

**Strategic Health Impact Assessment on
Wind Energy Development in Oregon:
Response to Comments**

March 2013

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Comment response process

The draft of the Strategic Health Impact Assessment on Wind Energy Development in Oregon was open for public comment between January 3, 2012 and March 30, 2012. During that time we received more than 1,000 pages of comments and reference materials. In addition, more than 30 people participated in comment sessions held in Pendleton and Bend in March 2012.

Staff from the Oregon Health Authority's Public Health Division (PHD) read all comments submitted during the public comment period. We grouped the comments by topic area, responded to comments under each topic, and revised the report to ensure it is as accurate as possible. PHD's responses to comments are shown in blue, and changes to the Wind HIA report are shown in green. Some commenters had specific questions, requests for clarification, or recommended changes to the report, and PHD was able to provide specific responses. Many comments were more general in nature, and PHD provided general responses to these comments as a group. The names of commenters have been removed along with any identifying information. PHD did not publish all comments received in this document.

Several commenters provided additional resources, studies, and information for us to consider, including four binders of literature and information. PHD reviewed these documents to determine if they provided new information that could substantively change the major findings, conclusions or recommendations from this report, and made changes as appropriate.

As noted on page 5 of the Wind HIA report, this HIA is not an exhaustive review of the literature. Further, we did not cite every study, article or document that we reviewed for the initial or final versions of the report.

Please note:

Corrections

1. **Commenter 1** – “On page 5 the report indicates that a county planning director or staff served on the Steering Committee. We know that not to be true.”

Response: PHD regrets the error. A city (not county) community development director served on the Steering Committee.

Change to Report: Change page 5 paragraph 2: “...county elected officials, a county public health director, a city community development director, community members...”

HIA Scope, Process, and Treatment of Evidence

Scope

Several commenters pointed out health impacts and issues that were not addressed in the report. These health issues include worker safety, projectiles, fire hazards, impacts to wildlife and impacts of wildlife losses on human health.

Worker safety

2. **Commenter 2** – “Did you include information on what OSHA requirements are for people who work at operating wind farms? Do they base their requirements on your reports?”

Response: We did not address OSHA requirements for workers at operating wind energy facilities. OSHA’s general industry standards cover many of the potential [health and safety hazards at wind energy facilities](#). OSHA does not develop their worker safety requirements based on PHD reports.

Projectiles from turbines

3. **Commenter 3** – “Wind turbines are known for miscellaneous breakdowns where a bolt or piece part from turbines has blown a half mile or more from the tower during a breakdown.”

Fire danger—health impacts from smoke

4. **Commenter 3** – “Wind towers are not safe as many people have noted the potential for fires in dry land wheat areas that have limited resources for fire fighters (most of the fire fighters are volunteers). These wildfires of course would cause additional air pollution.”
5. **Commenter 4** – “There are many other topics pertaining to the human health impacts of wind turbines that should be studied in more detail as well, such as the cumulative effects of wind turbines, community fire dangers from wind turbines, habitat and aquifer disruption from wind power projects, property devaluation near wind power projects and the economic feasibility of wind power projects, among many other issues.”
6. **Commenter 5** – “I contested the case of the HWPF to the Department of Energy. One of the critical issues was fire danger to residents who are living in the middle of the project. These 134 turbines are sited in standing wheat and CRP. Fire danger is quite high because of the fuel loads, low humidity in the summer months, a volunteer fire department in the Helix fire district, travel time for the nearest fire district, and of course wind. I have included a photo of how a lot of farm dwellings are situated in the middle of wheat fields. The wheat is farmed right up to the property line of the neighboring property – thus

increasing the danger to the neighboring homes and properties. Many turbines will be in the same fields that homes are located in. In the HWPF project there will be at least 35 homes or more that are in harms way if a fire should start.”

Wildlife and impacts of wildlife loss on human health

7. **Commenter 6** – “There is an increasing environmental backlash. Opinions amongst environmentalists are diverging over the killing of birds, (particularly raptors) bats, disruptions of migratory flyways, and wide scale habitat disruptions. Google, ‘wind energy opposition by environmental groups’ and the results are extensive.”
8. **Commenter 6** – “There is a real and now health connection between vector control species such as bats, raptors and insect eating songbirds that are under population pressures, of which deaths from wind turbines are a contributing factor. American Bird Conservancy (largest bird conservancy group operating solely in the U.S.) has ‘formally petitioned the US Department of Interior, US Fish & Wildlife, to protect millions of birds from negative impacts of wind energy by developing regulations that will safeguard wildlife. Wind facilities will be subject to mandatory permitting and required to mitigate harm to birds and bats.’”
9. **Commenter 6** – “The HIA, when discussing global warming, theorizes that increased temperatures will lead to diseases such as malaria but fails to make the current, real and now, connection between loss of vector control species and increase in disease. Further, the pivotal role bats and birds play in our food supply is essential in controlling insect pests. Without them, agriculturalists would be forced to become more dependent on pesticides.”
10. **Commenter 6** – “Environmental conflict with respect to industrial wind turbines is on the rise. For example, the lawsuit by environmentalists against an Invenergy project in Duo, W.VA forcing the shutdown of turbines at night, during times of the year when bats are not hibernating, due to testimony projecting bat kills of 111,000 per year.”

Cumulative Effects

11. **Commenter 7** – “There should also be a standard for visual impacts and the cumulative effect of these installations resulting in complete transformation of rural Oregon needs to be considered.”
12. **Commenter 4** – “There are many other topics pertaining to the human health impacts of wind turbines that should be studied in more detail as well, such as the cumulative effects of wind turbines, community fire dangers from wind turbines, habitat and aquifer disruption from wind power projects, property devaluation near wind power projects and the economic feasibility of wind power projects, among many other issues.”

Response (Comments 2-12): PHD acknowledges that this report is not as comprehensive as some may have hoped. PHD could not address every potential health impact of concern due to limited scientific or public health information on several of these issues, and because of resource and time constraints. PHD narrowed the HIA’s scope to the five domains that were of greatest concern to Oregon communities, that had some scientific information to support the assessment, and which were agreed upon by the HIA steering committee. See page 5, Appendix B, and Appendix D of the report for more information on PHD’s scoping process.

Treatment of Evidence

13. **Commenter 8** – “Key Findings and Recommendations: One of the greatest concerns is your admission in the next to the last paragraph on page 5. You stated that ‘Despite our best efforts we acknowledge that our review was constrained ... by limited staff, time, and resources...’ If you can’t do the job right, should you even try? Does 134 pages come down to this?”

Response: While the literature review conducted for this HIA did not include every piece of literature written on the five topic areas, it included the best available scientific and other credible literature available at the time. Some of these topic areas (including wind turbine noise) are new areas of study. Because this was a strategic assessment, we were not able to be more specific about potential impacts in these domains. However, we are confident that this report reflects the best available information at the time it was written and that providing any consideration of health impacts is better than offering none at all.

14. **Commenter 1** – “The ██████ County Court has been concerned since the inception of this project that it was a solution seeking a problem...Of greatest concern is the outcomes are not based on a scientific review of the data, but are influenced by emotion and rhetoric.”

Response: HIA is "a systematic process that uses an array of data sources and analytic methods and considers input from stakeholders" to assess the effects of project or policy on a community’s health. PHD conducted this HIA in a structured, impartial and transparent manner, adhered to a high level of scientific rigor, and also considered input from the many stakeholders in this issue. This HIA went through rigorous review by the steering committee and leaders within the Oregon Public Health Division prior to its public release.

In Appendix B (Methods) we discuss our treatment of the evidence considered for inclusion in this assessment. All sources were evaluated using a hierarchy of evidence (reproduced below). The HIA steering committee agreed to this hierarchy of evidence early in the HIA process. Sources that most closely matched the study types, measurements, and sources near the top of the chart were given the most weight in our examination of the evidence. Sources that more closely matched items near the bottom of the chart were given less weight.

Table 14: Hierarchy of evidence used in Wind Energy Strategic HIA.

Weight	Study Type	Measurements	Source
More   Less	Population-based	Measured	Peer-review Journals
	Risk assessment	Validated model	Public health/medical reports
	Case series/ case reports	Non-validated model	Publications by public health authorities
	Animal studies		Publications by other groups (Industry, community members)
			Other: Web sites, news articles, opinions, etc.

15. **Commenter 9** – “Unless substantiated scientific proof can be provided that there are ‘positive health impacts’ as a result of wind energy, this statement throughout the report must be removed.”

Response: PHD respectfully declines this request for the following reasons:

- HIA is a methodology that examines how a proposed project, policy or program could have both positive and negative impacts on health.
- Removing these statements/considerations would ignore community and stakeholder input collected throughout the HIA process.
- Based on our review of evidence, PHD believes that properly sited wind energy facilities could have overall positive health impacts on health.

PHD cannot provide substantiated scientific proof for any of the impacts examined in this report. HIA is a prospective approach that seeks to predict potential impacts based on the best available information. As such, there will always be some amount of

uncertainty involved in these assessments. However, we believe the report provides a balanced assessment of the best available evidence available at the time the report was written.

16. **Commenter 3** – “Most of the studies were reference in the Health impact assessment were generated by the wind industry themselves creating a biased representation of what the real health impacts are from wind towers.”

Response: Please see our response to comments #13 and 14. PHD did use reports generated by the wind industry, and treated them according to the hierarchy of evidence shown above. We acknowledge that some readers might find this objectionable, just as other readers find our inclusion of case studies and case reports objectionable.

Transparency during HIA steering committee meetings

17. **Commenter 8** – “On page 100, ‘HIA support inclusive, transparent and democratic decision-making’: my husband and I were told to leave when we attempted to attend an HIA meeting in The Dalles last fall. We wanted to attend as audience members only but were told it was not open to the public. Why was this the case if HIA truly supports transparent decision-making.”

18. **Commenter 11** – “Reading the HIA report makes it clear that the scoping process was heavily influenced by industry representatives. I attended one steering committee meeting and it was apparent that the industry bias held sway in the dynamics of the meeting. An acquaintance who attended a different steering committee meeting reported a similar experience. I was not allowed to attend another ‘working’ meeting later as an audience member. This appears to be a legal stretch of Oregon’s open meeting laws.”

Response (comments 17 and 18): PHD places great value on the input, information and perspectives we received from the many people and organizations in Oregon with expertise, information and interest in the subject of wind energy production and health. As such, we endeavored to conduct this HIA in the most open and inclusive manner possible.

All but one meeting of the steering committee were open to the public. The one exception was a meeting where steering committee members were asked to share their individual feedback on an embargoed version of the report. The report was embargoed (and the meeting closed) because the report was unfinished, and we wanted to ensure that the most complete and accurate report would be released for public comment. Prior to forming the steering committee we checked with the Oregon Department of

Justice to determine whether or not the steering committee meetings would be subject to Oregon's Sunshine Law. ODOJ determined that the meetings were not subject. Therefore, we did not violate Oregon's laws on public meetings.

Bias Communication/Language

There were some comments claiming that PHD was biased toward a particular viewpoint in the report.

19. **Commenter 8** – “Foreword: It would be preferable to stick to the facts rather than taking such an obvious ‘pro-wind’ stance. You treat wind energy as important while making ‘positive contributions.’ This is where you might mention that there are some problems, too.”
20. **Commenter 8** – “Foreword: In the final paragraph you present a lame discussion about how development projects may be in opposition to public health. But, then, you say this is a ‘false dichotomy.’ Which way do you want it? While development and health need not always be at opposite ends of the spectrum, there are times when that will be the case. Each case is different. Your attempt to dismiss the potential conflict is biased and misleading.”
21. **Commenter 7** – “This document is disappointing in its pro-wind energy bias which is clearly evidenced in the Forward written by Mel Kohn. In spite of the fact that there is clear evidence that industrial wind energy facilities do not decrease, but rather increase Green House Gas emissions, Dr. Kohn begins the Forward by stating, “Wind Energy is an important area of renewable energy development for the Pacific Northwest and for the United States.” He ends his statement by saying that it is his hope that this HIA will be a useful tool for future wind energy projects in Oregon. A more appropriate title of this report would be “Strategies to Assist Wind Developers work with Disadvantages Oregonians in Rural Areas.”
22. **Commenter 12** – “Shame on you for not accepting fair value to the opposition of wind energy development as your draft is obviously slanted to the Industry we need protection from.”
23. **Commenter 9** – “The ‘objectives,’ per page 4 of Key Findings, confirms the fact this report is nothing more than a collection of information from biased sources and lacks the substantive conclusion, but does render more on the stance of a politically motivated evaluation.”

Response (comments 19-23): We have carefully reviewed the sections mentioned in the above comments, and stand behind the wording of the report.

Implementation of a site-specific HIA

On page 5 and in other sections of the strategic HIA report, PHD states the need for “site-specific assessments” of individual wind energy developments in local communities. We received several questions and comments about these statements. Specifically, commenters requested PHD to provide more clarification on how a site-specific HIA would be integrated into the current siting process, whether HIA findings would be legally binding, and whether a site-specific HIA would provide more precise or actionable information than the strategic HIA.

24. **Commenter 13** – “The OHA has not given a complete indication as to how it plans to utilize and integrate the HIA process into the existing siting process or whether the recommendations can be accomplished through existing regulatory mechanisms. While the report notes it is the policy of the State of Oregon to site and construct energy facilities ‘in a manner consistent with protection of the public health’ the actual statutory framework provides little in the way of actual methods to accomplish that policy.”
25. **Commenter 13** – “The OHA has not indicated where, from a timing perspective, a site specific HIA would be used during the EFSC process.”
26. **Commenter 13** – “Because the HIA covers topics that are not addressed in the siting process and because the OHA is not an agency from which EFSC seeks comment on energy facilities, we fail to understand how the report would serve as the described ‘starting point’ or ‘reference material’ for any future wind development. A developer would have no obligation to use the HIA as a starting point. An HIA that is performed to provide ‘site specific assessment’ would essentially exist on its own, without any regulatory home and with unclear lines regarding the effect of its conclusions. ■■■ does not believe OHA has fully considered how those site specific assessments would affect the siting process or the development of a wind energy project. A suggestion that developers and other stakeholders ‘may need to implement sound mitigation strategies’ if complaints arise, including sound monitoring, documentation of residents’ symptoms, operating the facility at a reduced production and communication of the strategies to local residents, seems to indicate that the HIA would be more than just a starting point, but also a continuing assessment point. And here again, ■■■ does not believe OHA has fully investigated how such a continuing assessment would be accomplished or acted upon by industry.”

Response (comments 24-26): Ideally, a site-specific HIA (or similar evaluation of health impacts) would be integrated into the existing EFSC process. We do not intend for site-specific assessments to exist “on their own” with no impact on or connection to the siting process. One possible opportunity for a site-specific HIA is during the first phase of the EFSC siting process, which begins when a developer submits a Notice of Intent (NOI) to

ODOE (see ODOE’s website for a [description of the EFSC siting process](#)). As stated on ODOE’s website, the NOI “enables ODOE and other government agencies to identify potential issues and data needs and plan for staffing for the review process”. A rapid HIA during this point of the EFSC process would review data presented in the NOI, review public comments received in response to the NOI, and provide recommendations for specific information or analyses (if any) to be included in the developer’s application for a site certificate.

PHD has not fully mapped out the process or timing for a site-specific HIA. PHD is working with ODOE to pilot an assessment that will be integrated into the current siting process. As part of this work, we will undoubtedly gain practical experience with EFSC’s siting process, timing and requirements, which will inform the scope and recommendations of a site-specific HIA.

PHD acknowledges that adding additional stakeholders, content areas and analyses to the already lengthy siting process may be perceived as burdensome to developers. We do not expect that all of the topics addressed in the strategic HIA will (or should) be included in a site-specific assessment. However, while some of these topics lie outside of Oregon’s existing regulatory framework they may still be important to a particular community. Developers and government agencies can choose to take actions beyond what is required by law in order to answer community questions about health.

27. **Commenter 13** – “The HIA also envisions acting upon developers after the siting process is complete. But the OHA has not indicated how a developer would implement any of the recommendations that require post-siting actions.”

Response: Our understanding is that developers have an obligation to ensure their facilities meet applicable rules and regulations when in operation. Therefore, if decisions made during the siting process prove inadequate to meet applicable standards (e.g., Oregon’s noise standard), developers will need to implement actions to bring their facility into compliance with these standards. The HIA’s recommendations for post-siting actions are suggested strategies (obtained from the literature we reviewed) for scenarios where mitigation of impacts are needed.

28. **Commenter 13** – “Assuming that the findings within an HIA lack the force of law, project developers would not be required to perform any of the recommended actions within the HIA but could be subject to attack from opponents of a project, including possibly legal challenges. This will add cost to building and operating a project, even if nothing is changed because of findings. If the findings within an HIA do have the force of law, and [REDACTED] does not believe they do, it is unclear what the penalty would be for failing to

comport development or operational actions to its contents. It is also unclear how a developer would interact with the OHA in the development of a site-specific HIA and whether there would be opportunities for comment, review or judicial challenge. The HIA process does not have a statutory home, it has not been reviewed by the legislature and is not required by law. Thus, [REDACTED] asks the following questions: Is the HIA an administrative rule, or is it an administrative order? What is the obligation of the developer regarding HIA recommendations? What is the obligation of the OHA in response to concerns from a developer? What is the obligation of a state agency regarding HIA recommendations? Can a developer be sued for failing to comply with an HIA recommendation? An even finer point exists for regulated utilities, like [REDACTED], who build their own projects. Regulated utilities developing energy projects must justify any actions taken and costs incurred to the Oregon Public Utility Commission through a prudence determination. If an action or cost is not required by regulation, it may be difficult to obtain recovery from its customers for that action or cost. If an HIA recommended certain actions in order to protect health, but there was no statutory duty to perform those actions, an investor owned utility might actually be prohibited from recovering those costs.

