TO: Todd Bianco
EFSB

10/10/2017

I want everyone to take out their crystal balls -

Now look into your crystal ball and tell me what our energy needs and energy options will be in 10 years - how about 20 years --- can you see 30 --- Now look at 40 years from now.....

That is how long Invenergy wants us to commit to their fracked gas and diesel burning power plant -- 40 YEARS! 40 years of toxins spewing in the air - 40 years of unknown water use - 40 years plus of loss of economic development, tourism and recreational use for Burrillville. 40 years for 20 jobs --

In addition what will the renewable energy sector look like in 40 years. What kind of upgrades will we have in Solar and Wind as well as hydro and biodiesel. Think of how far we have come in the last 40 years when it comes to renewable and green energy.

Do we really want RI to be stuck with an outdated technology if the plant is ever permitted - Power plants cannot be upgraded once they are constructed but solar panels and windmills can.... How much of a life cycle does fracked gas have? It is already becoming more and more expensive to extract -- what will the industry look in 10 years - 20 years 30 years and longer....

40 years from when it is suppose to be sited it will be around 2060! Should RI really be beholden to Invenergy and the CREC until that time... is that really a bridge fuel... or a bridge to nowhere.... And then there is global warming and climate disruption - will we even need more oil and fracked gas for heating in upcoming winters... New England winters are getting warmer and warmer so our need for additional fossil fuel heating sources will be less and less. Why stick us with a plant for 40 years when our winters may become shorter and shorter!

Burrillville does not need this plant, Glocester does not need this plant, RI does not need this plant, New England does not need this plant the United States does not need this plant! And we will stop it.

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Clearing the Air: A Review of the Effects of Particulate Matter Air Pollution on Human Health

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Abstract

The World Health Organization estimates that particulate matter (PM) air pollution contributes to approximately 800,000 premature deaths each year, ranking it the 13th leading cause of mortality worldwide. However, many studies show that the relationship is deeper and far more complicated than originally thought. PM is a portion of air pollution that is made up of extremely small particles and liquid droplets containing acids, organic chemicals, metals, and soil or dust particles. PM is categorized by size and continues to be the fraction of air pollution that is most reliably associated with human disease. PM is thought to contribute to cardiovascular and cerebrovascular disease by the mechanisms of systemic inflammation, direct and indirect coagulation activation, and direct translocation into systemic circulation. The data demonstrating PM's effect on the cardiovascular system are strong. Populations subjected to long-term exposure to PM have a significantly higher cardiovascular incident and mortality rate. Short-term acute exposures subtly increase the

premature deaths

rate of cardiovascular events within days of a pollution spike. The data are not as strong for PM's effects on cerebrovascular disease, though some data and similar mechanisms suggest a lesser result with smaller amplitude..Respiratory diseases are also exacerbated by exposure to PM. PM causes respiratory morbidity and mortality by creating oxidative stress and inflammation that leads to pulmonary anatomic and physiologic remodeling. The literature shows PM causes worsening respiratory symptoms, more frequent medication use, decreased lung function, recurrent health care utilization, and increased mortality. PM exposure has been shown to have a small but significant adverse effect on cardiovascular, respiratory, and to a lesser extent, cerebrovascular disease. These consistent results are shown by multiple studies with varying populations, protocols, and regions. The data demonstrate a dose-dependent relationship between PM and human disease, and that removal from a PM-rich environment decreases the prevalence of these diseases. While further study is needed to elucidate the effects of composition, chemistry, and the PM effect on susceptible populations, the preponderance of data shows that PM exposure causes a small but significant increase in human morbidity and mortality. Most sources agree on certain "common sense" recommendations, although there are lonely limited data to support them. Indoor PM exposure can be reduced by the usage of air conditioning and particulate filters, decreasing indoor combustion for heating and cooking, and smoking cessation. Susceptible populations, such as the elderly or asthmatics, may benefit from limiting their outdoor activity during peak traffic periods or poor air quality days. These simple changes may benefit individual patients in both short-term symptomatic control and long-term cardiovascular and respiratory complications.

Keywords

Particulate matter Air pollution Cardiovascular Respiratory Public policy

Introduction

While some correlation between poor air quality and human disease has been recognized since antiquity, the health effects of air pollution entered the world's consciousness in the twentieth century. In 1930, sulfur dioxide from local factory emissions mixed with a dense fog over the Meuse Valley in Belgium. Over 3 days, several thousand people were stricken with acute pulmonary symptoms, and 60 people died of respiratory causes [1]. In December 1952, a dense smog containing sulfur dioxide and smoke particulate descended upon London, resulting in more than 3,000 excess deaths over 3 weeks and as many as 12,000 through February 1953 [2]. The lethality of air pollution was immediately

recognized but not well understood. To this day, because the effects of air pollution on illness occur at a population level, many clinicians fail to appreciate the relationship between air pollution and health.

The 1970 Clean Air Act (CAA) was the first major American regulatory effort aimed at both studying and setting limits on emissions and air pollution. The 1970 CAA defined the National Ambient Air Quality Standards (NAAQS [3]). These standards set limits on six primary pollutants found in air: carbon monoxide, lead, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter (PM) [4].

PM is a complex mixture of extremely small particles and liquid droplets made up of acids, organic chemicals, metals, and soil or dust particles [5]. Sources of PM are both natural and anthropogenic. Manmade sources of PM include combustion in mechanical and industrial processes, vehicle emissions, and tobacco smoke. Natural sources include volcanoes, fires, dust storms, and aerosolized sea salt.

PM can be described by its "aerodynamic equivalent diameter" (AED). Particles of the same AED will tend to have the same settling velocity. Researchers traditionally subdivide particles into AED fractions based on how the particles are generated and where they deposit in human airways: <10, <2.5, and <0.1 μm (PM_{10}, $PM_{2.5}$, and $PM_{0.1}$, respectively). Particles with a diameter greater than 10 μm have a relatively small suspension half-life and are largely filtered out by the nose and upper airway. Researchers define a diameter between 2.5 and 10 μm ($PM_{2.5-10}$) as "coarse," less than 2.5 μm as "fine," and less than 0.1 μm as "ultrafine" particles. When interpreting PM research, it is important to appreciate that PM_{10} contains ultrafine ($PM_{0.1}$), fine ($PM_{0.1-2.5}$), and coarse ($PM_{2.5-10}$) fractions. In a mixed environmental sample, the total number and total surface area of these particles *increases* exponentially as the diameter of the particle decreases. However, the total particulate mass of a substance generally *decreases* exponentially with decreasing particle diameter. For example, in a sample of PM_{10}, the numerical majority of particles would be ultra-fine, but these particles would make up a negligible portion of the sample's total particulate mass (Fig. 1).

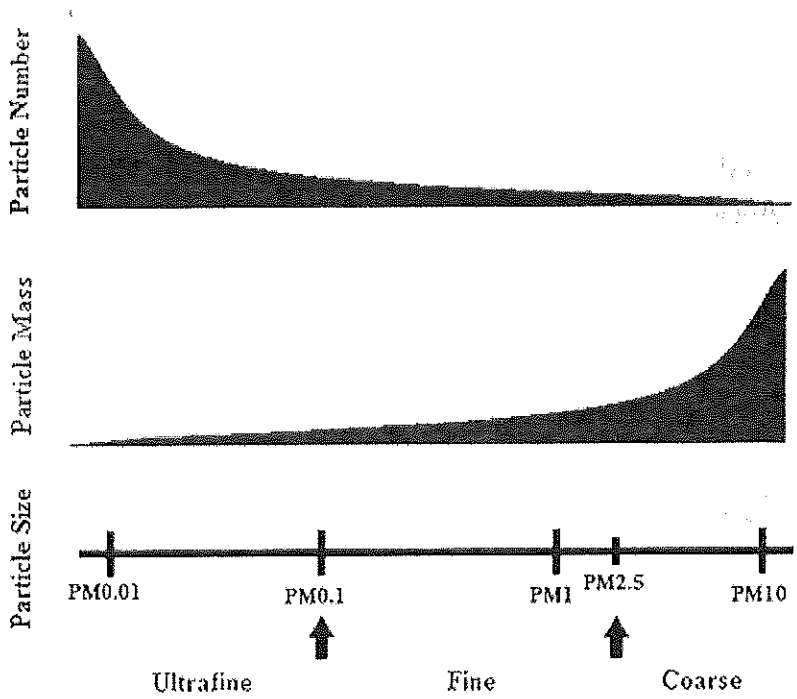

Fig. 1
A hypothetical mixed particle distribution

Studies show an increase in morbidity and mortality related to PM exposure. While the increased daily risks from PM exposure are modest for any individual, the costs of the worldwide healthcare burden are staggering when applied to populations. The World Health Organization estimates that $PM_{2.5}$ concentration contributes to approximately 800,000 premature deaths per year, ranking it the 13th leading cause of mortality worldwide [6].

This paper provides a review of the effect of ambient airborne PM on human morbidity and mortality. We review the current understanding of the mechanisms that underlie the observed clinical findings. Emphasis is placed primarily on research concerning the cardiovascular, respiratory, and cerebrovascular systems. This review concludes with public health recommendations based on a summary of the reported literature's findings.

Methods

The authors conducted a scientific review of all available literature published over the last 30 years. Our primary objective was to determine the association or lack of association between PM and human health. Our secondary objective was to summarize the proposed mechanisms for any purported associations based on existing human, animal, and in vitro studies. We initiated a PubMed database search using the MESH terms "PM," "particulate

Author	Year	PM	ΔPM (in μg/m³)	Outcome measure	Effect (95% CI)	
Dockery et al. [17]	1993	PM_{10}	18.6	All-cause mortality	26% (8–47)	
Pope et al. [18]	1995	PM_{10}	24.5	All-cause mortality	17% (9–26)	
			PM_{10}	24.5	Cardiopulmonary mortality	31% (17–46)
Hoek et al. [28]	2002	BS	10.3	Cardiopulmonary mortality	71% (10–167)	
Pope et al. [25]	2002	$PM_{2.5}$	10	Cardiopulmonary mortality	9% (3–16)	
Pope et al. [26]	2004	$PM_{2.5}$	10	Ischemic CVD mortality	18% (14–23)	
			$PM_{2.5}$	10	CHF, arrhythmia, CP arrest	13% (5–21)
Miller et al. [27]	2007	$PM_{2.5}$	10	Cardiovascular event	24% (9–41)	
			$PM_{2.5}$	10	Cardiovascular mortality	76% (25–147)
Toren et al. [29]	2007	PM	Not measured	Cardiovascular mortality	12% (7–19)	

PM particulate matter, *ΔPM* increase in ambient PM, *BS* black smoke

Pope et al. [8] followed this in 1995 with another prospective cohort study of 552,000 patients in 151 metropolitan areas using the American Cancer Society's Cancer Prevention 2 database (ACS CPS 2). These data showed a 17% (95% CI, 9–26%) increase in all-cause mortality and a 31% (95% CI, 17–46%) increase in cardiopulmonary mortality when comparing the most and least polluted cities. In 2002 [25] and 2004 [26], Pope et al. re-reviewed the expanding ACS CPS 2 database, now with 1.2 million participants, and extended the follow up. Their research demonstrated an average increase in cardiopulmonary mortality of 9% (95% CI, 3–16%) for each 10-μg/m^3 increase in $PM_{2.5}$. Subsequently, they determined that a 10-μg/m^3 increase in PM increased ischemic cardiovascular disease mortality by 18% (95% CI, 14–23%) and mortality from arrhythmia, congestive heart failure, and cardiac arrest by 13% (95% CI, 5–21%).

In 2007, the Women's Health Initiative Study [27] followed a cohort of over 65,000 postmenopausal women with no previous heart disease over approximately 6 years. The investigators revealed that long-term PM exposure in this population resulted in a 24% (95% CI, 9–41%) increase in cardiovascular events and an astonishing 76% (95% CI, 25–147%) increase in cardiovascular mortality per 10-μg/m^3 increase in $PM_{2.5}$. While these results had fairly wide confidence intervals, these data suggest that this cohort of patients may be particularly susceptible to ambient PM exposure.

The findings of cardiovascular effects from PM exposure are not unique to the USA. In the Netherlands, long-term exposure to traffic-related air pollution increased cardiopulmonary mortality by 71% (95% CI, 10–167%) [28]. A 2007 cohort study [29] of 250,000 Swedish construction workers from 1972 to 2002 found that workers with occupational PM exposure had a 12% (95% CI, 7–19%) increase in ischemic cardiovascular disease mortality.

While increases in PM have been consistently shown to increase cardiovascular morbidity and mortality, the effects of PM reduction have also been studied. In the 72 months following the ban of bituminous coal sales in Ireland in 1990, black smoke concentration decreased by 35.6 μg/m^3 over this time, and standardized respiratory and cardiovascular mortality decreased by 15.5% (95% CI, 12–19%) and 10.3% (95% CI, 8–13%), respectively [30]. An 8-year extension of the Harvard Six Cities data studied the population subset that moved from areas of higher to lower PM concentration [31], finding that a 10-μg/m^3 decrease in $PM_{2.5}$ resulted in a 27% (95% CI, 5–43%) decrease in overall mortality.

Short-Term Effects

A 2001 review [32] of 12 prior studies concluded that a 10-μg/m^3 increase in PM_{10} increased hospital admissions for congestive heart failure and ischemic heart disease by

0.8% (95% CI, 0.5–1.2%) and 0.7% (95% CI, 0.4–1.0%), respectively. Similarly, a 2006 review [33] showed a 0.44% (95% CI, 0.02–0.86%) and 1.28% (95% CI, 0.78–1.78%) increase in admissions for ischemic heart disease and heart failure for a 10-μg/m^3 increase in $PM_{2.5}$, respectively. In a smaller trial, Pope et al. [34] used a case-crossover of 12,000 patients in Utah to show that a 10-μg/m^3 increase in $PM_{2.5}$ led to a 4.5% (95% CI, 1.1–8.0%) increase in acute ischemic coronary events. In an analysis of PM concentrations from 20 major cities in the USA using the National Morbidity Mortality Air Pollution Study (NMMAPS) data, Samet et al. [9] showed a 10-μg/m^3 increase in PM_{10} caused an increase in all-cause and cardiopulmonary mortality by 0.5% (95% CI, 0.1–0.9%) and 0.7% (95% CI, 0.2–1.2%), respectively (Table 2).

Table 2

Short-term effects of PM on the cardiovascular system

Author	Year	PM	ΔPM (in $\mu g/m^3$)	Outcome measure	Effect	
Morris [32]	2001	PM_{10}	10	Hospital admission, IHD	0.7% (95% CI, 0.4–1.0)	
			PM_{10}	10	Hospital admission, CHF	0.8% (95% CI, 0.5 –1.2)
Domicini et al. [33]	2006	$PM_{2.5}$	10	Hospital admission, IHD	0.44% (95% CI, 0.02–0.86)	
			$PM_{2.5}$	10	Hospital admission, CHF	1.28% (95% CI, 0.78 –1.78)
Barnett et al. [36]	2006	$PM_{2.5}$	10	Hospital admission, IHD	1.6% (95% CI, 0.7 –2.4)	
			$PM_{2.5}$	10	Hospital admission, CHF	3.6% (95% CI, 1.8 –5.4)
			$PM_{2.5}$	10	Hospital admission, AMI	2.7% (95% CI, 1.3 –4.2)
Pope et al. [34]	2006	$PM_{2.5}$	10	Ischemic cardiac event	4.5% (95% CI, 1.1 –8.0)	

Author	Year	PM	ΔPM (in $\mu g/m^3$)	Outcome measure	Effect	
Samet et al. [9]	2000	PM_{10}	10	All-cause mortality	0.5% (95% CI, 0.1–0.9)	
			PM_{10}	10	Cardiopulmonary mortality	0.7% (95% CI, 0.2 –1.2)
Omori et al. [35]	2003	TSP	20	All-cause mortality	1.0% (95% CI, 0.8–1.3)	
			TSP	20	Cardiopulmonary mortality	1.1% (95% CI, 0.7 –1.5)

PM particulate matter, *ΔPM* increase in ambient PM, *TSP* total suspended particles, *IHD* ischemic heart disease, *CHF* congestive heart failure, *AMI* acute myocardial infarction

Similar results have been found in Japan [35], Australia, and New Zealand [36]. In 2008, Samoli et al. [37] re-analyzed the data of the APHEA 2, NMMAPS, and several Canadian studies in order to assess the coherence of findings using the same methods for all three sets of data. They were able to show an increase in daily all-cause mortality for Canadian, European, and US cities. Interestingly, the short-term mortality resulting from acute increases in PM are not limited to the critically ill or dying. In fact, much of the mortality occurred among active individuals with one or more risk factors.

PM and Respiratory Health Effects

While much of the interest in PM has focused on the cardiovascular system [7, 8], many studies evaluated the association between PM exposure and respiratory illness. Researchers have evaluated endpoints including respiratory symptoms, medication use, lung function, health-care utilization, and mortality.

Respiratory Mechanisms

PM triggers pulmonary oxidative stress and inflammation. Human airway epithelial cells exposed to PM express inflammatory cytokines [38, 39]. Alveolar macrophages exhibit respiratory burst activity, producing reactive oxygen species, nitrogen species, and release TNF-α and IL-1 after exposure [40]. In addition to oxidative stress generated from activation of inflammatory cells, reactive oxygen species may be directly generated from the surface of particles [41]. These responses can be potent and were shown to cause measurable pulmonary damage after only a single exposure in mice [42]. This oxidative damage is associated with the primary development of asthma and chronic obstructive pulmonary disease (COPD). Long-term exposure to PM results in airway remodeling and chronic inflammation [43]. PM may also contribute to asthma development by enhancing atopy and IgE responses [44, 45]. Several controlled human experiments have demonstrated adverse affects on the pulmonary system. PM exposure has been shown to increase airway responsiveness to methacholine [46], increase neutrophil numbers in bronchial lavage [47], decrease CO diffusion capacity, and decrease maximum mid-expiratory flow [48].

Respiratory Symptoms and Medication Usage

As part of the Children's Health Study, McConnell et al. [49] found that asthmatic children had a 40% (95% CI, 10–80%) increased risk of bronchitic symptoms for a 19-μg/m^3 increase in PM_{10}. Similarly, a 10-μg/m^3 increase in PM_{10} led to a 12% (95% CI, 4–22%) increase in severe asthma symptoms in Seattle children [50]. A study of inner-city asthmatic children revealed an association between $PM_{2.5}$ increases and missed school days for asthma [51]. A study of adult Parisians [52] showed a 41% (95% CI, 16–71%) increase in acute asthma exacerbations per 10-μg/m^3 increase in PM_{10}. Interestingly, nearly all PM levels in these studies were below levels set out in the NAAQS.

Respiratory medication use also increased in times of peak PM concentration. Use of rescue bronchodilators increased as ambient $PM_{2.5}$ rose in Denver [53] and the Northeast USA [54]. A review of 80,000 Alaskan Medicaid enrollees found prescription rates for

increases of 6.5 μg/m³ are associated with a 15% (95% CI, 2–30%) increase in respiratory-related hospital admissions [69] (Table 3).

Table 3

The effects of PM on respiratory admissions

Author	Year	PM	ΔPM (in μg/m³)	Outcome measure	Effect (95% CI)	
Karr et al. [67]	2006	$PM_{2.5}$	10	Infant bronchiolitis admissions	9% (4–14)	
Lin et al. [68]	2005	$PM_{10-2.5}$	6.5	Pediatric respiratory admissions	17% (6 –29)	
Samoli et al. [92]	2011	PM_{10}	10	Pediatric asthma admissions	2.54% (0.06 –5.08)	
Peng et al. [93]	2008	$PM_{10-2.5}$	10	Respiratory admissions	0.33% (–0.21 –0.86)	
Zanobetti et al. [70]	2009	$PM_{2.5}$	10	Respiratory admissions	2.07% (1.2 –2.95)	
			$PM_{2.5}$	17	Pneumonia admissions	6.5% (1.1 –11.4)
Medina-Ramon et al. [71]	2006	PM_{10}	10	COPD admissions	1.47% (0.93 –2.01)	
			PM_{10}	10	Pneumonia admissions	0.84% (0.5 –1.19)
Dominici et al. [33]	2006	$PM_{2.5}$	10	COPD admissions	1.61% (0.56 –2.66)	
McGowan et al. [77]	2001	PM_{10}	14.8	Respiratory admissions	3.37% (2.34 –4.40)	

Author	Year	PM	ΔPM (in μg/m³)	Outcome measure	Effect (95% CI)
Ostro et al. [94]	2009	$PM_{2.5}$	14.6	Pediatric respiratory admissions	4.1% (1.8 −6.4)

PM particulate matter, *ΔPM* increase in ambient PM

For adults, several large studies have demonstrated an association between respiratory hospitalization and ambient PM_{10} [70] and $PM_{2.5}$ [71] concentrations. This includes admissions for asthma, COPD, and pneumonia. The effects appear to be stronger for elderly patients with even short-term exposures [72]. A study [73] of 12 million Medicare enrollees in 108 counties demonstrated significant increases in respiratory hospitalizations for increases in $PM_{2.5}$ in the Eastern USA. Because the same effects were not consistently observed in the Western USA, the authors suggested that morbidity may be related to the specific chemical constituents of PM which differs across the country. Several recent large studies have provided further evidence that the strength of PM effect may depend on the composition [74]. Investigations in European cities [75], Asian cities [76], and Oceania cities [77] have demonstrated a consistent and small though significant association between PM concentrations and emergency visits for respiratory diseases.

PM and Respiratory Mortality

The Six Cities study [7], 20 cities study [9], and ACS CPS 2 [8] cohort revealed an association between PM exposure and cardiopulmonary mortality. These studies did not, however, separate the impact on respiratory mortality versus cardiovascular mortality. A follow-up investigation using data from the 20 Cities Study revealed a 0.87% (95% CI, 0.38 −1.36%) increased respiratory mortality for short-term increases in PM_{10} by 10 μg/m³ [78]. This was subsequently expanded into a larger cohort of 112 US cities, where researchers found a 1.68% (95% CI, 1.04–2.33%) increase in respiratory mortality for every 10-μg/m³ increase in $PM_{2.5}$ [79]. A study of California counties similarly revealed an increased respiratory mortality with increases in PM_{10} [80].

These results have been reproduced in countries around the world. A Norwegian study [81] demonstrated a 17% (95% CI, 9–25%) increase in mortality risk from COPD for every quartile increase in $PM_{2.5}$. In a study of 275,000 adults in ten Italian cities [82], short-term

PM_{10} increases led to a 2.29% (95% CI, 1.03–3.58%) increase in respiratory mortality. Similar results for increased respiratory mortality have been found in Asian cities where researchers have demonstrated excess respiratory mortality risk for increases in PM_{10} [83]. Nearly identical effect sizes for respiratory mortality were found in the APHEA2 trial which studied this relationship across 29 European cities [84]. One study even demonstrated an association between PM_{10} and respiratory mortality in children under age five [85] (Table 4).

Table 4

The effects of PM on respiratory mortality

Author	Year	PM	ΔPM (in μg/m³)	Outcome measure	Effect (95% CI)
Zeka et al. [78]	2005	PM_{10}	10	Respiratory mortality	0.87% (0.38 −1.36)
Zanobetti et al. [79]	2009	$PM_{2.5}$	10	Respiratory mortality	1.68% (1.04 −2.33)
Wong et al. [83]	2008	PM_{10}	10	Respiratory mortality	0.62% (0.22 −1.02)
Analitis et al. [84]	2006	PM_{10}	10	Respiratory mortality	0.58% (0.21 −0.95)
Hales et al. [91]	2010	PM_{10}	10	Respiratory mortality	1.3% (0.5 −2.1)
Pope et al. [25]	2002	$PM_{2.5}$	10	Lung cancer mortality	8% (1–16)
Ostro et al. [80]	2006	$PM_{2.5}$	10	Respiratory mortality	2.2% (0.6 −3.9)

PM particulate matter, *ΔPM* increase in ambient PM

PM and Cerebrovascular Health Effects

Ischemic cerebrovascular and cardiovascular disease share many risk factors, features, and pathophysiological mechanisms. As an example, CRP, similar to cardiovascular disease, has also been implicated in the genesis of stroke [86]. However, the evidence linking PM and stroke is more sporadic and the mechanisms less well understood.

Dominici et al. [33] reviewed an air quality data for 204 US urban counties and showed that a 10-μg/m^3 increase in ambient $PM_{2.5}$ increased the risk of hospitalization for cerebrovascular events by 0.8% (95% CI, 0.3–1.3%). A separate review [87] of Medicare patients found an increase of 1.03% (95% CI, 0.04–2.04%) for hospital admission for ischemic stroke for each 10-μg/m^3 increase in PM_{10}. Still other investigators found a previous day $PM_{2.5}$ increase of 5.2 μg/m^3 led to a 3% (95% CI, 0–7%) increase in risk of TIA and ischemic stroke.

In contrast, a recent large prospective multi-center stroke registry found no increase in the general population for ischemic stroke from exposure to $PM_{2.5}$. There was, however, an 11% (95% CI, 1–22%) increase in stroke risk in exposed patients with diabetes [88]. A large case-crossover study found an association between other components of air pollution (NO2 and CO) and cerebrovascular disease, but no correlation was noted with changing PM levels [89]. Similarly, a large registry of first-ever strokes found no association with PM_{10} for ischemic or hemorrhagic stroke [90].

There are several reasons why studies of PM and cerebrovascular disease have produced conflicting results. Some studies do not completely adjust for all confounding variables. There is further heterogeneity due to differences in the definition of cerebrovascular disease, or whether pollution is measured on the day of admission or symptom onset [88]. Further, it is possible that exposure to PM may not contribute to an overall increase in cerebrovascular disease, but only trigger events in vulnerable populations.

Recommendations and Conclusions

In evaluating the literature, there appears to be a small, but consistent and significant, effect of PM on human health. Overall, the small individual effects result in a large global public health burden. Notably, the effects are most pronounced for cardiovascular disease. Several studies have demonstrated an increase in cardiovascular mortality and hospitalizations. There are similar effects, of smaller amplitude, in respiratory disease. More study is needed to clarify the relationship between PM and cerebrovascular disease.

Table 5

Air quality index and recommendations

AQI level	AQI value	$PM_{2.5}$	PM_{10}	Actions to protect your health from particle pollution
Good	0–50	0–15	0–50	None
Moderate	51–100	16–35	51–154	Unusually sensitive people should consider reducing prolonged or heavy exertion
Unhealthy for sensitive groups	101–150	36–65	155–254	Susceptible groups[a] should reduce prolonged or heavy exertion
Unhealthy	151–200	66–150	255–354	Everyone else should limit prolonged or heavy exertion Susceptible groups[a] should avoid all physical activity outdoors

AQI level	AQI value	$PM_{2.5}$	PM_{10}	Actions to protect your health from particle pollution
				Everyone else should avoid prolonged or heavy exertion
Very unhealthy	201–300	>150	>354	Susceptible groups[a] should remain indoors and keep activity levels low
				Everyone else should avoid all physical activity outdoors

EPA-456/F-09-002

Air quality index: a guide to air quality and your health. EPA, August 2009

AQI air quality index

[a]People with heart or lung disease, children, or older adults

Though PM exposure is ubiquitous, there is no defined and studied "safe" level. Patient education and behavioral modification strategies may contribute to better overall health. Additionally, these data can enable policy makers, after weighing the economic impact, to

enforce or strengthen existing legislation that limits PM exposure. Volcanoes, forest fires, and other natural PM sources are part of our world and are unavoidable. However, by reducing modifiable PM exposure, we will likely see reductions in morbidity and mortality.

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Particulate Matter (PM) Pollution

Toxic air pollution particles found in human brains

Small particulate matter can easily travel 25 miles from this power station which will effect most all of RI

PM stands for particulate matter (also called particle pollution): the term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small they can only be detected using an electron microscope.

Particle pollution includes:

- **PM_{10}** : inhalable particles, with diameters that are generally 10 micrometers and smaller; and
- **$PM_{2.5}$** : fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.
    - How small is 2.5 micrometers? Think about a single hair from your head. The average human hair is about 70 micrometers in diameter – making it 30 times larger than the largest fine particle.

Prof David Allsop, an Alzheimer's disease expert at Lancaster University and part of the researcl team, said: "There is no blood-brain barrier with nasal delivery. Once nanoparticles directly ent olfactory areas of the brain through the nose, they can spread to other areas of the brain,

Neurodegeneration

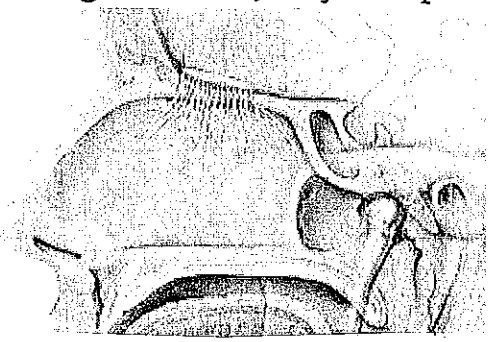
Neuroinflammation

Oxidative stress

Stroke risk

Cognitive impairment

Brain volume loss



Accelerated brain aging

Behavioral changes

Blood-brain barrier breakdown

Sensory processing deficits

Developmental impairments

Intelligence (IQ) reduction

"What this is pointing towards perhaps is there needs to be a major shift in policy and an attem to reduce the particulate matter burden on human health." Maher said. "The more you realise t impact this is having, the more urgent and important it is to reduce the concentrations in the atmosphere."

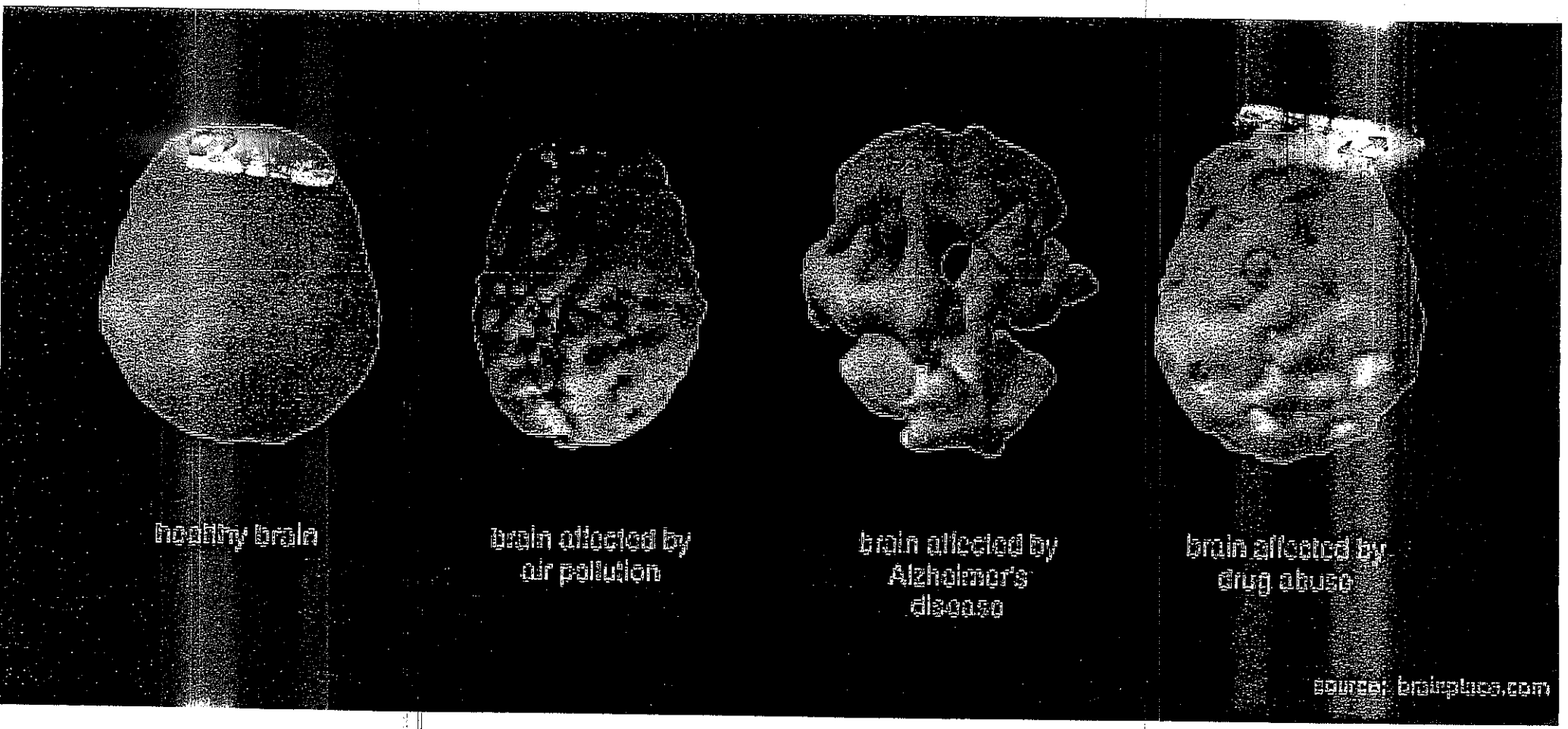
Particulate matter contains microscopic solids or liquid droplets that are so small that they can be inhaled and cause serious health problems. Particles less than 10 micrometers in diameter pose the greatest problems, because they can get deep into your lungs, and some may even get into your bloodstream.

Environmental damage

Particles can be carried over long distances by wind and then settle on ground or water. Depending on their chemical composition, the effects of this settling may include:

- making lakes and streams acidic
- changing the nutrient balance in coastal waters and large river basins
- depleting the nutrients in soil
- damaging sensitive forests and farm crops
- affecting the diversity of ecosystems
- contributing to acid rain effects.

"Many of the magnetite particles we have found in the brain are very distinctive," said Maher. "They are very rounded nanospheres, because they were formed as molten droplets of material from combustion sources, such as car exhausts, industrial processes and power stations, anywhere you are burning fuel."


healthy brain
brain affected by air pollution
brain affected by Alzheimer's disease
brain affected by drug abuse
source: brainplace.com

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Air Pollution Causes Brain Damage (Scientific Research)

Anyone living in a big city that has taken a vacation to experience nature (e.g. a cabin in the woods) can often detect a stark contrast in air quality. In the big city, the air you're breathing in often smells dull and polluted, and you may sense that it's taking a toll on your health. In a naturalistic setting, the air you're breathing in smells vibrant, stimulating the olfactory system in ways that the big city air never would, and reinvigorates your sense of wellbeing.

Many people can sense that their brain performs better when they're breathing in clean oxygen from nature. Living in large cities with significant air pollution (e.g. New Delhi, Beijing, Lima) not only can increase your chances of developing lung cancer, but it can simultaneously damage your brain. Unfortunately, many people living in big cities often become desensitized to the air that they're breathing in and/or never experience naturalistic contrast of high quality air.

