Multi Municipal Energy Working Group
AGENDA

MMEWG-2023-04
Thursday, September 21, 2023, 7:00 p.m.
Virtually via Microsoft Teams

Pages

1. Meeting Details

   To obtain the meeting calendar invite, please email Julie Hamilton, Recording Secretary at jhamilton@arran-elderslie.ca

   Microsoft Teams meeting

   Join on your computer, mobile app or room device

   Click here to join the meeting

   Meeting ID: 280 442 746 952
   Passcode: iVAUPN

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2. Call to Order

3. Adoption of Agenda

4. Disclosures of Pecuniary Interest and General Nature Thereof

5. Minutes of Previous Meetings

9. Members Updates

   Members may provide updates on recent activities and findings relevant to the purpose of the MMEWG.

10. New Business

11. Closed Session (If Required)

    Not required.

12. Confirmation of Next Meeting

    November 16, 2023 at 7pm via Teams

13. Adjournment

Multi Municipal Wind Turbine Working Group

MINUTES

MMWTWG-2023-03
Thursday, May 11, 2023, 7:00 p.m.
Virtually via Microsoft Teams

Members Present: Mark Davis - Municipality of Arran-Elderslie - Citizen Appointee
Ryan Nickason - Municipality of Arran-Elderslie
Scott Mackey - Township of Chatsworth
Tom Allwood - Municipality of Grey Highlands
Dan Wickens - Municipality of Grey Highlands
Jim Hanna - Township of Huron Kinloss
Mike Hentz - Municipality of Dutton-Dunwich
Todd Dowd - Municipality of Northern Bruce Peninsula

1. Meeting Details

2. Call to Order

The Chair called the meeting to order at 7:03 pm. A quorum was present.

3. Adoption of Agenda

The Working Group passed the following resolution:

MMWTWG-2023-22

Moved by: Dan Wickens - Municipality of Grey Highlands

Seconded by: Jim Hanna - Township of Huron Kinloss

Be It Resolved that the Multi-Municipal Energy Working Group hereby adopts the agenda of the Thursday, May 11, 2023 as distributed by the Recording Secretary.

Carried

4. Disclosures of Pecuniary Interest and General Nature Thereof

None.

5. Special Guests

5.1 MPP Rick Byers

Chair Allwood welcomed MPP Byers to the meeting.

MPP Byers is looking forward to working with the group to understand the pressing issues and concerns.

Chair Allwood reviewed the main concerns that the Working Group has been advocating for.

The Working Group is happy to see that municipalities have siting controls back however there are still concerns regarding setbacks. The Working Group has made recommendations on what appropriate setbacks should be and continues to advocate for those changes to be made.

There are concerns regarding safety and protocol requirements with wind turbines projects. There have been some catastrophic failures associate with wind turbines. The Working Group has received a response from the Ministry that all concerns are addressed and reported on and the Working Group has requested copies of the reports but has not been successful.

There are concerns regarding the taxation of wind turbines and whether they are being taxed appropriately. The Working Group has received correspondence from the Ministry of Finance on that matter.

The newest concern relates to the IESO RFP that is currently ongoing. The extra generation will need to be housed somewhere and there are many new battery storage facilities being proposed. These proposals bring forward concerns related to fire suppression measures and emergency protocol, setback provisions and noise emissions.

MPP Byers spoke briefly to the provinces Green Energy Plan. The current and continued thrust is in the nuclear power program. Storage is another area that is of focus and will continue to be in the long-term plan.

6. Delegations/Presentations

6.1 Bill Palmer - Brief Update on the Stachura matter

Mr. Palmer provided a brief overview of his role with the group as Technical Advisor to the group as well as the Stachura matter.

The Stachura's are residents living in the K2 Wind Development area. In 2017, they had brought forward issues related to the adverse effects on their lives and the enjoyment of their property from the tonality of the K2 wind turbines.

Feedback has just been received however said very little, other than that the Ministry had received the audit information, had reviewed it, and concluded, "*Those acoustic audits were reviewed by ministry staff and found to be in compliance with ministry's requirements as outlined in the Compliance Protocol for Wind Turbine Noise."* The Ministry letter went on that, "*The ministry's review of the complaint investigation immission audit reports, (audio files), and supporting documents concluded that the K2 wind facility has satisfied the complaint investigation procedures outlined in the letter dated November 30th, 2018."*

Mr. Palmer has written two technical papers that have been published on the K2 tonality issues and it was also one of the primary issues raised during his 2018 briefing with Minister Yurek.

He has reviewed some of the material that the Stachura's have received back. They had to go through Freedom of Information and pay to receive the audit reports. The reports show that there is in fact tonality in the samples.

He provided the Working Group with a brief explanation of A-weighting, noise and sound.

Mr. Palmer noted that it is distressing that the Ministry will not review and revise its compliance protocols in light of the evidence that is being provided to them on the inconsistencies.

Once his technical paper is completed and published, he will share it with the Working Group.

Following Mr. Palmer's presentation, Chair Allwood noted that it touched on two of the main issues the Working Group has raised and advocates for, setbacks and noise receptors. The 550m that is the current regulation does not address the issues of tonality.

There are hundreds of complaints of this nature and the Ministry has indicated that they are reported on quarterly however the Working Group has met roadblocks when trying to obtain those reports.

Subsequent to further discussion, the Working Group passed the following resolution:

MMWTWG-2023-23

Moved by: Todd Dowd - Municipality of Northern Bruce Peninsula

Seconded by: Mark Davis - Municipality of Arran-Elderslie - Citizen Appointee

Be It Resolved that the Multi Municipal Wind Turbine Working Group hereby receives Mr. Palmer's presentation for information purposes.

Carried

6.2 Warren Howard - BESS Considerations for Zoning Bylaws

Mr. Howard made a presentation to the Working Group regarding considerations for municipal bylaws.

Some of the considerations Mr. Howard suggested included:

- location on prime agricultural land
- setbacks from existing structures
- treatment of vacant lots
- setbacks from property lines
- do proposals meet fire safety standards
- noise emissions
- emergency plan requirement
- handling of fire emergencies
- environmental monitoring

Mr. Howard asked for any feedback from the Working Group.

Chair Allwood addressed the BESS concerns during a training session with the Office of the Fire Marshall's office. They indicated that these systems are relatively new and they would be provide training to the Fire Chiefs. They are actively working on regulating these systems but they are about a year away of having anything in place.

Subsequent to further discussion, the Working Group passed the following resolution:

MMWTWG-2023-24

Moved by: Dan Wickens - Municipality of Grey Highlands

Seconded by: Scott Mackey - Township of Chatsworth

Be It Resolved that the Multi Municipal Wind Turbine Working Group hereby receives Mr. Howard's presentation on BESS setback considerations, for information purposes.

Carried

6.3 Warren Howard - IESO Long Term RFP - Request for Feedback

Mr. Howard made a presentation to update the Working Group on the IESO RFP process.

The most recent presentation took place on May 4th. The IESO is requesting feedback by May 18th.

Feedback should be sent to engagement@ieso.ca

Mr. Howard suggested that feedback be provided as follows:

Expansion of Existing Projects
• Municipal Support required for changes to increase capacity or to extend contract terms of existing projects
• Provide confirmation that existing project is fully compliant with all terms of its Renewable Energy Approval.
• Noise emissions from revised project will meet current standards for noise emissions.

Municipal Support

Information requirements are insufficient
• Currently only type of project, maximum project capacity, description of site

Municipalities require detailed Information
• Site, setbacks, noise emissions, fire safety, emergency plan
• Statement of Benefits to Community

Ability to Withdraw Municipal Support
• When new information becomes available

Community Engagement

Proper Community Engagement Required
• Proper written notice to adjoining landowners and wider community
• Limited internet capabilities require in person meetings
• Full project description made available. If details notavailable or if they change, additional public meetings required.
• Statement of benefits to community
• Precedes municipal consideration of project
• Opportunity for direct community feedback to IESO

Indigenous Support
• Indigenous involvement is important.
• Projects cannot proceed without local Indigenous support.
• Applies to local community within the traditional lands of the Indigenous community.
• Investment by other native groups only permitted when local community supports project.

Mr. Palmer suggested that the issue of hydrogen be included. The IESO talks of 1500 MW of hydrogen from unknown sources. The problem is that wind turbines can be put up to supply hydrogen and become a part of the hydrogen supply field and not necessarily the wind turbine field which is a very significant concern.

Subsequent to further discussion, the Working Group passed the following resolution:

MMWTWG-2023-25

Moved by: Dan Wickens - Municipality of Grey Highlands

Seconded by: Jim Hanna - Township of Huron Kinloss

Be It Resolved that the Multi Municipal Wind Turbine Working Group hereby receives Mr. Howard presentation on the IESO and that the Working Group will draft a response to the IESO by May 18, 2023.

Carried

7. Minutes of Previous Meetings

The Working Group passed the following resolution:

MMWTWG-2023-26

Moved by: Ryan Nickason - Municipality of Arran-Elderslie

Seconded by: Scott Mackey - Township of Chatsworth

Be It Resolved that the Multi-Municipal Energy Working Group hereby approves the minutes of the Thursday, March 9, 2023 meeting as presented by the Recording Secretary.

Carried

8. Business Arising from the Minutes

8.1 Follow Up Letter - Wind Turbine Failures

The Working Group passed the following resolution:

MMWTWG-2023-27

Moved by: Dan Wickens - Municipality of Grey Highlands

Seconded by: Jim Hanna - Township of Huron Kinloss

Be It Resolved that the Multi Municipal Wind Turbine Working Group hereby approves the distribution of the letter regarding the Wind Turbine Failures as presented.

Carried

8.2 Minister of Health - Health Hazards Letter

The Working Group passed the following resolution:

MMWTWG-2023-28

Moved by: Jim Hanna - Township of Huron Kinloss

Seconded by: Todd Dowd - Municipality of Northern Bruce Peninsula

Be It Resolved that the Multi Municipal Wind Turbine Working Group hereby approves the distribution of the letter regarding Health Hazards.

Carried

8.3 Letter to the Office of The Fire Marshall regarding Battery Storage Systems

The Working Group passed the following resolution:

MMWTWG-2023-29

Moved by: Scott Mackey - Township of Chatsworth

Seconded by: Ryan Nickason - Municipality of Arran-Elderslie

Be It Resolved that the Multi Municipal Wind Turbine Working Group hereby approves the distribution of the letter to the Office of the Fire Marshall as presented.

Carried

8.4 Feedback from circulation of BESS Presentations to Fire Chiefs

The Working Group provided direction that a follow up letter be sent to Member Municipalities requesting that the information be provided to Council for information.

Members can than make a motion requesting that their respective fire chiefs provide a report back to Council on the matter if they wish.

Mr. Byers thanked the Working Group for the invitation. He will follow up with Chair Allwood to ensure he clearly understands the issues. He departed the 8:12 p.m.

8.5 Approval of Terms of Reference & Annual Fee by Member Municipalities

Approvals have been received from:

Arran-Elderslie

Grey Highlands

The Recording Secretary will forward this request a second time so that the new Terms of Reference can be finalized.

9. Correspondence

9.1 Requiring Action

9.1.1 Approval of March and April Recording Secretary Invoice

The Working Group passed the following resolution:

MMWTWG-2023-30

Moved by: Dan Wickens - Municipality of Grey Highlands

Seconded by: Ryan Nickason - Municipality of Arran-Elderslie

Be It Resolved that the Multi Municipal Wind Turbine Working Group hereby approves the payment of the invoice for the March and April Recording Secretary services.

Carried

9.2 For Information

9.2.1 Correspondence Items from Ruby Mekker for information

Ms. Mekker provided an explanation of the materials that she provided.

She has sent a letter to North Stormont providing information on a bylaw that was passed in 2010 by Arran-Elderslie to amend the municipal code to incorporate certain health and safety provisions with respect to the locating and erecting of wind generation facilities within the Municipality. It also touched on the noise issues and other health effects experienced by people.

She also provided information on contamination effects from the shrapnel and chemicals in the breakdown of industrial wind turbine blades and provided some information on bylaws that other municipalities have passed regarding industrial wind turbines.

Subsequent to further discussion, the Working Group passed the following resolution:

MMWTWG-2023-31

Moved by: Todd Dowd - Municipality of Northern Bruce Peninsula

Seconded by: Ryan Nickason - Municipality of Arran-Elderslie

Be It Resolved that the Multi Municipal Wind Turbine Working Group hereby accepts the correspondence for information purposes.

Carried

10. Members Updates

Chair Allwood has taken the Essentials of Municipal Fire Course through the Office of the Fire Marshall. As noted before, he addressed the BESS concerns during the training session. They indicated that these systems are on their radar however they are about a year away before they would have anything they could share with municipalities. Municipalities could consider putting in place an interim control bylaw in place until that information is available.

There were no other updates from Members.

11. New Business

None.

12. Closed Session (if required)

13. Confirmation of Next Meeting

The next meeting will be held on September 14, 2023.

14. Adjournment

The Working Group passed the following resolution:

MMWTWG-2023-32

Moved by: Ryan Nickason - Municipality of Arran-Elderslie

Seconded by: Dan Wickens - Municipality of Grey Highlands

Be it Resolved that the meeting of the Multi-Municipal Wind Turbine Working Group is hereby adjourned at 8:33 p.m.

Carried

Tom Allwood, Chair	Julie Hamilton, Recording Secretary

From: Melnychuk, Jodi (She/Her) (MOH)
To: Julie Hamilton
Subject: E-Correspondence 361-2023-4458 Health Hazards - Tom Allwood, Chair, Multi-Municipal Energy Working Group
Date: August 25, 2023 11:40:09 AM

Dear Mr. Allwood and Working Group Members,

Thank you for your correspondence regarding wind turbine noise levels.

The Ministry of Health, in collaboration with Public Health Ontario, monitors and reviews new and emerging evidence on health effects of wind turbines. Recent studies examining human health effects related to wind turbine noise have focused on annoyance and sleep disturbance. While the current body of evidence supports an association between wind turbine noise and annoyance, the literature did not find consistent evidence of adverse effects on sleep or other health effects.

Additionally, the Ministry of Environment, Conservation and Parks (MECP) is responsible for policies, protocols, laws and regulation pertaining to wind farms and wind turbines, including wind turbine noise levels. Sound level limits established for wind facilities in the province were established to be protective of human health and are consistent with World Health Organization limits. If you have questions regarding MECP oversight of wind turbines, please contact Shawn Burr, Divisional Program Specialist at shawn.burr@ontario.ca.

Should you wish to report a concern about a renewable energy facility, you may contact the Public Information Centre at Toll-free: 1-800-565-4923.

The Ministry of Health continues to regularly review all new scientific evidence to ensure that the measures in place are protective of the environment and of human health.

Sincerely,

Jodi Melnychuk
Director, Health Protection, Policy and Partnerships
Office of the Chief Medical Officer of Health, Public Health
Ministry of Health, Ontario

MULTI-MUNICIPAL ENERGY WORKING GROUP
TOM ALLWOOD, COUNCILLOR, GREY HIGHLANDS, CHAIR
JIM HANNA, DEPUTY MAYOR, HURON-KINLOSS, VICE-CHAIR
1925 BRUCE ROAD 10, BOX 70, CHESLEY, ON NOG 1L0
519-363-3039 FAX: 519-363-2203
jhamilton@arran-elderslie.ca

May 18, 2023

The Multi-Municipal Energy Working group wishes to submit the following feedback regarding matters related to the IESO LTI RFP Process.

Expansion of Existing Projects
Expansion or changes to projects should be treated similar to the initial proposal process.

- Municipal Support should be required for changes to increase capacity or to extend contract terms of existing projects.
- Confirmation should be provided to the municipality that an existing project is fully compliant with all terms of its Renewable Energy Approval.
- Noise emissions from revised project shall meet current standards for noise emissions.

Municipal Support
The current information requirements are insufficient.

- Currently, only the type of project, maximum project capacity and project are required to be provided.
- Municipalities should be provided detailed Information such as site plans, setbacks, noise emissions, fire safety and emergency plans.
- Proposals should include a statement of benefits to the community.
- There should be the ability to withdraw municipal support when new information becomes available

Community Engagement
Proper community engagement practises should be required.

- Proper written notice to should be provided to adjoining landowners and the community to a specified radius limit.
- In-person meetings should be a requirement to eliminate barriers related to internet connectivity issues.
- A full project description should be made available and if details are not available, or if changes are made to proposals, additional public meetings should be required.
- The community engagement should require that the benefits to community are included in the presentation and materials.
- Community engagement should take place prior to presentation to municipal consideration of the project.
- There should be an opportunity for direct community feedback to IESO.

Indigenous Support

Indigenous involvement is important.

- Projects cannot proceed without local Indigenous support.
- Applies to local community within the traditional lands of the Indigenous community.
- Investment by other native groups only permitted when local community supports project.

The Multi-Municipal Energy Working Group will continue to stay current on the IESO Long-Term Request for Proposal and offer feedback when relevant to the mandates of the MMEWG.

Regards,

Tom Allwood,
Chair, Multi-Municipal Energy Working Group
Councillor, Municipality of Grey Highlands

Terms of Reference
Multi-Municipal Energy Working Group
MMEWG

Name:

The committee shall be known as the Multi-Municipal Energy Working Group (the "Committee"). The Committee may be cited by its short title MMEWG, when appropriate to do so.

Purpose:

The purpose of the Committee is to draw together representatives from municipalities to share, discuss and advocate "best practices" and other means to address mutual concerns regarding energy generation facilities and storage infrastructure to all the relevant Government Ministries and Agencies.

Activities:

The Committee will meet on a regular basis to discuss ongoing matters and, where applicable, make recommendations to the Councils of the member municipalities for support and/or action as applicable.

The Committee will also undertake research into various related topics and liaise with other similar working groups as appropriate to share information and ideas.

The Committee may form sub-committees to concentrate on specific matters, which sub-committees will report back to the Committee on an ongoing basis.

Delegated Authority:

The Committee is a working group and has no delegated authority except for the advocacy of best practices.

The Committee has no authority to direct staff from any of the member municipalities, and any recommendations requiring implementation, reports, staff action, or a commitment to expend money must first be approved by the respective Council or Councils as the case may be, depending on the municipality(ies) impacted, before any action by staff may be taken.

Committee Composition:

The membership of the Committee will be comprised of representatives appointed by Council resolution or by-law from participating municipalities as follows:

- Two members of council from each participating municipality appointed as regular members of the Committee
- One member of council from each participating municipality appointed as an alternate to attend in the absence of one or both of the regular member representatives from that municipality (appointment of alternate is at the discretion of each member municipality)
- One citizen member may be appointed by each member municipality for the purpose of bringing additional expertise to the discussion

Should any participating municipality wish to opt out of the Committee, a resolution from the participating municipality shall be received by the Committee by December 31st of the year they wish to cease membership. There will be no refund of the annual fee to the municipality wishing to opt out.

Term of Office:

All members of the Committee shall be appointed for the term of the Council of the member municipality that appointed them.

Each appointing Council reserves the ability to replace its appointees at its sole discretion and may do so at any time by notifying the Recording Secretary by way of resolution or by-law.

Administration of the Committee:

The Committee will elect a Chair and Vice-Chair from amongst its members on an annual basis, at the beginning of each calendar year.

The Committee will be governed by the Procedural By-law of the Municipality of Arran-Elderslie, except as set out in these Terms of Reference.

Meetings of the Committee shall be open to the public, subject to the exceptions set out in Section 239 of the *Municipal Act, 2001*, as amended.

A maximum of three (3) delegations will be permitted to be placed on the agenda for any Committee meeting, or at the discretion of the Committee. The request to be added to the agenda and the nature of the delegation must be provided to the Recording Secretary not less than five (5) business days prior to the meeting. Each delegation will be allotted ten (10) minutes for their presentation, at the discretion of the Committee.

Notwithstanding the limit to the number of delegations to be placed on the agenda, with the approval of a majority of the Committee members present, up to an additional three (3) 5-minute delegations may be permitted to address the

Committee at any given meeting on short notice.

Delegations will not be permitted to appear before the Committee to present the same information on more than one occasion, nor shall multiple delegations be permitted to repeat the same information as previous delegations, and the ruling of the Chair of the Committee with respect to this matter shall be final.

Staff attending meetings of the Committee are not members of the Committee.

All members of the Committee agree to provide financial support for the secretarial support for the Committee by forwarding, to the Municipality of Arran-Elderslie an amount as established by the Committee, and approved by consensus of the Councils of the participating municipalities. The Committee will review and levy this amount on an annual basis, at the beginning of the calendar year and this levy must be paid by June 1st in each year. In case of any participating municipality discontinuing their participating in Committee, the said municipality shall remain liable for payment of their support for that calendar year.

If the Committee is disbanded, the members of the Committee at the time of disbandment shall agree how the remaining funds shall be distributed, and approved by consensus of the Councils of the remaining participating municipalities.

The Committee shall provide an annual fee structure which shall be approved by Councils of the participating municipalities. A year-end financial statement will be forwarded to the Clerks of the participating municipalities by April 1st of the following year.

Minutes from Committee meetings will be presented for adoption by the Committee at its next regular meeting and once adopted, forwarded to the member municipalities for information and disposition of recommendations as necessary.

Membership:

A yearly record of membership will be established by the Recording Secretary and the agendas and minutes will reflect the name of the appointed member's municipality represented. This record of membership shall be updated from time to time as required, and be provided to all participating municipalities.

Quorum:

Quorum shall be a representation of appointed officials from a majority of the participating municipalities, either by one, two or three of the appointed

members or the alternate appointee (where such appointee exists). Quorum shall be more than 50% of the participating municipalities.

If there is no quorum within thirty minutes after the time appointed for the meeting, the Recording Secretary shall call the roll and record the names of the members present and the meeting shall stand adjourned until the next regular meeting or until a special meeting is called.

Voting Strength:

Each appointed member shall carry a voting strength of one (1) vote per individual.

Agendas and Minutes:

The Agendas will be prepared by the Recording Secretary and distributed to each participating municipality for posting in accordance with their standard practices.

The minutes, once adopted by the Committee, will be forwarded to each participating municipality and made public by each participating municipality in accordance with their standard practices.

Meeting Schedule:

It is expected that the Committee will meet on a bi-monthly basis, or at the call of the Chair, as may be determined from time to time.

Meetings will be primarily held virtually using Microsoft Teams or other suitable virtual platform in an effort to broaden the membership and participation area. Meetings may also be held in other appropriate formats to accommodate the needs of the Committee.

The platform in which meetings are held will be reviewed by the committee from time to time and altered to accommodate the needs of the committee by a general consensus of the committee members.

The Committee will establish a proposed meeting schedule on an annual basis at the beginning of the year to facilitate planning.

Remuneration:

Committee members shall be compensated for meeting attendance by their respective member municipality in accordance with their municipalities remuneration policy and/or procedures.

Staff Resources:

Secretarial support including preparation of agendas and minutes of meetings will be provided by the Recording Secretary who is hired by the Committee.

The Committee may appoint a technical assistant at a rate to be determined, and approved by consensus of the Committee, but will not exceed the annual budget.

Miscellaneous:

These Terms of Reference for the Multi-Municipal Wind Turbine Working Group are established by consensus of the Councils of the participating municipalities and can only be altered by consensus of those municipalities.

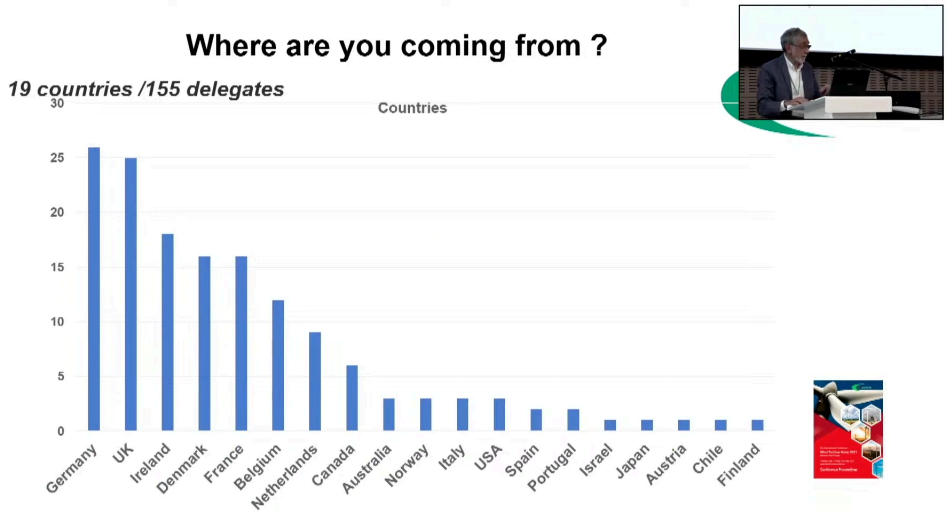
Date of Adoption of Terms of Reference: February 2011
Date of Amendment: September 2015
Date of Amendment: March 2023

10th International Conference on
Wind Turbine Noise
Dublin, Ireland + Remote
June 21-23, 2023

The 10th International Conference on Wind Turbine Noise (WTN 2023) was held as a "hybrid" local and remote conference. 125 delegates attended locally at Trinity Business School, Trinity College, Dublin, Ireland and 30 additional delegates attended remotely (watching on-line) with some 12-15 routinely connected by "chat" to share ideas and comments with each other.

I may have been the only conference attendee in the "Objector" category, as I noted no others.

The 155 delegates represented 19 (or 20 said on closing) countries, including 6 from Canada.



The 6 from Canada included 3 developer representatives, there as listeners who were not heard from; 2 as Session Sub-Chairs, David Michaud from Health Canada who also was a lead-off speaker at a forum titled "Impact on People," and David Colby, former Medical Officer of Health from Chatham Kent; and finally myself as the only paper presenter from Canada.

44 – 20 minute papers were presented (including 3 remotely) grouped in the following sessions, with each group followed by a discussion / question and answer period:

- Propagation (mostly about model development for sound travelling from the wind turbine to receptors) – 7 papers in a split session
- Mode Management (methods and the impact of reduction of turbine speed and output to reduce noise, when necessary to meet regulatory limits) – 3 papers
- Guidelines and Regulations – 5 papers
- Source Noise (mostly about models to predict the noise at the source, - the wind turbine) – 7 papers in a split session
- Impact on People – 8 papers in a split session (Including mine, presented remotely)
- Compliance (mostly about monitoring campaigns) – 4 papers
- Miscellany – Including Amplitude Modulation – 5 papers
- Tonal Noise – 5 papers

The paper presenters might be categorized roughly as follows (some authors represented several fields, so this list is only approximate):

- University wind departments – 18 papers (some doctoral candidates, or post-doc fellowships)
- Wind industry consultants – 14 papers
- Industries providing wind components – 6 papers
- National regulators – 2 papers
- Operators of wind developments – 2 papers
- Independent researchers – 2 papers (I've put myself into this category)

Additionally, the conference included 3 "Forums" of 40 minutes or so, usually opened by an address from one or two speakers, followed by a panel discussion, on these topics:

- Are we moving towards a consensus on Wind Turbine Noise Regulation?
- Wind Turbine Noise Reduction: Beyond Serration (blade trailing edge modification)
- Impact on People

This was the 8th WTN Conference that I attended. I anticipated that attending "remotely" would mean missing out on the person-to-person contact that formed a big part of the WTN conferences previously attended. As it turned out, the majority of those who I looked forward to meeting again after past conferences were not there in person this time, in some cases because of personal or family health challenges, or perhaps because their work programs may have changed to no longer give them time (or perhaps interest) to attend the conference this time. In fact, more of the group who I would have hoped to speak to were also attending remotely than in person. A core group of 12 to 15 took an active part in the "chat" session daily that ran concurrently with the streamed presentations. These were active conversations.

Sharing of ideas during those sessions actually seemed to be more than occur in normal break-time at face to face conferences. Also, the organizers arranged a "Zoom" face to face chat each day, and a group of 6 to 8 gathered around a "Zoom Lunch Table" for an hour or so daily. I'd like to acknowledge the following group and thank them for their openness and sharing with an international flavor in those conversations. I learned a lot, thanks.

- Dick Bowdler UK / Scotland
- Alex McKenzie UK / England
- Geoff Leventhall UK / England
- Malcolm Hayes UK / Wales
- Thomas Sorensen Denmark
- Oscar Breugelmans Netherlands
- Mark Jiggins UK
- Kris Aper Belgium
- Robin Woodward UK / Wales
- Matthew Cand UK
- Cormack Staunton Ireland (who did a wonderful job of meeting the AV needs)
- Corneel Delesie Belgium
- Brice Geoffroy France
- Sophie Nyborg Denmark
- Sebastien Wschiansky Switzerland
- Pierre Fillion France

To those who were there in person or on line to whom I missed saying "hello" to renew past acquaintances, I apologize. Maybe next time? (Grouped alphabetically by country).

- David Colby Canada
- David Michaud Canada
- Bo Sondergaard Denmark
- Lars Sommer Sondergaard Denmark
- Jean Tourret France
- Fritz van den Berg Netherlands
- Cathy MacKenzie UK
- Sabine Hunerbein UK
- Bruce Walker USA
- Mark Bastasch USA
- And others who I've missed, sorry!

While there were things to learn from each of the 43 presentations other than mine, and the 3 forums, this is the list of key learnings that jump to the top for me. No doubt as I go back over the videos of each day's presentations, my notes, and the book of all presentation papers, more will come to mind. In my following comments, please note that my recollection of what was said by others is based on my notes of what I thought I heard people say. They are not based on a "transcription" of comments. Some might feel I misquoted what they thought they had said, and if so I apologize. There was certainly no intent to offend anyone by misquoting them.

1. Forum – Wind Turbine Noise Reduction – Beyond Serrations

This forum, moderated by Franck Bertagnolio (Danish Technical University) was comprised of these panelists from industry:

- Erik Sloth (Vestas Wind Systems)
- Roger Drobietz (GE Wind Energy)
- Cordula Hornung (Enercon)
- Jeremy Herault (LM Wind Power - blade manufacturer)

In the panel discussion about future options to reduce the blade noise, the opening position of Roger Drobietz was that 80-metre long blades are:

- very complex,
- undergo extreme loads and forces,
- need to last 25 years,
- have a shape that needs to be optimized for performance, to carry the loads
- mass too needs to be optimized, to avoid overloading the machine
- also, need to be optimized for stability, flexibility, aero-elasticity,
- and finally, (perhaps in that order?) need to be optimized for noise

For this reason, he noted that a pure noise optimization was never going to work. To add a slot in the blade to carry an active component to change the suction characteristic that might be adjusted to reduce noise would be very difficult, and he did not foresee it happening. It would need additional drivers to move the components. It would increase complexity, and would impact the blade structural integrity. It might positively impact noise, but would have many adverse effects. He did not see any new active systems in the next 10 years, and felt the need was to stay with passive methods, not active. There had already been discussion following the prior session that actively pitching the blades to accommodate varying wind speed from the bottom to the top on each rotation (due to wind shear), thus reducing the amplitude modulation (swoosh) would require many, many, back and forth cycles of the very large blades over their lifetime, and would risk failure. It too was not seen as likely. On a personal note, the representative of Siemens present during an Armow pre-construction public meeting in 2007 had assured me that their blades already did this, something I doubted at the time, but could not counter as the operational details were not provided. Now the experts from GE, Enercon, and Vestas, as well as the main blade manufacturer assure us that it is indeed not happening now, has not happened in the past, and is not likely to happen in the next decade.