Response: The strategic HIA is not an administrative rule or administrative order. As such, a developer cannot be sued for failing to comply with this report's recommendations. You are correct in stating that PHD does not have the regulatory authority to require compliance with the recommendations in this report. However, this report is a public document. The intended recipients of this report (specifically ODOE, EFSC and local elected officials) do have policy and/or regulatory authority, and may choose to use their authority to require the adoption of or compliance with the report's recommendations.

While no one is required or obliged to use it as a reference document or implement any of its recommendations, PHD hopes partner with interested stakeholders in applying the framework laid out in this document at a specific site. PHD is also available to discuss specific concerns from developers and other stakeholders about the intended use of this report.

PHD acknowledges that adding additional stakeholders, content areas and analyses to the already lengthy siting process may be perceived as burdensome to developers. We do not expect that all of the topics addressed in the strategic HIA will (or should) be included in a site-specific assessment. However, while some of these topics lie outside of Oregon's existing regulatory framework they may still be important to a particular community. Developers and government agencies can choose to take actions beyond what is required by law in order to answer community questions about health.

29. **Commenter 13** – “Due to concerns, we asked the HIA work to ensure results would be tied to projects or specific standards for maximum effect. However, perhaps because the HIA is a ‘strategic’ look, the document contains broad language such as ‘sound from wind

energy facilities in Oregon **could** potentially impact people’s health,’ ‘potential impacts from wind turbine sound could range from moderate disturbance to serious annoyance,’ ‘while aesthetic impacts are unlikely to directly affect health, they **may** play an important role in peoples’ perceptions.’ These are just a few examples of a number of places in the report where the language is so broad as to render the conclusion or recommendation difficult to implement and of questionable value. These types of phrases lack the certainty and precision necessary for project developers and regulators to act on the conclusions and recommendations.”

30. **Commenter 13** – “In addition, once again, the qualified language used in the HIA leaves a developer open to complaints from the community due to imprecise language: What is ‘near?’ What strategies are sufficient? How many strategies? What if evaluation finds no strategies available? Is there a cost/benefit component to the evaluation, that is, if the sound generation is a problem for one party and the strategy would cost \$10 million to implement, should it be done? From [REDACTED]’s perspective, this type of recommendation is fraught with problems.”

Response (comments 29-30): PHD understands the frustration with our use of broad and imprecise language throughout the document. Most of the ambiguity is due to the “strategic” focus of this HIA, and some of it is related to uncertainties in the evidence base. We expect that a site-specific HIA will provide precise language and actionable recommendations that are appropriate given the conditions and characteristics of a particular site.

Massachusetts’ Efforts

We received several comments encouraging PHD to review/adopt/conform with language and finding in the state of Massachusetts’ Wind Turbine Health Impact Study (available at: <http://www.mass.gov/dep/energy/wind/impactstudy.htm>). The state of Massachusetts conducted an effort to assess the health impacts of wind energy production at approximately the same time that PHD’s effort was underway

31. **Commenter 1** – “As a contrast we would encourage the Oregon Health Authority to review and consider adoption of the Massachusetts Wind Turbine Health Impact Study (January 2012). The seven member panel that drafted this study are experts in various fields relevant to the topics covered and the results are based on scientific evidence and data.”

32. **Commenter 14** – “I believe that the state of Oregon should follow the Massachusetts study for health affects of wind farms that deals with science. The studies in Europe that you are trying to follow are based on emotion and have not been peer reviewed. If Oregon follows your draft recommendations, it is a dangerous precedent for development of any kind in the state.”

Response: Please see our response below, and our responses to comments 13 and 14.

33. **Commenter 13** – “We highly recommend the study performed in the State of Massachusetts and released in the same month as Oregon’s HIA as an example of a health study with specific and clear language. Though it too is a ‘strategic’ look at wind siting in the state, the study contains such conclusions relating to noise as ‘whether annoyance from wind turbines leads to sleep issues or stress has not been sufficiently quantified’ and ‘there is insufficient evidence that the noise from wind turbines is directly (i.e., independent from an effect on annoyance or sleep) causing health problems or disease’ and ‘the strongest epidemiological study suggests that there is not an association between noise from wind turbines and measures of psychological distress or mental health problems.’ We believe there is a qualitative difference in the language used in both reports and their conclusions. In Oregon’s HIA, the paucity of literature on a subject is not dispositive but indicative there could be a problem. In Massachusetts’ HIA, the limited evidence is noted and used to call for additional study before determining a problem. ■■■ recommends the OHA carefully review the language contained in its recommendations to revise or remove language that is speculative or not fully supported by scientific literature.”

Response (comments 31-33): There are similarities and differences between the projects completed by Oregon and Massachusetts.

An important difference between the two efforts is that Massachusetts convened an “expert panel” to review the literature on wind turbines and potential health impacts. The Massachusetts Department of Environmental Protection contracted with the panel of experts. The state’s public health authority provided suggestions on the disciplines that were important to include and helped to develop the charge to the panel. An Expert Panel is designed to bring together a group of individuals with knowledge and expertise in a specific field and ask them to apply their knowledge to a specific topic or question; in this case, the Massachusetts Department of Environmental Protection (DEP) asked the group about the known health impacts from the wind energy facilities.

Oregon carried out a “health impact assessment”, conducted by Oregon’s public health authority. An HIA seeks to identify both the known and potential health impacts from a specific policy or project and is a tool designed to assist decision makers to improve their ability to consider health in their deliberations. In many instances there is a gap between the known impacts and those which are potential but may not be fully characterized or

understood. HIA has the flexibility to describe the areas which need additional study and openly weigh the presence and strength (or weakness) of the evidence so as to be of most service to decision makers who are grappling with decisions for which there is not a simple yes or no option. This Strategic HIA is intended to provide a framework for the assessment of future proposed facilities.

Despite these differences both efforts relied on the best science available. Massachusetts consulted experts on the state of the science, as did Oregon. Similar to Massachusetts, Oregon consulted experts who reported on their assessment of the science. In addition, PHD reviewed the state of the science directly, consulted with community members, wind industry representatives, utility sector representatives, planners, elected officials and other decision makers so as to best understand and incorporate a broader set of considerations into the assessment as a whole.

The conclusions of the two reports are strikingly similar. For example: Regarding the need for and utility of a mechanism to monitor the impacts of sound, Massachusetts recommends “an ongoing program of monitoring and evaluating the sound produced by wind turbines that are installed in the Commonwealth” and recommends “a more comprehensive assessment of wind turbine noise in populated areas”. The report also notes that “These assessments should be done with reference to the broader ongoing research in wind turbine noise production and its effects, which is taking place internationally. Such assessments would be useful for refining siting guidelines and for developing best practices of a higher category.” Similarly, Oregon found that “there does not appear to be a systematic process for documenting or responding to complaints from county-sited facilities” and recommends “systems and protocols for systematically documenting, responding to, and evaluating complaints.” We also agree that additional assessment is needed with regard to the impacts of wind energy production, particularly in populated areas.

Regarding the impacts of shadow flicker, Massachusetts notes that “Shadow flicker can be kept to acceptable levels either by setback or by control of the wind turbine”, while Oregon notes that “In the majority of cases, the setback distances required to meet Oregon’s noise standard are expected to minimize shadow flicker impacts.”

An important common theme in both the Massachusetts and Oregon report is the relative lack of epidemiologic evidence to support or refute the claims of adverse health impacts from wind energy facilities. Both recognize the need for additional research.

Noise

Sound vs noise

PHD received several comments about the use of the terms “sound” and “noise” in the document.

34. **Commenter 10** – “I find it both interesting and objectionable that ‘noise’ is now referred to as ‘sound.’ This appears to be one more example of the wind industry trying to downplay the negative effects of wind turbines. Noise is defined as sound that is ‘loud, unpleasant or unexpected.’ Cities have noise ordinances, not sound ordinances. Isn’t noise our concern here?”
35. **Commenter 11** – “The substitution of the use of the word “sound” for “noise” throughout the report makes for tortured reading and writing. Except for a couple of turbine industry funded white paper, all literature and studies on the subject do not attempt to interchangeably use the words ‘noise’ and ‘sound.’ Even M. Bastasch and G. Leventhall, are organizers of the bi-annual ‘Wind Turbine Noise Conference’, not sound conference. Since becoming involved with issues of wind turbines in 2007, I have read much and nowhere else has this substitution been done. There is no explanation in the HIA report to validate this. What is the rationale behind it?”
36. **Commenter 11** – “On page 51, Section B. Sound, once again based on your assessment, shouldn’t ‘noise’ be used instead of ‘sound.’ People in general don’t experience sound as a problem, but do experience noise as a problem.”
37. **Commenter 13** – “The difficulty for a project developer however, is the HIA definition of ‘noise as annoying sound’ is not consistent with the existing noise control rules that apply to energy generation facilities through the siting process. These rules, promulgated by the Oregon Department of Environmental Quality but applied by EFSC, use the term ‘noise’ to mean sound. OAR 340-035-0035, regulating industrial and commercial sources, prohibits noise levels at an appropriate measuring point, from exceeding certain levels. There is no requirement that the emitter of a sound wave measure the annoyance or disturbance of a receptor. This would be a difficult standard to apply to be sure.”
38. **Commenter 13** – “Another trouble with the concept of ‘noise as annoying sound’ is the susceptibility of the terms to be interchanged. The report notes the difficulty that is raised by making this distinction, but there are also places where it would appear the terms are not used in the correct manner. For example, on page 31, the report notes that the section ‘briefly describe[s] some metrics and guidelines used to assess and evaluate community **noise** encompasses a wide range of human reactions. People may become annoyed with a **sound** because it actually interferes with activities...’ In this case, we believe ‘noise’ was intended in the second instance. There are many other examples. ■

would recommend the report be carefully reviewed to determine in each instance the use of ‘sound’ or ‘noise’ that the correct term is meant.”

Response (comments 34-38): PHD made the distinction between “sound” and “noise” in an attempt to maintain an objective and unbiased tone throughout the document. However, we recognize that our use of these terms created unnecessary confusion throughout the document, and is not consistent with scientific, regulatory or everyday use of these terms.

Change to report: Replace “sound” with “noise” throughout the document (unless sound is technically more accurate).

Annoyance as an outcome

39. **Commenter 1**– “Of equal concern is the use of the overly broad definition of health put forth by the World Health Organization. This definition allows ‘annoyance’ to become a scientific factor in determining overall health. This should be of concern to all because using this definition and allowing general annoyance such a significant role could, and probably will, stifle development.”

40. **Commenter 13** – “█ would like to see the HIA provide either greater support from scientific literature for the assertion that annoyance is a health outcome that must be mitigated against or a greater acknowledgement of the subjective nature of annoyance and that annoyance per se is not a health outcome.”

Response (comments 39-40): On page 28 of the report, PHD defines annoyance and provides some discussion about its use as a measure of exposure or effect in noise surveys and studies. As discussed in the report (page 30), there is considerable variation in how people respond to noise (especially at lower levels). At the population level, scientists measure the effects of noise exposure using subjective measures such as “not disturbed”, “annoyed” or “highly annoyed”. Policy makers then determine an acceptable level of exposure (i.e., x% of people highly annoyed) and develop noise limits or guidelines based on this level. HIA Reference #7 (UK Health Protection Agency, *Environmental Noise and Health in the UK*. 2010.) provides an excellent discussion of these issues.

PHD stands by our use of the WHO’s definition of health. Under this definition, annoyance from noise (as discussed on page 28) qualifies as a health effect. However, we acknowledge the need for additional discussion on the links between subjective effects (e.g., annoyance) and objective effects on health (e.g., changes in blood pressure), and made the following change to the report.

Change to report: Revise “Impacts from environmental noise” paragraph on page 28 (see response to comment 49 for specific changes) and “Biological mechanism” paragraph on page 29 as follows:

Scientists do not completely understand the complex mechanism by which noise produces health effects in humans. Figure 4 shows one possible model for how noise produces health effects through direct and indirect pathways. In the direct pathway, noise exposure activates the nervous and endocrine systems and results in short-term physiological stress response. In the indirect pathway, a person perceives sound as noise and becomes annoyed, which triggers a short-term physiological stress response. The physiological response in both the direct and indirect pathways involves short-term changes in stress hormone levels, heart rate, blood pressure and other factors; these changes resolve when the noise exposure ends. In cases of chronic or long-term noise exposures, people may become habituated to regular noise sources or develop coping mechanisms that reduce their stress response. If this does not occur, the continued stress response to noise may contribute to long-term health risks for cardiovascular disease [8, 73]. As mentioned previously, scientists have not identified a threshold level of exposure for the more harmful effects of noise exposure.

41. **Commenter 15** – “Page 28, Annoyance Quote: Using a feeling about noise dating back more than sixty years fails to put into context a discussion of noises in the 21st century. Why not reference studies on wind turbine operations cited elsewhere in the HIA? *Recommendation:* Replace your quote with the following, taken from the Massachusetts Department of Public Health study: ‘While annoyance as such is certainly not to be dismissed, in assessing global burden of disease the World Health Organization (WHO) has taken the approach of excluding annoyance as an outcome because it is not a formally defined health outcome per se (Concha-Barrientos et al., 2004). Rather, to the extent annoyance may cause other health outcomes, those other outcomes could be considered directly. Nonetheless, because of a paucity of literature on the association between wind turbines and other health outcomes, we consider here the literature on wind turbines and annoyance.’”

Response: Please refer to our comments under “Massachusetts’ Efforts” for similarities and differences in Massachusetts’ and Oregon’s reports. The Suter (1991) quote on page 28 provides a clear description of the use and limitations of “annoyance” in noise surveys. Annoyance continues to be used in studies (including those conducted in the 21st century) to assess noise impacts at a population level. For additional information, please refer to Chapter 5 in HIA Reference #7 (UK Health Protection Agency, *Environmental Noise and Health in the UK*. 2010, Health Protection Agency: Didcot, Oxfordshire).

We were unable to locate the reference that states that the WHO “has taken the approach of excluding annoyance as an outcome because it is not a formally defined health outcome per se”. The Concha-Barrientos et al. (2004) reference we did find is WHO manuscript entitled “[Occupational noise: Assessing the burden of disease from work-related hearing impairment at national and local levels.](#)” In this manuscript, the authors describe potential health outcomes to include in assessments of burden of disease from occupational noise. On page 8 of this document, the authors include this discussion:

“Applying these criteria, it is clear that NIHL (noise-induced hearing loss) should be included in any national assessment, as it is strongly supported by epidemiological evidence, and is one of the health outcomes often assessed in national health statistics and as part of WHO burden of disease assessments. It is generally most straightforward to exclude outcomes such as annoyance, as they are not a formally defined health outcome per se. Should annoyance cause other health outcomes, such as hypertension and associated cardiovascular disease, then other outcomes could be considered. If there is a strong local reason for including such outcomes, then it is possible either to assess comparative disability weights independently, to take them from other studies (e.g. de Hollander et al., 2004), or to extrapolate them from similar health outcomes. You should be aware that an independent assessment of the severity of such outcomes introduces additional uncertainty when the results are compared with other risk factors or geographical areas.”

Again, the authors are discussing outcomes related to exposure to occupational noise, not environmental noise. Our understanding is that the WHO continues to consider annoyance a noise-related health outcome, but has acknowledged the difficulty in using annoyance as an endpoint when calculating noise-related burden of disease (i.e., calculating Disability Adjusted Life Years lost due to annoyance from noise. See WHO’s [Burden of disease](#) reports for additional information).

42. **Commenter 16** – “As the HIA suggests, ‘objective measures of sound do not necessarily correlate with subjective experience of sound.’ This observation strikes near the heart of the issue. While some non-peer reviewed studies have linked wind turbine sounds to annoyance factors, there is no overarching proof that connects any wind turbine-created sounds (“infrasounds” or otherwise) to medical problems. Moreover, the HIA establishes – and we agree – that these studies have serious limitations. Though some people have claimed to experience a variety of problems related to wind turbine sounds, the correlation seems to be that people already dislike the turbines for another reason and are therefore predisposed to be annoyed by what they “hear.”

43. **Commenter 9** – “To insinuate that only the people who do not like wind farms are those that are affected with health issues is an attempt to discount the fact wind farm noise is a daunting health concern and is not subjective.”

44. **Commenter 13** – “Part of the difficulty with annoyance as part of the definitions of ‘noise’ is that the annoyance may be caused by factors other than the sound itself; for example, the visual effects of the wind turbines, inequities of property lease payments, or additional traffic caused by maintenance and service vehicles. The HIA notes that these factors in its recommendations on page 52, but fails to disaggregate the factors from the noise effects. At least one study that was included in the HIA, suggests that visual intrusion was what caused the annoyance and not the sound.”

Response (comments 42-44): We discuss the many factors that influence human perception and response to noise (in general) on page 30 and wind turbine noise on page 41. We do not believe that mentioning these factors discounts wind turbine noise as a potential health concern; these factors were identified in the few epidemiological studies that are available on this topic. We also do not believe there is sufficient evidence to attribute annoyance from wind turbine sound solely to these factors. Annoyance from wind turbine noise may result from the interplay of a number of individual, environmental and noise-related factors. We do not know the relative importance of these factors in predicting annoyance because of the complexity of and current lack of scientific evidence on this issue.

Change to report: In Noise Key Findings #5 (pgs 6 and 52), add sentence: “Factors unrelated to noise may explain some of the annoyance reported in the few epidemiological studies of wind turbine noise. These factors include being able to see wind turbines from home, having a negative opinion about turbines, and self-reported sensitivity to noise [16, 17, 20, 22].”

Additional context regarding public health impacts of noise

45. **Commenter 15** – “The failure to put the issue of noise and public health into perspective tends to exaggerate concerns regarding wind farm operations and their potential influence on public health. For example, within the Columbia River Gorge, I-84 and its daily use by 15,000 vehicles and adjacent heavy rail corridor surely must pose greater potential direct and indirect public health impact issues (air, noise, etc.) than the sound emitted from wind farm operations.”