After several years (or even months) of living in an environment with polluted air, the pollutants act as neurotoxins, damaging the brain and killing brain

cells. This results in rapid cognitive decline, foggy thinking, and a sense that something is cognitively amiss. To avoid unintentionally damaging your brain with pollutants, it is best to be aware of the risks associated with inadvertent insufflation of these neurotoxins.

How Air Pollution Damages the Brain

There are a variety of ways in which air pollution inflicts damage on the brain. Air pollution is known to reduce volumetric measures of white matter, permanently impair cognitive development in children, and increase likelihood of neurodegenerative diseases like dementia. Moreover, many victims of air pollution ironically experience significant "brain fog" and have sensory processing deficits in smell, hearing and balance.

- **Accelerated brain aging**: Exposure to 2 mcg (micrograms) per cubic meter of fine-particulate matter is associated with a 0.32% reduction of brain volume. While this may not seem substantial, experts suggest that this amount is an approximate equivalent to one additional year of brain aging. Individuals exposed to 4 mcg per cubic meter of fine-particulate matter therefore would experience 2 years of accelerated brain aging.
- **Behavioral changes**: Some people experience significant behavioral changes as a result of exposure to air pollution. Behavior change may not be apparent overnight and tends to occur gradually with consistent exposure to pollutants. Individuals exposed to air pollution may act more impulsive, and have a difficult time correcting detrimental behaviors.
- **Blood-brain barrier breakdown**: The blood-brain barrier helps protect your brain from pathogens and limits entry of potential toxins. However, consistent exposure to air pollution causes the blood-brain barrier to gradually deteriorate. Deterioration of the blood-brain barrier can result in compromised immune function, poor information processing, and abnormal neuronal functioning. Breakdown of the blood-brain barrier is a sign of an aging brain and indicative of cognitive impairment.
- **Brain volume loss**: Studies have confirmed that exposure to air pollution results in losses of brain volume. The loss of brain volume experienced from exposure to an average amount of fine-particulate matter in a large city is roughly equivalent to an additional year of brain aging. It appears as though air pollution contributes to substantial losses in white matter, which

serves as an insulator and transmits signals between various parts of the brain.

- **Cognitive impairment**: Regardless of age, regular exposure to ambient air pollution is known to cause working memory deficits and poorer cognitive performance. Cognitive impairment from air pollution is likely most notable among children without fully developed brains. That said, even among adults, exposure to pollutants can affect memory and attention.
- **Developmental impairments**: Another significant consequence associated with air pollution exposure is suboptimal neurocognitive development. The brains of children are highly sensitive to environmental inputs and are constantly being molded via synaptogenesis. Significant exposure to air pollution impairs brain development and literally may be rewiring the brain to become dumber.
- **Intelligence (IQ) reduction**: Certain studies assessed performance on IQ tests among individuals living in areas with high air pollution and compared the results to individuals from areas with low air pollution. After controlling for a variety of potential confounding factors, researchers determined that those living in areas with low air pollution had increased IQ scores. This is likely due to the fact that air pollution decreases brain volume and executive task performance.
- **Mood disorders**: There are a variety of factors that can contribute to mood disorders, one of which happens to be air pollution. Exposure to particulate matter is known to reduce brain volume and impair connectivity of various regions. Moreover, many mood disorders are associated with specific regional and structural deficits – both of which could be caused by air pollution.
- **Neurodegeneration**: Research has proven that exposure to air pollution increases biomarkers associated with Alzheimer's and Parkinson's disease such as: hyperphosphorylated tau protein, amyloid plaques, and α-Synuclein misfolding. Some speculate that risk significantly increases for developing a neurodegenerative disease when exposed to air pollution. In addition, it appears as though individuals with certain genes (e.g. the E4 allele of APOE) exposed to air pollution may experience more substantial and rapid neurodegeneration.
- **Neuroinflammation**: Air pollution is associated with significant increases in brain inflammation. Inflammation of the brain is associated with a variety of neurophysiological deficits including, cognitive decline, mood

disorders, and neurodegeneration. It is thought that neuroinflammation contributes to the severity of a variety of neurological disorders. By minimizing exposure to air pollution, your chances of neuroinflammation are decreased.

- **Oxidative stress**: Those living in areas with high amounts of air pollution tend to have greater levels of oxidative stress within the brain. This means that various reactive oxygen species accumulate as a result of exposure to pollutants (e.g. fine-particulate matter) and wreak havoc on your brain. Reactive oxygen species can contribute to neurodegeneration, cognitive impairment, stroke, and other pathologies.
- **Sensory processing deficits**: The ability to process smell, sounds, and maintain balance may be compromised with increased exposure to air pollution. Evidence suggests that children living in urban environments with high exposure to polluted air tend to have significant deficits in olfactory, auditory, and vestibular functioning compared to children living in areas without substantial air pollution.
- **Stroke risk**: There is an increased risk of silent strokes upon exposure to air pollution among the elderly. Assessments suggest that 2 micrograms (mcg) of fine-particulate matter pollution is associated with nearly a 50% increase in the likelihood of a silent-stroke. Silent strokes refer to strokes that appear on brain scans, but don't have any overt symptoms.

Source: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4129915/
Source: http://www.psr.org/assets/pdfs/air-pollution-effects-nervous.pdf

Common Types of Air Pollution

Below is a list of some common types of air pollution. While outdoor air pollution is common in large cities, many people fail to consider that the inside of their homes and/or apartments are filled with indoor air pollutants. Both indoor and outdoor air pollution can compromise your physical health and damage your brain.

Outdoor Air Pollution

The EPA (Environmental Protection Agency) is required to set National Ambient Air Quality Standards for six of the most common air pollutants. These pollutants include: particulate matter, ozone (ground-level), carbon

monoxide, sulfur oxides, nitrogen oxides, and lead. Despite efforts to maintain clean air, many people are still exposed to significant pollution, ultimately impairing their brain function.

1. **Particle Pollution**: Particulate matter is considered a medley of tiny particles and drops of liquid. It consists of various acids (e.g. nitrates, sulfates, etc.), metals, dust particles, and other organic chemicals. Particulate matter under the size of 10 micrometers can easily travel through the throat and damage the lungs, and possibly the heart. Sources of particle pollution include: industries, power plants, and motor vehicles.
2. **Ozone (Ground-Level)**: Ground-level ozone is considered a potent air pollutant in that it is created by chemical reactions between nitrogen and volatile organic compounds under sunlight. Examples of things that can contribute to ground-level ozone include: manufacturing facility emissions, motor vehicle exhaust, chemical solvents, gasoline vapor, etc. Inhalation of ozone is associated with lung disease and asthma.
3. **Carbon monoxide**: This is an odorless, colorless gas that is derived from combustion. In large cities, carbon monoxide pollution is more common. High levels of carbon monoxide can be fatal, but moderate levels will reduce oxygen to both your brain and heart, leading to physical and mental decline. The brain needs sufficient oxygen to operate at its best, but when exposed to carbon monoxide, it becomes incapacitated.
4. **Sulfur oxides**: These are considered gasses that are commonly produced at power plants and industrial plants. Other sources of sulfur oxides include: metal extractions, trains using sulfur-based fuels, ships, and other equipment. Sulfur oxides can damage respiratory functions and elicit a variety of detrimental effects on the brain.
5. **Nitrogen oxides**: These are considered reactive gasses that accumulate as a result of motor vehicle (bus, car, truck, etc.) emissions. Nitrogen oxides also form from power plants and usage of industrial equipment. It should be noted that nitrogen oxides facilitate the formation of ground-level ozone and particulate matter pollutants.
6. **Lead**: This is a metal that is present naturally within the environment, but is also found within many manufactured products. In the past when gasoline contained "lead," there was significantly more toxic exposure than these days. Lead was removed from gasoline, which is why you now see that all gasoline is sold as "unleaded." That said, there is still lead in the air as a

result of lead smelters and airplanes using lead gasoline.

Indoor Air Pollution

Most people are familiar with outdoor air pollution, but indoor air pollution is often ignored. In fact, many people don't even consider the fact that the inside of their home and/or apartment could be polluted. What's more unsettling is that most individuals are absolutely clueless that their aerosol sprays (e.g. hair spray), colognes / perfumes, candles, etc. – are a source of pollution.

Those scented "plug ins" that are supposed to serve as air fresheners often are a source of toxins. Those tiny little "clip on" scents that people place upon the air ventilation system within their cars are likely another source of neurotoxins. Something as simple as living in an apartment with poor air flow can cause particulate matter to accumulate, and ultimately impact your brain.

Pollution can come from second-hand smoke, burning of wood, a fresh coat of paint, adhesives, and more. Other common sources of indoor air pollution include: accumulation of radon gas (from the surface of the Earth), insulation (and other construction-related particles), as well as mold. Many people severely underestimate the implications of certain products (e.g. aerosol) on the short-term and long-term health of their brain.

Air Pollution Causes Brain Damage (Scientific Research)

Research suggests that living in cities with significant air pollution can have many deleterious effects, both acute and long-term. It should be emphasized that children and adolescents are at greatest risk of potentially life-altering neurological disorders associated with air pollution due to the fact that their brains' aren't fully developed. That said, regardless of whether you're a child or an adult, living in constant pollution (indoor or outdoor) can promote permanent cognitive decline and other central nervous system (CNS) impairments.

2015: A report published in 2015 suggested that inhalation of particulate matter has significant detrimental effects on the brain. Particulate matter that

is considered ultrafine is small enough to make its way to the brain, and ultimately contribute to numerous neurological pathologies including: depression, stroke, neuroinflammation, oxidative stress, and neurodegeneration. Specifically, it was mentioned ambient air pollution can increase: hyperphosphorylated tau protein, amyloid plaques, and facilitate α-Synuclein misfolding.

Among animal models, exposure to particulate matter prompts a neurodegenerative and neuroinflammatory response. The combination of increased inflammation and reduction in brain volume results in many cognitive, behavioral, and functional deficits. Authors of this report suggest that air pollution can damage a person's CNS (central nervous system) and permanently decrease quality of life.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/25256239

2015: Another study from 2015 notes that air pollution likely acts as a neurotoxin, damaging the brain. This study analyzed a total of 2,715 children (between the ages of 7 and 10) from 39 schools located in Barcelona. All of these children were exposed to either high or low air pollution, and their cognitive development was tested (4 times each) with a computer-based assessment.

Researchers measured air pollution resulting from motor vehicle traffic including: particulate matter, nitrogen dioxide, and elemental carbon – both inside and outside the classroom. Cognitive function was tested with the "N-back" and other working memory tests. After adjusting for a variety of factors (age, sex, socioeconomic status, etc.), researchers determined that children in schools with higher pollution experienced poorer cognitive development than those in less polluted environments.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/25734425

2015: A study published in 2015 documented that children exposed to urban air pollutants experience neuroinflammation and biomarkers associated with neurodegenerative diseases (e.g. Alzheimer's). This study investigated how the APOE (apolipoprotein E) E4 allele influences brain development among

children compared to the E3 allele. Specifically, researchers wanted to determine whether the allele differences altered brain development among those exposed to air pollution in Mexico City.

Results indicated that children with the E4 allele of APOE may be at increased risk of developing a Alzheimer's disease if they are exposed to air pollution. This was evidenced by differences in white matter, attentional deficits, memory impairment, and poor scores on a verbal IQ test. This suggests that if you have certain genetics associated with neurodegenerative diseases, air pollution may act synergistically with these genes to increase your risk.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/25633678

2015: Authors from a 2015 study suggested that "green space" is associated with superior physical and mental health. Increased exposure to "green space" is thought to improve cognitive function among children. Researchers conducted a study to determine whether exposure to green space has any significant impact on cognitive development of over 2,500 school children (aged 7 to 10) in Barcelona.

Measures of cognitive development were recorded at 3 month intervals for a period of 12 months. These measures included tests of working memory and attention. Green space was calculated based on satellite data. Results indicated that the children with the greatest "green space" had greater cognitive development compared to other children, in part due to the fact that the green space decreased air pollution.

- Source: http://www.pnas.org/content/112/26/7937.abstract

2015: A study from 2015 recruited 789 elderly women to determine whether APOE alleles influence cognitive function following exposure to air pollution. Researchers measured levels of particulate matter and nitrogen oxides and collected data on traffic-induced air pollution. Cognitive function was tested with the CERAD-Plus test to gauge the impact of air pollution and the APOE alleles.

Greater exposure to air pollution was associated with impaired cognitive

function and performance. Among individuals with the E4 allele of APOE, it was documented that air pollution from traffic exposure had the most significant impact on cognitive function among elderly women.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/26092807

2015: Researchers reported that millions of children in Mexico City often experience heightened levels of neuroinflammation, oxidative stress, and breakdown of the blood-brain barrier as a result of air pollutants. To better understand the effects of air pollution, researchers recruited 139 children and assessed various biomarkers. The goal was to determine differences between those exposed to low pollution versus high pollution.

Results indicated that high levels of air pollution can contribute to neuroinflammation and increases in biomarkers associated with neurodegenerative diseases like Alzheimer's and Parkinson's. Since air pollution can damage the blood-brain barrier, it is thought to detrimentally alter interactions between the brain and immune system. Authors of this research document the increasing importance of investigating air pollution's impact on the mental health of children.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/25147109

2015: A study focused on analyzing whether brain volume was influenced by exposure to fine particulate matter pollutants in elderly women. Researchers recruited 1,403 older women without neurodegenerative diseases and analyzed brains with MRI neuroimaging. They specifically focused on determining the volume of gray matter and white matter.

Estimates were made to determine particulate matter exposure, and various adjustments were made to rule out confounding factors. It was noted that women exposed to greater particulate matter had significant reductions in white matter volume. There was a correlation between total exposure to fine particulate matter and average volume of white matter.

Results indicated that white matter was noticeably reduced in the corpus callosum, frontal lobe, and temporal lobe. Researchers concluded that exposure

to fine particulate matter contributes to white matter reductions in elderly women.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/26075655

2014: An interesting report was published in 2014 hypothesizing the effect of air pollution exposure while exercising on cognitive function. Researchers noted that BDNF levels are associated with the psychological benefits of exercise such as cognitive enhancement; they are also associated with growth of new brain cells. Based on studies suggesting exercise is healthy for the brain, and evidence that air pollution damages the brain, authors concluded that aerobic exercise in a polluted city offsets the positive effect of exercise on cognition.

Therefore if you are exercising in a large city with polluted air, you may not be reaping the maximum benefit for your brain. Due to an increase in respiratory rate, you are likely breathing in significantly more pollutants than you would if you were walking. One may surmise that aerobic exercise in a large city may amplify deleterious effects associated with exposure to air pollution.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/25119155

2014: A pilot study published in 2014 analyzed the effect of particulate matter-based air pollution on human cells. Specifically, cultures of human brain cells (microglia, neurons, and astrocytes) were exposed to ultrafine particulate matter and measures of biomarkers we recorded including to determine oxidative stress (based on reactive oxygen species) and neuroinflammation (based on proinflammatory cytokine TNF-Alpha). Results demonstrated that inflammation significantly increased based on TNF-alpha biomarkers.

Surprisingly, reactive oxygen species experienced a decrease when exposed to the particulate matter. This response is different than rodent cells, which experience an increase in reactive oxygen species when exposed to air pollution. In any regard, it appears as though neuroinflammation is a likely outcome upon exposure to particulate matter.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/24999231

2014: A report published in 2014 suggested that ultrafine particulate matter is inhaled and may damage the brain. Among the most common sources of exposure to ultrafine particulate matter is traffic-emissions. Authors note that exposure to ultrafine particulate matter as a result of motor vehicle emissions is likely to evoke a neuroinflammatory response as well as increased oxidative stress.

References were mentioned to past research noting that air pollution, particularly from diesel exhaust may cause neurotoxicity. The air pollution induced neurotoxicity is thought to cause neurodegeneration and possibly neurodevelopmental disorders (e.g. autism spectrum disorder).

- Source: http://www.ncbi.nlm.nih.gov/pubmed/24524086

2014: One study sought to determine how metallic concentrations in household dust differed in hair samples of children. Researchers collected hair samples of children living in a mining area and children living in the suburbs. A total of 113 hair samples were collected from children in Bolivia, and behavior was assessed.

In the mining district, it appeared as though the children were exposed to a significant amount of metals via dust particles. Exposure to these dust particles resulted in notable behavioral differences compared to the children in the suburbs that were not exposed to significant amounts of metals via indoor dust. This suggests that indoor dust laden with metallic elements may have detrimental effects on behavior.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/24762646

2013: Research published in 2013 discovered that children exposed to air pollution in Mexico City have impaired communication between the brain and immune system. This discovery was made by comparing various biomarkers in children exposed to high air pollution and comparing them to children exposed to low air pollution. Chronic exposure to air pollution resulted in systemic inflammation and neural immune response dysregulation.

Researchers speculate that millions of children end up with compromised

neurophysiological functioning as a result of air pollution. It is important to increase awareness of how air pollution affects these children and implement policies to decrease exposure to pollutants.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/24133408

2013: Lead is a well-established neurotoxin, and increased concentrations of lead within the bloodstream are thought to reduce intelligence (IQ) and cognitive performance. Researchers published a study in 2013 to determine whether levels of Lead within the blood affected IQ and academic performance. A total of 1,341 children from China participated in the study.

The level of Lead within the blood was assessed and intelligence tests were administered. Results indicated that children with high concentrations of Lead within the bloodstream had lower IQs than those with low levels. Academic performance was worse among the children with greater levels of Lead within their blood.

While Lead has become a less common in the U.S. as an air pollutant since its removal from gasoline, it may still be a problem in other countries. Inhalation of Lead particles clearly has a detrimental impact on cognitive function among children in poor and/or developing countries.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/23734241

2012: Statistics suggest that children living in cities with high air pollution tend to have increased tau hyperphosphorylation and amyloid plaques. By comparison, children living in cities with low pollution tend to have no apparent tau hyperphosphorylation nor amyloid plaques. These biomarkers are associated with increased likelihood of developing a neurodegenerative disease (e.g. Alzheimer's).

Researchers measured white matter hyperintensities (WMH) among children exposed to air pollution and those with low exposure to air pollution. White

matter hyperintensities are linked to cognitive impairment and brain atrophy. MRIs and blood samples were collected from the children, and cognitive performance was assessed.

Children without white matter hyperintensities experienced inflammation as a result of air pollution; this was evidenced by various biomarkers. Those with white matter hyperintensities experienced increases in gray and white matter following exposure to air pollution. Authors concluded that cytokines and chemokines modulate responses to air pollution.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/22531421

2012: Lead is an air pollutant that is well-known to have deleterious effects on brain development, intelligence, and cognitive function among individuals of all ages. Even low amounts of lead exposure can elicit detrimental neurodevelopmental effects, which are especially prominent among children. In the year 2000, the country of Taiwan banned "leaded gasoline" to minimize its effect as an environmental pollutant.

Researchers published a study in 2012 investigating the impact of low level exposure to Lead (Pb) among young children. Between 2001 and 2002 they recruited 430 Taiwanese pregnant women in their "third trimester" and administered questionnaires. Follow ups were conducted on the children to assess their neurodevelopment and cognitive performance.

To measure exposure to Lead, researchers collected blood samples and evaluated the amount of "whole blood" Lead as a biomarker. It was determined that even low levels of whole blood Lead resulted in lower IQs and cognitive deficits compared to other children of the same age. This study highlights that postnatal exposure to Lead such as via air pollution can provoke developmental abnormalities, delays, and cognitive impairments among children.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/22280932

2012: It appears that even prenatal exposure to various pollutants can have significant implications for the neurodevelopment of an infant. A study conducted in 2012 investigated prenatal exposure to air pollutants including:

PAH (polycyclic aromatic hydrocarbons) and ETS (environmental tobacco smoke). Researchers used the Wechsler Preschool and Primary Scale of Intelligence to determine IQ score when the children were 5 years of age.

A form of high-performance liquid chromatography was used to detect exposure to PAH, while ETS exposure was approximated based upon personal interviews. Following adjustment for confounds, exposure to PAH and ETS weren't found to have significant effects on standard IQ. That said, it appeared as though measures of verbal IQ were notably lower in accordance with PAH and ETS exposure.

Authors concluded that PAH exposure (as a result of coal-burning plants) and environmental tobacco smoke may promote cognitive deficits in young children. Fortunately, the specific coal-burning plant considered in this study has since been shut down as a result of government health regulations.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/22386727

2011: In 2011, it was reported that air pollution is associated with significant brain inflammation and increases likelihood of neurological disorders among both humans and animals. That said, researchers wanted to determine the outcomes associated with long-term, consistent exposure to airborne pollutants. For the study, they analyzed the CNS alterations as a result of exposure to diesel exhaust at a subchronic level.

Their goal was to determine the minimal amount of diesel exhaust it would take to prompt a neuroinflammatory and/or abnormalities of the CNS. The study involved using a total of 344 rats that were exposed to diesel exhaust as a result of inhalation over a 6 month term. Results indicated that subchronic diesel exhaust exposure increased biomarkers of TNF-alpha in nearly every region of the brain; the increase was most prominent in the midbrain area.

Other biomarkers were altered in the frontal lobes of mice and tau protein levels were elevated with increased exposure to diesel exhaust. Results suggest that subchronic exposure to diesel gasoline may elicit neurological changes associated with development of both Alzheimer's and Parkinson's disease. Prior to the noted increases in biomarkers, neuroinflammatory responses were

apparent, suggesting that inflammation is apparent prior to protein increases.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/21864400

2011: It was noted that exposure to significant air pollution prompts inflammatory and structural changes in the brains of children. A study in 2011 sought to determine links between brain growth patterns, cognitive dysfunction, and white matter hyperintensities (WMH) may stem from exposure to airborne pollutants. Researchers conducted baseline measures in children with MRI scans (to determine volume) and intelligence tests (to determine cognitive function).

Children from Mexico City were compared based on whether they were noted as having white matter hyperintensities (+) versus not having white matter hyperintensities (-) and were compared to controls from a city without pollutants. Researchers noted significant deficits in white matter volumes among children from Mexico City, regardless of white matter hyperintensities. These differences were most apparent in the bilateral temporal region and right parietal lobe.

The children living in Mexico City performed poorer on a spectrum of cognitive assessments compared to children in the low-pollution control group. Researchers concluded that air pollution exposure may alter the neurodevelopment of children and ultimately cause cognitive impairment. Therefore it is important to recommend taking action to minimize exposure to air pollution, particularly among children with developing brains.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/22032805

2010: A study conducted in Poland involved determining whether prenatal exposure to air pollution in an urban environment may cause disordered behavior and neurological functioning. Specifically, researchers investigated exposure to PAH (polycyclic aromatic hydrocarbon) and intelligence among children at 5 years. They controlled for a variety of potential confounding factors that may also influence neurodevelopment.

All of the pregnant women participating in the study were considered non-

smokers and "healthy." During pregnancy, a questionnaire was administered and air samples were collected to determine air quality. In addition, blood samples were collected from babies at time of delivery. Following baseline measures, 214 children were followed until the age of 5.

These children were given a nonverbal reasoning ability test called the Raven Colored Progressive Matrices (RCPM). Results indicated that greater exposure to PAH resulted in significantly decreased scores on the RCPM assessment, suggesting lower nonverbal reasoning skills. Researchers went as far as to estimate that IQ decreased by 3.8 points among those prenatally exposed to PAH.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/20406721

2009: A similar study was conducted among pregnant African-American and Dominican-American women in New York City. Researchers sought to determine exposure to PAH by assessing air quality of the women during pregnancy. Follow ups with 249 children were conducted at age 5.

All of the children were assessed for intelligence using the Wechsler Preschool and Primary Scale of Intelligence (Revised). After adjusting for a variety of confounds, it was discovered that prenatal PAH exposure was associated with significantly reductions in both full-scale and verbal IQ. Estimates suggest that IQ scores were 3 to 5 points lower among the mothers exposed to significant airborne PAH.

This demonstrates that air pollution can affect cognitive development among children even in the United States, with New York City as an example. Pregnant mothers should be especially concerned with minimizing exposure to environmental air pollution in effort to maximize the neurodevelopmental potential of their children.

- Source: http://pediatrics.aappublications.org/content/124/2/e195.abstract

2009: An array of animal research has discovered that exposure to particulate matter (particularly "ultrafine") can cause brain inflammation. This particulate matter is inhaled via respiration and is transmitted from the upper respiratory

tract directly to the brain, where it can accumulate and cause damage. Brain inflammation is associated with nearly every serious neurological disorder.

A study conducted in 2009 sought to determine whether long-term exposure to ultrafine atmospheric particulate matter could facilitate neurodegeneration in the form of mild cognitive impairment (MCI) – a condition that often leads to Alzheimer's. Researchers recruited 399 elderly women who lived for 20+ years at the same address. Estimates were calculated for particulate matter concentrations and traffic-related particulate matter.

All 399 women were administered a test to detect mild-cognitive impairment (MCI). Researchers noticed specifically that exposure to traffic-related particulate matter exposure was associated with mild cognitive impairment. Authors go as far as to suggest that particulate matter exposure may increase risk of Alzheimer's disease.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/19733348

2008: Researchers published a study in 2008 determining whether living in cities with high air pollution is associated with neuroinflammation and/or neurodegeneration. They focused on measuring various biomarkers in the brains of healthy children and young adults that died unexpectedly. Biomarker measures included: mRNA cyclooxygenase-2, interleukin-1beta, and CD14 in specific regions of the brain.

A total of 12 brains were from areas of low air pollution exposure, while 35 brains were from high pollution areas. Results indicated among brains highly exposed to air pollution, the measures of: cyclooxygenase-2, interleukin-1beta, and CD14 had significantly increased. Moreover, blood-brain barriers were disrupted, inflammation was evident, and oxidative stress had increased.

Researchers could literally see the accumulation of particulate matter within neurons (brain cells) of those that were highly exposed to pollution. Biomarkers that increase likelihood of developing neurodegenerative diseases like Alzheimer's and Parkinson's were noted even among children in the environment with significant air pollution. This study portrays the alarming consequences associated with living in a pollution-filled city.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/18349428

2008: It is known that exposure to air pollutants increase risk of a variety of neurological conditions. Researchers suspected that one major risk associated with exposure to significant pollutants is that of brain cancer. They conducted a study to determine whether there was a relationship between air pollution in the form of petrochemicals and increased incidences of brain cancer.

Researchers collected records of all brain cancer fatalities in Taiwan spanning from 1995 to 2005. They also collected data of petrochemical pollutant exposure based on each of the individuals' living address. It was discovered that those living in areas with high amounts of petrochemical air pollution had the highest risk of developing brain cancer compared to those in areas with minimal petrochemical air pollutants.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/18214804

2008: Past research has documented that brain inflammation results from exposure to air pollution in Mexico City. This inflammatory response doesn't only occur among humans, but is apparent among canines. Researchers conducted more research to determine the effects of ambient air pollution on a total of 55 children from Mexico City compared to 18 children living in a low polluted city.

All were assessed with MRI neuroimaging and administered psychometric tests. MRI scans were also conducted on 7 healthy canines exposed to air pollution in Mexico City. The brains of these canines indicated an increase in frontal lesions, neuroinflammation, and accumulated deposits of particulate matter.

Researchers determined that children exposed to air pollutants had poorer performance on cognitive tasks – both "fluid" and "crystallized." Over half of the children from Mexico City demonstrated white matter lesions within the prefrontal cortex. It is speculated that air pollutants from Mexico City damage the prefrontal cortex and promote cognitive impairment in otherwise healthy children.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/18550243

2007: It was noted that individuals residing in Mexico City are exposed to significant ground-level ozone and ultrafine particulate matter. Even dogs living in Mexico City have been discovered to have significant neuroinflammation and neurodegeneration (similar to Alzheimer's). Among residents of Mexico City (regardless of age), biomarkers such as COX2, IL-1beta, and ABeta 42 accumulate in the frontal cortex as a result of air pollution.

Due to the fact that Alzheimer's disease is associated with both brain inflammation and accumulation of ABeta 42, it is not farfetched to hypothesize that exposure to air pollution could cause Alzheimer's disease. In addition, exposure to air pollution may amplify risk and/or rapidity of neurodegeneration among those already experiencing mild-cognitive impariment.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/17325984

2004: More research highlights the fact that dogs exposed to air pollution experience neuroinflammation and Alzheimer's-like brain changes. A study published in 2004 investigated whether individuals living in cities with significant levels of air pollution experienced neuroinflammation. To assess inflammation, they documented COX2 expression and beta-amyloid 42 (ABeta 42).

A total of 19 brains were evaluated with tissue autopsies, 9 were from cities with low pollution, while the remaining 10 were from polluted cities. It was determined that individuals from cities with high air pollution had greater COX2 expression in multiple regions (the frontal cortex and hippocampus) and greater accumulation of beta-amyloid 42. This suggests that the brain is susceptible to inflammation and preclinical symptoms of neurodegeneration as a result of air pollution.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/15513908

2003: A study published in 2003 discussed the implications of air pollution among dogs living in Mexico City. Authors of the study note that air pollutants enter the body via the respiratory tract and are capable being transmitted from

the respiratory tract to the brain. To determine the effects of air pollutants on the brain of dogs in Mexico City, researchers measured various biomarkers including: NFkappaB p65, iNOS, COX2, APP, ABeta 42, APOE, MT1, and MT2.

A total of 40 young dogs (mongrels) were assigned to live in a high-pollution (26) or low pollution environment (14). Results indicated that pollutants of Nickel and Vanadium were noted within various regions of the brains. Dogs exposed to significant pollution had greater levels of nearly every aforementioned biomarker (e.g. COX2, APP, ABeta 42, etc.) compared to the dogs living in cities with low pollution.

Evidence indicated that the dogs displayed brain changes similar to preclinical Alzheimer's pathology in humans. The greater the exposure to air pollutants, the more substantial the neurological abnormalities. Moreover, it appears as though respiratory and olfactory barriers as a result of pollution results in greater future exposure and heightened inflammation.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/14692621

2002: Another study conducted on canines (mongrels) in Mexico City sought to assess whether air pollution resulted in variations in the expression of unhealthy biomarkers. Specifically, the study assessed NF-kappaB, iNOS, cortical structures, and subcortical structures from mongrel canines. A total of 32 mongrels from Mexico City were assessed and compared to 8 mongrels from a low pollution city (Tlaxcala).

It was noted that the dogs exposed to pollutants in Mexico City experienced significant increases in NF-kappaB, and iNOS biomarkers. In addition, it appeared the blood-brain barrier was damaged (and altered), cortical neurons had experienced degeneration, and white matter cells were being destroyed. In addition, APOE deposits and other plaques had also increased – indicating that early-onset Alzheimer's may result from air pollution.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/12051555

1996: It is well-known that cigarette smoke is toxic and full of carcinogens. In 1996, researchers investigated whether smoking cigarettes during pregnancy

would influence intelligence of the newborn children. Two samples of children were compared: one from mothers who smoked during pregnancy and the other from non-smoking mothers.

All children were assessed with the Wechsler scale to measure their intelligence. After considering various confounds, it was determined that smoking during pregnancy decreased intelligence by approximately 15 IQ points. Researchers speculate that the pollutants from smoking cigarettes penetrate the placental barrier and detrimentally impact the neurodevelopment of the fetus.

- Source: http://www.ncbi.nlm.nih.gov/pubmed/9216801

How to Avoid Air Pollution and Maintain Brain Health

The aforementioned research should provide you with a sense of urgency to avoid air pollution. Those who aren't avoiding air pollution run the risk of neuroinflammation, impaired cognitive function, and increased risk of neurodegeneration. Below are some suggestions to help you maximize your air quality and minimize the likelihood of air pollution-induced neurological pathologies

Consciously choose your residence

Many people live in large, crowded urban cities with significant air pollution. Some people may have lived in these cities for their entire lives, while others may gravitate towards these cities for job opportunities. While large cities certainly have plenty of job opportunities, they also have significant air pollution.

Before you blindly accept living in a large city, you may want to consider the fact that the air quality may be poor. Should you choose to live in a large city, it's really a matter of time before ultrafine particulate matter and other airborne toxins are inhaled and transmitted from your respiratory tract to your brain. They accumulate within your brain, promoting neurodegeneration and expediting development of Alzheimer's.

You may want to think twice about where you live and look up the air quality. Sometimes looking up the air quality may not be as helpful as giving the air a "sniff" – if it doesn't smell fresh or smells polluted, it may have deleterious effects on your brain. Choose a residence with low traffic-related pollution and clean air.

Get your air tested (and cleaned)

There are many independent companies that will test the air quality inside and outside your home to determine whether it is within a safe range for breathing. While it is relatively easy to determine outdoor air quality, indoor air quality is often difficult to determine. Many people use sprays, candles, and other "fresheners" that are laden with chemicals.

These chemicals may be of a pleasant odor, but may be damaging your brain each time they are inhaled. Indoor air shouldn't have any significant amounts of mold, lead, or radon. If you suspect that you may have mold, it is best to get an ERMES test, which compares the density of mold particles within your home to those outside.

If you live in an area with low pollution, you can easily open your windows to "air out" your house of any chemicals and circulate fresh air. Those living in an urban environment may run the risk of inhaling unpleasant exhaust and other noxious intoxicants each time they attempt to "air out" their homes. If you suspect that your home is full of a particular pollutant, your best bet is to test for it.

Indoor plants

The presence of indoor plants is helpful for filtering out certain pollutants that may be floating through the air. Plants are known to promote cleaner air and reduce exposure to indoor air pollution. Therefore it may be beneficial to maximize the number of indoor plants you can accommodate within your home.

There is even evidence that having desk plants at work can improve mood and substantially increase productivity. It is estimated that plants are capable of removing nearly 90% of volatile organic compounds (VOCs) from the air every 24 hours. Various VOCs in your home could include: benzene, formaldehyde, and trichloroethylene (all of which are found in man-made materials).

Indoor plants can purify the air by literally pulling contaminants into their soil. Once they are pulled into the soil, microorganisms within the root system convert the volatile organic compounds into food that helps the plant grow. As a rule of thumb, some sources suggest having approximately one large plant (6" to 8" diameter) for every 100 square feet.

Plant trees in your yard

Assuming you have a yard, one of the best ways to clean up the air is to plant trees. When we breathe, our body inhales oxygen and exhales carbon dioxide. Trees replenish our supply of fresh air by absorbing carbon dioxide and producing oxygen.

In addition, trees are able to intercept air pollutants such as carbon monoxide, ground-level ozone, and sulfur dioxide. Intercepting these pollutants results in cleaner, more purified air. Due to the fact that air pollution is linked to a variety of neurological disorders, it makes logical sense that living near trees is linked to increased less antidepressant prescriptions.

In addition to absorbing air pollution, trees are also able to filter fine particulate matter from the air by trapping it within their leaves and bark. Ultrafine particulate matter is considered extremely damaging to the brain, especially when inhaled over the long-term. Therefore an increased number of trees in your yard could help mitigate the problem.

Spend time in nature

If you cannot escape your residence within a smog-filled city, do your best to escape whenever possible. Find a local nature park and/or visit a place with cleaner air than your current residence. Spend as much time within this cleaner environment as possible as this will help you minimize inhalation of ultrafine particulate matter that would occur at your urban residence.