Erik Sloth continued that any additional complexity of the blade would result in maintenance difficulties (such as dirt or ice getting into any openings on the blade for retractable components). Any control systems for an active system (wiring, actuators, etc.) in the blade would result in additional lightning strikes. He continued that while they are trying to reduce sound power in the outer 15% of the blades by serrations, brushes, or other modifications, perhaps they needed to stop adding “add-ons” to the outer parts of the blades and to focus instead to the inner part of the blades (closer to the blade root or hub), to reduce the noise

actually getting to the neighbours. To paraphrase his words, perhaps they are not dealing with the right part of the problem – but they are dealing with what the regulators are requiring. I find it concerning that those who know the issues best, are not standing up to the regulators and legislators, to advise them what the best path forward is.

Cordula Hornung added that the need was to reduce the low frequency range of sound emission. Serrations impact the mid frequency range, not low frequency. Control of low frequency noise would require dealing with inflow noise for which there is currently no solution. There is research into things like leading edge serrations, but they would be very hard to implement. They also need to consider the fact that the propagation models are based on a monopole source, and thus are not fully accurate.

Jeremy Herault added that it is difficult to predict what might be next after serrations to reduce noise, and something new would only be added to the blade construction if it adds value. He too doubted that any active system will be implemented, although there may be some progress on other passive modifications.

In summary, the panelists concluded that any complex system in the blades with active drivers is unlikely in the next 10 years. Perhaps changing the shape of the serrations might be a path forward to improve the situation. The panelists suggested that they should not be focusing so intently on sound emission, but they must comply with the regulations. Erik Sloth concluded, "But are the regulations protecting the neighbours? I see they are not."

Eric Sloth also noted that, the angle of attack (the angle at which impingement of incoming air hits the blade) changes with wind speed across the rotation. The angle of attack "is massively important – for both performance and noise." While cyclical blade pitching might be possible, it is unlikely to happen. The wear on the blade tilt bearings could also be an issue.

I could not help thinking back to 2009 at WTN 3 in Aalborg, when my paper titled, "A New Explanation for Wind Turbine Whoosh – Wind Shear," had suggested that the variation of the angle of attack caused by the change in wind speed due to wind shear across the blade resulted in the "whoosh." However, my suggestion had been discounted by all present. Now after 12 years the importance of "angle of attack" on "amplitude modulation" – aka the rising and falling swoosh, seems to be recognized as important. Things just take time.

David Colby queried if anyone had done study of biological systems. He noted that owls fly silently, so modeling owls might make a silent turbine. Eric Sloth replied that serrations are indeed modeled on the shape of a bird's feathers, but noted that an owl flies very slowly compared to the speed of a wind turbine blade tip. He noted that if they could reduce a wind turbine tip speed from the current value of about 60 m/sec, to the speed at which an owl can fly silently (less than 1 or 2 metres per second) they could make wind turbines very quiet, but they would also be very expensive. As an example, a Vestas V82 with a rotational speed of 14.4 rpm, and a 41-metre long blade has a tip speed of (2•π•41m•14.4 rpm) / 60 min/sec = 62 m/s. (> 220 km/hr) They only look to be slowly moving through the air because of their size.

Erik Sloth concluded, “At conferences like this we can recognize that we can do better. We can decrease annoyance and get more energy if we do it right. The challenge is to get politicians to realize that we are telling them a good idea.”

2. Tonality Reduction Through “Adaptive Tuned Mass Dampers”

An interesting paper by Alexander Busch of ESM-GmbH of Germany showed how vibration in wind turbine drive systems can result in tonality that can be radiated from the turbine, resulting in annoyance. Some of the charts he presented looked remarkably familiar to ones seen from processing recordings of K2 sound samples. They have a number of vibration solution systems, including a tuned mass damper that can be tuned to frequencies between 50 to 600 Hz, as well as a system they describe as an adaptive tuned mass damper that can be tuned to vibration that changes as machine speed changes.

https://www.esm-gmbh.de/en/products/noise-tuned-mass-dampers/ - adaptive-TMD

I plan to select several appropriate examples showing tonality experienced from the Siemens SWT 101 wind turbines in the K2 array from recordings we have, to send to the company. It is worth asking if this is the sort of issue they have experience with, before sending the information to the Ministry and K2, identifying that the annoyance issue from tonality with the K2 turbines might be addressed.

3. To Find the Source of Problems Follow the Money

While this was not the subject of a presented paper, I could not help thinking that it was just below the surface in many. The most obvious and troubling one, to me, was another remote presentation by Mr. Nicholás Bastián-Monarca, Director of Engineering of Acústica Austral in Chile. His presentation went through the steps required to license a wind power development in Chile. What bothered me most was that for citizens, who would be living in rural areas, 24/7, 365 days a year, the requirement for wind turbines was to meet either background plus 10 dBA, or 65 dBA in the daytime and 50 dBA at night. (Ontario requires a limit of 40 dBA day or night in rural areas.) However, in contrast, in areas that tourists might visit, the Chilean recommendation will be to not exceed the background noise level (that is, at least 10 dBA less than for people living in the area, 24/7, 365 days a year.) Yes, I thought, (although it was NOT said in the presentation) money talks, and we mustn’t make tourists go away.

4. Softening of Standards to Enable More Wind Developments

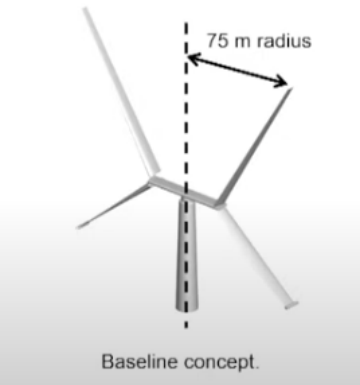
I lost count of how many times I heard that the International Energy Agency was requiring more wind power developments to be built in order to meet the zero carbon limits set by the Paris 2015 Climate Change Conference. A good overview of the issue was given by Madelon Ekelschot-Smink on behalf of herself and Erik Koppen, in a presentation titled, “Standards for regulating environmental impact of wind turbines.” Both authors represent “Arcadis” noted on their website as an engineering company headquartered in the Netherlands, but with offices in over 70 countries globally, who note themselves as “the world’s leading company delivering sustainable design, engineering, and consultancy solutions for

natural and built assets." The presentation discussed how as a result of a court decision, the Netherlands has dropped all national regulation for wind turbines, and are reconsidering setback limits. They noted, for example, Poland has reduced limits from 10x height setback for wind turbines (perhaps 2400 metres for some), to 700 metres (actually up from a 500 metre proposal), regardless of size. This was required of Poland by the European Union, "to receive European funds under the national recovery plan." The state of Bavaria in Germany will reduce from a 10X height setback to 800 metres "for wind priority areas" to "catch up in the production of wind energy." Other nations were noted as having limits of 4x height. The main criteria for setback was noted to be "to prevent visual nuisance", and "visually overwhelming effects." Standards are dropping like flies was my thought.

Neeraj Paul Manelil spoke on a paper titled, "Influence of atmospheric boundary layer characteristics and source height on sound propagation from a 5 MW wind turbine." The interesting part though, was his opening noting his motivation as "the harmful effects of noise pollution" that highly annoyed 10% with effects of stress and sleep deprivation. The paper includes the line, "*This has led to an increase in the number of onshore wind turbines, but with it come concerns surrounding the environmental and safety impacts of this technology. In particular, noise has become an increasingly significant health problem in recent years, as exposure to excess noise can lead to stress, sleep deprivation, cognitive impairment, hypertension, and cardiovascular disease…"* In the discussion following, Dr. Gundula Hübner, a professor of social psychology at the MSU Medical School, Hamburg, who was the first session chair on "Impact on People", and later presented on "Analysis of Mitigation Measures for Wind Turbine Noise Annoyance," was quick to point out, (I paraphrase only) "you cannot say there are health problems from wind turbines. There may be annoyance but there is no confirmation of health effects." Annoyance and sleep deprivation appear to be reduced in emphasis to being minor irritants, and not important enough to hold back further development.

5. Session on Source Noise

Seven papers discussed research into ways that might be applied to reduce the noise from wind turbine blades. They mostly represented work ongoing at Universities and tended to be quite heavy with equations and calculations. The comment was made by one chat participant about not being able to follow the presentations, but being glad that someone was doing the in-depth work. Some of the researcher's comments on the ease of implementing additional components to reduce noise had admittedly left me wondering if practicality was considered. One speaker had commented that the need was just to send someone up to stick "Vortex generators" on the blade surface, to result in a potential improvement. Just "sending someone up on the blades" to stick on components (that might be thrown off, and become airborne) struck me as perhaps not fully thought through.



There was one notable exception in this series of talks, which was a presentation on development work for an "X Rotor" hybrid turbine for offshore application.

The X-Rotor turbine, as described would have two 100-metre long upper blades, with the top tips separated by 150 metres, and two 65-metre long lower blades, each with a secondary 6.5-metre rotor on the lower blade tips.

A simulation of the expected acoustic output of the turbine was played. It was very loud. I could only think, "Oh my!"

6. Population Effect versus Individual Effect

The seemingly un-reconcilable conflict between population effect versus individual effect with respect to wind turbines continued to be seen in the conference. To my mind, there should be no conflict between these two areas of focus. Both need to apply. I can remember making the point in my testimony at the first Ontario Environmental Review Tribunal for the Kent Breezes wind power development. I had discussed that wind turbines should mirror the nuclear safety area which addressed BOTH the population safety effect and the individual safety effect for:

- the entire population living in the environment of the plant,
- as well as the individual living at the plant fence.

If the plant was surrounded by a large population density, then the population impact was predominant. In contrast, if the population in the vicinity was low, then the individual impact was predominant, but both limits had to be met. I had noted that for wind turbines, the predominant safety effect would not be a population effect, but an individual effect for the person living nearby. In cross examination, the counsel for the developer had posed the statement, "But surely you must agree, Mr. Palmer, that the consequences of being harmed by a nuclear accident are far more serious than the consequences of being harmed by a wind turbine." My response was simple. "Actually, sir, the consequences of being harmed (or killed) by either are exactly the same, you are dead."

One of the first demonstrations of the conflict between these two mutually required areas of protection was seen following the discussion session after the three presentations on "Mode Management." The presenters had noted work being done to optimize production output while enabling meeting sound limits, by maneuvering turbine output through the use of "modes" to reduce turbine speed, and hence noise when necessary. David Michaud identified

himself as representing Health Canada, and posed the statement, “It seems very strange to me that you’d want to use modes to reduce the power output in the first place. Because, presumably you want to offset fossil fuels burned with clean energy, and by reducing the mode … you increase the percent required from fossil fuel required by the electrical grid … so the net health effect on the population could be worse when you are reducing power output … You are using modes to reduce exposure … presumably because that annoys people that might interfere with sleep … but by reducing sound level you have get power from somewhere else.”

One presenter replied, you are speaking about the population effect, but the developer or wind farm operator has to comply with the regulations.

David Michaud continued … “I wonder if the community realizes … why not just … for every minute or hour above the limit, if we distribute some benefit to the community, and leave the turbines alone … it must cost a lot of money to reduce power output … just distribute the money to the community … what happens is they actually want the turbines to be audible then … you are really protecting health by not over relying on other sources.”

The interpretation I felt I had heard, was that the position of Health Canada being represented was that the population was best served by high wind turbine output, and the individual concerns were of less importance. It seemed that for Health Canada both population and individual effects did not need to be met, only the population effect, as more important.

The session chair Bo Sondergaard closed the session with a chuckle, suggesting, “David you will have to make a presentation at some time later and argue for the fact that more noise is better for the surroundings. It will be very interesting to hear the response to that.”

In a later session, after the Forum discussion on “Wind turbine noise reduction: beyond serration,” the population versus individual position of Health Canada seemed to be reinforced. David Michaud posed the question, “Would a community prefer an invisible turbine or a silent turbine?” He then responded to his own question, saying, “They would prefer an invisible one, I suspect.” This effectively represents the population position, rather than the individual position. The general population is little impacted by sound from the turbines, but have to look at them as they travel through the countryside. Hence, the population position is biased towards visual impact not sound. In contrast, for the individual who lives next to a turbine, the prime concern is usually the sound. That is what individuals mention as what keeps them from sleeping, not what the turbine looks like.

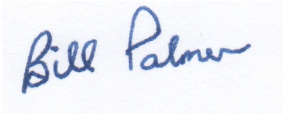
One might argue that in Ontario, and possibly some other jurisdictions, the main population

effect of wind turbines is their impact on the price of electricity and it's knock on impacts on the economy. However, in Ontario, one reads on the IESO (electrical system operator) website, that, "since Jan. 1, 2021, approximately 85% of non-hydro renewable energy contract costs are being shifted from the rate base to the tax base." Those renewable energy costs formerly increased the price of electricity in a "global adjustment term" but the shift effectively moves those costs into the provincial debt, to be paid for in the future. Hence the main population impact has become invisible, as it became a "pay-me-later" cost instead of "pay-me-now." The debate as to which eventually costs more, "pay-me-now" or "pay-me-later" is a subject for another day, but I suspect the population impact will not be negligible.

While I mean no offence to anyone, I suspect the "population vs. individual" concern is what drives those in positions of power (e.g. government leaders and regulators) to favour population emphasis. They believe they are most effective by focusing on "the big picture." Yes, it impacts the most voters. Individual needs come a distant second. This has the effect of putting those leaders in conflict with individuals. My personal model has to be the one put forward by Jesus, who although the highest possible leader, was not above stopping to deal with the needs of the individual, such as the woman spoken of in Luke chapter 8. Even though crowds pressed around Jesus, the woman thought "If I just touch his garment, I will be healed." Jesus stopped, even with the crowd demanding his attention, and focused on the needs of the one, as he did many times. I cannot but believe that we are called in the same way, to deal with the individual, at times. "Love God, and love one another," is the commandment, not, "Love the crowd." Both the population effect and the individual effect matter for a just society.

As promised, this initial summary only highlights the top issues (for me) from this conference. No doubt more will continue to come to mind as I go back over my notes, and carefully read all the presentation papers, but this will give an overview for interested folks of what I learned. I thank the conference organizers for their work, and for permitting me to present my paper as a "remote" one to a "hybrid" conference, since that was not the initial intent.

Sincerely, thank you.



William K.G. (Bill) Palmer trileaem@bmts.com

Closing In on the Wind Turbine "Sasquatch" – Whose Name is "Annoyance"

William K.G. (Bill) Palmer
trileaem@bmts.com

INCE*EUROPE*

10th International Conference on Wind Turbine Noise Dublin – 21st to 23rd June 2023

Hello, thanks for listening.

It's a privilege to send greetings to the 10th Wind Turbine Noise Conference from Canada.

But, in a virtual presentation, how do you know it the greetings are real?

It's like the topic I'll discuss, *"closing in on the wind turbine "sasquatch" – whose name is "annoyance."*

But a "sasquatch" is only imaginary, isn't it? So how can we show annoyance is real?

Let's see.

Is annoyance real?

- Let's use references from past Wind Turbine Noise Conferences

WTN Conference	Total # of Papers	# of Mentions of "Annoyance"
WTN 2005	29	78
WTN 2013	72	406
WTN 2021	40	438

- The data suggests "annoyance" has not gone away
- Our objective is to replace a "subjective" assessment of annoyance with an "objective" (measureable) one

We'll begin by using real references from past wind turbine noise conferences.

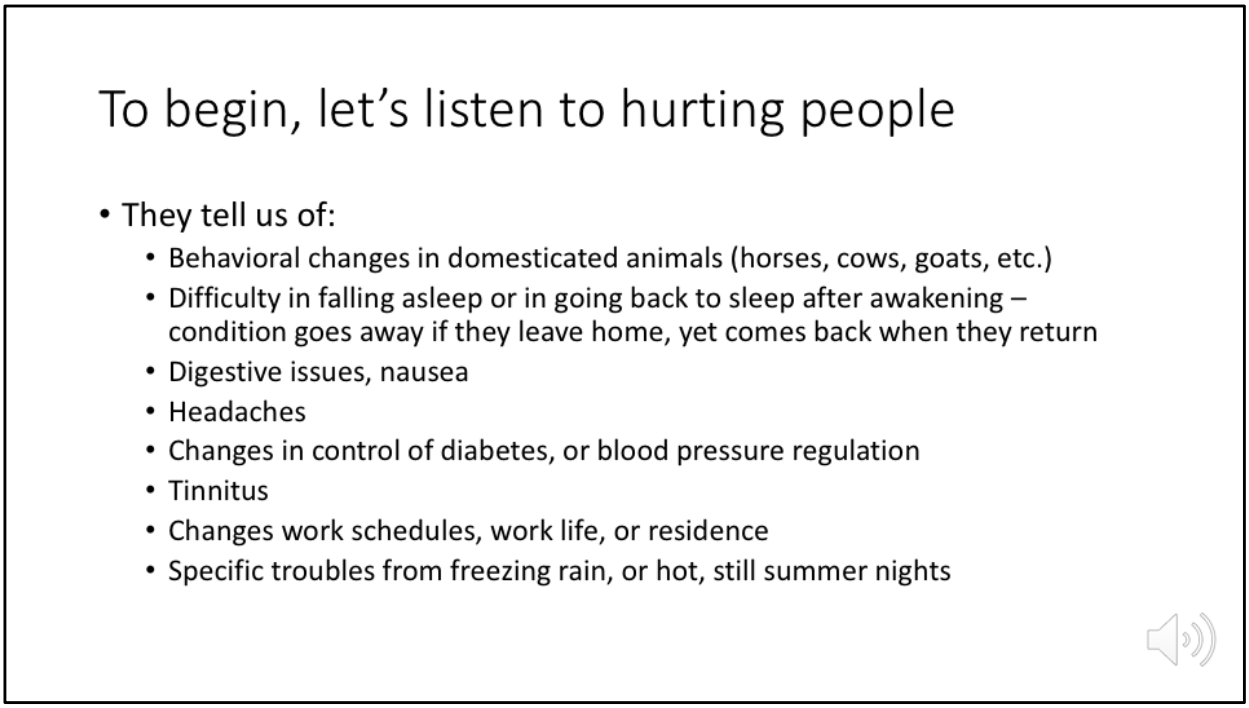
The First Wind Turbine Noise Conference in 2005 had 29 papers, which used the word "annoyance" 78 times.

By 2013, the paper count had more than doubled to 72, but mentions of "annoyance" increased by over 5 times to 406.

The last conference in 2021 had fewer papers, at 40, but mentions of annoyance continued to grow to 438.

It seems that discussion of annoyance keeps increasing, which does not sound like it is imaginary.

Our objective here is to replace a subjective assessment of the term "annoyance" with an objective, or measurable one.



We'll begin, by listening to what hurting people tell us.

They speak of behavioral changes in animals – those animals do not have prejudices, so why should their behavior change if something is imaginary?

People speak of difficulty falling asleep, or difficulty going back to sleep after they awaken. A condition that goes away if they leave home, but comes back when they return.

They speak of digestive issues, nausea, headaches, changes in control of diabetes, or blood pressure, and of tinnitus.

They tell us of needing to change work schedules because they cannot sleep properly, or the need to leave their regular employment because they could not function normally, or even to leave their homes.

In their stories, they tell of specific issues when freezing rain occurs, or on hot summer evenings.

Listening, non-judgmentally, we can hear they are clearly hurting, even if they do not know why.

Mining the data on hand

- Spot measurements near, and away from wind turbines since 2007
- Short duration attended recordings since 2011
- Two years of continuous acoustic recordings from mid 2018 to mid 2020 at one site ~ 787 m from the nearest wind turbine, and local spot recordings at a second site in the same array
- 9 months of continuous acoustic recordings from a site ~ 537 m from the nearest wind turbines (of a different type) from 2020 through 2023, along with some simultaneous recordings > 6 km from the same wind turbines
- Resident complaint data filed with the Ministry of the Environment at the sites near wind turbines
- Could any link be established between the complaints and the sound?

To put a finger on the reason, we will look at hard data we do have.

- We have spot measurements taken since 2007.
- Then there are short duration attended recordings taken since 2011, with increasingly sophisticated equipment.
- We have 2-years of continuous acoustic recordings taken using 90 mm primary and 450 mm secondary wind screens, from mid 2018 to mid 2020 at one site 787 m from the nearest wind turbine, with 16 turbines within 3 km. and spot recordings at a second site in the same array with the closest turbine at 703 m and 18 within 3 km.
- Then we have a further 9 months of data recorded between mid 2020 and early 2023, at a home 537 m from the nearest wind turbine, with 19 within 3 km.
- We also have the logs of complaints these families filed with the Ontario Ministry of the Environment.
- Could we mine this real data of recordings and complaints, to see if there was a correlation?

Data analysis suggests a hypothesis

- In general we think that a 3 dB change in dBA value can be perceived by most people
  - lets consider cases where the difference between LA90 (typically the background levels) and LA10 (typically the loudest sounds occurring ≤ 10% of the time) is ≤ 3dB as representing those cases that might not readily be perceived
  - Lets look for simultaneous cases when the full spectrum shows LZ10-LZ90 is ≥ 6 dB (two 3 dB changes, potentially more readily perceived)
- There was a good match – between the annoyance complaints and the recorded conditions at the time of the complaint matching those conditions, suggesting a possible hypothesis:

Annoyance can be predicted for LZ10-LZ90 ≥ 6 dB while LA10-LA90 ≤ 3 dB

We read the general understanding that most people can perceive a 3 dBA change in sound level.

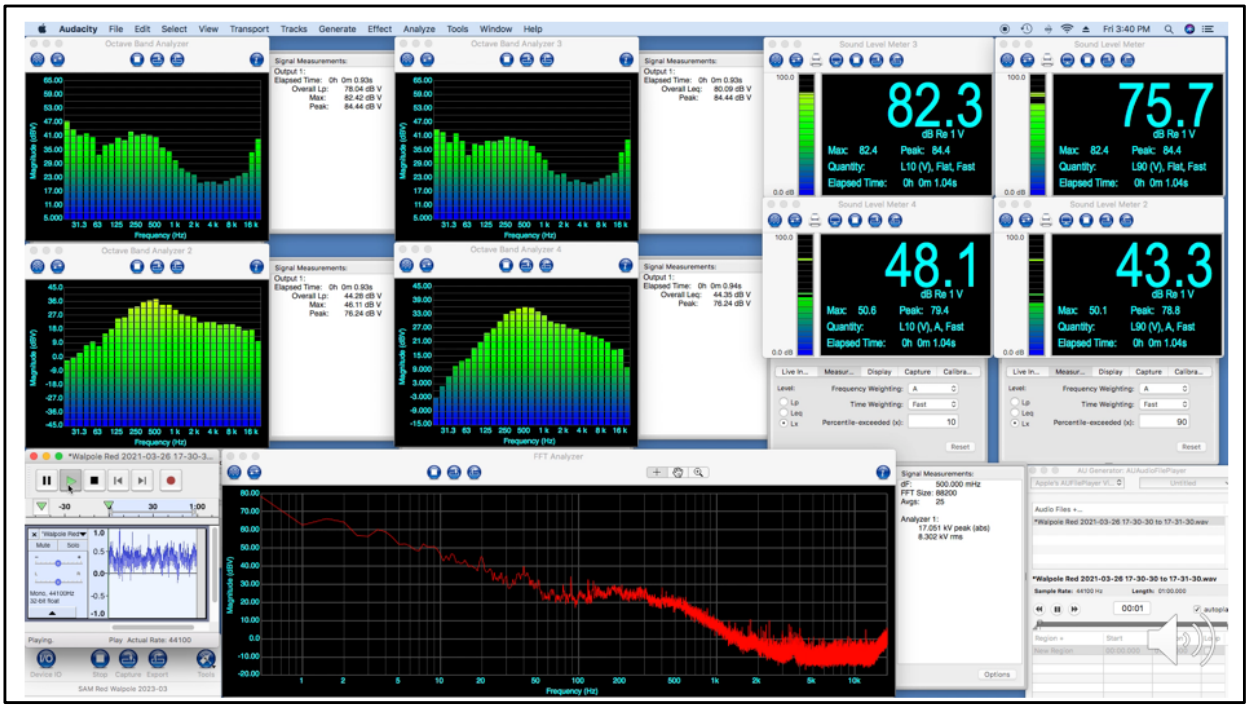
So we thought, let's examine the cases revealing a difference between the 2 minute LA90 sound level (the level present 90% of the time, typically considered to be background) and the 2 minute LA10 sound level (the loudest levels present less than 10% of the time). If this difference was less than 3 dB, than possibly the change might not be perceived.

With that, let's look at the simultaneous conditions showing a difference between the loudest 10% of the full spectrum sound level (called unweighted, flat, or Z weighted) compared to the background 90% of that same full spectrum sound If this difference was over 6 dB (or 2 full 3 dB increases) then we might expect the difference would probably be perceived.

What we found was a good correlation between the times of the logged complaints and the existence of LA conditions that might not be perceived, but LZ conditions we expected would, suggesting a possible hypothesis, which was:

Annoyance can be predicted for LZ10-LZ90 ≥ 6dB, when at the same time LA10-LA90 ≤ 3dB.

So we set out to test that hypothesis.



We've analyzed thousands of samples, using the tools of the application "Electroacoustics Toolbox." Here's a sample display of a 1 minute analysis (shortened from the normal 2 or 3 minutes analysis for this presentation). The upper right shows calibrated sound level meters for LZ10 and LZ90 above meters for LA10 and LA90. The left side shows one-third octave spectral analyzers. LZeq is in the top centre, and a real time LZ at it's left. Below the LZ analyzers are the comparable LA filtered analyzers. An unweighted FFT display of the one minute sound file is shown at the bottom of the display. It uses a hann window with a 17 kilo Hz span. There is 0.5 Hz resolution, a 50% overlap between each calculation, and displays the average of the last 25 calculations for each line. A small audacity window at the lower left allows tracking a visual presentation of the waveform, and provides an audio file as a listening aid.

Let's watch and listen to a sample being processed.

What did we just witness?

This was the analysis of a time categorized by the resident as 7/10 in annoyance. Note that this resident considers a 7/10 event as the minimum level that would be logged with the Ministry.

Here we saw the LZ10 – LZ90 difference to be 7.3 dB, and the LA10 – LA90 difference to be 2.6 dB, so this would meet the Criterion established in the hypothesis. At the same time, the 1 minute LZeq was 78.6 dB and the 1 minute LAeq was 44.1 dB.

Testing the hypothesis – could it just be the wind?

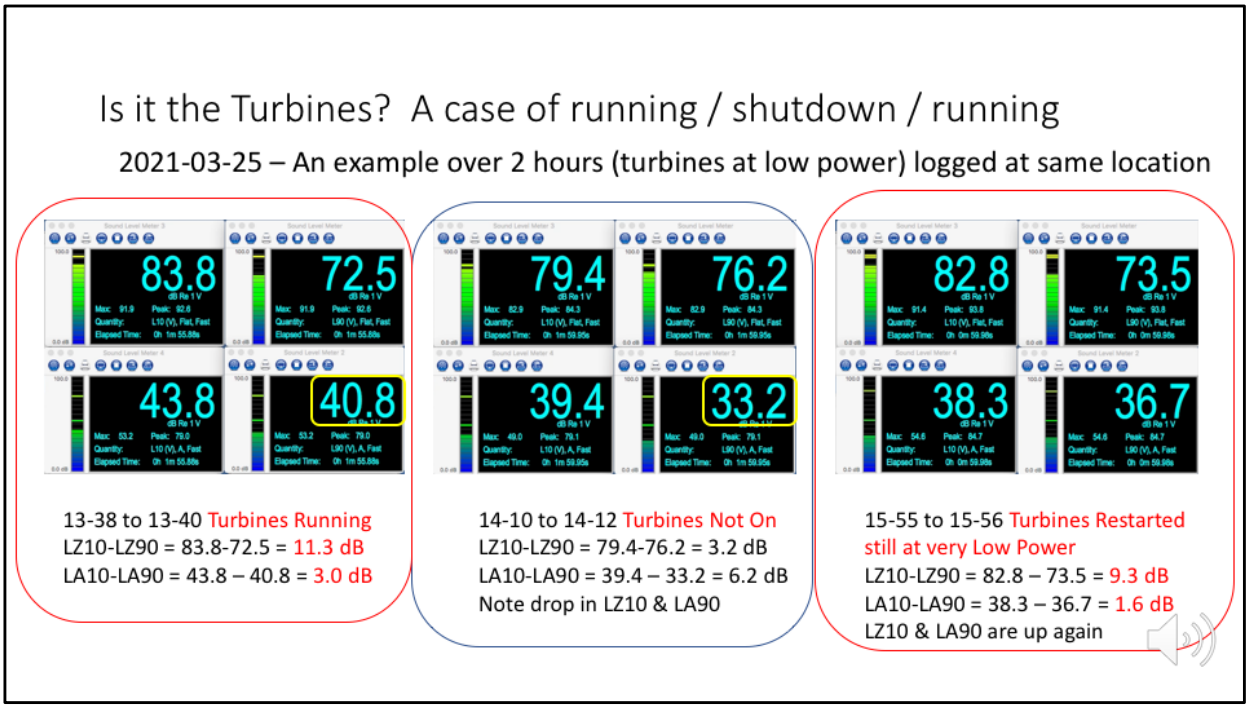
- Closely examined data from times turbines shut down or started up (as wind speeds do not change appreciably over the short transition)
- Also compared data recorded simultaneously at the site ~ 537m from turbines, and at a site > 6 km to the same wind power array
  - same terrain, same proximity to roadways, closely matched environmental conditions (wind, temperature, pressure, humidity, precipitation, etc.)
- Tested analysis microphones against Level 1 IEC 61094-4 compliant ACO Pacific 7046 free field microphone to ensure consistent readings
- Extended data set to test at regular 1 or 2 hour intervals, to ensure not only testing complaints, but sampling all conditions
- Looked at months of data

It was important to test the hypothesis to ensure that the measurements being recorded were actually related to the wind turbines, and not just to the wind itself.

Close examination was given to cases where the wind turbines shut down or started up.