Response: PHD agrees that other sources of noise, air pollution, etc. pose public health risks to Oregon communities. We also agree that context and perspective are important, and did our best to provide context when appropriate. For example, on page 27 we include a short discussion and diagram with examples of common indoor and outdoor noise levels. PHD believes that where community concerns exist about real or perceived

impacts from wind energy facilities, they should be acknowledged as valid concerns in their own right and addressed during the decision-making process. This HIA attempts to provide a framework to address such health concerns.

46. **Commenter 15** – “Page 24, 1st paragraph, 2nd sentence: ‘Elevated levels of community noise is widely...’ *Recommendation*: Please add, ‘According to the *Journal of Noise Control Engineering* (Volume 54, Number 5; Sept-Oct, 2006, page 311), between 20% and 40% of the European Population is highly annoyed by sources of community noise.”

Response: As discussed in sections 2.2, 2.3 and 2.4, it is difficult to quantify the impacts of community noise at a population level. While there are several estimates/references for the European population, PHD could not identify similar estimates for the U.S. or Oregon population, which would be relevant and useful information for this HIA. Therefore, we respectfully decline to make the recommended change.

47. **Commenter 15** – “HIA reference 16 also addresses the potential for sleep disturbance, which the draft HIA indicates as a potential substantial concern. *Recommendation*: Please consider expanding the context by adding the following: The researchers also noted that, ‘The increase in odds of sleep disturbance with increasing sound levels was relatively low. Inspection of the data revealed that the proportion of respondents who reported being interrupted in their sleep by a noise source was rather stable at all levels of wind turbine sound, except at the strongest levels.’ And concluded that ‘The impact of noise did not increase gradually with the noise level, but rather had a sharp increase around 40 dB(A) in the first Swedish study around 45 dB(A) in the Dutch study, corresponding well with the recommended highest exposure levels in the two countries. Sleep interruption was not common in the second Swedish study of more densely populated areas with suburban characteristics. It is not clear why sleep interruption was less common in these areas, but a combination of lowered expectations of quietness and higher levels of background noise (without incidents of heavy traffic at night) could be an explanation.’ (HIA Reference 16).”

Change to report: Page 41, bullet 3 add: “The researchers observed that the impact of noise on sleep interruption “did not increase gradually with noise levels”; instead, the rates of reported sleep interruption were stable at lower noise levels, and increased at 40 dB in the Swedish study and at 45 dB in the Dutch study [16].”

48. **Commenter 15** – “Page 28, 5th and 6th paragraphs: What is the context in which you make a link between environmental noise and hypertension and cardiovascular disease? At what noise levels and frequency does disease occur? *Recommendation*: State more simply, and consistent with your references 16 and 17, and in the executive summary, that major reviews of the potential effects of wind turbines found no link between wind turbine noise exposure and hypertension or cardiovascular disease. Use HIA reference 16 to note ‘The exposure level in these traffic studies were higher than those relevant for

residents living in the vicinity of wind turbines... but it cannot be excluded that strong feelings of annoyance, despite sound levels, play a role in endocrine influenced diseases, possibly as inhibitors of physiological restitution.’

49. **Commenter 15** – “Page 28, 5th and 6th paragraphs: Reference the Massachusetts Department of Public Health study (page 24), ‘A WHO report provides a good review of this literature (WHO, 2009). The lowest threshold levels for seeing any effect are about 35 dBA for some physiological sleep responses, but these thresholds are for levels inside the house near the sleeper, which will be much lower than what is experienced outside the house. The lowest threshold level for complaints of well-being were estimated at 35 dBA as a yearly average outside the house at night. But for health outcomes the thresholds for any effect are much higher, for example 50 dBA for hypertension or myocardial infarction.”

Response (comments 48-49): In reference to your question about page 28 (paragraphs 5 and 6) we agree that these statements should indicate the type of studies referenced and made changes accordingly.

Change to report: Page 28, paragraphs 4 and 5:

“At the levels usually found in community settings, environmental noise is most strongly associated with annoyance, sleep disturbance and decreased cognitive performance [7, 9]. The long-term average day-time noise levels associated with increased annoyance are 50 to 55 dBA for outdoor noise, and 35 dBA for indoor noise (measured as L_{eq}) [7, 8]. The indoor night-time noise levels associated with sleep disturbance are 30 to 35 dBA (measured as $L_{eq,8}$) [7, 8]. The lowest average night-time outdoor noise levels associated with changes in sleep patterns or self-reported sleep disturbance are between 30 to 40 dBA (measured as $L_{night, outside}$) [69]. Community noise rarely reaches levels that cause hearing loss or decreased hearing sensitivity; these effects occur at levels above 85 dB for long-term or continuous exposures, and at levels beginning at 120 dB for short-term exposures [7, 9].

A limited but growing body of evidence has linked environmental noise to small increased risks for hypertension and cardiovascular disease [7, 70]; this evidence is from European community noise studies focused on aircraft and traffic noise. The increased risks for hypertension and cardiovascular disease were observed at higher noise levels compared to the levels associated with increased annoyance and sleep disturbance. Scientists have not established a threshold or dose-response relationship for these effects [7]. Laboratory studies have documented short-term changes in blood pressure and stress hormones following noise exposure; however, these studies have not established if these physiological changes persist after the noise exposure stops.”

Page 40, add bullet (#4): “In the analysis of combined data, the researchers did not find statistically significant associations between annoyance (indoors or outdoors) and other self-reported health outcomes included in the study (including diabetes, high blood pressure, cardiovascular disease, tinnitus, and other outcomes) [16].

Noise Key Finding 5 (pages 6 and 51) add: “These studies have not identified positive associations between wind turbine noise and hypertension, cardiovascular disease, or other diseases.”

50. **Commenter 15** – “Page 29, last paragraph: This risk of cardiovascular disease from noise should be put into a broader view of risk factors for such disease and it should also be noted that HIA reference 7 states: ‘updated review suggests an increased risk of coronary heart disease associated with sound levels above 65-70 dBA, largely from prospective studies...’ and that while such studies are based on transportation sources, such levels are over twice to over four times as loud as those associated with wind turbines.”

Response: See our changes in response to comments 48 and 49.

51. **Commenter 15** – “Page 27, footnote 8: Shouldn’t you include nighttime noise as well (or just don’t make a distinction)?

Change to report: Remove “day-time” from footnote.

52. **Commenter 15** – “Page 51, Conclusions: Sound from ANY source, not just wind, as noted above the 10 dB(A) threshold reference, is not well understood, as noted on Page 2 of HIA Reference 7: ‘That sleep can be affected by noise is common knowledge. Defining an exposure-response curve that describes the relationship between exposure to noise and sleep disturbance has, however, proved surprisingly difficult. Laboratory studies and field studies have generated different results. In part this is due to habituation to noise that, in the field, is common in many people.’”

Response: See our changes in response to comments 40, 48 and 49.

53. **Commenter 15** – “Page 41, 3rd Bullet: The Massachusetts Department of Public Health critique (page 17-18) notes that these studies’ response rates leave them subject to reporting bias indicating that annoyance may be overstated.”

Change to report: Page 42, 3rd bullet: add “...possible reporting bias from relatively low response rates (37%, 57.6% and 68.4% for the Netherlands, 2007 Sweden and 2004 Sweden studies respectively)”

Inclusion of case studies

54. **Commenter 13** – “[REDACTED] is concerned about the inclusion of case series reports at all in the HIA as evidence of potential health effects from wind turbine siting. The inclusion of non-peer reviewed material without fully discussion the flaws with the material leaves the

reader to the conclusion the material has value, when, in reality, the value is minimal if at all. Stating that some investigators used ‘self-select, self-report method’ does not describe the problems with such a method. And stating that ‘none of the investigations appeared to include independent medical examinations,’ while useful, does not fully explain why that fact is important to the reader. We again contrast this with the treatment given the same reports in the Massachusetts HIA. For example, in reviewing the Pierpont report, the Massachusetts HIA notes that descriptions of health symptoms can be important but they are ‘generally not considered evidence for causality’ and that ‘limitations to the design employed make it impossible for this work to contribute any evidence to the question of whether there is a causal association between wind turbine exposure and health effects.’ ■■■ recommends either removing the discussion of non-peer reviewed material or bolstering the discussion of the material such that the flaws with those studies are more apparent.”

Response: PHD respectfully disagrees with the assertion that the case series reports have no value and declines to remove these materials from the HIA report. We agree that these studies must be placed in their proper context, and believe we have done so in this report. Technically, epidemiological studies of any kind (even randomized controlled clinical trials) can only identify associations between a factor and outcome. Laboratory studies are needed to understand causation. We reviewed the report to determine if we overstated any of our findings or conclusions, particularly related to the case-series reports. We did not find any areas that needed changes based on this comment.

As discussed previously, the Massachusetts effort was not an HIA; therefore, they may have used a different approach to evaluating evidence for their report.

Requests for additional context regarding WHO, EPA and other noise guidelines

55. **Commenter 15** – “Given the frequency at which the WHO guidelines are references and relied upon, it would be helpful to include the following or expand on the discussion on page 36 relative to interpreting the guidelines and provide context o the overall potential risk or importance to public health can be appropriately evaluated: *Recommendation:* With respect to the WHO guidelines, the reference document includes the following and should be included: ‘The WHO guidelines represent a consensus view of international expert opinion on the lowest noise levels below which the occurrence rates of particular effects can be assumed to be negligible. Exceedances of the WHO guideline do not necessarily imply significant noise impact and indeed, it may be that significant impacts do not occur until much higher degrees of noise exposure are reached. The guidelines form a starting point for policy development. However, it will clearly be important to

consider the costs and benefits of reducing noise levels and, as in other areas, this should inform the setting of objectives.’(WHO,1999)”

Response: Thank you for your recommendation. We believe page 36 of the HIA report provides adequate context for the WHO and EPA guidelines for the purposes of this report.

56. **Commenter 15** – “Page 33 – last bullet: The context of the nighttime noise guidelines must be expanded on as it is incomplete to solely note that WHO recommended an annual nighttime limit of 40dBA, as an interim target of 55 dBA was established (see below) and acknowledges the role policy makers have in balancing priorities. WHO (2009) also states: ‘Considering the scientific evidence on the threshold of night noise exposure indicated by $L_{\text{night, outside}}$ as defined in the Environmental Noise Directive (2002/49/EC), an $L_{\text{night, outside}}$ of 40 dBA should be the target of the night noise guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly. $L_{\text{night, outside}}$ value of 55 dBA is recommended as an interim target for the counties where the NNG cannot be achieved in the short term for various reasons, and where policy-makers choose to adopt a stepwise approach.’”

Change to report: On page 33 last bullet include following sentence: The WHO also established an interim night-time noise target of 55 dBA $L_{\text{night, outside}}$ for jurisdictions unable to achieve the 40 dBA guideline in the near term. The WHO notes that the interim target is not health-based and does not protect vulnerable groups, and recommends its use as “as a feasibility-based intermediate target which can be temporarily considered by policy-makers for exceptional local situations”.

57. **Commenter 15** – “Page 35, 1st paragraph, last sentence: After the last sentence, please consider adding a sentence that the evaluation of increase sound levels and community response must take into consideration the metric or statistical level used to establish the baseline sound level as well as the duration over which the metric is evaluated. The often cited 5 dB(A) increment as being necessary to illicit a community response is based on the annual average L_{dn} , which is based on the L_{eq} statistic and representative of the maximum sound levels that occurring over the measurement interval. Additionally, context here would help; for example, “A 5 to 10 dB(A) increase in an average 24-hr sound levels will likely have a different (GREATER) impact on nearby communities than shorter-term increase of 5 to 10dB(A), as such deviations on a short term basis are likely routinely experienced – event from natural sounds.”

Change to report: In first paragraph on page 35, insert “long-term” or specific metric ($L_{\text{eq}}/L_{\text{dn}}$) where appropriate to clarify that this discussion is on long-term community noise levels. In third paragraph, change to “different (and likely greater) impact”. Page 36, change 2nd bullet to: “These guidelines address the effects of long-term exposures to

environmental noise (as measured by L_{eq} , L_{dn} , L_{night}), and may not be appropriate for assessing impacts from short-term exposures (as measured by L_{10} , L_{50} , L_{90} , etc.) [10].

58. **Commenter 15** – “Page 47, after third sentence, L_{50} vs L_{eq} : According to my experts, the hourly L_{ed} will be dominated by single event noise such as birds chirping, passing vehicles or wind gusts. The hourly L_{50} filters out such intermittent events and is therefore a more conservative metric (that is the L_{50} will be less than the L_{eq}). Similarly when the L_{dn} is calculated from 24 individual L_{eq} 's, given the logarithmic nature decibel math, the L_{dn} is substantially influenced or skewed towards the loudest hours.”

Change to report: Page 48, after last sentence. “This is a conservative assumption that may overestimate the L_{eq} depending on the character of the noise (footnote). L_{50} tends to be lower than L_{eq} since it is less influenced by noise events (ref: <http://www.muellerenvironmental.com/documents/100-054.pdf>). In footnote: “ L_{eq} is approximately equivalent to L_{50} for noise that is steady (i.e., does not fluctuate too much). For noise with larger fluctuations, L_{10} may be a more appropriate approximation; for intermittent noise events, the L_{eq} may be some value between L_{90} and L_{50} .”

59. **Commenter 15** – “Page 47, after the last bullet: It must be explained that the EPA and WHO’s 5 dB(A) increase is over longer term average levels and would result in louder levels than those under Oregon’s 10 dB(A) increase in the hourly L_{50} approach. This is understandably consuming. Details on how the variability in background levels and between various metrics must be made clear.

Change to report: Page 48, last bullet: add “long-term” after “typical”. Add sentence “These guidelines address change in long-term community noise levels and are based on equivalent noise metrics (L_{eq}/L_{dn}). A 5 or 10 dBA increase in L_{eq} will likely be greater (louder) than a 5 or 10 dBA increase in L_{50} .”

60. **Commenter 15** – “Page 50, last bullet, sub bullet: Please consider adding: - As noted in the Massachusetts Department of Public Health Study, ‘for health outcomes the thresholds for any effect are much higher, for example 50 dB(A) ($L_{night, outside}$) for hypertension or myocardial infarction.’ – The WHO stated an ‘ $L_{night, outside}$ value of 55 dB(A) is recommended as an interim target for the counties where the NNG cannot be achieved in the short term for various reasons, and where policy-makers choose to adopt a stepwise approach.’ – Oregon’s established noise limits for wind turbines at non-participants at 36 dB(A) are more restrictive than those identified by the USEPA and WHO.”

Response: Please see our response to comment #40 above. Under our definition of health, we consider sleep disturbance and annoyance to be health effects associated with noise exposure.

Oregon Noise Standard

61. **Commenter 17**– “The report, however, misstates the applicable Oregon noise standard for wind energy facilities. The first reference to the standard appears on page 7: “In order to comply with Oregon’s noise standard, a development cannot increase the median background sound levels by the greater of 36 dBA or 10 dBA over measured background levels. However, landowners have the option to waive this standard; in these cases, the facility can increase outdoor sound levels up to 50 dBA.” The Department of Environmental Quality (DEQ) rule, OAR 340-035-0035(1)(b)(B)(i), does not allow a new sound source to increase median background sound levels by “36 dBA” over “measured background levels.” Even with a landowner waiver, the rule does not allow a new wind energy facility to “increase outdoor sound levels up to 50 dBA.” Perhaps the report’s authors have tried to state the DEQ rule in as few words as possible, but they have used language that will be misunderstood by many, and they have combined the two parts of the standard in a way that is confusing and misleading. There are really two separate standards in the DEQ rule. In applying the rule, Oregon’s Energy Facility Siting Council (EFSC) has identified these two standards as the “ambient degradation test” and the “maximum allowable test.” Under the ambient degradation test, a wind energy facility must not increase the L₁₀ or L₅₀ ambient noise level at a residence by more than 10 dBA, as compared to an assumed background ambient level of 26 dBA or a measured background level. Contrary to the report’s statement of the rule, an increase of 36 dBA “over measured background levels” would greatly exceed the standard. The DEQ rule limits the increase over the background ambient sound levels to 10 dBA. The rule does not, however, require the developer of a new wind energy facility to measure the background ambient levels. The developer may, instead, assume a background L₅₀ ambient sound level of 26 dBA. If the developer chooses that option, the wind facility must be designed so that the ambient sound levels at any residence do not exceed 36 dBA (including the *assumed* background of 26 dBA and the new sound levels generated by the wind facility). If the developer chooses to measure the background ambient sound levels, it is possible that the measured ambient level at a residence would be louder than 26 dBA. If that is the case, an increase that complies with the ambient degradation limit of 10 dBA may result in ambient sound levels at the residence that are higher than 36 dBA. The second part of the DEQ noise rule is the maximum allowable test. Although the rule refers to “Table 8,” EFSC uses the lowest sound level from DEQ’s Table 8 when it applies this part of the rule. An hourly L₅₀ noise level of 50 dBA is the maximum allowable nighttime noise limit. To comply with the test, a wind energy facility must not generate sound levels (as perceived at the residence) that exceed 50 dBA. It is an important distinction to understand that the background ambient noise levels are not relevant to determining compliance with the maximum allowable test. The HIA report

fails to make this distinction. What is relevant are the sound levels generated by the wind facility. If the facility complies with the standard, it will not contribute more than 50 dBA to the sound perceived at the residence, but the actual ambient sound level could, in some cases, exceed 50 dBA, depending on the contribution from other existing sources of sound. Because most new wind energy facilities will be located in rural areas on land not previously used for commercial or industrial facilities, both parts of the DEQ rule—the ambient degradation test and the maximum allowable test—must be met. The ambient degradation test, however, would not apply to a wind facility located on a previously used industrial site. The HIA report refers to the DEQ noise standard in several places (pages 7, 8, 46, 48 and 50). Each of these references should be carefully re-written to accurately describe the limits on sound levels from wind energy facilities.