There is increasing evidence to suggest that nature is beneficial for a person's mental health. It is clear that inhalation of air pollution results in suboptimal mental health and brain functioning. Therefore, certain beneficial effects of nature on mental health may be a result of increased inhalation of purified air and/or improved air quality in a naturalistic setting.

Avoid indoor air contaminants

I want to emphasize the importance of avoiding chemical products (e.g. cosmetic sprays) that are chock-full of toxic chemicals. These sprays may "smell good" to your average person, but there are clear concerns associated with inhalation of these chemicals. Do your best to minimize usage of any sprays, regardless of whether they're for cleaning or cosmetic purposes if you want to maintain healthy indoor air.

Should you end up using any indoor spray, it is best to do it near a ventilation system that rapidly filters out the airborne chemicals. Opening the windows for increased natural airflow may help eradicate your house of "chemical smells" should they accumulate as a result of contaminant usage. Unfortunately, many individuals are ignorant to the long-term consequences of aerosol sprays, perfumes, wall "plug ins," and cleaning products.

Have you been exposed to air pollution?

If you've been exposed to acute and/or long-term air pollution, feel free to share whether you believe it has had a significant impact on your mental health. To help others understand your situation, discuss how long you were exposed to air pollution, the severity of the pollution, and whether you developed any neurological conditions. Also mention the specific type of air pollution to which you were exposed (if you are aware of it).

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Siddharth Samarth March 4, 2016, 3:49 pm

Do you know much about pollution levels of air in Delhi, and potential long term effects?

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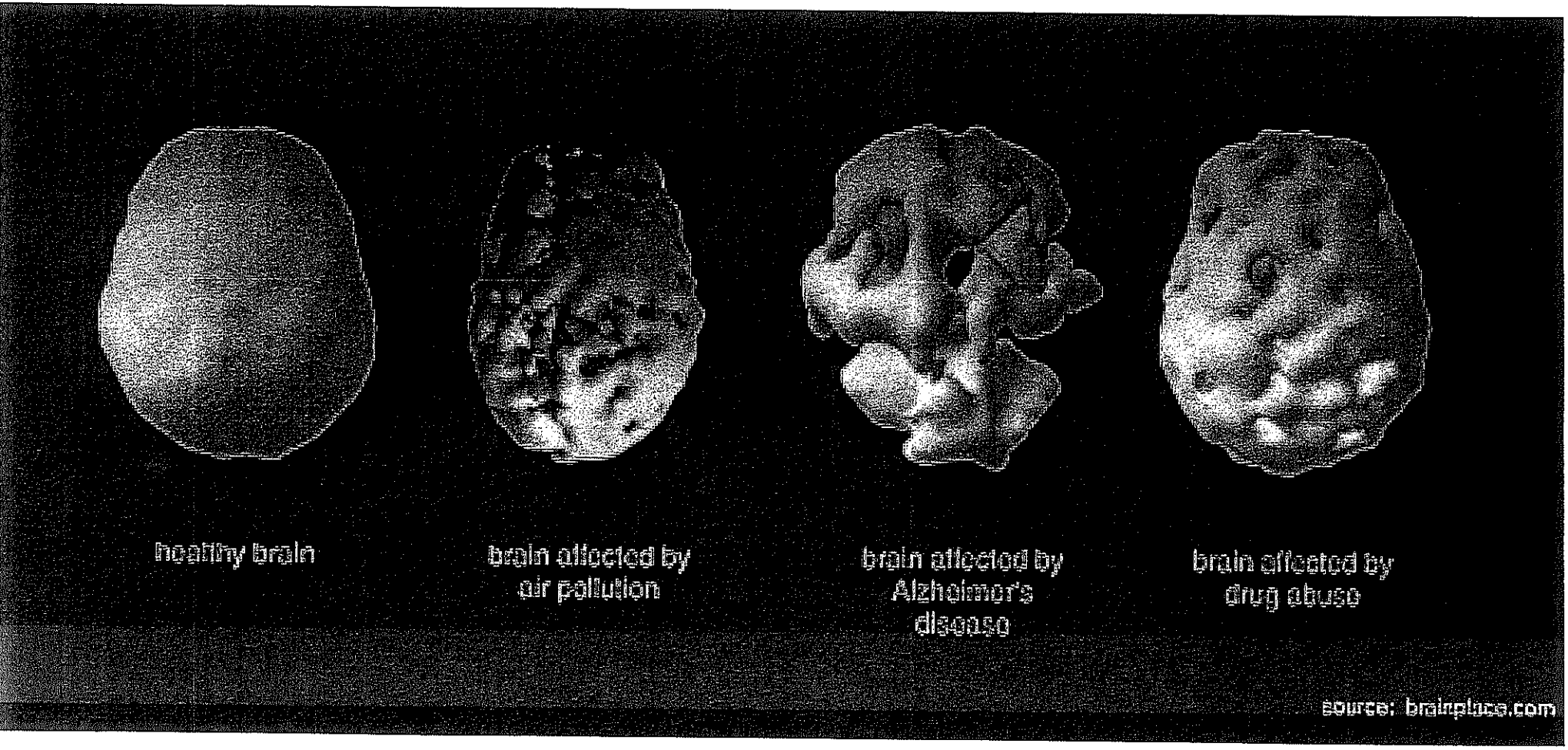
healthy brain
brain affected by air pollution
brain affected by Alzheimer's disease
brain affected by drug abuse
source: brainplace.com

TO: RI Energy Facility Siting Board

RE: RI Statewide Planning Program's Supplemental Advisory Opinion, Docket No. SB-2015-06

BY: Marc J. Tremblay, CF

DATE: October 10, 2017

As a forester working in RI over the past 29 years, and as a member of the Advisory/Technical Committees for both the 1999 RI Urban and Community Forest Plan and the 2005 Forest Resources Management Plan, as well as a member of the 2010 Forest Resources Assessment and Strategies Advisory Committee, I am writing to provide input in response to the RI Statewide Planning Program's written opinion concerning the consistency of these Guide Plan elements to the proposed Clear River Energy Center in Burrillville, RI.

All three of the guidance documents referred to above have a common theme: minimizing further fragmentation of the forest resources of Rhode Island.

Development of guide plans must take into account a variety of factors, and encourage the protection of the resource through available means, as described in Statewide Planning's Supplemental Advisory Opinion (pp 21 & 22). In reference to landscape-scale Guide Plan Elements addressed here, these factors must also include the appropriate siting of large projects, such as the proposed Clear River Energy Center.

Rather than developing their opinion on actual planning principles that guide the development of our state, RI's Statewide Planning Program has chosen to ignore context and the appropriate scale of private development in our forested landscape by relying on the minutia contained in these Guide Plans. Despite the proposed project's negative impact on the landscape, Statewide Planning's opinion is that the proposed project is consistent with these Guide Plan Elements "because the Plan recognizes that private development will occur and that the appropriate control of such development is through State and municipal regulation".

Recognizing that private development will occur, and that private property rights are an important tenet of land ownership and land use, the scale and context of such development must be considered in determining the appropriate type of development and the extent to which private property rights can supersede the public good.

Proper siting of a large-scale energy project such as the Clear River Energy Center requires that the Siting Board consider its impact on the surrounding landscape. Existing industrial sites exist where such a project could be built without further impacting and fragmenting southern New England's last remaining significant forested region.

Good evening. My name is Ava Woods, and I live at 300 Olney Keach Road in Pascoag, less than a mile from the proposed site.

I am opposed to the licensing of this proposed power plant because it is ***not needed*** and because ***it will cause harm unacceptable to the environment*** of the state and the Town of Burrillville, as shown by testimony and advisory opinions that have already been filed with the board.

In the Ocean State Power decision of the EFSB dated October 25, 1988, this Board stated "an Environmental Impact Statement is essential to the Board's deliberations. While the Board does not have jurisdiction over major environmental permits. . .state policy requires that major energy facility 'produce the fewest possible adverse effects on the quality of the state's environment' and the Board must implement that policy in its final decision. Thus, we conclude that the Board has both the responsibility and power to evaluate all individual and cumulative environmental impacts of the proposed facility before arriving at a final decision regarding the OSP application. Preparation of an Environmental Impact Statement is the most efficient way of identifying those impacts for Board review."

An Environmental Impact Statement was prepared in the Ocean State Power case and it was reviewed by this Board. In fact, the review was delayed in order to have the Environmental Impact Statement available for review by the Board. In the case of Invenergy, ***no environmental impact statement has been prepared.*** We understand that the Army Corps of Engineers is doing an assessment to determine whether they will perform and Environmental Impact Statement. However, we submit that given the adverse environmental impacts which have already been identified, not only by the Town's experts, but by Invenergy's own experts, this Board should order Invenergy to produce a full Environmental Impact Statement.

As this board stated in the Ocean State Power case, "the Board continues to believe that the best way in which to analyze environmental data is by the preparation of such data by an independent entity or, at a minimum, review of such data by an independent entity."

In the Environmental Impact Study performed for Ocean State Power, the very same site now being proposed for the CREC facility, then known as the Buck Hill Road property, was eliminated from consideration for the siting of the Ocean State Power plant. The elimination was based on traffic, cost for a cooling water pipeline, and land use incompatibility. A proper Environmental Impact Statement may again determine that this site is also inappropriate for the CREC facility based on similar unacceptable environmental impacts.

Finally, there is already a power plant in the town of Burrillville which displaced my family. We moved to our current location in full confidence that we chose property that was deemed safe because of the previous Ocean State Power Environmental Impact Study. If this land was once too environmentally fragile for a power plant, today it is even more so in the wake of the havoc being wrought in the earth.

I am Marie Schopac a retired florist business owner from Charlestown. This statement was co-written by Robert Malin, who couldn't be here for health reasons.
When we started protesting the expansion of fracked Methane Gas infrastructure with the expansion of the Spectra Compressor station. We were accused of being paranoid, that this was a routine expansion. We soon found out about the Clear River Power Plant and our fears were confirmed.We talked about tipping points and run away climate change, about how methane was an accelerant and about the health ramifications of the entire process. We talked about the insanity of accelerating global warming in light of articles like the one in the 2015 National Geographic written by Nadia Drake entitled "Will Human Survive the Sixth Great Extinction." http://news.nationalgeographic.com/2015/06/150623-sixth-extinction-kolbert-animals-conservation-science-world/.

Back in Charlestown, Several times we brought up opposition to the Burrillville Fracked gas to our Town Council and they had the wisdom to stand with Burrillville against the Power Plant. Invenergy's water use has been a moving target, and no-one knows how much diesel it will actually burn. No contracts limit the amount they can purchase in any way. Now, with the alleged Narragansett Indian Tribe water deal, we find that it could have a direct effect on our wells, including mine. Can you really consider the Tribal water which is in a Federal Trust as a reliable second source when this is disputed by tribal members or the full Tribal Council?
Can you do this without guaranteeing our water supply won't be depleted? I
Furthermore, our State road are in poor shape so any increased truck transportation is a bad idea.

FFRI feels that the siting board has no choice but to reject this Power Plant Proposal, but it may not because the voice of money is powerful. Will the EFSB ignore the will of the people, including 2/3 of the cities and towns, the states own health department which advised against this project both on the grounds of health concerns and dangers of climate change, and the entire the environmentalists community? If you rubber stamp this proposal, you will confirm suspicions that our state government and political system at large is a wholly owned property of the fossil fuel industry. This decision will live on as another example of RI's reputation for corruption.

We hope that the EFSB will do the right thing, listen to the public, the citizens of Burrillville, Charlestown, Providence and Scituate in particular, RI Department of Health, the environmentalists community, and reject Invenergy's proposal. If you chose to respond to the wishes of the monied power brokers, which sadly includes allies on other campaigns, you will force an escalation of tactics, including electing different representatives who will hire boards that practice real oversight.
It is our most sincere desire that you do not disappoint us. You have been tell us to trust the process, with this decision, we will see if our trust has been abused.

Robert Malin
Marie Schopac
20 INDIAN TR
CHARLESTOWN RI

Burrillville Conservation Commission

105 Harrisville Main Street
Harrisville, Rhode Island 02830

October 9, 2017

State of Rhode Island
Public Utilities Commission
Energy Facilities Siting Board
89 Jefferson Boulevard
Warwick, RI 02888

RE: RI SB 2015-06
Invenergy Thermal Development, LLC.
Clear River Energy Center
Town of Burrillville, RI

Honorable Siting Board,

The Burrillville Conservation Commission (BCC) would like to take this opportunity to provide its evaluation of the Biological Inventory Report prepared for Invenergy by the ESS Group on August 2, 2017.

Getting right into the report, the findings indicate two State Protected Species, Four State Threatened Species and One State Endangered Species were identified within the inventory. The presence of these vertebrate species underscores all the important wildlife and plant species also identified during the course of the study.

BCC cannot emphasize more the importance of maintaining these rare samplings of species identified as being present in this area. The suggestion that mitigation as an alternate means to allow for the displacement of these identified species is extremely concerning to this Commission and the protection of the natural resources in our municipality that demands the protection status they not only have been classified with, but also by right, they deserve.

As has been stated in 1988 by RIDEM Environmental Scientist, Christopher Rathiel, this area is of utmost importance to the biological continuity of the northern part of the State and "this area is by far the most inappropriate location for a power plant." Now that we know for sure why this is the most inappropriate location for a power plant based on the diversity of ecology present at this site alone and the surrounding contiguous swaths of vast open space that surrounds this environmentally important area, how is this siting proposal even still a consideration for the Board?

Some of the species listed of certain concern need vast, contiguous biological areas to support their breeding and survival. This Commission along with the many other non-profit agencies such as The Nature Conservancy, The Sierra Club, The Audubon Society and Conservation International cannot ring the bell louder in promoting the protection of this important biologically diverse area, the permanent calling for its protection and the immediate dismissal of this application before this Board. Every bird biologist worth their weight in Warblers or Bobcats should be making the call for the dismissal of this

application and this Commission has not and still does not support this application as it now is a clear and present threat to important, endangered wildlife that resides within our the corporate boundaries of the Town of Burrillville.

The proposal before this Board would otherwise destroy and disrupt the breeding grounds of 47 of the 454 species listed within the Wildlife Action Plan that are classified as species of greatest concern. This is not an acceptable loss of wildlife that should be considered by this Board. The Statewide Planning Advisory Opinion Supplement, Parts E & F, titled Ocean State Outdoors and Forest Resources, falls far short of identifying this area as an area of concern that needs to be protected and the advisory opinion as such should be inadmissible for the Board's consideration of use. This opinion supplement suggests to this Board that the application includes the destruction of some of the "highest quality forest lands within the State." The Statewide Planning Advisory Opinion Supplement makes no mention of mitigation as a strategy for consideration which otherwise indicates that the displacement of this ecologically sensitive area is an acceptable loss of wildlife resources and forest habitat the State can afford.

Moreover, the mere suggestion that "mitigation" may be an alternate consideration to permit the decimation of the breeding grounds of these rare species through the loss of this important habitat is not only an insult to the intelligence of the people of this community and State, but a indicates the incompetency of the Board's ability to make the call to deny the granting of this license.

It should be noted that a mitigation strategy as an offset to displacing a wildlife area is a last resort to the impact. The Board should be informed that mitigation is truly only mitigation if a sector of equal wildlife area can be created and there is much complexity in creating such an area that any individual in the biodiversity development profession would agree upon, as an alternate equal. The area this power plant is proposed for siting cannot be mitigated, it cannot be replicated elsewhere and therefore should not be compromised. For the applicant to simply propose a mitigation strategy that may procure lands elsewhere that may already be undeveloped, is not a suitable equal, as these lands may already possess their own respective concentrations of wildlife and cannot be classified as a "creation of a new, equal wildlife area" which possess the same values of the mitigated original area. If simple acquisition of lands for protection be the case, the loss still indicates a net loss of this important forest area contiguous with norther RI. Source protection is the call out by this Commission.

In the essence of preserving time, the BCC provides you with this unique opportunity to deny the license of this application, and would also like to remind you there are a myriad of other reasons the Board should compel themselves to deny this application and quite simply they are:

1. Need: ISO has proven this plant is not needed now or in the immediate future.
2. Traffic: The application includes the trucking of all consumables needed to maintain this operation and that is simply unacceptable to this community, as has been expressed in other testimony.
3. Climate: The RI GHG reduction plan 2050 will never be met by allowing this "polluting monster" to be permitted within our State. Enabling this proposal not only negatively effects residents of our Town and State, but those that live near the areas where the hydraulically fracked resources to fuel this plant come from.
4. Forest Framentation: We are losing forest habitat at an alarming rate and no one seems to care.

This Board needs to be compelled to make the right decision for the State of Rhode Island and the Town of Burrillville, and the although there may be some logic to this decision being validated there are more reasons for which this license must not be granted.

In the spirit of minimizing the Town's expenses moving forward, and the anguish this proposal has caused to the community, the BCC respectfully requests and compels this Board to deny the permit for the greater good of the public. You have all the reasons you need to right in front of you, just choose one.

Respectfully submitted on behalf of the
Burrillville Conservation Commission

Kevin Cleary, PE, Chairman

Cc: Burrillville Town Council
U.S. Sen. Sheldon Whitehouse
The National Audubon Society
The Sierra Club
The Nature Conservancy
Conservation International

I'm Janice Creamer from South Kingstown, R.I., and as a member of Fossil Free Rhode Island, the Green Task Force at our church, (U.U.C.S.C.) the Raging Grannies of Westerly, and as an individual, I oppose the proposed power plant!!

This song is called "Clear River Valley" that I wrote.

(1) From Clear River we wish you were going, (Invenergy)
We wouldn't miss your evil plan to defile—
All the land, water, air that brings sunshine,
To the creatures and people awhile!

(2) Do please think of the endangered wildlife
Do not hasten to bid them adieu!
Just remember 33 R.I. Town Councils,
Passed resolutions ~~for~~ for no building too!!

(3) Methane from fracked gas and diesel oil is deadly
Even R.I. D.O.H. did say—
Killer of people and ecosystems
Invenergy, take your money and go away!

(4) We don't need any more infrastructure
Poisoning water, the land, and the air
Near those precious preserves in the forest.
The destruction would be too much to bear!

(5) Invenergy made a deal to buy the water,
From the Narragansett Indian Tribe,
But they need $\frac{3}{4}$rds vote before they do that;
It was illegal leaders and an illegal bribe!!

(6) Invenergy has paid off our dear governor
Wants to do the same with Audubon too,
With no morals and devious deep pockets
They would like to do the same thing with you!!

(to the old tune of Red River Valley)

written by Janice M. Creamer
40 Elm Rd.
Wakefield,
R.I. 02879
(401) 783-2889

DIESEL FUEL

4-8 What is the volume of diesel fuel to be stored? Is this the volume required for the amount of time that the plant will be allowed to run on diesel fuel? Can the storage volume be reduced with trucking to the site in instances when the diesel is to be used? If not, why not?

RESPONSE 4-8: Approximately 2,000,000 gallons of ultra low sulfur diesel fuel ("ULSD") will be stored at the site which will allow one generating unit to operate at base load for 72 hours during a curtailment of natural gas availability. This volume was selected based on the reasonable worst case expected gas curtailment. If a gas curtailment is anticipated to extend beyond 72 hours, delivery of ULSD by trucks will be required to operate the plant beyond the 72 hour time frame.

RESPONDENT: John Niland, Invenergy Thermal Development LLC

DATE: April 27, 2016

Brad Bridge
280 Whipple Rd
Bridge for RI
568-2068

[redacted]

To: Bradley Bridges
From: Louise Phaneuf, Burrillville Town Clerk
Date: 9/27/17

Dear Mr. Bridges,

I'm attaching some of the data requests/responses—particularly related to oil. Call me if there's anything else I can offer.

Louise

Louise R. Phaneuf, Town Clerk
Town of Burrillville
401—568-4300

PUBLIC SAFETY

INVENERGY IS OKAY WITH 18 TRUCK ACCIDENTS EVERY THREE YEARS FROM GLOCESTER TOWN LINE TO WALLUM LAKE ROAD AT PROPOSED SITE IN THREE YEARS.

HEATING OIL AND AMMONIA

Two MILLION GALLONS TO BE USED EVERY 72 HOURS EQUALS 167 -12 THOUSAND GALLONS TRAILER LOADS FOR 15 DAYS BEFORE THEY HAVE TO ASK FOR PERMISSION TO CONTINUE.

TWO MILLION GALLONS EQUALS ONE HUNDRED AND SIXTY SEVEN TRAILER LOADS OF HEATING OIL EVERY 72 HOURS.

TWENTY TWO MORE TRUCKS OF WATER AND TWO TRAILER LOADS OF AMMONIA AND TWO TO FIVE TRUCKS OF WASTE WATER IN 72 HOURS. THAT TOTALS 196 TRAILER TRUCKS GOING AND 196 TRAILER TRUCKS COMING BACK FOR A TOTAL OF 392 TRAILER LOADS EVERY 72 HOURS PASSING ON CHURCH STREET.

THE OTHER POWER PLANTS IN THE AREA ARE ALL REQUIRE TO HAVE HOME HEATING OIL ON HAND TO RUN WHEN THERE IS NO GAS OR WHEN IT IS SO COLD THAT THEY HAVE TO DIVERT ALL THE GAS TO THE CITY AND TOWNS.

ASSUMING THAT THEY WILL USE APPROXIMATELY THE SAME AMOUNT OF OIL THAT INVENERGY STATED IN THEIR PAPERWORK TO THE TOWN OF BURRILLVILLE. THIS COULD BE UPWARDS TO 20 TO 30 MILLION GALLONS OF HEATING OIL OUT OF THE STATE RESERVES THUS INCREASING THE PRICE OF OIL FOR EVERYONE IN THE STATE OF RHODE ISLAND.

THE TRAILER TRUCKS CANNOT MAKE THE TURN AT DUNKIN DONUTS AND AT CVS WITHOUT TAKING UP BOTH LANES OF TRAFFIC. THIS WILL PUT THE 392 TRAILERS THAT I STATED BEFORE ON CHURCH STREET WHERE THERE IS A SCHOOL FULL OF CHILDREN AND BUSES AND CARS PARKED ON THE STREET.

ALSO AFTER THEY PASS SERIO PIZZA THERE ARE ALL THE RESIDENTS ARE ON PRIVATE WELLS. ANY TRAILER THAT HAVE A PROBLEM WILL CONTAMINATE THE WELLS AND WILSON'S RESERVOIR.

This is a recipe for a MAJOR DISASTER!

Brad Bridge

6'68 2068

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DIESEL FUEL

15-1 Are you aware of whether any databases exist for accidents that have occurred at power plant sites, including, but not limited to, accidents that involve chemical spills, hydrogen accidents, fuel oil accidents, and/or ammonia accidents? If so, please provide information regarding any such databases, including, but not limited to, electronic links, if any exist.

RESPONSE 15-3: The vehicle type was obtained from the crash reports provided for the study horizon analyzed (2013-2015). From this data, it has been determined that within the truck route corridor from South Main Street at the Glocester town line to Wallum Lake Road at the proposed site entrance, there were a total of 18 truck related crashes that occurred over this three year period.

The operation of the power plant proposes a small number of ammonia and oil deliveries over the course of the year. Oil is expected to be delivered by truck 3-4 times per hour over the course of several days on rare occurrences to the facility, and ammonia deliveries are expected by truck approximately twice per month (every 15 days).

Based on the existing daily number of trucks traveling on the truck route and the expected number of trucks expected to access the proposed site, there would be an increase of approximately 1% of truck traffic along the truck route to the proposed site. Based on this, it is expected that there would be a negligible increase (a small fraction of a vehicle) of truck crashes per year along this corridor.

RESPONDENT: Maureen McMahon, McMahon Associates
Robert Smith, McMahon Associates

DATE: August 19, 2016

The RCPF indicates when reserves (peakers) were called upon, which can be a good indicator of when dual fuel units may have had to switch to oil.

The availability of natural gas is monitored by ISO-NE, who may declare a "Cold Weather Event," a "Cold Weather Watch" or a "Cold Weather Warning" according to its market rules. Natural gas will be deemed to be unavailable when the natural gas supplier informs the Clear River Energy Center ("CREC") that the natural gas supply is being curtailed or if there is a Force Majeure event.

Invenergy examined the publically available data over the past five years from data of duel fuel units running on oil were built using the Velocity Suite Online application, created by ABB Group, Inc. ("ABB"). The ABB Database of Unit Generation & Emissions - Hourly (Standard) provides unit-level hourly generation and emissions data for fossil-fuel generating units. This data comes from the United States Environmental Protection Agency (CEMS reporting), ISO-NE and the Nuclear Regulatory Commission.

The CEMS database can be accessed directly from this public website: https://ampd.epa.gov/ampd/.

Invenergy has included this data in th#e attached spreadsheet which includes the raw data and its source reference. Invenergy summarized the data to show the oil fired and dual fuel units run times (in hours) both annually and monthly for all units. This is the data used to create the maps that were included in Invenergy's Response to the Town's 16th Set of Data Requests. The summary data tab provides the number of hours each unit ran on oil by year and the maximum consecutive run time on oil.

The reason that Invenergy provided the map for these units in Invenergy's Response to the Town's 16th Set of Data Requests is that most of these units are not on the main pipeline (with the exception of Ocean State Power), and as can be seen from the maps that further away from the main pipeline a unit is located or if it is a highly constrained area like downtown Boston or Providence, the consecutive run times for these units increases as compared to other units that are closer to the main pipeline. Based on this data, Invenergy expects that the times when the unit would need to switch to oil would be short lived, i.e. less than a day, however the facility has been configured to allow for longer duration runs on oil should it be necessary.

RESPONDENT: John Niland, Invenergy Thermal Development LLC

DATE: October 4, 2016

DIESEL FUEL

22-8 **Under the water plan, is it correct that the worst case scenario you present is that oil tank depletion (2 MG) will equal 19 trucks per day to replenish, or 38 trips to and from the site? Is this a guarantee? Please explain.**

RESPONSE 22-8 The worst-case-scenario presented is a total of 22 trucks per day following an oil fired event as indicated in the traffic analysis, Appendix E to the Water Supply Plan. The analysis assumes approximately 13 water trucks (2 for normal operation and 11 for water replenishment), 7 oil trucks, and 2 additional trucks consisting of either 1 aqueous ammonia truck, 1 wastewater truck or 1 mobile demineralizer trailer.

No, this is not a guarantee but represents a reasonably conservative estimate of the number of trucks per day that are expected. It is difficult to guarantee because there could be weather events or unexpected disruptions that could cause the number of trucks during one day to be less and correspondingly the number could be more on the following day.

RESPONDENT: Amit Nadkarni, Invenergy Thermal Development LLC

DATE: February 14, 2017

DIESEL FUEL

22-15 **What will happen if an oil operation event occurs more frequently, or lasts longer due to a gas shortage? All the events above indicate that in addition to the figures provided, a 3 truck a day rate is needed just to supply water in addition to the figures above. Do you agree? Please explain.**

RESPONSE 22-15 It is difficult to predict the frequency or duration of oil operation events. Invenergy anticipates that they will not be frequent or long in duration. Generally speaking, Invenergy anticipates that it will replenish the tanks shortly following an oil operation event, at the rate specified in the Water Supply Plan. The rate of approximately 22 trucks a day as specified in the Water Supply Plan includes the water trucks needed for continued operation on gas following an oil operation event. The units can run only as long as there is an adequate supply oil and water onsite. Once the oil and water is depleted, the units cannot run, as set forth in 22-7 and 22-8.

RESPONDENT: John Niland, Invenergy Thermal Development LLC

DATE: February 14, 2017

DIESEL FUEL

22-41 **Is there a plan for monitoring and/or enforcing the voluntary extension of the oil-firing replenishment duration? Are the specifics of this duration extension documented somewhere? Wouldn't this be inefficient and costly for the operators? Please explain.**

RESPONSE 22-41 The durations that were based on the 22 trucks per day, were based on Invenergy's reasonable expectation and is Invenergy's commitment to balance the needs for replenishment with traffic impacts. The specifics are documented in Invenergy's Water Supply Plan, Section 2.2.1, Section 2.3.1 and Appendix E.

RESPONDENT: John Niland, Invenergy Thermal Development LLC

DATE: February 14, 2017

DIESEL FUEL

5-15 Please explain in detail when oil will be involved in the operation of the facility.

RESPONSE 5-15: The plant will be operated on low sulfur diesel oil only during periods of natural gas curtailment or supply interruption. This is expected to occur only when there are extended periods of extremely cold weather (like the "polar vortex" of 2014). There have only been a few occasions over the past several years in which the unit would have operated on oil, and our estimate is that on average there would be less than 5 to 10 days per winter where oil operations would be needed. This will vary from year to year. As an example, this past winter there would have been zero days of operation on oil.

RESPONDENT: John Niland, Invenergy Thermal Development LLC

DATE: April 28, 2016

DIESEL FUEL

5-11 With regard to the diesel fuel, are the filling, conveyance, and pumping areas going to be lined to protect the ground water? Please explain.

RESPONSE 5-11: Drainage and spill containment within the diesel fuel oil unloading station area will be in accordance with all applicable codes, standards and local jurisdictions.

The filling and pumping areas will be lined to contain any oil spills. Underground conveyance (transportation piping) will be double walled. Above ground piping will be inspected periodically for leaks.

RESPONDENT: Mike Feinblatt, ESS Group, Inc.
John Niland, Invenergy Thermal Development LLC

DATE: April 28, 2016

DIESEL FUEL

15-4 What onsite resources at the facility will be provided to address onsite accidents, including chemical spills and other possible accidents? Please provide all details.

RESPONSE 15-4: Please refer to Section 13.2.4 (Countermeasures) of Exhibit 1, the Preliminary Draft Spill Prevention Control and Countermeasure Plan for details on the onsite resources which will be provided to address onsite accidents at the Facility.

RESPONDENT: Michael E. Feinblatt, ESS Group, Inc.

DATE: August 19, 2016

DIESEL FUEL

5-14 Please explain where your oil supply will come from.

RESPONSE 5-14: The oil supply will be provided by truck from a nearby oil storage and transport company. There are several of these companies in Rhode Island and the oil will likely come from one of them.

RESPONDENT: John Niland, Invenergy Thermal Development LLC

DATE: April 28, 2016

DIESEL FUEL

22-18 **How exactly will Invenergy "limit winter distillate oil firing" as discussed in paragraph 2.2.1 (third paragraph)? Will the CREC be subject to pay for performance payments? If so, how much?**

RESPONSE 22-18 Winter distillate oil firing is limited by the quantity of water and oil available onsite as well as the ability to re-fill the on-site storage. Invenergy will participate in the ISO-NE day ahead energy market and is subject to all of its associated rules. In the event that both natural gas and oil are not available for the unit(s) to operate and the unit(s) are called on to operate, it is possible that CREC would be subject to pay for performance penalties. It is not possible to determine the penalty amount as that is dependent on the specific market conditions at the time of the capacity shortfall.

RESPONDENT: John Niland, Invenergy Thermal Development LLC

DATE: February 14, 2017

DIESEL FUEL

18-2 The Invenergy October 2015 Application states:

> **During the infrequent periods when the Facility is requested to fire one of the gas turbines on oil, the daily water demand for the Facility will increase to approximately 925,000 gpd, or 0.925 MGD for each day of oil firing. Although the total water ruse of the Facility increases when firing ultra low sulfur diesel (ULSD) oil, the total number of days that the Facility will be required to fire oil will typically be determined by the grid operator (ISO-NE) based on the severity of winter conditions when there is a need to conserve natural gas for heating needs of the region. Generally, based on history, the number of days per year the Facility will be requested to use ULSD will be approximately five days. (October 2015 EFSB Application, Page 18).**
>
> ***
>
> **To put the above in perspective, over the last five years with the current limited pipeline capacity into the region, there has been an average of only five days per year when gas fired electric generation was asked to switch to distillate oil. Five days per year means, if the Project had existed for the last five years, that the Project would have fired natural gas 98.6% of the time, and as a result, the Project's daily water use and wastewater discharge would have been in the range of 102,240 gpd and 69,000 gpd respectively 98.6% of the year. Projecting forward with the natural gas pipeline expansions underway, the total annual days of Project oil firing should lessen with the increasing supplies of natural gas helping to reduce winter shortage of this critical fuel to the region.**

Provide a confirmation from ISO-NE that this information is accurate. We understand that the plant can operate in this condition for as long as 3.6 days based on information provided by John Niland of Invenergy. Would the expected days be consecutive or not? Please provide information for operating in this condition for the last five years.

RESPONSE:

Please see Invenergy's Responses to the Town's 16th data requests, particularly 16-2 and 16-4. Invenergy checked with multiple ISO-NE staff members in Operations and System Planning and was informed that ISO-NE does not provide confirmation as to when generators should be expected to switch to ULSD. What the ISO-NE could provide was data on when a Reserve Constraint Penalty Factor ("RCPF") Activation event had occurred over the past five years (and back to 2006). Please see the publically available spreadsheet which can be found at:
https://www.iso-ne.com/static-assets/documents/2015/12/rcpf_event_data_from_may_2015.xlsx

DIESEL FUEL

15-5 What do you expect the Town of Burrillville should do regarding service levels needed to address possible accidents at the facility, including chemical spills?

RESPONSE 15-5: Invenergy will coordinate with the Town of Burrillville with regard to the location and amount of storage of hazardous materials on-site and the associated training, personal protective equipment and emergency procedures which may be required in the event of a release.

Please refer to Section 7.0 (Notifications), Section 13.2.4 (Countermeasures), and Appendix A of **Exhibit 1**, the Preliminary Draft Spill Prevention Control and Countermeasure Plan for details on the emergency response procedures which will be implemented at the Facility and the service levels needed to address possible accidents.

RESPONDENT: John Niland, Invenergy Thermal Development LLC
Mike Feinblatt, ESS Group, Inc.

DATE: August 19, 2016

DIESEL FUEL

4-25 What is the capacity and structure of the retaining dike around the fuel tanks?

RESPONSE 4-25: The fuel oil storage secondary containment berm (dike) will be designed and installed in accordance with National Fire Protection Agency ("NFPA") 30 (22.11.2.1 through 22.11.2.8) and local environmental regulations. It will be sized to hold the full volume of one storage tank (1,000,000 gallons).

The structure of the containment berm will consist of compacted engineered fill placed at a slope not steeper than 2:1 and sized to exceed the volume of the tank inside the berm as required by code. The berm and containment area will be covered with an impermeable synthetic liner.

RESPONDENT: Mike Feinblatt, ESS Group, Inc.

DATE: April 27, 2016

DIESEL FUEL

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RESPONDENT: Mike Feinblatt, ESS Group, Inc.

