particular in relation to the use of ETSU-R-97. Detailed investigation of these issues was outwith the scope of the study, however they have been identified as recommendations for further research.

ETSU-R-97

6.14 The stakeholders identified that some parts of ETSU-R-97 and the IOA Good Practice Guide still left some areas of the approach to assessing noise impacts open to interpretation, which presented difficulties for the planning authorities. It is therefore recommended to carry out an in-depth review of the methodology within ETSU-R-97 and the IOA Good Practice Guide to identify areas where additional detail on interpretation would be required from a planning authority perspective. This should draw on the experience of stakeholders and would add to the value provided by the IoA Good Practice Guide, providing further clarification on those areas of ESTU still identified by stakeholders as ambiguous.

Policy framework

6.15 The study reviewed development plan policies and supplementary guidance and identified variation in the levels of detail provided on noise assessment and limits. It is recommended that there should be further investigation of the value of detailed local policy and guidance on noise, comparing those planning authorities with more detail, with those with less.. This could be achieved through a workshop event or similar for environmental health officers and planners which would provide a forum for structured discussion and sharing good practice on noise policies and in particular, supplementary guidance. This could cover the scope, wording and potential for locally specific limits within policy and guidance. The outcome of this event could be recorded in a summary report to provide a reference source for local authorities addressing noise issues.

Noise complaints

The stakeholder discussions provided some information on noise related complaints and the issues surrounding these, but did explore the issues in any detail. A more detailed investigation of a sample of noise related complaints regarding wind farm developments would allow further conclusions to be drawn on ETSU limits and the nature and occurrence of noise related complaints.

Appendix 1
Study Methodology

Methodology

This appendix provides additional detail on the methodology of the study.

Benchmark analysis

The purpose of the benchmark analysis was to:

- Confirm the scope of the technologies included in the study (e.g. types of hydro scheme, sizes of wind turbine);
- Outline the noise issues associated with each (focusing on operational rather than constructional noise), taking account of the source, character, incidence and potential mitigation / control of noise;
- Map out the best practice / agreed standards in the assessment of noise and setting of noise limits; and
- Map out the existing national planning policies, guidance and advice, and any relevant environmental health standards relating to these technologies or to receptors.

The benchmark analysis involved the following tasks:

- Review of the type and scale of each technology being considered
- Defined the type of technology being covered within the study
- Identified the noise impacts associated with the types of technology being considered
- Defined when noise impacts may occur
- Outlined the planning context
- Identified relevant noise assessment guidance and standards to the technology.

Local authority policy review

The local authority policy review involved the identification of the relevant development plans (adopted, proposed and including supplementary guidance) and any available environmental health policies on noise. This was undertaken through an internet search of the policy context for each case study planning authority. The local authority policy review was designed to determine the following:

- Which of the above policy documents are in place;
- Whether noise issues associated with each of the three renewable technologies are identified;
- The extent to which PAN 1/2011 Planning and Noise, TAN: Assessment of Noise, ETSU-R-97, IOA Good Practice Guidance, MCS 020 and other relevant guidance and standards have been reflected or interpreted in local policies; and
- Whether references to national policy, guidance and advice are up to date.

Case work review

The purpose of the case work review was to identify a representative sample of planning applications to explore how noise issues have been considered during the development management process. It was intended to identify and review sufficient numbers of applications for the three renewable energy technologies, for each planning authority, from the previous 12 months. Once the task was started it became apparent that there were insufficient case study examples from the last twelve months and the search period was extended to the last three years. The task of identifying case studies was also more time consuming than originally anticipated because it was necessary to go into the planning decision or environmental health

consultation documentation for each case to confirm whether it is a valid case and whether there is a reference to noise issues, including the setting of noise limits through conditions. This led to the final identification and analysis of 87 case studies, although with some uneven distribution of the three technologies within the case study planning authorities, for example with hydro case studies solely within Highland.

- Are the noise policies identified in the local authority review being applied consistently?
- How are gaps in policy being addressed in the development management process?
- Are additional policies, guidance or best practice being referenced in the development management process?
- How are noise issues, including the setting of operational noise limits, being reflected in planning conditions?

Noise limits review

The noise limits review examines the noise limits that are being set for planning consents for the three types of renewable energy. It will aim to answer the following questions:

- Are operational noise limits being set?
- If not, what are the reasons for this?
- Are these limits generic to the council area as a whole or specific to the development in question?
- How are these noise limits derived?
- How are noise limits monitored and enforced?

Interviews

Structured interviews were also carried out with planners and environmental health officers from the six case study local authorities. The interviews provided the opportunity to explore the issues emerging from the review of policy and case work. The interviews were tailored to environmental health officers and planners but covered the issues of:

- Policy guidance and training;
- Noise limits;
- Amplitude modulation;
- Enforcement and monitoring.

The questions are provided overleaf.

Questions: Environmental Health

1) Policy guidance and training

a) What skills and experience does the EH team have in noise issues, including in relation to planning applications for renewable energy development?

b) What environmental health policies or procedures do you use to assess noise from wind / hydro or air source heat pumps (ASHP)?

c) The review has identified that there is a lack of planning policy and guidance on noise issues in relation to renewable energy within the national and local planning context. Would you agree with this conclusion? How does the lack of policy and guidance affect your approach to assessing and responding to noise impacts, particularly in relation to the technologies of ASHP, hydro and wind?

d) In relation to wind energy, are you confident in applying the ETSU guidelines? Do you have any comments on the ETSU guidelines?
e) The Institute of Acoustics produced a Good Practice Guide to applying ETSU-R-97 in 2013. Do you use it? If yes, does it help with the review of wind farm applications?
f) What aspects of wind farm noise assessment cause most difficulties when reviewing planning applications (background noise surveys, derivation of limits, source of wind turbine data, predictions)?

