Review of

Rijksinstituut voor Volksgezondheid en Milieu 2013 Report No. 200000001/2013

"Wind turbines: impact on perception and health of residents: Municipal Public Health Service Environmental Public Health report Update 2013 "

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January 2016

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1. BACKGROUND

As a leading expert on the biological response to low frequency noise exposure (see brief biographical background offered at the end of this document), the author was requested by the Law Offices of Li & van Wieringen, on behalf of Platform Storm, to provide a Review of Report No. 200000001/2013, prepared by the Rijksinstituut voor Volksgezondheid en Milieu (RIVM) of The Netherlands, and titled: *Wind turbines: impact on perception and health of residents: Municipal Public Health Service Environmental Public Health report Update 2013*, herein referred to as 2013 RIVM Report.

1.1. Disclaimer

a) *The author of this review and the research team represented are not party to anti-technology sentiments;*
b) *Wind turbines are considered by this author and team as welcome additions to modern technological society;*
c) *In no way can or should this review be construed as a document arguing for or against the implementation of wind turbines;*
d) *The review provided herein has one, and only one, agenda - that of pure scientific inquiry.*

1.2 Goal of this Review

To evaluate the aforementioned Report, within the author's area of expertise and therefore, exclusively focused on the infrasound and low frequency noise (ILFN) health-related issues claimed to be associated with wind turbines operations, specifically, the concept of noise annoyance.

1.3 The 2013 RIVM Report under scrutiny

The immediate goal of the 2013 RIVM Report was stated as follows:

> *This report … is aimed at supporting the answering of questions concerning the effects of wind turbines on the wellbeing of local residents. These questions often play a prominent role in local discussions on plans for … a wind turbine park* (p 3).[1]

While the ultimate goal seemed to be:

[1] Page number citations of the 2013 RIVM Report refer to the translated version, as provided to this author.

> *In the discussions on local wind energy projects, the Municipal Public Health Services can focus on providing accurate information regarding the effects on actual and perceived health to policy makers as well as the public* (p3).

The methodology adopted for answering these questions was *a systematic review of the literature* (p21), with the word search strategy explained in Appendix 2. The terms "animals" and "humans" were excluded (p57). The following are a few examples of the applied search words: wind turbine, wind park, wind energy, low frequency noise, infrasonic *and* perception, annoyance, sleep disturbance, noise sensitivity, social barrier, public resistance, dose-response, health aspects, health outcomes (p57). Two databases were used for the literary review – Scopus and Medline.

The conclusions included the following statements:

> *Local residents may experience annoyance for the noise of wind turbines; this is the most described effect of living near wind turbines*. (p43)
>
> *Under certain conditions, shadow flicker can also occur, which can be annoying*. (p43)
>
> *There is currently insufficient data available to evaluate the effect of wind turbine noise on sleep*. (p43)
>
> *There is no evidence of other direct health effects*. (p43)
>
> *[F]or some people, health complaints can be caused or worsened by the annoyance and stress caused by the feeling that the placement of wind turbines will result in a deterioration of the quality of the environment or quality of life*. (p43)
>
> *Similar to other sources, the low-frequency portion of wind turbine noise is likely to result in extra-annoyance, but there is currently no evidence that this is a significant factor for wind turbines*. (p44)
>
> *The presence or even the planned presence of wind turbines is enough to cause annoyance, driven by personal and contextual factors*. (p44)

Shadow flicker, sleep disturbances and annoyance seem to be the principal endpoints, with annoyance taking a more prominent role.
This author has been informed that no author of the 2013 RIVM Report possesses credentials as a medical doctor.

1.4 Scope of this Review

Major conceptual difficulties are pointed out, specifically:

-- Inappropriate use of self-reported data on noise annoyance levels;
-- Use of subjective data as if it were objective data;
-- Non-compliance with the exigencies of Evidence-based Medicine;
-- Non-compliance with the exigencies of The Scientific Method;
-- Absence of clinical corroboration associated with the "impact on health;"
-- Absence of clinical information among literature reviews;
-- ILFN is considered merely as psychosocial agent instead of a physical agent of disease.

1.5 Definitions

For the purposes of scientific clarity, the following definitions are used:

Sound: Airborne pressure wave events capable of being perceived by the human auditory system.

Noise: Airborne pressure wave events capable of being perceived by the human auditory system, and that are deemed as unwanted.

Acoustical phenomenon: any airborne propagating pressure wave that may, or may not, be perceived by the human auditory system. If perceived by the human auditory system, it becomes sound. After a sound is perceived and processed, it may be deemed as "noise."