62. **Commenter 15** – “Page 48, last bullet: The text indicates that a project level of 50 dB(A) is the ‘long term sound level’. This should be modified to consider the fact that this is the maximum level and that the long term average sound level will encompass periods of calm or lower winds when the turbine sound emissions will be less or none at all. That is an annual average, L_{eq} or L_{dn} increase of over 20 dB(A) as stated is not assured and is overstated particularly given Oregon’s regulatory approach. It is nonetheless appropriate to note that it will likely result in a very noticeable change when the turbines are operating. Residents interested in how a turbine may sound are readily able to visit nearby facilities.”

Response (comments 61-62): Thank you for clarifying DEQ’s noise standard for wind energy facilities. We have made changes to improve the accuracy of our statements regarding the noise standard (see below).

Lack of definitive conclusion on Oregon’s noise standard

63. **Commenter 15** – “While you focus your analysis on sleep disturbance and stress, you fail to reference the Oregon standard for noise, and the fact that Oregon’s hourly median level 36 dBA is below the threshold identified by current research as appropriate for protecting public health.”
64. **Commenter 13** – “Additionally, the authors of the report fail to connect this HIA and its review of the relevant epidemiological studies to any enforceable state standard relating to health, other than the noise standard – failing, even in that instance, of providing certainty to project developers regarding whether existing state standards for noise are, or are not, protective of human health.”
65. **Commenter 13** – “The report does not discuss in any great detail how an outdoor sound level at or near the WHO, EPA and Oregon DEQ limit would affect sleep occurring indoors. The report notes the WHO does have a recommendation to protect against

sleep disturbance of 30dBA, but does not note whether Oregon’s limit, when met at the outside wall of a residence, would be reduced by enough by the building shell to ensure meeting this standard.”

66. **Commenter 13** – “The report, perplexingly, contains a conclusion that exceeding the 40 dBA long-term outdoor community sound level might cause moderate to serious annoyance and sleep disturbance, which then will cause increased risk of other diseases and long term health effects from sleep disturbances. But the HIA fails to mention that such a level would not be heard if the developer meets the basic Oregon standard and fails to clearly explain that the WHO noted that the 40 dBA level was the lowest sound level at which *any* disturbance was noted, not ‘moderate to serious’ annoyance. Even more perplexingly, the report recommends that developers ‘should evaluate and implement strategies to minimize sound generation from wind turbines when **outdoor** sound levels are **at or near** Oregon’s standard. ■■■ believes the OHA needs to revise these conclusions to include a statement that Oregon’s noise standard for wind turbines is more restrictive than the standard identified by the US EPA and WHO as protective of human health. The OHA must clarify that a developer whose turbines generate sound that is below the Oregon standard meets WHO and US EPA standards. And finally the OHA should include a statement that a developer who meets the Oregon standard meets a standard that is protective of human health.”

Use of the word “near”

67. **Commenter 5** – “The state standard of 26 dba plus 10 above should be strictly adhered to. The word ‘near’ must be stricken from the HIA document. 26 dba plus 10 above is the law in the state of Oregon. I also would like to point out that all wind turbine projects use noise modeling. This gives an estimate of the amount of noise the turbines will generate. No industrial wind project should ever be built until it is confirmed with the physical findings at noise sensitive receivers.”
68. **Commenter 6** – “The Oregon Industrial Wind Turbine Noise Standard as defined by the Oregon Department of Environmental Quality of 36 dBA is upheld in the draft Health Impact Assessment. However, I note the usage of ‘or near’, page 9, recommendations, paragraph 1, line 3. On page 7 of the HIA the Oregon noise limit for wind turbine facilities chart reiterates that the maximum allowed is 36 dBA or 10 dBA over an assumed ambient background of 26 dBA. Nowhere else in the HIA is this ‘or near’ language used. What does ‘or near’ mean? Five dba over, 10, 20? The noise standard is specific and I suggest that the enormous loop hole that ‘or near’ creates for irresponsibility sited industrial wind developments be removed.”

69. **Commenter 8** – On page 9, “item 1 of Recommendations, the topic again is wind turbine noise. You state ‘when outdoor sound levels are at or near Oregon’s standard....’ That ‘or near’ part does not add anything to the discussion. It creates ambiguity.”
70. **Commenter 10** – “On page 9, to avoid noise issues, the Health Impact Assessment recommends that planners and developers evaluate and implement strategies to minimize sound generation from wind turbine when sound levels are at or near Oregon’s standards. Although well intentioned, this recommendation is basically meaningless. The problems need to be prevented on the front end through proper siting rather than through ineffective mitigation attempts. As an example, the idea that mitigation can be achieved by changing the blade speed so that noise of the blades is mitigated by the noise from the wind is not realistic. This doesn’t work as the wind can be blowing hard enough at the hub height to produce energy while it is calm at grounds level. This means that there would be no wind noise at the ground level to mask the turbine noise. The reason wind turbines are placed up high it because that is where the wind is.”

Change to report (in response to comments 61-70):

Page 46, starting at 2nd paragraph:

Under DEQ’s noise regulations, wind energy facilities in Oregon must meet two standards: an ambient degradation standard and a maximum allowable standard [27]. The ambient degradation standard specifies that a wind energy facility cannot increase the L10 or L50 ambient noise level at a residence by more than 10 dBA. A developer can either measure the actual ambient background noise levels or assume a background L50 of 26 dBA. Under the assumed background L50 of 26 dBA, the facility must be designed so that the resulting ambient noise levels at a residence do not exceed 36 dBA (26 dBA plus the 10 dBA allowed by the ambient degradation standard). The facility may result in ambient noise levels above 36 dBA if the developer measures ambient noise levels and finds that the background L50 is greater than 26 dBA. The maximum allowable standard requires wind energy facilities to meet DEQ’s “Table 8” limits for general industrial and commercial noise sources in Oregon. Under this rule, a wind energy facility must not contribute more than 50 dBA to the noise measured outside of any residence. The maximum allowable rule only applies to noise generated by a facility and does not consider the background noise level or the contribution of other noise sources.

Landowners in Oregon have the option to waive the ambient degradation standard. In these cases, the developer must still comply with the maximum allowable standard and ensure that the facility does not contribute more than 50 dBA to outdoor ambient L50 noise levels.

During the siting of a proposed facility, a developer must demonstrate compliance with the ambient degradation and maximum allowable standards by modeling the anticipated noise levels at a receptor. These models must assume that all of the facility’s turbines are operating between cut-in speed (the minimum speed at which a wind turbine will generate energy) and the wind speed that produces the maximum sound power level (i.e., the "worst-case scenario" in terms of noise levels). In practice, projects evaluate compliance with Oregon’s noise standard based on the maximum warranted SPL, which is typically + 2 dBA over the levels that manufacturers expect the turbine will produce. OAR 340-035-0035 has additional details on the methods and procedures for modeling noise from wind energy facilities in Oregon.

Table 8: Summary of noise limits (measured outside residence) for wind turbine facilities in Oregon.

	Ambient Degradation Standard	Maximum Allowable Standard*	
Landowner does not waive ambient degradation standard	L ₅₀ = 36 dBA (background + 10 dBA)	Daytime L ₅₀ : 55 dBA L ₁₀ : 60 dBA L ₁ : 75 dBA	Evening L ₅₀ : 50 dBA L ₁₀ : 55 dBA L ₁ : 60 dBA
Landowner waives ambient degradation standard	N/A		
*In practice, EFSC determines compliance with the maximum allowable standard based on the lowest level from Table 8, which is 50 dBA.			

Page 49, starting at 1st paragraph:

For landowners who do not waive Oregon’s noise standard, a new wind energy facility cannot increase outdoor median noise levels by more than 10 dBA. If the background L50 level is assumed to be 26 dBA, the maximum outdoor L50 level allowed under Oregon’s ambient degradation standard is 36 dBA.

- When compared to absolute health-based guidelines, an outdoor L50 of 36 dBA is not expected to result in sleep disturbance, disturbance of communication, or annoyance in the general population.
- Landowners who do not waive Oregon’s standard could experience up to a 10 dBA increase in outdoor hourly median noise levels. Given that a 10 dBA increase in

noise levels is generally perceived as a doubling in loudness [10] and that wind turbine noise may be more noticeable than other forms of community noise [17], a 10 dBA increase could represent a noticeable change in outdoor noise levels.

For landowners who waive Oregon’s ambient degradation standard, a wind energy facility can contribute up to 50 dBA to outdoor ambient L50 noise levels under Oregon’s maximum allowable standard. The total outdoor L50 level could exceed 50 dBA if noise from other sources contributes more than 40 dBA to the outdoor L50.

- When compared to absolute health-based guidelines, an outdoor L50 of 50 dBA or more could result in sleep disturbance or serious annoyance. This may be especially true in rural areas, where ambient noise levels are relatively low compared to urbanized areas.
- Landowners who waive Oregon’s ambient degradation standard could experience a substantial change in outdoor noise levels at times when the L50 reaches or exceeds 50 dBA. An L50 of 50 dBA could be perceived as approximately four times louder than 26 dBA. Typically, an increase in long-term noise levels of this magnitude (over 20 dBA) is expected to cause widespread annoyance, complaints and possibly threats of legal action [10]. The actual change in long-term noise levels from a wind energy facility may be less than 20 dBA, since the facility is not expected to continually operate at levels that will result in the maximum L50 allowed by Oregon law. Landowners who waive Oregon’s ambient degradation standard may perceive and respond differently (potentially more favorably) to the new noise levels, particularly if they benefit from the facility or have good relations with the developer [10, 16].

Footnote text: Noise levels are measured on a logarithmic scale and cannot be added or subtracted in the “typical” arithmetic way. For example, 50 dBA + 50 dBA = 53 dBA (not 100 dBA). If the difference between two noise levels exceeds 10 dBA, the resulting noise level will be the “louder” of the two noise levels. In other words, adding 50 dBA to a background of 26 dBA will result in a total noise level of 50 dBA.

Key Findings (Pages 7-8, 52-53)

In Oregon, a developer must demonstrate that a new wind energy facility complies with an ambient degradation noise standard and a maximum allowable noise standard. These standards are defined in rule by the Oregon Department of Environmental Quality. The ambient degradation standard states that a wind energy development

cannot increase the median background sound levels by more than 10 dBA. Developers can either measure the actual background noise levels or assume an hourly median (L_{50}) noise level of 26 dBA. Based on the assumed background level of 26 dBA, the maximum L_{50} allowed under the ambient degradation standard is 36 dBA. Under the maximum allowable standard, a wind energy facility may not contribute more than 50 dBA of the noise measured outside of any residence. A landowner can waive the ambient degradation standard, in which case the facility must still comply with the maximum allowable noise standard [27, 28]. [DROP TABLE 1]

For landowners who do not waive Oregon's noise standard, a new wind energy facility cannot increase outdoor median sound levels by more than 10 dBA. If the background L_{50} level is assumed to be 26 dBA, the maximum outdoor L_{50} level allowed under Oregon's ambient degradation standard is 36 dBA.

- When compared to WHO and USEPA health-based guidelines, an outdoor L_{50} of 36 dBA is not expected to result in sleep disturbance, disturbance of communication, or annoyance in the general population.
- Landowners who do not waive Oregon's standard could experience up to a 10 dBA increase in outdoor hourly median sound levels. Given that a 10 dBA increase in sound levels is generally perceived as a doubling in loudness [10] and that wind turbine sound may be more noticeable than other forms of community sound [17], a 10 dBA increase could represent a noticeable change in outdoor sound levels. However, the resulting noise levels are below the WHO and USEPA's recommended guidelines for outdoor noise.

For landowners who waive Oregon's ambient degradation standard, a wind energy facility can contribute up to 50 dBA to outdoor ambient L_{50} noise levels under Oregon's maximum allowable standard. The total outdoor L_{50} level could exceed 50 dBA if noise from other sources contributes more than 41 dBA to the outdoor L_{50} .

- When compared to WHO and USEPA health-based guidelines, an outdoor L_{50} of 50 dBA (or higher) could result in sleep disturbance or serious annoyance. This may be especially true in rural areas, where ambient sound levels are relatively low compared to urbanized areas.
- Landowners who waive Oregon's ambient degradation standard could experience a substantial change in outdoor noise levels if the total L_{50} reaches or exceeds 50 dBA. An L_{50} of 50 dBA could be perceived as approximately four times louder than 26 dBA. Typically, an increase in long-term noise levels of this magnitude (over 20 dBA) is expected to cause widespread annoyance, complaints and possibly threats of legal

action [10]. The actual change in long-term noise levels from a wind energy facility will likely be less than 20 dBA, since the facility is not expected to continually operate at levels that will result in the maximum L_{50} allowed by Oregon law. Further, landowners who waive Oregon's ambient degradation standard may perceive and respond differently (potentially more favorably) to the new noise levels, particularly if they benefit from the facility or have good relations with the developer [10, 16].

Conclusions (pages 9 and 54)

1. Given the current scientific evidence, Oregon's ambient degradation standard of 36 dBA for wind energy facilities is not expected to result in annoyance, sleep disturbance or other health effects in the general population, and is protective of public health. However, the 10 dBA change allowed under this standard could result in a noticeable change in outdoor noise levels.
2. Landowners who waive Oregon's ambient degradation standard could experience outdoor L_{50} noise levels up to 50 dBA from an operating facility under Oregon's maximum allowable standard. This could represent a substantial change in outdoor noise levels and possibly result in sleep disturbance and moderate to serious annoyance. The likelihood and magnitude of any impacts will depend on a number of factors, including time of day, characteristics of the noise, and the receptors' perceptions of the noise source.
4. The Oregon Department of Energy is responsible for responding to noise complaints related to large energy facilities sited through the EFSC process. To date, there have been no complaints related to operating wind energy facilities sited through the EFSC process [29]. However, there does not appear to be a systematic process for responding to complaints from county-sited facilities. While PHD has anecdotal evidence of noise complaints and reported health impacts from a few operating facilities in Oregon, we currently lack the data needed to evaluate the frequency or magnitude of any noise-related impacts from existing facilities in the state.

Recommendations (pages 8- 9 and 54)

1. To reduce the potential for health effects from wind turbine sound, planners and developers should evaluate and implement strategies to minimize sound generation from wind turbines when outdoor sound levels exceed Oregon's standards for wind turbine noise. These strategies could include the following:

- During the planning phase, consider site-specific factors that may influence sound propagation and perceived loudness of sound from wind turbines, particularly factors that may influence actual or perceived sound levels at night.
- Continue to evaluate scientific evidence on how local conditions could change the propagation and character of wind turbine sound (e.g., the effects of wind shear on amplitude modulation and sound generation at night).

Noise complaints in Oregon

71. **Commenter 15** – “Page 9, bullet 4: The Oregon legislature authorized the Oregon Department of Environmental Quality to enforce noise standards. OPEH has no statutory authority in this area of policy; therefore, it is inappropriate to convey any expectation that the [OHA] should have the capacity to assess the frequency or magnitude of noise-related complaints from operating facilities in the state.
72. **Commenter 8** – “Sound (starts at top of page 6): On page 9, item 4, you report that your Office of Environmental Public Health has anecdotal evidence of noise complaints from some wind facilities in Oregon but that you can’t assess the frequency or magnitude of those impacts. I suppose you couldn’t do so unless you sent some people to investigate. Actually trying might provide the answer.”
73. **Commenter 15** – “An increase above a low level of sound can still result in quiet levels. For example, is there any evidence that a 10dB(A) increase from 26dB(A) to 36dB(A) results in changes in community response? The HIA only indicates that OPEH has anecdotal evidence that there is a concern at some projects which may not comply with the standard.”
74. **Commenter 1** – “There is also reference to ‘anecdotal evidence of noise complaints and reported health issues.’ To our knowledge you did not reach out to the impacted counties for information to confirm or deny this ‘anecdotal evidence.’”
75. **Commenter 18** – “P. 51. Conclusions 4. You state: ‘To date, there have been no complaints related to facilities to operate wind energy facilities sited through the EFSC process. However, there does not appear to be a systematic process for responding to complaints from county-sited facilities.’ The quotes statement indicates that further studies in this area must be undertaken. If such complaints exist the Health Department would have an opportunity to get further knowledge and understanding the about the effect of wind turbines noise on the people of Oregon.”
76. **Commenter 9** – “To make the statement that there have been no noise complaints to date while there has been numerous reports in public meetings to make ODOE aware of the issues of health effects regarding wind farms. For ODOE to claim there has been no noise complaints to date are ridiculous. It appears that ODOE is requiring that a written

complaint be filed by people that are affected by wind farms and ignoring the verbal complaints. This is weak justification by ODOE in an attempt to discount the issue.”

Response (comments 71-76): The key message in bullet 4 on pages 9 and 51 of the report is that there is no systematic process for documenting or responding to wind energy facility-related noise complaints in Oregon. This HIA is not a primary data collection effort, and we utilized data and information that were readily available at the time the report was written. PHD does not have the authority or capacity to collect data on or respond to noise complaints related to wind energy facilities in Oregon. ODOE is responsible for monitoring and enforcing Oregon’s noise standards at EFSC-sited facilities, and counties assume these responsibilities at county-sited facilities. At the time the report was written, ODOE reported that they had not received any specific complaints related to operating wind energy facilities that had been sited through the EFSC process. PHD acknowledges that we should have contacted counties for information on complaints they may have received related to county-sited wind energy facilities, and we regret this oversight on our part. However, it is unlikely this information would have changed our main point: there is no system to collect complaint data from EFSC or county-sited wind energy facilities.

Without systematically collected complaint data, PHD and other government agencies cannot assess the incidence, frequency or nature of such complaints, or identify the noise levels at which these complaints occur. A “systematic” process uses standardized forms and defined procedures to collect, evaluate and respond to complaints or issues. Unfortunately, verbal complaints, newspaper articles, or complaints made during public meetings or in private do not substitute for systematically collected information.