2) Noise limits

a) What factors do you take into account when commenting on / recommending noise limits for the three technologies of wind, hydro and ASHP?
b) How much is the character of the noise environment (e.g. a busy urban environment or a quiet peaceful rural setting) and people's perception of it taken into account in assessing proposals, decision making and setting of conditions?
c) The case study review identified variation in the setting of noise limits within the local authorities for all three technologies. Are you aware of the variation in noise limits within your local authority? Can you provide any information on the reasons for variations in noise limits? (does it reflect case specific details, does it depend on the individuals involved in the case etc.?)
d) Specifically in relation to wind, how are cumulative assessments considered, and is there any local guidance?
e) What is your view on the approach of moving away from the setting of noise limits, to a focus on the effect of noise on health and quality of life of receptors?

3) Amplitude modulation

Amplitude modulation is the name given to the distinctive acoustic character of wind turbines often described as a 'swish', which is also referred to as amplitude modulation (AM). Recent evidence suggests that at times this 'swish' can become more of a pronounced 'thump', leading to complaints from wind farm neighbours.)

a. Are you aware of amplitude modulation (AM) issues relating to wind turbines?

b. Are you aware of the following:

- The Institute of Acoustics Amplitude Modulation Working Group and the recent report on the method for rating AM?
- the recent (August 2016) report published by the Department for Business, Energy and Industrial Strategy: *Review of the evidence on the response to amplitude modulation (AM) from wind turbines*, with recommendations on control through the use of a planning condition (Wind Turbine AM Review: Phase 2 Report)?

c. Do you have any comments on the method proposed and recommendations put forward in these documents?

d. Have AM issues arisen in relation to any recent planning applications? Have you advised on AM issues in planning conditions – for example in requiring detailed monitoring following complaints? If such monitoring identified problems, how would you deal with them through the planning process (application for variation on planning condition, or new application?).

4) Enforcement and monitoring

a) Can you provide an indication of what levels of noise complaint are associated with existing wind turbines / hydro / ASHP?
b) Do you believe the current guidance provides a correct balance between protecting residential amenity, without unnecessarily hindering wind farm development?
c) What factors influence if a noise related complaint will be upheld?
d) What is the process of addressing a noise complaint if it is upheld?
e) What monitoring and enforcement of noise limits takes place?
f) Do you feel sufficient weight is given to EH comments on noise related issues in planning applications?

Questions: Development Management

1) Policy and guidance

a) What skills and experience does the DM team have in noise issues, including in relation to planning applications for renewable energy development for the three technologies?
b) What policies or procedures do you use to assess noise from wind / hydro or air source heat pumps (ASHP)?
c) The review has identified that there is a lack of policy and guidance on noise issues in relation to renewable energy within the national and local planning context. Would you agree with this conclusion? How does the lack of policy and guidance affect your approach to assessing and responding to noise impacts, particularly in relation to the three technologies of ASHP, hydro and wind?
d) How much do you rely on the noise expertise of EH officers?

2) Noise limits

a) How much is the character of the noise environment and people's perception of it taken into account in assessing proposals, decision making and setting of conditions?

- Human perception (types of receptor)
- Ambient noise levels e.g. a busy urban environment or a quiet peaceful rural setting
- Day / night time differences

b) When involved in pre-application discussions, or in setting noise limits for wind energy developments, do you:

- measure it against benchmark set by ETSU-R-97; or
- set noise limits lower than ETSU-R-97 with the purpose of allowing potential for additional development;
- set noise limits lower than ETSU-R-97 with the aim of keeping noise levels as low as possible?

c) In your experience, are modern, quieter machines being used to develop quieter schemes, or to allow larger schemes?
d) Do you consider noise to be an important issue in relation to ASHP or hydro schemes? How often does it crop up? What guidance to you use? How do you deal with it in conditions?
e) The case study review identified variation in the setting of noise limits within the local authorities. Do you adopt a standard approach to setting noise limits and including these within planning conditions? If not, why do you vary your approach?
f) What is your view on the approach of moving away from the setting of noise limits, to a focus on the effect of noise on health and quality of life of receptors?

3) Amplitude Modulation

Amplitude modulation is the name given to the distinctive acoustic character of wind turbines often described as a 'swish', which is also referred to as amplitude modulation (AM). Recent evidence suggests that at times this 'swish' can become more of a pronounced 'thump', leading to complaints from wind farm neighbours.

a) Are you aware of amplitude modulation issues relating to wind turbines?

b) Are you aware of the following:

- The Institute of Acoustics Amplitude Modulation Working Group and the recent report on the method for rating AM?
- the recent (August 2016) report published by the Department for Business, Energy and Industrial Strategy: *Review of the evidence on the response to amplitude modulation (AM) from wind turbines*, with recommendations on control through the use of a planning condition (Wind Turbine AM Review: Phase 2 Report)?

c) Do you have any comments on the method proposed and recommendations put forward in the documents?

d) Have AM issues arisen in relation to any recent planning applications and consents? Have you addressed AM issues in planning conditions – for example in requiring detailed monitoring following complaints? If such monitoring identified problems, how would you deal with them through the planning process (application for variation on planning condition, or new application?).

4) Enforcement and monitoring

a) Can you provide an indication of what levels of noise complaint are associated with existing wind turbines / hydro / ASHP?
b) What factors influence if a noise related complaint will be upheld?
c) What is the process of addressing a noise complaint if it is upheld?
d) What monitoring and enforcement of noise limits takes place?

5) Scottish Government Training

a) Did planning officers from your authority attend the Scottish Government training on renewables and noise held in March? If so, was the training pitched correctly? Has it influenced the way that you deal with noise issues?

Appendix 2 Benchmark Analysis

Wind

Introduction and overview of the technology

A number of different types of wind turbines are available, including vertical and horizontal axis types and models with two or three blades. Most schemes in the UK use three blade horizontal axis machines. Wind turbines capture kinetic energy from wind blowing towards a turbine's blades. The spinning blades turn a central drive shaft which turns relatively slowly, although the blade tips may be moving at high speed. The low rotation speed of the drive shaft needs to be increased to allow the generator to work efficiently, so most turbines include a gearbox which steps the rotation speed up from around 16 revolutions per minute (rpm) to around 16,000 rpm. The generator, which sits behind the gearbox, converts the kinetic energy into electrical energy. Turbines are designed to turn into the wind so as to capture the maximum amount of energy. Brakes are applied if wind speeds are too high, and to facilitate routine maintenance.