Vibration: solid-to-solid (not airborne) transmission of a pressure wave and/or the result of airborne pressure waves impacting solid or viscoelastic material.

Infrasound: acoustical phenomena occurring at frequencies ≤ 20 Hz and that are considered as not perceived by the human auditory system

Low frequency noise: acoustical phenomena occurring at frequencies > 20 Hz up to at least 100 Hz, although some scholars also consider an upper limit of 200 Hz, 250 Hz and 500 Hz. Within this range of frequencies, the acoustical phenomena may, or not, be perceived as sound.

Infrasound and low frequency noise (ILFN): Acoustical phenomena occurring within frequencies ≤ 250 Hz.

2. WHAT IS NOISE ANNOYANCE?

> "Annoyance is probably the most widely experienced and least studied of all human emotions. How do we know that? We don't really. There is no Department of Annoying Studies or annoyingologists. There are no data, no measurements of how many people are annoyed or how annoyed people are, no investigations into what makes people annoyed, and no systematic looks at how people cope with annoyance. In fact, if you talk to psychologists, practitioners of a scientific discipline that one would think would have grappled with annoyance, you get the feeling that there might not be such a thing as annoyance at all" [1].

One of the more controversial topics in noise exposure is this human response of *annoyance*, often coupled to the concept of *noise sensitivity*.

2.1 The various definitions of noise annoyance

Quantification of annoyance among noise-exposed populations began in the 1970's in the United States, and the annoyance parameter was determined to be a useful *noise predictor* [2].

More recently, a comprehensive definition for *noise annoyance* was provided by the European Environment Noise Team in its 1999-2000 Report:

> *Annoyance is the scientific expression for the non-specific disturbance by noise, as reported in a structured field survey.*
>
> *Nearly every person that reports to be annoyed by noise in and around its home will also experience one or more of the following specific effects:*
> - *Reduced enjoyment of balcony or garden;*
> - *When inside the home with windows open: interference with sleep, communication, reading, watching television, listening to music and radio;*
> - *Closing of bedroom windows in order to avoid sleep disturbance.*
>
> *Some of the persons who are annoyed by noise also experience one or more of the following effects:*
> - *Sleep disturbance when windows and doors are closed;*
> - *Interference with communication and other indoor activities when windows and doors are closed;*
> - *Mental health effects;*
> - *Noise-induced hearing impairment;*
> - *Hypertension;*
> - *Ischemic heart disease* [3].

By 2010, the European Environmental Agency (EEA) asserted that the variable *annoyance disturbance* had been sufficiently proven to impact the "psychosocial,

quality of life" dimension of health and wellbeing, and *noise annoyance* was accepted as "a term used in general for all negative feelings such as disturbance, dissatisfaction, displeasure, irritation and nuisance" [4].

2.2 Opposing definitions of noise annoyance

In 2013 the European Commission's Network on Noise and Health (ENNAH) published their Final Report, where the ontological status (or formal definition) of *noise annoyance* varied, sometimes significantly [5].

In the interest of scientific inquiry, all the various notions of *noise annoyance* included in the ENNAH report were collected and are reproduced below.

Sometimes, "annoyance" was <u>considered a health effect</u>:

> A "negative effect on health" related to environmental noise exposure (p8),
> A "potential non-auditory health" effect (p25),
> "Appears to be" the "primary effect of infrasound" (p26),
> A "health outcome" (p27),
> A "health endpoint" (p45),
> A "non-direct health outcome" (p84),
> A "'soft' health outcome" (p86),
> A "severe" health effect and a "very widespread effect" of environmental noise (p91).

Other times, "annoyance" was <u>not considered a health effect</u>:

> Presumed to cause "indirect health effects" (p9),
> "Can be the result of noise exposure, but also a mediator" (p27),
> An endpoint in social surveys (p42),
> "An effect modifier of the relationship between the noise level and the health endpoint in some noise studies" (p43),
> A "moderator and mediator" for noise and health (p124).