77. **Commenter 10** – “On page 9, it states that EFSC has received no noise complaints. Consider that residents who sign wind turbine easement agreements are giving up their right to complain. As an example, in a noise easement agreement used in Sherman County, it states that present and future noise influences might be annoying to users of the property, noise influences might change over time, changes in wind project operation could result in increased noise influences, and that the user’s perception of the noise exposure could change and that the user’s sensitivity to noise could increase. The grantor releases any right, claim or cause of action as result. The result of signing this type of agreement is a de facto gag order.”
78. **Commenter 11** – “On page 9, it states that the Oregon department of Energy is responsible for responsible for responding to noise complaints and that to date there have been no complaints. This statement should be taken in context as any resident (receptor) within the noise contour maps used by EFSC (i.e. those over the DEQ noise regulation limit) has signed a noise waiver agreement accepting this and agreeing not to

complain. EFSC uses independent private contractors to advise them during the application process. Due to budget reductions, DEQ has no staff to respond to noise complaints, neither do local agencies.”

79. **Commenter 9** – “The several thousand dollar pay-off waiver provided by the developer to adjacent landowners to tolerate the noise issue and agree to not complain, is not in the best interest of the people of Oregon. This is a hoax and does not solve the problem. Setbacks are the solution to protect people, not a few thousand dollars.”

Response (comments 77-79): PHD cannot comment on the content of agreements between developers and landowners who waive the ambient degradation standard. In order to be effective, a noise complaint system should be available to anyone with legitimate complaints about noise from a particular facility. As we state in our recommendations, all residents living near a facility, regardless of whether they have signed an agreement or easement, should be able to report health issues and concerns if they choose.

Low Frequency Noise/VAD

Several commenters felt that PHD’s report did not adequately address the issue of low frequency sound, and the potential health effects from exposure to low frequency sound. They also requested that PHD recommend a standard for low frequency sound.

80. **Commenter 4** – “The Oregon HIA even cites more reports of adverse health effects from inaudible low-frequency sound. This low-frequency sound is associated with Vibro-acoustic Disease, known as VAD. With all the research and science now available on these health impacts, I believe that this draft study does not take these concerns fully into consideration and actually dismisses and trivializes many of these concerns.”
81. **Commenter 11** – “In regards to infrasound or low frequency noise (LFN), overall studies point to the need for further studies using both an A weighted and C weighted comparison. There are more recent studies done in the last 2 years showing the wind turbines do have an LFN component (refer to Wind Turbine Noise Conference 2009 and 2011). To say that LFN is not a valid concern because you can’t hear it, is using simplistic logic. (Reference G. Leventhall’s 2006 article listed in your bibliography: He states that if you can’t hear it (LFN), it can’t hurt you. This is like saying x-rays can’t hurt you because you can’t see them.) Acousticians such as Leventhall and sound engineers are not qualified to comment on the possible long term health effects of LFN in relation to human physiology. To do so would be similar to asking a public health expert for financial advice.”
82. **Commenter 19** – “In the past, some commentators have stated low frequency noise from IWTs is not an issue. Other references indicate most available evidence suggests that

reported IWT health effects, such as sleeplessness and headache, are related to audible low frequency noise. As June 2011 Federal Australian Senate committee investigating IWT and adverse health effects report recommended: ‘...noise standards adopted by the states and territories for the planning and operation of rural wind farms should include appropriate measures to calculate the impact of low frequency noise and vibrations indoors at impacted dwellings.’”

83. **Commenter 6** – “I endorse a recommendation that the Oregon wind turbine noise standard also include adoption of a dBC standard to address low frequency / infrasound.” Commenter 6 then goes on to list the title of 7 recent publications that touch on low frequency/ infrasound.

84. **Commenter 7** – “I recommend that a standard be included for low-frequency noise and that there be enforcement for non-compliance of sound standards.”

Response (comments 80-84): We believe the report accurately characterizes the available scientific evidence on low frequency noise from wind turbines: there is insufficient evidence to determine if it is associated with increased annoyance, disturbance or other health effects. This lack of evidence does not mean that there are no impacts; rather it means we don’t have enough information to evaluate this question. Because of this lack of information, we cannot recommend a standard for low frequency noise at this time.

85. **Commenter 15** – “Executive Summary: Add the following summary statements from the Massachusetts Study: - Claims that infrasound from wind turbines directly impacts the vestibular system have not been demonstrated scientifically. Available evidence shows that the infrasound levels near wind turbines cannot impact the vestibular system (MA Study, page ES-6) – There is no evidence for a set of health effects from exposure to wind turbines that could be characterized as ‘Wind Turbine Syndrome’ (MA study, ES-7) – The strongest epidemiological study suggests that there is not an association between noise from wind turbines and measures of psychological distress or mental problems... we conclude the weight of the evidence suggests no association between noise from wind turbines and measures of psychological distress or mental health problems (MA study, page ES-7) – Scientific evidence suggests that shadow flicker does not pose a risk for eliciting seizures as a result of photic stimulation (MA study, page ES-7).”

86. **Commenter 15** – “Revise Page 7, first bullet, to reflect the findings of the MA Study.”

Response (Comments 85-86): Please see our response to comments 31-33.

87. **Commenter 15** – “I recommend you review pages 49 to 51 of the Massachusetts Department of Health study and note that the Falmouth study was not peer reviewed, there are numerous issues with the stated wind speeds, and the data in the report and the appendix are inconsistent (for example, the Appendix includes weather data in mph

whereas those levels are stated as m/s/ in the report, which implies it overstates the wind speed by approximately a factor of 2).”

Change to report: Page 39 last bullet: Insert “self-published” after “2011”. Add “(self-reported symptoms from the two investigators) after “collected”.

Other comments

88. **Commenter 15** – “Page 37, last paragraph, first sentence: ‘Some modern turbines have features to minimize turbulence-sound emissions...’”

Response: The design features discussed in this paragraph are intended to minimize turbulence between wind and turbine blades. Reduced turbulence is expected to increase power output and reduce noise emissions. We explain the relationship between turbulence, power output and noise in the previous paragraph on page 37, and do not see a need to change this sentence as suggested.

89. **Commenter 15** – “Page 39, 2nd Bullet: ‘... they **may** produce higher levels of low frequency

Change to Report: Add “may” as suggested.

90. **Commenter 2** – “One question I had is whether it is possible to measure how loud the wind is by itself. You mention that the wind can sometimes mask the turbine sound (which is our experience). We have always had the nuisance of the winds before any turbine were built – just how loud is the wind?”

Response: The level of noise from wind alone will likely vary on a site-by-site basis and change with time of day, season, meteorological conditions, etc. We suggest consulting with an acoustician about the specific methods for measuring noise from wind.

91. **Commenter 15** – “Page 49, Last bullet: Please add: ‘Such factors are not unique to noise from wind turbines.’”

Response: The studies referenced in this bullet point specifically examined wind turbine noise.

92. **Commenter 10** – “The wind industry continues to deny that noise is a serious problem and deny the validity of any complaints.”

93. **Commenter 15** – “Page 42: Please refer to the Massachusetts Department of Public Health evaluation of this same evidence that states (page 21-22): ‘As with the other studies discussed, this study has the limitation of being cross sectional... the response rate in the study is rather low, and unfortunately, there are no data in the New Zealand study on non-participants. This raises concern that self-selection into the study could differ by important factors in some way between the two groups. The difference seen in education level between the groups exacerbates this concern. It is also unclear whether appropriate statistical analysis methods were used given that there may have been multiple respondents from the same household, which is not stated but would have

needed to have been accounted for in the analysis. The lack of control for other variables that may be related to reporting of QOL (quality of life) is also a limitation. In this regard it is important to note that a lack of a statistically significant difference in factors between groups does not rule out the possibility of those factors potentially accounting for some of the difference in outcome scores between groups, particularly when the sample size is small like in this study. Whether participants could see wind turbines was not assessed, but it is likely that most if not all in the exposed group could and most if not all in the control group could not, given their locations. Given the finding in the Swedish and Dutch studies, this means that even if the difference in QOL scores seen are due to wind turbines, it is possible that it is driven by seeing the turbines rather than sound from the turbines. Overall, the level of evidence from this study for a casual association between wind turbines and reported QOL is limited.”

94. **Commenter 15** – “Page 51, Conclusions: As the Massachusetts Public Health Department report states on Page ES-12: ‘There is some evidence of an association between participation, economic or otherwise, in a wind turbine project and the annoyance (or lack thereof) that affected individuals may express.’ In other words, the potential for annoyance and sleep disturbance are not strictly physiological issues. In addition, the Massachusetts Department of Public Health study concludes, “Whether annoyance from wind turbines leads to sleep issues or stress has not been sufficiently quantifies.” Whereas there is a substantial body of literature that documents the potential for sleep disturbances from transportation sources which are allowed to generate much higher levels of noise than wind turbines are.”
95. **Commenter 15** – “Executive Summary: In general, revise your comments on sounds and annoyance to reflect the results found in the Massachusetts Public Health Authority report. In particular, the findings summarized on pages ES4-7 should inform a review of your own findings: - Self reported claims seem to be a function of the sound itself ,sight of the turbine, and attitudes towards wind turbine projects – There is limited epidemiologic evidence suggesting an association between exposure and annoyance – Evidence of an association between noise and annoyance, independent from seeing a wind turbine, is insufficient.”
96. **Commenter 15** – “Revise Page 9, second bullet, by removing the sentence associating wind farm operations with cardiovascular disease. The Massachusetts Public Health study’s conclusions refute this correlation.

Response (Comments 93-96): Please see our response to comments 31-33.

97. **Commenter 15** – “Page 30, last bullet: Throughout the HIA you reference perceptions of fairness and equity. Please add this factor to the last bullet. If you need a reference to justify this request, please consider the following: Maris, E. et al, *J. Acoustical Society of America*, April 2007 and December 2007 and HIA reference 87.”

Visual Impacts

98. **Commenter 20** – “I agree with the recommendations for shadow flickers, but I do not see a discussion of viewshed impacts. Viewshed are tangible and marketable.”

Response: As noted on page 59 of the report, we did not address viewshed impacts in this report, but acknowledge that they may be important to local communities.

99. **Commenter 16** – “As with sound/noise issues, the proof just is not there that sight of wind turbines in the viewscape will destroy local communities. Again, multiple studies show that shadow flicker, “looming,” and distracted driving are not health threats to the general public.

Response: PHD does not claim anywhere in the report that noise, visual or other impacts from wind turbines will destroy local communities. Based on the limited available evidence on these topics, shadow flicker, looming and distracted driving are unlikely to cause adverse health impacts in the general population. This does not prove that people are not affected by these issues, only that the weight of evidence suggests a low likelihood of these impacts in the general population.

100. **Commenter 8** – “Visual Impacts (starts at the top of page 11): Apparently, because Oregon is not situated at more northerly latitudes, we will not have any significant problems with shadow flicker. That is ludicrous. How about atmospheric conditions, time of day, seasons, etc.?”

Response: One page 60, we note that geographic location is one of many factors that influence the magnitude and likelihood of shadow flicker. We include time of day, season, and light intensity related to meteorological conditions among the other factors that influence people’s experience of shadow flicker.

101. **Commenter 5** – “Shadow flicker in and around people’s homes is not a nuisance – it is an annoyance that can and does lead to stress and health issues. This assessment in the HIA must be changed.”

Response: We define nuisance and annoyance on page 62. We used the term “nuisance” in order to be consistent with the report we referenced in this section (2011 Update of UK Shadow Flicker Evidence Base).

102. **Commenter 9** – “The uncorroborated statements reported on shadow flicker needs to be further reviewed. It is obvious that the committee did not review and/or consider what is happening at other sides in Idaho and the Midwest. Refer to websites:” Websites provided.

103. **Commenter 9** – “To make the statement flicker is unlikely to cause adverse health issues; one would ask on what scientific basis was this determined? There are no OAR’s or ODOE guidelines established for setbacks to solve the noise or flicker issue. Once

again, this report did not adequately address the shadow flicker health issues or present realistic solutions.”

Response (comments 102-103): Thank you for providing these references. We believe the report adequately describes the scientific evidence on health effects associated with shadow flicker. As noted on page 61 of the report, there is very limited evidence on this topic, and no evidence from epidemiological studies. We cannot comment on people’s experiences in other states or countries. We can only draw conclusions based on the available evidence and our understanding of Oregon’s siting process for wind energy facilities.

104. **Commenter 15** – “Page 58: Please insert: According to the Epilepsy Foundation: - About one percent of the U.S. population has epilepsy. – About three percent of the one percent has photosensitive epilepsy. – Even in the predisposed individuals, many factors must combine to trigger the photosensitive reaction. –Frequency most likely to trigger seizures is between 5 and 30 Hertz (flashes per second), where are much faster than the speeds at which a wind turbine operates.”

Change to report: On page 61, insert sentence: “Epilepsy affects approximately 2 million people in the U.S., or 0.6% of the U.S. population.”

Reference:<http://www.cdc.gov/chronicdisease/resources/publications/AAG/epilepsy.htm>

105. **Commenter 15** – “There is limited scientific evidence of an association between annoyance from prolonged shadow flicker (exceeding 30 minutes per day) and potential transitory cognitive and physical health effects. Given the relatively limited exposure to flicker risk (requires relatively low sun angle, no cloud cover or particular matter than diffuses light), I propose that you estimate the amount of time per day/month/year/season associated with flicker. Scott Zilka, HDR Engineering, Inc, is a nationally known expert in this field.”

Response: Thank you for your suggestion. We believe this type of analysis is more appropriate for a site-specific assessment if it is needed.

106. **Commenter 13** – “From XXX’s perspective, it would appear that the HIA should conclude that shadow flicker is not a problem. Instead, the HIA recommends ‘developers should consider the distance, orientation and placement [of] turbines relative to homes and buildings, and the use of visual obstructions to block flicker.’ From a developer perspective, this opens the door to additional costs and delay due to people claiming that shadow flicker is a ‘potential issue.’ ■■■ recommends that the OHA revise its conclusions and recommendations to more accurately reflect the scientific literature and to provide certainty that shadow flicker is not a problem for wind development in Oregon if setback requirements for Oregon’s noise standard are met.”

107. **Commenter 15** – “I urge you to consider the conclusions drawn by the Massachusetts Study (ES-7-8): - Scientific evidence suggests that shadow flicker does not pose a risk for

eliciting seizures as a result of photic stimulation. *Recommendation:* Amend your conclusions to reflection the more affirmative tone adopted by the Massachusetts Study authors: Shadow Flicker does not pose a risk...”

Response (comments 105-107): We believe the report accurately reflects the scientific literature given the limited evidence available on this topic. Our intention is not to add cost or delay a project, but ensure that valid impacts are addressed during the siting process. If it is clear that people will not be impacted by shadow flicker at a particular site, then no additional analyses are needed. As noted in comment #100, there are resources to assist developers to screen shadow flicker as a potential issue at a specific sites (including guidance documents, modeling programs and national experts). Nonetheless, we made a small change to conclusion #2.

Change to report: Pages 10 and 64, conclusion 2: While Oregon does not have specific guidelines for shadow flicker, the setback distances (i.e., the distances between turbines and other structures) required to meet Oregon’s noise standard ~~may~~ should be sufficient to minimize shadow flicker impacts in most cases.

108. **Commenter 15** – “Page 11, Third bullet: Describing a 4:1 distance to height ration in urban environment, then questioning whether or not the ratio is applicable in a rural environment, is confusing. Using 400 feet as the average base-to-tip height of a modern wind turbine, 1600 feet is roughly 1/3 of a mile – approximately the distance between the Portland office of the Department of Public Health and the Willamette River. A tall, relatively thin object, that distance from your offices would not loom. *Recommendations:* -Delete all comparisons to 4:1 distance to height references to applicability to wind farms and looming in rural areas (pages 11, 60, 61) – Include a reference to Oregon noise standards and distance. In our opinion, compliance with noise standards will more than address concerns associated with looming.”

109. **Commenter 15** – “Revise Page 11, bullet 3 to conform with the Massachusetts Public Health Study: ‘There is no evidence to support the notion that looming has adverse effects on public health.’

Response (comments 108-109): The steering committee agreed to include looming in the scope of the report. We acknowledge the limitations of our discussion on this issue; these limitations reflect the lack of information available on this topic. Our discussion of this issue (and the 4:1 guideline mentioned in your comment) summarizes the key findings of the one report we found on looming (Blau, D., C. Everett, and T. Bronk, *Visual looming effect in the landscape: Research, analysis and case study*. 2009). While we do not expect the information about looming will change siting decisions or processes in Oregon, we agreed to include it as a potential health concern, and included what we were able to learn about looming in this report. This report is intended to serve as a

reference guide for decision-makers and stakeholders on health questions related to wind energy facilities, and the information on looming may be useful in some instances.

Change to report: Page 10 and 64, bullet 3 2nd sentence: “Urban planning guidelines that recommend a 4:1 distance-to-height ratio to minimize negative psychological reactions from feeling “enclosed” by a tall building or object may not be applicable to wind turbines in rural environments [33].”

Air Pollution

110. **Commenter 8** – “(Page 70, above Figure 5): When speaking of the proportion of the state’s electricity that is generated by wind, you should specify how much of that wind energy that is used in Oregon. You should also specify if that wind energy is based on maximum potential or actual production figures. Accuracy is always a good thing.”

111. **Commenter 8** – “Air Pollution (starts at the top of page 12): Another related problem has to do with the fact that the wind energy produced in Oregon is not needed here. Nearly all of our wind energy is sold outside Oregon. So, we get some health problems and despoil our environment to produce a product we do not need in Oregon. If you state the obvious gains presented by wind generation, then, you should disclose the problems, too.”

Response (comments 110-111): On page 72 of the report, we note that electricity is bought and sold on a regional level, and that power generated in one state may ultimately be consumed in another state. [ODOE’s website](#) states that 4.3% of the energy consumed in Oregon in 2010 was produced by wind; however, it does not specify if all of this 4.3% was from in-state wind facilities. Figure 5 shows the actual amounts of electricity generated by various sources, not the maximum potential generating capacity.