Wind energy schemes currently account for around 70% of the total renewable energy installed capacity in Scotland. Commercially available turbines range in height from around 10 metres to the models which are approaching 200m from ground to blade tip. Schemes range in size from single turbines or small groups of turbines to large wind farms comprising well over a hundred turbines.

Study scope

This study covers noise issues associated with all sizes of wind turbine, with the exception of domestic turbines mounted on buildings.

Noise sources and characteristics

A number of noise issues are associated with the operation of wind turbines:

- The movement of blades through the air results in aerodynamic noise which, particularly closer to the turbine, may vary in intensity with blade movement;
- The turbine gearbox and transmission can result in mechanical noise, taking the form of a rumble, hum or low whine.

Noise effects will vary, with wind direction and strength being the determining factors. Downwind turbine noise tends to be concentrated closer to the ground, while upwind noise is transferred away from the ground. More pronounced mechanical noise can occur as a result of mechanical failure, though this is relatively rare.

Potential noise impacts

Previous research for ClimateXChange considered the way that noise generated by wind turbines can impact upon the occupiers of residential properties. Generally, the severity of impacts will depend on a number of factors, including:

- Characteristics of the noise in question (e.g. aerodynamic 'swish' or mechanical whine);
- The frequency with which the noise occurs;
- Any variations in noise over time;
- The times of day and / or night that the noise occurs;
- Whether receptors are present;
- What receptors are doing (e.g. working, taking recreation, sleeping); and
- Personal circumstances and attitudes towards the source of noise. There is some evidence that people less well disposed towards wind energy schemes are more likely to describe noise nuisance (along with other impacts) than those who are more positive.

Planning context

Applications for wind farms generating in excess of 50 megawatts are considered by the Scottish Ministers through the Energy Consents Unit. Applications for schemes up to 50 megawatts are made to the relevant planning authority.

Scottish Planning Policy (Scottish Government, 2014) requires planning authorities to identify where there is strategic capacity for wind farms, including those areas with greatest potential for wind development. This 'spatial framework' provides the context within which a more detailed development management process assesses the merits of individual proposals against a wider range of environmental, community and community effects.

Paragraph 169 lists the factors that should be taken into account by planning authorities during the development management process. These include:

- impacts on communities and individual dwellings, including visual impact, residential amenity, **noise** and shadow flicker; and
- cumulative impacts … recognising that in some areas the cumulative impact of existing and consented energy development may limit the capacity for further development.

The Scottish Government's online guidance on Onshore Wind Turbines[16] requires that development plans should provide clear guidance for applicants covering:

- design, including the number and height of turbines, location and supporting infrastructure
- the scale and character of the landscape
- the need to safeguard ecological, community, historic environment, aviation and defence interests the need to consider cumulative impacts and decommissioning.

The guidance directs readers to the following sources of information relevant to the assessment of noise from wind turbines:

- The Assessment and Rating of Noise from Wind Farms (Final Report, Sept 1996, DTI), (ETSU-R-97)
- An Analysis of How Noise Impacts are Considered in the Determination of Wind Farm Planning Applications (Hayes McKenzie for DECC, April 2011);
- Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (Institute of Acoustics).

Planning Advice Note (PAN) 1/2011 outlines how noise should be addressed in development planning and development management. It highlights the role of development plans in limiting the number of people exposed to the adverse of noise by guiding development to the right locations. It lists the following issues which should be taken into account during preparation of a development plan:

- Avoidance of significant adverse noise impacts from new developments,
- Applying noise impact criteria reasonably,
- Use of mitigation measures to manage noise impacts,
- Protection of Quiet Areas, and
- Avoidance of development significantly adversely affecting Noise Management Areas.

The PAN also addresses the role of development management, noting that selection of a site, the design of a development and the conditions which may be attached to a planning permission can all play a part in preventing, controlling and mitigating the effects of noise.

Issues which may be relevant when considering noise in relation to a development proposal include:

- Type of development and likelihood of significant noise impact,

[16] http://www.gov.scot/Resource/0045/00451413.pdf

- Sensitivity of location (e.g. existing land uses, NMA, Quiet Area),
- Existing noise level and likely change in noise levels,
- Character (tonal, impulsivity etc), duration, frequency of any repetition and time of day of noise that is likely to be generated, and
- Absolute level and possible dose-response relationships

The PAN refers to the role of Noise Impact Assessment (NIA) (carried out as part of an Environmental Impact Assessment or separately) in assisting the consideration of noise issues during the development management process. A NIA should identify whether any significant adverse noise impacts are likely to occur and if so, identify what effective measures could reduce, control and mitigate the noise impact. In commencing a NIA, planning authorities and applicants should agree:

- any potential representative limits of noise and /or the relevant NIA methodology in the context of the proposed development, its location and the surrounding area, and
- criteria for assessing any significant adverse noise impact or predict and describe ambient noise levels (including noise from transport sources) that the proposed development is likely to generate and/or is likely to be subjected to.

The PAN outlines a range of generic measures which can be implemented through planning conditions in order to control or limit exposure from noise. It cross refers to the Addendum[17] to Circular 4 1998 which sets out some model conditions relating to noise issues.

With specific respect to noise from wind turbines, the PAN refers back to the Scottish Government online guidance on Onshore Wind Turbines and the ETSU-R-97 guidance.

Technical Advice Note: Assessment of Noise provides detailed technical guidance on noise assessment and which summarises legislative context and which refers back to the online guidance note above, the ETSU-R-97 Guidance and the Institute of Acoustics bulletin (see below).