Oftentimes its status was ultimately <u>unclear</u>:

> "Could serve as indicator of noise level" (p39),
> A "psychological" effect (p21),
> A "health indicator" (p50),
> "Not believed to be on the pathway to … any … health measures" (p60),
> A "noise outcome" (p81),
> Appropriately assessed by Lden (day-evening-night equivalent level) values (p84),
> "Very specific to a particular microenvironment" (p94),
> An "omnipresent" effect (p124),
> "Impacted by environmental noise" (p124),

The 2013 ENNAH Report further asserts:

> *It is still unclear whether annoyance is a consequence of the noise affecting on the human body or whether the indirect pathway to ill-health might be mediated by annoyance … [T]he role of noise sensitivity with regards to environmental noise and annoyance is unconfirmed. There has been evidence that other factors such as socioeconomic status, age, gender or other environmental factors like air-pollution also confound or moderate health outcomes … but their role in these interactions is unclear to date.* (p24)

The Report also defines Priority Research Areas for the Scientific Community, where the "Role of annoyance and noise sensitivity" was listed among the "first most important" topics to be investigated (p29):

> *The experts suggested that policy makers should emphases noise reduction at the source in order to minimise noise related health effects rather than focusing on noise mitigation interventions, reducing noise annoyance or using other tools* (p30).

2.2 Noise annoyance is analogous to a clinical symptom

In the extensive experience of our team, "noise annoyance" is considered a *symptom*. Patients who report being highly noise annoyed, or noise sensitive, have been confirmed as those individuals who have had extensive prior noise exposure (fetal, residential, occupational or recreational) [6-10]. Our team has learned to recognize noise annoyance as analogous to a fever. The level of individual noise annoyance *greatly depends* on prior noise exposure patterns.

3. EVIDENCE-BASED MEDICINE AND THE SCIENTIFIC METHOD

Objective, instead of subjective, parameters are required in order to proceed within the scientific exigencies of Evidence-based Medicine and The Scientific Method.

As can clearly be ascertained in the excepts transcribed above from

a) the conclusions of the 2013 RIVM Report,
b) the European Environment Noise Team 1999-2000 Report [3],
c) the EAA statement [4], and
d) the 2013 ENNAH Final Report [5],

annoyance is clearly viewed as a *subjective* parameter. Otherwise, it would not be observed to vary with economic gain, or visualization, or *feelings* of decreased quality-of-life.

Since many authors do not appear to have any significant clinical background, the following analogy is offered in the interest of clarifying the difference between objective and subjective data within a clinical context.

3.1 Subjective vs. objective parameters for "health effects"

A patient's *subjective* complaints of feelings of lethargy, lack of appetite and excessive warmness (or intense coldness) may suggest the existence of a fever. The physician's empirical observations (called signs, as opposed to symptoms) are also subjective, albeit based on a more systematic, informed and focused clinical observation.

For implementing the desired guidelines of Evidence-based Medicine and The Scientific Method, a *thermometer* is produced to *objectively* evaluate a parameter. This evaluation either corroborates or denies the existence of a fever. A subjective sensation is thus translated into an objective measurement.

Objectively measuring a symptom also provides crucial information for denouncing malingerers (i.e. individuals merely pretending to be ill).

Noise annoyance levels are evaluated through questionnaires, sometimes over the telephone, other times mailed in, and only rarely with direct personal interviews. The numerical and statistically-treated *self-reported* data is then manipulated as objective data, and sometimes even as clinical data. This contradicts the basic methodology subjacent to The Scientific Method, whereby scientific data must be of an *objective* nature. It also contradicts the precepts of Evidence-based Medicine, whereby "evidence" must also be of an objective and scientific nature.

Clinical Medicine is the branch of medicine that tries to associate patient symptoms and physician-observed signs, to objective scientific parameters. Patient complaints of fever-like symptoms added to the observation of signs of fever in the patient, induces the physician to advance the hypothesis that the patient may be presenting with fever. The hypothesis is only confirmed or denied by the *thermometer reading* – no matter how warm and lethargic the patient claims to feel, and no matter how warm the patient feels to the physician's touch.

The health effect character of "noise annoyance" is analogous to the health effect character of fever. Fever has an effect on health but, in itself, it is neither disease, nor the causative factor of illness. Rather, it is a response. Within the precepts of Evidence-based Medicine and The Scientific Method, fever is considered an *indicator*. The number (objectively) measured on the thermometer *indicates* whether or not the body is still diseased or if it has had some measure of recovery. Thus, a "health effect" is scientifically and clinically ascertained. Such a similitude exists with noise annoyance and noise exposure, as has been corroborated by our team since the 1980's [6-10].

4. NOISE ANNOYANCE IS A SYMPTOM OF WHAT?

Individuals exposed to excessive ILFN do not complain of hearing loss. Quite on the contrary, they complain of "hearing too much," even though audiometric testing sometimes shows losses in the lower frequencies (<500 Hz). Excessive exposure to infrasound and low frequency noise (ILFN) does not cause hearing loss. Instead it causes increased sensitivity to noise [6-10].