DATE: April 27, 2016

MAY 18, 2017 by Pilita Clark

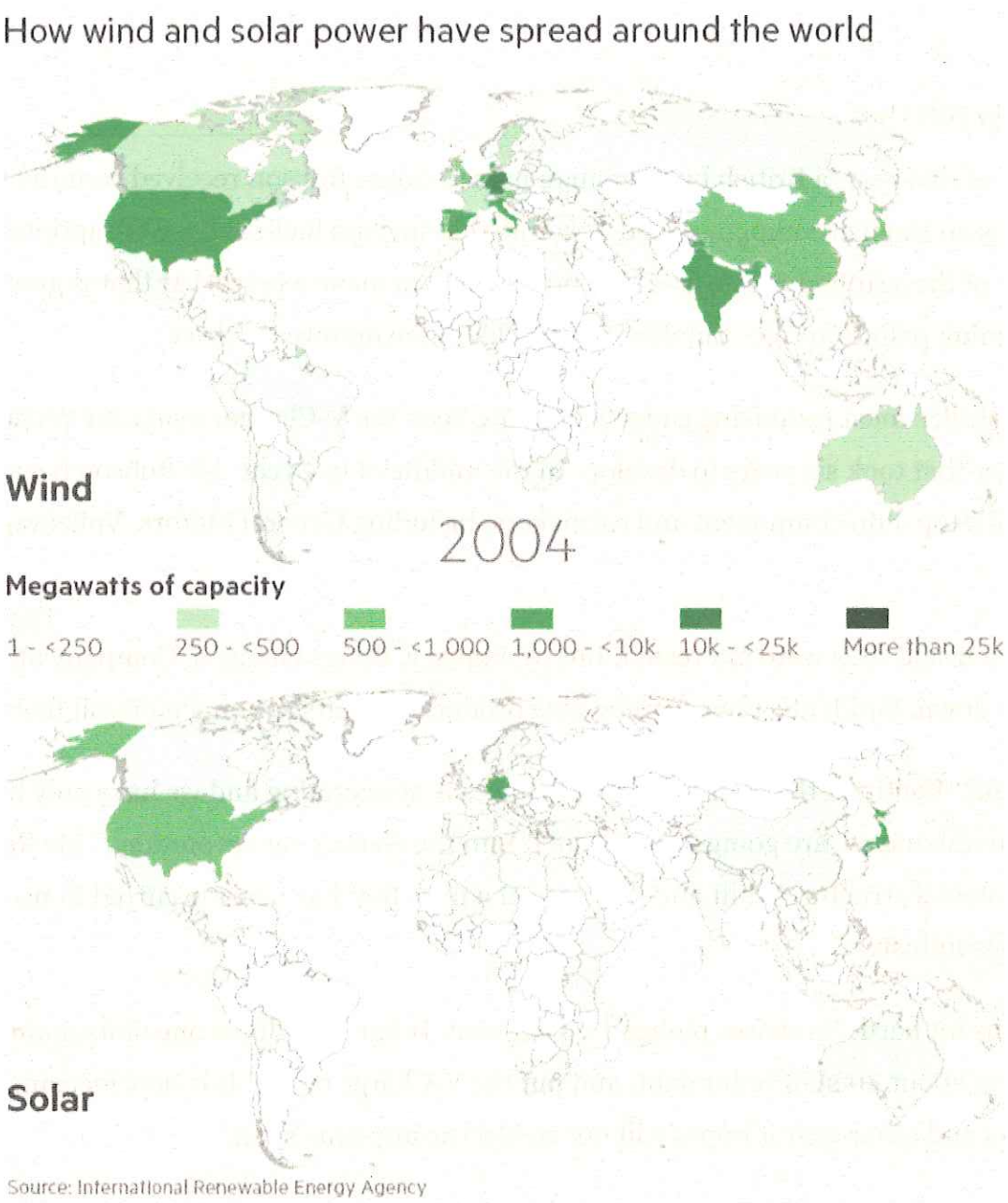
At the start of this year, a British businessman named Adam Robson received some awful news. Mr Robson runs an English company called Torotrak that invents fuel-saving contraptions aimed at solving one of the auto industry's great dilemmas: how to make a petrol car that is green enough to meet tightening pollution rules but does not feel like a lawnmower to drive.

One of Torotrak's most promising gadgets has long been the V-Charge, a smarter version of a turbocharger that took six years to develop. In the middle of last year, Mr Robson began pitching it to the world's top auto component and carmakers, including General Motors, Volkswagen and Toyota.

About a dozen said they were interested. But by January, things changed. Company after company turned him down. Suddenly, none wanted new products for cars running on fossil fuels.

"They all said, 'We think the shift to electric vehicles is accelerating and we have only limited R&D money to invest and we are going to put all of it into the electric car revolution'," Mr Robson says. "This is a colossal structural shift and it's come at a pace that has never occurred in people's careers before in this industry."

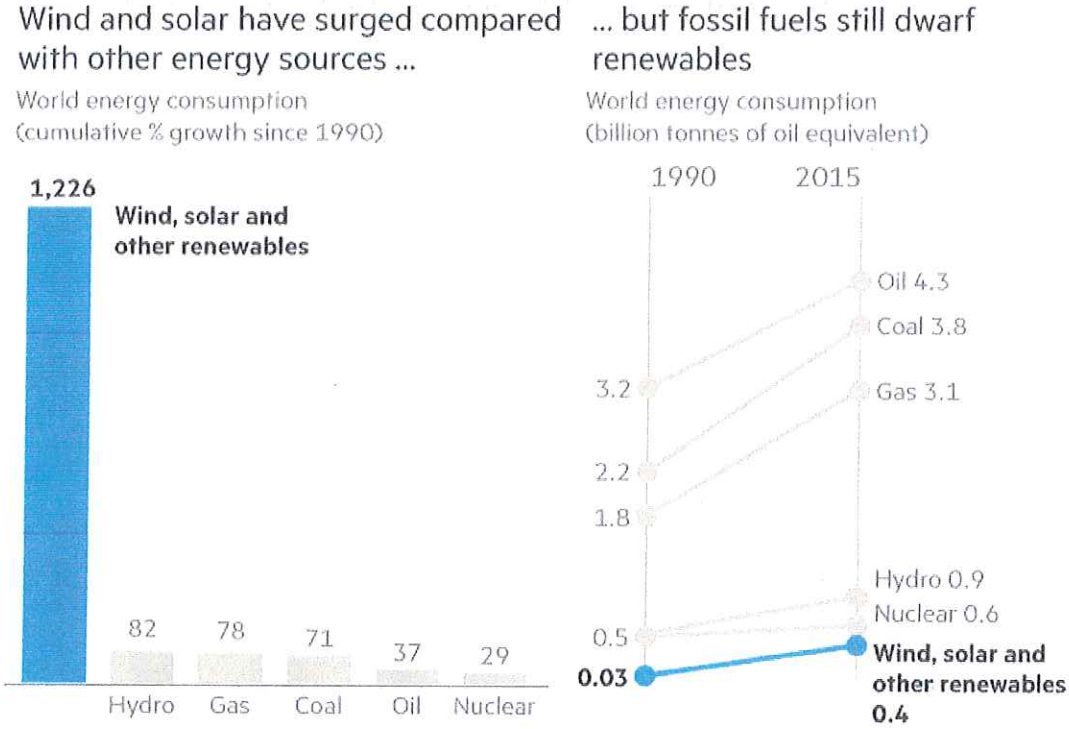
Torotrak was hit hard. Its shares plunged 40 per cent. It has shut down one of its main engineering sites, making about 40 staff redundant, and put the V-Charge on ice. It is now focusing on heavy-duty diggers and other gear it hopes will not go electric any time soon.



Mr Robson's experience is just one example of the disruptive impact of green energy on companies — and entire industries — around the world. After years of hype and false starts, the shift to clean power has begun to accelerate at a pace that has taken the most experienced experts by surprise. Even leaders in the oil and gas sector have been forced to confront an existential question: will the 21st century be the last one for fossil fuels?

It is early, but the evidence is mounting. Wind and solar parks are being built at unprecedented rates, threatening the business models of established power companies. Electric cars that were hard to even buy eight years ago are selling at an exponential rate, in the process driving down the price of batteries that hold the key to unleashing new levels of green growth.

"This clean energy disruption has just started and what is striking is how much of a financial impact it is already having on some companies," says Per Lekander, a portfolio manager at London's Lansdowne Partners hedge fund, who has tracked global energy markets for more than 25 years.



Source: BP

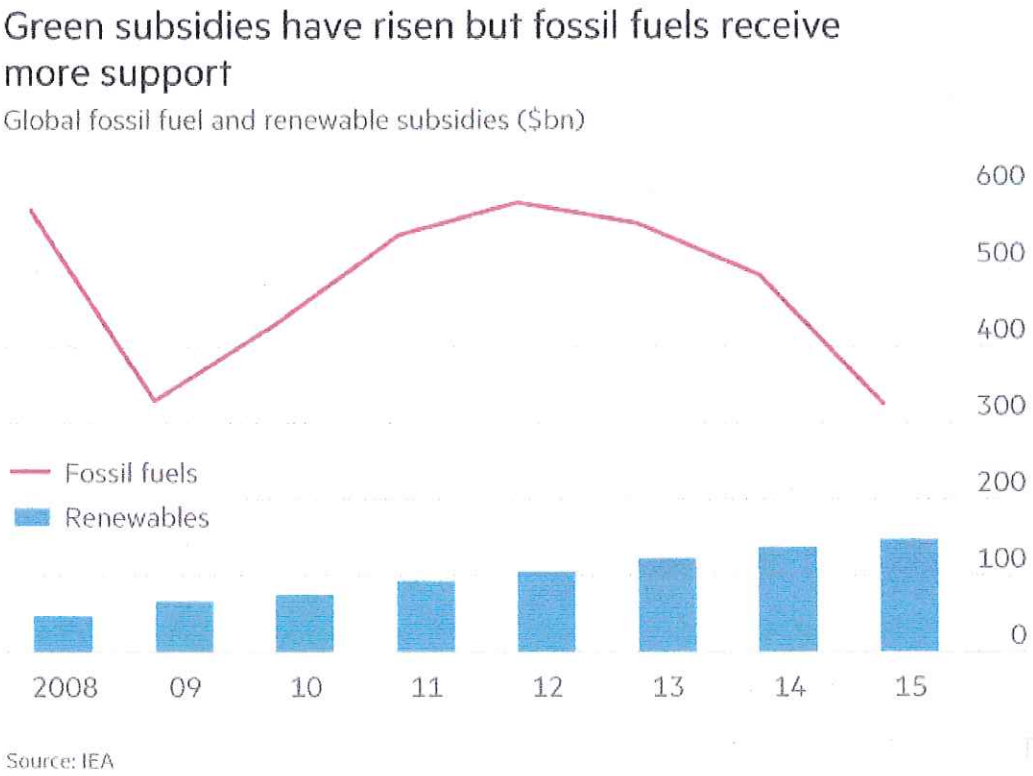
"It hit the electricity sector first, in Europe in 2013 and then the US two years later. Now it has spread to the auto sector and I think the oil industry is next."

The shift has come as increased government efforts to curb climate change and smog have driven down costs and spurred technical advances, creating a green energy industry that looks nothing like it did a decade ago: expensive, sluggish and German.

Today, China and India have picked up the baton and are driving a sector that has spread to every continent. The result was a banner year for green energy in 2016.

Global renewable power generation capacity rose by 9 per cent last year — a fourfold increase from the start of this century — buoyed by the growth of newer sources such as solar power that shot up by more than 30 per cent. For the second year in a row, renewable energy accounted for more than half the new power generation capacity added worldwide. Sales of plug-in electric vehicles last year were 42 per cent higher than in 2015, growing eight times faster than the overall market. The storage capacity of big lithium ion battery systems more than doubled last year.

These advances have become too significant for the oil and gas industry to ignore. In the first three months of this year, the heads of some of the world's largest oil companies have spoken of a "global transformation" (Saudi Aramco) that is "unstoppable" (Royal Dutch Shell) and "reshaping the energy industry" (Statoil). Isabelle Kocher, chief executive of French power and gas group Engie, calls it a new "industrial revolution" that will "bring about a profound change in the way we behave".



None of this means the problem of climate change has been solved, or that fossil fuels will vanish in the near future. Oil, gas and coal still account for about 86 per cent of the energy keeping the world's lights on, cars running and homes warm — a share that has barely changed in 25 years. Coal and gas-fired power plants are still being built, especially in the developing world where 1.2bn people lack electricity.

Modern renewables, in contrast, are growing from a tiny base and are often less dependable than dirtier power generators that do not rely on the weather. Wind and solar power accounted for a puny 4.4 per cent of global electricity in 2015, and big battery systems can only store enough power to satisfy a few seconds of global electricity demand, says the International Energy Agency. Electric vehicle sales last year were just 0.9 per cent of all vehicles sold, according to the EV-Volumes consultancy.

But the emerging energy transition is already causing trouble for companies around the world, from writedowns and shrinking sales to sliding share prices and wholesale break-ups:

• In sunny Nevada, casino companies are unplugging from the state utility. NV Energy lost nearly 6 per cent of its customer base virtually overnight in October after MGM Resorts International and Wynn Resorts agreed to pay a combined $103m to defect and buy their power elsewhere. MGM cited "the sharp decline in the cost of renewable energy" as a primary driver of its decision. Caesars later did a $47.5m deal to quit.

• In Chile, shares in some of the country's electricity companies, including AES Gener and Colbún, slid in August after they lost out in an auction that pitted renewables against fossil fuel generators for 20-year power contracts. Among the winners was a solar scheme that undercut fossil fuel bids with a record low price of $29.10 per megawatt hour.

• In Australia, a $200bn investment splurge in liquefied natural gas projects has put the country in position to overtake Qatar as the world's largest LNG exporter. But new schemes have come online as LNG prices have collapsed amid fears of a supply glut that some economists say could linger as renewables become more affordable. "It just makes sense for countries to think about renewables as an alternative," says Jürgen Weiss of the Brattle Group consultancy.

• In Michigan, car parts supplier BorgWarner, which makes most of its money selling components for conventional combustion engine vehicles, made one of the largest acquisitions in its 89-year history in 2015, when it paid $950m in cash for US electric motor maker Remy International. BorgWarner's shares subsequently dived but analysts say the industry's shift to electric cars means the deal made sense. "Without Remy, the narrative of their long-term value would have been difficult to justify," says Adam Jonas, head of global auto research for Morgan Stanley.

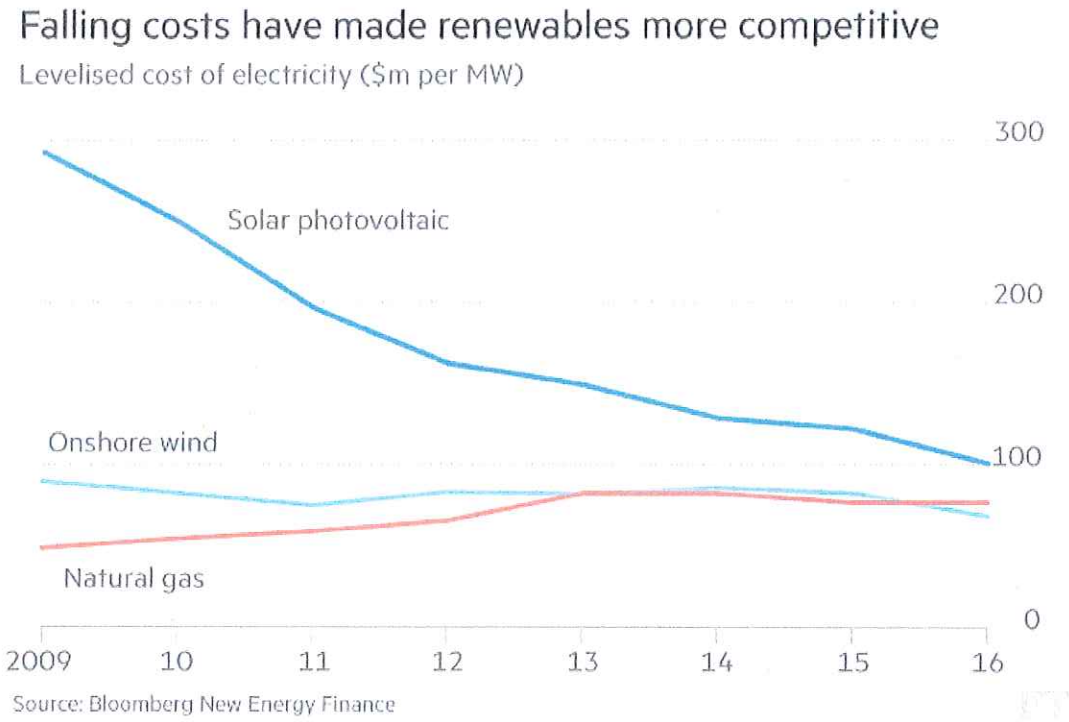
Isabelle Kocher, chief executive of French energy group Engie: "[This is] an industrial revolution [that will] bring about a profound change in the way we behave" © Leo Novel/FT

Thanks, Germany

When the definitive history of the energy transition is written, the taxpayers of Germany will deserve their own chapter. They bankrolled the green energy revolution known as the *Energiewende*, pioneering generous subsidies nearly 20 years ago that helped drive renewables up from 9 per cent of Germany's electricity mix in 2004 to 32 per cent last year.

As other European nations — and some US states — boarded the green power wagon, it kindled a wave of demand for wind turbines and solar panels that helped drive costs down worldwide. Solar's price fall was especially steep after a Chinese manufacturing boom spurred global over-supply.

The result was doubly miserable for conventional fossil fuel generating companies: renewables crowded them out while simultaneously driving down wholesale power prices, causing billions of euros in losses.



Germany's two largest power utilities, Eon and RWE, shook the industry last year when they split themselves in two, hiving off struggling fossil fuel operations from cleaner power businesses.

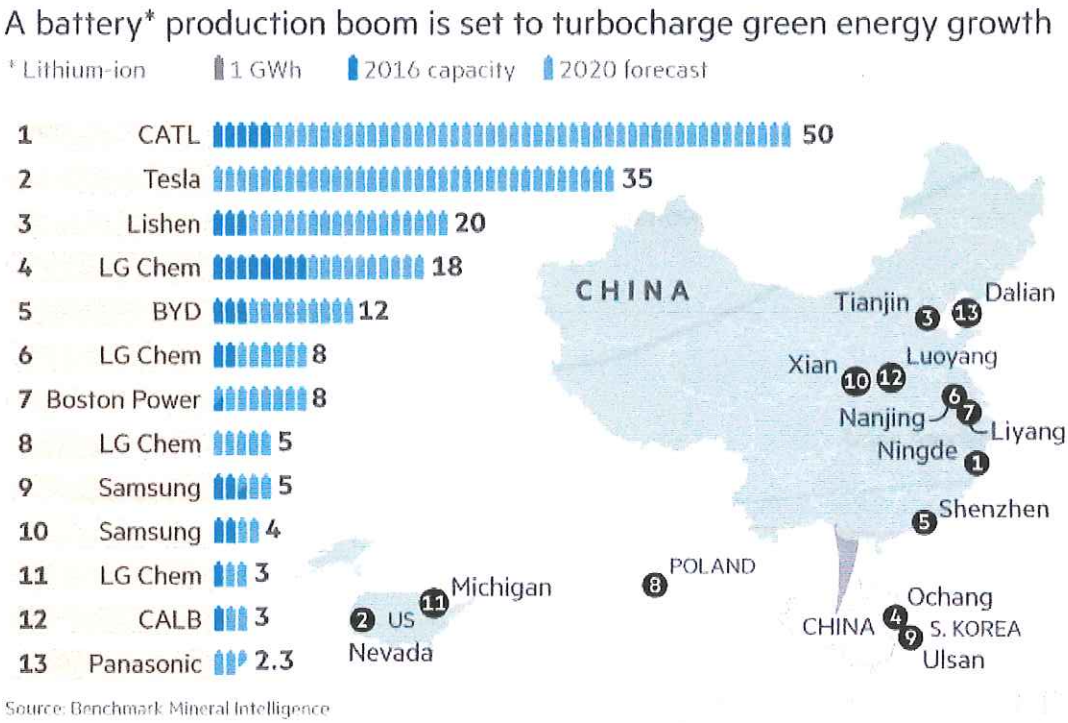
"For two real pillars of the German corporate world to radically break themselves up is something I cannot recall ever seeing in my lifetime," says Peter Atherton, a UK power analyst.

Yet a lot of places have begun to look more German this year — even the US, where President Donald Trump wants to unleash more fossil fuel production.

The US solar industry employs more than twice as many workers as the coal sector, a report showed in February. Manhattan has more Tesla charging spots than petrol stations, though many are in fee-paying parking garages.

And across the US, where power companies are facing lower wholesale prices thanks to cheaper natural gas, renewables are adding pressure too — even in unlikely spots such as oil-rich Texas.

Texas now has more installed wind power capacity than Canada and Australia combined. If it were a country, it would rank as the world's sixth-largest wind power, after China, the US, Germany, India and Spain.



NRG, the second-largest US power producer, has about a quarter of its generation capacity in Texas and has been reshaping its business so it relies less on squeezed wholesale power prices.

Mauricio Gutierrez, NRG's chief executive, warned in February that companies failing to do this would be rendered "obsolete" by the "unprecedented disruption" in the industry.

Brian Marrs, NRG's director of policy and strategy, says: "I think what we're seeing in the US now is the German postcard from the future finally arriving across the Atlantic."

Yet fast-growing industrialising nations are seeing some of the most profound changes. Towering over them all is smog-choked China, which has become a green energy juggernaut after designating renewables a strategic industry.

China has more than a third of the world's wind power capacity; a quarter of its solar power; six of the top 10 solar-panel makers; four of the top 10 wind turbine makers and more battery-only electric car sales last year than the rest of the world combined.

India is eager to follow: it built one of the world's largest solar photovoltaic farms last year; ranks fourth in the world for wind power capacity; and could become the world's third-biggest solar market this year. It also wants to boost its use of electric cars.

The big debate

The world has been through energy transitions before, often shaping the course of human history. The age of wood gave way to coal in the 1800s. Coal was in turn squeezed by oil and natural gas, transforming the fortunes of Middle Eastern desert kingdoms.

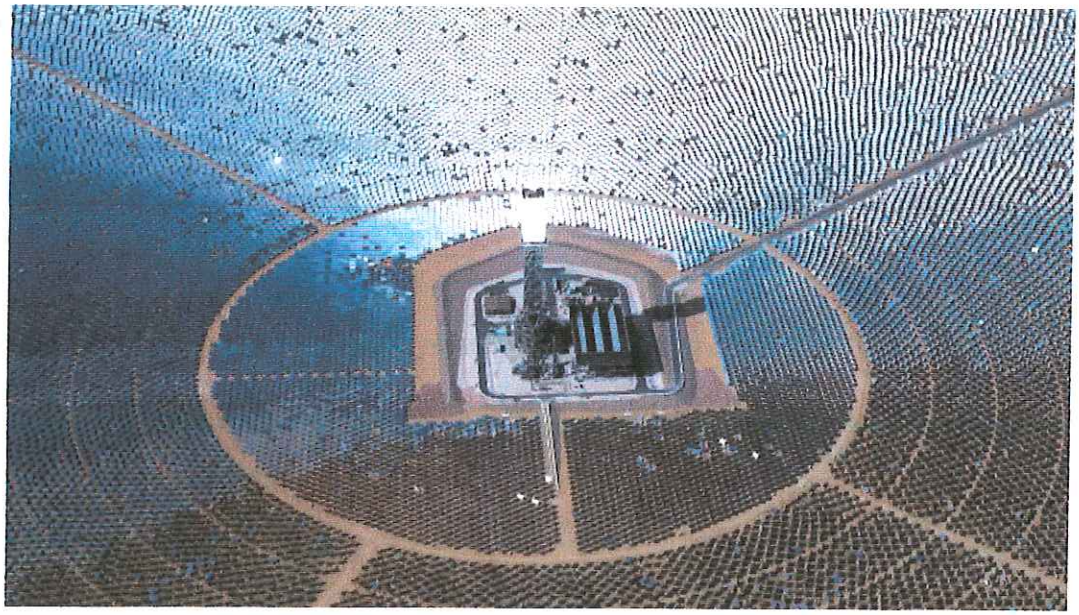
Such shifts usually take decades. But the growth of the latest one has prompted some to wonder if the age of fossil fuels might fade faster. Some mainstream thinkers are dubious.

Their view is embodied by Professor Vaclav Smil, an energy scholar whose fans include Microsoft co-founder Bill Gates. ("There is no author whose books I look forward to more," Mr Gates says.)

Prof Smil says "naive" people who are "enchanted" by the idea of a rapid end to fossil fuels ignore the fact that it has typically taken 50 to 60 years for a widespread shift from one dominant fuel to another. As coal gradually displaced wood, for example, it reached 5 per cent of all fuel energy in 1840 but was still only about 50 per cent by 1900.

"People want to be deceived," he says in an interview. There is a dearth of green alternatives to the fossil fuels used to make steel, cement or plastics, he adds. And replacing a global fossil fuel energy system that took an estimated $25tn to create over the 20th century with today's crop of renewables is a job that will occupy us "for generations".

Still, a much-discussed paper published last year by Professor Benjamin Sovacool of the University of Sussex suggests energy transitions in some places can be speedier. Nuclear power in France went from 4 per cent of the country's electricity supply in 1970 to nearly 40 per cent in 1982, for instance.



The Ivanpah Solar Electric Generating System, owned by NRG Energy, Google and BrightSource Energy, in the Mojave Desert in California near Primm, Nevada © Getty

Others think the latest energy transition could be swifter because it is driven by deliberate efforts to curb climate change, rather than chance. Countries around the world have adopted more than 1,200 climate change laws, up from about 60 two decades ago, a study this month showed. Renewables now receive direct policy support in an estimated 146 countries, nearly triple the number in 2004.

That backing has seen the cost of wind turbines fall by nearly a third since 2009 and solar panels by 80 per cent, says the International Renewable Energy Agency. This underlines an advantage for renewables: unlike coal, oil or gas, every country has wind and sun.

As panel and turbine costs have fallen, "It is as if every country in the world woke up one bright morning to find that it had a North Sea at its disposal", says London energy analyst Kingsmill Bond.

He says the more relevant point for investors is not the decades it may take for fossil fuels to be eliminated but the fact that small falls in market share can have a profoundly disruptive impact.

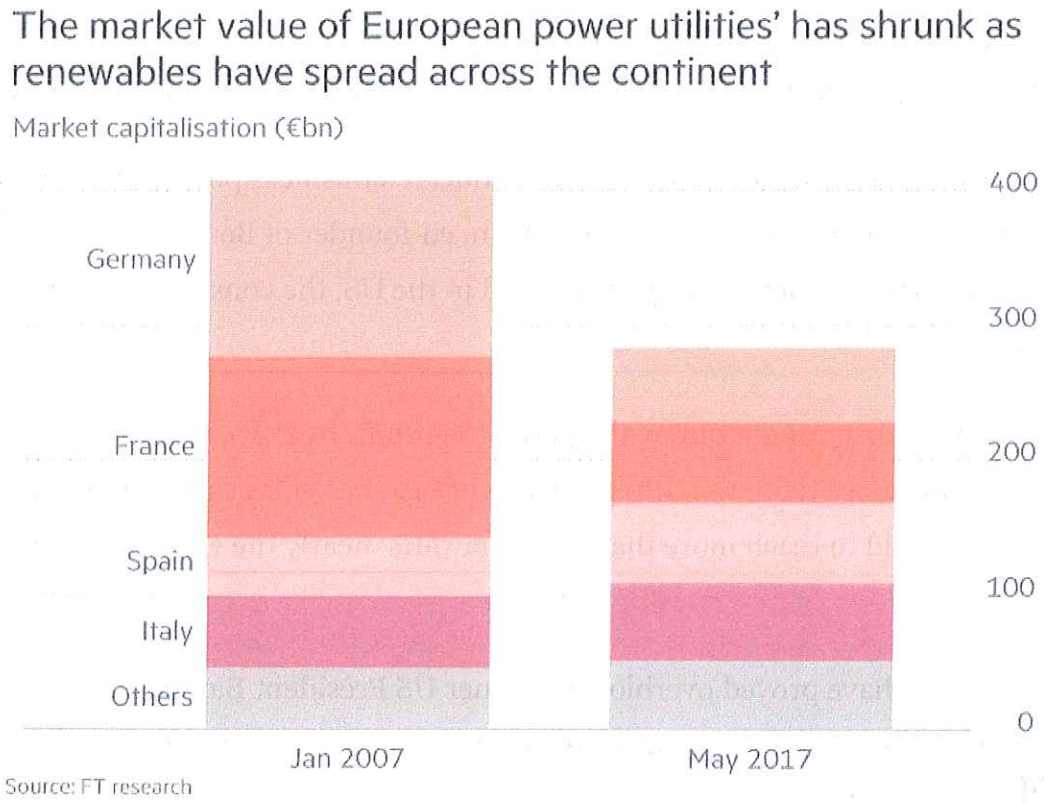
Exhibit one: most major carmakers are planning new electric models even though fewer than 1 per cent of cars sold each year have a plug.

The end of subsidies

There is another reason some energy industry watchers expect the green power sector to accelerate: the more costs fall and technologies improve, the less it needs conventional subsidies.

Costs are already lower than widely understood. "In 2010 we financed a 15 megawatt solar plant in southern California that cost $55m to build," says Jim Long, a partner at Greentech Capital Advisors, a global clean energy advisory firm. "This year we have done another one the same size in the same area that has cost $15m and will produce at least 40 per cent more energy."

This is one reason countries managed to adopt the global climate change agreement in Paris in 2015 after years of negotiations, says Christiana Figueres, the former UN climate official who helped seal the accord. "Switching away from coal no longer looked impossible, even in developing countries," she says.



Costs are expected to fall further as countries spurn expensive subsidies guaranteeing set prices for generators in favour of competitive auctions or tenders. The amount of auctioned renewable electricity last year was triple that in 2015, according to Bloomberg New Energy Finance, while the average global price of auctioned solar power has plummeted fivefold since 2010.

One of the most striking auction results came in Germany in April when Denmark's Dong Energy, the largest builder of costly offshore wind farms, said it would build two new schemes without subsidies, relying instead on market prices alone. Advances in wind technologies — including the prospect of much more powerful turbines — were one reason for Dong's move, a step others are expected to follow.

"Renewables have reached a tipping point globally," says Simon Virley, head of power and utilities at KPMG. "A subsidy-free future is now in reach for a number of technologies and geographies."

Mainstream Renewable Power, an Irish wind farm developer, shows how new technology is making a difference. It was a winner in last year's power auctions in Chile, which require customers' demand for electricity to be met 24 hours a day. That means generators face the potentially pricey risk of buying power on the spot market to make up for any shortfalls.

Mainstream says more precise wind measuring technology makes it easier to predict how much extra power is needed, and therefore whether wind projects can be profitable.

Investors say important trends like this are obscured in countries where the existence of climate change is still so widely contested that the scale of the energy transition is under-estimated.

"I think it's happening much faster than most well-educated business people in America understand," says veteran investor Jeremy Grantham, co-founder of Boston asset manager GMO. "Because the science is being deliberately obfuscated in the US, the consequences are being obscured as well."

Even the experts have been caught out by the pace of the shift. In 2010, IEA projections suggested it could take 14 years before there was 180 gigawatts of installed solar capacity. It took less than seven years for the world to reach more than 290 gigawatts, nearly the entire generating capacity of Japan.

Still, some predictions have proved overblown. Former US President Barack Obama said that by 2015, the US could be the first country with 1m electric cars. Only about 400,000 materialised.

This time could be different

Some green energy veterans bruised by past setbacks think there is a reason to be more optimistic today: batteries.

"I have been early twice in financing the low-carbon energy transition," says Bruce Huber, co-founder of the Alexa Capital advisory group. "But we feel it's third time lucky."

One reason for his optimism is what he calls the "tectonic plate-shifting" in the car industry that is driving down the cost of energy storage. Storing clean power has long been a holy green grail but prohibitive costs have put it out of reach. This has begun to change as battery production has ramped up to meet an expected boom in electric cars.

Lithium ion battery prices have halved since 2014, and many analysts think prices will fall further as a slew of large battery factories are built.

The best known is Tesla and Panasonic's huge Nevada "gigafactory". Tesla claims that once it reaches full capacity next year, it will produce more lithium ion batteries annually than were made worldwide in 2013.

It is only one of at least 14 megafactories being built or planned, says Benchmark Minerals, a research group. Nine are in China, where the government is backing electric cars with the zeal it has directed at the solar industry.

Could this led to a China-led glut like the one that helped drive solar industry write-offs and crashing prices after the global financial crisis?

"It's something to watch," says Francesco Starace, chief executive of Italy's Enel, Europe's largest power company. The thirst for electric cars, not least in China, means "the dynamics of demand are completely different" for batteries than for solar panels, he adds.

Tesla Motors founder Elon Musk © Reuters

Still, Enel's internal forecasts show battery costs falling by about 30 per cent between 2018 and 2021 and it is among the companies already pairing batteries with solar panels to produce electricity after dark in sunny places where power is expensive, such as the Chilean desert.

Tesla finished a similar system in Hawaii in October and its chief executive, Elon Musk, made a characteristically flamboyant offer this year — via Twitter — to build a much larger one within 100 days to help fix power outages in southern Australia.

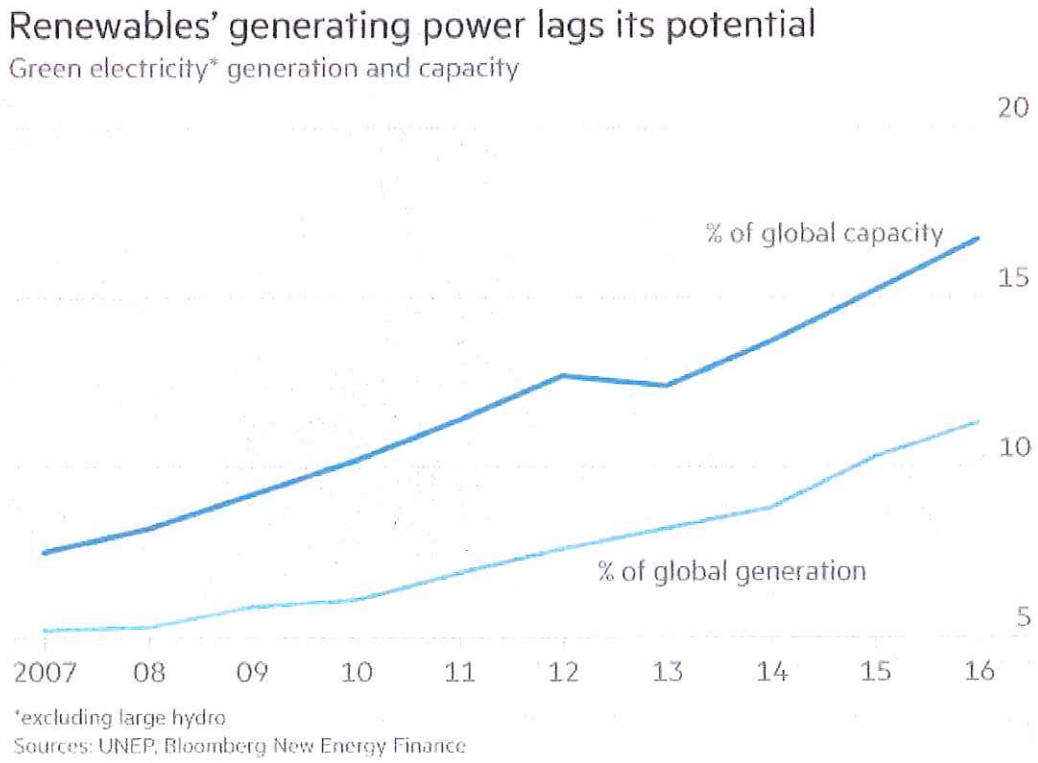
For all the excitement about batteries, the technology is still not ready to let householders in any part of the world stick a solar panel on the roof, a battery in the garage and abandon grid power completely. It would cost hundreds of thousands of dollars in snowy places like Nebraska and probably require an extra garage to house all the batteries, the CLSA brokerage calculated last year.