The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011 identify wind energy development comprising more than two turbines, or involving turbines where the hub height of any turbine (or other structure) exceeds 15 metres as potentially requiring Environmental Impact Assessment (EIA) dependent on factors including the potential for cumulative impacts, the generation of pollution and nuisance, the characteristics and sensitivity of the proposed location of the development and the potential significance of the impacts of development (e.g. extent, magnitude, probability, duration and frequency). Developers may request a screening opinion from a planning authority to determine whether EIA is required based on these factors. Most larger schemes are subject to EIA, with the scoping process designed to focus the assessment on those environmental effects most pertinent to the proposed scheme and its location. Even where EIA is not required, a more specific Noise Impact Assessment (see above) may be requested.

Noise assessment and standards

Reflecting the fact that noise represents one of the most commonly occurring areas of potential impact on human receptors, a considerable amount of work has been undertaken to inform the process by which effects are assessed and noise limits for wind energy proposals set.

Noise is often critical to the development management decision, while noise limits (a threshold beyond which a consented scheme is not allowed to operate) are usually embodied with conditions attached to a planning consent.

ETSU-R-97 sets out a UK noise assessment methodology for all wind turbine developments. This approach comprises six main steps:

- Prediction of noise from all turbines at the nearest receptors;
- Determine the study area;

[17] http://www.gov.scot/Publications/1998/02/circular-4-1998/circular-4-1998-landscape

- Identify potentially affected properties;
- Measure background noise at affected properties, simultaneous with wind speed and direction at proposed turbine sites;
- Analyse data to derive noise limits for the scheme; and
- Update noise predictions and assess compliance with noise limits for candidate turbine and identify mitigation opportunities where these are exceeded.

Under this methodology, noise limits are set with reference to the ambient or background noise levels prevailing before the scheme is developed, rather than defining a standard noise level that is deemed acceptable in any location or context. Ensuring that the noise limit is correctly defined, reflected in planning conditions, monitored and enforced are evidently critical to the approach. If limits are set too high, receptors are likely to be adversely impacted. Conversely, if limits are too low, the ability to operate the wind energy development may be unnecessarily limited. Established noise limits can also have implications for cumulative development where, for example, the noise limits set for one development are set higher than necessary and effectively prevent any further developments in the local area.

The approach set out in ETSU-R-97 includes the following recommendations:

- Noise limits should apply to wind speeds of up to 12 m/s measured at 10m height;
- Separate noise limits should apply for day-time and for night-time;
- the LA90 (10 min) descriptor should be used for both the background noise and the wind farm noise;
- Noise from the wind farm should be limited to 5dB(A) above background for both day and night-time;
- In low noise environments the day-time level of the LA90 (10 min) of the wind farm noise should be limited to an absolute level within the range of 35-40dB(A) dependent on number of dwellings, effects of the noise limits on the energy generated and the duration and level of exposure;
- the fixed limit for night-time is 43dB(A), allowing for 10dB(A) attenuation through an open window, with 2dB subtracted to account for the use of LA90 (10 min) rather than LAeq (10 min);
- Where the local authority and the developer are in agreement that the background noise levels do not vary significantly between the amenity periods and the night-time, then a single lower fixed limit of 35 – 40 dB(A) can be imposed based upon background noise levels taken during the amenity periods and the night analysed together;
- if the noise is limited to an LA90 (10 min) of 35dB(A) up to wind speeds of 10m/s at 10m height, then this condition alone would offer sufficient protection of amenity, and background noise surveys would be unnecessary;
- both day- and night-time lower fixed limits can be increased to 45dB(A) and that consideration should be given to increasing the permissible margin above background where the occupier of the property has some financial involvement in the wind farm.

Application of the ETSU-R-97 methodology has evolved as best practice has developed. As a result, and at the request of the now defunct Department of Energy and Climate Change, the Institute of Acoustics (IOA) published updated good practice guidance in 2013[18]. The focus of the new guidance was on updating the methodology to reflect practice and research, rather than to redefine acceptability of noise limits. The updated guidance included the recommendation that noise predictions and limits should relate to wind speeds up to 10 m/s.

A consequence of evolving guidance and practice is that the noise effects associated with wind energy schemes have not been consistently assessed, though it is anticipated that the fidelity of the assessment process, and of the noise limits defined for a particular scheme, has been improving over time. That said, it is notable from the previous ClimateXChange research, that

[18] http://www.ioa.org.uk/sites/default/files/IOA%20Good%20Practice%20Guide%20on%20Wind%20Turbine%20Noise%20-%20May%202013.pdf

assessment of around half of the wind energy schemes examined had underestimated noise levels during operation.

The ETSU-R-97 and IOA methodology and guidance are specifically referenced within Scottish Government policy and guidance. This includes:

- Scottish Government online guidance on Onshore Wind Turbines[19];
- Planning Advice Note 1/2011 Planning and Noise[20] which sets out how noise issues should be addressed in development planning and development management and which refers to wind turbines at paragraph 29;
- Technical Advice Note: Assessment of Noise[21] which, as the title suggests, provides technical guidance on noise assessment and which summarises legislative context and which refers back to the online guidance note above.

Together, these describe how the operational noise impacts of wind turbines should be addressed in the planning system in Scotland, including their consideration in development plans and treatment through the development management process.

[19] http://www.gov.scot/Resource/0045/00451413.pdf
[20] http://www.gov.scot/Resource/Doc/343210/0114180.pdf
[21] http://www.gov.scot/Resource/Doc/343341/0114220.pdf

Hydro

Introduction and overview of the technology

Recent years have seen a notable increase in the number of hydro-electric schemes proposed and implemented in Scotland. Once the mainstay of the UK's renewable energy capacity, this type of development was once dominated by large scale schemes based on major impoundments and water transfers between catchments. Examples include the Tummel Valley, Breadalbane and Sloy/Awe schemes. Developed from the late 1940s, by 1965 these schemes included 78 dams with 54 power stations which between them generate over 1000MW.