As an example, individuals who are exposed to noise that causes hearing impairment will have a tendency to increase the volume of a television set otherwise they cannot hear it properly. On the contrary, ILFN-exposed individuals *lower* the television set volume because they "cannot stand it." There is a significant difference between the body's response to noise exposure, and the body's response to ILFN. As the symptom of hearing difficulty can indicate that excessive noise exposure has occurred, the onset of noise annoyance can indicate that excessive ILFN exposure has occurred.

Sound is transduced to the brain through an anatomical structure called the cochlea. Cochlear cilia are made of a biopolymer called actin, and consist of finger-like structures rooted into a basilar membrane. When an acoustical pressure wave impacts the ear, it gets translated into movement at the level of the basilar membrane that, in turn, causes movement in the cilia. This ciliary movement originates the neural signal that is then relayed through the upper cochlear structure, called the tectorial membrane, and is ultimately processed by the brain. Cilia are lost with the normal aging process and with excessive noise exposure.

Loss of cilia *does not* occur in ILFN-exposed rodents (Wistar rats) when compared to age-matched non-exposed rodents. In fact, cilia are seen to fuse amongst themselves *and* with the upper tectorial membrane. In 2003, our group postulated that these unique anatomical changes might form the underlying organic etiology for the symptom of noise annoyance [11,12].

In fact, behavioral changes in the ILFN-exposed rats corroborated this postulation. Rats are particularly sensitive to the sound of a "blown kiss" and react by jerking their heads and becoming tense. After ILFN-exposure, the "blown kiss" causes them to rise on their hind legs, often falling backward, with tremors [13]. Other actin-based structures, namely in the respiratory system, were also observed to fuse in ILFN-exposed rodents [13,14].

5. ILFN LEVELS AND THE ONSET OF ILFN-INDUCED PATHOLOGY

In 2000, this team began receiving complaints from families claiming to have developed pathology due to their residential ILFN, *unrelated to wind turbines*. Clinical and acoustical studies then ensued:

-- The physical agent of disease (ILFN) was quantified *within* the homes of the complaining families; and
-- The clinical protocol (medical examinations) established for ILFN-exposed workers was provided to these residentially-exposed individuals.

Residentially-exposed patients presented the same pathological indicators of ILFN-induced pathology as those seen in ILFN-exposed workers [15].

In fact, in residentially-exposed individuals, the time evolution profile of disease seemed to be accelerated when compared with that of ILFN-exposed workers [16].

In 2006, we were contacted by a family living in Portugal and who complained of feeling ill ever since wind turbines were installed around their home. The *same, systematic approach* was used regarding the clinical corroboration of the family's symptoms, and the acoustical quantification of in-home ILFN. Papers on this case were first presented in 2007, and provided *clinical confirmation* for the symptoms described by the family [17].

This particular family owned a Lusitanian thoroughbred horse breeding-farm, and abnormalities were soon observed in these animals as well. In 2010, the same systematic studies applied to ILFN-exposed rodent tissue were applied to biological tissue taken from these ILFN-exposed horses.

The anatomical abnormalities identified in the horses were the same as those identified in ILFN-exposed rodents, (and also in biopsy material of ILFN-exposed humans) [18,19].

In 2015, a follow-up of this case was presented at Euronoise 2015. In point of fact, family members who abandoned that residential location (i.e. ceased excessive ILFN-exposure) saw a *clinically-corroborated* recovery [20].

It is often claimed that the studies conducted by our team over the past 3 decades are unrelated to the onset of disease among families living in the vicinity of wind turbines because our studies have focused on much larger levels of ILFN (simulating industrial occupational environments) than those encountered in residential environments.

These statements are usually pronounced by individuals with no medical training, no clinical background, and who possess a reductionist view of the interaction between

acoustical phenomena and biological tissue, normally reflected by the sentence "what you can't hear won't hurt you."

More importantly, these claims are not accompanied by *any* objective scientific evidence, as is mandatory when making statements intended to have scientific validity. In fact, the reason why these claims are made is a result of the lack of information on how physical agents impact biological organisms: It is not merely the *amount of the physical agent* that is important; the *amount of exposure time* is also of the utmost significance.

5.1 Occupational versus residential ILFN exposures

Our ILFN-exposed rodents were exposed to occupationally-simulated ILFN exposure. This means they *only* spent 8 hours/day in the ILFN environment and, moreover, spent the *entire weekends in silence*.