However, other analysts say investors need to pay attention to the disruption that even partial grid defection could cause in places where batteries make more financial sense.

In Australia, where household electricity prices nearly doubled in the decade up to 2014 and rooftop solar levels are among the world's highest, more than 6,700 battery systems were sold last

year, up from 500 in 2015, says the solar consultancy SunWiz. By 2020, about 1m homes could have batteries, according to Morgan Stanley analysts.

"We think most incumbent utilities downplay the earnings risks from solar and battery take-up," the bank said last year. "All utility investors should monitor Australian market developments" to anticipate how the market will evolve elsewhere, it added.



Battery companies flocking to Australia say it is only one example of a new breed of "prosumers", people using renewables and batteries to produce and consume their own power.

"We were doubted before," says Philipp Schröder, managing director of Germany's Sonnen home battery group. He says big utilities are copying his company's business model now, purely because "the economics are right".

In quake-prone Japan, a hotbed of battery technology, industry leaders say it is inevitable that home solar-storage systems will become commonplace.

"In future we think all new houses will generate and consume their own electricity and grid power will only be used for industry," says Hiroichi Yoshida, founder of Eliiy Power, a lithium ion battery-maker that specialises in solar storage systems.

When a powerful earthquake rocked the southern Japanese city of Kumamoto last year, black-outs plunged most homes into darkness for nearly a week. But the lights stayed on in at least 20 houses

with solar-storage units, says Eliiy, which is planning to open a third battery production plant in 2019 as sales rise.

"I think even the industry has been surprised at the momentum it has gathered over the past two years," says IHS Markit solar analyst, Sam Wilkinson. "The possibilities this opens up are extremely compelling."

Hedging their bets

Meanwhile, some fossil fuel companies are starting to put serious money into green energy.

Seven oil and gas groups, including France's Total, Royal Dutch Shell and Norway's Statoil, have together invested almost $15bn in renewables over the past four years, according to the Oil and Gas Climate Initiative industry group.

Total bought France's Saft battery company last year for almost €1bn, having already acquired a controlling stake in a US solar company, SunPower.

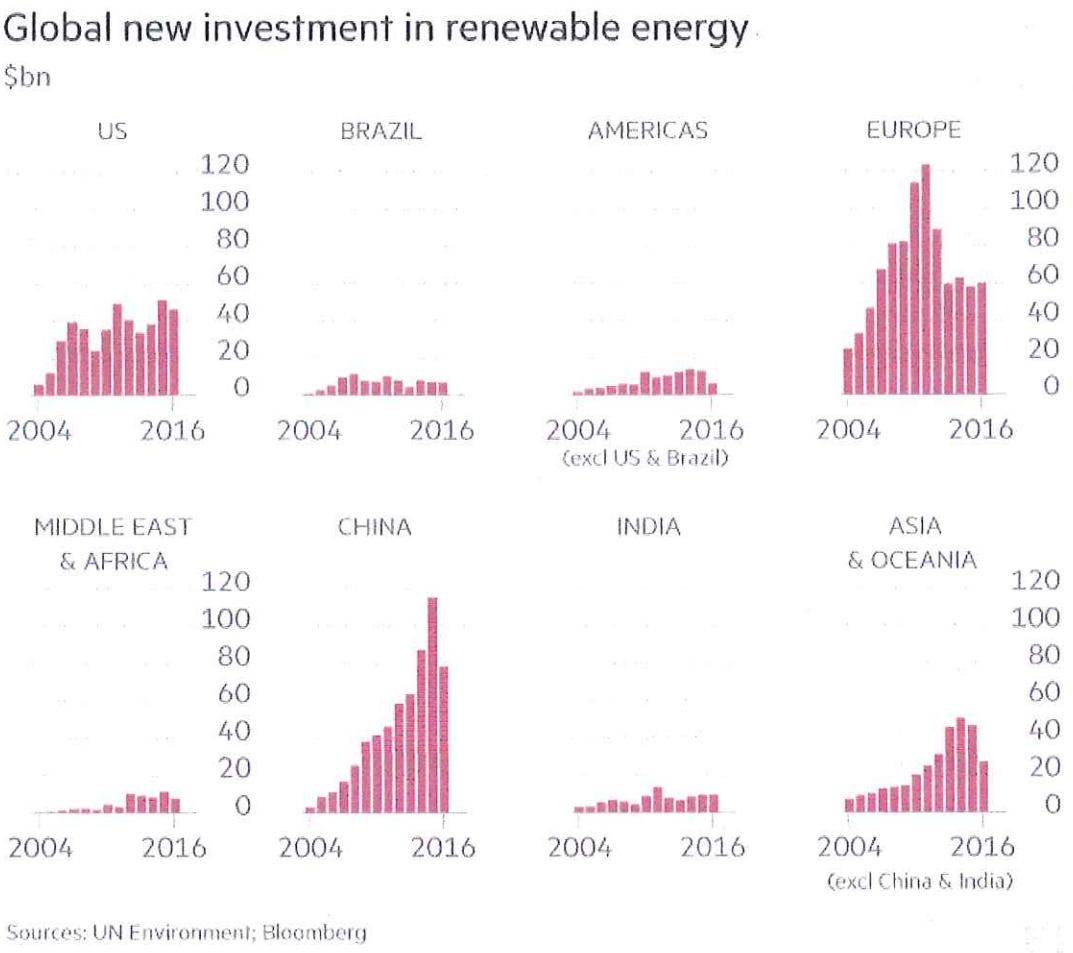
Norway's Statoil is spending $500m a year on clean energy projects and expects to spend even more after 2020, says Irene Rummelhoff, head of the company's "new energy solutions" unit.

"It is the first time we've devoted this much money to clean energy," she says, adding she expects to see more companies follow suit amid the "tremendous shift" of plummeting renewables costs.

"Clearly it is to some degree a threat but at Statoil we have chosen to see it as an opportunity," she says. The company has six offshore wind projects operating or in development, including an innovative floating wind turbine park off the coast of Scotland it plans to hook up to a battery system next year.

Royal Dutch Shell is also ploughing into offshore wind farms, to the point that Henrik Poulsen, chief executive of Dong Energy, says he now regards both Shell and Statoil as "competitors".

But oil and gas companies may need to act faster if the ambitious plans of other large energy companies succeed.



France's Engie, for example, is investing €1bn over three years on new energy technologies that could strike at the heart of fossil fuels. The company's head of research, technology and innovation, Thierry Lepercq, says this includes creating zero-emissions power plants that generate electricity for "the Rio Tinto price" — the price that the metals and mining company seeks when deciding where to build a new smelter.

Mr Lepercq thinks Engie will find a way to build such plants "within two years", partly because of "sinking and sinking" battery costs. Engie has no interest in technology requiring subsidies, he says. "It's a fundamentally business-driven approach."

None of this means the future of clean energy will be entirely smooth. Indeed, its very success poses a raft of questions for governments that some have barely contemplated.

Chief among them: what to do with power markets that were never designed for millions of people turning their rooftops into mini power stations?

How to pay for upgrading grids to cope with the influx of all this renewable power? What to do about incumbent companies calling for the brakes to be slammed on to protect them from green

power incursions? Then there is Mr Trump, who is seeking to unwind the clean power policies of his predecessor.

In the rest of the world, however, the future of green power appears assured. So much so that an industry that has spent years on the defensive is beginning to show a rising sense of confidence.

"Fossil fuels have lost," says Eddie O'Connor, chief executive of Irelands's Mainstream Renewable Power. "The rest of the world just doesn't know it yet."

Graphics by Federica Cocco and Steven Bernard. Illustration by Ollanski

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FT Clean Energy Week, May 23-25 2017 — more details here

FT Energy Transitions Strategies, May 24 2017 -- more details here

Letter in response to this article:

Renewables require a bigger surge of investment / From Dr Stephan Singer, Brussels, Belgium

NO NEW POWER PLANT

NORTHERN RI ©

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Mike Lamoureux
608 Camp Dixie Rd, Pascoag, RI 02859

Thank you for the opportunity to address the board tonight and thank you for coming to Burrillville again. It is important. Some time has passed since we have all had the opportunity to testify. We have come to learn a lot during this time.

We have all become much more familiar with how the energy process works as well as the procedures of the EFSB. We are now very familiar with the fact that the EFSB must make a decision on Invenergy's proposal by weighing the need vs the environmental impact vs the economy of the state. The board will make such a decision by leveraging advisory opinions from different agencies throughout the state. In this particular proposal, the board has been fortunate to have an additional advisory opinion – time.

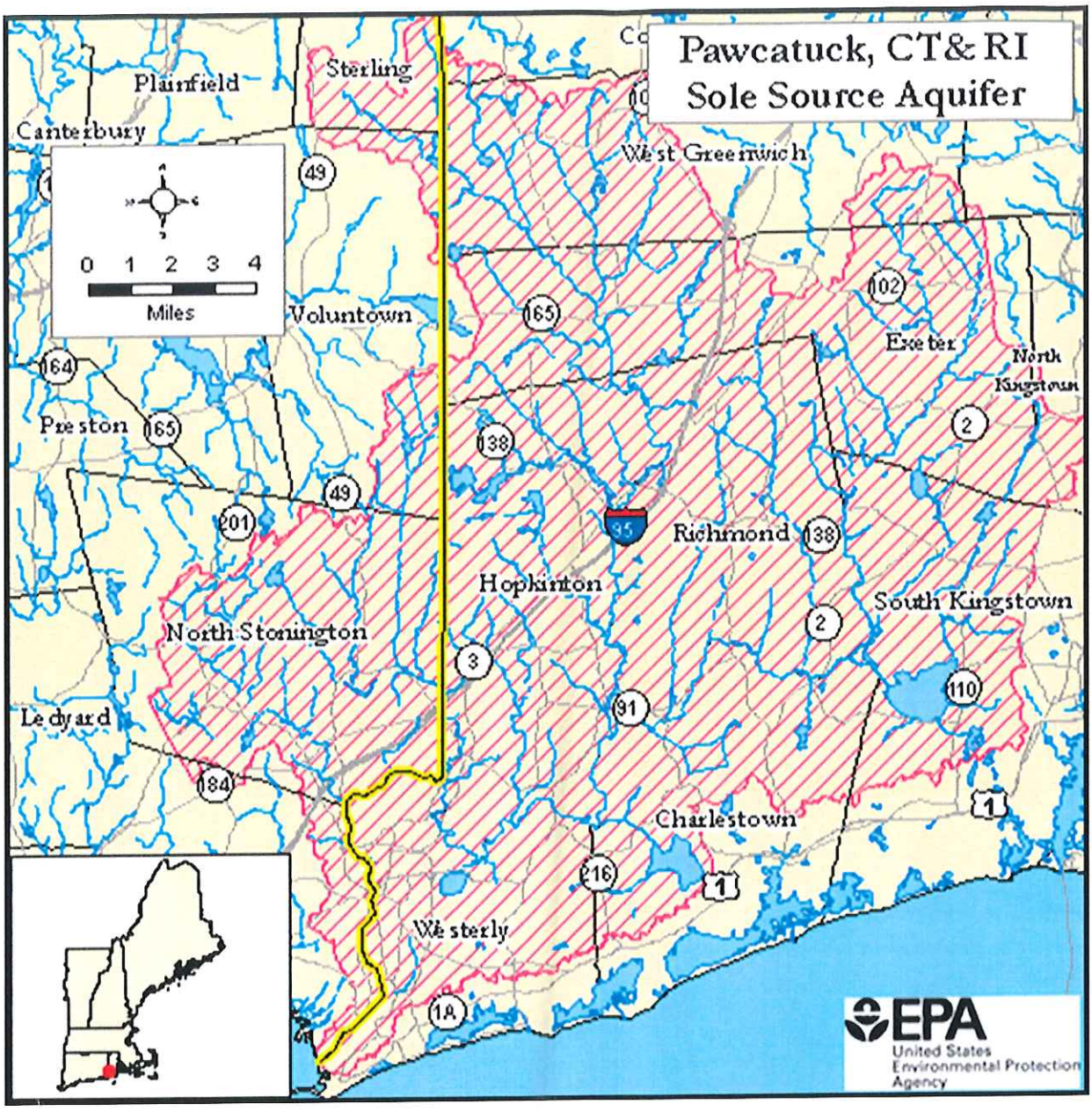
You see, time has allowed us all to better assess the overall need of this project. The original proposal was submitted at a time when ISO-New England was awarding high energy costs due to a forecast which predicted a potential gap in generation capacity. This of course was an expected gap due to many older plants coming offline. Thankfully time has shown us that this forecast was incorrect as we did not know that through energy efficiencies and renewables our actual demand would decrease.

The fact that there is an impact to the environment is a given. The EFSB's own procedure acknowledges this and requires that you weigh the impact vs the overall need. But through the gift of your additional advisory opinion, "TIME" we have all been reminded of the money invested by RI DEM to conserve this area of the state. An area that RI DEM published as one of the most critical areas to conserve. Invenergy has confirmed this to be true with their own assessment of this area which validates the many plants and animal species that would be impacted by this project.

When assessing the economic impact to the state, TIME has helped us again. Through Invenergy's own admission we have learned that the original cost savings that were communicated to us several times have been grossly overstated.

The advisory opinion of TIME has allowed RI DOH to insist that you consider climate change in your decision. The advisory opinion of TIME has allowed 35 municipalities (32 in RI, 2 in MA, and 1 in CT) to formally state that this project is not a good idea.

In closing, TIME is powerful metric. A good project will still be a good project as time passes. A bad project....well over time, a bad project will still be Invenergy's project.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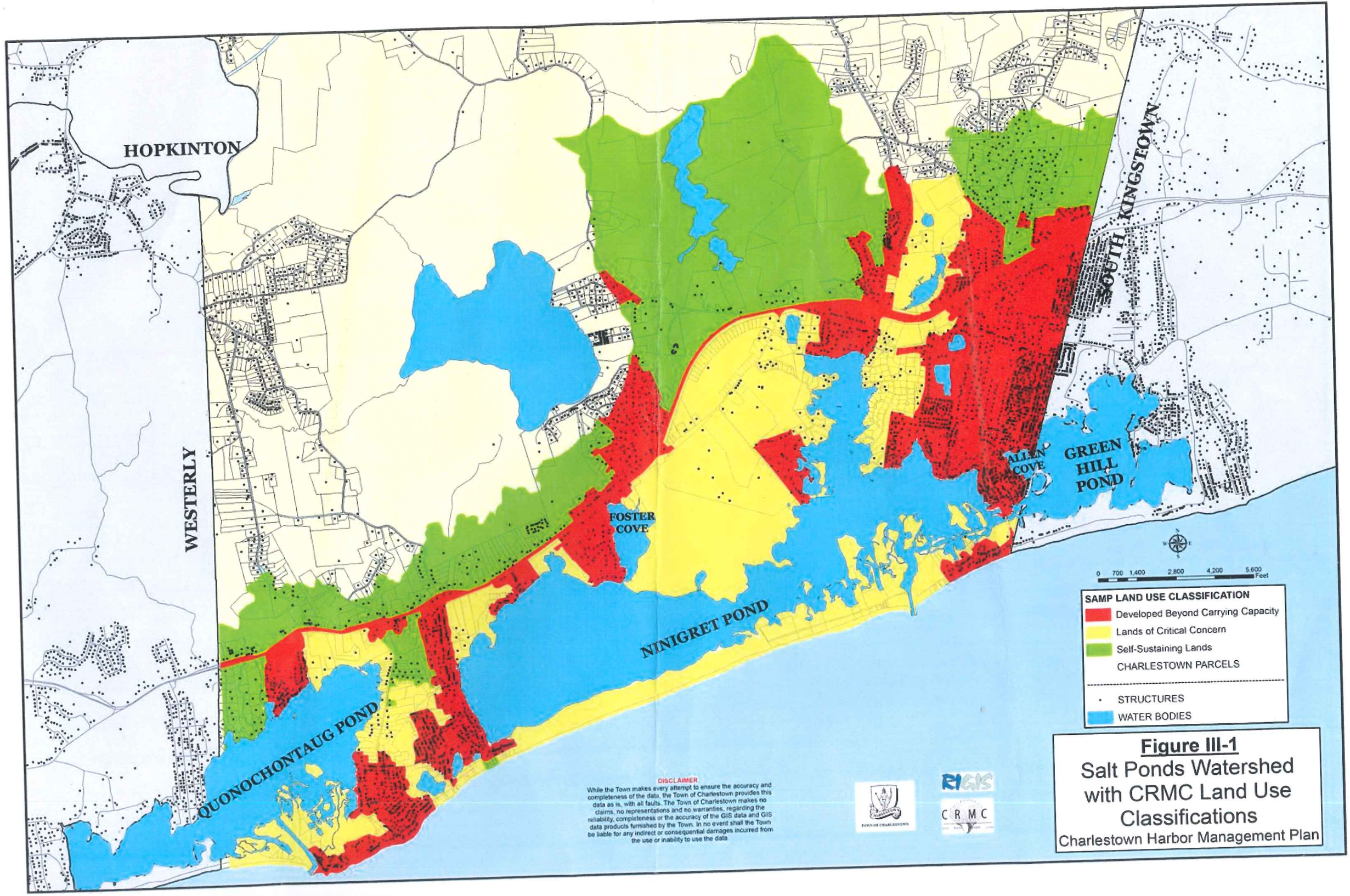

Figure III-1
Salt Ponds Watershed with CRMC Land Use Classifications
Charlestown Harbor Management Plan

#Environment
September 27, 2017 / 12:06 PM / Updated a day ago

Weather extremes, fossil fuel pollution cost US $240 billion: study

Alister Doyle

OSLO (Reuters) - Weather extremes and air pollution from burning fossil fuels cost the United States $240 billion a year in the past decade, according to a report on Wednesday that urged President Donald Trump to do more to combat climate change.

This year is likely to be the most expensive on record with an estimated $300 billion in losses from Hurricanes Harvey, Irma and Maria and a spate of wildfires in western states in the past two months, it said.

"The evidence is undeniable: the more fossil fuels we burn, the faster the climate continues to change," leading scientists wrote in the study published by the non-profit Universal Ecological Fund.

Costs to human health from air pollution caused by fossil fuels averaged $188 billion a year over the past decade, it estimated, while losses from weather extremes such as droughts, heat waves and floods averaged $52 billion.

Trump could curb the $240 billion costs, equivalent to 1.2 percent of U.S. gross domestic product, by revising his plans to promote the U.S. coal industry and to pull out of the 195-nation Paris climate agreement, it said.

"We are not saying that all (weather extremes) are due to human activity, but these are the sort of events that seem to be increasing in intensity," co-author Robert Watson, a former head of the U.N. panel of climate scientists, told Reuters.

Higher ocean temperatures, for instance, mean more moisture in the air that can fuel hurricanes.

And, in a sign of increasing risks, there were 92 extreme weather events that caused damage exceeding $1 billion in the United States in the decade to 2016, against 38 in the 1990s and 21 in the 1980s.

The combined cost of extreme weather and pollution from fossil fuels would climb to $360 billion a year in the next decade, the study said. Trump's pro-coal policies could mean more air pollution, reversing recent improvements in air quality.

Last month, the U.S. Environmental Protection Agency accused scientists who linked record extreme rainfall from Tropical Storm Harvey to man-made climate change as trying to "politicize an ongoing tragedy."

Wednesday's study has been in the works for months, said co-author James McCarthy, professor of Oceanography at Harvard University. He said there was widening evidence that a shift from fossil fuels made economic sense.

"Why is Iowa, why is Oklahoma, why is Kansas, why is Texas investing in wind energy? Not because they are interested in sea level rise or ocean temperatures but because it's economically sensible," he told Reuters.

Reporting By Alister Doyle; Editing by Robin Pomeroy

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Published *on Inside Climate News* (https://insideclimatenews.org)

Harvey Aftermath: A Public Health Crisis in the Making. From water contamination to diseases to mold in the walls, dangers continue long after the hurricane. These sorts of risks accompany climate change. By Nicholas Kusnetz August 31, 2017

Below is an excerpt of the article

Petrochemical Industry Adds a Toxic Brew

As the storm approached, energy companies began shutting refineries to protect their operations—emitting toxic gases in the process. Facilities have reported releasing more than 2 million pounds of hazardous chemicals into the air since the shutdowns began last week, according to an analysis of state regulatory filings by the Environmental Defense Fund. That equals nearly 40 percent of all the releases from the facilities in 2016.

"On a good day, there's already a high risk of cancer," said Luke Metzger, director of Environment Texas, an advocacy group based in Austin. "This amount of pollution in such a short time just makes that risk even higher."

In one of the largest releases, the Chevron Phillips Chemical Cedar Bayou plant estimated that it emitted [7] 28,505 pounds of benzene, a carcinogen, as part of its total release of more than 750,000 pounds of hazardous chemicals.

Importantly, these figures are just estimates. State officials shut down air monitors in the area ahead of the storm to protect them, so it's impossible to know what exactly nearby residents were exposed to. But people reported smelling foul chemical odors [8].

Facilities are continuing to release more pollutants even as the storm has moved out of the region. On Wednesday, Kinder Morgan's Pasadena Terminal reported [9] that the roof of a tank holding gasoline had been partially submerged. The company estimated that more than 12,000 pounds of hazardous chemicals were released.

Elena Craft, a scientist with the Environmental Defense Fund, said the incidents revealed poor planning on the part of the region's petrochemical infrastructure and the need to rebuild to a higher standard for larger storms. "The reality is these are happening more regularly and they're larger in magnitude," she said. "We can't keep doing our disaster management using the same information we have been for years."

Costs of Climate Change: Early Estimate for Hurricanes, Fires Reaches $300 Billion

A new report starts adding up the damage from the past few weeks of western wildfires and Hurricanes Harvey, Irma and Maria. It sees climate costs rising. *By Sabrina Shankman*

In order to understand the big picture please watch ***Gasland*** available on Youtube.com & ***Gasland 2*** available at stores. These two documentaries shows the big picture—the impact on our environment, health and even the food we eat and the water we drink.

See biographies and the research of Dr. Anthony Ingraffea, Dr. Mark Jacobson, and Dr. Robert Howarthy, interview on Democracy Now with World-renowned Scientist Dr. Theo Colborn on the Health Effects of Water Contamination from fracking, YouTube lectures by Weston Wilson, retired Environmental Engineer in the EPA Denver's Office

Anthony Ingraffea

Dr. Ingraffea spent two years as a structural engineer with the Grumman Aerospace Corporation and two years as a county engineer with the Peace Corps in Venezuela before he began doctoral studies. He has taught structural mechanics, finite element methods,and fracture mechanics at Cornell since 1977.

Dr. Ingraffea's research concentrates on computer simulation and physical testing of complex fracturing processes. He and his students performed pioneering research in the use of interactive computer graphics in computational mechanics. He has authored with his students over 200 papers in these areas. He has been a principal investigator on over $35M in R&D projects from the NSF, NASA Langley, Nichols Research, NASA Glenn, AFOSR, FAA, Kodak, U. S. Army Engineer Waterways Experiment Station, U.S. Dept. of Transportation, IBM, Schlumberger, Digital Equipment Corporation, the Gas Research Institute, Sandia National Laboratories, the Association of Iron and Steel Engineers, General Dynamics, Boeing, Caterpillar Tractor, and Northrop Grumman Aerospace.

Professor Ingraffea was a member of the first group of Presidential Young Investigators named by the National Science Foundation in 1984. For his research achievements he has won the International Association for Computer Methods and Advances in Geomechanics "1994 Significant Paper Award" for one of five most significant papers in the category of Computational/Analytical Applications in the past 20 years, and he has twice won the National Research Council/U.S. National Committee for Rock Mechanics Award for Research in Rock Mechanics (1978, 1991). His group won a NASA Group Achievement Award in 1996, and a NASA Aviation Safety Turning Goals into Reality Award in 1999 for its work on the aging aircraft problem. He became a Fellow of the American Society of Civil Engineers in 1991.

Professor Ingraffea has received numerous awards his outstanding teaching at Cornell. He received the first Society of Women Engineer's Professor of the Year Award in 1997, the 2001 Daniel Luzar '29 Excellence in Teaching Award from the College of Engineering, and, in 2005, was named Weiss Presidential Teaching Fellow at Cornell University. He has been a leader in the use of workstations and information technology in engineering education, with grants from the NSF, U.S. Department of Education, Digital Equipment Corporation, Sun Microsystems, and Hewlett-Packard in these areas. He organized and was the first Director of the NSF-supported, $15M Synthesis National Engineering Education Coalition, a team of eight diverse engineering colleges. Synthesis developed, implemented, and assessed innovative programs and technologies to improve the quality of undergraduate engineering education and to attract and graduate larger numbers of women and under-represented minority engineers. He was Cornell Co-PI on a NASA/NYS/AT&T sponsored project to develop an Advanced Interactive Discovery Environment for collaborative distance design in engineering education, teaming with faculty from aerospace, mechanics, and civil engineering from Cornell and Syracuse universities.

He was named Co-Editor-in-Chief of Engineering Fracture Mechanics in 2005, received the ASTM Irwin Award for meritorious contributions to the practice of fracture mechanics in 2006, and was named a Fellow of the International Congress on Fracture in 2009. In 2011, TIME Magazine named him one of its "People Who Mattered".

Mark Jacobson

Professor of Civil and Environmental Engineering, Senior Fellow at the Precourt Institute for Energy, and at the Woods Institute for the Environment

- Professor, Civil and Environmental Engineering
- Senior Fellow, Precourt Institute for Energy
- Senior Fellow, Stanford Woods Institute for the Environment

Mark Z. Jacobson's career has focused on better understanding air pollution and global warming problems and developing large-scale clean, renewable energy solutions to them. Toward that end, he has developed and applied three-dimensional atmosphere-biosphere-ocean computer models and solvers to simulate air pollution, weather, climate, and renewable energy. He has also developed roadmaps to transition states and countries to 100% clean, renewable energy for all purposes and computer models to examine grid stability in the presence of high penetrations of renewable energy.

Honors and Awards

- Cozzarelli Prize, National Academy of Sciences (2016)
- Grist50 Innovators, organizers, and visionaries, Grist (2016)
- Ascent Award, American Geophysical Union (2013)
- Atlas Award Honoring Climate Heroes, Atlas Awards (2013)
- Editors' Citation for Excellence in Refereeing, Journal of Geophysical Research-Atmospheres (2013)
- Global Green Policy Design Award, Global Green (2013)
- Partial share of the 2007 Nobel Peace Prize as a research contributor and reviewer for IPCC, Norwegian Nobel Committee (2007)
- Editors' Citation for Excellence in Refereeing, Journal of Geophysical Research-Atmospheres (2005)
- Henry G. Houghton Award, American Meteorological Society (2005)
- New Investigator Award, NASA (1999-2002)
- Career Early Development Award, National Science Foundation (1995-1998)

Education

- PhD, University of California, Los Angeles, Atmospheric Sciences (1994)
- MS, University of California, Los Angeles, Atmospheric Sciences (1991)
- MS, Stanford University, Environmental Engineering (1988)
- BS, Stanford University, Civil Engineering (1988)
- BA, Stanford University, Economics (1988)

11

COMMENTS

Metacomet Land Trust covering MATT 15 towns.

THANK YOU FOR THE OPPORTUNITY TO ADDRESS THE BOARD.

MY NAME IS LISA MOSCZYNSKI AND I LIVE IN DOUGLAS, MASSACHUSETTS A FEW SHORT MILES FROM THE PROPOSED PLANT'S LOCATION. THE DOUGLAS BOARD OF SELECTMEN AND THE WEBSTER BOARD OF SELECTMEN ALONG WITH THE DISTRICT'S STATE SENATOR, AND THOMPSON, CONNECTICUT, HAVE JOINED TOGETHER TO SUPPORT THE TOWN OF BURRILLVILLE IN ITS OPPOSITION TO THE SITING OF THIS PLANT.

DOUGLAS IS PROUD OF ITS ACRES OF STATE FOREST AND FOR SHARING WALLUM LAKE WITH BURRILLVILLE. THE COMMONWEALTH OF MASSACHUSETTS HAS INVESTED MILLIONS OF DOLLARS SINCE THE 1930S TO BUILD A PUBLIC PARK THAT EVERYONE CAN ENJOY. TOGETHER WITH THE HOLDINGS IN RHODE ISLAND AND CONNECTICUT WE HAVE OVER 25 SQUARE MILES OF FOREST UNIQUE TO SOUTHERN NEW ENGLAND. AND LIKE OUR STRONG AND DEDICATED NEIGHBORS IN BURRIVILLE, WE ARE A COMMUNITY THAT PRIDES ITSELF ON OUR NATURAL RESOURCES, LOCAL AGRICULTURE AND TOURISM. WE WANT TO PRESERVE THIS WAY OF LIFE, NOT DISRUPT IT!

BUT BEFORE YOU IS THE PROPOSED CLEAR RIVER ENERGY CENTER APPLICATION AND IT WILL BE A ***DISRUPTOR***.

THE PROPOSED PLANT WILL ***DISRUPT*** THE FOREST HABITAT BY DISCONNECTING THE ANCIENT PATHS USED BY ANIMALS AND MAN ALIKE. THE SITE WILL CUT A HUGE SWATH THROUGH TREES THAT PROVIDE NESTING HABITAT FOR STATE LISTED BIRDS THAT THE PROPONENT'S OWN CONSULTANTS IDENTIFIED. THE PLANT OPERATIONS WILL LIGHT UP THE NIGHT SKY AND ***DISRUPT*** THE LAST CONTIGUOUS TRACT OF DARKNESS IN SOUTHERN NEW ENGLAND. THE WIND THAT KNOWS NO BOUNDARIES WILL CARRY THE PLANT'S EMISSIONS

AND THEY WILL NOT STOP AT TOWN, CITY OR STATE BOUNDARY LINES. WE ALREADY HAVE TOO MUCH CHILDHOOD ASTHMA AND TOO MANY OF OUR ELDERLY HAVE COMPROMISED AND CHRONIC HEALTH CONDITIONS. WE NEED TO TAKE CONTROL OF OUR ENVIRONMENT AND PREVENT AIR POLLUTION NOT INVITE IT INTO OUR HOMES!

THE PROPONENT CLAIMS THAT NOISE WON'T AFFECT NEIGHBORS. IT WON'T – IT WILL ***DISRUPT*** THEM AND MAKE THEIR LIVES MISERABLE. THE PROPONENT CLAIMS TO BE TRUCKING IN WATER – THE TRUCK TRAFFIC WILL ***DISRUPT*** OUR COMMUNITIES AND JEOPARDIZE THE SAFETY OF OUR ROADS.

WHY DO WE NEED ANOTHER POWER PLANT IN BURRILLVILLE? THIS IS AN UNNECESSARY BURDEN ON THIS TOWN AND ITS NEIGHBORS. THIS PROPOSED PLANT SYMBOLIZES ***ENVIRONMENTAL INJUSTICE*** WHERE ONE COMMUNITY, ONE TRI-STATE AREA IS OVERBURDENED AND SADDLED WITH TRADING THEIR ENVIRONMENT FOR THE PROFIT OF A FEW. THERE IS NO WEIGHT TO THE PROPONENT'S ARGUMENT THAT THE ENERGY POSSIBLY GENERATED BY THIS PLANT IS NEEDED. THE FUTURE CAPACITY ISN'T BEING SOLD ON THE ISO, MASSACHUSETTS' ATTORNEY GENERAL PUBLISHED A COMPREHENSIVE STUDY THAT CLEARLY EXPLAINS THAT ***IT ISN'T NEEDED***.

WHILE CALIFORNIA BURNS AND OUR COASTS ARE DEVASTATED BY INCREASINGLY STRONG HURRICANES THAT CAN BE TIED DIRECTLY TO AN INCREASE IN GLOBAL TEMPERATURE, WE DO NOT NEED TO BE HOSTS TO YET ANOTHER FOSSIL FUEL BURNING PLANT. NEW ENGLAND AND NEW YORK – INCLUDING RHODE ISLAND -- HAVE COME TOGETHER UNDER THE REGIONAL GREENHOUSE GAS INITIATIVE (REGGI) TO PUSH FOR REDUCTIONS THAT JUST MIGHT MAKE A DIFFERENCE TO THE FUTURE OF OUR CHILDREN AND GRANDCHILDREN.

I SAY TO THE BOARD: DENY THIS APPLICATION BECAUSE NOW IS NOT THE TIME TO STAMP A TICKET ON A TRAIN MOVING BACKWARDS, IT'S THE TIME TO ***LEAD***.

Good evening. My name is Wade Richmond, and I live at 100 Knibb Road in Pascoag.

I am opposed to the licensing of this proposed power plant first, because it is not needed, and also because it will cause unacceptable harm to the environment of the state and the Town of Burrillville, as shown by testimony and advisory opinions that have already been filed with the Board.

In 2016, Connecticut, Massachusetts, and Rhode Island issued a joint request for clean energy, and to procure 460 Megawatts of clean energy from large scale wind and solar resources.

By law, Massachusetts is soliciting huge amounts of clean energy. These clean energy proposals in Massachusetts will equal approximately 9,450,000 megawatt hours of long term baseload renewables, which will drive down any need for new fossil fired facilities. Massachusetts is also continuing to promote solar through its Solar Massachusetts Renewable Target Program that is anticipated to add *an additional 1,600 megawatts of solar and energy storage projects* to the ISO New England system.

In Connecticut, a 485 Megawatt project known as *Bridgeport Harbor 6* was approved on July 22, 2016 by the Connecticut Siting Council and will be coming on line, and a 350 megawatt project in Massachusetts known as the *Canal 3 Project* was approved by the Massachusetts EFSB on July 5, 2017 and will also be coming on line.

CREC's proposed new units *do not need to be added to the mix to meet demand*, which is falling. It should also be noted that in the cases of both *Bridgeport Harbor 6 Project* and *Canal 3 Project*, the local communities supported approval of those projects, unlike CREC, ***which has virtually no local support for this project***.