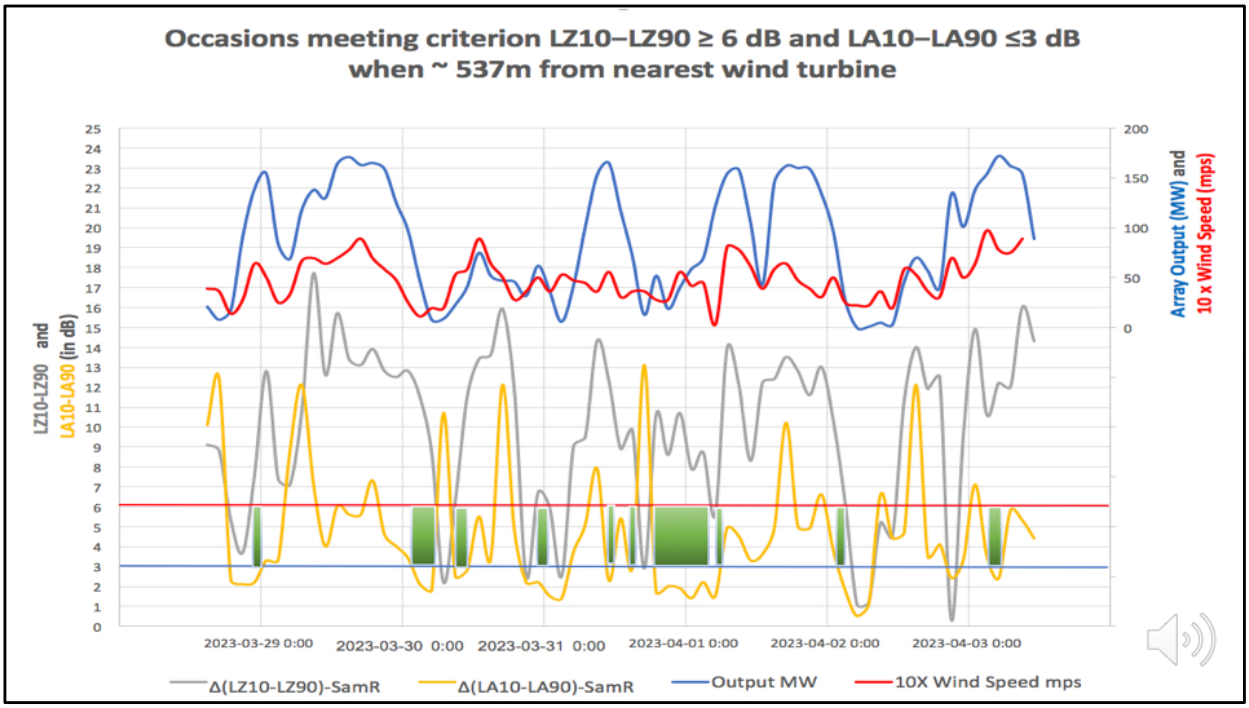
- At some times these might just be due to wind speed falling below the operational threshold,
- In other cases, the turbines were shut down due to the electrical system operator offering the turbine operators the option of shutting down (while still being paid for possible output) during times the system demand was lower than baseload generation available.
- Recordings were also made of data recorded simultaneously at the site ~ 537 m from turbines and a second site > 6 km from the nearest turbine of the same wind turbine array.
- Additional recordings were made to ensure the microphones used were consistent in output with a Level 1 IEC 61094-4 compliant ACO Pacific 7046 free field microphone.
- The data set was extended to ensure data was recorded at regular 1 to 2 hour intervals, to sample all conditions proportionally, and not just to sample

complaints.



Here's an example of a shut down and restart at low power conditions. The left side shows the criterion test before the shutdown where (LZ10-LZ90=11.3 dB while LA10-LA90 = 3 dB). Just after the shut down, you can see the 7.6 dB drop in LA90 from turbines operating to shut down.

The subsequent restart is also shown on the right.



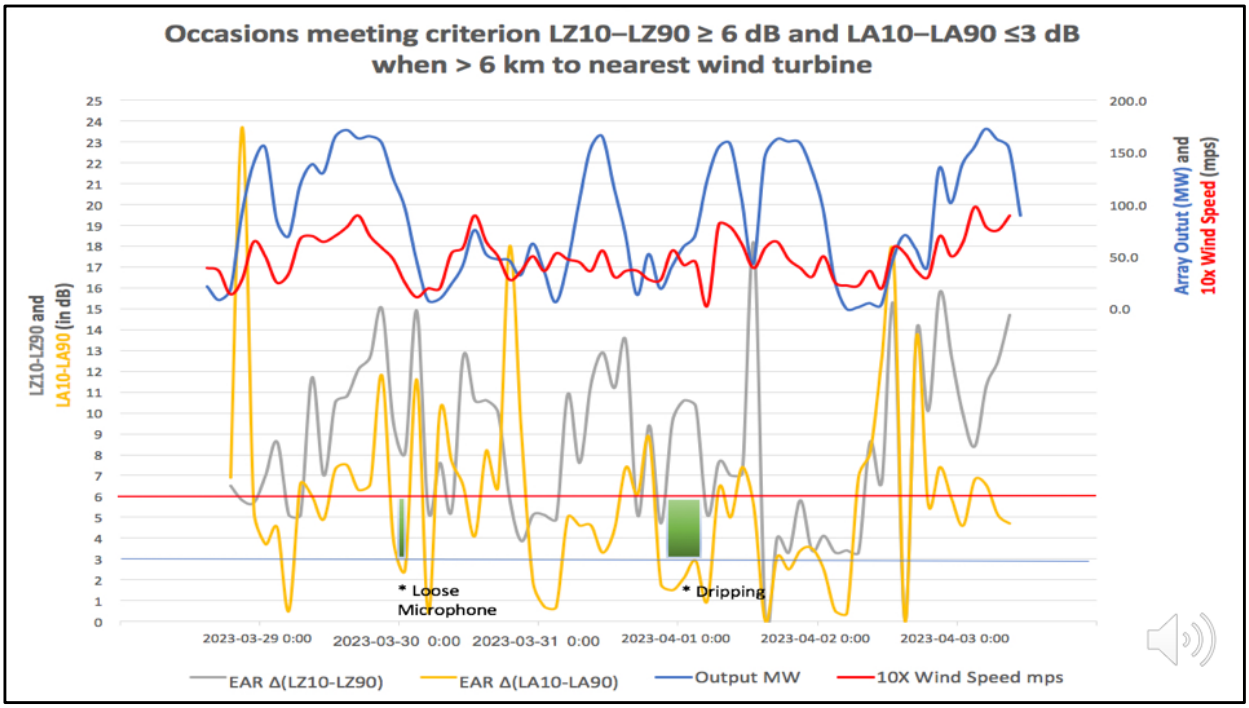
This chart shows the test to see if the proposed hypothesis was met during a week from measurements taken at the site ~ 537m from the nearest wind turbine.

The top of the chart shows the wind turbine array output in blue on a scale from 0 to 200 MW. The top also shows the wind speed in red measured at the nearest Environment Canada monitoring station, recorded as 10 x the actual wind speed to match the chart scale from 0 to 200 metres per second, so the actual wind speed shown is from about 0 to 10 metres per second. As expected, the turbine output tracks the wind speeds up and down quite closely. (Wind shear is not as significant a factor this early in the spring as it is in the summer).

The bottom of the chart shows in grey the difference between LZ10 – LZ90, as it ranged from near zero to near 18 dB. In yellow we see the difference between LA10 – LA90 as it varied from near zero to about 13 dB for this week.

The flat red line at 6 dB on the chart shows the minimum value for LZ10-LZ90 to meet the criterion limit of being ≥ 6 dB, while the flat blue line at 3 dB shows the maximum value for LA10-LA90 to meet the criterion of being ≤ 3dB.

The Green shaded areas shows the times when the criterion LZ10-LZ90 ≥ 6dB and LA10-LA90 ≤ 3 dB was met. While the first case on the left, and the last case on the right show this occurring when the turbine output and wind speeds were high, in the majority of the cases, the criterion was met when the turbine output was less than 50 MW and the wind speed was not at it's highest values.



In contrast, this chart shows the conditions for the hypothesis test at the site > 6 km to the nearest wind turbines for the same week.. The blue turbine output and red wind speeds are identical to the last chart.

However, in this chart, the higher wind speeds generally accompany higher values of LA10-LA90. In this case the distant wind turbines are not raising the LA90 values as they did near the wind turbines. As a result, here we see a higher difference between LA10-LA90, thus failing the criterion test.

Only 2 examples appear to meet the criterion of LZ10-LZ90 ≥ 6 dB while LA10-LA90 ≤ 3 dB. However, on doing a listening test, it was clear that these situations were due to an increase in LZ10 due to either rain drops “drumming” on the microphone protective cover, or a loose microphone rattling in the secondary wind screen. Neither of the conditions were due to the wind, or wind turbines.

Summarizing 136 hours of data near & far

~ 537 m from nearest wind turbine

- 4 wind turbines within 1 km, 19 within 3 km
- 35 hours meet criterion
- Listening confirms all 35 meeting the criterion show a cyclical acoustic signature

> 6 km from nearest wind turbine (same array)

- 5 hours seem to meet criterion, but listening test reveals:
  - 3 due to water dripping on microphone,
  - 2 due to loose microphone rattling in the wind screen,
- Thus 0 hours meet criterion

Summarizing, the 136 hours of simultaneous recordings near and far from the wind turbines, showed the following:

537m from the wind turbines, 35 hours (about 26% of the cases) meet the criterion, and listening tests confirmed all these samples demonstrated the cyclical acoustic signature.

> 6 km from the wind turbines, none of the cases truly meet the criterion, but were only due to artifacts of a loose microphone or rain drops drumming on the microphone protective cover.

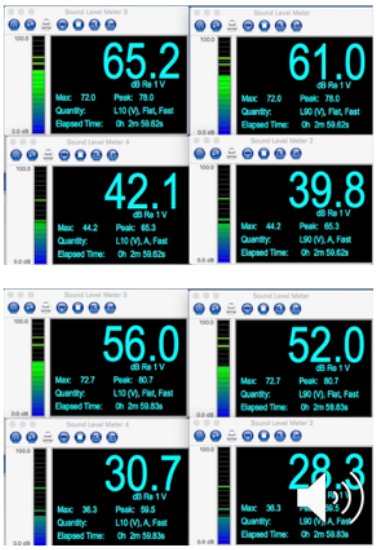
One limitation of criterion – some high power cases

Case 1: (2 turbines in 1 km, 16 in 3 km)

- Before shutdown
  - Turbines 60% output
  - Wind 5 mps
  - LZ10-LZ90 = 4.4 dB
  - LA10-LA90 = 3.7 dB
- After shutdown
  - Turbines 0%
  - Wind 5 mps
  - LZ10-LZ90 = 4.6 dB
  - LA10-LA90 = 1.5 dB
  - Note ~10 dB drop in dBA values

Case 2: (6 turbines in 1 km, 13 in 3 km)

- Before shutdown
  - Turbines 60% output
  - Wind 5 mps
  - LZ10-LZ90 = 4.2 dB
  - LA10-LA90 = 2.3 dB
- After shutdown
  - Turbines 0%
  - Wind 5 mps
  - LZ10-LZ90 = 4.0 dB
  - LA10-LA90 = 2.4 dB
  - Note ~11 dB drop in dBA values



However, it became clear that the criterion was not predicting annoyance during some conditions we expected it might. We found it tended to under-predict expected annoyance for some situations.

This page gives examples recorded at two sites shortly before and shortly after the wind turbine array was shutdown from high power due to excess generation on the electrical system.

In this case, the wind turbine array output dropped from > 60% to zero on the shutdown. Wind speed did not change appreciably between recording of the acoustic conditions with wind turbines operating to the conditions with the wind turbines shutdown. You can note the drop in each parameter of a bit less than 10 dB in the dBZ values, and a bit over 10 dB in the dBA values,

However, neither case 1, nor case 2 predicted annoyance using the criterion.

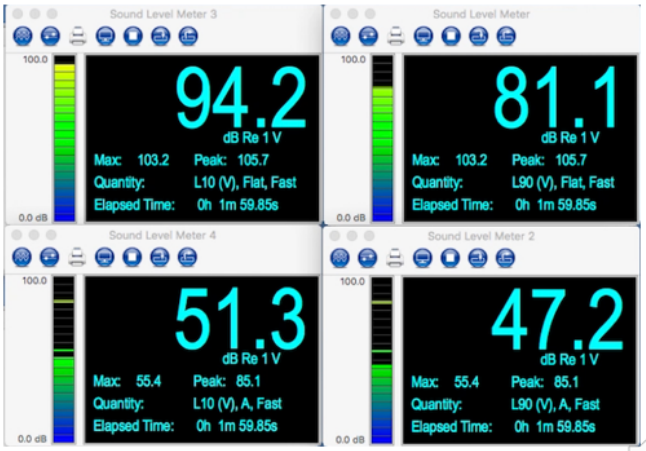
A further limitation of criterion – high winds

Example:
Site ~ 537m from nearest turbine, 19 within 3 km

- Wind speed ~ 6.7 mps
- Turbine output 157 MW

LZ10-LZ90 = 13.1 dB
LA10-LA90 = 4.1 dB

Higher winds tend to prevent triggering the criterion.



This slide shows a second condition that prevented the criterion from being met.

It was found that high wind speeds tended to drive up all sound levels, and prevent the criterion from being met.

Summarizing 236 recent hours of recordings

- 19 hours met criterion for the 126 hours when turbine output > 50%
- 23 hours met criterion for the 110 hours when turbine output < 50% (but above zero)
- Hence ~ 18% of operating hours met the annoyance criterion
- However, this matched annoyances reported, in that annoyances tend to be reported when turbines are most intrusive (or dominating)

When we summarize the most recent 236 hours of recordings made at the home ~ 500 metres from the nearest wind turbine, we find that 19 hours met the criterion during the 126 hours when the turbine output was > 50%. During the 110 hours when the turbine output was < 50%, 23 of the hours met the criterion.

Hence, about 18% of the operating hours met the annoyance criterion.

However, the conditions present for annoyances flagged by the criterion, tended to match the annoyances over time by the residents. It suggested that annoyances tend to be reported when turbines are most intrusive, or dominating.

Conclusions

- The annoyance criterion LZ10-LZ90 ≥ 6 dB while LA10-LA90 ≤ 3 dB is not perfect at predicting annoyance in all cases.
- It tends to under-predict annoyance during high wind speeds, or high power situations.
- However, it tends to match actual annoyance reports, by detecting situations when wind turbines dominate the environment.
- While it does not replace criteria for assessing LAeq, tonality, or accurate measurements of amplitude modulation, it is quick to assess, and is useful for screening to predict annoyance.
- It can be a useful additional tool in the regulatory tool-kit to predict & assess when citizens may be impacted by wind turbine annoyance.

To conclude:

The criterion LZ10-LZ90 ≥ 6 dB and LA10-LA90 ≤ 3 dB is not perfect to flag all expected cases of annoyance.

It tends to under-predict annoyance during high wind speeds, or high power conditions.

However, it tends to match actual annoyance reports, by detecting situations when wind turbines dominate the environment.

While the annoyance criterion does not replace the need for criteria to assess LAeq, tonality, or accurate measurements of amplitude modulation, it is quick to assess, and is useful for screening to predict annoyance.

It can be a useful additional tool in the regulatory tool-kit to predict and assess when citizens may be impacted by wind turbine annoyance.

Last Words

- Like the “sasquatch”, wind turbines matter most when they become a bother.
- The difference is that wind turbines are real.
- This paper provides a better picture of the wind turbine “sasquatch” named “annoyance.”
- Real measurements give a clear prediction for annoyance.
- There is a real basis for annoyance reported from wind turbines.
- Thanks for listening.

Like the "sasquatch" wind turbines matter most when the become a bother.

The difference is that wind turbines are real.

This paper provides a better picture to identify the wind turbine "sasquatch"

It shows evidence that real measurements of readily available data give a clear indication for when annoyance will occur

There is a real basis for annoyance reported from wind turbines.

Thanks for listening. I look forward to your discussion questions.

10th International Conference
on
Wind Turbine Noise
Dublin – 21st to 23rd June 2023

Closing in on the Wind Turbine "Sasquatch" – Whose Name is "Annoyance"

William (Bill) K.G. Palmer P. Eng. trileaem@bmts.com

Summary

A research project under way is described, the objective of which is to determine an objective measure to predict annoyance from wind turbines. Some would state categorically that there is nothing specific in the noise profile of wind turbines to cause annoyance. Claims have declared that wind turbine annoyance is the result of stress, and that stress is the result of misinformation about adverse impacts. Annoyance from wind turbines is perceived like the "Sasquatch", a mythical being, for which there is no actual evidence. Yet, a fraction of credible individuals attest that when near operating wind turbines they are irritated, or annoyed, and suffer adverse impacts. When they separate themselves from wind turbines, or when the wind turbines shut down, the individuals find the adverse conditions diminish. However, when they are again exposed, the conditions reoccur. Over time a sensitivity seems to develop, so that the annoyance and adverse conditions occur with reduced exposure. This research project examines the acoustic, environmental, and wind turbine operational conditions existing when impacted individuals report annoyance. Factors such as wind turbine visibility, wind speed and direction, as well as the noise resulting from ambient winds are also considered. The project seeks to determine if the annoyance could be arising independent of the wind turbine noise profile, or from misinformation. Insights arising from the research are discussed, as the project circles closer, and closer, to substantiate a verifiable measure of the character of the wind turbine "Sasquatch."

1. Introduction

The proceedings of the Wind Turbine Noise Conferences indicate that the subject of annoyance from wind turbine noise has not gone away. While the number of papers has gone up and then down, the number of mentions of the word "annoyance" continued to rise.

Conference	# of Papers	# of Mentions "annoyance"
WTN 2005	29	78
WTN 2013	72	406
WTN 2021	40	438

Table 1 – Mentions of "Annoyance" at International Wind Turbine Noise Conferences

The word commonly found used with "annoyance" is "subjective." The challenge this presents is that "subjectivity" is in the mind of the beholder. We are told, the only way to make a fair "subjective" assessment is to assemble an impartial panel of observers, commonly called a "jury." Yet, even in a court of law, this presents challenges. Lawyers make their arguments as to whether potential jurors are representative "peers" for their client or the community, or if they should be rejected as having an ingrained bias. Anyone who has been called as part of the pool of potential jurors for a court case can speak to the mystery of determining "a panel of your peers." There are many tests reported in the wind turbine noise literature, where panels of observers are assembled, to listen to recordings of wind turbine noise and make an assessment of "annoyance." However, any subjective test is open to challenge. Were the test subjects really peers? Were the conditions or setting the same as experienced by residents reporting impact? Were the tests sustained for days on end? In reports of community observations, questions might be asked such as were the turbine parameters (output, size, height, number, and separation distance) representative? Subjective assessments such as, "I am annoyed by the noise from wind turbines," are often countered by, "You do not like wind turbines because you are jealous that your neighbours profit, while you don't." There must be a better way to demonstrate respect for each other. Sitting down with, and really listening to those reporting concerns is a beginning place.

Clearly, an "objective" measure of annoyance, that is not dependent on a representative jury exposed in a similar setting, sustained for a similar duration would be preferred. There are objective measures for measuring noise, most commonly perhaps by A-weighted sound level. However, even when these measures are modified in various ways such as Leq, or Lden, they are still challenged by other sound in the environment from wind, human activity, wildlife, or the special qualities of sound to be able to measure annoyance. This paper gives an overview of am approach to find an objective measure for the annoyance from wind turbine sound.

2. Listening to those Impacted

Listening to real people pour out their heart raises concerns about the ethical principles of doing so. Will their confidentiality be assured? Will they remain anonymous? (Unless they specifically gave permission to share their specific details, as some did.) Can they be assured that the listener will not substitute the interviewer's opinions or biases, in place of those of the one being listened to? University studies, the Code of Ethics of Professional Engineers Ontario, the Institute of Noise Control Engineers, and the Acoustical Society of America, have specific requirements regarding ethical practices, with regard to conducting surveys of the public. For clarity, the information reported in this paper are not the result of a formal survey, in which informants are asked to give formal informed consent, to whom specific questions were asked. Instead, they were the result of informal conversations, in which the participants volunteered information casually, or of their presentations before public forums. Often, this information was predicated by a statement such as, "you are involved in wind turbine noise, isn't there something you can do?" At no point were the participants offered benefit, or harm from providing or withholding information, and ethical principles of regarding the duty to public welfare were held paramount in including comments in this paper.

Those who volunteered information were not considered to be expressing an attitude of disdain for care of the environment. A tutorial presented by George A. Luz, PhD titled, "Some People are More Noise Sensitive than Others" presented at the 161th Meeting of the Acoustical Society of America in Seattle, WA, in May 2011 comes to mind. Luz noted that, "The most outstanding impression of those people who were noise sensitive was that they were typically friendly, generous and sociable and very much aware of their environment." If a common perception might be summarized, it was that the informants expressed hurt. They had honestly reported their concerns and impacts to those considered to be responsible to act, but their reports had been dismissed or not acted on.

Many of that volunteered information did so publicly in deputations before the members of the Multi Municipal Wind Turbine Working Group. (MMWTWG). This working group is formally constituted

under the regulations of the Ontario Municipal Act, with public meetings, and public record of meeting minutes. The Working Group is composed of elected representatives from Municipal Councils and a citizen appointee from member councils, from a number of Municipalities in the Province of Ontario concerned about the impact of wind turbines on citizens.

2.1 Summarizing Issues Raised (not necessarily attributed to wind turbines, but by those living in the environment of multiple wind turbines within less than 1 km)

- Some reported change in behaviour of domesticated animals (such as horses, goats, dogs or cattle) after the commencement of operation of wind turbines in their environment. Presumably these animals had no attitude of jealousy, or miss-information.
    - One man reported on a specific change in behaviour of ponies, trained to draw a cart. The man showed me the stable previously housing his cart ponies. After the wind turbines had started up, the ponies which had been stabled fine before, had kicked holes in the walls in the stable. He noted that after the wind turbine start-up he would sometimes visit the stable to find the ponies "all lathered up" as if they had been out for a run, even though they were only standing in the stable. On another occasion, the ponies, while harnessed to their cart had suddenly bolted, and run through a wire fence, cutting themselves up. He noted that after this event, he had given the ponies away to relocate them away from the wind turbines, and they had reverted to their previously docile behaviour.
    - The same man reported on changes in behaviour of the family dog, to not want out, as it had previously. Others reported in change in behaviour of their family pet dogs as well.
    - Another family reported changes in behaviour of goats, and another in changes in behaviour of a dairy herd, requiring the family to relocate.
- The same man who had reported the change in behaviour of his ponies reported changes in his personal health, including a bleed (a stroke was how he described it) in an eye. He reported that his wife, who was away from the house most of the day, at work, experienced no adverse effects. Anecdotally he reported adverse impacts occurring in several neighbours, which were not followed up on. They left the home.
- Another gentleman reported difficulty in sleeping after the wind turbine started up. His family physician had prescribed sleeping tablets. He noted that when away from home on vacation, the "slept like a baby" but on return home, again his sleep deprivation recurred. He also reported balance instability. His wife was not impacted. They moved from the environment, and the condition disappeared, although the gentleman passed away shortly after. Sleep deprivation was reported by a number of others, again, a condition which disappeared when away from home, but returning when back at home. As before, not all family members appeared to be impacted.
- Digestive issues, or nausea, were reported by some.
- Headaches were a common report, for the one reporting, or for other family members.
- Some reported changes in control of diabetes, or changes in control of blood pressure, or other cardio-vascular issues, with some requiring relocation to address the issue.
- Tinnitus or sensations of vibration transmitted into homes were reported by some.
- Some addressed the necessity to change work schedules, to relocate residence, or to retire prematurely from work due to difficulty in sleeping, due to concerns of work errors, or due to health deterioration.
- Some identified specific issue with tonality of the sound, reporting a rising and falling "wooing".
- Specific changes in sound during conditions of freezing rain or hot, still summer nights were reported by a number of people, using terms such as, "pounding" intensity.

- Some reported being able to perceive if nearby wind turbines were operating or not on awakening, even without viewing the turbines, or hearing specific sounds.

2.2 Investigation of Issues Raised

- While it was not possible by the author to do a detailed investigation of each issue raised, for a period of over 15 years, the author has conducted investigations and collected acoustic data at over 20 sites in over 8 different wind power developments, with at least 4 different wind turbine types (Vestas V80, Vestas V82, Enercon E82, and Siemens SWT 2.3 – 101) and at a number of sites at least 5 km distant from wind turbines. The level of detail collected in each investigation has increased over the 15-year period.
    - Initially the information collected was a simple record of 1 minute duration readings at the sites using calibrated A-weighted and C-weighted sound level meter readings and wind speed monitoring at 1.5 metres above ground level, along with the associated wind power development output level and the nearest Environment Canada weather station information.
    - By 2010, the data collected progressed to 1 to 2 minute recordings of the sound pressure level from a calibrated Knowles BL-21994 microphone with a 60-mm primary and 300 mm secondary wind screen. All those recordings are on file.
    - By 2013, data collection progressed to making recordings of the sound pressure level using a calibrated Earthworks M30-BX microphone with a flat frequency response from 9 Hz to 30 kHz (although measured to be flat lower then 9 Hz) using a 90-mm primary and 450 mm secondary wind screen.
    - From 2017, data collection progressed from intermittent records to a continuous record collected at first one, and then several sites using a “2 channel SAM Scribe” monitoring system that collects and records a continuous string of 10-minute sound samples. The SAM-Scribe was purchased by an Ontario resident to collect data at their home, with assistance in setup and monitoring by the author. Since 2020, the resident has loaned the SAM Scribe system to the author for monitoring at the homes of other impacted residents. Roughly a 5-year continuous record of data is now available from the SAM Scribe system, principally at two different wind power developments, with Siemens SWT-101 and Vestas V82 wind turbines, as well as some recordings distant from the wind turbines.
    - Additional data has been collected from time to time to verify the data collected by the SAM Scribe using an ACO Pacific system. This system uses an IEC 61094-4 (Measurement Microphone) compliant 7046 free-field microphone and a 4012 pre-amplifier. The pair have a rated frequency response ±2 dB from 2 Hz to 20 kHz. Additionally, data has been collected using the Earthworks M30BX microphone, and using a pair of Superlux ECM-999 measurement microphones.
    - A further source of data has been recordings performed at sites using an external MOVO omnidirectional Measurement Microphone (rated as flat from 35 Hz to 18 kHz) protected with a primary “muff” type windscreen, used in a protected location away from direct wind exposure, as an external microphone on an iPhone. While not initially thought of as an acoustical monitoring device, performance of the pair give remarkable results. They permit recording a calibration signal from a 94-dB calibrator, and provide a simple method for recording a simultaneous video and calibrated audio file that can be easily transmitted for later analysis.
- Analysis of the collected acoustical data from the various methods has been conducted using the Faber Acoustics application Electroacoustics Toolbox version 3.9.10 on a 3.6 GHz intel Core i5 iMac computer system running macOS 10.13.6.

3. Progression to determine an objective measure for annoyance

Listening to those impacted suggested that annoyance might arise from a number of different pathways. Initially, to determine if a common parameter might be identified, analysis focused on the times identified by the residents at the monitoring sites as annoying, or irritating, to the regulator, the Ontario Ministry of the Environment. While residents do not identify every situation considered as annoying, they do log sample times they consider as typical examples. Recording is by phone to a Ministry "Spills Line" and generally includes a brief description of the condition, the local environmental conditions, and a "rating" of annoyance from 1-10 as requested by the Ministry contact person, although there are no specific criteria for this rating. Progression from analysis of these "annoyance" conditions to a full analysis near and far from wind turbines is described in this section.

3.1 Results of the initial analysis

The key to the analysis technique used on this paper arose from a comment made in discussion at the Wind Turbine Noise Conference in 2021 by Andy McKenzie PhD BSc FIOA, of Hayes McKenzie in the UK. Andy noted that in the UK it was common to use LA90, the A-Weighted sound pressure level exceeded 90% of the time, effectively as the background sound pressure level. This suggested a clue to determine an annoyance measure of the classical signature "swish / or / swoosh" sound variation of a wind turbine.

A simplified display of the cyclical nature of the wind turbine sound might be considered as a sine wave. In reality the situation is considerably more complex. Impacted residents are often impacted by more than one wind turbine. Thus, the composite sound level, while varying cyclically, will be more complex than a simple sine wave.

The difference between the L90 value (the quiet times) and the L10 value (the loud times) gives an assessment of the change in sound level from quiet to loud. While not an exact measure of the value of the "swoosh" it is a simply determined parameter. The parameter gives a readily available measure of cyclical change in sound pressure level near wind turbines. The difference was calculated for both LZ10-LZ90, and for LA10-LA90. These values can be found from modern sound level meters or assessment applications such as the electroacoustics toolbox. The analysis results consistently showed that in the situations identified by the residents as annoying, LZ10 exceeded LZ90 by a value in the order of 6 dB or more, while LA10 was not more than 3 dB higher than LA90. Hence, an initial assessment of an objective measure to signify annoyance was LZ10-LZ90 > 6 dB, while LZ10-LA90 was less than 3 dB.

Figure 1 shows a display of the electroacoustic toolbox sound level meters for LZ10, LZ90, LA10 and LA90. These are for a 2-minute recording sample at a site with 4-Vestas V82 wind turbines within 1000 metres. The 181.5 MW array of 110 wind turbines generated 129 MWh for the hour of the sound sample, The Environment Canada average wind speed for the same hour at the nearest monitoring site was 6.9 metres per second. The display shows the difference between LZ10 and LZ90 to be greater than 10 dB, while the difference between LA10 and LA90 was less than 3 dB. A factor not seen in the static figures, but will be shown in the conference presentation, is how the lower frequency 1/3 octaves "dance" up and down, while the higher frequency 1/3 octaves change little.

Listening to such examples, as will be demonstrated in the conference presentation, shows that such a case clearly portrays the "swoosh." However, in cases where the LA10 exceeds LA90 significantly, (as for example if there is a lot of traffic noise, or bird cries) then the wind turbine "swoosh" is less apparent, and is less likely to be identified as annoying. Similarly, it was found that if the turbines were shutdown then the LZ10-LZ90 was reduced, and again the situation was perceived as less annoying. Thus, the 6dB minimum for LZ10-LZ90, and a 3dB maximum for LA10-LA90 seemed to be reasonable criteria for further analysis.