112. **Commenter 8** – “Foreword: You list hydro as renewable in the same paragraph with a brief discussion of Oregon’s RPS goals. Surely, you must know that hydro is not in our RPS mix.”

113. **Commenter 9** – “The comment from the Air Pollution report referring that hydro power is ‘constrained’ is incorrect. In fact, SB838, due to the wind lobbyists convincing our politicians to exclude hydro power as renewable and a serious mistake, is the real constraint. The federal government considers hydroelectricity a renewable energy while Washington and Oregon do not.”

Response (comments 112-113): Oregon’s RPS lists hydropower as an eligible resource with some restrictions. Oregon allows the following for hydropower: In 2010, the Legislature amended the Renewable Portfolio Standard through [House Bill 3649](#) and

House Bill 3674 to allow electricity from low-impact hydroelectric facilities to qualify as a RPS-eligible resource, with the following restrictions:

- a. Facilities in operation before January 1, 1995: up to 90 average megawatts (aMW) per utility per compliance year of low-impact certified hydropower, capped at 50 aMW owned by an Oregon utility and 40 aMW not owned by a utility but located in Oregon.
- b. Facilities that became operational on or after January 1, 1995: No cap if located outside of certain state, federal, or NW Power & Conservation Council protected water areas. (References: http://www.oregon.gov/energy/RENEW/docs/RPS_Long_Summary_July%202012.pdf; http://www.oregon.gov/energy/RENEW/Pages/RPS_home.aspx)

Our statement that “Hydroelectric generation is constrained by fish and wildlife protections and other environmental considerations” (page 73) is based on the Northwest Power and Conservation Council’s assessment of energy resources in the Northwest in the Sixth Northwest Conservation and Electric Power Plan (2010).

Generation capacity, reliability, and dependence on other energy sources

114. **Commenter 8** – “Key Findings and Recommendations: Your discussion at the top of page 4 speaks of generating capacity of Oregon’s wind factories. A more correct and valid measure is actual production. We must recognize that on average wind turbines generate power but 30% of the time. So we must admit that other sources must ‘back-up’ wind generation for 70% of the time.”
115. **Commenter 8** – “Air Pollution (starts at the top of page 12): I believe we all understand that wind turbines do not emit GHG when they spin. And, we know that is an advantage when compared to generating facilities that are powered by fossil fuels. But, it is also known that wind energy is unpredictable and that wind turbines may generate power about 30% of the time. Therefore, when we try to replace fossil fuel energy plants with wind energy we have a problem. Often times, these coal and gas plants will still be emitting GHG’s. The point here is that wind power is unpredictable and that fact must be admitted. Anything less would not be truthful.”
116. **Commenter 9** – “The following excerpt from page 12 of the report is very deceptive. ‘Wind energy facilities do not generate air emissions from electricity production, and reduce air pollution.’ When in fact they create emissions per Cascade Policy Institute’s report, ‘*Think Twice: Why Wind Power Mandates Are Wrong for the Northwest.*’ Since the wind does not always blow, alternate sources of energy, i.e., gas and coal, are continually running to back up the wind facilities. These backup sources are not generating actual electricity while in spinning reserve; nevertheless, they are consuming

fuel and emitting greenhouse gases with the ramping up and down of these alternative sources to accommodate the intermittent wind generation, gas and coal plants lose up to 45% efficiency. In the end, wind will require more fossil fuel plants to be built to provide backup when the wind does not blow; as a net result, wind actually increases emissions.

117. **Commenter 18** – “P 12. Air pollution. ‘Wind energy facilities do not generate emissions from electricity production.’ Wind energy facilities as a rule require a constant ‘on line’ electrical generating facility that can be ‘put on line’ in an instant to make up for loss of wind generated electricity. Only Hydro and Geothermal and Solar boilers are a source that qualify as non polluting sources available with technology. That leave Natural gas (presently preferred source) and other carbon fueled systems. Your paper is deficient in not recognizing this situation. Therefore, any conclusions made about reduction of air pollution will be in error.”

118. **Commenter 21** – “Solar energy is far more predictable and reliable than industrial wind energy, so do not be misled by those who say that battery back-up is needed for solar energy to be viable since batteries are not required for everyday use.”

Response (comments 114-118): PHD acknowledges that our discussion of wind energy’s impact on air pollution did not acknowledge the points raised in these comments. We made the following changes in order to provide more context on this issue. However, as we note on page 69 of the report, obtaining accurate estimates of wind energy’s impacts on local air emissions is a complex process that is beyond the scope of this report.

Change to report: Page 72, first sentence: Wind energy facilities do not generate air emissions from electricity production, and could reduce regional air pollution levels if they displace electricity generated from gas, coal, and other fossil fuels [37, 38].

Page 74: Insert the following text before 3.1.b:

Changes in air emissions

To estimate changes in air emissions due to wind energy developments, we need information on the following factors:

- The source and amount of fossil-fuel energy displaced by wind energy
- The type and amount of air pollutants emitted by the displaced energy source per unit energy
- Current or future technological and policy changes that affect air emissions from fossil fuels

Energy Displacement

Energy displacement refers to the amount of fossil-fuel generated electricity that wind energy replaces in a particular region. Energy displacement depends on many factors, including the following:

Displacement factor	Modifiers/Supporting information
The amount of energy actually generated by wind energy facilities	Currently, commercial wind energy facilities in the U.S. are estimated to have an average generating capacity that is 30% of their nameplate capacity[3]. For example, a 20 MW facility with a 30% average I generating capacity will produce 52,560 MW-hours of electricity in a year.
The amount of wind energy integrated into the regional electrical grid	Wind energy is considered an intermittent source of energy because it depends on having adequate wind speeds to produce electricity. The extent to which intermittent energy sources are integrated into electrical grids depends on the accuracy of supply/demand forecasts, mix of available energy sources, the grid's ability to accommodate variations in demand and output, and other factors.
The electric energy source(s) that wind energy displaces (e.g., coal, natural gas, nuclear, hydroelectric), and the amount of displacement that occurs	Electric grid operators respond to changes in electricity demand by dispatching power plants based on cost and availability. Because of its variability, wind energy is typically not used to meet peak energy demand. The types of energy sources displaced by wind energy (in both the near and long-term) will depend on the relative costs of each energy source.

GHG emissions and climate change

119. **Commenter 6** – “The inclusion of the HIA section on global warming/climate change with theoretical health consequences was outside the scope of what was to have been a locally / regionally focused health assessment of industrial wind facilities in Eastern Oregon. As the vast majority of CO₂ emissions in Oregon stem from the Portland metro area (cars) and the state’s primary source of energy comes from non carbon producing hydroelectric dams, I question how global warming factors into a ‘local’ assessment.”

Response: During the scoping discussions with the steering committee in early 2011, PHD proposed to narrow the HIA’s scope using the following “filter” questions:

- 1) Does this question focus on local health impacts?
- 2) Is this question answerable with available resources?
- 3) Will answering this question now help state and local decision-makers with future siting processes?

4) Does this question reflect input or concerns from members of the public?

An early draft of the HIA did not include much information about climate change. Our reasoning at the time was that climate change is a global phenomenon and it would be difficult to estimate the impact of local developments on global GHG emissions, or on climate-related changes that could impact health. However, after reviewing the literature and considering input from community members and steering committee members, PHD decided to include a short discussion on climate change and health, for the following reasons:

- First, while climate change is a global phenomenon, its impacts vary at a local level (see page 68 of the report for specific impacts expected in the Pacific Northwest).
- Second, policies to support renewable energy development in Oregon (such as the Renewable Portfolio Standard) are based in part on Oregon’s GHG emission targets, which represent Oregon’s “fair share” of needed global emissions reductions. While there may be uncertainty and limited data on the extent to which wind energy developments reduce GHG emissions, we feel there is sufficient evidence on the health impacts of climate change to include general information on this issue in the report, and.
- Lastly, while PHD sought to obtain consensus from the steering committee on major decisions related to the HIA, we reserved the right to make a final determination on the topics and content of the report.

120. **Commenter 8** – “Air Pollution (starts at the top of page 12): I have seen no reports of coal or gas plants closing in Oregon due to development of wind factories. I also have no reports of how our GHG emissions have actually changed. If you have such data I would like to hear of its existence. If you don’t have the data I think it is time to find out the truth. I’ve been told that a new gas generating plant will be built near Troutdale. How does that work out with our GHG emissions?”

121. **Commenter 7** – “The CO₂ savings assumed in the report are highly questionable and there has been no analysis of the high cost per ton of CO₂ reduced by wind energy! Numerous studies including the Bentek Energy LLC study in the US are based on actual measurements and show very little reduction and actually a possible increase in CO₂ due to inefficient use of fossil fuel facilities to back up wind variability.”

122. **Commenter 6** – “As Oregon relies principally on non-emitting hydro generated electricity, offsetting hydro with wind generated electricity results in no net gain in CO₂ emission reductions. Since wind generated electricity is intermittent it is not able to provide reliable base load or peak demand power. Conventional fossil fueled natural gas

and coal plants are required to run at less than optimal efficiency, constantly ramping up and down, to offset the vagaries of wind. The net effect of offsetting industrial wind facility power may actually contribute to increased CO₂ emissions. Multiple studies based on actual smoke stack emissions in Colorado, Texas, the United Kingdom, Denmark, Germany, the Netherlands and Ireland indicate fossil fuel facility cycling, to accommodate wind facility vagaries, actually increase CO₂ emissions.”

Response (comments 120-122): In the report, we did not attempt to quantify the actual impact of wind energy developments on GHG emissions in the state. The report only describes some factors that could influence how wind energy developments impact GHG emissions. To our knowledge, there have been no analyses that examine the actual change in GHG emissions due to wind energy development in Oregon. While studies in other countries or states provide some context for this issue, they may not represent conditions or impacts in Oregon.

Oregon has two greenhouse gas emission inventories. A production-based inventory, which reports on the amounts of GHGs produced by various sectors within Oregon, is available through ODOE’s Climate Change Portal (<http://www.oregon.gov/energy/GBLWRM/Pages/portal.aspx>). The inventory currently has data from 1990-2008. The data include estimates of emissions from in-state electricity generation. Since 1990, the gross GHG emissions from electricity generation have increased; this upward trend appears to be driven by increased emissions from natural gas combustion. It is important to note that these data are presented as gross (total) emissions, and are not adjusted to reflect changes in population, demand, energy sources, economic output, etc. They also do not indicate the amount (if any) of GHG emissions “prevented” by conservation efforts or renewable energy development.

Oregon also has a consumption-based inventory, which reports on global GHG emissions associated with residential, business and governmental consumption within Oregon (<http://www.deq.state.or.us/lq/consumptionbasedghg.htm>).

Non-production related emissions

123. **Commenter 5** - Living where we do and seeing the construction phase of wind turbine projects, I can tell you that there is a great deal of air pollution with the travel of construction equipment on country gravel roads. The several hundred trips per day by a farm home with concrete trucks, personnel pick ups, gravel trucks, rock trucks and the construction workers personal vehicles all add up to a huge cloud of dust and debris that hangs in our canyon daily and nightly.”

124. **Commenter 9** – “Vestas, the world’s largest wind tower producer, has documented that it required 150 tons of coal to manufacture on wind machine. There are significant emissions required in building and installing wind towers. For example, to get the massive machines to the site, it requires nine truck loads per tower, and then a substantial amount of emissions are expelled to assemble them at the site.

Response (comments 123-124): We acknowledge that construction-related impacts (including air pollution) may be disruptive to nearby neighbors and communities. We discussed possible impacts from construction-related pollution on pages 77 and 78.

125. **Commenter 9** – “First of all, the local utilities where wind farms are located are required to provide electric power to their local wind farm projects to keep it in operation for the following reasons:1) Rotor Yaw to turn the mechanism into wind; 2) Blade pitch to adjust the blades to the angle of the wind; 2)Lights, controller, communication, sensors metering and data collection; 4)Heating of the blades during cold temperatures (this may require 10-20% of the turbine’s power); 5)Heating and dehumidifying the nacelle; 6) Heating and cooling of the oil; 7) Hydraulics to lock the brakes when the wind is too strong; 8) Thyristor which graduate the connection and disconnection between turbine generation and the grid; 9) Magnetizing the stator; the indication generators used to actively power the magnetic coils. This helps start the rotor turning. Using the generator as a motor to help start the blades turning when the wind is low. This creates the illusion the facility is producing electricity when it is not especially during site tours. It also spins the rotor shaft to prevent warping when there is no wind.”

Response: All energy developments (wind, solar, natural gas, coal, nuclear, etc.) will result in some environmental impacts and pollution during their lifecycle. As noted in these comments, wind energy facilities will result in GHG production, air emissions, and other environmental discharges during the manufacturing, planning, transportation, construction, and operational phases. For GHGs, the available evidence indicates that renewable energy systems produce less GHGs over their lifecycles than nuclear, natural gas or coal-based systems (see Sovacool (2008) in Energy Policy volume 36 for one reference). We acknowledge that construction-related impacts (including air pollution) may be particularly disruptive to nearby neighbors and communities. We discussed possible impacts from construction-related pollution on pages 77 and 78.

Other Comments

126. **Commenter 9** – “The claim that wind power will reduce emissions is blatantly false which I have covered in previous explanations, as a result all of these emission claims need to be removed from this report. Emissions are a result of vehicle traffic, home and business heating and numerous other sources.”

127. **Commenter 15** – “Page 18: An important but missing element of your description of wind energy development is the role played by Pacific Northwest power generation in the overall effort to diversify energy generation technology and geographic location. Achieving both goals helps to ensure a more reliable energy generation system, placing less pressure on the existing (aging) generation system.
128. **Commenter 16** – “We agree with the virtually self-evident conclusion that operating wind farms do not provide any air pollution threat, and that the possible disturbances from construction are minimal. More importantly, we endorse the report’s conclusion that wind energy decreases the power sector’s emissions of greenhouse gases and air pollutants that pose a public health hazard. [REDACTED] also supports the conclusion that society should more fully utilize the ‘mechanisms that link the development and integration of wind energy for electricity consumption.’”

Economic Effects

Property Values

129. **Commenter 10** – “On page 14, it states that there is little evidence regarding the negative effects on property values. I disagree. In 2007 before the current recession, when UPC proposed the Cascade Wind project in Wasco County, realtors reported that people would ask if property was near where the proposed wind turbines would be located and, if so, they weren’t interested. In the current recession, property values are down everywhere.”
130. **Commenter 8** – “Economic Effects (starts at top of page 14): You stated that ‘there is little evidence to determine if wind energy facilities impact local property values.’ How much is little? Is it ‘any’? Just that simply you try to dismiss the possibilities. Where are your references?”
131. **Commenter 7** – “To state there is no evidence on residential property values is ridiculous! Our realtor will not even give us an appraisal on our home value while the potential exists of wind turbines surrounding our valley! PLEASE do not put your heads in the sand about this.
132. **Commenter 16** – “We also applaud the HIA for not succumbing to anecdotal evidence about the value of housing near wind projects – for, as the HIA states, studies have shown that property values have not been negatively affected by operating wind projects.”
133. **Commenter 6** – “The HIA’s failure to recognize residential property value impacts is frustrating and contradicts common sense. Data submitted that demonstrated loss of

property value in areas where industrial wind facilities proliferate was not incorporated in the HIA. Under economic effects, Page 87, para 2, line 3, etc., the HIA acknowledges that, ‘few studies’ were reviewed. In fact, the HIA lists only two ‘studies’ in the Reference Section. The first, by B. Hoen, *The Impact of Wind Power Project on Residential Property Values in the United States*, is a widely criticized three year study finished in Dec 2009, so presumably started in 2006. Hoen’s conclusions are carefully prefaced with such caveats as, ‘given current research.’ But even if only considering the Hoen study I suggest the HIA review his clarifying, follow up analysis.” In a subsequent slide presentation Hoen gave at the *New England Wind Energy Education Project* webinar, 2010, he presented his study. Slide #29 states, “Do these results imply that property values effects near turbines do not exist? No!” And, ‘So given these results, are property values something stakeholders should be concerned about? OFCOURSE!’ Hoen continues on slide 31, ‘Property Value Risks Will Persist Unless They Are Measured, Mitigated and Managed’ and on slide #32 Hoen suggests that property value guarantees be considered. He calls for continued measures to better understand effect. And, perhaps most importantly, on slide 25, he explains that ‘Absence of Evidence’ does not equate to ‘Evidence of Absence’. In other words, insufficient data, at that point in time, had yet to be gathered and continued research was necessary.”

134. **Commenter 21** – “Wind turbines next to my home leaves me with no due process for compensation or litigation (at my own expense) after the turbines are in place if I am not under contract with the wind energy industry, and would lead to a certain devaluation of my property.”
135. **Commenter 10** – “On page 14, in regards to the recommendation that cash payments be disbursed to residents, this is not a positive health impact for someone living too close to the turbines. How much is the livability of your home worth, especially if you have no desire to leave?”

Response (comments 129-135): Several commenters interpreted our finding on page 13, bullet 5 (“Decreased property values are often an issue of community concern. However, influences on property values are complicated to determine and currently there is little evidence to determine if wind energy facilities impact local property values.”), to mean that a lack of evidence means we believe there is no problem. We have clarified the language in the report to reflect the true meaning of our finding, which is that there is insufficient evidence to determine whether or not there is an impact on property values. Assessing impact on property values is challenging because of the many factors that affect local property values. While there have been a few stories from Oregon that could demonstrate a possible negative impact on home values, there is insufficient evidence, anecdotal or otherwise, to determine whether or not industrial wind energy facilities have an impact on home values throughout impacted communities in Oregon. It would

likely be necessary to gather more data on this topic before the impact of wind energy facilities on home values in Oregon communities could be understood.