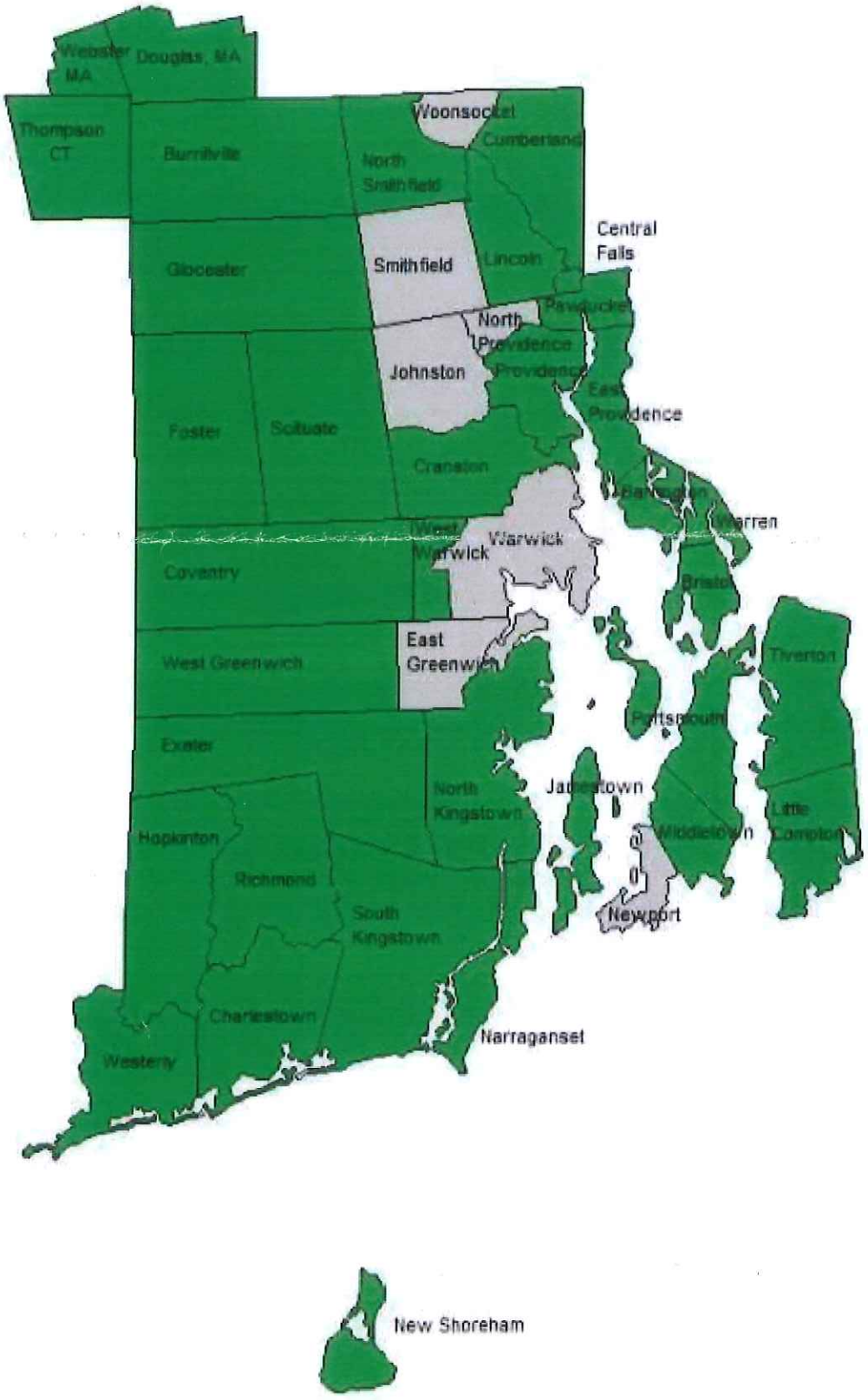
Both the 484 megawatt *Bridgeport Harbor 6 Project* and the 333 megawatt *Canal 3 Project* will have fast start, ramping, and flexibility characteristics.

Worth note also, is the fact that Massachusetts and Rhode Island have been combined together for electrical purposes by ISO New England into the Southeastern New England load zone, so efficiency or renewable programs implemented in Massachusetts will benefit the entire zone, including Rhode Island.

And lest anyone still have the misguided belief that this is an issue that only Burrillville or Norther Rhode Island cares about, I would draw your attention (once again) to the map of cities/towns in RI who have passed resolutions opposing CREC. THIRTY-THREE cities and towns throughout Rhode Island have categorically said "NO" to the siting of this power plant ... and those voices should ring loudly in the ears of the members of the EFSB, as they will (no doubt) ring loudly at the polls during the next election!

It is clear that the CREC plant should not be approved - it is obviously not needed, as evidenced on many levels.

Towns in Green have passed a resolution against CREC



To:EFSB
From: Jeannine Fortin- Pascoag RI
Re: Proposed Power Plant CREC / Burrillville RI

Welcome Again to our Rural Town
First I would like to make an inquiry as to why the last EFSB meeting in September 2017 was not streamed as we have
come to expect it would be?

I will present the **facts** as we have learned them.

Fact: It has been well over 2 years since our battle began. It started out quietly, then it quickly grew, got louder and bigger until it's organized protest reached the entire state and outside its borders. To date 35 cities and towns and countless organizations have formally opposed this power plant through a resolutions. So 90% of our state says NO!! Thousands are opposed!!!

FACT: The land surrounding the proposed plant was purchased by RI voters and we still pay to maintain and fund its operations. The people of RI own it!!
In a 1988 study it was deemed the most unsuitable place to host a power plant due to its environmentally sensitive areas, plant and animal species, waterways, recreational areas ,contiguous forest and conservation land.This alone is grounds to dismiss this whole project for this location. 200 acres WILL BE DESTROYED to finish this project never to be a forest again. Once gone it cannot be replaced!!

Fact: Invenergy will be forced environmental pollution, if this is permitted. The town of Burrillville and the tiny state of RI should not be forced to bear the burden of another power plant, suffer more countless areas of damage to its environment, roads and infrastructure. Ocean state power plant has already proven that. It very often depletes its water supply forcing it to rely

HEAVILY on outside sources during low water months. Hundreds of Large tanker trucks travel route 7 daily and I personally observed the trucks swerving dangerously and spilling water on the roads and into oncoming traffic.
(see youtube ocean state water shortage 9-9-16)

Facts:
*CREC will emit tons of CO2 per year along with tons of Methane, which is 20% more potent of a Greenhouse gas producer.

*Fracked gas can have over 700 different toxic chemicals in it. This siting would give CREC permission to expel whatever deadly toxic chemicals that come through the pipeline. Threatening everything in its path.

*Burrillville or RI does **NOT** belong to Invenergy as it has been implied many times.

*While under oath Invenergys Ratepayer savings were proven grossly inflated. Actual savings even at the inflated savings came out to $3.00 per person per year!!!! NOT COST EFFECTIVE!!!!

*Invenergy twists the facts and figures and changes information to suit the audience as explained in all their advertisements.

*Invenergy is offering to buy and give land to DEM to offset the land they will destroy!! Blood money!! NOT ACCEPTABLE!!

*Invenergy made a backdoor deal with the Narragansett tribe few, lacking concern over allowing their laws to be broken, and still not even concerned that they managed to upset every Native American tribe in RI in doing so. More chaos.!!

*Added an extra lawyer to their already enlarged fleet. One without a RI practice license. Also lawyers practicing with ties to National Grid.

*Once this land is destroyed it WILL BE GONE FOREVER. ANOTHER PIECE OF LAND WILL NOT HAVE THE SAME GIFTS!!!

Truth be told, CREC has been PROVEN NOT NEEDED!! So therefore why is this made into such a dilemma??

Fact: Hundreds of people across our state have unselfishly given hundreds of hours of their time to fight this power plant. Many have taken money from their own savings and pockets to fight for the cause. Others put their lives on hold for over 2 years. We eat, sleep and breathe fighting against Invenergy. It is totally worth all the sacrifices that have been made. I have met so many dedicated, intelligent giving people. I am honored to stand side by side with each and everyone!! RI'ers have such heart!!!

WE WON'T BACK DOWN!

Jeannine Fortin

Credits
Congress.gov rep 113-62 bill s 371
Energyjustice.net
Web.stanford.edu
Invenergy advertisements
youtube

●●○○○ AT&T 6:14 PM 60%

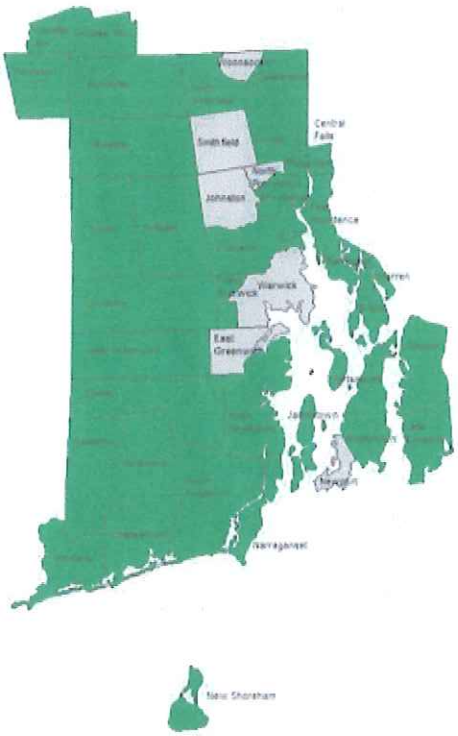
65 2 Messages

Map

[redacted] Could you send me an updated map? [redacted]

Sent from my iPhone

Towns in Green have passed a resolution against CREC



CLEAR RIVER ENERGY CENTER

Just the Facts

Energy Rhode Island Needs

One third

That's the amount of New England's total energy supply the region is expected to lose in the next decade, as old and dirty plants retire. The Clear River Energy Center will help New England meet the challenge of filling that gap. Renewables alone can't fill the shortage quickly enough. We'll need a mix of energy supplies, and the region's grid operator has already selected 485 MW – enough to power almost 218,000 homes – from this project to be part of the future energy mix for Rhode Island.

not true ISO-power plant not needed

Saving You Money

Millions in savings

Using the latest state-of-the-art technology from GE, Clear River Energy Center will convert natural gas to electricity more cleanly and efficiently than any other power plant in New England. Ultimately, that will save you money on your electric bill by providing more affordable energy. Our estimate: millions in savings over just the first four years of operations.

not true original projection equals less than $3 per person

Reducing Emissions

124,000 cars off the road

New, cleaner and more efficient energy also means cleaner air for Rhode Islanders. The majority of our energy today comes from plants that are 40 – even 60 – years old. The Clear River Energy Center will replace older, dirtier plants, helping to reduce regional emissions by one percent annually. That's like taking 124,000 cars off the road each year.

CREC will put out large amts CO^2 + methane which is worse for greenhouse gases 20% more

A Sensible Water Solution

Designed to minimize traffic

We will need just two to three truck deliveries to get water from Johnston to supply the plant on a typical day – far fewer deliveries than your average grocery store. These water deliveries will travel along state roads for the entirety of their journey to Wallum Lake Road, where the project is located. With air cooling, recycling, and reusing water, we've reduced our water use to the lowest possible level – 90 percent less than similar plants in the region.

has not been tested + when they run on diesel oil far more pollutants + many many more water trucks

A Smart, Compact Site

Well-buffered

The Clear River Energy Center will be sited on just 20 acres of a 67-acre site, well-buffered by woods. We're working with permitting authorities to ensure our evening lighting plan meets local standards. Existing natural gas and transmission lines are adjacent, minimizing the amount of land that's needed for new pipes or lines. Very few sites in New England have this combination of attributes, making this a smart location for the new plant.

200 acres cleared with National Grids upgrades + CREC

f /clearriverenergycenter | @clearriverec

Learn More
www.ClearRiverEnergyCenter.com
info@clearriverenergycenter.com

NO NEW POWER PLANT NORTHERN RI

We, members of the No New Power Plant group, dispute the Invenergy articles in the Bargain Buyer.

Invenergy says the plant will power almost 218,000 homes from this project to be part of the future energy mix for Rhode Island.

In truth, the ISO of New England experts agree this power plant is **not needed.** We will not need the power plant in the future because of new solar and wind projects, much cheaper than running the big outrageous plant in 5000 acres of preserved land in Burrillville.

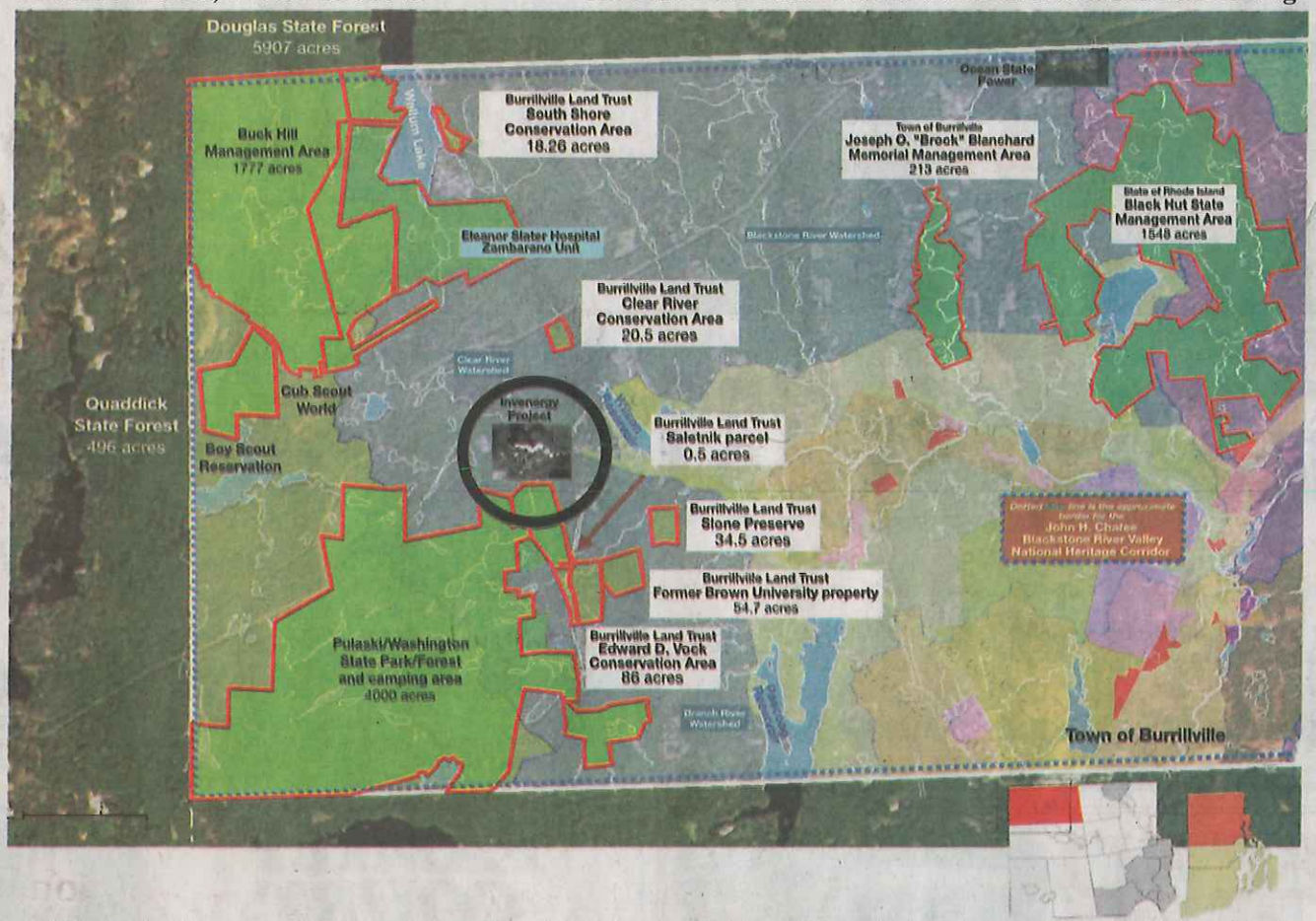
The plant would affect the clean air and water of the nearby Boy Scout Reservation, Zambarano Hospital, George Washington State Park, and Pulaski State Park.

That is not including the approximately 20 lakes and ponds in the area that Invenergy will pollute.

DEM said it was not the right area in 1986 to build a power plant. **WHY** would you want it 31 years later where there are many more children and families to be affected?

Consider all of the wild animals and wildlife growth that is not found anywhere else in Rhode Island.

We don't want it, we don't need it! **LEARN THE FACTS from www.BurrillvilleLandTrust.org**



FACTS!

1032 truck trips every 30 days - True. Over 32 tanker truck trips a day will travel through Apple Valley, Rt. 44 through Chepachet, Rt.100 delivering millions of gallons of Scituate Reservoir water, oil, 40,000 gallons of ammonia, thousands of gallons of hydrogen, waste water and more. Roads will be icy in winter from leaky water trucks. One spill will cause havoc!

CREC will be the largest energy project in NE - FALSE. In 2016, the largest new energy project in all New England was solar installations. 2017 will be the same. So too in 2018. At a time when alternatives to fossil fuels are abundant, this is the wrong time to go backwards. More jobs are created by solar installations than any centralized fossil fuel power plant.

Cooling water comes from the Scituate Reservoir - True. Water for cooling the power plant will come from potable drinking water from the Scituate Reservoir. That's right! The Scituate Reservoir! Why waste this precious resource that 60% of RI depends on.

Paid for by a concerned citizen, Ken Putnam, Jr.

Conflict of Interest

SHOW MORE...

"This is a lot of smearing going on here," said Mr. Frias, after Mattiello alleged a series of potential conflicts for Frias, who left a job as a lawyer at the state Public Utilities Commission in 2007 to work for a Boston-based law firm that represents National Grid (a company "you used to regulate") and for his wife Cynthia Wilson-Frias, the $94,844-a-year deputy chief of legal services at the PUC.

Mattiello: "At the end of the day, you shouldn't benefit from politics. He's been in politics a very long time. He's the [GOP] national committee person. His family's benefited from that. And that's fine, but that's not fine for the voters of Cranston."

"I could have gotten political jobs," added

ed to determine which of the sites considered in the alternatives analysis for the project was t

eferred alternative. In the end, the current site of OSP was chosen as the preferred alternative f

at project, based on all of the considerations of the alternatives analysis, not because the Bu

ll Road site had a fatal flaw.

Similarly, in its analysis of potential sites for the CREC, Invenergy considered ma

ctors, including environmental constraints and distance to sensitive receptors and concluded th

(No alternatives)

e site selected was the preferred alternative for the Project. Because the site was not consider

the preferred alternative for one power plant project nearly thirty years ago does not elimina

e potential for it to be considered as the preferred alternative for a very different power pla

oject nearly thirty years later.

there were no other sites.

. **CONCLUSIONS** Never was there any other sites considered.

Fagan's expertise, something Invenergy tried to call into question in pre-filed testimony, and two, it helped prove Fagan's case that the proposed power plant was not necessary.

Though high-powered attorneys Alan Shoer and Jerry Elmer set the tone for the meeting, it's most likely that RIPUC attorney **Cynthia Wilson-Frias** will have the most impact on Commissioner DeSimone's advisory opinion, given that she will likely help author it and DeSimone can be expected to lean heavily on RIPUC's in house legal expertise. Wilson-Frias asked pointed questions about the fact that Invenergy already sold some of its expected output to ISO-NE. She indicated that since the energy sold, it is by definition needed. Fagan countered this logic well, his entire testimony was in fact a rebuttal of sorts to this idea, so it comes down to how much weight Wilson-Frias gives Fagan's views versus the more mainstream "free" market ideas favored by Invenergy.

PROVEN NOT NEEDED!

The last day of the hearing is today, and unfortunately I will not be in attendance. I hope to get an update from Jerry Elmer after the hearing.

You can view the entire days proceedings below:

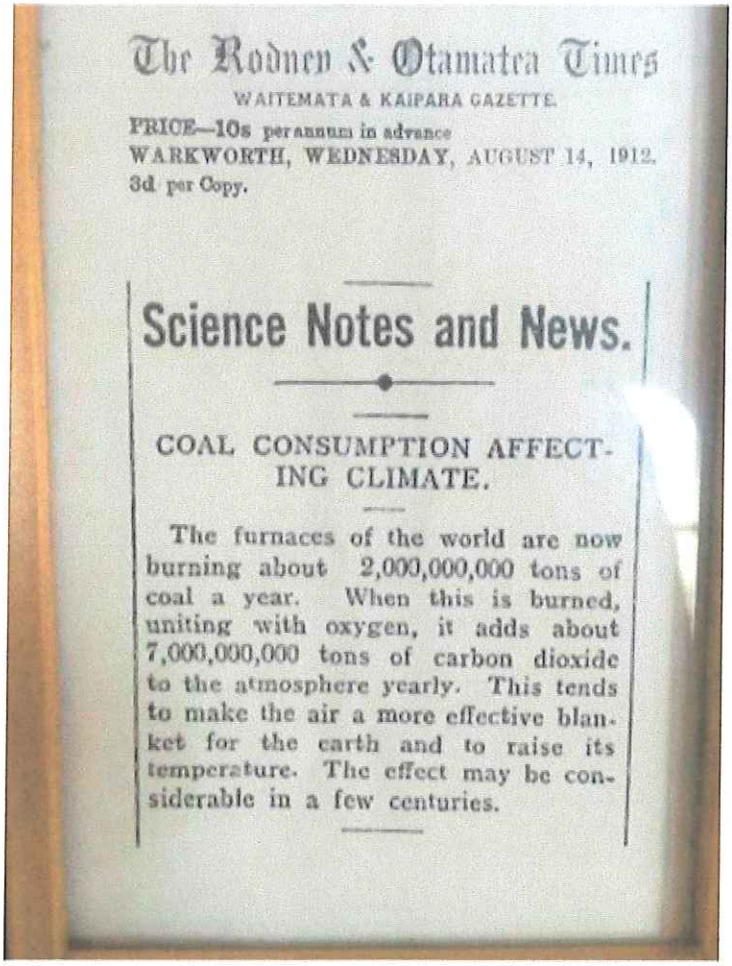
●○○○○ AT&T 12:41 PM 81%

facebook.com

[redacted]

15 hrs ·

WOW! Lookie this! I am now officially stunned.



The Rodney & Otamatea Times

WAITEMATA & KAIPARA GAZETTE.

PRICE—10s per annum in advance

WARKWORTH, WEDNESDAY, AUGUST 14, 1912.

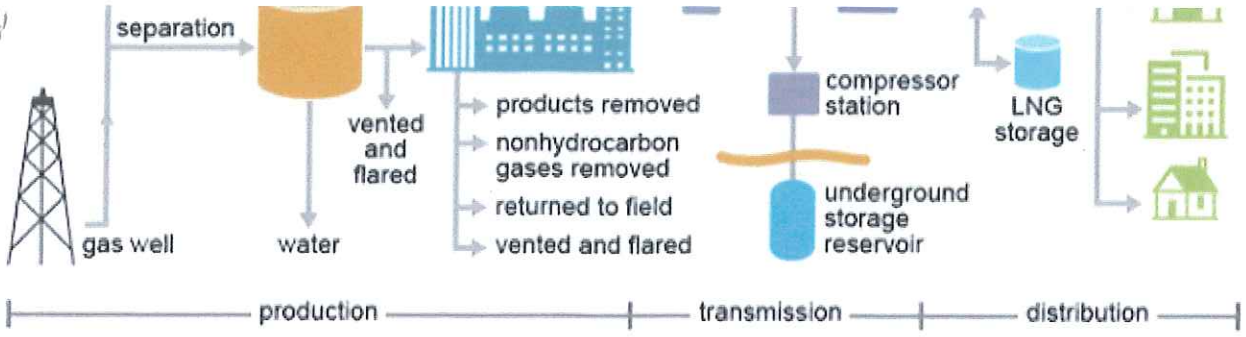
3d per Copy.

Science Notes and News.

COAL CONSUMPTION AFFECTING CLIMATE.

The furnaces of the world are now burning about 2,000,000,000 tons of coal a year. When this is burned, uniting with oxygen, it adds about 7,000,000,000 tons of carbon dioxide to the atmosphere yearly. This tends to make the air a more effective blanket for the earth and to raise its temperature. The effect may be considerable in a few centuries.

Ellie Finlay September 7 at 11:04pm ·



NATURAL GAS IS STILL A NON-RENEWABLE FOSSIL FUEL

"Natural Gas" is often touted as a clean alternative to other fossil fuels. And while it does produce lower CO2 emissions when burned, it's much higher in methane content, which is over 20 times more harmful as a greenhouse gas. (Source)

• The greenhouse gas power of methane produced by natural gas production negates any savings in CO2 emissions.

CLIMATE PROGRESS — **By The Time Natural Gas Has A Net Climate Benefit You'll Likely Be Dead And The Climate Ruined**

READ MORE

fossil fuels cost. The burning of fossil fuels in the conversion to energy creates waste of H2O and CO2. While CO2 is a natural greenhouse gas, too much of it in the atmosphere has been proven to cause global warming. Last year, emission of CO2 from fossil fuels was 6.2 billion tons, increasing fourfold from 1950 (Flavin and Dawn, 113).

(Energy Information Administration)

The increase in emissions of CO2 are projected to increase even more dramatically in the next 20 years if we continue to increase the production of energy through the burning of fossil fuels. The increasing trend of CO2 in the atmosphere overwhelms the natural cycling of carbon by oceans and forests and has brought the CO2 concentration in the atmosphere to 29% above the pre-industrial level. If the world stays on the current path of increasing emissions, it is possible that global temperature could increase by approximately 1-3.5 degrees Celsius (Schneider, 375). Because of the complexity of the earth's weather system, it is hard to predict the effects of the rapid change in the composition of the atmosphere, but some scientists have predicted such consequences as flooded cities, diminished food production, and increased storm damage (Schneider, 375). Avoiding dangerous climate change will depend in large part on our ability to develop and continue to use renewable energy supplies.

The solution to the problems of limited fossil fuels and their impact on the environment is to have renewable resources play a larger role in the supply of energy. Converting sunlight, earth's heat, wind, and nuclear power into energy could, in the next century, meet most of the world's energy needs. Technologies have become available to combine the use of heat and power, providing energy services far more efficiently than fossil fuels. These technologies are much more clean than burning fossil fuels; the use of them could cut carbon emissions by 60-80% (Flavin and Dawn, 123). Renewable resources such as geothermal and nuclear energy are clean and nearly inexhaustible. An effort to move the world in the direction it needs to go in order to slow down the problem of climate change came in December of 1997 when representatives from 160 countries met in Kyoto, Japan to set goals and targets to lower carbon emissions. Yet many countries, such as the United States, have not ratified the Kyoto Protocol and have continued to use fossil fuels, despite having the technologies to use renewable and clean resources.

A major reason for countries not adopting the technologies of these renewable resources is the cost. While it is almost sad to think that we are too worried about short-term monetary costs to invest in these technologies rather than avoiding the even larger costs that a dramatic climate change or international economic crisis would bring, it is still reality. Any plant that converts a renewable resource into energy requires a very large initial capital investment. What most people don't know, is that once you can get past the initial payment, costs of energy will be almost identical to costs of energy converted from the burning of fossil fuels. As of now, since there is still what seems to be a plentiful supply of fossil fuels, most countries have been unwilling the monetary cost of investing in these

- Chemicals contained in the gas traveling through pipelines are known to off-gas at compressor stations along the pipeline. These include benzene, dimethyldisulfide, ethyl-methylethyl disulfide, trimethyl benzene, diethyl benzene, tetramethyl benzene, carbon disulfide, naphthalenes, methyl pyridine, carbonyl sulfide, toluene among others – and other known carcinogens and neurotoxins. They have been found at air tests near compressor station. (Source)
  » Learn more about compressor stations

- Methane emissions along natural gas transmission routes are 25-75% higher than original EPA estimates, depending on the site, and are particularly high at pressure stations along the route. (Source)

- Methane is a greenhouse gas over 20 times

the pipeline in the case of explosions, to environmental contamination and health impacts from volatile chemicals contained in the gas from non-exploding leaks. (Source)

- Although touted as a safer form of gas transportation, there have been over 990 natural gas transmission line accidents deemed "Significant", with 137 injuries and 34 fatalities since 2000. (Source)

- Chemicals contained in the gas traveling through pipelines are known to off-gas at compressor stations along the pipeline. These include benzene, dimethyldisulfide, ethyl-methylethyl disulfide, trimethyl benzene, diethyl benzene, tetramethyl benzene, carbon disulfide, neph-

My name is Rhoda Northrup..
I live in Cranston.

I am here tonight with a book

This book was created by a very special, dedicated group of people who live here in this town.

It is titled: OUR STORY, WE ARE ALL BURRILLVILLE!

16,000 people live here.....

This is a story that is told in pictures.

It is about life in this beautiful rural community.....This community must be preserved!

NO NEW POWER PLANT!

Experts tell us that the power plant is not needed to keep the lights on in Rhode Island.

Presently, we have ~~39~~ 35 city and town councils who are opposed to this monster polluter!

This power plant is not wise economic development and it will have a negative impact on tourism.

Mr. Bianco,
I would like you to take this book and enter it into the record and I would like you to record it on the EFSB website...

← EFSB-Mary

Good evening. My name is Mary Gauvin, and I live at 755 Buck Hill Road in Pascoag.

I am opposed to the licensing of this proposed power plant first, because it is not needed, and also because it will cause unacceptable harm to the environment of the state and the Town of Burrillville, as shown by testimony and advisory opinions that have already been filed with the Board.

Mr. Epner, who is a trained air emissions professional, said it best in his direct testimony when he stated: "It is my professional opinion that the CREC facility will cause an unacceptable harm to the environment, particular the purity of the air, the health of citizens, and the aesthetic value of the area. The proposed CREC facility will emit significant amounts of many air pollutants, including: sulfur dioxide; particular matter; carbon monoxide; carbon dioxide; ozone, oxides of nitrogen; volatile organic compounds, etc."

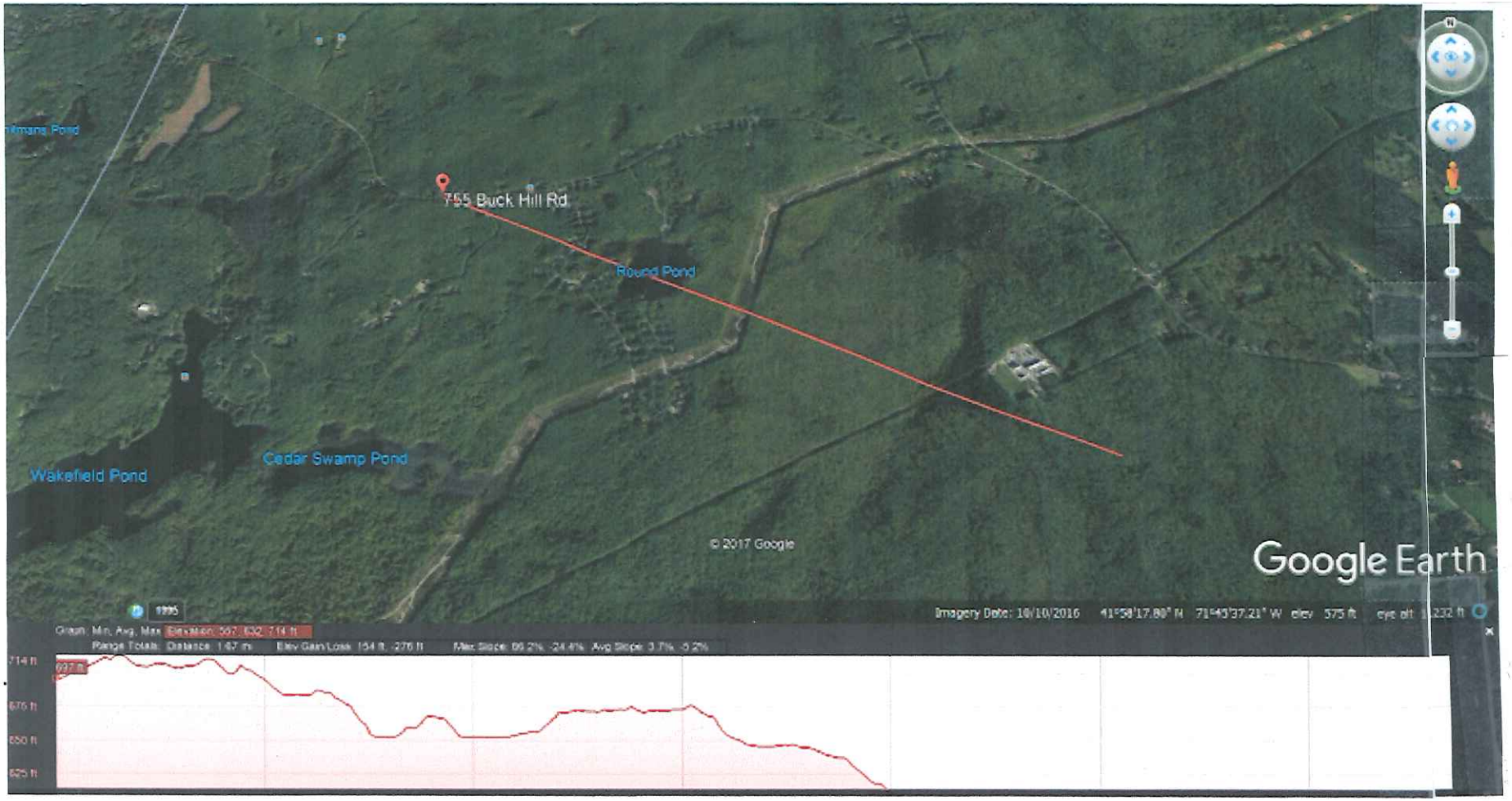
If CREC is approved, ***air emissions in Rhode Island and Burrillville will greatly increase***. In fact, the increase in carbon dioxide alone would be an increase of 30% over existing Rhode Island carbon dioxide emissions, making it virtually impossible for Rhode Island to comply with the Resilient Rhode Island Act and the Paris Agreement on global warming, to which Governor Raimondo recently committed the State after President Trump withdrew the United States.

Mr. Epner has also explained that there is not enough available information for Invenergy to support its claim that regional air emissions would be reduced by 1% to 2%, and there is *no guarantee or legal requirement* that older, less efficient generating facilities would actually be shut down if and when CREC is constructed.

And lastly, a less than 1% regional reduction in carbon dioxide is not worth the huge increase in pollutants that will occur in the air over the State of Rhode Island, and primarily in the air over the Town of Burrillville.

Now to the personal part of my objection to the siting of this power plant. I am attaching a map from Google Earth, and it also includes an elevation profile that details the land elevations between my home and the proposed power plant.