Other large scale hydro projects include pumped storage schemes (including the Cruachan Power Station and the consented scheme at Coire Glas near Loch Lochy in Lochaber) which use excess power (e.g. during the night) to pump water to fill an uphill reservoir with impounded water being released to generate electricity during periods of peak demand. The Cruachan Power Station was commissioned in 1965 and has an installed capacity of 440MW. The Coire Glas scheme was consented in December 2013 and when constructed will have an installed capacity of 600MW.

Most recent developments are of a much smaller scale, however, with installed capacity which tends to be between 1 and 2 MW. These schemes tend to fall into two groups:

- projects where turbines are retrofitted into existing structures such as weirs or former mill-races. These can often be close to other buildings, including residential properties. Most of these schemes have an installed capacity of between 1 and 2 MW.
- so-called 'run of river' schemes which extract water from a river, pipe it to a building accommodating a turbine before returning the water to the river. Most of these schemes have an installed capacity of between 1 and 2 MW.

Study scope

This study covers operational noise issues associated with smaller scale hydro schemes. It excludes large scale pumped storage schemes and projects based on large scale impoundment based schemes.

Noise sources and characteristics

Noise impacts associated with small scale hydro schemes generally focus on the mechanical noise (hum or whine) from the turbine itself, with secondary effects including the hum from any transformers and the sound from the tail race as water is returned to the river. Construction noise will depend on the scheme itself and the extent of engineering works such as excavation and rock cutting that is required. Operational noise is usually controlled through conditioned noise limits and occasionally by restrictions on the hours of operation. Where turbines are housed within buildings there is usually potential for mitigation in the form of noise insulation.

Potential noise impacts

Potential noise impacts may occur where hydro turbines are located close to noise sensitive buildings such as residential properties.

Planning context

Scottish Planning Policy (Scottish Government, 2014) requires planning authorities to identify in their development plans areas capable of accommodating hydro schemes related to river or tidal flows.

Paragraph 169 lists the factors that should be taken into account by planning authorities during the development management process. These include:

- impacts on communities and individual dwellings, including visual impact, residential amenity, **noise** and shadow flicker; and

- cumulative impacts … recognising that in some areas the cumulative impact of existing and consented energy development may limit the capacity for further development.

Planning Advice Note (PAN) 1/2011 outlines how noise should be addressed in development planning and development management. It highlights the role of development plans in limiting the number of people exposed to the adverse of noise by guiding development to the right locations. It lists the following issue which should be taken into account during preparation of a development plan:

- Avoidance of significant adverse noise impacts from new developments,
- Applying noise impact criteria reasonably,
- Use of mitigation measures to manage noise impacts,
- Protection of Quiet Areas, and
- Avoidance of development significantly adversely affecting Noise Management Areas.

The PAN also addresses the role of development management, noting that selection of a site, the design of a development and the conditions which may be attached to a planning permission can all play a part in preventing, controlling and mitigating the effects of noise.

Issues which may be relevant when considering noise in relation to a development proposal include:

- Type of development and likelihood of significant noise impact,
- Sensitivity of location (e.g. existing land uses, NMA, Quiet Area),
- Existing noise level and likely change in noise levels,
- Character (tonal, impulsivity etc), duration, frequency of any repetition and time of day of noise that is likely to be generated, and
- Absolute level and possible dose-response relationships

The PAN refers to the role of Noise Impact Assessment (NIA) (carried out as part of an Environmental Impact Assessment or separately) in assisting the consideration of noise issues during the development management process. A NIA should identify whether any significant adverse noise impacts are likely to occur and if so, identify what effective measures could reduce, control and mitigate the noise impact. In commencing a NIA, planning authorities and applicants should agree:

- any potential representative limits of noise and /or the relevant NIA methodology in the context of the proposed development, its location and the surrounding area, and
- criteria for assessing any significant adverse noise impact or predict and describe ambient noise levels (including noise from transport sources) that the proposed development is likely to generate and/or is likely to be subjected to.

The PAN outlines a range of generic measures which can be implemented through planning conditions in order to control or limit exposure from noise. It cross refers to the Addendum[22] to Circular 4 1998 which sets out some model conditions relating to noise issues.

Technical Advice Note: Assessment of Noise provides detailed technical guidance on noise assessment.

The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011 identify hydro schemes with an installed capacity of more than 0.5MW as potentially requiring Environmental Impact Assessment (EIA) dependent on factors including the potential for cumulative impacts, the generation of pollution and nuisance, the characteristics and sensitivity of the proposed location of the development and the potential significance of the impacts of development (e.g. extent, magnitude, probability, duration and frequency). Developers may request a screening opinion from a planning authority to determine whether EIA is required based on these factors. Most larger schemes are subject to EIA, with the scoping process designed to

[22] http://www.gov.scot/Publications/1998/02/circular-4-1998/circular-4-1998-landscape

focus the assessment on those environmental effects most pertinent to the proposed scheme and its location (e.g. aquatic ecology, flood risk and where relevant, noise). Even where EIA is not required, a more specific Noise Impact Assessment (see above) may be requested.

Noise assessment and standards

Specific guidance for the noise assessment of hydro-electric schemes does not exist, however the Scottish Government Technical Advice Note: Assessment of Noise promotes the principles of good design to ensure that quality of life is not unreasonably affected. Consequently for industrial environmental noise, and protection of residential amenity, local authorities typically request a full noise assessment based on BS4142 Methods for rating and assessing industrial and commercial sound, and the World Health Organisation (WHO) Guidance for Community Noise. BS8233 is occasionally referenced as a noise limit, and this contains recommended internal noise levels which are in line with those presented in the WHO guidance. Other noise limits associated with hydro-electric schemes include planning conditions set to Noise Rating (NR) within the nearest residential properties.

Air source heat pumps

Introduction and overview of the technology

Air source heat pumps absorb heat from the outside air in the same way that refrigeration units extract heat. This heat can then be used to heat radiators, underfloor heating systems, or warm air convectors and hot water. Air source heat pumps are usually located at ground level immediately adjacent to a building, or at roof level. They are similar in appearance to air conditioning units.