Residential ILFN exposure can occur over 24-hour periods, in a continuous manner, and recovery periods are only afforded if and when individuals *leave their homes*. Despite the validity of this explanation, the ultimate corroboration for ILFN-induced pathology developing in ILFN-rich residences comes solely from *scientifically objective* and *clinical relevant* data [15,17,20]

Within this context, and as per the exigencies of Evidence-based Medicine and The Scientific Method, assertions by themselves do not constitute facts, and they particularly do not constitute *scientific* facts.

Thus, sentences such as those found in 2013 RIVM Report where ILFN-induced pathology is considered "highly unlikely at current wind turbine sound levels" (p35), without any benefit of any clinical corroboration, cannot be taken seriously by informed clinical and medical professionals, and should not be taken seriously by decision-makers.

5.2 Evaluating health effects due to a physical agent of disease

The *amount of physical agent* to which humans are exposed is normally a cumulative quantity, i.e., past exposures condition the biological response to that agent.

When infrasound and low frequency noise is the physical agent under study, information of past fetal, residential, occupational and leisure ILFN exposures is crucial for determining veridical "health effects."

6. USING THE dBA UNIT TO ASSESS INFRASOUND & LOW FREQUENCY NOISE

The dBA unit was developed in order to be able to enter an acoustical environment and (only) measure the sound that humans can hear well, i.e., the sound specifically associated with *hearing loss*.

Noise that is measured in dBA units *does not* contain any useful scientific data pertaining to ILFN.

WHO Guidelines for Community Noise, published in 1999, explicitly state that quantification of ILFN-rich environments in dBA units is inappropriate:

> *Noise measurements based solely on LAeq values do not adequately characterize most noise environments and do not adequately assess the health impacts of noise on human well-being ... If the noise included a large proportion of low-frequency components, values even lower than the guideline values will be needed, because low-frequency components in noise may increase the adverse effects considerably. When prominent low-frequency components are present, measures based on A-weighting are inappropriate* [21].

The acoustical output of WT is normally considered to have two distinct origins: a) mechanical noise associated with the gearbox mechanisms in the nacelle, and b) the aero-acoustical noise associated with blade rotation. Complaints are generally more associated with the aero-acoustical portion of the physical phenomena than with the mechanical noise.

Numerous studies have been conducted to assess the acoustical output of wind turbines, some of them mentioned in the 2013 RIVM Report (p 25). Usually these studies use the dBA unit to quantify the sound level and, in general, microphones are placed *outside* and adjacent to the dwellings.

Acoustical studies conducted under these conditions *do not* adequately assess neither *the amount* nor *the nature* of the physical agent of disease, i.e., ILFN.

Within the scope of our extensive research, the inadequacy of the dBA unit for the quantification of ILFN and the lack of usefulness of ILFN measurements taken outside the home, were obvious early on.

Figure 1 shows acoustical measurements obtained *in the bedroom* of the home of the aforementioned Portuguese wind turbine case.

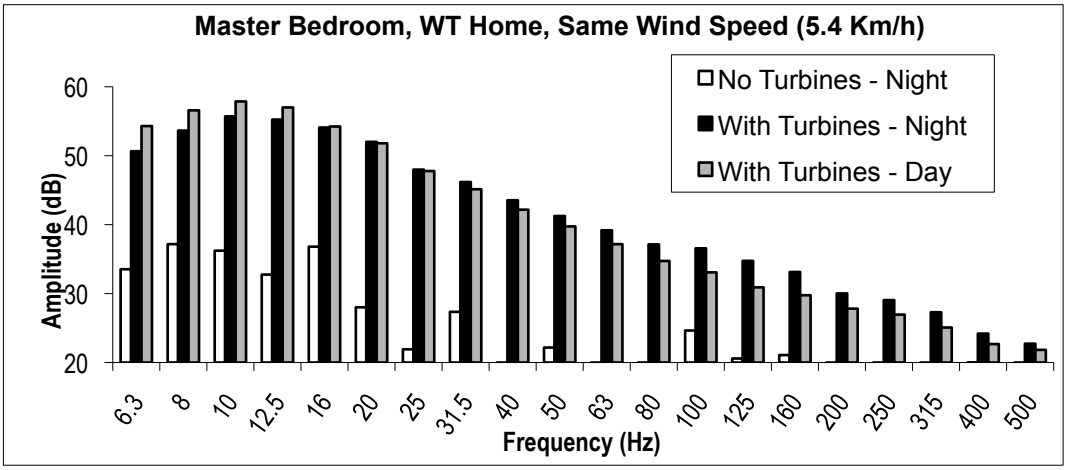

Fig. 1. Data continuously collected over a 14-day period by an independent accredited firm, *inside* the Master Bedroom of the wind turbine home, and in 3 distinct situations. Data compiled by the author in order to compare the 3 acoustical environments *at the same windspeed* [17].