My home is on the LEFT endpoint of the line between the two sites, and the RIGHT endpoint is approximately where Invenergy wants to build this monster. My home sits at 697 feet above sea level. CREC would sit at approximately 564 feet above sea level. There would be 200 foot smoke stacks on the property, from which all of these noxious gases would be emitted. Therefore, 564 plus 200 equals 764 feet above sea level. That means that this plume would be emitting all of these harmful chemicals at only SIXTY-SEVEN FEET ABOVE MY FRONT YARD!


755 Buck Hill Rd
Round Pond
Cedar Swamp Pond
Wakefield Pond
© 2017 Google
Google Earth
Imagery Date: 10/10/2016 41°58'17.80" N 71°45'37.21" W elev 575 ft
714 ft
675 ft
650 ft
625 ft

My name is Javis Gquvin. I live on >55 buckhill road. I am 11 years old.

For the last 2 years my mom ishathere alot she's always at meetings. It makes me sad.

I dont like powerplants I dontwant it. If I move I wont be able to see My freinds any more.

Power plants make bad air and give people cancer.

we sould build solor and wind turbines.

Thank you for reading this.

Jo

My name is Sam Gauvin.
I live on 755 Buck Hill Road.
I am 9 years old.

I don't want the power plant.

I don't want to move because I won't be able to see my friends again.

I like where I live.

Sam G

My name is Joshua A. Gavin. I live at 755 Buck Hill Road, Pascoag R.I. 02859 and I oppose this Power Plant.

My name is Mary Gauvin. I am the owner of a Rhode Island small business, Mary Originals.

I strongly oppose the siting of the proposed 1,000 mw fracked gas/ oil burning "Clear River" Energy Center.

Holding Rhode Island back by forcing another 40 years of fossil fuel derived energy is unwise and undesired by many.

What a shame it is to continue to run our state and our businesses on this dirty, outdated, risky energy source.

On behalf of my business I oppose this proposed power plant.

Mary Gauvin

Hello. My name is Alicia Gravin. I live on 755 Buck Hill Road. I am 13 years old. I hate this. I hate the idea of losing my home. I hate the fact that for the past 2 years, the time with my mom has been limited, because of her active involvement in the process. I hate the stress I get at the thought of losing my home if this thing gets built. The past 2 years, my mom has been sacrificing time with me and my brothers to go and fight this Power Plant. This means that a lot of nights were spent with my brothers and I sitting bored at home, waiting for Mom to come home. Often times she would come home at midnight, so we would not be able to see her for almost the entire day. The topic Power Plant would be brought up in almost every conversation I have with Mom, and honestly at this point, I'm sick of it. It makes me upset to think that this whole thing started when I was only 11. When I think about it that way, it makes me realize how long this really has been going on. I grew up in Burrillville. This is my home. I have met so many nice people here, and it would break me if I had to move away from them all. If this plant is built, it would make it more difficult for me as an adult. Not only would I be in a less familiar neighborhood, but climate change would worsen because of this Power Plan

Copies for EFSB

To: Energy Facility Siting Board

Date: October 10, 2017

From: Richard W, Enser, Curtis Corner Road, South Kingstown, RI 02879

Items Included:

1. Review of Statewide Planning Program Advisory Opinion, first published on website of Keep Rhode Island Beautiful
2. Review of DEM Advisory Opinion, first published by ecoRI News
3. Copy of Tonight's tesitimony

Review of the Statewide Planning Advisory Opinion Concerning the Clear River Energy Center, Burrillville, Rhode Island, and the Facility's Consistency and Compliance with the State of Rhode Island Guide Plan

Richard W. Enser

On March 10, 2016 the Rhode Island Energy Facility Siting Board (EFSB) requested an advisory opinion from the RI Department of Administration, Statewide Planning Program, concerning three basic issues concerning the development of the proposed Clear River Energy Center (CREC) in Burrillville. One of these issues concerned, "the Facility's consistency and compliance with the State Guide Plan".

On September 12, 2016 the Statewide Planning Program (SPP) submitted its advisory opinion which included the following conclusion regarding the State Guide Plan:

"The Program finds that the proposed Clear River Energy Center is consistent with the State Guide Plan including the state's energy plan, Energy 2035; that the Project is consistent with the Plan's goals and performance measure targets, and the Project is consistent with the Plan's policy themes and strategies." (page 46)

However, previously on page 24 of the advisory opinion is the following admission:

"Given the breadth of the State Guide Plan, it is inevitable that certain goals and policies will come into conflict with other goals and policies. As such, a finding of 'State Guide Plan consistency' cannot realistically be based on a project being completely consistent with each and every individual goal, objective, and policy found in the SGP." (underline added)

It is this inconsistency in the opinion – that the project is "consistent" with the SGP, when indeed it is literally impossible for it to be "completely consistent" – that raises serious concerns about the validity of the SPP advisory opinion.

Keep Rhode Island Beautiful (KRIB) has conducted a review of the SPP advisory opinion and offers the following critique that examines the inconsistencies rampant in the opinion. It should be clearly noted, that this

analysis was conducted by a group of citizens deeply concerned about the "process" being undertaken to review the CREC. We have conducted no scientific analysis of the conclusions drawn in the opinion, we are simply using the document's own words to illustrate the incompleteness, lack of professionalism, and bias that characterizes the SPP opinion.

Incompleteness. The Program admits, on page 25 of their opinion, that seven (7) elements of the Guide Plan were not reviewed because *"these SGP elements primarily involve environmental and recreational considerations which are to be evaluated by the Department of Environmental Management and others"*. This statement clearly illustrates the lack of understanding by the SPP of their responsibility in providing an advisory opinion on the entire State Guide Plan, not just selected portions. What is most disturbing is that the seven elements not reviewed include those that would be the least favorable to the construction of a power plant in a rural area that contains numerous high natural resource values. The seven un-reviewed elements include:

- Rivers Policy and Classification Plan
- Nonpoint Source Pollution Management Plan
- Blackstone Region Water Resources Plan
- Forest Resources Management Plan
- Urban and Community Forest Plan
- Ocean State Outdoors: Rhode Island's Comprehensive Recreation Plan
- A Greener Path: Greenspace and Greenways Plan for Rhode Island's Future

In addition, the SPP determined that SGP Element 715 (Comprehensive Conservation and Management Plan for Narragansett Bay) was found *"not to be applicable to the Project because it did not contain any content relevant to the project."* However, we would submit the observation that most of the town of Burrillville lies in the watershed of Narragansett Bay (as clearly illustrated on page 2.2 of Element 715 – page 2.2 and that the conclusion by the SPP that Element 715 is not applicable in this case should be reevaluated.

In regard to the seven un-reviewed SGP elements, deferring review of the goals, objectives and policies contained in these elements to other state agencies clearly violates the intent of the EFSB request, and also illustrates a lack of

understanding within the SPP as to their responsibilities. The SPP was charged with reviewing the entire State Guide Plan, not just those elements selected by the SPP. It is not, for example, the responsibility of the Department of Environmental Management to provide an advisory opinion on any policies approved by the State Planning Council. DEM may provide assistance to the SPP in interpreting a particular policy, but ultimately it is the responsibility of the SPP to provide opinions on which policies in the SGP are consistent with a power plant in Burrillville, and which policies are inconsistent. In this manner, the EFSB is provided with two lists – policies that are consistent, and those that are not – which they can use when they review other state agency opinions.

Unfortunately, this lack of understanding within SPP means that NO review has been conducted of these seven critical elements, and hence there has been no assessment of consistency of the CREC with any state policies concerning forest resources, outdoor recreation, biodiversity, rivers, greenways, or Narragansett Bay.

Unprofessionalism and Bias. The issue of the "missing elements" can simply be excused by a lack of unprofessionalism that seems to characterize many state agencies recently. But lack of motivation can not excuse bias, or what we see as a deliberate crafting of an advisory opinion that is clearly supportive of the project.

This problem is best illustrated in the SPP's review of one of the elements they did decide to review, State Guide Plan Element 121, *Landuse 2025: Rhode Island State Land Use Policies and Plans*. The purpose of this plan is to "*guide future land use and development and to present State Guide Plan policies under which State and local land development activities will be reviewed for consistency*".

In *Landuse 2025* are detailed the goals, objectives and policies, approved by the State Planning Council, to guide activities toward fulfillment of the primary, over-riding objectives of the plan. The first cited primary objective of the plan is to: *Sustain Rhode Island's unique character through use of the Urban Services Boundary, rural centers, and holistic approaches to planning*. In support of this vision statement is Objective LUO 1A, which states: *Focus growth within the*

urban services boundary and in centers of different sizes and types; support traditional centers instead of new development.

The SPP selected this objective to review, and offered the following opinion:

"With respect to Objective LUO 1A to "Focus growth within the urban services boundary," the Project is located approximately 1.3 miles from the northwest segment of a village-centered Urban Services Boundary in Burrillville. However, the Program concludes that the chosen site, by providing immediate access to an existing gas pipeline, thereby reducing the need to extend infrastructure elsewhere, and, the fact that the USB is not intended to be (an) absolute determinant for any specific project, means the Project is not inconsistent with Land Use 2025's objective of focusing growth within Urban Service Boundaries."

The SPP may consider this interpretation of *Landuse 2025* to be valid, but we emphatically do not. The actual wording in *Landuse 2025* is as follows:

Major Concepts

Sustaining the Urban-Rural Distinction

*The distinction between Rhode Island's historic urban centers and neighborhoods and their rural natural surrounding areas is still strong. It remains the most important feature of the State's land use pattern. Land Use 2025 identifies an Urban Services Boundary, based upon a detailed land capability and suitability analysis that demonstrates the capacity of this area to accommodate future growth. The Plan directs the State and communities to concentrate growth inside (*underline added*) the Urban Services Boundary and within locally designated centers in rural areas, and to pursue significantly different land use and development approaches for urban and rural areas. Achieving a sound policy for appropriate growth in urban areas will allow us to preserve more of our rural landscape (underline added). Growth and preservation thus become a single issue.*

The proposed CREC is clearly outside the Urban Services Boundary, 1.5 miles to be more exact. Therefore, the CREC is clearly inconsistent with Objective

LUO 1A, which once again states, *Focus growth within the urban services boundary*. Once again, the CREC is clearly inconsistent with this objective – it will be 1.5 miles outside of the USB.

Despite this clear inconsistency, the SPP persists in its advisory opinion to offer more evidence for consistency of the CREC with the objectives in *Landuse 2025*. Objective LUO 3C states: *"Maintain and protect the rural character of various parts of Rhode Island."* In regards to this objective, we believe that any reasonable person, be they planner, carpenter, or school child, would recognize that a power plant is not consistent with maintaining rural character; however, the SPP seems to make a special effort to prove otherwise.

Beginning on page 39 of the opinion:

"The construction of the CREC will impact the project site itself but in the context of the "rural character" of Burrillville, its impact will be minimal. The construction of the CREC would not impede the larger vision of a Rhode Island that is beautiful, diverse, connected, and compact with a distinct quality of place in our rural and urban centers"

The rationale continues: *"As reported by Edward Pimentel of Pimentel Consulting, Inc., 'Although CREC will own in excess of 67 acres, less than one-half or approximately 29.44 acres will be dedicated to the operation proper. The operation will be aligned along the rear (westerly portion) of the property, thereby maintaining in excess of 37.6 acres in a naturally-vegetated state. The site will have a naturally vegetated frontage which will provide screening from the residences situated along Wallum Lake Road."*

In regards to the above, we offer the following observations:

1. Mr. Pimentel has appeared before the Burrillville Zoning Board as the "applicant's (underline added) expert witness in land use planning". Our question is, why was this particular private consultant, employed by the applicant, used to qualify the advisory opinion of a state agency?
2. Mr. Pimentel's opinion is that the simple screening of the power plant by natural vegetation will suffice to retain the rural character of western Burrillville. Unfortunately he fails to address other factors that will degrade rural character, including noise, air pollution, light pollution, and

now the continual passage of tanker trucks along previously lightly-travelled, rural roads.

Once again, to be fair, we could accept these issues as simple incompetence. But in the final analysis, review of Landuse 2025 by the SPP appears was a highly selective process. Only a few of the objectives in the plan were reviewed to inform the SPP final opinion, that: "*The Program finds the Project to be consistent with Land Use 2025.*" Unfortunately, the SPP failed to consider over 40 additional policies outlined in Land Use 2025, including:

LUP 2: Control sprawl and the urban exodus of business and industry.

LUP 4: Achieve a livable, coherent, and visually pleasing environment.

LUP 14: Design open space systems and corridors to protect complete ecologic units and provide structure and character to the built environment. Maintain the openness of our western borderlands and recognize the significance of this system within the Northeast Corridor.

LUP 17: Preserve and enhance wildlife, fish, and plant species diversity and stability through habitat protection, restoration, enhancement, and prevention or mitigation of adverse impacts due to human activities.

LUP 23: Preserve and enhance the distinctiveness of urban, suburban, village, and rural communities and landscapes.

LUP 29: Conserve and enhance desirable existing industrial areas, regional shopping areas, office complexes, and concentrations of service activities to maximize the investment and utilization of existing infrastructure.

LUP 31: Plan new or expanded public sewer and water services, highway improvements, and mass transit service, for industrial and commercial development where such development is appropriate in terms of natural constraints of the land, air, and water, and where the area is being developed at an intensity that is consistent with State land use policy and will not promote wasteful use of resources.

And there are more. Not all of these policies would necessarily be inconsistent with the project, depending on how one wants to spin it. But, they remain un-reviewed none-the-less.

Our critique of the SPP advisory opinion is also incomplete. Our group does not include individuals who are knowledgeable enough to address other portions of the State Guide Plan (State Energy Plan, for example), or other parts of the original request from the EFSB to SPP, which included a) analysis of the socio-economic impact of the proposed facility, and b) consistency and compliance with the State Energy Plan. People more qualified than ourselves can review these portions of the SPP opinion. However, if a preliminary review by a group of grassroots citizens is able to find such glaring inconsistencies and examples of bias, what additional issues would be uncovered by a full professional review of the entire document?

For the time being however, it is enough to say that based on KRIB's review of only a portion of the document, that the SPP advisory opinion is tainted and should be returned to rectify deficiencies and provide an honest, thorough assessment of the State Guide Plan that the citizens of Rhode Island are entitled to.

DEM Passes On Its Obligation to Fully Vet Environmental Impact of Power Plant

February 15, 2017

By RICK ENSER

Recently, a concerned citizen's group, Keep Rhode Island Beautiful, released a critique of the Statewide Planning Program's (SSP) advisory opinion to the Energy Facility Siting Board (EFSB) regarding the Clear River Energy Center proposed for Burrillville. This critique concluded that the SPP opinion was deficient and in some areas biased in favor of the fossil-fuel power plant.

Most notable was the SPP's decision to ignore seven elements of the State Guide Plan, explaining that "these SGP elements primarily involve environmental and recreational considerations which are to be evaluated by the Department of Environmental Management and others." Based on this erroneous conclusion, it's fair to also look at DEM's advisory opinion to see if that agency did indeed examine the issues neglected by the SPP.

This piece will also try to clarify the responsibilities of both DEM and SPP in regards to "the process" that was established by the Energy Facility Siting Act of 1986, or rather how this process is completely unworkable when trying to analyze the full complement of environmental impacts that will be caused by the largest energy-producing project in Rhode Island history.

Trying to make sense of the environmental impacts of this project stretches the capabilities of the state agencies charged with evaluating those impacts, as is evidenced by the poor quality of the advisory opinions that have been rendered.

It should be noted that the SPP's choice to ignore several key elements of the State Guide Plan, in expectation that DEM would cover them, is not only wrong administratively, but also evades the intent of the EFS Act, which specifically mandates Statewide Planning Program review of the State Guide Plan. In other words, it's the SPP's legal obligation to prepare an advisory opinion that addresses the entire State Guide Plan.

But, since that opinion has already been delivered, the EFSB is left no choice but to dig into the DEM opinion to learn if the Clear River Energy Center is consistent with the issues and policies detailed in the seven missing elements.

For DEM, the most important of the missing elements is "Ocean State Outdoors: Rhode Island's Comprehensive Outdoor Recreation Plan." Ocean State Outdoors is Rhode Island's plan for outdoor recreation, conservation and open space, and provides policies for addressing the many issues involved with these resources. There are three primary goals of Ocean State Outdoors, the most relevant to this review being Goal No. 1: to build a green-space network that preserves and protects natural and cultural resources. Seven policies are identified for achieving this goal that cover the basic resource categories of natural diversity, water, wetlands, coastal areas, forests, agriculture, fish and wildlife, cultural, and scenic.

Policy No. 2 calls for maintaining natural diversity by preserving the integrity of Rhode Island's ecosystems. At the time of the writing of Ocean State Outdoors, the office identified with advancing this policy was the Natural Heritage Program (NHP) at DEM. It was the responsibility of the NHP to "identify and document important natural areas and features for protection" and "insure that critical natural habitats are identified and appropriately protected through the subdivision and development review process."

During the 28-year duration of the NHP, literally hundreds of development projects were reviewed by program staff for potential conflicts with rare species and ecosystems using a database of known locations of these biological elements as a basic guide. Since the demise of the NHP in 2007 most of this review capability has been lost; however, on June 1, 2016, the EFSB specifically requested from DEM a review of "the impact of the proposed facility on rare species, including those identified in the Rhode Island Natural Heritage database."

Rather than fulfilling this request, DEM offered the following excuse: "A lack of Natural Heritage records is typical of private property in Rhode Island regardless of its conservation value and is often a reflection of the property not having been inventoried. Such is the case with the subject parcel. DEM does not enter onto private property without permission, and generally not without invitation."

The EFSB also requested information from DEM concerning "the impact on fish and wildlife that will be caused by disruption of the habitat." Although this request would seem to be an

easy task for DEM's Division of Fish and Wildlife, the agency once again evaded the issue by claiming that, "DEM cannot, with such little site-specific information, make conjectures on the full suite of species that would be impacted by the project and the exact nature and extent of those impacts."

It also concluded that, "with additional survey it is plausible that State-listed species may be found to occur within the project footprint and/or within the extended limits of indirect impacts from the Facility."

This conclusion is highly disingenuous. Plausibility is not in question, for in fact there are state-listed species found within the project footprint — as reported by Invenergy's consultants — and the Natural Heritage database does document many rare species populations within the "extended limits of indirect impact."

Apparently, DEM decided to simply place the blame on the applicant for not providing enough information, rather than doing the job it was requested to do, such as review the Natural Heritage database, or taking the initiative to request access to the property to conduct its own surveys.

Is the Clear River Energy Center consistent or inconsistent with Policy No. 2 of Ocean State Outdoors? There is little information in the DEM opinion that would allow the EFSB to make that determination, although I think most people would agree that building a power plant of any size in the midst of one of the state's most significant forested ecosystems is inconsistent with this policy.

The degree of inconsistency, however, is in the details that are nowhere to be found in DEM's advisory opinion.

Another EFSB request to DEM was to determine "whether the Facility will present an unacceptable harm to the environment." The response to this question was: "DEM is charged with determining whether projects and activities present an acceptable harm to the environment through the various permits, licenses, and reviews authorized under the General Laws and the associated rules and regulations promulgated thereunder."

According to DEM, the facility is subject to the following permitting actions: freshwater wetlands, air-pollution control, water-quality certification, and point-source discharge. As

the only permit applied for by Invenergy to date is the air-pollution control permit, the conclusion was, "DEM cannot yet render an opinion as to whether the Facility presents an unacceptable harm to the environment."

Unfortunately, by the time Invenergy applies for the outstanding permits it will have already received a license to proceed, and it's highly unlikely that a nearly $1 billion project would be halted because a permitted action might result in unacceptable harm to the environment.

Instead, DEM will find ways to "mitigate" any unacceptable harm, at least to the limits that regulations allow. But what about other impacts from the project not subject to a permit or license? Does DEM consider the direct and indirect loss of hundreds of acres of forest and the plants and animals that reside therein to be acceptable? Are the levels of noise and light pollution that will result from the project considered acceptable?

DEM was also asked to consider "the impact of the proposed Facility on state conservation priorities and plans." At least with this issue the EFSB finally gets an opinion, which reads: "What is also clear from plans such as the Land Acquisition Plan and the RIRPP, as well as from actual land acquisitions, is that Rhode Island has prioritized and invested in this area for wildlife conservation for decades. The location of a Facility of this size and scope immediately adjacent to substantial acreage of State holdings of conservation land is not consistent with the conservation priorities that informed these state conservation plans."

This response merely points out the obvious, but the conclusion could be drawn for any part of the state where land conservation has been conducted, and begs the question, Why has the state prioritized and invested in this area? A review of the relevant conservation plans would have helped the EFSB understand the particular significance of this area, as shown in the following examples:

Rhode Island Resource Protection Project, Environmental Protection Agency, 1995

Moosup River/Western Blackstone Resource Protection Area. These watersheds comprise the northern section of Rhode Island's "Western Forest," the largest tract of forest habitat in the state. It's also a significant non-urbanized area in the Washington, D.C., to Boston corridor, especially considering its interstate connections with Connecticut and Massachusetts.

This area is inhabited by species that require large unfragmented tracts of forest, including neotropical migrant birds — that use these forests for nesting habitat — and wide-ranging mammals such as the bobcat and fisher. The higher elevations and cooler microclimate in this part of the state support natural communities typical of regions north of Rhode Island. The public is able to enjoy the large amounts of open space that are accessible through significant state holdings and the North/South trail currently under development.

Protecting Our Land Resources: A Land Acquisition and Protection Plan, DEM, 1996

Western Forest focus area. Particularly within this focus area, preventing fragmentation is of crucial importance to perpetuating the native biological communities and reducing the level of homogenization of species assemblages brought about by reduction in forest patch size. Within the Western Forest lies the greatest potential to expand on those areas already protected to maximize available habitats and increase buffering.

Northwest Corner Conservation Plan, The Nature Conservancy, 1997

The northwest corner of Rhode Island is notable for its large patches of relatively unfragmented forest. This forest harbors a few high-quality examples of rare natural communities and many species threatened because of their need for sizable patches of undisturbed forest. A number of these forest interior species are at the southern periphery of their range and are not found elsewhere in the state. Rhode Island's northwest corner is one of the most significant breeding areas for forest interior birds in the state.

Ocean State Outdoors: Rhode Island's Comprehensive Outdoor Recreation Plan, R.I. Department of Administration, Division of Planning and DEM, 2009

The western forest lands and the extensive state-owned management areas provide year-round opportunities to enjoy a variety of recreational pursuits. The character these areas offer is as near to an unaltered forest environment as can be found in Rhode Island, and for some residents, perhaps the only exposure to "wilderness" they will encounter in their lives. The recreational experiences these forested areas accommodate are special, and care must be taken to ensure that they aren't diminished by the insidious threats of overuse, resource degradation, pollution and conflicting uses on lands surrounding this public estate.

This last entry was written by the staff of the Statewide Planning Program, the same office that prepared the advisory opinion to the EFSB that found "the proposed Clear River Energy Center is consistent with the State Guide Plan."

As already noted, Ocean State Outdoors is one of the elements of the State Guide Plan not reviewed by the SPP. The question must be asked, Why would the SPP want to keep this relatively strong sentiment from the EFSB?

The advisory opinions of both DEM and SPP are incomplete, inaccurate and, in some areas, deceiving. The information that is provided is of little use to the EFSB, as it evaluates the environmental impacts of the proposed Clear River Energy Center. The deficiencies and poor quality of these opinions have only two possible explanations: the state employees charged with preparing the opinions are incompetent; or, more likely, this fossil-fuel power plant is simply a done deal that no state agency wants to take responsibility for undermining.

It appears to be a calculated attempt to diminish the ecological significance of western Burrillville to a level in which the impacts of the proposed power plant would be considered "acceptable."

In July 2016, following Gov. Gina Raimondo's visit to Burrillville, Steve Ahlquist of RIFuture wrote: "Governor Raimondo urged the people to 'trust the process,' but if the people don't trust the process, it's not out of some perverse anti-authoritarian impulse, it's out of first-hand experience with the very process she's telling them to trust in. The people understand the process intimately, and they know that the process favors Invenergy, not the people."

That observation was made two months before the advisory opinions of the SPP and DEM were submitted, and apparently neither agency got the message.

Where do we go from here? The EFSB or the governor needs to take responsibility for the failings of their agencies and demand that they do their jobs. Specifically, the Statewide Planning Program must fulfill its legal obligation under the Energy Facility Siting Act by providing an advisory opinion that addresses the entire State Guide Plan. And, if DEM is unable to provide the data and interpretation needed to fully assess the environmental impacts of the Clear River Energy Center, then other sources outside the agency should be contracted to provide that information.

Testimony of:
Richard W. Enser, 722 Curtis Corner Road, South Kingstown, RI, 02879; rickenser@gmail.com
Presented to the Energy Facility Siting Board, October 10, 2017

I'm here to talk about process.

The EFSB can "designate agencies of state government for the purpose of rendering advisory opinions" on issues to be considered by the Board."

That's a big responsibility, and Rhode Islanders expect the professionals employed in their state agencies to take the task seriously, to accurately and completely consider the issues assigned to them, and render honest, unbiased opinions regarding these issues.

Many of us have been waiting for a rational, objective review of the primary question facing the Board: "will the proposed facility cause unacceptable harm to the environment?" There was been little recognition of the ecological significance of the selected location, or the decades of assessment and conservation planning that has gone into this part of the state. Having had some experience in these assessments, I expected to hear in both DEM's and SPP's advisory opinions a reconfirmation of the long-recognized significance of this area, and expected these agencies to argue why this project would be highly detrimental to one of Rhode Island's most valued natural areas.

But the advisory opinions of DEM (specifically the Division of Fish and Wildlife) and Statewide Planning are, to say the least, disappointing. Both have failed to conduct their assignments, and their opinions are completely unusable when addressing the question, "will this facility cause unacceptable harm to the environment."

The Board originally requested an opinion from DEM, in part on the "impact of the proposed facility on…..fish and wildlife habitats, and rare species, including those identified in the Rhode Island Natural Heritage database."

DEM's responded that they could not, with such little information, make conjectures on the full suite of species that would be impacted by the project and the exact nature and extent of these impacts."

Subsequently, Invenergy conducted a biological inventory that reported 17 state-listed species and 47 species of greatest conservation need, but even with this inventory in hand DEM stated in their supplemental opinion that:

"little of what has been made available subsequent to DEM's advisory opinion allows for a detailed discussion on the nature of fish and wildlife impacts"

That's all. No review of the Natural Heritage database, and no interpretation of the rare species reported by ESS. In short, they asked for more data, but did nothing with it when they got it. Interpretation of this data is vital to understanding how these species will be affected by the power plant, especially, will any be lost from Rhode Island as a result of this project?

Spoiler alert: The answer to that is a probable YES! So why is DEM shirking its responsibility and failing to provide you with a detailed analysis of the potential impacts to rare species?

The issue with Statewide Planning is their review of the State Guide Plan. The Act specifically recognized the importance of

the Guide Plan and mandates Statewide Planning to provide a review of the consistency of any project with the Plan. The State Guide Plan is comprised of 18 elements, one being Ocean State Outdoors, the State comprehensive plan for outdoor recreation, conservation, and open space.

It shouldn't take much to understand that there would be little consistency between the objectives and policies of Ocean State Outdoors and the siting of a power plant. This would be true for anywhere in Rhode Island. But, when a power plant is going to be placed within an area identified as a high priority for conservation, the degree of inconsistency multiplies.

But, despite this most obvious truism, the Statewide Planning Program found that, "the Project is not inconsistent with this State Guide Plan Element." I will submit to you, that statement is absurd.

Apparently, the Program only read the Executive Summary of Ocean State Outdoors and ignored the 130 pages of objectives and policies, such as "Maintain natural diversity by preserving the integrity of Rhode Island's ecosystems." Does one really need to ask, "Is a power plant consistent with this policy? The question should be, "How inconsistent is it? And, is it inconsistent enough to be considered an unacceptable harm to the environment?"

You have a situation. You cannot determine if this power plant presents an unacceptable harm to the environment because you don't have the crucial information that you requested to make that decision.

To repeat, it is the responsibility of the Division of Fish and Wildlife to provide information on rare species both on and in the vicinity of the site, as well as expert interpretation about the impacts to these species. This they have not done.

Furthermore, Rhode Islanders expect their State Guide Plan to receive the attention and respect it deserves. There are former state planners who spent their careers crafting Ocean State Outdoors, formulating what they foresaw as the best direction for the state in regards to conservation and providing recreational opportunities for all Rhode Islanders. In its assinine review of Ocean State Outdoors, the Program disrespects its own planners and their decades of commitment to crafting that document. In 2009, one of those former planners contributed the following to Ocean State Outdoors:

The western forest lands and the extensive state-owned Management Areas provide year-round opportunities to enjoy a variety of recreational pursuits. The character these areas offer is as near to an unaltered forest environment as can be found in Rhode Island, and for some residents, perhaps the only exposure to "wilderness" they will encounter in their lives. The recreational experiences these forested areas accommodate are special, and care must be taken to insure that they are not diminished by the insidious threats of overuse, resource degradation, pollution, and conflicting uses on lands surrounding the public estate.

Today's Statewide Planning staff saw no reason to bring this statement from one of their own former staff to your attention?

So, I'll end where I started talking about process, and how this process has been subjugated by the responses of our state agencies And it reminds me of a quote.

In July 2016, following Governor Raimondo's visit to Burrillville, Steve Ahlquist of *RIFuture* wrote: "Governor Raimondo urged the people to 'trust the process', but if the people don't trust the process, it's not out of some perverse anti-authoritarian impulse, it's out of first-hand experience with the very process she's telling them to trust in. The people understand the process intimately, and they know that the process favors Invenergy, not the people."

October 10, 2017 Donna L. Woods page 1

Good evening. My name is Donna L. Woods, and I live at 122 Grove Lane in Pascoag.

I am grateful for my 3 minutes before you tonight. I stood before you just about 801,883(eight hundred and one thousand, eight hundred and eighty three) minutes ago. It has been 1 year, 6 months and 9 days. At that time, I was overwhelmed with helplessness and doubt. Now, all this time later I am before you filled with hope. This time, I am backed by facts and this time I am before you knowing that you take seriously the charge of holding our local world in your hands. And although if I hear the phrase 'Trust the process' one more time, I will literally burst, I do indeed trust you three human beings sitting before us.

Now, respectfully, I will use my time to touch on a couple of facts that weigh the most heavily on my heart.

I am strongly opposed to the licensing of this power plant. First, because it is not needed, and second because it will without a doubt, cause unacceptable harm to the environment of the state. These facts are clearly shown throughout the testimony and advisory opinions that have already been filed with the Board.

Invenergy claims that because the computer modelled air emissions from the facility are below federal air quality standards, no adverse health impacts will result, common sense tells us differently.

In his testimony, Mr. Eric Epner not only contradicts this, he goes into great detail as to why.

Hundreds of thousands of pounds of air pollutants will be annually emitted from this facility, and that pollution in the air above Burrillville will increase cancer risks and respiratory health issues, *even if CREC operates within the air quality limits*. Think about that!

There will also be significant harmful emissions from construction vehicles and other trucks, when and IF this plant begins operation. Large diesel trucks will be providing materials, water, oil, ammonia, hydrogen, and other products to this plant. Not only will these trucks increase noxious air emissions to the detriment of the people and wildlife in the vicinity, but the additional traffic on Burrillville's small country roads, especially during the construction period, will cause significant environmental harm and extreme prolonged stress to residents and wildlife.

Not only does Mr. Epner's testimony identify the many different hazardous pollutants that will be emitted, he goes on to describe the adverse health effects of each. Some of which are extremely serious. In fact, many of these hazardous air pollutants he identified are known to cause cancer and have other serious health impacts.

I have spent the last 801,883 (eight hundred and one thousand, eight hundred eighty three) minutes shouting from the mountain tops that these facts alone, these risks alone, are worthy of a denial of this application. I have begged to be that voice you heard. Now, with these last 3 minutes I actually feel hope. I actually feel comfort. I actually feel like you did hear me and I can't thank you enough for listening. Don't ever forget this time. Don't miss your chance to be heroes for us, the wildlife and our precious, irreplaceable environment.

Good evening. My name is Bill Potvin, 85 Glendale Meadow Lane, Harrisville.

I am opposed to the licensing of this proposed power plant based on lack of need, and unacceptable harm to the environment. These facts have been shown by testimony and advisory opinions that have been filed with the Board.

We all know that when facts don't bear out your argument – you spin them. One of the many spins by Invenergy is their ongoing statement that another plant is needed due to the upcoming closure of older plants. We know this is not true as closures are built into the forward energy needs by ISO - but they know that if they keep saying it – people will believe it. And those not in the know do believe it.

Invenergy produced a witness, Mr. Hardy, who was completely wrong when he predicted that Unit 2 would be picked up in FCA 11. In fact, it was not picked up for two auctions in a row. And, as a matter of fact, no new large generators cleared in FCA 11.

The major reason was energy efficiency and demand reductions of 640 megawatts cleared the auction. This is the equivalent of a large power plant, and this efficiency and demand reduction is a 72% increase from FCA 10. There is a trend here, and this single year shows how dramatically and quickly non-fossil resources have affected the market.

In FCA 10, ISO New England procured 1,416 Megawatts of surplus capacity, and in FCA 11, 1,926 Megawatts of surplus - the equivalent of 2 full CREC power plants.

Further, when Invenergy realized they were not going to meet their construction deadline, they were able to satisfy their first year commitment in a reconfiguration auction – without even building one new unit in Burrillville.

These facts clearly demonstrate that neither unit 1, nor unit 2, are needed.

And Mr. Hardy's prediction that unit 2 will be picked up in FCA 12 is likely to be just as wrong as his prediction was for FCA 11. Mr. Walker, another expert, is of the opinion that Unit 2 will not receive a Capacity Supply Obligation over the next several auctions, if ever.

Mr. Hardy's inaccurate assumptions have created a false hypothetical need – their spin.

In 2001 a Power Plant was proposed in North Smithfield by a company called Indeck. As the plan went to the EFSB, neighbors argued it would pollute the air with debris and noise, threaten water supplies, and ruin the view. It was ultimately denied by the EFSB. An article published in the Valley Breeze at the time said: "word of the denial traveled the town. At a press conference, town leaders stood around a podium pulled out at Memorial Town Hall. The start was delayed a few minutes for Attorney General Sheldon Whitehouse to arrive from Providence.

The decision, Whitehouse said, means an outside firm "cannot come in and force a project on a community that won't accept it."

Watching were a growing crowd of residents who hurried over as they heard the news.

Vincent Marcantonio stood with his wife Maureen. The two had attended all 24 meetings of the siting panel.

"I'm very, very impressed," he said. "The siting board was very fair and paid attention to details. They were very concerned about the environment. It wasn't politically based," he said.

"This is a great day for North Smithfield," he said, adding, "It makes me proud of Rhode Island again."

Ladies and gentlemen, we are hoping for a great day for Burrillville, and all of Rhode Island. Please don't succumb to the politics, and the spin, and make us proud of your work - and our State.

Thank you.