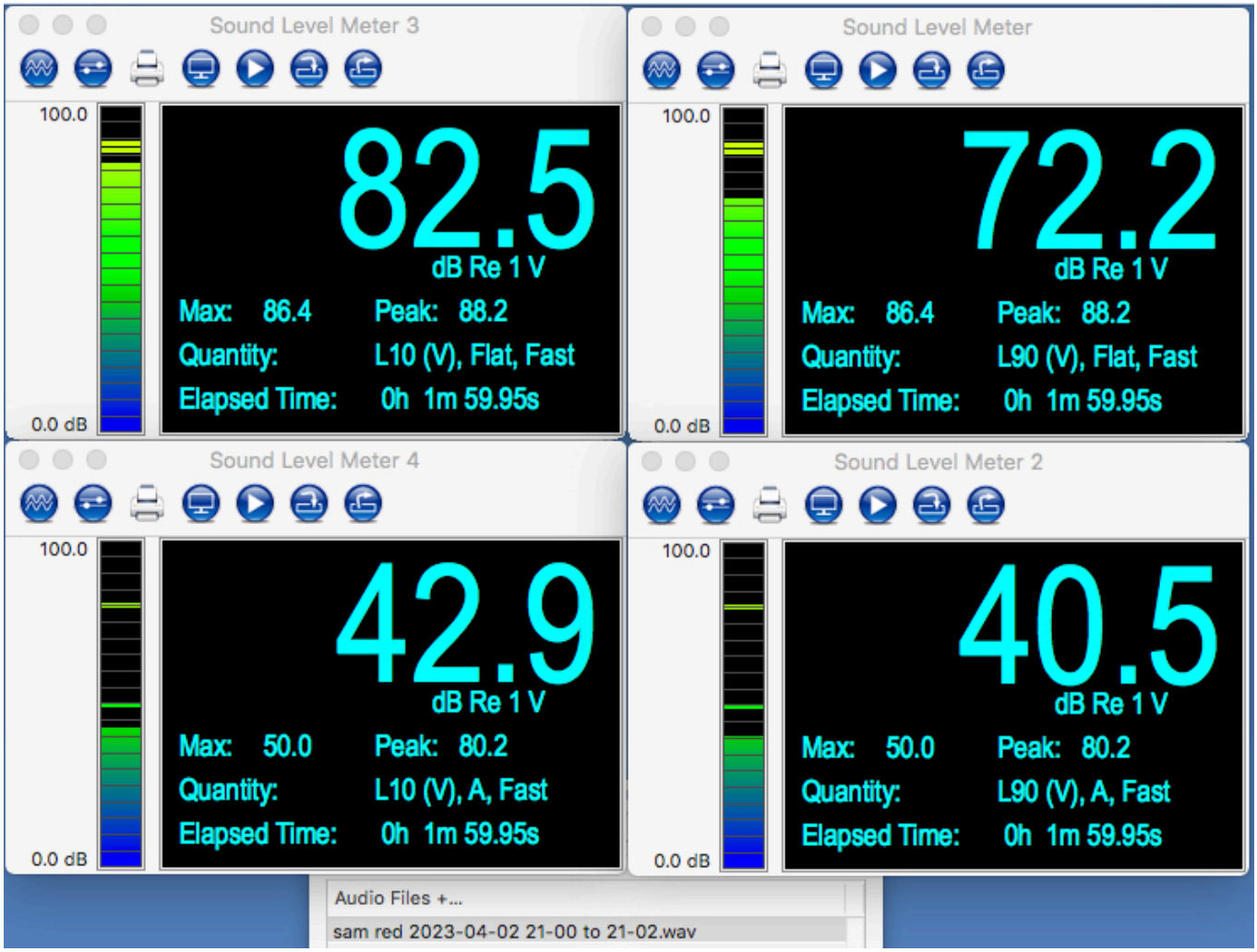


Figure 1 – A typical case perceived as annoying (electroacoustic toolbox LZx and LAx results)

3.2 Verification of the initial analysis as a measure of a wind turbine parameter

To verify that the measurement was not simply a measurement of wind noise, a simultaneous set of recordings were taken at a site > 6 km distant from the nearest wind turbine. This is considered as the "remote site" if further discussion. Turbines at the monitoring site are within view from remote site. The remote site also has on site wind speed and direction monitoring which show close correlation to the nearest Environment Canada monitoring location. The results at the remote site are shown in Figure 2. At this remote site, LZ10 was the same as LZ90 close to the wind turbines, and LA10 was within 1 dB of LZ90 at the site close to the turbines. LZ10-LZ90 was somewhat higher at 14.8 dB, and LA10-LA90 was also higher at 7.3 dB. Five 2-minute data samples in the 10 minutes prior to and after the presented data for both the wind turbine site and the remote site were calculated. The five samples were similar, although particularly intense gusts in the last sample near the wind turbines would have placed it outside the criteria for being considered as annoying.

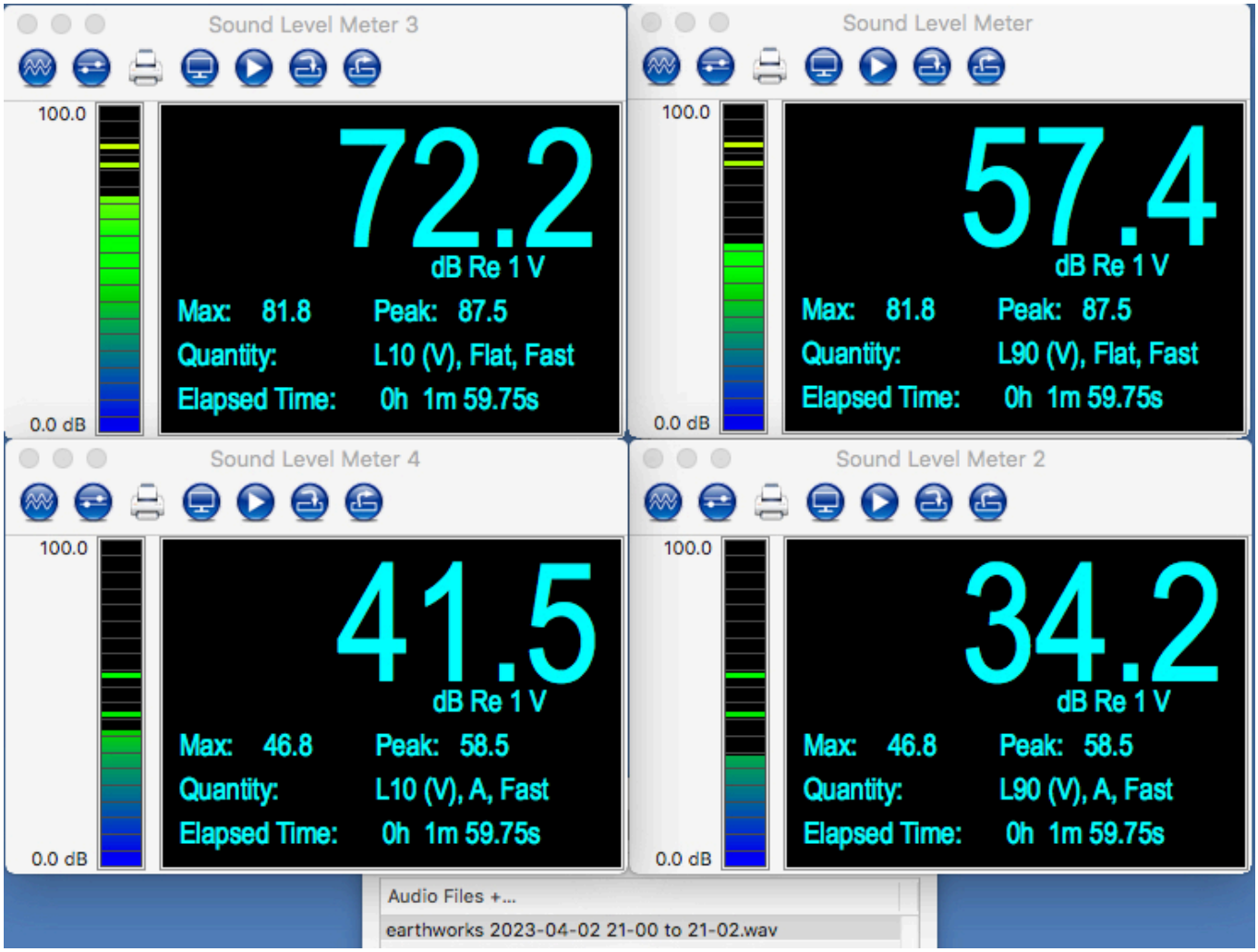


Figure 2 – Analysis of data recorded at same time as in Figure 1, remote from wind turbines

Date 2023-04-02 Time as Shown	Near Wind Turbines		Remote from Wind Turbines	
	LZ10-LZ90 (dB)	LA10-LA90 (dB)	LZ10-LZ90 (dB)	LA10-LA90 (dB)
20-50 to 20-52	7.6	2.1	13.1	6.4
20-55 to 20-57	8.5	2.1	9.4	3.2
21-00 to 21-02	10.3	2.4	14.8	7.3
21-05 to 21-07	9.7	2.9	14.0	4.3
21-10 to 21-12	14.7	5.4	10.5	4.5

Table 2 – Five samples near and remote from wind turbines in period of Figures 1 and 2

3.3 Further analysis underway to verify annoyance criteria

Ongoing analysis continues to verify the criteria indicating conditions consistent with a judgement by residents of annoying conditions. Simultaneous data collection at a site near wind turbines and remote from wind turbines continues. Analysis of over 100 hours of data continues to confirm that the criteria of LZ10-LZ90 > 6 dB and LA10-LA90 < 3 dB only present themselves remote from wind turbines rarely (at a frequency of about 7 times per 100 cases), This has been detected only during conditions of heavy rain, particularly when water droplets are falling from the secondary windscreen to hit the protection at the top of the primary windscreen. The microphone records this similar to a “drum thump”, and are not representative of actual conditions. Ontario regulations as an example do not permit collection of wind turbine noise samples during precipitation, and these are only a subset of those conditions.

Near the wind turbines, conditions meeting the criteria of LZ10-LZ90 > 6 dB and LA10-LA90 < 3 dB occur quite frequently. The frequency of this condition being met had been approximately 20 times per 100 cases. This criteria has been tested against previous cases identified to the Ministry of the Environment by residents as annoying with high correlation.

Data collected in the past at various wind turbine locations is being tested against the criteria. The criteria are showing that it has good potential for use as a screening technique. The technique provides a measurable assessment criteria, independent of subjective assessment.

4. Conclusions

Work underway is getting closer to presenting a formal paper demonstrating a measurable criteria to match subjective assessments of annoyance. The criteria shown to be effective is:

LZ10-LZ90 > 6 dB and LA10-LA90 < 3 dB

This is important as it reduces the need to assemble, and expose, a representative panel of "peers" of noise sensitive persons to assess annoyance. It also demonstrates respect for complaints filed by individuals of adverse impacts when exposed to wind turbines for sustained periods. A criteria to assess, and thus enable prevention of adverse impacts is particularly important due to planned expansion of wind turbine to meet rising electricity needs. Work has shown that the criteria responds well to the conditions near wind turbines, while being largely independent of wind noise. Work to date has shown that the criteria can provide a useful screening tool. Further development is ongoing to help remove the necessity for a listening test to address outside influences. To date a listening test is needed to differentiate influences such as road traffic, aircraft, and spurious noise arising from rain droplets penetrating the microphone windscreen, or windscreen "bumping" during gusts.

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Lessons Learned at 10th Wind Turbine Noise Conference Dublin, Ireland, June 2023 & related updates

Prepared for the Multi Municipal Energy Working Group

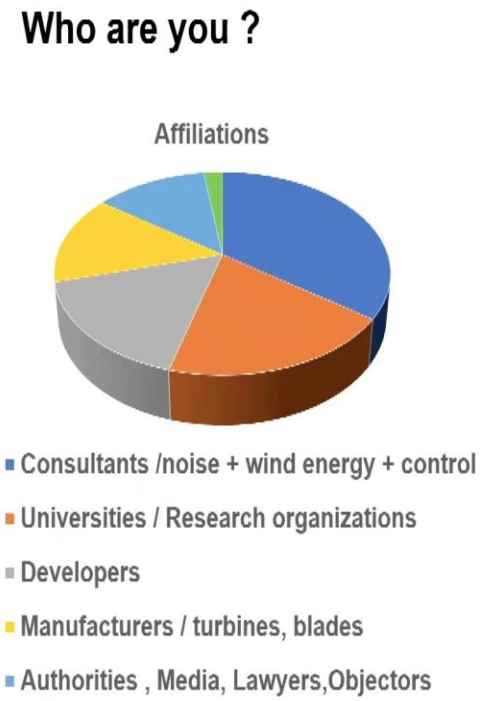
By William Palmer, P. Eng.

For presentation Sept 21, 2023

palmer.b@bmts.com

Overview – 10th International Wind Turbine Noise Conference (my 8th participation at WTN Conferences)

- 125 delegates attending at Trinity Business School, Trinity College Dublin Ireland, joined 30 attending remotely, in June 2023



44 Papers Presented at WTN 2023

(vs. 40 papers presented remotely in 2021, or 114 in person in 2015)

- Propagation (mostly about model development for sound travelling from the wind turbine to receptors) – 7 papers in a split session
- Mode Management (methods and the impact of reduction of turbine speed and output to reduce noise, when necessary to meet regulatory limits) – 3 papers
- Guidelines and Regulations – 5 papers
- Source Noise (mostly about models to predict the noise at the source, - the wind turbine) – 7 papers in a split session
- Impact on People – 8 papers in a split session (Including mine, presented remotely)
- Compliance (mostly about monitoring campaigns) – 4 papers
- Miscellany – Including Amplitude Modulation – 5 papers
- Tonal Noise – 5 papers

Key Learnings from WTN 2023

1. Forum – Wind Turbine Noise Reduction – Beyond Serrations
   - 4 panelists representing industry (Vestas, GE, Enercon, LM Blades)
     - Blades have to meet many needs, noise is only one, so pure noise optimization will never happen.
     - See no significant changes over next 10 years, as changes to reduce noise would increase blade complexity, increase risk of failure
     - Focus has been to reduce A-Weighted sound power by serrations, brushes, etc., on outer part of blades - perhaps need to consider larger inner parts of blades to reduce lower frequency sound reaching neighbours.
     - Industry agrees, may not be dealing with the real problem of what bothers neighbours, but are doing what regulators ask (to reduce A-Weighted “sound power”)
     - “angle of attack” changes as turbines rotate, changes sound profile around rotation
     - Could do better to reduce annoyance, but need to convince regulators to change focus.

Key Learnings from WTN 2023 – continued (2)

2. Tonal Reduction – Might be possible through tuned dampers
   - Several presentations focused on tonality in wind turbines, and how it might be reduced through modification of the turbine coupling & gearbox systems, or the addition of dampers.
   - Correspondence with the authors since the conference gave some hope that those experiencing tonality from Siemens turbines at K2 and Armow might benefit from modifications, but the suppliers are cautious to make any predictions. Further follow up with K2 and the Ministry is possible, but not done yet.

Key Learnings from WTN 2023 – continued (3)

3. Follow the money to find the problems
   - While not a specific paper topic, this theme was just below the surface in most
   - An obvious example arose in a presentation about WTN standards in Chile
     - Citizens, who will experience the turbines 24/7 – 365 days a year will have protection at a level of either background plus 10 dBA, or 65 dBA in the daytime and 50 dBA at night .
     - Tourists, who will experience the turbine noise only for the duration of their visit, will experience a level to not exceed background (10 dB less than citizens). Is this fair?
     - But, sending tourists away would cost money.
   - Similarly in many other presentations, action is based on profit.
     - If no money will be earned, then no action occurs.

Key Learnings from WTN 2023 – continued (4)

4. Worldwide, standards are softening to allow more turbines
   - International Energy Agency requires more wind power developments to meet the carbon limits set by the Paris 2015 Climate Change Conference.
   - Paper from the Netherlands noted all their national wind turbine regulations have been dropped, and they are reconsidering all setback limits.
   - Example, Poland has reduced limits from 10x height setback (perhaps 2400 metres), to 700 metres, regardless of turbine size. Required of Poland by the EU, “to receive European funds under the national recovery plan.”
   - State of Bavaria (Germany) reducing setbacks from 10X height to 800m in “wind priority areas” to “catch up in the production of wind energy.”
   - Other nations were noted as having limits of 4x height. The main criteria for setback was noted to be “to prevent visual nuisance”, or “visually overwhelming effects.”

Key Learnings from WTN 2023 – continued (5)

5. Population Effect vs. Individual Effect

- Regulators appear to be more interested in *possible* overall population effect, than in *known* impact on the fewer people living near turbines.
- Example – following 3 presentations on "mode management" to optimize output while meeting sound limitations, David Michaud of Health Canada stated,
  - *"It seems very strange to me that you'd want to use modes to reduce the power output in the first place. Because, presumably you want to offset fossil fuels burned with clean energy, and by reducing the mode … you increase the percent required from fossil fuel required by the electrical grid … so the net health effect on the population could be worse when you are reducing power output … You are using modes to reduce exposure … presumably because that annoys people that might interfere with sleep … but by reducing sound level you have get power from somewhere else."*
  - He continued, *"why not just … for every minute or hour above the limit, if we distribute some benefit to the community, and leave the turbines alone ?"*
  - The session chair countered, *"David, you will have to give a presentation at some time, and argue that more noise is beneficial to the community."* There was a general chuckle from the audience.

Hopefully, a Key Learning for others came from my paper, re *"developing a measurable objective for wind turbine annoyance"*

- Began noting that annoyance from wind turbines is not going away

WTN Conference	Total # of Papers	# of Mentions of "Annoyance"
WTN 2005	29	78
WTN 2013	72	406
WTN 2021	40	438

- The paper's stated objective was to replace a "subjective" assessment of annoyance with an "objective" (measureable) one.

It began, from listening to hurting people

- They tell us of:
  - Behavioral changes in domesticated animals (horses, cows, goats, etc.)
  - Difficulty in falling asleep or in going back to sleep after awakening – condition goes away if they leave home, yet comes back when they return
  - Digestive issues, nausea
  - Headaches
  - Changes in control of diabetes, or blood pressure regulation
  - Tinnitus
  - Changes work schedules, work life, or residence
  - Specific troubles from freezing rain, or hot, still summer nights

Next, we looked at data already on hand

- Spot measurements taken near, and far, from wind turbines since 2007
- Short duration attended recordings near turbines since 2011
- Two years of continuous acoustic recordings from mid 2018 to mid 2020 at one site ~ 787 m from the nearest wind turbine, and local spot recordings at a second site in the same array
- 9 months of continuous acoustic recordings from a site ~ 537 m from the nearest wind turbines (of a different type) from 2020 through 2023, along with some simultaneous recordings > 6 km from the same wind turbines
- Resident complaint data filed with the Ministry of the Environment at the sites near wind turbines
- Could any link be established between the complaints and the sound?

Data analysis suggested a hypothesis

- Most people will perceive a 3 dB change in dBA value
- Considered cases where the difference between LA90 (considered as background levels) and LA10 (typically the loudest sounds occurring ≤ 10% of the time) is ≤ 3dB as representing those cases that might not readily be perceived
  - Looked for simultaneous cases when the spectrum including low frequency showed LZ10-LZ90 is ≥ 6 dB (two 3 dB changes, potentially more readily perceived)
- There was a good match – between the annoyance complaints and the recorded conditions at the time of the complaint matching those conditions, suggesting a possible hypothesis:

Annoyance can be predicted for LZ10-LZ90 ≥ 6 dB while LA10-LA90 ≤ 3 dB

- Set out to prove this hypothesis.

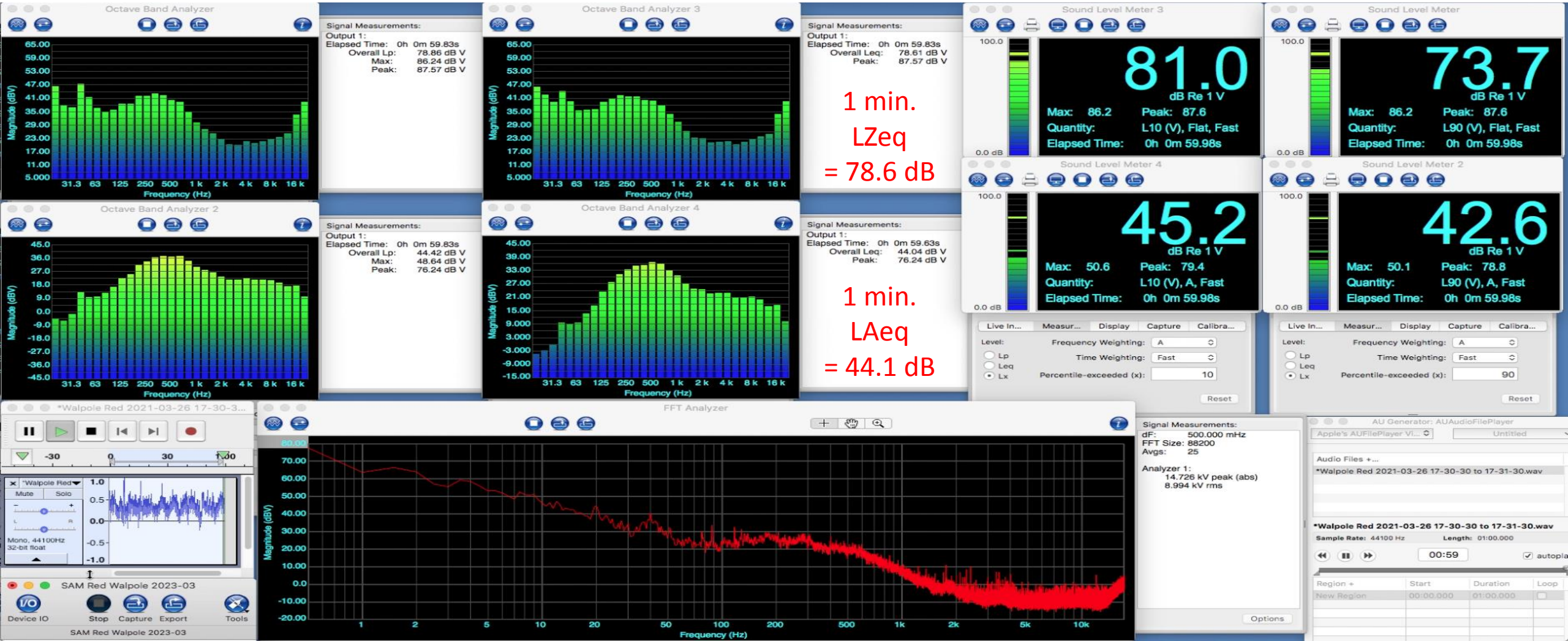
Displayed analysis of an example

(Categorized by resident as annoyance level 7/10)

For this case, analysis showed:

LZ10 (81.0) – LZ90 (73.7) = 7.3 dB

LA10 (45.2) – LA90 (42.6) = 2.6 dB



Tested if the results could just be the wind?

- Closely examined data from times turbines shut down or started up (as wind speeds do not change appreciably over the short transition)
- Also compared data recorded simultaneously at the site ~ 537m from turbines, and at a site > 6 km to the same wind power array
  - same terrain, same proximity to roadways, closely matched environmental conditions (wind, temperature, pressure, humidity, precipitation, etc.)
- Tested analysis microphones against Level 1 IEC 61094-4 compliant microphone
- Extended data set to test at regular 1 or 2 hour intervals, to ensure not only testing complaints, but sampling all conditions
- Looked at months of data

Is it the Turbines? Here is a case of running / shutdown / running

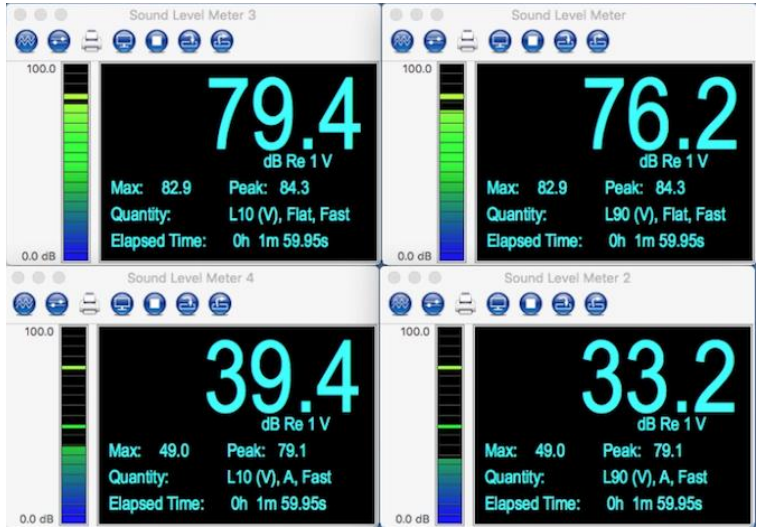
2021-03-25 – An example over 2 hours (turbines at low power) logged at same location

13-38 to 13-40 Turbines Running

LZ10-LZ90 = 83.8-72.5 = 11.3 dB

LA10-LA90 = 43.8 – 40.8 = 3.0 dB

14-10 to 14-12 Turbines Not On



LZ10-LZ90 = 79.4-76.2 = 3.2 dB

LA10-LA90 = 39.4 – 33.2 = 6.2 dB

Note drop in LZ10 & LA90

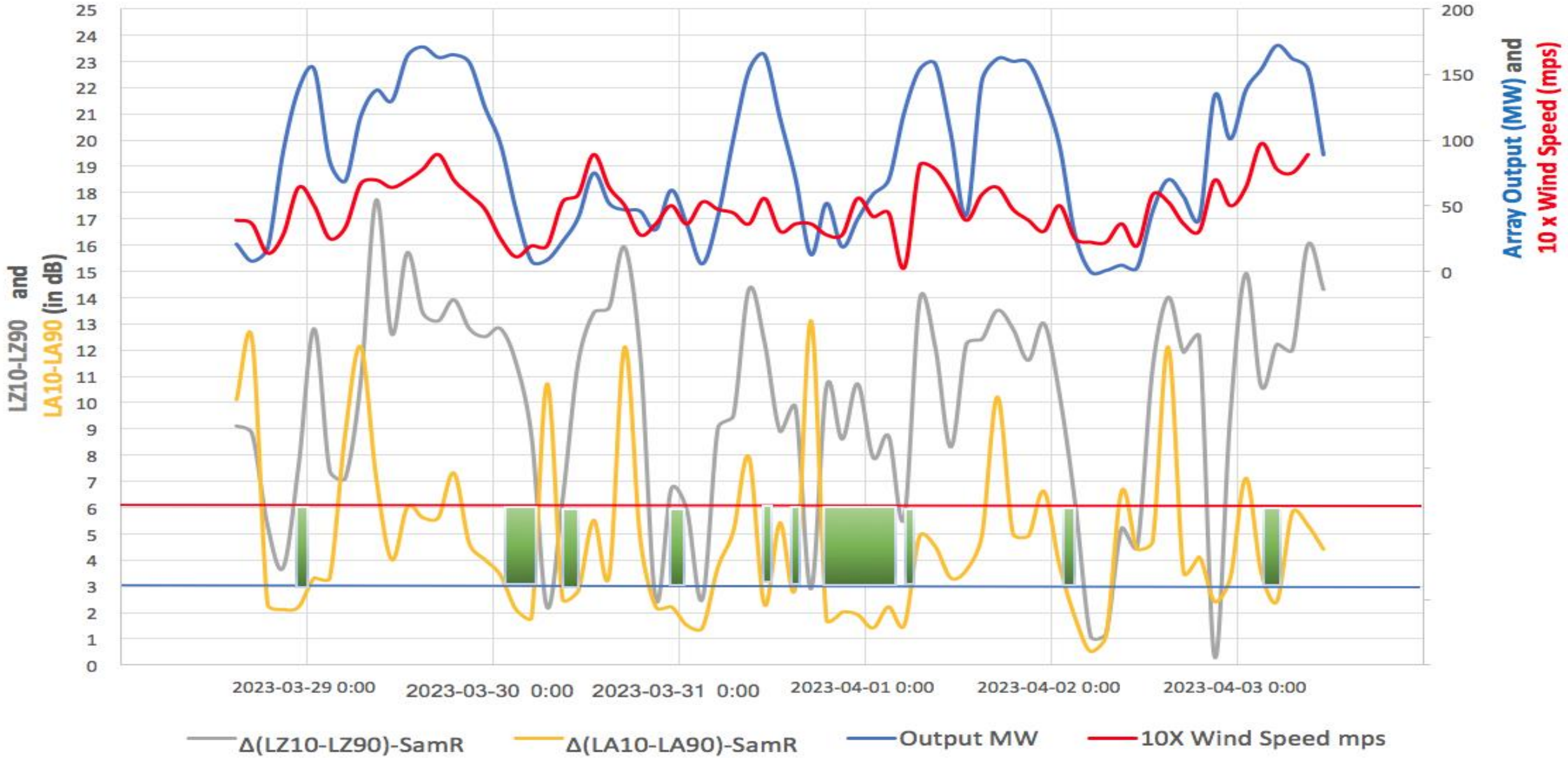
15-55 to 15-56 Turbines Restarted still at very Low Power

LZ10-LZ90 = 82.8 – 73.5 = 9.3 dB

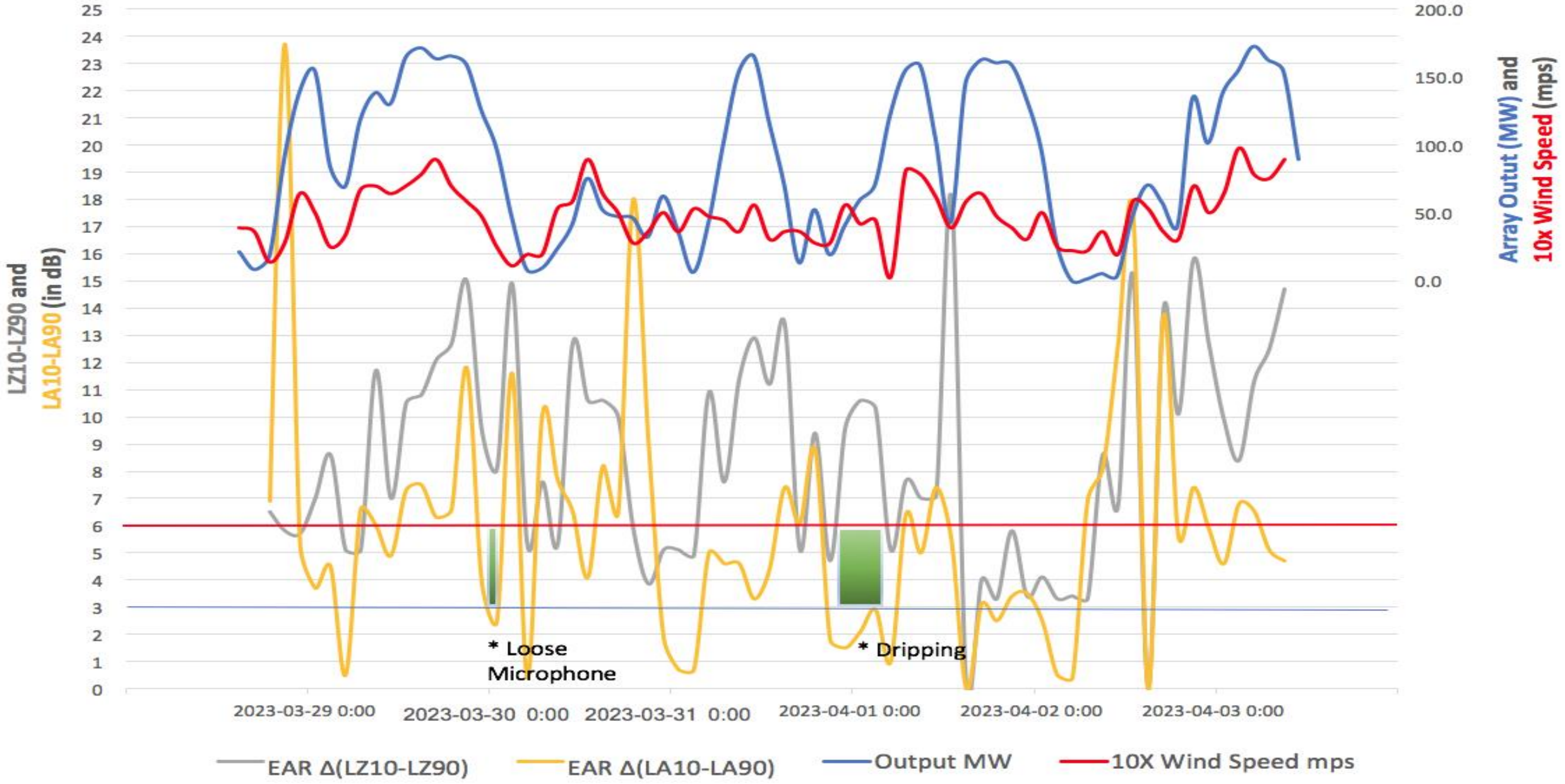
LA10-LA90 = 38.3 – 36.7 = 1.6 dB

LZ10 & LA90 are up again

Occasions meeting criterion LZ10–LZ90 ≥ 6 dB and LA10–LA90 ≤3 dB when ~ 537m from nearest wind turbine



Occasions meeting criterion LZ10–LZ90 ≥ 6 dB and LA10–LA90 ≤3 dB when > 6 km to nearest wind turbine



Conclusions

- The annoyance criterion LZ10-LZ90 ≥ 6 dB while LA10-LA90 ≤ 3 dB tends to match actual annoyance reports, by detecting situations when wind turbines dominate the environment.
- While it does not replace criteria for assessing LAeq, tonality, or accurate measurements of amplitude modulation, it is quick to assess, and is useful for screening to predict annoyance.
- It can be a useful additional tool in the regulatory tool-kit to predict & assess when citizens may be impacted by wind turbine annoyance.
- There is a real basis for annoyance reported from wind turbines.