Study scope

The study includes air source heat pumps requiring planning consent (see below).

Noise sources and characteristics

Air source heat pumps generate noise during operation. This is principally associated with compressor and fan, with some noise coming from expansion valves and transformers. Noise levels vary according to the power level (reflecting the heating demand) which the character of noise changes when the unit goes into a defrost cycle to melt the ice that accumulates on the heat exchanger.

Potential noise impacts

Potential noise impacts may occur where air source heat pumps are located close to noise sensitive buildings such as neighbouring residential properties.

Planning context

In Scotland, domestic air source heat pump systems are classified as permitted development, provided it meets the following criteria:

- The air source heat pump will be used to provide domestic heating or hot water;
- There is only one air source heat pump within the curtilage of the dwelling in question;
- The air source heat pump is not located forward of the main elevation (or side elevation where alongside a road);
- Within Conservation Areas the air source heat pump is located at ground floor level on the rear elevation;
- Addition of the air source heat pump would mean the total height of a structure would exceed 3 metres;
- The air source heat pump is not within a World Heritage Site or within the curtilage of a listed building;
- The air source heat pump is removed when no long needed or capable of providing heating or hot water;
- Installation of the air source heat pump complies with the UK Microgeneration Certification Scheme Planning Standard (MCS 020)[23] (or equivalent) which sets out the procedure that installers should follow to ensure that noise effects are acceptable.

Prior to March 2016 permitted development rights did not apply if the installation was within 100m of another residential building (amongst other requirements). This change means that as of March 2016 all air source heat pump installations in Scotland should be working to the same noise standards and thresholds.

[23] http://www.microgenerationcertification.org/admin/documents/MCS%20020%20Planning%20Standards%20Issue%201.0.pdf

Noise assessment and standards

As noted in the previous paragraph, the UK Microgeneration Certification Scheme Planning Standard (MCS 020) provides the principal means of ensuring that the noise impacts of air source heat pumps are acceptable.

Appendix 3 Standards and Guidance on Assessing Noise

Standards and Guidance on Assessing Noise

This Appendix contains a brief description of commonly used standards and guidance that exist for assessing noise for the three renewable technologies wind, air source heat pump, and hydro.

IEMA Guidelines for Environmental Noise Impact Assessment

The Institute of Environmental Management and Assessment (IEMA) have published the "Guidelines for Environmental Noise Impact Assessment"[24]. The guidelines are applicable to noise impact assessment for any scale of development proposal, including core principles to achieve effective integration with the Environmental Impact Assessment (EIA), and provide advice on the issues that need to be considered in a noise impact assessment and whether the appropriate conclusions are being reached. The factors include:

- The appropriateness of the noise parameters used for the situation;
- The reference time period used in making the assessment;
- The level, character and frequency content of the noise sources under investigation; and
- How the predicted noise levels relate to relevant standards and guidelines.

The guidelines also recommend that the assessor should determine the degree of impact based on the evidence derived from the assessment.

Section 3, titled "The Process of Assessing Noise Impacts", considers how noise impact of a development should be assessed. It is advised that the assessment should include an understanding of the existing noise climate (the baseline condition), the predicted noise likely to be generated, mitigation measures, and the assessment of noise impact at the sensitive receptors.

The guidelines state that the assessor should set out the criteria specific to each assessment and to determine whether or not other factors would change the category of significance to another category.

BS 7445-1:2003

BS 7445-1:2003 Description and measurement of environmental noise - Guide to quantities and procedures, defines the basic quantities to be used for the description of noise in community environments, and describes basic procedures for the determination of these quantities[25].

The standard provides details of the instrumentation and measurement techniques to be used when assessing environmental noise, and defines the basic noise quantity as the continuous A-weighted sound pressure level (L_{Aeq}).

It is stated in the standard that it is important that details of the measurement instrumentation, measurement procedure, and conditions prevailing during the measurements, are carefully recorded and kept for reference purposes.

The standard also states that when it is desired to minimize the influence of reflections, measurements should, whenever possible, be carried out at least 3.5 m from any reflecting structure other than the ground, and when not otherwise specified, the preferred measurement height is 1.2 m to 1.5 m above the ground.

[24] IEMA, Guidelines for Environmental Noise Impact Assessment, Institute of Environmental Management and Assessment, October 2014
[25] BS 7445-1:2003 Description and measurement of environmental noise – Part 1: Guide to quantities and procedures

Environmental Protection Act 1990

The Environmental Protection Act 1990 provides powers for a Local Authority, to serve a noise Abatement Notice, in order to demand that an individual or company who the Local Authority believes to be generating unnecessary and objectionable noise, refrains from causing a nuisance in the future.

World Health Organisation

The World Health Organisation (WHO) Guidelines for Community Noise[26] state that in dwellings, the critical effects of noise are on sleep, annoyance and speech interference. To protect the majority of people from being seriously annoyed during the daytime and night-time, criteria are presented in the guidelines, which are shown in Table 1.

Table 1 WHO Guidance Noise Levels

Specific Environment	Critical Health Effect (s)	L_{Aeq} (dB)	Time base (hours)	L_{AFmax} (dB)
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60

To avoid the possibility of sleep disturbance, indoor guideline values for bedrooms are 30 dBL_{Aeq} for continuous noise and 45 dBL_{Amax} for single sound events. These correspond to sound pressure levels at the outside façades of the living spaces which do not exceed 45 dBL_{Aeq} and 60 dBL_{Amax}, so that people may sleep with bedroom windows open. These values have been obtained by assuming that the noise reduction from outside to inside, with the window partly open, is 15 dB as noted in the WHO Community Noise Guidelines.

BS 4142:2014

BS 4142:2014 Methods for rating and assessing industrial and commercial sound[27], is a standard that describes methods for assessing whether existing, and new, industrial noise sources are likely to give rise to significant adverse impacts on the residents living in the nearby area.