Change to report:

Page 13 and 94, bullet 5:

Decreased property values are often an issue of community concern. Economic studies have not found an association between nearby wind energy facilities and changes in long-term property values [45, 46]. However, because property values are influenced by many factors, and it is difficult to generalize these findings to individual or local changes in property values near a given facility [34]

Page 91, paragraph 2:

Another potential impact to personal income or wealth is changes in property value. This may be an issue of concern for community members with properties adjacent to or within site of wind turbines, as well as for community members concerned about overall impacts to the viewshed or area. Changes in property value can have a substantial impact on personal income, since residential property or land may account for a large portion of a person's or family's financial assets. To date, there have been few studies to evaluate the impacts of wind energy facilities on property values, and it is difficult to draw conclusions from this body of evidence because of methodological differences between studies and methodological limitations within studies [144]. Perhaps the most comprehensive study conducted to date is a 2009 analysis that examined whether concerns about area, scenic vistas, or nuisance affected property values at various distances and stages during a facility's development. The study analyzed 7,459 residential sales transactions near 24 existing facilities in nine states [144]. The 2009 analysis did not find evidence that post-construction property values were consistently or significantly affected by "either the view of wind facilities or the distance of the home to those facilities" [144]. The authors did find evidence that property values for homes closest to the facility decreased during the period after the facility was announced but before construction; they also found that the values of these homes increased after construction was completed. Other analyses have also found a decrease in property values during the time period between the approval and operation of a facility, and a subsequent recovery in value after the facility is in operation [145, 146].

While the studies reviewed for this report did not find an association between nearby facilities and long-term property values, this does not mean that property values near a facility have not or will not be impacted. Given the many factors that affect local property values, it is difficult to generalize these studies' findings to individual or local changes in property values at a given facility[35].

Baseline/SES data on Oregon

136. **Commenter 9** – “Within Oregon, there are noticeable disparities in SES between urban and non-urban areas. Compared to urban areas of the state, non-urban areas have relatively lower levels of personal income, lower wages, and higher rates of unemployment.’ Just because the non-urban residents are not in a higher income and/or education bracket does not put less value on their lives or health. This is appallingly condescending and should be removed from this report.”
137. **Commenter 9** – “The socioeconomic issue makes some troubling implications that impacts to the rural area can affect peoples’ health by insinuating that it is due to lack of education, healthcare and lower income as a result of the lack of quality jobs. It also suggests that if some people benefit in a community (i.e. landowners getting wind project payments) that non-beneficiaries are likely to be less healthy which is nothing more than class warfare. There is far more to socioeconomics than what is represented in this report. Come and live in a community where a wind farm has destroyed the way of life for the benefit of a few ranchers and farmers who claim they can no longer survive without wind farm revenue. Did these ‘researchers’ observe rural communities where people need less because they value the dollar and have large gardens, chickens and cows? Perhaps quality of life is in the eye of the beholder or the researcher.”

Response: PHD included data on education, employment and income levels and disparities in Oregon because the assessment of “baseline” conditions is a required step in HIA (see Appendix A and B of the report for more information). Since this is a strategic HIA (as opposed to a site or community-specific assessment), we described baseline conditions using state-level data and trends. We did not intend for these data to imply that the concerns of non-urban communities, or communities with higher or lower income/education, have higher or lower value.

Distribution of economic benefits and harms

138. **Commenter 10** – “On page 14, 1., the wind turbines do not have an economic benefit for those living close to them if they ruin their health and destroy property values.”
139. **Commenter 12** – “We can no longer support an industry that cannot stand financially on its own and fails to protect the broader interests of the community and people’s lives of the respective communities of the state.”
140. **Commenter 20** – “I do not see a discussion of equity of economic benefits – obviously the local landowner benefits greatly, a few jobs might be created, and perhaps the community collects taxes, but this section seems quite cursory and does not discuss how

benefits are distributed among individuals. They are clearly very uneven. This point could be discussed more. It could also be added as a bullet on page 93, under community sources of conflict (uneven distribution of benefits and burdens). More community discussion is not the solution to inequitable distributions of benefits and burdens.

141. **Commenter 5** – “The rest of the affected non-participating landowners will lose value to their property and to their quality of life. I would say that the damage to our community is far outweighed than any benefit to a small handful of landowners that profit at their neighbors expense.”

Response: During the listening sessions in fall 2010, we heard from several people who had concerns about the inequitable distribution of benefits and burdens, specifically those related to economic impacts. Inequitable impacts (whether from noise, air pollution, or economic changes) could be a concern to the community’s health. As stated in our key findings on page 13 of the report, “Higher levels of income inequality in a community are associated with poorer health outcomes [42].” Additionally, in the Conclusions section on page 13 the report states: “Wind energy developments could indirectly result in positive health impacts in Oregon communities if they increase local employment, personal income, and community-wide income and revenue. However, these positive effects may be diminished if there are real or perceived increases in income inequality within a community.”

To emphasize this point, we have made the following changes to the report on page 91 and 92:

Change to the report:

Page 91 of the report (3.1.b. Personal Income)

Another potential impact to personal income or wealth are changes in property value. Land lease payments can significantly increase property values for some landowners. However, community members with properties adjacent to land leased for wind turbines or within sight of these facilities may be concerned that a facility near their home will result in a decline in their property values.

Add new paragraph:

The distribution of positive or negative impacts to personal income is an issue of concern at many wind energy facilities. Landowners who lease their land to developers may accrue substantial economic benefits through increases in personal income or property values. However, landowners who do not lease their land will not directly experience these benefits, and may experience negative impacts if their property values decrease, or

if they are adversely affected by unwanted noise, visual impacts, air pollution during construction, and other impacts.

Tax credits, Job creation, Strategic Investment Plans (SIPs), and other “benefits”

142. **Commenter 9** – “In addition, if the tax credits, such as PTC and BETC funding, were eliminated, wind farms will become a thing of the past. The frightening mystery is the fact we do not know what the final costs are going to be once these wind projects are obsolete and are to be decommissioned. The impacts to our environment may never be restored, what is that cost?”
143. **Commenter 11** – “On page 78, economic benefits: a) the greatest economic benefit is not to citizen but to developers in the form of tax credits, etc. b) the largest consumer group of the electricity from Wasco Electric Coop is wind turbines, who benefit from a preferred rate that is 40% lower than that of residential user. As a result, residents and local businesses face even greater rate increases. This is due to paying at a higher BPA tier rate to accommodate the expanded overall usage resulting from wind turbines. c) The Shepherds Flat wind project has created 1 job per \$34 million dollars of federal tax credits, not including state tax credits. d) Consider June 2010 when BPA attempted to deal with record water runoff and the resulting excess power. The industry’s greatest concern was the loss of its production tax credit, in spite of the free replacement power provided. e) The benefit of the accelerated depreciation and discounted tax rates received by the industry enables them to take advantage of the communities they move into as they pay less than full tax value of their taxable assets. f) How does the desire for green energy translate into economic efficiency? Consider that every dollar used for tax credits given to the wind industry is one less dollar spent elsewhere within the community.
144. **Commenter 8** – “Economic Effects (starts at top of page 14): You failed to speak of the outright cost of public funds for wind projects in terms of how much is paid out for each permanent full-time job. Some analysis would show that in many cases those jobs cost several million dollars each. I hope you don’t think that is a good price.”
145. **Commenter 9** – “There is some short term benefit from property tax payments, but due to the accelerated depreciation schedule that is allowed for wind farms, the property tax benefit drops significantly after the 5th year.”
146. **Commenter 8** – “Economic Effects (starts at top of page 14): You overlooked the fact that wind factories also require much in terms of government grants, subsidies, and tax credits. The members of these same communities are bearing their share of these expenses, too. Your omission of this fact demonstrates, once again, your biased analysis.”

147. **Commenter 5** – “The wind energy industry would like to have the American public believe that they are good for the economy. This had proved to be untrue and a lot of tax payers are finding this fact unacceptable. If you will read the comments made on bill HR3307, you will find this to be true. Wind energy came in and made Strategic Investment Plans with many communities that thought they were getting a great deal. The wind energy companies were using the American tax payer to foot the bill on the SIPs. Iberdrola Renewables has an approved project in Helix, Or and there is NO benefit to the community of Helix. No SIP is in place for the Helix Wind Power Facility with the community of Helix. The only ones who will financially benefit from the HWPF are the handful of landowners who have signed their land into the HWPF.”
148. **Commenter 6** – “The high economic costs and adverse impacts of creating wind energy jobs: I suggest the HIA revisit this domain and reconsider the cost benefits of industrial wind energy to Oregon’s economy. For example, *The Oregonian*, concluded that so few jobs were created (35) at the Shepard’s Flat Wind Project (largest facility in the world) that they amounted to \$34,000,000 per job. George Mason University Economics professor, Alex Tabarrok, PhD, estimated the 35 permanent jobs at \$30,000,000 each. Ignoring available offsetting data, the Economic section of this HIA, as it stands, takes a political position versus a balanced assessment. Balanced consideration should include the following: Increases in electricity rates, lost discretionary purchasing power due to higher electricity rates, exorbitantly high cost of jobs created, displacement of jobs in energy intensive industries, lost opportunity costs of funds committed to industrial wind facilities, extra costs required to build additional backup power facilities to compensate for variability and inconsistency of wind power, cost of extra transmission facilities to bring wind generated electricity from distant facilities to point of use, displacement of conventional jobs by subsidized ‘green’ jobs, impacts of deficit federal financing to subsidize industrial wind facilities, the impact on services and tax shortfalls caused by the Oregon Business Energy Tax Credit (BETC), disruption of regional electricity markets, parasitic power costs when wind turbines are not wind operating but required to move to maintain operability, and regional stigma costs.”
149. **Commenter 8** – “Economic Effects (starts at top of page 14): I am no fan of the Boardman coal facility. However, as you endeavor to prepare an economic analysis you should not ignore that as many as 250 jobs will be terminated when that facility closes. That’s more than all the permanent wind jobs in Eastern Oregon.”
150. **Commenter 16** – “██████████ is proud that the HIA has recognized wind power’s contribution to Oregon’s economy: ‘Data from Oregon indicate that wind energy facilities have increased employment in Oregon’s renewable energy sector and the economy as a whole.’ Wind energy development has dramatically promoted rural economic

development in Oregon over the last decade, and it is important to acknowledge that fact.”

151. **Commenter 5** – “The energy companies are would like us to believe that they create jobs for the community. Shepards Flat created 1 permanent job for \$16 million dollars. In what way does this make good financial sense? They do not create jobs – they just cost us the tax payer to support an industry that is not ever going to be viable without tax payer dollars.
152. **Commenter 9** – “In addition, the money the wind farm provides is nothing more than getting our own money back due to a taxpayer kickback through production tax credits and grants. In this report, it states there has only been 225 jobs created as a result of wind energy. After all the billions of tax subsidies that have been given to wind projects, it is a joke to say we get local benefit. This skewed information is direct from the wind lobbyists’ script.”

Response: We acknowledge that our discussion of economic impacts is limited for several reasons. First, this is a strategic assessment, and therefore we were only able to address economic impacts in a very general way. Second, as stated on page 84, there is limited data on the actual economic impacts of these facilities at the local, state-wide or national level. Until recently, most studies have relied on models that predict the direct, indirect and induced effects of a single or multiple projects. One commonly used model (JEDI, or Jobs and Economic Development Impact Models) reports only on “gross” impacts on a handful of variables. The JEDI model is not a cost/benefit analysis, assumes that the project is financially profitable and viable, and does not incorporate a number of issue identified in these comments and other comments (tax credits, changes in electricity rates, etc.). At the time the report was written, PHD did not find any credible publications that describe the net economic impacts of wind energy development in Oregon.

The geographic scale used to understand economic or other impacts will likely influence any conclusions about whether these impacts are positive or negative (i.e., local communities may experience or value some impacts differently than the population of a county or state). In the strategic HIA, PHD tried to identify impacts that could have the greatest effects at the local level. All Oregonians will likely be impacted by policy decisions related to tax credits, but the communities located near proposed developments will also experience impacts related to job creation or loss, changes in personal income or property values, or local taxation decisions.

Change to report: Page 88, 3rd paragraph, insert after 2nd sentence: “These studies, and the models on which they are based, have some important limitations. For example, one commonly used model (the Jobs and Economic Development Impact Model, or JEDI)

provides predictions on the gross impacts of a facility on a handful of economic variables. While the JEDI model provides approximate values for the magnitude of economic impacts, it does not provide estimates of net impacts (e.g., does not account for losses due to increased electricity rates, displaced economic activity, or reduced tax revenue), and is a static model that does not account for changes in energy demand, costs or production [140].”

153. **Commenter 15** – “Page 14, first bullet: Restrictions on hiring to incentivize local labor may result in violations of interstate commerce. Please delete this bullet; instead, encourage use of regionally trained technical people from the many accredited colleges and universities.”
154. **Commenter 16** – “While we agree that developers should hire and purchase locally, we observe that doing so many not be possible. Much of the work required for wind turbine construction and maintenance is skilled labor, and it isn’t always possible to find that talent locally. Thus, recommending such in the HIA may lead to unrealized expectations. We do agree, however, that whenever possible, developers should seek that talent from in or around host communities.”
155. **Commenter 9** – “Purchases from local suppliers is also very limited due to most local suppliers do not provide many of the components used in a wind farm project.”
156. **Commenter 9** – “In many cases, land lease payments do not benefit the local economy since many of the landowners are absentee owners who would not put the money back into the local economy.

Response: Buying and hiring locally is simply one of the strategies we found that could possibly maximize the local economic benefits of wind energy facilities.

Cost of energy produced by wind facilities

157. **Commenter 8** – “Economic Effects (starts at top of page 14): None of us can escape the truth that wind energy is uneconomical. It costs us 12.6 cents per kilowatt-hour compared to 3.5 cents per kilowatt-hour for hydro power. These figures came from an article by Angela Perez titled Quest for Power: Finding the Best Source in my February, 2012 Ruralite. So, wind energy costs a little more than 2 ½ times as much. How helpful would that be to the economy of that same community?”
158. **Commenter 9** – “This statement ‘wind energy’s relative cost-effectiveness’ from the report is discouraging at best, since wind is not cost effective. There are numerous reports that have been written that have shown wind is not cost effective, just go to the internet and do an inquiry. One is an article the Cascade Policy Institute’s report, ‘*Think Twice: Why Wind Power Mandates Are Wrong for the Northwest.*’”

159. **Commenter 20** – “You mention that disbursing cash is a solution – I agree but cheaper power would be even better (or is this out of your control?).”

Response: We did not include household costs in our assessment, including those related to purchasing energy. Instead, as stated on page 80 of the report, we examined the links between income level, educational attainment, and employment status and health.

Changes to the report: Page 92, after bullet points:

To our knowledge, Sherman County is the county in Oregon that shares revenue in this way.

Other

160. **Commenter 15** – “We also suggest you revisit the data regarding... the industry’s overall contribution to the U.S. economy. For example, in 2005, fewer than 10% of a wind turbines parts were manufactured in the U.S.; today, that number exceeds 60%. According to AWEA, over the past ten years more than ten billion dollars has been investing in the U.S. wind turbine manufacturing.”

Response: Where possible, the HIA focused on data from Oregon to understand the impacts of wind energy facilities in the State.

161. **Commenter 9** – “There is an entire section in this report, ‘Economic Effects,’ which has nothing to do with the health issue. It appears to be a feeble attempt to justify wind farm development in rural Oregon. This entire section should be removed.

Response: Appendix A of the report gives an overview of Health Impact Assessments. In that appendix you will find information relevant to our inclusion of this domain, including the World Health Organization’s definition of health as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.” See the introduction to Section E: Economic Effects (page 79) for an overview of the known connections between economics and health and mortality risks.

162. **Commenter 13** – “█ recommends that conclusions be modified to indicate that projects owned by in-state entities are considered ‘community owned’ for purposes of the term as used in the HIA.

Response: For the purposes of the HIA, “community owned” refers to projects where local residents, businesses, schools, utilities, etc. have a direct financial stake in the project, are involved in siting decisions, and bear most of the costs/benefits of the facility. The electricity from community-owned projects is either distributed within a local area or sold as wholesale power. Projects that are built and managed by in-state entities may not necessarily be “community-owned”.

Community Conflict

PHD received a number of comments about public engagement, community conflict and stress. Some of these comments raised specific questions, issues or concerns about the community conflict section of the report. Other comments were more general nature, or were descriptions of personal experiences or thoughts about community conflict and public engagement related to wind energy facilities in Oregon.

Poll Referenced in Community Conflict

163. **Commenter 9** – “The poll question below shows bias towards wind energy stating wind turbines are clean sources of renewable energy, which has been addressed in previous paragraphs and proving this incorrect: *From the Public Opinion Poll: ‘Most wind power energy comes from turbines, which can be as tall as a 10 to 20 story building and have three 200 foot long blades. The energy generated by these wind turbines is clean sources of renewable energy that produce no air or water pollution.* Would you oppose or support wind farms being erected within sight of your home?”
164. **Commenter 5** – “The HIA report that stated 78% of rural Oregon residents would be in favor of wind turbines in sight of their homes and communities? I would question the integrity of that poll strongly. As someone who gathered signatures on our 2mile setback petition for Umatilla county this goes in direct opposition with what we heard time and time again from our residents. Randomly knowing on doors I gathered 387 signatures asking 406 people. Of the 19 people who would not sign our petitions, it was because they had land leased for turbines/were going to get them, they worked for the wind industry or had relatives that did on that particular gather of signatures.”
165. **Commenter 6** – “The HIA cites a 2010, poll conducted by DHM Research (page 92, para 1). DHM could not clarify whether or not any of those polled were living near industrial wind facilities. The principal question posed was, ‘if you knew it was clean and renewable would you support wind energy?’ I suggest that had the question been, ‘If you knew it (wind turbine) had the potential to create noise that adversely affects your health, would you support it?’ the poll would have had a different outcome.”