Other Papers – Already Delivered

- Delivered template to Rep. Carrie Barth, Kansas Legislature at her request, as input for presentation to Shawnee County Planning Commission regarding proposal to increase number of wind turbines in Kansas.
  - Kansas specifics, state population of 2.9 million, has ~ 4000 wind turbines now (8240 MW), supply nearly 50% of their electrical consumption (caution, a lot of this is exported, while coal, nuclear, and gas fill in day to day needs)
  - The usual realities of lower wind output in Jan,Feb / Jul,Aug while high in Mar,Apr, Oct, Nov. resulting in export. Discussed storage not viable for seasonal shift.
  - Discussed public health concerns & setbacks:
    - As general rule, limit total sound emissions received at a residence to < 35 dBA, and < 50 dBZ.
    - A setback of 1 mile (5280 feet, 1610 metres) would limit emissions received at residence to < 35 dBA, and < 50 dBZ for today's turbines if more than 1 turbine possible.
  - Discussed public safety risk and setbacks (used Ontario failure data of 12 failures)
    - Needs safety setback of 400 metres (1/4 mile or 1320 feet) from turbine
    - Ensure any turbines permitted have integral fire protection
    - Consider rights of leaseholder to waive rights for others (vulnerable family, employees, contractors)
  - Discussed storage
    - Remember storage consumes energy, and all energy consumed increases heat in the world (global warming)

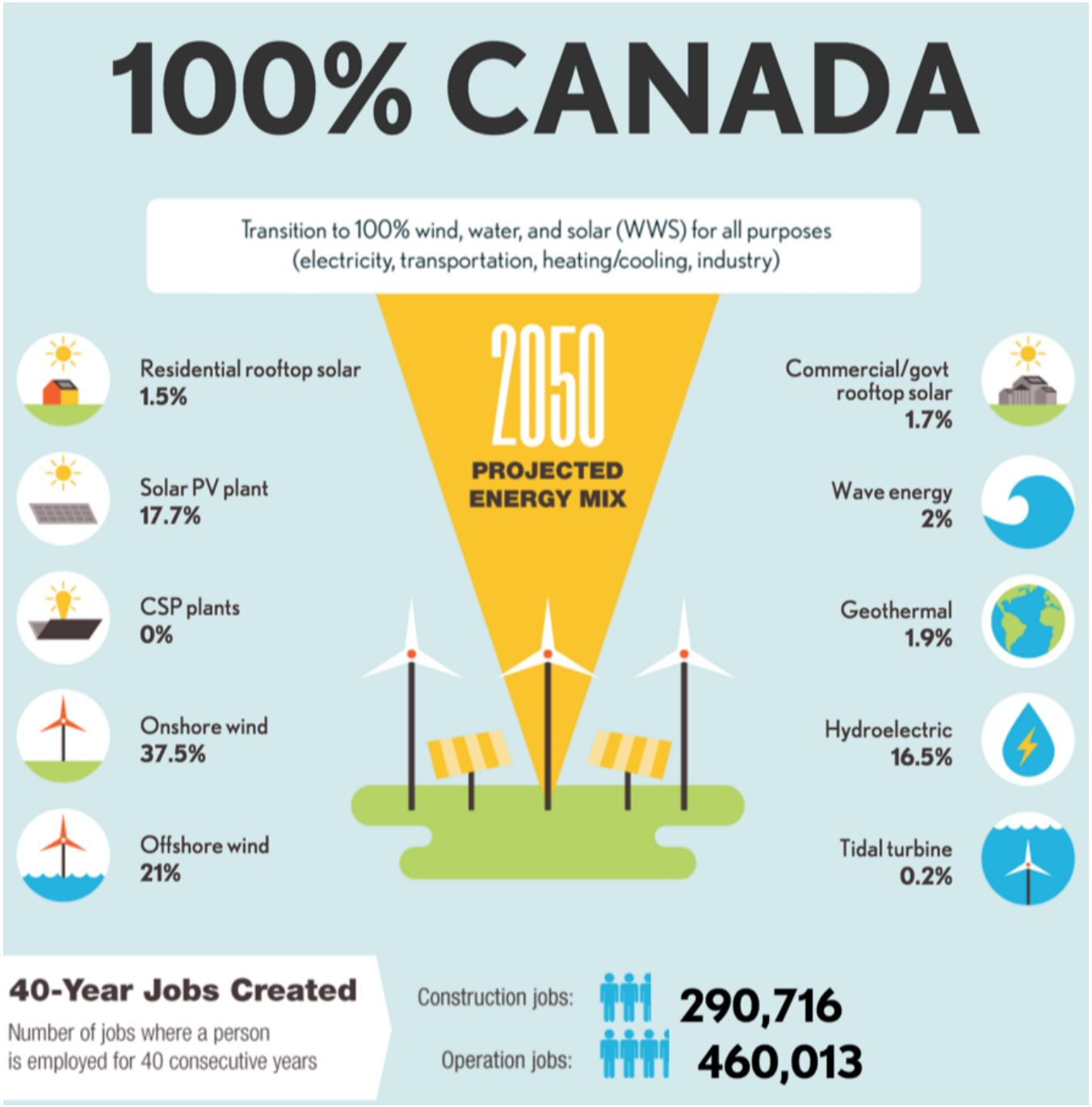
Other Papers – Upcoming - Acoustics

- Acoustics Week in Canada (Canadian Acoustics Association)
  - Montreal Oct. 3-6
  - Paper - **LESSONS LEARNED MONITORING NEAR AND FURTHER FROM WIND TURBINES**
  - Will present follow-up results from paper presented at WTN 2023
  - Data gathered, acoustic, environmental, and wind turbine performance.
  - Resident annoyance level, showing development of screening criterion useful to identify when annoyance will occur
  - To be published in the Journal - Canadian Acoustics (peer reviewed)

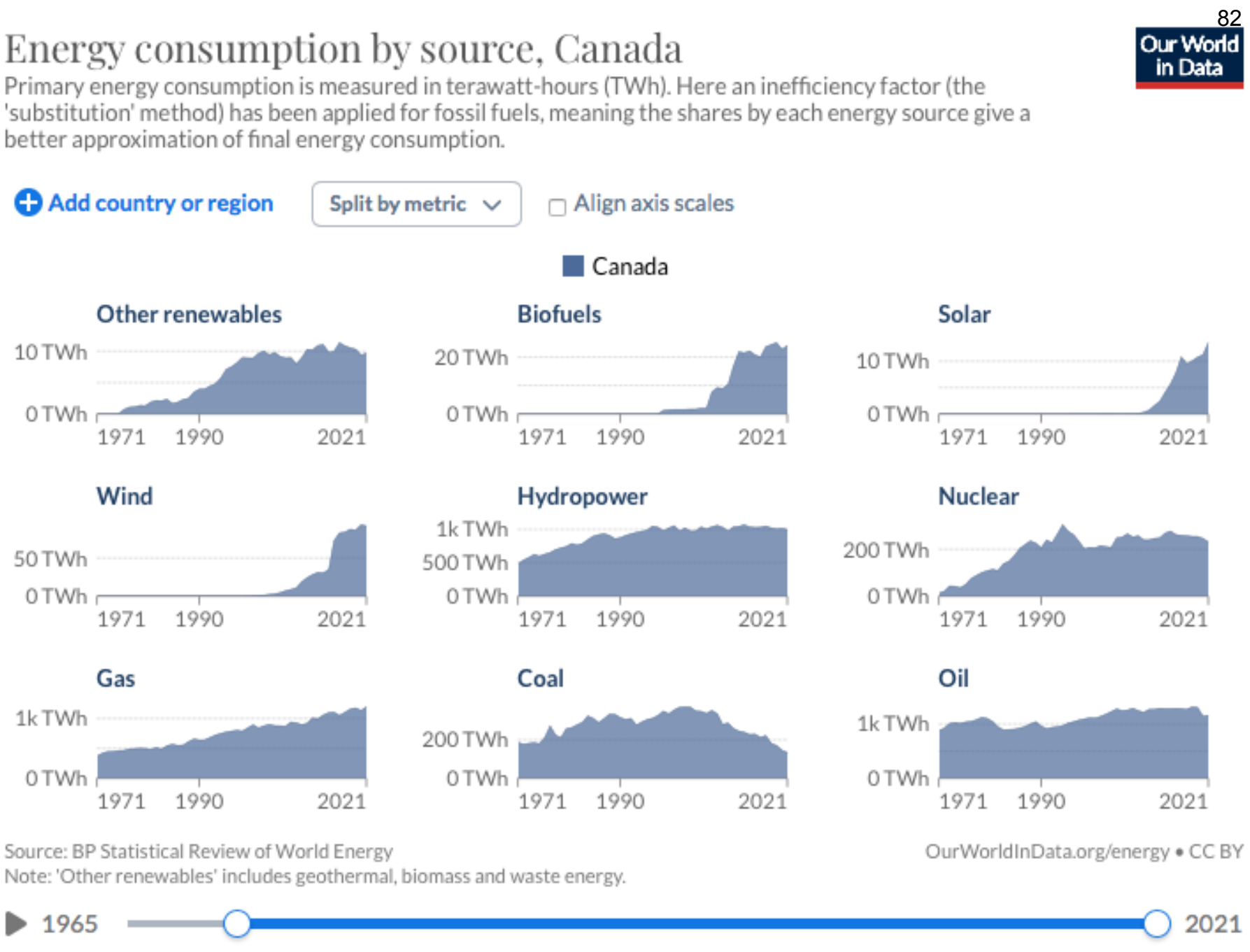
Also Upcoming Presentation – Energy Supply

- Requested by Ontario Society of Professional Engineers to present continuing education module to a “Thought Leadership Thursday” Oct. 12 on the subject, “Understanding the Challenges Facing the Ontario Electrical System.”
- Will try to bring some reality into the global objective stated in 2022 by UN Secretary General António Guterres, for the supply of renewables of water, wind, and solar to double by 2030, and to double again by 2050.
- Canada has an even more challenging objective, to transition to 100% wind, water, and solar for all purposes (electricity, transportation, heating/cooling, and industry) by 2050.
- But, numbers show us that in 2019 (latest data available) electricity supplied 16% of Ontario’s energy needs, while petroleum and natural gas supplied 76%. Meeting the objective of 100% supply from renewables of hydro wind, and solar by 2050, is well, challenging.

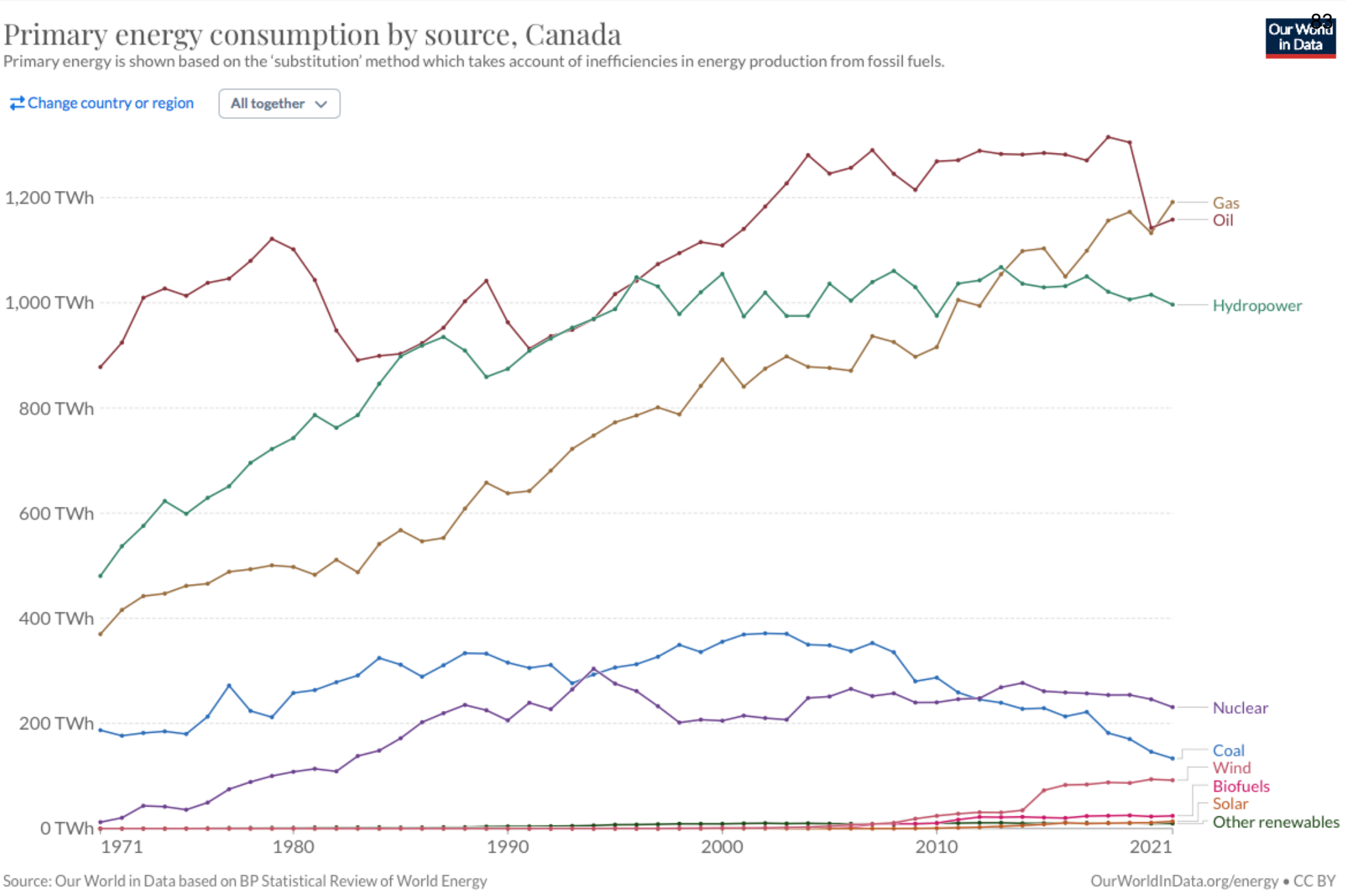
Canada's Goal:



Leaders Love This Slide



They Forget Reality

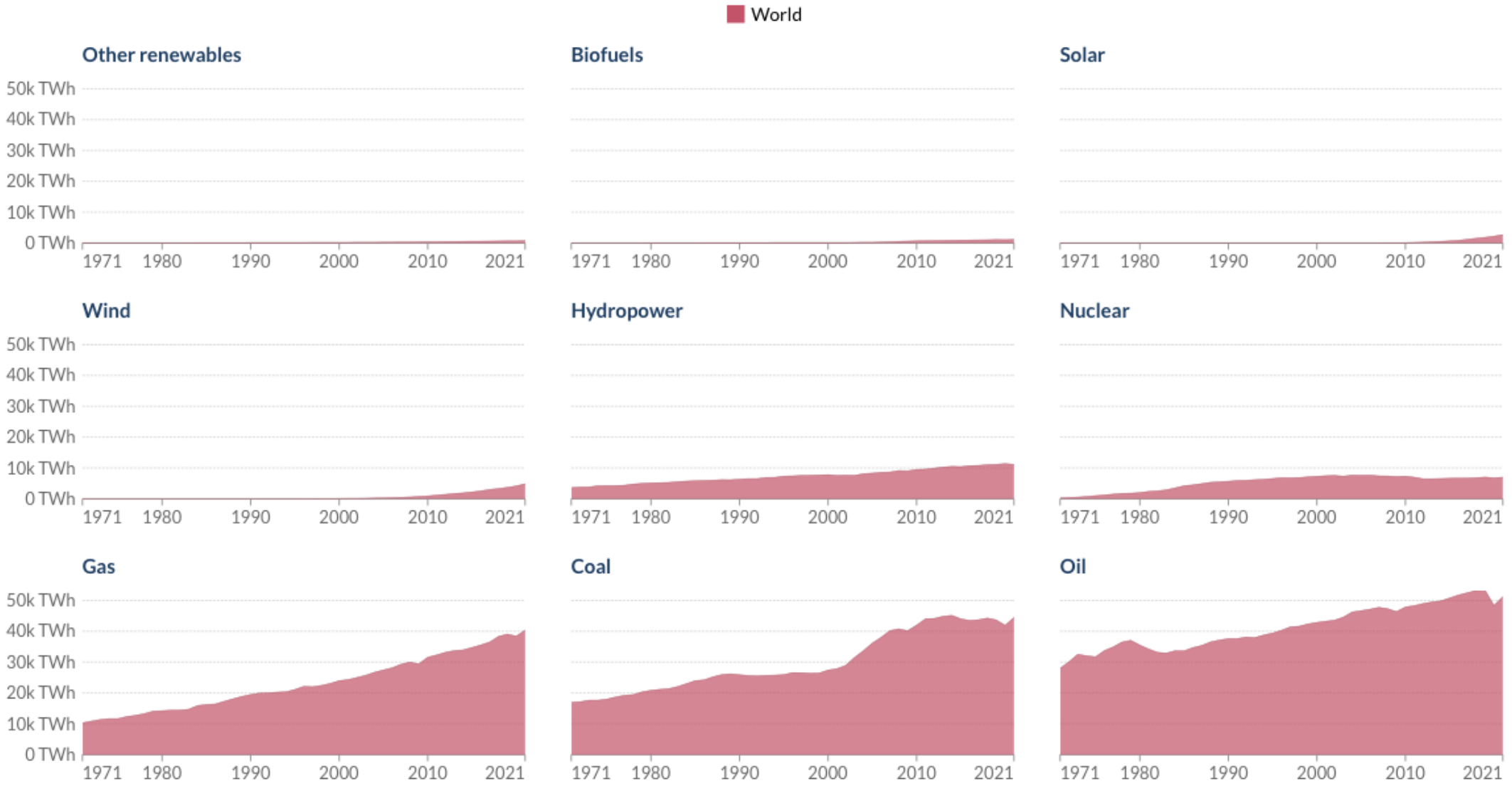


Energy consumption by source, World

Primary energy consumption is measured in terawatt-hours (TWh). Here an inefficiency factor (the 'substitution' method) has been applied for fossil fuels, meaning the shares by each energy source give a better approximation of final energy consumption.

Our World in Data

Add country or region | Split by metric | Align axis scales



Source: BP Statistical Review of World Energy
Note: 'Other renewables' includes geothermal, biomass and waste energy.

Energy consumption by source, Canada

Primary energy consumption is measured in terawatt-hours (TWh). Here an inefficiency factor (the 'substitution' method) has been applied for fossil fuels, meaning the shares by each energy source give a better approximation of final energy consumption.

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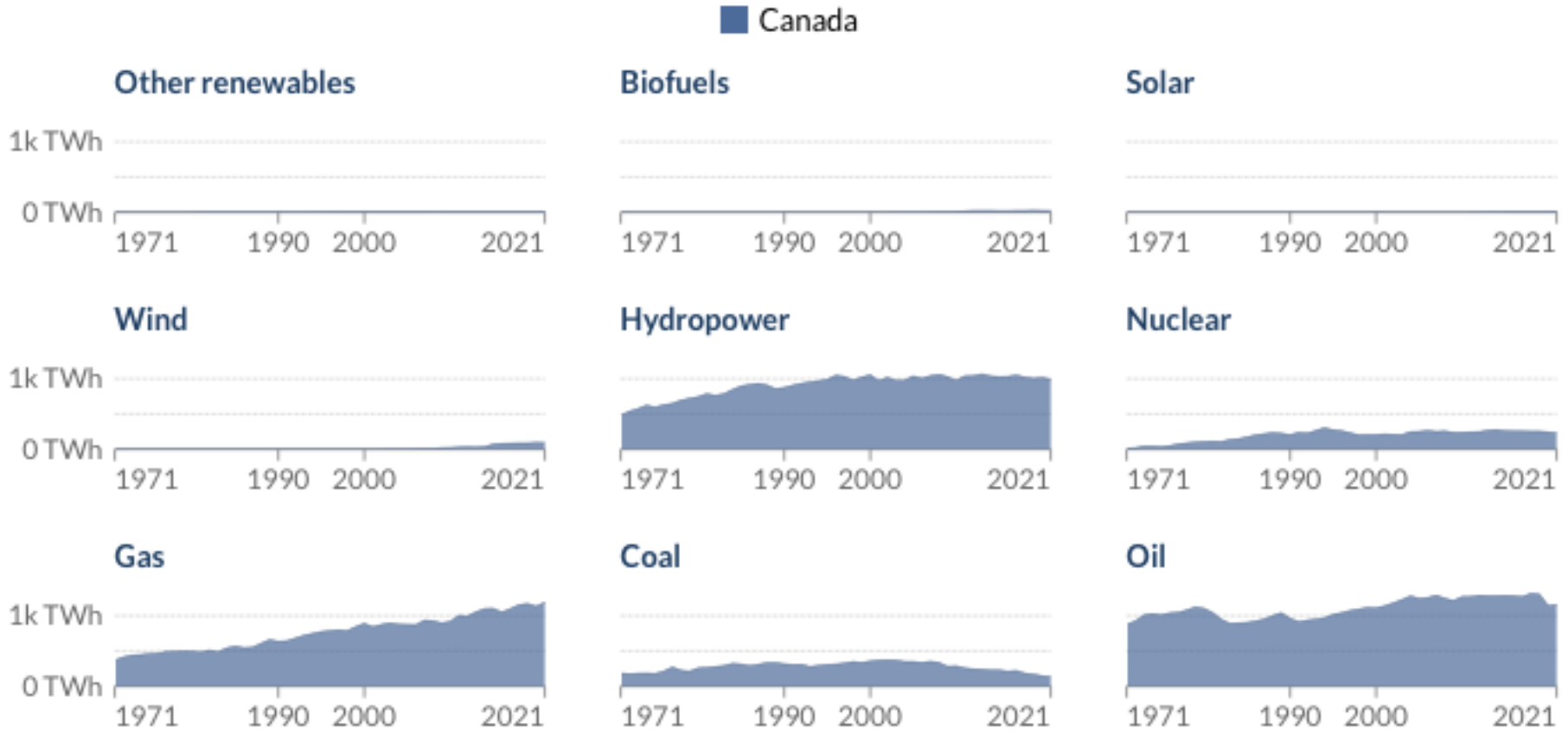


Source: BP Statistical Review of World Energy
Note: 'Other renewables' includes geothermal, biomass and waste energy.

OurWorldInData.org/energy • CC BY

1965 — 2021

Municipality of Chatham-Kent
Corporate Services
Municipal Governance
315 King Street West, P.O. Box 640
Chatham ON N7M 5K8

Chatham-Kent
Cultivating Growth, Shore to Shore

May 30, 2023

Hon. Sylvia Jones
Minister of Health
Sylvia.jones@ontario.ca

Resolution re Request to proceed with sampling and testing of private water In North Kent

Please be advised the Council of the Municipality of Chatham-Kent, at its regular meeting held on May 29, 2023, passed the following resolution:

"Whereas the Ontario Ministry of Health recently conducted The All-Hazard Investigation of water wells in North Kent, where water well sediment collection and analysis was the principal motivating factor for the investigation.

And whereas the All-Hazard Investigation instead analyzed only water (not sediment) from the participating wells.

And whereas the results from a more recent analytical testing of sediment from nine private wells in North Kent, that was funded by private donations, showed concentrations similar to concentrations known to exist in the metals' rich Kettle Point Black Shale, which are potentially toxic and dangerous heavy metals.

And whereas the need to complete the full analytical testing, including the testing of sediment in the water wells in North Kent, has become ever more evident.

Therefore, be it resolved that the Municipality of Chatham-Kent formally request and strongly encourage the Ontario Ministry of Health to proceed with completion of specific health hazard testing that remains incomplete following the All-Hazard Investigation as stated in the report by the expert panel that advised the investigation.

Further, to ask the Ontario Ministry of Health to proceed with sampling and analytical testing of private water wells and complete studies of bio-availability of potential toxic substances associated with the sediment in all water wells in North Kent, in the footprint area of the North Kent 1 Wind Farm, the East Lake St. Clair Wind Farm and the Boralex Wind Farm."

If you have any questions or comments, please contact Judy Smith at ckclerk@chatham-kent.ca

Sincerely,

Judy Smith, CMO
Director Municipal Governance/Clerk

C Local MPPs

From: Ruby Mekker
To: Julie Hamilton
Subject: Letter with permission to share
Date: September 18, 2023 1:40:41 PM

Hi Julie,
I was going to mention this email in my update on Chatham-Kent water. I don't know if you want to add it to agenda documents or not but I do have permission to share. Ruby
---------- Forwarded message ---------
From: **Rhonda Jubenville** <Rhonda.Jubenville@chatham-kent.ca>
Date: Wed, Sep 13, 2023 at 11:25 AM
Subject: Resolution from Chatham-Kent regarding water well sediment testing
To: rjmekker@gmail.com <rjmekker@gmail.com>

Hello Ruby,

Thank you for reaching out to me. You are fortunate to be meeting with the Minister of Energy's Parliamentary Assistant, Stéphane Sarrazin, and I am hopeful he can bring some light to this dire situation in Chatham-Kent.

On May 29th, 2023, Chatham Kent Council made a Resolution regarding water well sediment testing to be facilitated by the Province. It was forwarded to the Hon. Sylvia Jones, Minister of Health on May 30th and again on June 15th, 2023. To date, the Municipality has not received a response.

I will be reaching out to our CAO, who indicated he would ask our MPP, Monte McNaughton for assistance, and if needed, follow up directly with Ms. Jones. This has not happened yet, but I will be following up with CAO, Michael Duben soon. Unfortunately Minster McNaughton has also ignored previous pleas from concerned Chatham-Kent citizens regarding the water well situation here, so I'm not sure if he would move forward with assistance.

I know you have the Resolution, but here is an important excerpt from it.

"Therefore, be it resolved that the Municipality of Chatham-Kent formally request and
strongly encourage the Ontario Ministry ot Health to proceed with completion of specitic health hazard testing that remains incomplete following the All-Hazard Investigation as stated ni the report by the expert panel that advised the investigation.
Further, to ask the Ontario Ministry ot Health to proceed with sampling and analytical testing ot private water wells and complete studies of bio-availability of potential toxic substances associated with the sediment in all waterwells in North Kent, in the footprint area of the North Kent 1 Wind Farm, the East Lake St. Clair Wind Farm and the Boralex Wind Farm."

I really appreciate your willingness to help out regarding this grave situation in Chatham-Kent. I am also appreciative of any time MPP Stéphane Sarrazin is able to offer in assisting us to resolve this matter.

Kind regards,

Rhonda Jubenville
Councillor
Ward 4 - North Kent
Municipality of Chatham-Kent

C 519-350-1306
P 519-360-1998
E rhonda.jubenville@chatham-kent.ca
www.chatham-kent.ca

My working hours and your working hours may be different. Please do not feel obligated to reply outside your normal working hours.

DEPUTATION REGARDING WATER WELLS IN NORTHERN CHATHAM – KENT

Dr Keith Benn, P. Geo.

May 29, 2023

CURRICULUM VITAE: Keith Benn

- Originally from Wallaceburg; Resides in Port Lambton
- Professional Geoscientist (P. Geo.) practicing in Ontario
- BSc: Western U ; MSc: Univ Laval ; Doctorat: Univ de Montpellier II
- Post-doc fellowship (NSERC funded): Univ de Toulouse III
- 1991 – 2008: Tenured Assistant / Associate Professor at U of Ottawa
- 2008 – present: Management & Executive roles in the minerals industry ; presently independent consultant
- 2019 – 2021: Served on the Expert Panel advising the ***All-Hazard Investigation of Well Water in Chatham-Kent***

MOTIVATION FOR THE A-H INVESTIGATION

- Complaints of increased sediment load and turbidity in domestic water supply during construction and operation of Industrial Wind Complexes
- Fears that the sediment includes metal-rich black shale

OBJECTIVES OF THE A-H INVESTIGATION

1.1 Objectives

The Ministry of Health ("the Ministry") is seeking an independent third-party vendor to collect and test water and sediment samples from private wells located in a study area in Chatham-Kent and in the surrounding area on the Kettle Point aquifer (Part 5, Maps 1 and 2).

The vendor will complete the "private well water and sediment sampling and testing program", in consultation with the Ministry, to inform an all-hazard investigation by an Expert Panel which will determine if the quality of the water poses a risk to those consuming it.