The latest version of the standard incorporates an assessment of uncertainty in environmental noise measurements, and introduces the concept of "significant adverse impact" rather than likelihood of complaints.

[26] World Health Organisation Guidelines for Community Noise, 1999
[27] BS4142:2014 Methods for rating and assessing industrial and commercial sound

BS 4142 requires that the measured Rating Level (L_{Ar}) is compared to the Background Noise Level (L_{A90}), measured in the absence of the noise under assessment.

BS 4142 refers to the following;

"A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

A difference of around + 5 dB is likely to be an indication of an adverse impact, depending on the context.

The lower the rating level relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."

The concept of a Rating Level (L_{Ar}) is introduced to account for the fact that certain characteristics of the noise source can increase the likelihood of complaints. These characteristics include noise sources of an irregular nature or that contain distinguishable, discrete tonal noise.

The acoustic correction feature takes account of:

- Tonality;
- Impulsivity; and
- Intermittency.

The methods for assessing whether an acoustic feature is present are:

- Subjective method;
- Objective method for tonality; and
- Reference method.

For the subjective method a rating penalty for tones of 2 – 6 dB can be added, while for impulsive noise a correction of up to 9 dB can be applied. The perception of audibility at the monitoring location determines the value of the penalty to be applied.

For the objective methods section 9.3 and Annex C and D of the standard are referred to.

The determination of the specific sound level, free from sounds influencing the ambient sound at the assessment location, is obtained by measurement or a combination of measurement and calculation. This is measured in terms of the $L_{Aeq,T}$ where T is a reference period of:

- 1 hour during daytime hours (07:00 hrs to 23:00 hrs); and
- 15 minutes during night-time hours (23:00 to 07:00 hrs).

Considering the above guidance the impact magnitude criteria is summarised in Table 2.

Table 2 Noise impact magnitude criteria for BS 4142

Rating Level dB L_{Ar}	**Impact Criteria**
Measured LA90	Low Impact
Measured LA90 + ≥ 5 dB	Adverse Impact

ETSU-R-97

The methodology described in The Assessment and Rating of Noise from Wind Farms (ETSU-R-97)[28] was developed by a working group comprised of a cross section of interested persons including environmental health officers, wind farm operators and independent acoustic experts.

The guidance makes it clear that any noise restrictions placed on a wind farm must balance the environmental impact of the wind farm against the national and global benefits that arise through the development of renewable energy resources. The principle of balancing development needs against protection of amenity may be considered common to any type of noise control guidance.

The basic aim of ETSU-R-97, in arriving at the recommendations contained within the report, is the intention to provide:

"Indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development or adding unduly to the costs and administrative burdens on wind farm developers or local authorities."

The guidance advises using the $L_{A90,10min}$ noise index for both turbine and background noise, and noise limits are set relative to the background noise, but not in particularly quiet areas where a lower limit is applicable otherwise this would unduly restrict developments, which are recognised as having wider national and global benefits.

Noise from the wind farm are limited to 5 dB above background for both day and night-time, subject to a lower limit of 35 to 40 dB during the day and 43 dB at night. The fixed limit of 43 dB is recommended for night-time, and this is based on a sleep disturbance criterion of 35 dB with an allowance of 10 dB for attenuation through an open window (free field to internal) and 2 dB subtracted to account for the use of $L_{A90,10min}$ rather than $L_{Aeq,10min}$. In low noise environments, the day-time level of the $L_{A90,10min}$ of the wind farm noise is limited to an absolute level within the range of 35-40dBA, and this depends on the number of nearby dwelling, effect on generation, and the duration and level of exposure.

IoA Good Practice Guide

The Institute of Acoustics Good Practice Guide to the Application of ETSU-R-97, for the Assessment and Rating of Wind Turbine Noise[29], provides guidance on all aspects of the use of ETSU-R-97 and has been endorsed by the governments in Scotland, England, Wales and Northern Ireland. It describes methods for background noise data collection, data analysis, noise limit derivation and noise predictions.

BS 8233:2014

BS 8233:2014 Sound Insulation and Noise Reduction for Buildings - Code of Practice[30], is a standard that suggests indoor ambient noise levels for dwellings, and states that:

"in general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values".

The standard also states that occupants are usually more tolerant of noise without a specific character, and only noise without such character is considered in the criteria taken from the standard shown in Table 3.

[28] The Assessment and Rating of Noise from Wind Farms, The Working Group on Noise from Wind Turbines, ETSU Report for the DTI, ETSU-R-97

[29] A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, Institute of Acoustics, May 2013

[30] BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

Table 3 BS8233:2014 Recommended Internal Noise Levels

Activity	Location	0700-2300	2300-0700
Resting	Living room	35dBLAeq,16hour	-
Dining	Dining room/area	40dBLAeq,16hour	-
Sleeping (daytime resting)	Bedroom	35dBLAeq,16hour	30dBLAeq,8hour

The design criteria for bedrooms recommends that internal noise levels should not exceed 35 $dBL_{Aeq,16hour}$ during the daytime (0700 to 2300) and 30 $dBL_{Aeq,8hour}$ during the night-time (2300 to 0700).

BS8233:2014 states that the acoustic environment of external amenity areas, that are an intrinsic part of the overall design, should always be assessed, and noise levels should ideally not be above the range 50-55 $dBL_{Aeq,16hour}$.

The standard also states that these guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces, but should not be prohibited.

It is also stated that if relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.

It is also noted that the level difference through a window, partially open for ventilation, can vary significantly depending on the window type and the frequency content of the external noise.

Noise Rating (NR) Curves

Noise Rating (NR) curves are primarily used in the UK, whereas Noise Criteria (NC) curves are the US equivalent. Noise curves are a common way to measure and specify audio noise in buildings and occupied spaces. Their purpose is to produce a single number rating for the background noise spectrum in a space.