Given the physical nature of airborne pressure waves, characterized by large wavelengths, the impact on residential structures will vary immensely depending on (for example) a) the surrounding geological features (mountains, bodies of water, forests etc), and b) the dwelling's construction materials and floor-plan.

Although this seems to be recognized by the 2013 RIVM Report (p 25), acoustical measurements in dBA and taken outside of ILFN-rich dwellings are nevertheless believed to represent an accurate measurement of the agent of disease. This methodology does not stand up to scientific scrutiny, i.e., it is not scientifically valid.

7. ILFN – A PHYSICAL AGENT OF DISEASE

Acoustical phenomena are mechanical events. Noise is a pressure wave that can physically impact a variety of different structures of human (and animal) bodies.

This is the reason why it is considered a *physical* agent of disease as opposed to chemical, biological, psychosocial, or ergonomic agent of disease.

The physical nature of noise is reflected in the WHO *International Classification of Diseases* [22]. In Chapter XX, *Exposure to inanimate mechanical forces*, the following "external causes for morbidity and mortality" are defined:

> *W42 Exposure to noise*
> *Includes: Sound waves, supersonic waves*
>
> *W43 Exposure to vibration*

Includes: infrasound waves

For reference and contextualization, the entries immediately before and after W42 and W43 are as follows:

W41 Exposure to high-pressure jet

W44 Foreign body entering into of through eye or natural orifice. [22]

7.1 Mechanical signaling within cells and tissues

It is beyond the scope of this Review to expound on how the biomolecular and biomechanical nature of tissues and cells transduce ILFN-induced pathology, as seen in ILFN-exposed individuals and animals. A full review can be found in [10].

In short, a human body is not some solid, stone-like object. Rather, it is composed of many different types of materials. Using words more familiar to Structural and Materials Engineers, the human body is a composite of viscoelastic materials, possessing the properties of *creep, relaxation* and *hysteresis*. As such, anisotropic acoustic impedances and wave propagation throughout viscoelastic tensegrity systems constitute the underlying mechanisms for ILFN-induced pathology.

The notion that airborne pressure waves just ricochet off of the human body has no scientific validity. In fact, the energy of an airborne pressure wave can be transduced into the several different types of viscoelastic biomaterials that compose the human body.

Using electron microscopy, several different types of tissue fragments from ILFN-exposed organisms have been studied by our team with the goal of identifying possible morphological (i.e. organization of tissue structures) changes. These could help explain the biological pathways of ILFN-induced pathology, and ultimately contribute to clinical and diagnostic questions.

Within this context, the response to ILFN exposure was identified as essentially mechanical [10,23], with the pronounced growth of collagen (considered the steel of human biomaterials given its strength) causing biological structures to thicken, such as blood vessel walls [24], tracheal epithelia and lung pleura in humans [25] and animals [26], and pericardium [27,28].

When the blood vessels whose walls are thickening happen to be coronary arteries, ischemic events occur, hence the increased risk of cardiovascular events among ILFN-exposed persons [10].

These types of “health effects” are not capable of being assessed through questionnaires.

7.2 Evaluating physical outcomes with questionnaires, interviews and surveys

Throughout the 2013 RIVM Report, several studies and authors are proposed as relevant to the investigation of "health effects" that allegedly develop among families living in the vicinity of wind turbines. Herein, this author will refer to only two of such "health studies."

> **A. Report of Independent Expert Panel, prepared for the Massachusetts Department of Environmental Protection and Department of Public Health titled *Wind Turbine Health Impact Study* (Jan 2012).** [29]

In order to investigate the issue of health effects and wind turbines, the authors of this report offer a literature review. The search strategy applied to this literature review ultimately justified the sole consideration of four "peer-reviewed" studies, and another four "non-peer-reviewed documents," as listed below in Table 1:

Table 1. Studies considered by the Independent Expert Panel for their Report.