- **Summarized by the paragraph above which is clipped from the RFB (Request for Bids) Tender no. 12528**
- **NOTE – Not one sample of sediment was collected.**

SEDIMENT GRAIN SIZE ANALYIS (2017)

Raw Counts Sorted	0.4 to 1 micron x<1 microns	1<=x<2 microns	2<=x<5 microns	5<=x<10 microns	10<=x<15 microns	15<=x<20 microns	20<=x<40 microns	40<=x<60 microns	60<=x<100 microns	100<=x microns	Total
Normalized to population/unit volume (counts/ml)											
Unclassified	5567	1614	484	242	2	0	0	0	0	0	7910
Black shale	403	161	81	0	0	0	0	0	0	0	645
* iron rich	9440	7907	3308	807	1	0	0	0	0	0	21464
silicon rich	3066	2098	2179	565	0	0	0	0	0	0	7908
calcium rich	807	323	968	81	0	0	0	0	0	0	2179
Total	19284	12103	7020	1694	3	0	0	0	0	0	40106

→ eye →

	Clast name	Diameter Range
Medium-grained	Sand	63 µm - 2 mm
	coarse	500 µm - 2 mm
	medium	250 µm - 500 µm
	fine	63 µm - 250 µm
Fine-grained	Silt	2 µm - 63 µm
	Clay	Smaller than 2 µm

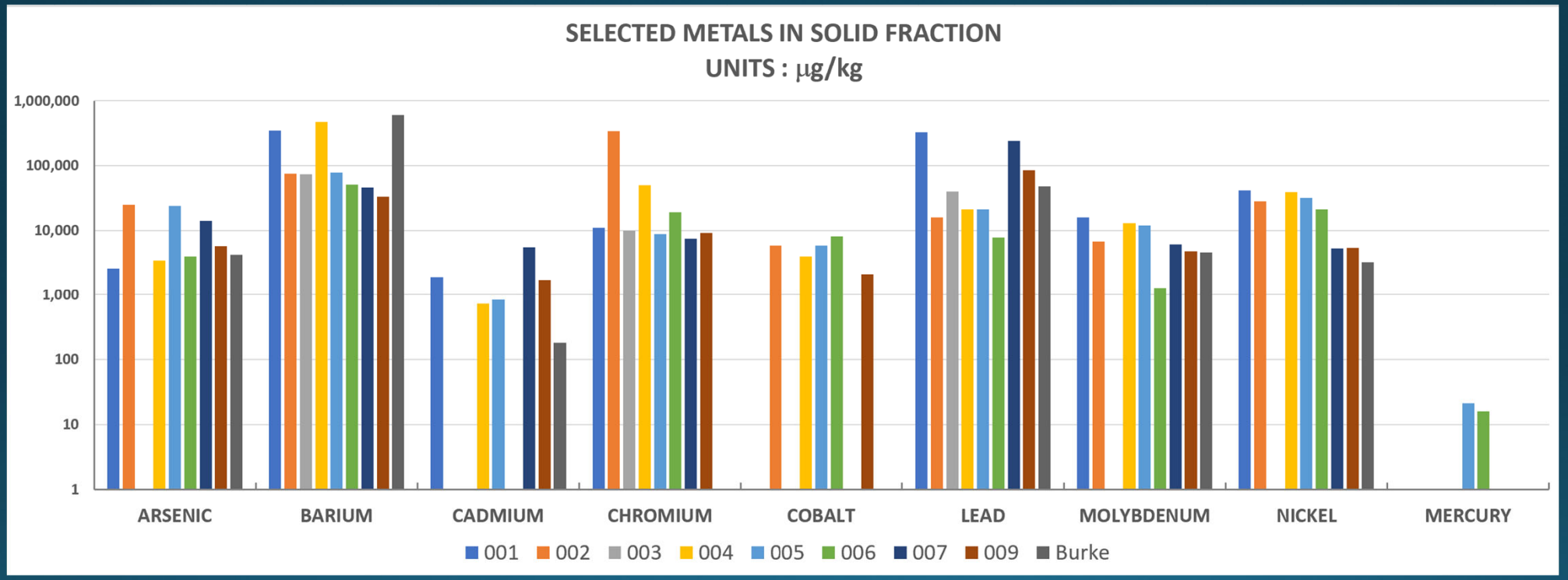
EXPERT PANEL : SELECTED RECOMMENDATIONS

- An effort should be made to capture solid particles that are in suspension in well water potentially by filtering water samples at the analytical laboratory. Then, filtered water and solid fraction could be analyzed separately to determine if one, the other or both might be enriched in contaminants. The resulting information might be of use in determining bioavailability of contaminants.

- Should elevated concentrations of metals be identified in the solid fraction, bioaccessibility testing could be considered to determine the leachability of these chemicals with an individual's gastrointestinal tract to determine whether these chemicals are actually sufficiently absorbed within the body after ingestion so as to pose a potential health concern.

- ***Bioaccessibility – the quantity of a compound that is released from its matrix in the gastrointestinal tract, becoming available for absorption***

METALS IN THE SEDIMENTS



Update on Provincial Activities

Multi-Municipal Energy Working Group

September 21, 2023

Ontario Energy Clean Plan

Clear Vision for the Electrical System

- Provincial population and economy is growing while role of electricity increasing.
- Demand growing from 44 MW to 88 MW in 2050

Key Components

- New nuclear at Bruce and Darlington. Refurbish Pickering.
- Pumped storage and BESS
- Maintain affordable electricity to support electrification
- New transmission lines for Algoma Steel and growth in Ottawa Region

Ontario Energy Clean Plan (cont'd)

Future of Renewable Energy

- "Start planning for Ontario's next competitive electricity procurement focused on clean resources including wind, solar, hydroelectric, batteries and biogas"
- Suggests an opportunity to fix current problems with wind:
  - Setbacks, pricing, existing contracts and repowering existing projects

Energy Planning Process

- Plan suggests that review of energy planning process needed
- IESO and MECP need to be fixed. Captured by industry they are supposed to be regulating.

Copy of Full Plan:

https://www.ontario.ca/page/powering-ontarios-growth

Hydro One BESS Requirements

- Lack of a standard to address potential impact of BESS fires identified as a gap in IESO process.
- Proposed draft standards developed by US consultants. Posted for comment in early August.
- Confirmed MMEWG concerns – some issues with detail
- Requirements for BESS connection to Hydro One:
  - Hazard mitigation analysis, Community Fire Risk assessment, air/gas dispersion study, Fire Protection Design document.
- Good road map for municipal requirements
  - Similar requirements for other adjacent properties

IESO Procurement Process

- "Final" version of RFP contract and documents posted on September 8
  - No change in Municipal Support Resolution to reflect MMEWG input that more details required
  - No learning from Hydro One requirements
- Target - Storage - 1600 MW; Non-Storage – 905 MW
  - Requirement for Dispatchable Power Remains
- To be issued in late September; due December 12
- Arran-Elderslie awarded contract in first round; Active proposal in Huron East
- Others?

Niagara Wind - Noise Audit Process

REA Noise Audit

- Noise testing at 5 receptors as a sample for whole project
  - Reduced to 4 receptors . When testing confirms locations are within 40 dBA, project approved.
- Testing showed 1 receptor was over 40 dBA
  - Protocol requires NAAP for project; only 1 turbine covered
  - REA was amended to reduce power level at the non-compliant turbine
- Decision was appealed – audit indicates problems with whole project.
- Handled by new tribunal which rejected appeal without hearings
  - Appeal scope was limited to decision on one turbine
  - No evidence of serious harm to human health provided

Niagara Wind - Noise Audit cont'd

- Only option in the new system is court appeal on matters of law
  - Appeal to Minister option eliminated
- Local group wrote letter to Premier asking for direction:
  - MECP not following their own rules for noise audits
  - MECP did not provide Tribunal complaint information showing other problems.
  - Serious health issues in Participant Statements and complaints is ignored.

Question: Who is responsible to enforce REA when MECP fails to act?

Draft Provincial Policy Statement

Driven by Need to Expand Housing

- Plan for a phased expansion of residential development
- Prime Agricultural Land may only be removed to support additional housing

Other Notable Changes

- **Definition of On-Farm Diversified Uses**
  - Solar and BESS permitted on Prime Agricultural Land only as a "diversified farm use"?
  - Wind turbines not included in definition
- **Airports to be protected from incompatible uses**
- **Plan for energy generation to current/projected needs**
  - Not specified - Local needs or provincial needs

INVOICE

Municipality - Arran-Elderslie
PO Box 70
1925 Bruce Rd 10
Chesley ON N0G 1L0

Customer Number
00000101072
1380-General Receivables

Invoice Number: 0104182
Billing Date: SEP 15,2023
Due Date: SEP 15,2023

MUNICIPALITY OF ARRAN-ELDERSLIE
PO BOX 70
CHESLEY, ONTARIO N0G 1L0

Description	Unit Charge	Qty	Amount
Invoice: 0104182 Multi-Municipal Energy Working Group/Services			
Recording Secretary Serv May, June, July & August	35.3600	8.00000	282.88
		Billing Amount:	282.88

Prev. Balance	0.00
Invoice Charges	282.88
Balance Due	282.88

Tax Reg: 87242 7158

A finance charge of 2% per month is added to balances not paid after 30 days.

Municipality - Arran-Elderslie
Telephone - (519) 363-3039

E. & O.E.

Please detach and return this portion with your payment.

1380-General Receivables
Invoice Number: 0104182
Billing Date: SEP 15,2023
Due Date: SEP 15,2023
Amount Due: 282.88
Amount Enclosed $_____

00000101072
MUNICIPALITY OF ARRAN-ELDERSLIE
PO BOX 70
CHESLEY, ONTARIO N0G 1L0

00000101072

Expedited Long-Term RFP (E-LT1 RFP) – Selected Proponents

Storage Category 1 Selected Proponents

Proponent	Qualified Applicant	Technology	Nameplate Capacity (MW)	Summer Contract Capacity (MW)	Winter Contract Capacity (MW)	Zone – Location
Hagersville Battery Storage Inc	Boralex Inc.	Electricity Storage Facility	300	285	285	Southwest – Haldimand
Napanee BESS Inc.	PORTLANDS ENERGY CENTRE L.P. (Atura Power)	Electricity Storage Facility	265	250	250	East – Greater Napanee
Tilbury Battery Storage Inc	Boralex Inc.	Electricity Storage Facility	80	76	76	West – Lakeshore
Walker BESS 4 Limited Partnership	Wahgoshig Solar FIT5 LP	Electricity Storage Facility	4.999	4.749	4.749	West – Windsor
Walker BESS 4 Limited Partnership	Wahgoshig Solar FIT5 LP	Electricity Storage Facility	4.999	4.749	4.749	West – Windsor
Walker BESS 4 Limited Partnership	Wahgoshig Solar FIT5 LP	Electricity Storage Facility	4.999	4.749	4.749	West – Windsor
York (Battery) LP	Capital Power Corporation	Electricity Storage Facility	120	114	114	Essa – King Township
		Total	**779.99**	**739.25**	**739.25**	

*Following the completion of the E-LT1 RFP, including Storage Category 2, the IESO may publish additional information regarding Selected Proponents, including aggregated or individual pricing information, subject to Section 3.10 of the E-LT1 RFP.

Non-Storage Category Selected Proponents

Proponent	Qualified Applicant	Technology	Nameplate Capacity (MW)	Summer Contract Capacity (MW)	Winter Contract Capacity (MW)	Zone – Location
East Windsor (Expansion) L.P.	Capital Power Corporation	Natural Gas	106	81	100	West – Windsor
Greenfield South Power Inc.	Eastern Power Inc	Natural Gas	212.5	175	195	West – St. Clair
		Total	**318.5**	**256**	**295**	

Expedited Long-Term RFP (E-LT1 RFP) – Selected Proponents

Storage Category Selected Proponents

Storage Category 1

Proponent	Qualified Applicant	Project Name	Nameplate Capacity (MW)	Summer Contract Capacity (MW)	Winter Contract Capacity (MW)	Zone – Location
Hagersville Battery Storage Inc	Boralex Inc.	Hagersville Battery Energy Storage Park	300	285	285	Southwest – Haldimand County
Napanee BESS Inc.	PORTLANDS ENERGY CENTRE L.P. (Atura Power)	Napanee Energy Storage	265	250	250	East – Town of Greater Napanee
Tilbury Battery Storage Inc	Boralex Inc.	Tilbury Battery Storage	80	76	76	West – Municipality of Lakeshore
Walker BESS 4 Limited Partnership	Wahgoshig Solar FIT5 LP	Walker BESS 4	4.999	4.749	4.749	West – City of Windsor
Walker BESS 4 Limited Partnership	Wahgoshig Solar FIT5 LP	Walker BESS 5	4.999	4.749	4.749	West – City of Windsor
Walker BESS 4 Limited Partnership	Wahgoshig Solar FIT5 LP	Walker BESS 6	4.999	4.749	4.749	West – City of Windsor
York (Battery) LP	Capital Power Corporation	York BESS	120	114	114	Essa – King Township
Storage Category 1 Total			**779.997**	**739.247**	**739.247**	

Storage Category 2

Proponent	Qualified Applicant	Project Name	Nameplate Capacity (MW)	Summer Contract Capacity (MW)	Winter Contract Capacity (MW)	Zone – Location
1000234763 Ontario Inc	1000234763 Ontario Inc.	SFF 06	4.99	4.74	4.74	East – Township of Cramahe
1000234763 Ontario Inc	1000234763 Ontario Inc.	903	4.99	4.74	4.74	Essa – Township of Armour
1000234813 Ontario Inc	1000234813 Ontario Inc.	OZ-1	4.99	4.74	4.74	Bruce - Municipality of Arran–Elderslie
Arlen Energy Storage 1 LP	Alectra Convergent Development LP	Arlen Energy Storage 1	20	19	19	Southwest – City of Guelph
Goreway (Battery) LP1	Capital Power Corporation	Goreway BESS	50	47.5	47.5	Toronto – City of Brampton
Vaughan 1E Energy Storage 1 LP	Alectra Convergent Development LP	Vaughan 1E Energy Storage 1	20	19	19	Toronto - City of Vaughan
Vaughan 3 Energy Storage 1 LP	Alectra Convergent Development LP	Vaughan 3 Energy Storage 1	40	38	38	Toronto – City of Vaughan
Walker BESS 4 Limited Partnership	Wahgoshig Solar FIT5 LP	Almonte BESS	4.999	4.749	4.749	East – Municipality of Mississippi Mills
Storage Category 2 Total			**149.969**	**142.469**	**142.469**	
Storage Total			**929.966**	**881.716**	**881.716**	

*The IESO may publish additional information regarding Selected Proponents, including individual pricing information, subject to Section 3.10 of the E-LT1 RFP.

The weighted average price of all Storage Category projects is $881.09/MW Business Day

Non-Storage Category Selected Proponents

Proponent	Eligible Expansion Counterparty	Project Name	Technology	Nameplate Capacity (MW)	Summer Contract Capacity (MW)	Winter Contract Capacity (MW)	Zone – Location
East Windsor (Expansion) L.P.	Capital Power Corporation	East Windsor Expansion	Natural Gas	106	81	100	West – City of Windsor
Greenfield South Power Inc.	Eastern Power Inc	Hydrogen Ready Power Plant	Natural Gas	212.5	175	195	West – St. Clair Township
Total				**318.5**	**256**	**295**	

*The IESO may publish additional information regarding Selected Proponents, including individual pricing information, subject to Section 3.10 of the E-LT1 RFP.

The weighted average price of all Non-Storage Category projects is $1,093.22/MW Business Day

WCO | WIND CONCERNS ONTARIO

September 15, 2023

Engagement@ieso.ca

RE: Feedback on IESO Long Term RFP Process

On May 18, Wind Concerns Ontario provided extensive comments on the proposed RFP process and related documents. In particular, we highlighted concerns with the forms and process for municipal support resolutions. The proposed process expects a municipal Council to endorse a resolution based on minimal information – the name of the proponent, the name, technology and maximum capacity involved and the precise location of the project.

There were no changes to the forms, as posted in the late August update.

In fact, there appear to be even fewer requirements for community consultation. The forms require confirmation that a website has been created and public meetings have been held, but there are no specific requirements related to what information is to be provided on the proponent's website or in the public meetings.

There is no process through which for citizen or community groups may express concerns about the nature of the project proposals.

Hydro One, as a participant in the process, identified in late June what they termed a gap in the IESO process related to the development of consistent standards that address that address the potential impact of BESS fires on Hydro One's critical transmission infrastructure. They generated a draft set of standards in mid-July that were put out for public comment (see attached). On page 10, they set out the minimum design documentation that is required for their assessment of the connection of BESS systems to Hydro One facility. While this specific work only applies to Hydro One facilities, most of their recommendations would also address more general municipal and community concerns about the impact of BESS facilities.

If proponents of BESS systems are required to provide this information to Hydro One before they can be approved for a Hydro One connection, it would seem appropriate that similar information be required for submissions requesting municipal support resolutions. In comparison, the IESO's continued recommendation that only minimal information be provided to municipalities seems completely inadequate.

In our May 18 comment document, we noted that the information provided by proponents when requesting a municipal support resolution needs substantially expanded. The IESO seems to have ignored this input, but the subsequent work by Hydro One confirms that our May 18 recommendation was appropriate and adjustments for the RFP forms are required. The information provided in the community consultation process should parallel the information required for municipalities.

These requirements represent a substantial change in the process which would invalidate all previous municipal support resolutions provided under the previous requirements. New municipal support resolutions based on full discussion of the requirements will be needed. Where these support resolutions were used by the IESO to award contracts, a provision will be required to allow municipalities to withdraw their previous support for the projects based on new information.

In the past, we have experienced situations where the IESO ignored recommendations regarding the municipal support process and were forced to change the terms of an RFP after it was issued. We trust that these very basic requirements can be implemented in the municipal support and community consultation forms before the next RFP is issued.

We have copied the Association of Municipalities on this letter as they may want to develop a set of requirements on behalf of their membership.

Yours truly,

Jane Wilson,

President, Wind Concerns Ontario

cc.
Association of Municipalities
Hon. Todd Smith, Minister of Energy, MinisterEnergy@ontario.ca
David Donovan, Chief of Staff, Minister of Energy - david.donovan@ontario.ca

WCO | WIND CONCERNS ONTARIO

May 18, 2023

Engagement@ieso.ca

RE: Feedback on IESO Long Term RFP Process

In the Engagement session on May 4, the IESO requested feedback on its proposed Long-Term RFP for additional capacity. This letter provides feedback from Wind Concerns Ontario, a coalition of organizations and individual members across Ontario. This grassroots base provides Wind Concerns with an information network throughout rural Ontario. This perspective seems to be lacking for other participants in the IESO's engagement process and may provide the IESO with unique feedback.

1. Alignment with Strategy

With regard to maintaining Ontario's leadership position in green electricity generation, there are a number of concerns with what seem to be anticipated outcomes from this RFP process and how they align with the government's wider strategy to achieve this goal.

Alignment with Government's Long Term Strategy – The government's strategy to meet its carbon emission reduction targets seems to be focused on nuclear solutions. This includes refurbishing existing nuclear facilities and commitments to modular nuclear generation. There is a need to clarify how the newest IESO RFP is consistent with the government's wider energy strategy. Ontario's shortfall in generation capacity seems to be for a short period in 2026 while the RFP involves long term contracts for storage. Will this capacity still be required in 2047?

Is Battery Storage an Effective Solution – The primary focus in the discussion about this RFP is on Battery Energy Storage Systems, but it is not clear how these installations are more than a stop-gap measure to address the capacity shortages anticipated by the IESO. The largest BESS facility is the Oneida Battery Storage facility which can provide 250 MW of electricity for four (4) hours. Information provided by IESO indicated that 70% of the shortfalls in capacity will exceed this four-hour window. The output from one of the eight units at Bruce Nuclear is twice this amount with no short-term restrictions on operations.

Impact on Electricity Costs – The impact of providing limited capacity (e.g., BESS) on electricity costs is also not publicly available at this time, if known. When the previous government of Ontario invested heavily in wind and solar programs, the unanticipated cost impact was so significant that part of the investment needed to be transferred to the provincial debt. While Indigenous groups have a high profile in the discussions, it is noted that no consumer advocates, who would normally address the impact on the seniors and other lower income segments of the population, have been involved the engagement process. Similarly, no large industrial users of electricity have been involved.

Emphasis on Dispatchable Sources – This RFP continues the requirement that new sources of generation be dispatchable. This approach allows the IESO to match electricity purchased with changes

in demand for the product. Ontario seems to have learned from its past experience with long-term contracts that committed the province to purchase output from intermittent sources whether or not it was required. This focus on dispatchable generation should be continued in future contracts. If proponents want to build intermittent sources of electricity, then they should only be paid for electricity when it is required and be responsible for developing storage capabilities for when it is not required with no additional compensation for the storage capacity.

Problems with Current Engagement Process – The current engagement process is dominated by special interests and their legal representation; this narrow self-interested representation does not provide the IESO with any perspective on the views of wider public views. The meetings are largely discussions among proponents looking to obtain favourable contracts with the IESO for the energy solutions that their companies provide. There is very limited participation by representatives of municipalities or any people who have a different solution to address the province's energy situation. On the IESO website, municipal consultation is mentioned, but the discussions taking place at municipal council meetings and in community meetings when matters related to these projects are assessed indicate very little apparent understanding of the systems and the IESO's objectives in these RFPs. We suggest that there should be a more effective effort at communicating with municipalities.

2. Support from Other Government Agencies

The rush to implement battery energy storage seems to be outpacing the response from other areas of government. Some examples:

Fire Safety – Experience with these battery energy storage facilities in other jurisdictions (e.g., U.S., Australia) indicate that they can present a serious fire hazard. The Ontario Fire Marshal's office unofficially indicated to some municipalities that it will be at least a year before they will be in a position to provide direction on the implementation of these systems. In the United States, UL Standards 9540 & 9540a are now accepted as appropriate guidelines. In terms of fire safety, the Fire Protection Association's Standard 855 is accepted. Municipalities are looking for direction from the Ontario Fire Marshal to move forward with these projects.

Protecting Prime Agricultural Land – The Provincial Policy Statement that sets out a direction for municipal planning activities places a strong emphasis on protecting Prime Agricultural Land. The only exception is using land to expand residential use. The policy statement also requires that there must be alternatives to using agricultural land. Despite this policy, many battery energy storage systems have been proposed on Prime Agricultural Land. In St Clair Township, this is the case even though the township has Brownfield sites that could be used to accommodate the project.

Setbacks from Other Activities – While Hydro One has established setbacks between BESS projects and their substations and transmission lines, Regulation 359/09 has not been updated to provide similar recommendations on setbacks between BESS projects and other facilities. These setbacks also provide protection from noise emissions produced by the battery system cooling equipment. Since Regulation 359/09 has not been updated, other protections in that regulation, i.e., the identification of vacant lot

receptors, mean that properties adjacent to a BESS installation is subject to effective downzoning without any compensation.

Emergency Response – BESS installations impose emergency resource requirements on host municipalities that are not present in most rural communities. These include special training for fire crews who could respond to a fire at the BESS site, the availability of large quantities of water to address fire situations and procedures to monitor air quality and to alert nearby residents if toxic fumes are emitted. These should be reflected in an emergency plan for the facility that is updated annually. Municipalities need to understand these requirements before, or at a minimum during, consideration of any support resolution for a project.

Approval Process – Once a contract is awarded, the proponent is then to develop a detailed proposal for the project. There is no approval process that applies to battery energy storage systems. This gap must be filled before contracts are issued. It is of particular concern to municipalities hosting the projects as it is likely that many will require site plan approvals from municipal Councils and building permits before a project can proceed.

These five process gaps involve a range of government organizations but as the apparent champion of battery energy storage systems, the IESO is responsible for ensuring that all the supporting mechanisms are in place before approving any contracts; if not, the implementation process is less likely to succeed. The situation is different from wind and solar contracts where the IESO was only responsible for issuing the contract and MECP was responsible for the environmental approval process.

3. Learning from the Existing RFP Process

The result of the process used to obtain feedback for the current RFP suggests changes are required in three areas to stop process issues from derailing the many projects.

Expansion of Existing Projects – In the May 4 IESO meeting, expanding existing projects was indicated as an option. There was no discussion of the requirements for these expansions. There has been considerable learning about the impact of these technologies on the surrounding communities since these projects were approved. Some of them pre-date the Green Energy Act. As for new projects, municipal support should be required before any process to increase capacity or to extend the length of existing contracts is approved. The proponent should also be required to provide proof that the existing project is fully compliant with the terms of its Renewable Energy Approval. Noise audit requirements[1] for many projects have not been met and resident complaints about adverse effects have been ignored despite requirements in approvals for speedy resolution. Many of these problems were linked to

[11] As of May, 2023, 38 percent of operating wind power projects in Ontario do not have a final, approved noise audit verifying compliance with regulations. A summary is available on request.

inadequate noise modeling requirements. These requirements have been amended and it is important that any changes to projects will meet current standards for noise emissions.

Contract extensions also provide an opportunity for the IESO to address problems with the existing long-term contracts covering the operations of these projects. In exchange for approval of a new contract, the "right of first access to the grid" and the highly favourable rates for electricity should be subject to renegotiation.

Municipal Support Resolutions – The May 4 presentation notes that mandatory requirements, like municipal support resolutions, are not subject to discussion. While municipal support needs to continue as a mandatory requirement, the process used to obtain that support needs to be revised considerably. The form used in the current process provides the municipality information only on the type of project, the maximum project capacity, and the description of the site. This is completely inadequate. If a subdivision proposal came to a municipality with such limited information, it would not even be forwarded to Council for consideration until more details were provided.

Municipalities require detailed information on energy projects before they can be reasonably expected to support a project. This would include a site plan, discussion of setbacks from adjacent land uses, projected noise emissions, fire safety considerations and a description of the municipality's expected role in providing emergency services to the facility. A review of the issues that caused battery storage projects to fail to achieve municipal support (e.g., Prince Edward County), would demonstrate concerns about protecting agricultural land, protection from noise pollution, and the need for fire safety requirements.

A statement of the benefits of the project to the community should also be required. In response to some questions about the benefits of these projects, some questionable benefit claims have been made in support of these projects.

Any existing Municipal Support Resolutions that have been obtained without this support should not be recognized for this RFP. Similarly, as new information on the project comes forward, municipalities need to have the right to withdraw municipal support from a project.

Community Engagement – The process used for community engagement in the current RFP is similarly flawed. Some public meetings were so badly publicized that attendance was limited to one or two people, or even zero as in the case of an Ottawa proposal. Other public meetings were attended by approximately 75 people who came prepared to ask very valid questions about the project. Unfortunately the proponent was unwilling or unable to answer a large number of questions about the project leaving the community very dissatisfied.

There is a well-documented consultation process that is used to handle changes to municipal zoning and this should provide direction for the requirements for community engagement on energy projects. These include written notices to broadly defined adjoining landowners as well as notices to the wider community. Notices are posted on the property involved with references to a project website for more details. Limited internet capabilities in rural areas require in person rather than "virtual" meetings exclusively.

The full project description that will be provided to the municipality, including the statement of benefits to the community, should also be widely available to the community. If details are not available, or if they change, additional public meetings would be required.

The community engagement meeting where all information is disclosed should take place before any consideration of municipal support for the project.

If the community feels ignored by the proponent and/or the municipality, the community should also be provided with an opportunity to provide direct community feedback on the project to the IESO.

Indigenous Support – Indigenous involvement in projects located on their traditional lands is important and no project should proceed without local Indigenous support. Support from Indigenous communities from other parts of the province should not be considered in the place of local Indigenous support. Investment by non-local Indigenous communities should only be permitted when local communities support the project.

In conclusion, it is our view that substantial changes are required in current RFP process to ensure that the projects receive a fair consideration by communities in Ontario and by municipal governments. The IESO needs to ensure that other government departments fill some specific gaps related to these projects before moving forward. There is also a need to ensure that the strategy coming from the IESO engagement focus aligns with the provincial government's energy strategy. At this point, Ontario needs effective action on carbon emissions with strategies that will work.

Yours truly,

Jane Wilson,
President, Wind Concerns Ontario

cc. Hon. Todd Smith, Minister of Energy, MinisterEnergy@ontario.ca
Hon. David Piccini, Minister of Environment, Conservation and Park, minister.mecp@ontario.ca
David Donovan, Chief of Staff, Minister of Energy - david.donovan@ontario.ca
Philip Welford, Chief of Staff, Minister of MECP - Philip.Welford3@ontario.ca

120 Adelaide Street West
Suite 1600
Toronto, Ontario M5H 1T1
T 416-967-7474
F 416-967-1947
www.ieso.ca

This page sets out the instructions for completing the Prescribed Form – Evidence of Municipal Support.

All capitalized terms used in these instructions and the Prescribed Form – Evidence of Municipal Support, unless otherwise stated, have the meanings ascribed to them in the LT1 RFP.

INSTRUCTIONS APPLICABLE TO ALL PRESCRIBED FORMS:

a. The first page of a Prescribed Form should be marked with the name of the Long-Term Reliability Project that is the subject of the Proposal. The Proponent should use the name given to the Long-Term Reliability Project in the Prescribed Form – Proponent Information, Declarations and Workbook.

b. This instruction page is not required to be submitted as part of the completed Prescribed Form.

c. The Prescribed Form is required to be submitted electronically via email to the IESO at LT.RFP@ieso.ca.

d. Information provided in each Prescribed Form should be consistent with the information provided in the Proposal.

e. Where the Prescribed Form has multiple pages, the pages of the Prescribed Form should be kept together in the Proposal in sequential order.

f. Where a blank field for a section/page reference is provided in a Prescribed Form, enter the section/page reference of the Proposal where the substantiating evidence for that particular item can be found.

g. Apart from the completion of any blanks, drop down lists, check boxes or similar uncompleted information in a Prescribed Form, no amendments may be made to the wording of a Prescribed Form.

h. Each Prescribed Form must be completed in its entirety. Fields marked <if applicable> must be completed if applicable to the Proposal. If not applicable, they should be marked " Not Applicable".

i. If a signature is required for a Prescribed Form, the Prescribed Form must be signed by a person with authority to bind the Proponent. The Prescribed Form may be printed, signed and scanned, or may be signed digitally through Adobe (Digital ID, or Fill and Sign), Apple Preview or DocuSign.

j. With the exception of this instruction page, instructions within a Prescribed Form will be enclosed in brackets.

INSTRUCTIONS SPECIFIC TO THIS PRESCRIBED FORM:

k. To be awarded Rated Criteria points pursuant to Section 4.3(b) of the LT1 RFP, a Proponent is to complete and submit in the Proposal a) the main body of this Prescribed

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Suite 1600
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T 416-967-7474
F 416-967-1947
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Form and b) the applicable evidence of Municipal Support Confirmation, as indicated in Section 2, from each Local Municipality with authority over the Municipal Lands.

l. Where the Municipal Support Confirmation is in the form of a Municipal Support Resolution, the Municipal Support Resolution must be dated no earlier than February 17, 2023.

m. The Municipal Support Confirmation must be provided in Exhibit B.

n. Councils of Local Municipalities have the option of using the form of Municipal Support Resolution provided Exhibit A, should they so choose. Alternatives to the Municipal Support Resolution is a Blanket Municipal Support Resolution.