Response: PHD used the DHM public opinion poll as an example to illustrate the observation made by some researchers that wind energy generally has broad public support, but some facilities may face substantial local opposition (Community Conflict sub-section 2.1). Our intent was to emphasize that general public opinion data may not reflect the values, concerns or dynamics of specific communities. To our knowledge, this poll was the only state-level public opinion data available regarding wind energy. We acknowledge that these data do not represent the views of a particular community. As

with any survey or polling data, there is some potential for bias based on the questions, methods, participant selection strategy, etc.

Public Engagement

Several commenters affirmed the need for early and increased public engagement but a few of these expressed that improved communication or involvement of the community is not enough. The commenters recommended other options to strengthen the public engagement component, including tangible benefits for the community that are equitably distributed, improved OAR's that protect the public's livelihood and environment, a better defined process, and the possibility of a project be stopped if overwhelming opposition exists. Other comments noted that 100% community consensus is impossible.

166. **Commenter 18** - P 21 paras 3. This para. is an excellent statement as to what is supposed to happen. However, your Community Comment section addresses what happens when the developer has not satisfied the 'social' problems described in the report. Your reference is ORS 469. The ORS address the technical and legal side of the issue. It specifically includes (OAR 345-022-0080) social items such as scenic view, identified as important or significant. The applicant must only propose, they do not have to accomplish anything. This creates frustration among the citizens and possible future mental-health problems."
167. **Commenter 18** - "The report keeps indicating that there needs to be more communication between the developer and the community prior to approval of a project. This is not what is needed. What is needed is new and improved OAR's that protect the public's livelihood, environment, wildlife, health and financial well-being."
168. **Commenter 2** - "People hate change – it is a human characteristic we all share. You should emphasize the need for EARLY communication by project managers with local community leaders and schools. The first natural reaction in any community will be negative and the media will generally reinforce the negative. Project managers could provide facts about the project such as taxes and employment. Outsiders will take the permanent jobs if information is not provided to encourage people to get the necessary training before the project is complete."
169. **Commenter 20** – "I agree with recommendations 2 and 3, but I do not see a means for actually addressing the issues of equity, engagement, and so on. I simply see more explanation to the community but no actual benefits to address community concerns. I think the community needs tangible benefits in cheaper power and higher tax revenues, not the typical vague corporate promise of building a playground or the like."
170. **Commenter 6** - "I strongly concur with the HIA recommendation that the permitting process of all future industrial wind facilities include a Health Impact Assessment. But to

be meaningful, any future implementation of the HIA process must include the possibility of wind facility projects being cancelled based on community input that indicates overwhelming opposition.”

171. **Commenter 6** - “The HIA does note ‘Place and Identity’ as important to a community and observes that wind developments may be perceived as ‘Large scale technologies that intrude spatially and culturally on accustomed ways of life.’ However, the presumption that ‘consultation and better education’ will remedy the problem is unlikely given the enormous negative and disparate ramifications. Residents living adjacent to these facilities are ‘educated’ about wind turbines. It is those of us whose health and daily lives have yet to be impacted that have much to learn. Industrial wind facilities and the attendant transmissions lines crisscrossing the terrain are a permanent alteration of the rural environment on a massive, unprecedented scale. ‘Consultation’ and ‘education’ will not remove the burden placed on these individuals and their communities.”
172. **Commenter 16** - “This is the only topic that [REDACTED] takes any quarrel with: ‘Community conflict over wind energy developments could potentially result in individual and community-level stress.’ While we agree that street cannot be good for a community, we ask whether it is the developer – or any business’ – duty to ensure that the entire community agrees with any given business endeavor. As the HIA says, “community conflicts over wind energy developments have many similarities to conflicts over other controversial siting or natural resource decisions in rural communities,’ and we don’t see that wind developers should necessarily be held to a higher standard than any other local business. The developer should of course be required to consider public comment periods and take appropriate mitigations as necessary, but it is unrealistic, to put it mildly, to ask for a developer to assume responsibility for the emotional well-being of an entire town.”
173. **Commenter 15** - “While early community engagement and dialog through the planning and permitting phase of a project can help alleviate some community concerns, it is impossible to eliminate all opposition to, and related annoyance with, a project and therefore unreasonable to set standards that would seek zero annoyance or community conflict as a goal. Our society cannot function if the permitting threshold is that zero percent of people will be annoyed.”

General comments about community conflict and stress

Social impacts, such as stress from community conflict, were one of the most frequently reported concerns during our public outreach process in the fall of 2010. We received several comments that affirmed that the siting of wind energy facilities can sometimes cause social and psychological stress in communities and individuals.

174. **Commenter 7** – “I live under the threat of an industrial wind facility being built in my community. I can tell you that my quality of life and my stress level have been impacted in a negative way by this threat. I cannot imagine how impacted I would be by the actual facility.”
175. **Commenter 6** – “The stress and disruption of rural communities and the natural environment by these large scale industrial facilities is unprecedented in rural Oregon. The proliferation of industrial wind facilities in Central and Eastern Oregon has exceeded the availability of open lands, void of human habitation. The ‘good’ spots are gone. Increasingly, wind facilities are now coming up against residential communities and communities are pushing back pitting participating landowners against non-participating homeowners. One of the most convincing conclusions to come out of the HIA listening sessions last year, second only to noise concerns, was that industrial wind facilities split communities. These are rural communities where you grow up with your neighbor, ride the same school bus, graduate together, and eventually raise your children alongside one another. In Morrow, Umatilla, and Union counties many neighbors no longer speak to one another, discontinuing business relationships and destroying friendships forged over generations. There are social impacts associated with rapidly turning rural landscapes into industrial zones.”
176. **Commenter 5** – “My own personal experience with community conflict lives right next door. My neighbor had land leased with Iberdrola and wants the wind turbines. I and my husband both testified before the Board of Commissioners in Umatilla county about wind turbine siting. Our neighbor was also at those meetings. From that point forward our neighbor has pulled his diesel farm trucks along our fences line and let them run – sometimes for hours at a time. This had not occurred before we had testified. Relatives and neighbors whom I had thought of as friends quit speaking to me in the grocery store.”
177. **Commenter 8** – “(Page 92): At the bottom of this paragraph you make brief reference to a community where voters appeared to be ‘almost evenly divided on a nearby development.’ If you mention that matter, then it needs a little further discussion. I know you included a footnote reference but that doesn’t tell the whole story. First the vote was a county-wide vote it was not evenly-divided. It was 52% against development and 48% in support. The developer and their supporters spent an estimated \$360,000 as compared to \$3,000 spent by those who opposed the project. In the town of Union the vote was almost 4 against for every 1 vote in favor. Now that is community conflict.”
178. **Commenter 9** – “In the Community Conflict section, it states that wind energy has strong support from the public is inaccurate. In the City of Union, the 2010 wind vote for Measure 3175 was 3 to 1 against the Antelope Ridge Wind Farm. County wide, 52%

voted against it, even with the hundreds of thousands of dollars spent by Horizon Wind in advertising and promotion of the project.”

Change to report: Page 97, 1st sentence 1st paragraph: “..often have support from the general public...”

Page 97, last sentence 1st paragraph: “One of these sessions was held in a county where voters appeared to be almost evenly divided in their support for a proposed wind energy development.”

179. **Commenter 6** – “On Page 93, under 2.1 ‘controversies at renewable energy facilities’: the HIA states that renewable energy facilities have unique characteristics compared to traditional siting conflicts because renewable energy has broad support from public, government, industry and environmental groups. The source the HIA reference for this ‘broad support’ stems from a 2004 proposed Biogas plant case study, not 400+ tall, noise making, ridgeline spoiling industrial turbines. Asking someone if they support renewable energy is a far cry from asking them if they support industrial wind turbines next to their homes that will potentially impact their health.”
180. **Commenter 9** – “Stress is very real in the rural community due to wind projects are all sited in the rural communities. These projects pit neighbor against neighbor and business against business. What it boils down to it is all about money where some landowners benefit at the expense of others by forcing some to lose their health, view shed, livelihood, way of life and property investment, at the same time using our tax money to develop the project.”
181. **Commenter 5** – “Many petition signers and myself are disturbed by the huge industrial wind projects such as Shepards Flat. They/I feel they have turned our vast rural spaces into industrial power plants.”

Wind Energy Facility Siting, Setbacks and Oversight

Setbacks

PHD received several comments requesting that we recommend a minimum setback distance for wind turbines in Oregon. Some commenters cited specific setback distances that have been recommended by other authorities, jurisdictions or advocates.

182. **Commenter 3** – “The study needs to address that a minimum setback should be required for all residents due to the noise that is created by large wind projects. Noise from turbines causing sleep deprivation is not an acceptable practice for this industry.

Noise impacts from wind can cause increased stress and decreased cognitive performance and many other effects.”

183. **Commenter 10** – “On page 15, recommendation: **WIND TURBINES NEED TO BE PROPERLY SITED WITH ADEQUATE SETBACKS.**”
184. **Commenter 21** – “Please allow a 2 mile setback from any home in both non-resource and resource zones in Oregon.”
185. **Commenter 21** – “Please allow a 5 mile setback from any city or town.”
186. **Commenter 4** – “Dr. Nina Pierpont has extensively documented the adverse effects of industrial wind turbines on human health in many publications over at least a decade. Her recent book published in 2009, “Wind Turbine Syndrome” was thoroughly peer-reviewed and was reference in the Oregon HIA study. She recommends at least a 1.5 mile setback between turbines and residences on level land and a 2-3 mile setback in mountainous topography.”
187. **Commenter 4** – “The French National Academy of Medicine has recommended at least a 1.5 kilometer setback, while Dr. Sarah Laurie of Australia recommends a 6 mile setback and further studies to be done.”
188. **Commenter 22** – Dr. Reeder provided 17 reasons why a 2-mile setback should be adopted. Within his submitted document, there are detailed definitions of the following 17 reasons: “1) Not intended to limit turbine numbers, 2) Intended to empower the neighbors, 3) Intended to protect the property values and/or assure equitable and appropriate compensation, 4) Intended to protect general health (broadly defined), avoid sleep disturbance, and protect learning and general lifestyle benefits for adults and children, 5) Intended to protect the rural values guaranteed by Oregon’s land use planning program, 6) Intended to give full value to ‘Just saying no’, 7) The neighbors are now enables to negotiate protective turbine siting decisions, 8) Eliminating the confidentiality provisions protects the public health and information interests, 9) The setback energizes and makes a full player of the neighborhood, 10) The setback provides an early warning notice to the neighbors, 11) Neighbors might now act collectively, with timely significant impact, 12) Neighbors can now protect their right to free speech concerning wind power development, 13) The 2-mile setback forces the wind developer to “thing community” in all respects, 14) Protects the citizenship benefits for all members of the community, 15) Assures that the full range of land use planning goals is reasonably considered and implemented, 16) Provides a productive opportunity to developers, 17) A major change is necessary in local community dynamics if wind power development is to continue.”
189. **Commenter 11** – “The cumulative effect of an array of multiple turbines increases the noise level and should be another consideration. As a reference, consider the noise contour maps that are done as part of the EFSC application process. Distances between

turbines and receptors (residences) demonstrate that the accepted 1-dBA increase to 36dBA (maximum allowable increase) is not met until there is a 1 to 1.5 mile setback. The Summit Ridge and Shepherds Flats projects are two examples of this.”

190. **Commenter 6** – “A 2011 Umatilla County citizen initiated petition that produced 3,400 signatures in two weeks supporting the county planning commission’s 2 mile setbacks and stricter limits on industrial wind facility proposals.”

191. **Commenter 11** – “On page 52, where are the peer reviewed studies that support your overall recommendations? Proper setback distances between residences (receptors) and wind turbines that comply with DEQ noise regulations (by not raising the sound level more than 10dBA over the assumed ambient level) has validity in helping communities faced with siting new industrial wind power generators.”

192. **Commenter 11** – “Page 53,54, additional recommendation: Again these do not address the issue of setbacks. Planning, modeling, anticipating problems, mitigating after installation are efforts by industry planners to put the best spin on the overall issue health effects and problems from wind turbine noise. In reality, greater setbacks are the only effective solution.”

Response: At this time, PHD cannot identify or recommend a health-based setback distance for wind turbines in Oregon. This is for several reasons:

1. PHD believes that facilities that comply with Oregon’s noise standards (both the ambient degradation standard and maximum allowable standard) will not result in noise levels that could adversely affect public health. Landowners who voluntarily waive the ambient degradation standard could potentially experience noise levels that could cause annoyance or sleep disturbance; however, since this is a voluntary choice, these landowners may be less affected by noise or less likely to report any health symptoms.
2. The distances required to meet Oregon’s noise standard will likely minimize any impacts from shadow flicker.
3. Given the limited scientific evidence on low frequency noise from wind turbines and its effects on human health, we do not think it is appropriate at this time to recommend a setback distance (or standard) based on low frequency noise.

As some commenters noted, some communities may have non-health reasons to consider or pursue specific setback distances. These reasons could include economic considerations, land-use laws, community values, and considerations of equity and the distribution of costs and benefits.

What has/is being done

193. **Commenter 1** – “On page 22, you assert there is limited oversight within the local approval process. We would encourage you to review the Wind Energy Siting guidelines adopted by the Association of Oregon Counties in December 2009. Additionally Oregon Revised Statute and Oregon Administrative Rule provide significant criteria that is applied to any number of energy facilities that has become more rigorous over the past decade as planning staff and commissions have become more knowledgeable about wind energy and its impacts on the land and communities.”
194. **Commenter 16**– “We also find it important to emphasize that the recommendations suggested by the HIA are already happening. The EFSC review requires a site-specific review of noise factors, as do many local ordinances. We wholeheartedly agree that developers need to act transparently, and that they should try to educate the local communities as much as possible about the proposed wind projects in their area. Many developers work hard to educate the public, and we congratulate them for doing so.”

Response: PHD acknowledges that state and local officials, developers, and other stakeholders in some areas of the state have gained experience and expertise in permitting and siting of wind energy facilities. We believe other counties that are considering or are new to the siting of these facilities could benefit from these experiences. However, to our knowledge, health impacts are not explicitly considered in either the EFSC or any local siting processes.

Change to report: Page 22 add paragraph: As wind energy development has expanded in some parts of Oregon, developers, decision-makers and community members have gained experience in evaluating the impacts associated with these facilities. This experience has led to the development of policies and processes to guide the siting of future facilities. Some examples include the passage of local ordinances for wind energy facilities, the use of strategic investment plans to guide tax payments and revenue from a facility, and the development of guidelines for counties involved in permitting decisions. These policies and guidelines may be useful for counties that are considering or are new to the siting of wind energy facilities.

Verification and enforcement

195. **Commenter 10** – “In regards to residents living near wind turbines reporting health issues, who enforces issues involving wind turbines? The answer is “no one” as DEQ doesn’t have the staff to do this.”

196. **Commenter 18** – “P7; Noise standards are defined. What not is not addressed is how do you effectively enforce the standards in the field. Suggestions are made as to how to reduce noise, but nothing about how they would work in the real world.”
197. **Commenter 20** – “Is there a requirement for BAT when selecting a turbine design? Could you define BAT criteria (noise would be one metric)? Can the permit process be used to get a quieter design? How does a developer guarantee low decibel levels before the fact, and what happens if he is wrong?”
198. **Commenter 6** – “Currently, sound propagation models are conducted by the wind developers in the state permitting process. The data they submit is projected as fact. After the facility is completed, the sound propagation model submitted during the permitting process should again be independently verified by the state or contracted engineers.”
199. **Commenter 10** – “Having accurate noise measurements is critical as the applicant is going to have to meet the DEQ noise standard. The applicant shouldn’t be the one supplying the noise measurement (or any other required survey results such as wildfire surveys.) A consultant or noise analyst hired by a company can spin the result for whoever hires them, as was the case with UPC’s proposed Cascade Wind project in Wasco County. In its application for a site certificate, it was clear that UPC didn’t follow the state DEQ regulations and took measurements when the wind was 18 mph while the limit is 10 mph (see *DEQ’s Sound Measurement Procedure Manual*, Section 4.5.2). Measurements were taken in a rural residential zone and applied to an F290 forest zone, a much quieter area several miles and a ridge top away. If this project had gone through as proposed, there would have been problems for the residents according to Kerrie Standlee, the noise analyst the state contracts with. The noise analysis needs to be done by an independent third party not selected by the developer. Allowing the applicant to submit their noise measurements is like letting them hire their own building inspector.”

Response: The Oregon Department of Energy is responsible for determining compliance with and enforcement of Oregon’s noise standard at facilities sited under EFSC’s jurisdiction. ODOE evaluates developers’ applications for a site certificate to determine if the facility meets all applicable standards that apply to the facility. As part of this evaluation, ODOE determines if the applicant has used the appropriate assumptions and procedures to model expected noise levels at a receptor (as specified in OAR 340-035-0035: Noise Control Regulations for Industry and Commerce). We defer to ODOE to describe any steps they take to independently verify developers’ noise models and predictions. Our understanding is that ODOE has the capacity to respond to complaints related to EFSC-sited facilities, and determine if the facility is in compliance the noise standard. As of the writing of the report, ODOE had not received any complaints related to EFSC-sited facilities.

Local governments are responsible for enforcing the noise standard at energy facilities sited at the local level. Local governments vary in terms of their laws, procedures and experience related to wind energy facility siting. These factors will likely impacts local governments' ability to evaluate compliance with Oregon's noise regulations during the siting process, or enforce standards when the facility is operating.

We do not know if the EFSC process has a requirement or criteria for using BAT (best available technology) when selecting a turbine design. ODOE is the best agency to contact regarding the requirements for wind energy facility design and siting. ODOE's website has several documents that outline these requirements, including the following:
<http://www.oregon.gov/energy/Siting/docs/WindSite.PDF>
<http://cms.oregon.egov.com/energy/Siting/docs/2008Guidelines.pdf>

Other

200. **Commenter 20-** "Is an EIS still required for siting a large wind farm?"

Response: Wind energy facilities built on federally-managed lands must undergo environmental reviews as specified by the National Environmental Policy Act (NEPA). This review may include the preparation of an Environmental Assessment (EA) or Environmental Impact Statement (EIS).