	Authors	Parameter(s)
Peer-Reviewed	Pederson *et al.* 2004	Annoyance questionnaire + dBA
	Pederson *et al.* 2007	Annoyance questionnaire + dBA
	Pederson *et al.* 2008	Mailed surveys + dBA
	Shepard *et al.* 2011	Quality of life questionnaire
Non-Peer-Reviewed	Van den Berg *et al.* 2008	General health questionnaire + dBA
	Phipps 2007	Survey
	Pierpont 2009	Survey
	Nissenbaum *et al.* 2011	Questionnaire + sleep distrubances

The conclusions of this Expert Panel included the following statements:

> *The strongest epidemiological study suggests that there is not an association between noise from wind turbines and measures of psychological distress or mental health problems. There were two smaller, weaker, studies: one did note an association, one did not. Therefore, we conclude the weight of the evidence suggests no association between noise from wind turbines and measures of psychological distress or mental health problems.* (p.ES-7)
>
> *Most epidemiologic literature on human response to wind turbines relates to self-reported "annoyance," and this response appears to be a function of some combination of the sound itself, the sight of the turbine, and attitude towards the wind turbine project.* (p.ES-5)
>
> *There is insufficient evidence that the noise from wind turbines is directly (i.e., independent from an effect on annoyance or sleep) causing health problems or disease.*

B. Chapman S, St. George A. *How the factoid of wind turbines causing 'vibroacoustic disease' came to be 'irrefutably demonstrated.'* Australian and New Zealand Journal of Public Health, 2013 [30].

Here, medical doctors specialized in Public Health decided to perform literature searches in order to disprove the existence of ILFN-induced pathology, i.e., vibroacoustic disease. In addition to performing electronic searches among the Medline, Premedline, Scopus and Web of Science databases, the authors also used Google's search engine:

> *An advanced Google search using the string 'vibroacoustic' and 'disease' and 'wind' was conducted on 10 different computers on 28 August 2012 with the average number of hits calculated. Running the search across different computers owned by different people is important because Google search results can vary according one's search history.*

The paper concludes:

> *Health concerns are being used by wind energy opponents to thwart new projects. Regulatory authorities should take care to critically examine the quality of evidence for claims that wind turbines harm health.*

7.3 And again, Evidence-based Medicine and The Scientific Method

If claims denying the existence of adverse health effects are to be scientifically acceptable, then they too must be gathered within the exigencies of Evidence-based Medicine and The Scientific Method.

In Medicine, conclusions based on literature surveys are not considered clinical data. While under certain circumstance they may serve as indicators, they do not constitute the clinical and objective data that are *sine qua non requirements* to make assertions on the absence or existence of an adverse or beneficial health effect.

Health effects, be they adverse or beneficial, have the mandatory requirement of clinical corroboration in order to be considered as scientifically valid data.

This author submits to the layperson reader of this Review the option of deciding on the use of literature reviews as clinically useful data.

7.4 Clinically useful data for ILFN-exposed individuals

Symptomatic patients that approach our team claiming to be exposed to excessive noise are given objective medical examinations. This establishes clinical confirmation, corroboration or denial of the physician's hypothesis as to the etiology of the patient's symptoms and of the physician-observed signs.

Choice of relevant medical examinations for each suspected clinical condition is, of course, of crucial importance. For example, a blood test checking for the presence of HIV will provide very little clinically-useful, diagnostic information for a patient suspected of having a herniated disc.

Within the context of ILFN-induced pathology, providing an electrocardiogram (for example) to ILFN-exposed individuals is non-relevant from a diagnostic standpoint since no statistically significant alterations are known to be present in ILFN-exposed individuals [7-10].

For future reference and contextualization, the most clinically relevant medical examinations to ascertain if an individual's health is (really) being affected by excessive ILFN exposure are listed below:

-- Evaluation of pre-existing medical conditions and prior noise exposure history
-- Echocardiography (pericardial echogenicity with GAIN<40)
-- P300 Event-Related Potentials
-- Brainstem Auditory Evoked Potentials
-- PCO_2 Respiratory Drive

The rationale for each of these clinical tests has been advanced in our body of work spanning 30 years, reviews of which can be found here [7-10], and a summary of which can be found here [31].

An account of how these tests were applied to the family in the wind turbine case can be seen here [17] and an updated follow-up here [20].

8. UNDERSTANDING WHAT IS AT STAKE

Humanity requires electricity – lots of it!

Coal- and oil-based technologies are no longer acceptable, and harvesting wind energy seems like a good alternative solution for humankind's energy requirements.