GUIDANCE FOR MUNICIPALITIES:

The IESO is undertaking the LT1 RFP to competitively procure year-round capacity from dispatchable New Build and Eligible Expansion resources, including New Build and Eligible Expansion facilities incorporating Electricity generation and storage that (i) are registered or able to become registered in the IESO Administered Markets; (ii) larger than one (1) MW; and (iii) can deliver a continuous amount of Electricity to a connection point on a Distribution System or Transmission System during the Qualifying Hours for:

(i) at least four (4) consecutive hours in the case of Electricity Storage Facilities; or

(ii) at least eight (8) consecutive hours in the case of Non-Electricity Storage Facilities.

The LT1 RFP provides Proponents with the opportunity to obtain Rated Criteria Points, which will be used to more favourably position their Proposal in the LT1 RFP evaluation process. Four (4) Rated Criteria points are available for evidence of having obtained support from each Local Municipality in whose jurisdiction(s) the Long-Term Reliability Project is proposed to be located.

Should a Local Municipality wish to support a particular Long-Term Reliability Project, a group of Long-Term Reliability Projects, or one or more particular technology types, they must either pass a Municipal Support Resolution (project-specific) or a Blanket Municipal Support Resolution.

Local Municipalities are encouraged to use the template Municipal Support Resolution in Exhibit A. Should a Local Municipality wish to develop its own resolution, the resolution must:

(A) identify:

(i) the Proponent;

(ii) the name, technology and Maximum Contract Capacity of the Long-Term Reliability Project; and

(iii) the Municipal Lands that are subject to the authority of the Local Municipality; and

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(B) state that the Local Municipality supports the development, construction and operation of the Long-Term Reliability Project on the applicable Municipal Lands. The statement in such resolution may be qualified as being solely for the purposes of enabling the Proponent to receive Rated Criteria Points under the LT1 RFP or to satisfy its obligations under any contract awarded under the LT1 RFP, and does not supersede any applicable permits or approvals under applicable Laws and Regulations that may be required for a particular Long-Term Reliability Project.

Pursuant to the LT1 RFP, Proposals that did not receive the formal support of the local jurisdictional authorities of all the project communities in which the Long-Term Reliability Project is located in the form of a support resolution may be required under the LT1 Contract to be awarded pursuant to the LT1 RFP to submit such support resolution for compliance with its obligations.

Though the Municipal Support Confirmation may impact the rank of the Proponent's Proposal in relation to other Proposals received by the IESO, it does not guarantee a contract will be offered to the Proponent under the LT1 RFP.

THE REMAINDER OF THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK

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Capitalized terms not defined herein have the meanings ascribed to them in the LT1 RFP.

Section 1 – Information of the Proponent and the Long-Term Reliability Project

a.	Unique Project ID of the Long-Term Reliability Project:	*<Enter Unique Project ID>*
b.	Name of the Long-Term Reliability Project:	*<Enter name of the Long-Term Reliability Project>*
c.	Legal name of the Proponent:	*<Enter legal name of the Proponent>*
d.	Property Identification Number (PIN), or if PIN is not available, municipal address or legal description of Properties included in the Municipal Lands	*< insert PIN(s) (if a PIN is not available, use Municipal Address or legal description) or Grid Cell(s), if applicable>*
e.	List of all Local Municipalities with authority over the Municipal Lands:	Local Municipality 1: *<insert name of the Local Municipality>* Local Municipality 2 (if applicable): *<insert name of the Local Municipality>*

Section 2 – Municipal Support Confirmation

a.	The form of Municipal Support Confirmation used for Local Municipality 1 named above in Section 1(e), attached in Exhibit B, is:	☐ A Municipal Support Resolution dated no earlier than February 17, 2023 OR ☐ A Blanket Municipal Support Resolution
b.	The form of Municipal Support Confirmation used for Local Municipality 2 (if applicable) named above in Section 1(e), attached in Exhibit B, is:	☐ A Municipal Support Resolution dated no earlier than February 17, 2023

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Suite 1600
Toronto, Ontario M5H 1T1
T 416-967-7474
F 416-967-1947
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OR

☐ A Blanket Municipal Support Resolution

120 Adelaide Street West
Suite 1600
Toronto, Ontario M5H 1T1
T 416-967-7474
F 416-967-1947
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I hereby confirm that I am an individual with the authority to bind the Proponent and that, if applicable, by signing this form using electronic signature, I agree to the content, terms and conditions set out in the document on behalf of the Proponent.

PROPONENT NAME: _____

Per: _____

Print Name:

Print Title:

(I have authority to bind the Proponent)

Date Signed:

120 Adelaide Street West
Suite 1600
Toronto, Ontario M5H 1T1
T 416-967-7474
F 416-967-1947
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EXHIBIT A
FORM OF MUNICIPAL SUPPORT RESOLUTION

Resolution NO: _____ Date: _____

[Note: The Municipal Support Resolution must not be dated earlier than February 17, 2023.]

WHEREAS:

1. The Proponent is proposing to construct and operate a Long-Term Reliability Project, as defined and with the characteristics outlined in the table below, under the Long-Term Request for Proposals ("**LT1 RFP**") issued by the Independent Electricity System Operator ("**IESO**").

Unique Project ID of the Long-Term Reliability Project:	*<insert Unique Project ID>*
Name of the Long-Term Reliability Project:	*<insert name of Long-Term Reliability Project>*
Proponent:	*<insert legal name of the Proponent>*
Technology of the Long-Term Reliability Project:	*<select one>*
Maximum Contract Capacity of the Long-Term Reliability Project (in MW):	*<insert the Maximum Contract Capacity of the Long-Term Reliability Project in MW>*
Property Identification Number (PIN), or if PIN is not available, municipal address or legal description of the portion of the Project Site that is located on lands subject to the authority of one or more Municipalities:	*<insert the applicable description>* (the "**Municipal Lands**")

120 Adelaide Street West
Suite 1600
Toronto, Ontario M5H 1T1
T 416-967-7474
F 416-967-1947
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2. Pursuant to the LT1 RFP, Proposals that receive the formal support of the local jurisdictional authorities of all the project communities in which the Long-Term Reliability Project is located in the form of a support resolution will be awarded Rated Criteria points for the purpose of ranking the Proposal in relation to other Proposals for a contract under the LT1 RFP; and

NOW THEREFORE BE IT RESOLVED THAT:

3. The council of <insert name of Municipality> supports the development, construction and operation of the Long-Term Reliability Project on the Municipal Lands.

4. This resolution's sole purpose is to enable the Proponent to receive Rated Criteria Points under LT1 RFP or to satisfy its obligations under any awarded LT1 Contract and may not be used for the purpose of any other form of approval in relation to the Proposal or Long-Term Reliability Project or for any other purpose. Rated Criteria points will be used to rank the Proponent's Proposal in relation to other Proposals received by the IESO under the LT1 RFP.

DULY RESOLVED BY THE LOCAL MUNICIPALITY

on the __ day of _____ , 20__

<Signature lines for elected representatives. At least one signature is required.>

120 Adelaide Street West
Suite 1600
Toronto, Ontario M5H 1T1
T 416-967-7474
F 416-967-1947
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EXHIBIT B
MUNICIPAL SUPPORT CONFIRMATION

Note: Attach the Municipal Support Confirmation.

Hydro One
BESS Fire Protection
Risk & Response Assessment Standard

Prepared for:

Hydro One, Canada
483 Bay Street,
Toronto, ON M5G 1P5, Canada

Prepared by:

Fire & Risk Alliance, LLC
7640 Standish Place
Rockville, MD 20855

Rev. 0
July 19, 2023

Initial Document Contributors

Hydro One	Fire & Risk Alliance, LLC
Farooq Qureshy	Derek Post P.E.
Robert Reinmuller	Anthony Natale
Quyen Diep	Jeffrey Reetz P.E.
Ajay Garg	Noah Ryder P.E., PhD, MBA
Hemant Barot	

Revision History

Revision	Date	Reason for Issue	Developed By	Checked By	Approved By
REV 0	July 2023	Initial Issuance	FRA	FRA	Hydro One

Revision Comments

Revision	Section	Changes Noted

TABLE OF CONTENTS

1.0 INTRODUCTION

Fire & Risk Alliance, LLC was requested by Hydro One (client) to develop a Fire Protection Risk & Response Assessment Standard (FPRRAS) which defines the required risk analysis, policies, and processes that will be required to ensure that emergencies and fires within Battery Energy Storage System (BESS) sites do not pose a risk to the transmission facilities.

The FPRRAS is intended to provide a high-level outline of fire protection requirements and best industry practices to an acceptable level of fire protection using active systems, passive systems, and procedural safeguards. The FPRRAS references fire protection requirements contained within National Fire Code of Canada 2020 and the Ontario Fire Code, a regulation under the Fire Protection and Prevention Act 1997, as adopted by Ontario, Canada. Recognizing that current codes, standards, and guidelines do not consider the consequences of any BESS events on transmission facilities, this FPRRAS defines setback requirements for the BESS from transmission facilities for maintaining reliability and integrity of the transmission system and ensuring long-term resiliency and sustainability. In addition, good engineering practices are referenced where applicable.

2.0 PURPOSE

To ensure the protection of Hydro One's assets and continuity of operations associated with BESS interconnections, FRA will provide information within the Fire Protection Risk & Response Assessment Standard to address the following:

- Fire Propagation & Explosion Risk Analysis Requirements
- Hydro One Setback Requirements from Utility Transmission Facilities and Equipment
- Fire Protection System (Detection & Suppression) Requirements
- Fault Condition Assessment
- Explosion Mitigation Requirements
- Commissioning Plan
- Operations & Maintenance Plan
- Decommissioning Plan
- Emergency Response Plan

3.0 APPLICABLE CODES AND STANDARDS

The standards and codes referenced in this document are applicable at the time of issuance and may change over time. The general intent is to apply the current version of the standards in between document revisions.

3.1 Adopted Standards and Codes:

- National Building Code of Canada – 2020
  - NFPA 72, National Fire Alarm and Signaling Code – 2019 Edition
  - NFPA 101, Life Safety Code – 2018 Edition
- National Fire Code of Canada – 2020
  - NFPA 13, Standard for the Installation of Sprinkler Systems – 2019 Edition
  - NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems – 2017 Edition
  - NFPA 68, Standard on Explosion Protection by Deflagration Venting – 2013 Edition
  - NFPA 69, Standard on Explosion Prevention Systems – 2014 Edition
- Fire Protection and Prevention Act (FPPA) – 1997
- Ontario Fire Code, a regulation under the FPPA – April 11, 2022

3.2 Recommended Industry Applicable Standards and Codes:

- National Fire Protection Association – USA
  - NFPA 551, Guide for the Evaluation of Fire Risk Assessments – 2022 Edition
  - NFPA 850, Recommended Practice for Fire Protection for electric Generating Plants and High Voltage Direct Current Converter Stations – 2020 Edition
  - NFPA 855, Standard for the Installation of Stationary Energy Storage Systems – 2023 Edition
- Underwriters Laboratories – USA
  - UL 1973, Batteries for Use in Stationary and Motive Auxiliary Power Applications – 2022 Edition
  - UL 9540, Energy Storage Systems and Equipment – 2020 2nd Edition
  - UL 9540A, Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems – 2019 4th Edition
- Institute of Electrical and Electronics Engineers – USA
  - IEEE 979, Guide for Substation Fire Protection – 2012 Edition
  - IEEE 2030.2.1, Guide for the Design, Operation, and Maintenance of Battery Energy Storage Systems, both Stationary and Mobile, and Application Integrated with Electric Power Systems – 2019 Edition

4.0 TERMS AND DEFINITIONS

Authority Having Jurisdiction (AHJ) [NFPA 855 §3.2.2]: An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

Battery Energy Storage System (BESS) [UL 9540A §4.2]: Stationary equipment that receives electrical energy and then utilizes batteries to store that energy to supply electrical energy at some future time. The BESS, at a minimum consists of one or more modules, a power conditioning system (PCS), battery management system (BMS), and balance of plant components.

Battery Management System (BMS) [NFPA 855 §3.3.3]: A system that monitors, controls, and optimizes performance of an individual or multiple battery modules.

BESS Event: Failure of the BESS equipment or facilities that results in fire and/or emission of pollutants or smoke from the facility.

Cell [UL 9540A §4.3]: The basic functional electrochemical unit containing an assembly of electrodes, electrolyte, separators, container, and terminals. It is a source of electrical energy by direct conversion of chemical energy.

Combustible: Readily or easily ignitable material. Specific definitions vary depending on material: dust, fibers, liquids.

Combustible Liquid [NFC §1.4.1.2]: A liquid having a flash point at or above 37.8°C and below 93.3°C.

Community Risk Analysis (CRA): An evaluation of exposure hazard utilizing a consequence analysis approach for the BESS facility.

Energy Storage Management System (ESMS) [NFPA 855 §3.3.8]: A system that monitors, controls, and optimizes the performance and safety of an energy storage system.

Energy Storage Systems (ESS) [NFPA 855 §3.3.9]: One or more devices, assembled together, capable of storing energy to supply electrical energy at a future time.

Energy Storage System Cabinet [NFPA 855 §3.3.9.2]: An enclosure containing components of the energy storage system where personnel cannot enter the enclosure other than reaching in to access components for maintenance purposes.

Fire Resistance Rating [NFC §1.4.1.2]: The time, in minutes or hours, that a material or assembly of materials will withstand the passage of flame and the transmission of heat when exposed to fire under specified conditions of test and performance criteria, or as determined by extension or interpretation of information derived therefrom as prescribed in the National Building Code of Canada 2020.

Fire Risk Assessment (FRA): A process to characterize the risk associated with BESS fire that addresses the fire scenarios of concern, their probability, and their potential consequences.

Hazard Mitigation Analysis (HMA) [NFPA 855 §3.3.14]: An evaluation of potential energy storage system failure modes and the safety-related consequences attributed to the failures.

Lithium-ion battery: A storage battery with lithium ions serving as the charge carriers of the battery. The electrolyte is a polymer mixture of carbonates with an inorganic salt and can be in a

liquid or a gelled polymer form. Lithiated metal oxide is typically a cathode and forms of carbon or graphite typically form the anode.

Module [UL 9540A §4.9]: A subassembly that is a component of a BESS that consists of a group of cells or electrochemical capacitors connected together either in a series and/or parallel configuration (sometimes referred to as a block) with or without protective devices and monitoring circuitry.

Proponents: A person or company advocating and supporting the installation of BESS equipment/facilities to existing Hydro One transmission infrastructure.

Stationary Energy Storage System [NFPA 855 §3.3.9.7]: An energy storage system that is permanently installed as fixed equipment.

Thermal runaway [UL 9540A §4.11]: The incident when an electrochemical cell's temperature increases at an accelerating rate in an uncontrollable fashion sufficient to result in damage to the cell. The thermal runaway progresses when the cell's generation of heat is at a higher rate than the heat it can dissipate. This may lead to fire, explosion and gas and smoke evolution.

Transmission Facilities: Refers to the Utility transmission facilities or transmission infrastructure, and includes any structures, lines, transformers, breakers, disconnect switches, buses, voltage/current transformers, protection systems, telecommunications systems, cables, and any other auxiliary equipment.

Unit [UL 9540A §4.12]: A frame, rack, or enclosure that consists of a functional BESS which includes components and subassemblies such as cells, modules, battery management systems, ventilation devices and other ancillary equipment.

5.0 MINIMUM DESIGN DOCUMENTATION

The following are the assessments required based on industry practice for proposed BESS installations:

- Hazard Mitigation Analysis (HMA), Including:
  - Code Review
  - UL 9540 Listing
  - UL 9540A Test Reports
  - Fault Condition Assessment
- Fire Risk Assessment (FRA), Including:
  - Community Risk Assessment
  - Air/Gas Dispersion Study
- Fire Protection Design Documentation, Including:
  - Passive Fire Protection Systems
  - Active Fire Protection Systems
- Commissioning Plan
- Emergency Response Plan

5.1 Hazard Mitigation Analysis

A Hazard Mitigation Analysis (HMA) is a documented report evaluating the potential energy storage system failure modes and the safety-related consequences attributed to the failures [NFPA 855 §3.3.14].

A hazard mitigation analysis shall be provided to the Authority Having Jurisdiction (AHJ) for review and approval where any of the following conditions are present [NFPA 855 §4.4.1]:

- Technologies not outside of the threshold quantities for each fire area including battery chemistries not identified by the prescriptive codes
- More than one BESS technology is provided in a single fire area where adverse interaction between the technologies is possible
- Where allowed as a basis for increasing maximum stored energy
- Where required by the AHJ to address a potential hazard with an ESS installation that is not addressed by existing requirements
- Where required for existing lithium-ion BESS systems that are not UL 9540 listed
- Where required for outdoor lithium-ion battery BESS systems

The HMA shall evaluate the following consequences for failure modes of the BESS [NFPA 855 §4.4.2]:

- A thermal runaway or mechanical failure condition in a single BESS unit

- Failure of an energy storage management system or protection system that is not covered by the product listing failure modes and effects analysis (FMEA)
- Failure of a required protection system including, but not limited to, cooling system, ventilation (HVAC), exhaust ventilation, smoke detection, fire detection, fire suppression, or gas detection

The HMA is permitted to be approved by the AHJ if the consequences of the document demonstrate that [NFPA 855 §4.4.3]:

- Fires will be contained within unoccupied BESS rooms for the minimum duration of the fire resistance rating specified in 9.6.4.
- Fires and products of combustion will not prevent occupants from evacuating to a safe location.
- Deflagration hazards will be addressed by an explosion control or other system.
- Fires and products of combustion will not adversely impact transmission facilities.

HMA requires a Fault Condition and Effects Analysis. The HMA shall also be provided to Hydro One as a part of self-certification document requirement:

5.1.1 Fault Condition Assessment

A fault condition assessment is a tool to evaluate the critical safety components and circuits of an energy storage system and system design by identifying the potential failure modes and their potential causes, consequences, and recommended mitigations to reduce risk. The failure modes are to be compared against the existing system installations to identify which could detect the failure mode. Rankings of occurrence and detection are specified to quantify the risk associated with each failure mode. For failure modes with unacceptable risk, mitigations are proposed to reduce the potential risk to adequate/manageable levels.

A fault condition assessment shall be conducted and provided by the system manufacturer to the AHJ and Hydro One, which examines the potential causes and effects of specific failures of components of the battery storage system. The following Fault Conditions shall be assessed as outlined in NFPA 855:

- Thermal Runaway
- Failure of BMS
- Failure of Ventilation or Exhaust System
- Short circuit on load side of battery storage system
- Failure of fire detection and suppression system
- Spill neutralization
- Protection from external environment

The fault condition assessment is to be presented as a running document with explanatory information or as a diagrammatic Bowtie style report identifying connections between failure modes and their associated effects.

5.2 Fire Risk Assessment

A Fire Risk Assessment (FRA) is a guide intended to aid AHJs in evaluating the appropriateness and execution of a given fire safety problem. The FRA primarily addresses regulatory officials; it is intended for others who review FRAs, such as insurance company representatives and building owners. The FRA does not mandate the methods for use in demonstrating acceptable risk; rather, it describes the technical review process and documentation that are needed in evaluating an FRA [NFPA 551 §1.1].

The perception of risk, and therefore the acceptance of risk, is influenced by the values of the stakeholders. Thus, the values of the stakeholders should be established in the risk metrics which may include life safety, property, business interruption, and intangibles. The metrics associated with these values may be people affected, dollars of loss, acreage, and so forth. The expression of the metric is usually rate based (e.g., frequency, or probability of occurrence over a specified time period). The stakeholders may attach different weights to a given risk, based on their perspective. Hydro One and the local AHJ may have their own weighting depending on role, location, and perceived value [NFPA 551 §1.5].

For fire safety, the hazards are generally fire, explosion, smoke, and toxicity associated with fire products. The likelihoods and corresponding consequences are derived from fire scenarios associated with these hazards. The impacts or harm from the fire scenarios are expressed in the metrics associated with the values, such as number of people affected per location per year [NFPA 551 §1.5.2]. This evaluation considers Community Risk and perceived risk based on the potential air/gas dispersion study.

The FRA is to list fire scenarios for a single or multi-system installation and assess the impact on risk given changes to a number of BESS installations parameters and fire protection systems (active and passive) outlined by stakeholders and involved parties. The assessment will provide numerical values for varying outcomes from the identified fire scenarios for stakeholders to evaluate what systems and criteria are weighed more heavily than others.

This FRA document is essential to the evaluation for each BESS installation to estimate risk associated with a fire event. The document will include a Risk Matrix evaluating probability levels and severity categories to represent a two-dimensional graphic. The ranges will indicate improbable hazards with negligible consequences to frequent hazards with severe consequences [NFPA 551 §5.2.5].

5.2.1 Community Risk Analysis

A Community Risk Analysis (CRA) is to be conducted to evaluate the potential thermal, overpressure and toxic hazards to the site, personnel, and the surroundings. Specifically, the objectives of the CRA study are to identify fire, deflagration, and gas release scenarios from the BESS that may impact the site and population surrounding the BESS facility without any mitigation measures. The CRA also analyzes the consequences of these scenarios to identify those, if any, that have potential for offsite impact as well as provides estimates for on-site impacts.

If applicable, and based on consequence analysis results, combine the hazard zones, frequencies of accident scenarios, and population data to calculate risk to the surrounding population. If applicable, and based on consequence analysis results, present societal risk as frequency versus potential fatality curves (F-N curves). All analysis to be done using module level gas venting calculations supplied by the manufacturer. The CRA is based on information provided by the manufacturer as well as gathered from publicly available sources. Supporting documents provide the information necessary to ascertain the likelihood and impact of hazardous consequences to surrounding populations.

5.2.2 Air/Gas Dispersion Study

Accidents begin with an incident, which usually results in a release of hazardous, toxic, or flammable material from a storage site or facility. A consequence analysis evaluates the expected outcome of an event and is measured or expressed as a hazard distance, hazard zone, or a hazard value at a specific location. A quantitative consequence analysis is carried out using mathematical models and computer software addressing the physical and chemical phenomenon.

Before conducting a consequence analysis, it is necessary to identify events that could follow the release of a hazardous material. The consequence analysis considers a range of potential hazards. In general, a hazardous material release may exhibit one or more of the following types of hazards:

- Flammable exposure (thermal radiation, flame impingement)
- Explosions (blast overpressure)
- Toxic vapor exposure or dispersion

A site-specific consequence analysis of the accidental release scenarios is to be conducted using the commercially available Process Hazards Analysis Software Tool (PHAST) consequence modeling software, or approved equivalent. PHAST can be used to determine the fire, toxic, and blast overpressure hazard consequences. The TNO Multi-Energy methodology within the PHAST tool can be used to evaluate any potential vapor cloud explosions.

5.3 Fire Protection Design Documentation

Fire protection design documents (e.g., design drawings, permit drawings, shop drawings, etc.) should be submitted in accordance with the requirements of the permitting AHJ as the project progresses. Documents shall be prepared in accordance with the applicable codes and standards listed herein and any local-authority specific requirements. Documents should be submitted for each type of system provided in the BESS installation for coordination and review.

6.0 BESS CLASSIFICATION AND SPATIAL SEPARATION

6.1 BESS Installation Classifications and Code Requirements

NFPA 855 requirements pertaining to BESS equipment must be applied for the site if the BESS threshold energy capacity is greater than shown in Table 1. Energy Storage System Threshold Quantity [NFPA 855 Table 1.3].

Table 1. Energy Storage System Threshold Quantity [NFPA 855 Table 1.3]

Technology	Energy Capacity
Lithium-ion Batteries	20 kWh
Lead-Acid	70 kWh
Ni-Cad, Ni-MH, Ni-Zn	70 kWh

If a single installation of a BESS system exceeds the energy threshold capacity, the requirements of NFPA 855 are to be applied. For all installations over the threshold quantity the documentation outlined in Section 5.0 Minimum Design Documentation is to be provided to Hydro One and the AHJ.

For outdoor BESS installations, NFPA 855 provides code requirements based on the proximity and location of the BESS equipment from adjacent lot lines. The installation classifications are listed below in Section 6.2 BESS Installation Location Classifications.

6.2 BESS Installation Location Classifications

BESS installations can be categorized into two types of locations per NFPA 855 §9.3. The installation classifications are as follows:

- Indoor Installation
  - *Dedicated-use Buildings:* The building shall only be used for energy storage, or energy storage in conjunction with energy generation, electrical grid-related operations, or communications utility equipment.
  - *Non-Dedicated-Use Buildings:* The building shares its uses with installation and occupiable spaces not related to the ESS installation.
- Outdoor Installation
  - *Remote Locations*: BESS located more than 100 ft (30.5 m) from buildings, lot lines that can be built upon, public ways, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards not associated with electrical grid infrastructure.
  - *Locations Near Exposures*: BESS locations that do not comply with remote outdoor location requirements.
  - Specific outdoor locations
    - *Rooftop Installations*: ESS installations located on the roofs of buildings.

- *Open Parking Garage Installations*: ESS installations are those located in a structure or portion of a structure with the openings on two or more sides that is used for the parking or storage of motor vehicles.

Electrical utility ESS installations typically fall under two of the categories listed above: Outdoor Installation and Indoor Installation.

The code requirements for remote locations classification are less stringent compared to locations near exposures classification, and less stringent compared to dedicated use building classification, and so on.

In rural applications, some project sites may not meet the definition of remote locations classification but have no significant exposure hazards. For such cases, dialogue with the local AHJ may permit re-classification of the BESS facility.

NFPA 855 provides requirements on system installations based on proximity and location of the BESS. The table involving outdoor installations is included below.

Table 2: NFPA 855 Table 9.5.2 Outdoor Stationary ESS Installations

Compliance Required	Remote Locations	Locations Near Exposures	NFPA 855 Reference
Administrative	Yes	Yes	Chapters 1-3
General	Yes	Yes	Sections 4.1-4.7
Maximum size	Yes	Yes	Section 9.5.2.4
Clearance to exposures	NA	Yes	Section 9.5.2.6.1
Means of egress separation	NA	Yes	Section 9.5.2.6.1.7
Walk-in units	Yes	Yes	Section 9.5.2.3
Vegetation control	Yes	Yes	Section 9.5.2.2
Enclosures	Yes	Yes	Section 4.6.12
Size and separation	No	Yes	Section 9.4.2
Maximum stored energy	No	Yes	Section 9.4.1
Smoke and fire detection	Yes	Yes	Section 9.6.1
Fire control and suppression	Yes	Yes	Section 9.6.2
Water supply	Yes	Yes	Section 9.6.3
Signage	Yes	Yes	Section 4.7.4
Occupied work centers	Not allowed	Not allowed	Section 9.5.1.2.1
Technology-specific protection	Yes	Yes	Section 9.6.5

Table 3: NFPA 855 Table 9.5.1 Indoor ESS Installations

Compliance Required	ESS Dedicated-Use Buildings	Non-Dedicated-Use Buildings	NFPA 855 Reference
Administrative	Yes	Yes	Chapters 1-3
General	Yes	Yes	Sections 4.1-4.7
Size and separation	Yes	Yes	Section 9.4.2
Maximum stored energy	No	Yes	Section 9.4.1
Elevation	Yes	Yes	Section 4.7.7
Fire Barriers	NA	Yes	Section 9.6.4
Smoke and fire detection	Yes	Yes	Section 9.6.1
Fire control and suppression	Yes	Yes	Section 9.6.2
Water supply	Yes	Yes	Section 9.6.3
Signage	Yes	Yes	Section 4.7.4
Occupied work centers	Not allowed	Yes	Section 9.5.1.2.1
Technology-specific protection	Yes	Yes	Section 9.6.5

The BESS system is required to be separated from adjacent exposures per NFPA 855. The indicated minimum separation clearance requirement is permitted to be reduced based on the UL 9450A test result and approvals from the AHJ. The BESS shall not be located such that it is a direct exposure to stored combustibles, other exposure hazards not associated with electrical grid, and means of egress. The required separation distance is permitted to be reduced to 3 feet when a 1-hour freestanding fire barrier is installed between exposers and the BESS assembly.

6.3 Maximum Allowable Quantities (MAQ)

NFPA 855 requires that all areas containing BESS shall not exceed the MAQ shown in Table 4. However, where approved by the fire code official, areas containing BESS that exceed the MAQ shall be permitted based on a HMA and fire testing conducted in accordance with the requirement of NFPA 855 [NFPA 855§9.4.1].

Table 4. Energy Storage System MAQ [NFPA 855 Table 9.4.1]

Battery Type	MAQ Energy Capacity
Lithium-ion	600 kWh
Lead-Acid	Unlimited
Nickel	Unlimited

NFPA 855 does not limit MAQ for outdoor remote installations. An HMA is required for all BESS installation that exceed 600 kWh regardless of MAQ.

6.4 BESS Spatial Separations

Spatial separation distance is measured as a straight line from the BESS equipment edge to the exposure of concern or to the anticipated flame front. Spatial separation is an effective method for reducing fire spread damage.

6.4.1 BESS Clearance to Exposures

BESS equipment is required to be separated from adjacent exposures as shown in Table 5: BESS Clearance to Exposures [NFPA 855 §9.5.2.6.1. Note: NFPA 855 does not require clearance to exposures for remote locations classification.

Table 5: BESS Clearance to Exposures [NFPA 855 §9.5.2.6.1]

Adjacent Exposures	Minimum Clearance NFPA 855 §9.5.2.6.1
Lot Lines	10 feet (3 m)
Public Way	10 feet (3 m)
Buildings	10 feet (3 m)
Stored combustible materials	10 feet (3 m)
Hazardous Materials	10 feet (3 m)
High-Piled Stock	10 feet (3 m)
Other Exposure Hazards	10 feet (3 m)

The following exceptions can be used to reduce the clearance limit for BESS facilities with limited spacing.

- Exception 1 [NFPA 855 §9.5.2.6.1.1]: Clearances are permitted to be reduced to 3 feet (0.9 m) where a 1-hour free-standing fire barrier, suitable for exterior use, and extending 5 feet (1.5 m) above and 5 feet (1.5 m) beyond the physical boundary of the BESS installation is provided to protect the exposure.
- Exception 2 [NFPA 855 §9.5.2.6.1.2]: Clearances to buildings are permitted to be reduced to 3 feet (0.9 m) where noncombustible exterior walls with no openings or combustible overhangs are provided on the wall adjacent to the BESS and the fire-resistance rating of the exterior wall is a minimum of 2 hours. Openings consist of doors, windows, vents, louvers, etc.
- Exception 3 [NFPA 855 §9.5.2.6.1.4 & §9.5.2.6.1.5]: Clearance to exposures other than buildings shall be permitted to be reduced to 3 feet where fire and explosion testing of the BESS demonstrates that a fire within the BESS enclosure will not generate radiant heat flux sufficient to ignite exposures. Clearances to buildings and exposures shall be

permitted to be reduced to 3 ft (0.9 m) where the enclosure of the ESS has a 2-hour fire resistance rating established in accordance with ASTM E119 or UL 263.