Noise rating (NR) is a graphical method for assigning a single-number rating to a noise spectrum. It can be used to specify the maximum acceptable level in each octave band of a frequency spectrum, or to assess the acceptability of a noise spectrum for a particular application. The method was originally proposed for use in assessing environmental noise, but it is now used in the UK mainly for describing noise from mechanical ventilation systems in buildings.

Different rooms, locations, regulations and applications may allow different acceptable noise ratings. The purpose is typically for background noise not to interfere with various ongoing activities such as the noise of an office air-conditioning system not interfering with telephone calls or conversations.

Annex B of BS 8233:2014 discusses the use of NR curves and provides a method of calculating NR values. The curve rating is obtained by plotting the octave band levels for a given noise spectrum, which is specified as having a curve rating equal to the lowest noise curve that is not exceeded by the spectrum.

BS 5228-1:2009+A1:2014

BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites - Part 1: Noise[31] provides recommendations for basic methods of noise and vibration control, relating to construction and open sites where work activities generate significant noise levels.

Recommendations are given regarding procedures for the establishment of effective liaison between developers, site operators and local authorities. The standard does not give noise limits for construction sites, but emphasis is placed on ensuring that best practical means are adopted to control noise on site.

This standard also provides guidance on methods of predicting and measuring noise, and assessing its impact on those exposed to it. This includes on site construction activities, as well as mobile plant for example deliveries to and from site.

Control of Pollution Act 1974

The aim of the Control of Pollution Act 1974 is to deal with a variety of environmental issues, including waste on land, water pollution, abandoned mines, noise pollution and the prevention of atmospheric pollution. It sets out the process for dealing with excess noise and noise from construction sites. Measures to be taken to reduce noise levels during construction, with due regard to practicality and cost, as per the concept of best practicable means are defined in Section 72.

MCS Planning Standards MCS 020

The UK Microgeneration Certification Scheme Planning Standard (MCS 020)[32] sets out the MCS Planning Standard which must be complied with for domestic installations of wind turbines and air source heat pumps to be permitted development.

It is designed to allow installation companies to establish whether an installation will comply with the MCS Planning Standard, and includes a calculation procedure designed to confirm whether the permitted development noise limit of 42dB $L_{Aeq,5\ mins}$ (at the assessment position, ignoring the effect of that façade) would be met. The standard, and the notes and calculations carried out by installation companies, are also used by local planning authorities and the MCS to verify compliance.

Compliance with the MCS Planning Standard on its own does not bestow permitted development rights, there are a number of other conditions and limitations which must be complied with for an installation to be permitted development.

Permitted Development Rights: Domestic Wind Turbines and Air Source Heat Pumps

The Permitted Development Rights: Domestic Wind Turbines and Air Source Heat Pumps[33] was a study to identify, understand and evaluate the benefits and impacts associated with both Domestic Wind Turbines (DWT) and Air Source Heat Pumps (ASHP) so as to provide the evidence for appropriate recommendations to Scottish Ministers on the granting of Permitted Development Rights in planning legislation to the two technologies.

[31] BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites - Part 1: Noise

[32] MCS 020, MCS Planning Standards, For permitted development installations of wind turbines and air source heat pumps on domestic premises, Department of Energy and Climate Change (DECC), 2008

[33] Permitted Development Rights: Domestic Wind Turbines and Air Source Heat Pumps Scottish Government Social Research 2009

The following Table 4 and Table 5 list the stakeholder identified issues, the proposed acceptable level of impact, and any possible mitigation measures for DWT and ASHP respectively.

Table 4 Impact Matrix for DWT

Issue	Description	Evidence of Impacts	Acceptable Impact Level	Mitigation	PD Criteria Recommendations
Noise (aerodynamic and mechanical)	Noise causing an unlawful interference with a person's use or enjoyment of their amenity.	A small number of upheld complaints	WHO recommended internal room noise level of 30dB(A) and external noise level of 45dB(A)	Reduce the DWT noise level to meet noise criteria. This may be by product design or installation design - i.e. suitable distance of device from receiver	Adopt a suitable maximum noise level, i.e. 30dB(A) internal, equating to 45dB(A) external or garden. A 5dB(A) penalty would be added if tonality was present in the noise. Guarantee these noise levels by use of a product and installer certification scheme. For example the MCS noise mapping methodology.
Vibration	Vibration of building fabric and annoyance of occupants	A small number of complaints leading to shut-down of DWT until modifications could be undertaken	Unknown – research is underway by DEFRA	Installation according to manufacturers installation standards with use of anti-vibration mounts on suitable properties	That accredited installers will ensure that only MCS certified DWTs are installed to best practice on detached properties

Table 5 Impact Matrix for ASHP Based on Stakeholder Responses

Issue	Description	Evidence of Impacts	Acceptable Impact Level	Mitigation	PD Criteria Recommendations
Noise	Acoustic noise nuisance - generally to neighbours	Small number of noise complaints dealt with by environmental health officers	Use of NR curves: NR25 or NR 30 viewed as suitable internal room measure. WHO recommended internal room noise level of 30dB(A).	Reduce the ASHP noise level to meet noise criteria. This may be by product design or installation design	Adopt a suitable maximum noise level, i.e. 30dB(A) internal, equating to 45dB(A) external or garden. A 5dB(A) penalty would be added if tonality was present in the noise. Guarantee these noise levels by use of a product and installer certification scheme.
Vibration	Vibration transmitted	No specific evidence, but	Unknown	Installation according to	That accredited installers will ensure

	through building fabric causes annoyance	possibility if incorrectly installed		reputable manufacturers installation standards with use of mechanical solution such as isolation anti-vibration mounts	that only MCS certified ASHPs are installed to best practice

Permitted development rights for wind turbines and air source heat pumps on domestic properties were introduced in December 2011. They include a requirement to comply with the Microgeneration Certification Scheme Planning Standards which specifies a noise limit of 42 decibels. The Government response to the consultation made a commitment to review the appropriateness of this noise limit after one year. A review of all responses indicated that the case was not made for a change in the noise level which remains at 42 decibels to comply with Microgeneration Certification Scheme Planning Standards.