There is an understandable urgency to change the underlying source of energy for our electricity-dependent societies. As a result, governments have been turning to wind energy and, as explained in the 2013 RIVM Report (p15-16, 18-19), are determined to reach a pre-defined quota of wind-energy output by the year 2020.

There are huge advantages in having a symbiotic relationship between harvesting energy and human biospheres, as history has shown us countless times. However, the urgency associated with attaining quotas does not seem to be allowing the necessary time for adequate symbiotic planning.

The assessment of “noise annoyance” levels, as explained by Verheijen *et al.* (2011) referenced in the 2013 RIVM Report, reflects this idea:

> *For The Netherlands, a socially acceptable percentage of severely annoyed lies around 10 % which can be derived from the existing limits and dose-response functions of railway and road noise* [32].

In accordance with our scientific, clinical data, this 10% of “severely annoyed” population will also see an increase in cardiovascular events, neurological disturbances, digestive problems and large joint pain. This, in turn, will increase absenteeism and medical expenses, causing social disruption among families and peers [33].

8.1 Giving the benefit of the doubt

Health, as defined by WHO:

> *A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity* [34].

Annoyance is not included in the WHO International Classification of Diseases (ICM 10- 2016 version) [22]. However:

> *Although high annoyance is not classified as a disease in the International Classification of Disease (ICD-9; ICD-10), it does affect the well-being of many people and therefore may be considered to be a health effect falling within the WHO definition of health as being a “state of complete physical, mental and social well-being”* [35].

It is possible that the strenuous attempts that have been made to associate “noise annoyance” to a “health effect” are related to the *social wellbeing* portion of the WHO definition for health.

It may be that many authors relate “noise annoyance” to “health effect” grounded in a legitimate concern regarding the *social wellbeing* aspect of health. It may also be the case that the great interest in self-reported “noise annoyance levels” are actually being used as *noise predictors*, as was their original intended use.

Whether or not these speculations are true, the fact remains that excessive ILFN exposure has a *de facto* physical effect on human health. This can be scientifically proven through objective medical examinations, and cannot be assessed by self-reported annoyance levels

The insistence on “noise annoyance questionnaires” in order to assess “health effects” deliberately ignores the *physical wellbeing* portion of the WHO definition of health.

8.2 ILFN-induced pathology and vibroacoustic disease

Chronic exposure to ILFN can lead to the development of pathology that (in the 1990's) was termed vibroacoustic disease.

Clinical stages and diagnostic criteria for VAD were formally established in 1999 [7,8], based on 20 years of prior clinical and laboratorial research of ILFN-exposed individuals and rodents [6,36-44, for example].

The statements made herein are supported by 30 years of clinical, biomedical and acoustical investigations, methodologically consistent with the exigencies of Evidence-based Medicine and The Scientific Method. To date, they have never been disputed with scientific evidence.

Noise annoyance is a symptom of vibroacoustic disease, i.e., ILFN-induced pathology. Treating it solely as a psychosocial agent of disease will not make this fact disappear. Ignoring it as a symptom of excessive exposure to a physical agent of disease is leading to dire consequences, not only for the 10% of "severely annoyed" segment of the population.

9. CONCLUSIONS

A.
The 2013 RIVM Report contradicts exigencies of Evidence-based Medicine and The Scientific Method when it asserts the existence or absence of a "health effect" based on self-reported questionnaires

A "health effect" can only be claimed or denied on the basis of clinical data, obtained through objective and relevant medical examinations.

A questionnaire is not an objective medical examination.

B.
The 2013 RIVM Report contradicts exigencies of Evidence-based Medicine and The Scientific Method when it assumes that "impact on perception" and "impact on health" are parameters of equivalent category.

The acceptance of self-reported data as a rigorous measure for assessing the "impact on perception" *and* "impact on health" is not scientifically tenable.

C.

"Noise annoyance levels" as conceptualized by the 2013 RIVM Report are advanced as useful indicators for territorial zoning, but not because of any veridical effect on physical health, even though it is so insinuated.

The urgency of reaching a certain energy quota by 2020 justifies the acceptance of a 10% "severely annoyed" segment of the population. While, real physical "health effects" proliferate among humans and animals living in the vicinity of wind turbines, psychosocial factors (at best) continue to be weakly evaluated.

D.

In accordance with the exigencies of Evidence-based Medicine and The Scientific Method, the 2013 RIVM Report *does not provide* "accurate information regarding the effects on actual … health to policy makers as well as the public," even though this was so stated as its goal.

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