6.4.2 BESS Means of Egress Separation

Outdoor BESS are to be separated from any means of egress component from buildings as required by the code official to ensure safe egress under fire conditions, but never less than 10 feet (3 m) [NFPA 855 §9.5.2.6.1.7(A)]. The separation code requirement includes the exterior exit discharge path.

Means of egress is comprised of three distinct components: exit access, exit, and exit discharge. Where ESS units are installed adjacent to occupiable buildings (i.e., office buildings, warehouses, factories, etc.), close attention to means of egress separation is required to ensure safe passage of the building occupants. ESS facilities with unmanned electrical grid infrastructure buildings typically do not need to account for means of egress separation.

Where approved by the AHJ, clearances are permitted to be reduced to 3 feet (0.9 m) where fire and explosion testing demonstrates that a fire within the ESS will not adversely impact the means of egress [NFPA 855 §9.5.2.6.1.7(B)].

The 10 feet minimum separation to means of egress components should be adhered to for all BESS installations. Where 10 feet (3 m) separation is not possible, the ESS equipment is able to utilize reduced 3 feet (0.9 m) separation with approval of the HMA by the AHJ.

6.4.3 Vegetation

Forest and grass fires can expose the ESS equipment to conductive smoke, fire plumes, radiant heat, and soot. Similarly, ESS equipment failure may expose the surrounding forested or vegetative areas to radiant heat.

Areas within 10 feet (3 m) on each side of outdoor ESS shall be cleared of combustible vegetation and other combustible growth [NFPA 855 §9.5.2.2.1]. Single specimens of trees, shrubbery, or cultivated ground cover such as green grass, ivy, succulents, or similar plants used as ground covers shall be permitted to be exempt provided that they do not form a means of readily transmitting fire [NFPA 855 §9.5.2.2.2].

In addition, the surrounding vertical vegetation (i.e., trees) heights should be analyzed to minimize fall potential that exists to the BESS facility.

6.4.4 General Spatial Separation of Oil-Insulated Equipment

Equipment and buildings should be separated from oil-insulated equipment to minimize the impact of a major fire. The spatial separation between the electrical equipment and oil-insulated equipment should be taken from the equipment edge to the anticipated flame front for large (i.e., >500 gallons [1,900 liters]), oil-filled equipment. The grid transformers are typically the largest oil-insulated equipment found in an electrical substation with a typical oil capacity of 3,000 – 7,000 gallons (11,400 – 26,500 liters). It is recommended that the oil filled equipment be separated based on the volumes identified in Table 6: Recommended Oil-Insulated Equipment Separation Distance [NFPA 850 Table 6.1.4.3].

Table 6: Recommended Oil-Insulated Equipment Separation Distance [NFPA 850 Table 6.1.4.3]

Equipment Oil Volume	Minimum Separation Distance
< 500 gallons (1,900 liters)	5 feet (1.5 m) 10 feet (3 m)
500-5,000 gallons (1,900 – 19,000 liters)	25 feet (7.6 m)
> 5,000 (19,000 liters)	50 feet (15.2 m)

Where oil containment is provided, the boundary of the oil containment should be considered as the anticipated flame front. Where oil containment is not provided, the spatial separation should consider the resulting anticipated flame spill area with permeability of the ground surface material. For equipment with oil volume more than 500 gallons (1,900 liters), the spatial separation should be taken from the equipment edge.

Where oil containment pits are provided with stone flame suppression, the spatial separation may be reduced pending AHJ approval, given that stone flame suppression surface is well maintained and free of dirt, debris, and organic matter that could prevent oil absorption.

The spatial separation between electrical equipment and small oil-filled equipment greater than 500 gallons (1,900 liters) should be taken from equipment edge to equipment edge. Small oil-filled equipment commonly found in BESS facilities consists of inverter transformers, medium voltage skids, and auxiliary transformers. General electrical equipment should be provided with 5 feet (1.5 m) minimum separation and BESS should be provided with 10 feet (3 m) separation.

As a good engineering practice, BESS equipment and other critical buildings should not be installed down slope of large oil-insulated equipment where failure of equipment or oil containment could engulf BESS equipment and critical buildings with combustible liquids.

For BESS sites where spatial separations to large oil-insulated equipment greater than 500 gallons (1,900 liters) cannot be provided due to site restrictions or limitations, the following options could be used:

- Fire barriers
- Calculated spatial separation

6.4.5 Fire Barriers

Passive fire protection using fire barriers of suitable construction may be installed as a means of spatial separation protection when the recommended separation distances cannot be achieved. Suitable construction may involve fire-resistive materials such as reinforced concrete, concrete masonry units (CMU), composite materials, or brick masonry.

For separation of BESS units to oil-insulated equipment greater than 500 gal (1,900 liters), a 2-hour fire barrier is recommended. The fire barrier construction should extend vertically and horizontally to block the line of site between the BESS unit to the exposure hazard.

6.4.6 Calculated Spatial Separation

As an alternative to prescriptive methods and separation distances, the minimum spatial separation may be derived from deterministic heat flux calculations. This method of calculated spatial separations is unique to the specific BESS project site and requires involvement of fire protection consultants/scientists and AHJ approval. This calculation method does not guarantee a successful outcome and end recipient of any calculations should be cautious of outcomes.

Example of project site specific parameters considered for calculated spatial separation analysis are as follows:

- Type and quantity of oil in the equipment
- Size of possible oil spill (surface area and depth)
- Type of construction of adjacent structures
- Type and amount of exposed equipment
- Power rating of exposed energized electrical equipment
- Provided fire protection systems
- Provided oil-filled equipment passive protection systems

Additional site-specific parameters may be needed for analysis depending on site specific conditions. This method is only recommended where the project site limitations do not permit prescriptive separation.

7.0 HYDRO ONE SETBACK REQUIREMENTS FOR CRITICAL TRANSMISSION INFRASTRUCTURE

7.1 Introduction

High voltage transmission facilities are part of the critical infrastructure and are extremely important for a safe, secure, and reliable supply of electricity. An outage on these facilities can result in power interruptions over a widespread area far from where the facility may be located. In Ontario, the Transmission System Code (TSC) requires the transmission company to maintain the reliability and integrity of its transmission system. It is therefore of the utmost importance that Hydro One ensures that the operation of these facilities is not affected by any BESS event.

In addition to the general requirements by the national and international codes for product and public safety, the setback distance for a battery electric storage system from high voltage transmission facilities, not addressed by the current codes and standards, depends on several factors, including local regulations, safety considerations, and project-specific requirements. Some general guidelines and considerations are as follows:

- Local regulations and codes: Different jurisdictions may have specific regulations or codes that dictate setback distances for battery storage systems from transmission facilities. These regulations are typically in place to ensure safety and mitigate potential risks.
- Safety considerations: Safety is a crucial factor in determining setback distances. Lithium-ion batteries used in electric storage systems have the potential to generate heat and, in rare cases, pose fire risks. Setback distances are established to minimize the risk of fire propagation and to provide adequate separation between the storage system and the transmission facilities.
- Emergency access and maintenance: Sufficient setback distances should be provided to allow for emergency access and maintenance activities for both the storage system and the transmission facilities. Adequate space is necessary for trucks and heavy machinery to conduct routine inspections, repairs, and emergency response activities to ensure safe, secure, and reliable operation of both systems.
- Transmission Facilities expansion plans: Sufficient setback distances should be provided to allow space for future transmission system expansion, and the BESS should not restrict the expansion of existing transmission right of ways or stations. For example, BESS should not limit the egress of new transmission circuits from stations. Consideration should be given to ensure there is sufficient space around transmission facilities (both lines and stations)

It is strongly recommended that the utility be consulted for any location that is in proximity to the transmission facilities.

7.2 Safety and Design Approach for Minimizing Impact on Transmission Facilities

As mentioned above, high voltage transmission facilities are critical for ensuring a safe, secure, and reliable supply of electricity. It is therefore of the utmost importance that the operation of these facilities is not affected by any BESS event. A two-step approach is to be followed to

minimize, control, or eliminate the impact of BESS events on the transmission facilities.

The first set of requirements are design and testing of BESS based on existing standards and industry experiences that minimize the adverse impacts from a BESS event, along with adequate protection and control and spatial separation within the BESS facility itself. Accordingly, most of the current safety requirements documented by the NFPA and others are targeted towards minimizing the possibility of the BESS event happening. This is covered by rigorous design and testing according to various codes as described earlier in Section 3. Design documentation and spatial separation between battery units are covered in Sections 5 and 6. The purpose is to reduce the probability of initiating an event in the first place. However, if it were to happen, the goal is to minimize the spread of the ensuing fire from a public safety perspective and the number of batteries affected.

The second set of requirements and/or considerations are to establish and maintain appropriate spatial separation of the BESS facility from the transmission facilities. A spatial separation ensures that BESS facility results in minimal or no impact on the present and/or future expansion of Hydro One transmission facilities and the impact of the event is confined to the immediate BESS area. Larger BESS facilities in standalone locations are classified as Outdoor Remote according to the NFPA classification (see Section 6.2). However, the 100 ft (30.5 m) separation is a general safety requirement and does not provide guidance on separation from critical Hydro One transmission facilities.

The key considerations from a Utility perspective to assure the safe, secure, and reliable design and operation of BESS are:

- There must be sufficient setback distances for multiple purposes: to allow safe operation of the grid and to allow for maintaining, connecting, and expanding the grid as needed.
- The BESS event must not result in an outage of an adjacent transmission line or station due to direct impact of smoke, combustion particles and/or fire.
- The BESS must not restrict or inhibit operation or expansion of transmission facilities (transmission line and/or transmission station).
- The BESS must not restrict egress or entry of transmission lines in/out of an adjacent substation.
- The BESS event must not result in a situation where the first responders to the BESS event require the utility transmission facility to be taken out of service to ensure a safe work area.

In addition, this helps ensuring long-term resiliency and sustainability of the transmission system.

7.3 Hydro One BESS Setback Requirement

Hydro One previously provided setback requirements for BESS facilities in its Transmission Generation Interconnection Requirement document in December 2022. These setback requirements have been reviewed based on the considerations presented above in Sections 7.1 and 7.2, and are summarized below:

Table 7 Hydro One Required BESS Facility Separation Distance Requirements

Item #	Hydro One Facilities	Hydro One Setback Distance[1,2]
1	Hydro One - 500 kV Right of Way (ROW)	150 meters
2	Hydro One - 230 kV ROW	100 meters
3	Hydro One - 115kV ROW	60 meters
4	Hydro One - 500 kV Substation	300 meters
5	Hydro One - 230kV Switching Substation	200 meters
6	Hydro One 115kV Switching Substation or Hydro One 230kV & 115kV step down Substation	120 meters

1. All distances are from the edge of right of way or Hydro One station property line.

2. For proponents that have acquired property rights or own the BESS property prior to January 1, 2023, and cannot meet the above distances, the layout must be discussed with Hydro One for assessment and approval.

The above separations are the minimum Hydro One requirements. It is suggested/expected that BESS Proponents promptly discuss the BESS layout and location with Hydro One to ensure it is not in conflict with Hydro One facilities including future expansion plans.

Two general depictions of common transmission facilities can be seen in Figures 1 and 2 below. Note that the figures are for visualization purposes only and multiple transmission lines of different voltages may enter and exit from a substation in varying directions. The distances are from edge of the right of way or the station property line.

Figure 1 Setback distance from substation property line

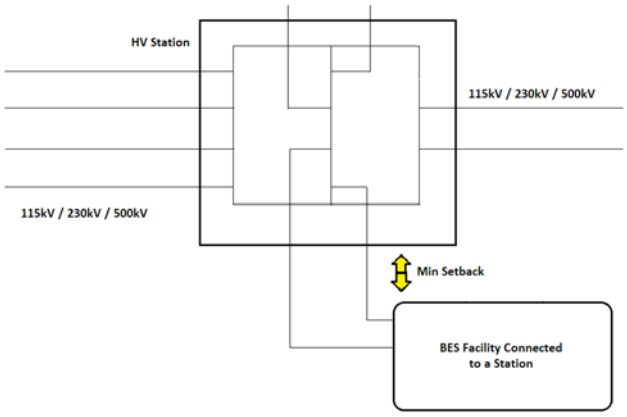
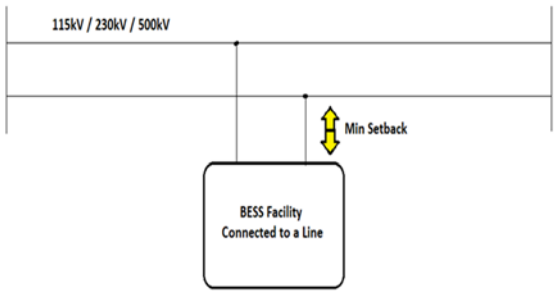


Figure 2 Setback distance from edge of right of way



These setback distances achieve multiple purposes: allow safe operation of the grid, allow for maintaining, connecting, and expanding the grid or station as needed, and reduce the proponent liability exposure in case of unplanned events. In addition, it allows access in case of emergency

on the grid or battery installation. Note that proponents must meet all the applicable setback requirements.

Prior to connecting to the transmission system, the BESS facility proponent is required to provide a signed self-certification document provided in Section 14 indicating that the following assessments as shown in the table below have been carried out and that the facility poses no known safety risks or unmitigated hazard to the Hydro One employees and transmission systems. The assessment reports will be made available to Hydro One, if/when requested, within 15 days of the request being made.

Table 8 Hydro One Required Assessments

Required Assessments	Up to 250m from Lines ROW	Up to 400m from Stations Property Line
• Hazard Mitigation Analysis (HMA) o Code Review o UL 9540 Listing o UL 9540A Test Report o Fault Condition Assessment	Required	Required
• Fire Risk Assessment (FRA) o Community Risk Assessment o Air/Gas Dispersion Study	Required	Required
• Fire Protection Design Documentation o Passive Fire Protection System o Active Fire Protection Systems	Required	Required
• Commissioning Plan	Required	Required
• Decommissioning Plan	Required	Required
• Emergency Response Plan o Fire Department Training	Required	Required

8.0 FIRE PROTECTION SYSTEM REQUIREMENTS

8.1 Fire Alarm & Detection System

An approved automatic smoke detection system or radiant energy-sensing fire detection system shall be installed in each outdoor unit containing electrochemical BESS. The fire alarm system shall annunciate alarm, trouble, and supervisory conditions in accordance with the appliable codes.

Alarm signals from the detection systems shall be transmitted to a central station, proprietary, or remote station service in accordance with NFPA 72 [NFPA 855 §4.8]. The FACP could alternatively be monitored by the substation SCADA system for alarm, trouble, and supervisory (where applicable) conditions if approved by the Hydro One and the AHJ for variance. If desired, trouble and supervisory signals can be combined into a single point monitored by SCADA.

Smoke and fire detection systems protecting an ESS with lithium-ion batteries shall be required to provide a secondary power supply in accordance with NFPA 72 capable of 24 hours in standby and 2 hours in alarm [NFPA 855 §4.8.3].

8.1.1 Types of Fire and Smoke Detection Devices

8.1.1.1 Spot Type Smoke and Heat Detector

Spot type smoke and heat detectors are the most commonly used detection methodology in the fire protection industry. A brief explanation of smoke and heat detector operational principal is provided below:

- Smoke detector, ionization – Operates using a radioisotope that detects the presence of smoke through current change via ionized particles. Ionization detectors are more sensitive to flaming fire.
- Smoke detector, photoelectric – Operates using a light-emitting diode and a photocell that detect the presence of smoke through current change with smoke obscuration. Photoelectric detectors are more sensitive to smoldering fires.
- Heat detector, fixed temperature – Operates using a heat-sensitive alloy that melts to produce a fire signal.
- Heat detector, rate of rise temperature – Operates using two thermocouples to detect a rapid rise of heat.

The two smoke detector types and fixed temperature heat detector are sometimes provided in a combined unit. Rate of rise heat detection is standalone and typically not combined with smoke detector. Possible combinations are as follows:

- Combination smoke detector (ionization/photoelectric)
- Combination heat detector (fixed temperature/rate of rise)
- Combination smoke/heat detector (ionization or photoelectric/fixed temperature)

The combination detector provides additional risk reduction by allowing the detector to respond faster to two types of fire.

8.1.1.2 Aspirating Smoke Detector

Aspirating smoke detectors (ASD) are a type of smoke detector that utilizes a centralized detector that continuously draws air into the detector from a sampling pipe network. ASD can be configured with multiple alarm thresholds providing detection capabilities for all fire stages from very early warning smoke detection at an incipient stage to fully developed fire. ASD piping network is highly configurable with capability to draw sampling air from the ceiling as well as from ducts and electrical cabinets. The ASD can be configured to provide additional gas detector sensors such as hydrogen gas and carbon monoxide.

8.1.1.3 Flame Detectors and Video Analytics

Flame detectors operated by detecting UV and/or IR radiation signature generated by a hydrocarbon and hydrogen flaming fires. Flame detectors could be integrated with a video camera similar to a surveillance camera. Proprietary video analytic software can be provided to scan the video feed for generated smoke to signal an alarm.

Flame detectors, with or without video analytics, could be a useful tool for outdoor BESS installations to provide additional layer of protection. However, for indoor installation, flame and smoke signatures detection is much delayed compared to the ASD early warning detection capabilities. The video camera option may prove useful for monitoring of BESS room conditions during fire events. However, continual monitoring during fire events may be hindered due to smoke obscuration.

8.1.1.4 Thermal Imaging Detectors

Thermal imaging operates by detecting thermal radiation generated by a heated surface. Thermal imaging may be applicable for lithium-ion battery failure by detecting small changes in temperature prior to thermal runaway or gas venting. This detection method requires line of sight to batteries and its effectiveness is reduced for BESS units with covered batteries.

8.2 Gas Detection System

Gas detection systems are used for monitoring gas concentration build up inside of BESS enclosures to monitor the level of combustible gasses off-gassing by the battery cells. Where gas detection is used to activate a combustible gas concentration reduction system and based on an appropriate NFPA 69 deflagration study, enclosures containing ESS shall be protected by an approved continuous gas detection system that complies with the following [NFPA 855 §9.6.5.6.7]:

- The gas detection system shall be designed to activate the combustible gas concentration reduction system on detection of flammable gases at no more than 10 percent of the lower flammability limit (LFL) of the gas mixture or of the individual components.
- The combustible gas concentration reduction system shall remain on, continually monitoring conditions, to ensure the flammable gas does not exceed 25 percent of the LFL of the gas mixture or of the individual components. The reporting LFL values

should be reported to the facility BMS or fire alarm panel/first responder panel where approved by Hydro One and the AHJ.

8.3 Annunciator Panel (First Responder Panel)

A typical BESS installation will encompass the installation of a firefighter first responder panel to display information to the responding fire department and substation/BESS personnel. A typical configuration for the annunciator panel to display information to the first responders is a textual output using LED display.

If desired by the AHJ or fire department, a complex building custom graphical annunciator or an interactive touchscreen annunciator may be provided to display information. A touchscreen annunciator provides automatic navigation to the emergency event location and is specific to a fire event. In addition, a time sequence display of fire detector activation provides easier capability to pinpoint the source of the fire and tracking of fire event progression.

8.4 Fire Suppression System

8.4.1 Water Based Suppression

Water is the most commonly used fire suppression medium. NFPA 855 requires automatic sprinkler systems be installed for BESS systems located inside buildings. NFPA 855 §4.9.2.1 requires a sprinkler water density of 0.3 gpm/sqft over an area of 2,500 sqft, a hose demand of 500gpm, and a duration of 120 min for buildings or walk-in enclosures.

A brief explanation of water-based fire suppression system types is provided below:

- Wet pipe fire sprinkler system – The most typical installation. Sprinkler pipes are filled with water which release upon operation of a closed sprinkler.
- Dry pipe fire sprinkler system – Sprinkler pipes are filled with pressurized air or nitrogen. Pipes are filled with water upon loss of pressure from closed sprinkler operation. Normally used for unconditioned outdoor spaces.
- Pre-action fire sprinkler system – Sprinkler pipes are filled with pressurized air or nitrogen. Single interlock operation fills the pipe with water upon smoke/heat detector activation. Double interlock operation filles the pipe with water upon smoke/heat detector activation and loss of pressure from closed sprinkler operation. Normally used for unconditioned indoor spaces or for water sensitive equipment.
- Deluge fire sprinkler system – Sprinkler pipes are open to air with open sprinklers. Pipes are filled with water with all sprinkler operating upon smoke/heat detection.
- Foam fire sprinkler system – Water based system with foam additives. Not recommended as foam insulates BESS fire event equipment increasing heat absorption of neighboring cells and equipment.

NFPA 855 allows for alternative automatic fire control and suppression systems based on NFPA 9540A large-scale fire testing result [NFPA 855 §4.9.3].

NFPA 855 allows fire suppression system omission for outdoor remote BESS installations based on large scale fire testing where the BESS fire event does not compromise the means of egress, does not present an exposure hazard, and is approved by a code official [NFPA 855 §4.9.1.6].

8.4.2 Fire Fighting Water Supply

Firefighting water supplies are essential for the BESS installation life cycle from the arrival of materials to the final stage of installation. An adequate water supply for firefighting shall be provided as soon as combustible or encapsulated mass timber construction material arrives on the site [NFC2020 §5.6.3.5]. The water supply may be either natural or developed and need not be the final water supply for the building or facility [NFC2020 §A.5.6.3.5(1)].

8.4.3 Clean Agent and Aerosol

Clean agent systems operate by disrupting the fire chemistry or creating an inert environment by reducing the oxygen concentration. Clean agent system will extinguish a fire but will not stop thermal runaway or off-gassing of cells.

Aerosol systems operate by disrupting the fire chemistry and will extinguish a fire but will not stop thermal runaway or off-gassing of cells.

Clean agent or aerosol systems, if provided, should not serve as a primary fire suppression system where required. If these systems are installed, there should be large-scale test data demonstrating their effectiveness and they should be backed up by a water-based fire sprinkler system.

If a clean agent or aerosol system is to be selected, the system should not inhibit/stop the normal operation of other building/enclosure mitigation systems such as an NFPA 69 ventilation system.

8.5 Fire Protection System Signage

NFPA 855 requires equipment signage provided with the installation of any new BESS Enclosure. The signage is to follow NFPA 704 *Standard System for the Identification of the Hazards of Materials for Emergency Response* identification markings and ANSI Z535.

8.6 Fire Department Access

NFPA 855 required fire department access roads shall be provided for outdoor BESS installations in accordance with local fire code [NFPA 855 §4.7.11]. An approved fire department apparatus access road shall be provided to each building by means of a street, private roadway, or yard [NBC2020 §9.10.20.3].

9.0 EXPLOSION MITIGATION REQUIREMENTS

9.1 Explosion Protection Systems

BESS equipment and/or buildings in which they are installed are required to be provided with an explosion protection system in accordance with NFPA 68 (deflagration venting), NFPA 69 (flammable gas ventilation), or an alternate performance-based design in accordance with NFPA 855. The ventilation system installation is required by NFPA 855 and is an industry practiced installation for BESS locations.

9.1.1 Deflagration Venting [NFPA 68]

The BESS should be equipped with NFPA 68 deflagration vents located on the roof or walls of the equipment enclosure or installed building. Deflagration vents are to be installed in locations where the potential for gas build up could occur in a confined space. Care should be taken to not block or install equipment that may obstruct the operation of the deflagration vents.

Where BESS is installed in geographic locations with routine ice and snow, any accumulation should be removed to ensure proper function of the deflagration vents. For these locations, it is recommended to provide flammable gas ventilation system as the primary explosion protection system.

9.1.2 Flammable Gas Ventilation System [NFPA 69]

The BESS or installed building may alternatively be provided with a NFPA 69 flammable gas ventilation system. The ventilation system is activated upon hydrogen or other appropriate gas sensor activation. Computational fluid dynamics (CFD) modeling is a tool for modeling the gas development and movement within a given defined boundary. The CFD model will illustrate the locations within a BESS enclosure with a lack of air moment or gas build up. This model is a performance-based approach to the development of a NFPA 69 ventilation system for gas build up relief. This model is recommended for evaluation of all BESS enclosure installations.

The power feeding the ventilation system is to be redundant and should be provided via two independent electrical utility grid connections or via an automatic transfer switch connected to a single electrical utility grid connection and a backup generator. NFPA 855 also requires a minimum of 2 hours of mandatory backup period for a flammable gas ventilation system/fan.

10.0 COMMISSIONING PLAN

Commissioning plans should be established for the fire protection features, BESS electrical utility interface.

10.1 Fire Protection and BESS - Acceptance Testing

The procedures and requirements for acceptance testing vary between different AHJs. The acceptance testing requirements should be verified during the start of the project. Some AHJs will require that they be notified and witness all fire protection systems acceptance tests. Other AHJ may allow or permit request for qualified third party to witness acceptance testing.

Prior to the final acceptance testing, the fire protection installing contractor should provide a written acknowledgement or certificate that a complete pretest of the system has been conducted and that all deficiencies found during pretest have been corrected.

All BESS electrical utility interface and BESS equipment is to be coordinated and confirmed with Hydro One and proponent prior to system installation. Testing and acceptance criteria shall be in line with the manufacture's requirements and NFPA 855.

10.2 Fire Protection and BESS - Record of Completion

The fire protection installing contractor is to furnish a signed Record of Completion for final signoff by the AHJ, the AHJ designated inspector, or a qualified third party after the successful completion of the final acceptance test.

Written documentation for all fire protection system testing should be maintained by the BESS fire protection system owner through the duration of the system's existence.

Final acceptance records of completion documentation shall be provided to Hydro One for the BESS equipment and interconnections upon final completion of the facility installation.

11.0 OPERATIONS & MAINTENANCE PLAN

Inspection, testing, and maintenance (ITM) is critical to the continued proper function of fire protection features provided for the BESS facility. All fire protection features should be inspected, tested, and maintained according to applicable NFPA standards and vendor recommendations. Fire alarm and gas detector (if installed) ITM should follow recommendations provided in NFPA 72. All water-based fire protection systems ITM should follow recommendations provided in NFPA 25.

The BESS manufacturer's manual includes the required maintenance to meet BESS specific requirements. Site level equipment is not included in O&M manual.

12.0 DECOMMISSIONING PLAN

12.1 Process Area

A process area must be established to receive modules removed from the container. Consideration for the location of the process area is as follows:

- They should respect the setback requirements from Transmission Facilities.
- Should cells begin to vent the process area should not be within 50-feet of any ignition sources.
- Should cells unexpectedly enter the thermal runaway phase, a non-combustible surface area should be used for the process area.
- The process areas should be located within 100-feet of a hydrant with fire department accessibility.
- The process area should not be located within 50-feet of combustible materials.
- The area should have one access point for control, staffed to ensure access only as needed.

12.2 Required Personal Protective Equipment

Personal protective equipment (PPE) required for the removal of any battery modules will be defined by the hazards found during the post-fire assessment. The decommissioning personnel must consider the potential hazards present to identify what level of PPE is appropriate for the hazard and the duration of use.

12.3 Removing Modules

All modules involved in fire or having exceeded the critical threshold temperatures should be disposed. Prior to removing modules, they should be assessed to ensure they are not in a state of venting.

12.4 Managing Stranded Energy/Reignition

The risk associated with transporting modules that do not have a zero state of charge is mitigated with the use energy absorbing materials. An environmentally friendly, mineral-based extinguishing agent should be used for suppression of problematic fires associated with the disposal of Lithium-Ion batteries.

12.5 Packaging and Transportation

A shipping package that can accommodate the dimension and weight of a module must be obtained. The container should be vented and transported on an open rack-body vehicle. Transportation manifests shall detail the contents of the containers and the state of charge of the batteries not compromised by fire.

13.0 EMERGENCY RESPONSE PLAN

13.1 Emergency Response Plan Document

An emergency response plan (ERP) shall be readily available at each BESS facility for use by facility operators, maintenance personnel, and the fire department [NFPA 855 §4.3.2.1.1]. The ERP is a living document that should be updated when conditions for the substation/facility change that affect the response considerations and procedure changes. At minimum, the ERP shall include the following [NFPA 855 §4.3.2.1.4]:

- Procedures for safe shutdown
- Procedures for inspection and testing
- Procedures in response to notifications of system alarms or out-of-range conditions
- Emergency procedures to be followed in case of fire, explosion, release of liquids or vapors, or damage to critical moving parts
- Response considerations for surrounding public area
- SDS (safety data sheets)
- Procedures for dealing with BESS equipment damaged from an emergency
- Other procedures determined as necessary by the AHJ (e.g., mitigation measures to minimize environmental impacts)
- Procedures and schedules for conducting drills

13.2 Fire Department Training

NFPA 855 requires the owner of the BESS unit or their authorized representative engage in emergency planning and training of emergency responders such that any foreseeable hazards associated with the outdoor BESS units can be effectively addressed [NFPA 855 §4.3.1].

13.3 Integrator Training

It is typically industry practice for the system integrator to conduct training on the new BESS enclosure; integration training is provided by the manufacturer to the Hydro One team members. This training typically looks at equipment usage and normal operation considerations rather than emergency response.

14.0 APPENDIX 1 - SIGNED AND SEALED DOCUMENT ASSEMBLY – SELF CERTIFICATION DOCUMENT

Proponent Company Name
Proponent Company Address
Proponent Company Logo

Proponent Certifying Individual's Name
Certification or Credential Criteria (Professional Engineer, NICET, Project Manager, etc.)

BESS Facility Project Name
BESS Facility Project Address

Name of Hydro One Substation or Transmission Point of Connection

Dear Hydro One Team:

Individual Name with Proponent Name certifies that the that the required assessments have been carried out and the documentation is accurate and complete for the BESS Facility Name interconnection to Hydro One Facility per the requirements of the Risk and Response Assessment Standard.

Individual Name with Proponent Name also certify that the BESS facility poses no known safety or outage risk or unmitigated hazard to the Hydro One employees and transmission system**.**

Assessments	
Hazard Mitigation Analysis (HMA), Including • Code Review • UL 9540 Listing • UL 9540A Test Reports • Fault Condition Assessment	 ☐ ☐ ☐ ☐
Fire Risk Assessment (FRA) • Community Risk Assessment • Air/Gas Dispersion Study	 ☐ ☐
Fire Protection Design Documentation, Including: • Passive Fire Protection Systems • Active Fire Protection Systems	 ☐ ☐
Commissioning Plan	☐
Decommissioning Plan	☐
Emergency Response Plan • Fire Department Training	☐ ☐

This letter is to certify that documentation is complete and will be made available to Hydro One, when requested, within 15 days of Hydro One making the request. Additional documentation outside the above list is not included in this certification declaration.

Signature

Name
Title Stamp or Seal
Date