October 10, 2017 EFSB

Here we are again at your table to plead our case against the CREC, when this industry has been not only at your table but more importantly at your ear. They have had these positions since the law governing this "trusted process" was conceived. EFSB law was created by well-paid lobbyist and politicians. This law gives you the right to allow this monster to proceed while ignoring the cries of B'villians and many other who are concerned about the corruption witnessed during these past years. This law affords you the right to ignore the effect of alternatives on the question of the necessity of this project. This power plant has a 20-30 year life. Why go forward when solar, wind and efficiency are on the rapid rise?

The following is an incomplete list of the ramifications should you choose to green light the CREC:

1) This board will be supporting the fracked gas industry. This industry, I call the fossils, has it seems a total disregard for all we the opponents hold dear i.e. clean air, clean and abundant water, a sustainable climate, fragile ecosystems and the earth itself that we all live on.
2) You, if you choose to, are condoning the corrupt process that has afforded the industry every opportunity to change the playing field of this "trusted process, while we, the opposition, was repeatedly denied your generosity.
3) The blinding influence of money and power has taken over your sight, maybe not total blindness but at least shortsightedness that will allow harm to, they say, seven generations to come. Not to mention the impression you would be leaving these little ones. What will they the children take away from this "trusted, corrupt process"?

In closing I plead to you Margret, Janet and Parag to open your eyes and see us to open your ears and hear us and to open your heart, humanity and conscience to a future filled with alternatives and not allow this flailing, desperate industry to go forward. Join us and say Save B'ville! No New Power Plants!

Lorraine Ledoux Savard

Lorraine Ledoux Savard

EFSB Public Hearing – October 10, 2017

Good evening. My name is Betty Mencucci, and I live at 1777 Victory Highway in Glendale. I am opposed to the licensing of this proposed power plant. First, it is not needed, and also because it will cause unacceptable harm to the environment of the state and the Town of Burrillville, as shown by testimony and advisory opinions that have already been filed with the Board.

For example: The testimony of Mr. Anthony James Zemba, a senior ecologist with 30 years' experience.

As Mr. Zemba has testified, DEM, in its advisory opinion, points out that the area of the proposed plant is a land conservation priority area, as defined in DEM's 2010 State Priority Forest Planning Initiative. As Mr. Zemba said in his testimony, and I quote, "the proposed facility would cause significant and unacceptable harm to the environment in that it would adversely impact biodiversity, including rare native Rhode Island species, and additional species of greatest conservation need."

Mr. Zemba also prepared a report based on his review of the biodiversity information submitted by Invenergy. Mr. Zemba concluded that direct adverse impacts to wildlife would occur if the proposed CREC facility was built due to habitat loss, fragmentation, and habitat degradation.

At this site, there are 17 state listed species, including 1 state endangered species, 4 state threatened species, 10 species of concern, and 2 protected species, as well as 47 species of greatest conservation need. These were all detected in the area during the course of Invenergy's own study. Moreover, by Invenergy's own admission in its August 2, 2017 report, "clearing and construction associated with the project will result in the loss of habitat currently used by a variety of animals and plant species." This is virtually the definition of unacceptable harm to the environment, especially with regard to biodiversity and habitats.

Invenergy's own biological inventory report dated August 2, 2017, concludes that there are 520 animal and plant species in the area.
These include:

- 81 birds
- 21 mammals
- 8 amphibians
- 3 reptiles
- 147 butterflies and moths
- 25 dragonflies and damselflies
- 48 other invertebrates, and
- 187 plants

According to Mr. Zemba unacceptable harm to the environment will include significant adverse impacts to biodiversity. The project would have significant adverse impacts on wetlands at the site, including adverse impacts on two special aquatic sites, one of which would be completely obliterated due to the construction of the facility. The other special aquatic site would be significantly degraded.

Mr. Zemba has recommended that this Board reject the application.
Remember that the Governor has stated that the plant will not be built if it is proven to harm anybody. The evidence is overwhelming. It will not only harm humans, it will harm the environment, the biodiversity, the wetlands, etc, etc.

Thank you.

Betty Mencucci
Glendale

October 10, 2017

To the Members of the RI Energy Facility Siting Board:

For almost 2 years I have observed the political maneuvering and back-room machinations of those who have a stake in the Clear River Energy Center. Partial truths have been disseminated and the public has been repeatedly misled. A very large advertising and public relations budget has been tapped to combat the limited resources of Rhode Island residents who oppose the power plant. The fight has seemed unfair and the people most directly impacted by the project have often felt powerless.

Despite my frustration, I have not given up hope that you, the members of the Energy Facility Siting Board, will ultimately do the right thing and deny the request to build this power plant. According to the statute that created the EFSB, construction of a new facility "shall only be undertaken when ... justified by long term state and/or regional energy need forecasts." ISO New England is the independent, expert organization that uses all available information to forecast the future energy needs of our region. The results of the past two ISO New England forward capacity auctions demonstrate that this plant is not necessary. Energy from the second Invenergy turbine was unable to be sold at the February 2017 auction. And the energy from the first turbine, which was sold 18 months ago, fits neatly into the surplus for that auction. Invenergy has already re-sold that obligation to another provider for 2019-20, since it has become clear that they will not have their power plant up and running in time. As new forms of renewable energy become available and we increase our focus on both conservation and efficiency, the need for a new fossil fuel power plant becomes even more questionable.

So, I trust the EFSB process. I believe that the evidence for denying this application is overwhelming, and that the threat of destroying 200 acres of Rhode Island forest to build one of largest power plants in New England will be lifted soon.

Thank you for the opportunity to speak.

Kathleen Good
Wallum Lake Rd.
Pascoag, RI

Testimony for the EFSB public hearing on October 10, 2017
Submitted by:
Joel Gates
15 Elmdale Road
Glocester, RI 02857

I have a question. What is the REAL cost of the planned Clear River Energy Center power plant? Is it the 1 billion dollars that Invenergy has proposed? The embedded costs of this power plant are astronomical; it will be much more!

What is the cost to the people and environment where the gas originates? What is the cost of health care for those who experience ill effects from drilling, hydraulic fracturing, and pumping of the gas wells?

Then there are leaky pipelines transporting the gas. All that released methane is not good for humans and other living things!

What is the cost of degrading the protected flora and fauna of northwest Rhode Island? What is the cost to Burrillville's residents and those in surrounding communities?

What is the cost of ocean acidification? What is the cost of climate change and rising sea levels? How many more Harveys, Irmas, and Marias do we need before we ALL get it?

Again I ask, "What is the cost?"

I don't know! And NO ONE here knows for sure! But all of us, ALL OF US know it will be much more than Invenergy is spending ~~to cause these problems!~~ But we will have to pay for it!

Joel Gates

This paper was originally written for my class at Clark University. I submit this as written testimony for the Energy Facilities Siting Board's public hearing on October 10, 2017.

Submitted by:

Anna Gates, 15 Elmdale Road, N. Scituate, RI 02857

Professor Stoddard

U.S. Environmental Politics

9 May 2017

No New Power Plant Northern RI

Garnering public attention regarding an environmental issue is perhaps the most important component if the environmental matter requires swift political action. On October 29, 2015, a company that develops, builds, and maintains both renewable and fossil fuel power generation facilities, by the name of Invenergy Thermal Development, filed an application to begin the construction of a natural gas power plant in Burrillville, Rhode Island. Burrillville is a rural town in Northwestern Rhode Island with a population of less than sixteen thousand. The small town already contains several power generating stations and the Algonquin natural gas pipeline that transports natural gas from New Jersey to Boston, Massachusetts travels directly through Burrillville. The Burrillville residents, along with several environmental interest groups, are predisposed to disapprove of the proposed natural gas power plant due to these aforementioned aspects. Political figures in the state of Rhode Island, such as the governor, as well as trade unions, support the construction of the natural gas power plant, rather than take environmental degradation, public health, and current and proposed policies into consideration.

The proposed natural gas power plant in Burrillville, Rhode Island would be particularly harmful to the natural environment, as well as the health of the residents of Burrillville. The physical combustion of natural gas is less detrimental to the environment as natural gas emits approximately fifty percent less carbon dioxide than coal-burning power plants. The combustion of natural gas also releases a decreased amount of sulfur, particulate matter, nitrogen oxides, and virtually no mercury into the atmosphere, as compared to other fossil fuels ("Environmental Impacts of Natural Gas"). However, during the process of natural gas extraction, methane is released from the wells in significant amounts. It is environmentally detrimental to discharge methane into the atmosphere because methane, a greenhouse gas, is thirty times more potent than carbon dioxide ("Environmental Impacts of Natural Gas"). The power plant would also have a detrimental effect on biodiversity in the rural town and surrounding areas.

The Clear River Energy Center natural gas power plant requires a water source to cool the steam that is utilized within the power plant for power generation. This water would be obtained from a surface water reservoir. After the water is used for cooling purposes in the power plant, the temperature of the water is significantly warmer, due to an exchange of heat. Invenergy has stated that the water would either be sent to the wastewater treatment facility in Burrillville or discharged into the Blackstone River. If Invenergy releases the water directly into the river, thermal pollution of the local aquatic ecosystems would occur. Thermal pollution could harm biodiversity in the Blackstone river because elevated water temperature corresponds with decreased levels of oxygen, carbon dioxide, and other gases that are necessary to sustain aquatic flora and fauna ("Elevated Water Temperature"). The construction of the power plant in Burrillville could result in a loss of terrestrial biodiversity as well.

The proposed natural gas power plant site is located particularly close to the Buck Hill Wildlife Management Area in Burrillville. The construction of the Clear River Energy Center power plant would obliterate all efforts to increase biodiversity in this protected area. The location of the power plant is also problematic as it would segment the John H Chafee Heritage Corridor, which is a portion of the larger Blackstone River Valley National Heritage Corridor (Applin & Marx 5). Habitat connectivity corridors are particularly important for larger animals, such as deer, coyotes, and red foxes, because corridors allow for the movement of wildlife throughout a larger habitat area. If the suitable wildlife regions are divided by the construction of the power plant, issues of reduced gene pools may arise, which can lead to the extinction of a species. However, the potential destruction of the environment can be prevented with current and proposed pieces of legislation and policy measures.

Firstly, the Constitution of the State of Rhode Island and Providence Plantations emphasizes the importance of environmental preservation by stating:

… it shall be the duty of the general assembly to provide for the conservation of the air, land, water, plant, animal, mineral and other natural resources of the state, and to adopt all means necessary and proper by law to protect the natural environment of the people of the state by providing adequate resource planning for the control and regulation of the use of the natural resources of the state and for the preservation, regeneration and restoration of the natural environment of the state. (RI Const. art. I, sec. 17).

The greenhouse gas emissions, thermal pollution, and threatened loss of biodiversity that would be created by the Clear River Energy Center power plant would violate this constitutional principle of environmental conservation. This section of the Constitution was adopted on

November 3, 1970, which coincides with the emergence of the environmental conservation movement ("Annotated Constitution of the State of Rhode Island and Providence Plantations" 8). More recently, the Resilient Rhode Island Act was passed in June of 2014. This act sets greenhouse gas emission mitigation targets for the state, which include reducing greenhouse gas emissions to ten percent below levels in 1990 by 2025 and eventually decreasing emissions to eighty percent below 1990 levels in the year 2050 ("The Resilient Rhode Island Act of 2014"). The natural gas power plant will produce greenhouse gas emissions and will not comply with the target emission rates set by the Resilient Rhode Island Act. The current pieces of legislation do not directly address the construction of the natural gas power plant in Burrillville, but a new proposed policy would certainly deter Invenergy from siting the power plant in Rhode Island.

The new policy is a carbon tax that was proposed by Representative Aaron Regunberg in February 2017. Power plants, such as the proposed plant in Burrillville, would be required to pay a fifteen dollar tax per ton of carbon dioxide that is released into the atmosphere (Faulkner). The carbon tax will go into effect on January 1, 2018 if it is approved. The tax will address the power plant siting issue as it will monetarily discourage Invenergy from constructing the Clear River Energy Center in Rhode Island. Regardless of the present and proposed policies, the Rhode Island governor continues to openly support the construction of the natural gas power plant in Burrillville.

Governor Gina Raimondo supports the Clear River Energy Center power plant because the construction of the power plant will provide three hundred temporary jobs and the maintenance and operation of the facility will provide twenty-four permanent positions (Ahlquist). The governor also favors the natural gas power plant because it will decrease energy

prices for Rhode Islanders. Governor Raimondo's stance regarding the natural gas power plant is particularly significant because Raimondo appointed each member of the Energy Facilities Siting Board. The Energy Facilities Siting Board is solely responsible for granting or rejecting Invenergy's permits and licenses to construct and operate the Clear River Energy Center power plant. As the Energy Facilities Siting Board has complete authority over this issue, the Burrillville Town Council has little political clout concerning the siting of the natural gas power plant. Regardless, the Burrillville Town Council, passed a resolution to oppose the siting of the power plant on September 22, 2016. Twenty-seven other municipalities have also passed resolutions to oppose Invenergy's power plant.

Interest groups in Rhode Island have become involved in the controversial siting of the Clear River Energy Center power plant, as well. The Rhode Island Building and Construction Trades Council, which is a conglomerate of sixteen Rhode Island trade unions with about nine thousand members employed in the construction sector, supports the natural gas power plant (Rhode Island Building and Construction Trades Council). The unions are economically in favor of the power plant as the construction of the facility will supply three hundred jobs for construction workers (Ahlquist). The Rhode Island Building and Construction Trades Council has attempted to influence the preferences of Burrillville residents at local town meetings. The president of the union, along with more than one hundred union members attended a town meeting at Burrillville High School on March 31, 2016, which Burrillville residents described as "intimidating" (Ahlquist). However, several other interest groups are opposed to the siting of the natural gas power plant.

The interest groups that oppose the Clear River Energy Center power plant are predominantly environmentalist groups. By March 2017, all sixty-five organizations that are members of the Environmental Council of Rhode Island had publicly stated their opposition toward the proposed natural gas power plant (Ahlquist). These interest groups include the Audubon Society of Rhode Island, the Conservation Law Foundation, and Fossil Free Rhode Island. The Audubon Society has stressed the importance of the extensive forested lands and the John H Chafee Heritage Corridor that are located in Burrillville. The Conservation Law Foundation has filed a lawsuit against Invenergy; this lawsuit challenges the legality of the proposed power plant's primary source of water for cooling. Fossil Free Rhode Island has also released a statement opposing the natural gas power plant due to the greenhouse gas emissions that the plant will produce and release into the atmosphere (Fossil Free Rhode Island). Burrillville residents have also expressed great concern regarding the environmental impacts of the natural gas power plant.

Burrillville residents have attended numerous town meetings to convey their concern about noise, water, and air pollution, diminished property values, habitat destruction, and the environmental hazards of hydraulic fracturing, as well as overarching concern about global warming and rising sea levels (Ahlquist). Many residents are also concerned about the negative impacts that the Clear River Energy Center power plant will have on the aesthetic rural beauty that the town of Burrillville is known for. Most importantly, however, Burrillville residents are terrified that their small town will, once again, experience an environmental disaster.

In 2001, it was discovered that an ExxonMobil gas station tank had been leaking into the soil and bedrock that was located beneath the site of the gas station for an undisclosed amount of

time ("Environmental Response Plan"). Methyl tertiary butyl ether, a chemical component of gasoline, permeated the soil and contaminated several residential wells that were located over a quarter of a mile away from the gas station. Methyl tertiary butyl ether is relatively soluble in water; this chemical property allows the substance to travel through soil quickly ("Chemical and Physical Information" 159). The Department of Environmental Management found that the concentration of methyl tertiary butyl ether in the well water was approximately 1700 ppb ("Environmental Response Plan"). The concentration levels that were discovered in Burrillville were more than forty times higher than the highest concentration that is deemed safe for human consumption. The threshold concentration of 40 ppb is suggested by the Department of Health ("Environmental Response Plan"). Burrillville residents have attributed skins rashes and incidents of cancer to the high methyl tertiary butyl ether concentration levels. This environmental disaster is still fresh in the minds of Burrillville residents. Many citizens fear that the Clear River Energy Center power plant will cause another environmentally detrimental incident that will negatively impact the live of Burrillville community members. Therefore, Burrillville residents oppose the natural gas power plant.

The political argument regarding the opposition of the Clear River Energy Center power plant lacks a particular policy that would strongly discourage the Energy Facilities Siting Board from supporting Invenergy's siting application. The current proposed carbon tax would not only deter the Energy Facilities Siting Board from granting the natural gas power plant application, the tax would also encourage Invenergy to abandon the permit application process, due to the increased taxes that would be placed on the greenhouse gas-emitting power plant. However, Governor Gina Raimondo and the Rhode Island Building and Construction Trades Council have

ignored the potential environmental impacts and fully support the power plant. This is concerning because Governor Raimondo and the construction trade union has much more political clout than environmental interest groups and Burrillville residents.

While this particular environmental issue may not be familiar to those who do not reside in Rhode Island, the location, construction, and operation of a natural gas power plant in the town of Burrillville could produce environmentally detrimental results. The Clear River Energy Center power plant would release greenhouse gas emissions into the atmosphere, segment habitat connectivity corridors and protected wildlife areas, and cause thermal pollution in nearby rivers. The Constitution of the State of Rhode Island and Providence Plantations, the Resilient Rhode Island Act of 2014, and the proposed carbon tax strongly discourage the construction of a power plant anywhere in Rhode Island, particularly in an ecologically important and delicate region. Also, more than sixty environmental organizations, along with the vast majority of Burrillville residents strongly oppose the natural gas power plant. Governor Gina Raimondo and the Rhode Island Building and Construction Trades Council support the construction and operation of the power plant, but the justification is exclusively economical. Given the significant environmental risks, Rhode Island must find another way to satisfy the energy and economic needs of the state without putting the Burrillville environment and residents' health at risk.

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Town Council meetings across Rhode Island
Public Hearings
Statehouse Rallies
Statehouse Hearings
Grassroots meetings
Secret meetings
Political Aspirations
Editorials
Edited Editorials
Family Feuds
Television Appearances
Radio Talk Shows
Business Opposition Letters
Individual Opposition Letters
Letter Campaigns
Disagreements
Social media posts
Social media pages
Email blasts
33 RI Communities for support
APRA requests
APRA denials
An injunction
A Governor's visit to Burrillville
Meetings with Senators
Bickering
Meeting with the Narragansett Indian Tribe
Pascoag Utility & Harrisville water District meetings
Concerts
Parades
Bargain Buyer Ads
Mail Drops
Petitions
Candy bar Sales
Pens
Patches
Bumper Stickers
Umbrellas
Magnets
4 x 8 ft. Handmade Wooden Signs

Sign Campaign
T-shirts
Postcards
Bracelets
Raffles
Chicken dinners
Coffee mugs
Beer glasses
Patches
Banners
Parades
A motorcycle run
20 RIPTA bus ads
A clambake
A scrapbook
Learn the Facts

This is just a small sampling of all that has occurred in the past 798 days. 798 days: Exactly two years, two months and 6 days since it was publicly announced that Invenergy was proposing to build the Clear River Energy Center in Burrillville, RI.

In the past 798 days, we have put forth a STATEWIDE effort to educate people on why the Clear River Energy Center is not only not wanted, but proven to be NOT NEEDED. RI residents from *across the STATE* have joined in an uphill battle with twists and turns and highs and lows in order to protect Rhode Island, a state that totes tourism as one of the very reasons to visit.

We have heard Invenergy state they are going to be a good neighbor because of the money the Town of Burrillville will receive from the tax agreement. My home is approximately 1200 feet from the entrance to the proposed plant and I will potentially be one of CREC's closest neighbors.

Webster's Dictionary defines a good neighbor as one who is 'marked by principles of friendship, cooperation, and noninterference in the internal affairs of another country'. Invenergy in no way fits this bill.

A ***good neighbor*** would not exclude a fellow neighbor's property who is a mere 3500 ft away from the proposed site from a Property Value Agreement protecting the value of that neighbor's property.

A ***good neighbor*** would not continuously refuse to provide complete and comprehensive plans for the plant to the very agencies responsible for providing advisory opinions to the EFSB.

And a ***good neighbor*** would CERTAINLY not fail to have an evacuation plan in place to protect their fellow neighbors who would undoubtedly be directly impacted should a disaster occur.

For the past 798 days, we have all sacrificed time away from our families, friends, jobs and hobbies.

For the past 798 days, we have lived in fear for the other shoe to drop.

For the past 798 days, we have found ourselves questioning our state and local leaders for putting us in this situation.

For the past 798 days, we have prided ourselves on our perseverance, tenacity, and dedication to stopping this monster from devastating everything we know and love.

For the past 798 days, we have fought tirelessly, and for the next 798 days, we will continue to fight until Invenergy finally goes away.

Hello my name is Suzanne Dumas....thank you for allowing me to speak one last time...We are all here tonight because an out of state corporation, Invenergy has proposed a power plant with a kind of a kind of whimsical name "Clear River"...However this plan is anything but whimsical....instead the plan will bring an ominous threat that will not only impact Burrillville but much of RI

I am a true face of RI...this has always been my home.

As a child I grew up in Woonsocket....city living was not the ideal place to enjoy a hot summer day...city sounds and smells abounding, so much hot pavement and so little grass...Mother Nature was not easy to find and enjoy. However on the week-end we escaped with family and friends and made our excursions to Wallum lake...our true haven....clean air, sparkling cool water and the pure sounds of Mother Nature and happiness all around....shade of so many marvelous trees and OH so much green. Those are memories I still revel in today even though more than 50 years have passed.

We were so blessed to have those excursions and so many others right here in Northern RI...the boys got to spend time at the scouting facilities of the Buckhill areas. Our family members camped and fished at Bowdish Lake. My husband, son and brothers hunted in this area...This locale became our true breath of fresh air.

So much time, effort and resources have been set aside over many decades to preserve our RI paradise. To site a power plant in the midst of all this is not what people had in mind when they set out to conserve and preserve this land....when they set out to protect our environment, and wild life habitat....a power plant was NEVER a part ot that vision. YET here we stand doing just that...trying to build a giant power plant THERE...kind of like fitting a square peg into a round hole.

I am now blessed to have my forever home here in Burrillville on Wilson's

Reservoir...where the nights have dark velvety skies that twinkle with a million stars, the lake waters shimmer and are teaming with fish...the air is so fresh and the sights and sounds of nature are common place. THIS will all be impacted by what Invenergy has planned for us,

We do not want it....we do not need it!

I along with so many fine RI citizens just want to keep our corner of the world the way it was always meant to be....a peaceful place where the beauty of Mother Nature abounds...a relaxing place for recreation at its best, a true asset to RI....a playground for the young and old alike. Please keep it the way it is for future generations to enjoy. It is a totally inappropriate place for this project. WHO EVER heard of a mega power plant in the middle of a National Park Corridor?

Never lose sight of the memoires made by a little girl who found her paradise right here in Northern RI

I implore you PLEASE DO NOT SITE A POWER PLANT HERE!

Thank you

Suzanne Dumas

75 Manly Dr.

Pascoag, RI

LIST OF DISEASES LINKED TO AIR POLLUTION IS GROWING

IN Donora, Pa., a mill town in a crook of the Monongahela River, the daily haze from nearby zinc and steel plants was the price of keeping their families fed. But on October 27, 1948, the city awoke to an unusually sooty sky, even for Donora. The next day, the high school quarterbacks couldn't see their teammates well enough to complete a single pass. The town was engulfed in smog for five days, until a storm finally swept the pollution out of the valley. By then, more than one-third of the population had fallen ill and 20 people were dead. Another 50 perished in the following months. After the Donora tragedy, the federal government began to clamp down on industries that release pollutants into the air. Environmental advocates in the coming decades fought for, and won, tighter regulations. As a result, combined emissions of six common air pollutants have dropped by about 70 percent nationwide since the 1970 passage of the Clean Air Act, which regulates U.S. emissions of hazardous air pollutants. In 35 major U.S. cities, the total number of days with unhealthy air has fallen by almost two-thirds just since 2000. It IS ONE OF THE GREATEST SUCCESS STORIES OF PUBLIC HEALTH!

Since then hundreds of studies report finding of connection three common air pollutants, ozone, nitrogen dioxide and particulate matter , and their association to respiratory diseases, Alzheimer's , Obesity and leads to Diabetes...and as recent as July of this year 2017 the **New England Journal of Medicine** reported what researchers from the Harvard School of Public Health recently found on links between air quality and mortality throughout the entire U.S. Medicare population ! That study includes more than 60 million people who are age 65 and older or disabled. The analysis looked at levels of two common air pollutants and death rates from 2000 to 2012, and found that when pollutant levels rose (but remained at levels below national standards),so did death rates .

So even with vast improvements in air quality since the 70s, people haven't stopped dying from the air they breathe. An analysis published in 2013 from researchers at MIT estimated that about 200,000 premature deaths occur each year in the United States because of fine particulate air pollution. A study published in January in /Environmental Health Perspectives/ reported that daily deaths over a decade in metropolitan Boston peaked on days when concentrations of three common air pollutants were at their highest , even though those levels would currently satisfy the U.S. Environmental Protection Agency. Despite a half-century of progress, airborne pollution effects health in ways that even the people of Donora never imagined. The culprits are power plants, industries, vehicles and other sources of fuel burning. The pollution is generally a mixture of gases such as carbon monoxide, sulfur dioxide and nitrogen oxides and particulate matter, the kind that will be spewed by CREC. These fine particulates (less than 2.5 micrometers wide, or about a quarter of the width of the smallest grain of pollen) are of greatest concern because they can penetrate deeply into the lungs . **Follow the Science**. Although the second opinion by RI DOH on the health effects of pollution is stronger than previous, as it should be, it

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ORIGINAL ARTICLE

Air Pollution and Mortality in the Medicare Population

Qian Di, M.S., Yaguang Wang, M.S., Antonella Zanobetti, Ph.D., Yun Wang, Ph.D., Petros Koutrakis, Ph.D., Christine Choirat, Ph.D., Francesca Dominici, Ph.D., and Joel D. Schwartz, Ph.D.

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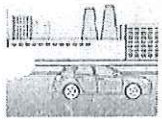
The adverse health effects associated with long-term exposure to air pollution are well documented.[1,2] Studies suggest that fine particles (particles with a mass median aerodynamic diameter of less than 2.5 μm [$PM_{2.5}$]) are a public health concern,[3] with exposure linked to decreased life expectancy.[4-6] Long-term exposure to ozone has also been associated with reduced survival in several recent studies, although evidence is sparse.[4,7-9]

QUICK TAKE VIDEO SUMMARY



Air Pollution and Mortality

Studies with large cohorts have investigated the relationship between long-term exposures to $PM_{2.5}$ and ozone and mortality;[4,9-13] others have estimated the health effects of fine particles at low concentrations (e.g., below 12 μg per cubic meter for $PM_{2.5}$).[14-18] However, most of these studies have included populations whose socioeconomic status is higher than the national average and who reside in well-monitored urban areas. Consequently, these studies provide limited information on the health effects of long-term exposure to low levels of air pollution in smaller cities and rural areas or among minorities or persons with low socioeconomic status.

To address these gaps in knowledge, we conducted a nationwide cohort study involving all Medicare beneficiaries from 2000 through 2012, a population of 61 million, with 460 million person-years of follow-up. We used a survival analysis to estimate the risk of death from any cause associated with long-term exposure (yearly average) to $PM_{2.5}$ concentrations lower than the current annual National Ambient Air Quality Standard (NAAQS) of 12 μg per cubic meter and to ozone concentrations below 50 parts per billion (ppb). Subgroup analyses were conducted to identify populations with a higher or lower level of pollution-associated risk of death from any cause.

METHODS

Mortality Data

We obtained the Medicare beneficiary denominator file from the Centers for Medicare and Medicaid Services, which contains information on all persons in the United States covered by Medicare and more than 96% of the population 65 years of age or older. We constructed an open cohort consisting of all beneficiaries in this age group in the continental United States from 2000 through 2012, with all-cause mortality as the outcome. For each beneficiary, we extracted the date of death (up to December 31, 2012), age at year of Medicare entry, year of entry, sex, race, ZIP Code of residence, and Medicaid eligibility (a proxy for low socioeconomic status). Persons who were alive on January 1 of the year following their enrollment in Medicare were entered into the open cohort for the survival analysis. Follow-up periods were defined according to calendar years.

Assessment of Exposure to Air Pollution

Ambient levels of ozone and $PM_{2.5}$ were estimated and validated on the basis of previously published prediction models.[19,20] Briefly, we used an artificial neural network that incorporated satellite-based measurements, simulation outputs from a chemical transport model, land-use terms, meteorologic data, and other data to predict daily concentrations of $PM_{2.5}$ and ozone at unmonitored locations. We fit the neural network with monitoring data from the Environmental Protection Agency (EPA) Air Quality System (AQS) (in which there are 1928 monitoring stations for $PM_{2.5}$ and 1877 monitoring stations for ozone). We then predicted daily $PM_{2.5}$ and ozone concentrations for nationwide grids that were 1 km by 1 km. Cross-validation indicated that predictions were good

across the entire study area. The coefficients of determination (R^2) for $PM_{2.5}$ and ozone were 0.83 and 0.80, respectively; the mean square errors between the target and forecasting values for $PM_{2.5}$ and ozone were 1.29 μg per cubic meter and 2.91 ppb, respectively. Data on daily air temperature and relative humidity were retrieved from North American Regional Reanalysis with grids that were approximately 32 km by 32 km; data were averaged annually.[21]

For each calendar year during which a person was at risk of death, we assigned to that person a value for the annual average $PM_{2.5}$ concentration, a value for average ozone level during the warm season (April 1 through September 30), and values for annual average temperature and humidity according to the ZIP Code of the person's residence. The warm-season ozone concentration was used to compare our results with those of previous studies.[10] In this study, "ozone concentration" refers to the average concentration during the warm season, unless specified otherwise.

As part of a sensitivity analysis, we also obtained data on $PM_{2.5}$ and ozone concentrations from the EPA AQS and matched that data with each person in our study on the basis of the nearest monitoring site within a distance of 50 km. (Details are provided in Section 1 in the Supplementary Appendix, available with the full text of this article at NEJM.org.)

Statistical Analysis

We fit a two-pollutant Cox proportional-hazards model with a generalized estimating equation to account for the correlation between ZIP Codes.[22] In this way, the risk of death from any cause associated with long-term exposure to $PM_{2.5}$ was always adjusted for long-term exposure to ozone, and the risk of death from any cause associated with long-term exposure to ozone was always adjusted for long-term exposure to $PM_{2.5}$, unless noted otherwise. We also conducted single-pollutant analyses for comparability. We allowed baseline mortality rates to differ according to sex, race, Medicaid eligibility, and 5-year categories of age at study entry. To adjust for potential confounding, we also obtained 15 ZIP-Code or county-level variables from various sources and a regional dummy variable to account for compositional differences in $PM_{2.5}$ across the United States (Table 1, and Section 1 in the Supplementary Appendix). We conducted this same statistical analysis but restricted it to person-years with $PM_{2.5}$ exposures lower than 12 μg per cubic meter and ozone exposures lower than 50 ppb (low-exposure analysis) (Table 1, and Section 1 in the Supplementary Appendix).

TABLE 1

Cohort Characteristics and Ecologic and Meteorologic Variables.

To identify populations at a higher or lower pollution-associated risk of death from any cause, we refit the same two-pollutant Cox model for some subgroups (e.g., male vs. female, white vs. black, and Medicaid eligible vs. Medicaid ineligible). To estimate the concentration-response function of air pollution and mortality, we fit a log-linear model with a thin-plate spline of both $PM_{2.5}$ and ozone and controlled for all the individual and ecologic variables used in our main analysis model (Section 7 in the Supplementary Appendix). To examine the robustness of our results, we conducted sensitivity analyses and compared the extent to which estimates of risk changed with respect to differences in confounding adjustment and estimation approaches (Sections S2 through S4 in the Supplementary Appendix).

Data on some important individual-level covariates were not available for the Medicare cohort, including data on smoking status, body-mass index (BMI), and income. We obtained data from the Medicare Current Beneficiary Survey (MCBS), a representative subsample of Medicare enrollees (133,964 records and 57,154 enrollees for the period 2000 through 2012), with individual-level data on smoking, BMI, income, and many other variables collected by means of telephone survey. Using MCBS data, we investigated how the lack of adjustment for these risk factors could have affected our calculated risk estimates in the Medicare cohort (Section 5 in the Supplementary Appendix). The computations in this article were run on the Odyssey cluster, which is supported by the FAS Division of Science, Research Computing Group, and on the Research Computing Environment, which is supported by the Institute for Quantitative Social Science in the Faculty of Arts and Sciences, both at Harvard University. We used R software, version 3.3.2 (R Project for Statistical Computing), and SAS software, version 9.4 (SAS Institute).

RESULTS

Cohort Analyses

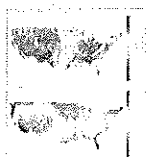
The full cohort included 60,925,443 persons living in 39,716 different ZIP Codes with 460,310,521 person-years of follow-up. The median follow-up was 7 years. The total number of deaths was 22,567,924. There were 11,908,888 deaths and 247,682,367 person-years of follow-up when the $PM_{2.5}$ concentration was below 12 μg per cubic meter and 17,470,128 deaths and 353,831,836 person-years of follow-up when the ozone concentration was below 50 ppb. These data provided excellent power to estimate the risk of death at air-pollution levels below the current annual NAAQS for $PM_{2.5}$ and at low concentrations for ozone (Table 1).

Annual average $PM_{2.5}$ concentrations across the continental United States during the study period ranged from 6.21 to 15.64 μg per cubic meter (5th and 95th percentiles, respectively), and the warm-season average ozone concentrations ranged from 36.27 to 55.86 ppb (5th and 95th percentiles, respectively). The highest $PM_{2.5}$ concentrations were in California and the eastern and southeastern

United States. The Mountain region and California had the highest ozone concentrations; the eastern states had lower ozone concentrations (Figure 1).

In a two-pollutant analysis, each increase of 10 μg per cubic meter in annual exposure to $PM_{2.5}$ (estimated independently of ozone) and each increase of 10 ppb in warm-season exposure to ozone (estimated independently of $PM_{2.5}$) was associated with an increase in all-cause mortality of 7.3% (95% confidence interval [CI], 7.1 to 7.5) and 1.1% (95% CI, 1.0 to 1.2), respectively. Estimates of risk based on predictive, ZIP-Code–specific assessments of exposure were slightly higher than those provided by the nearest data-monitoring site (Table 2). When we restricted the $PM_{2.5}$ and ozone analyses to location-years with low concentrations, we continued to see significant associations between exposure and mortality (Table 2). Analysis of the MCBS subsample provided strong evidence that smoking and income are not likely to be confounders because they do not have a significant association with $PM_{2.5}$ or ozone (Section 5 in the Supplementary Appendix).

FIGURE 1

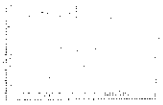


Average $PM_{2.5}$ and Ozone Concentrations in the Continental United States, 2000 through 2012.

TABLE 2

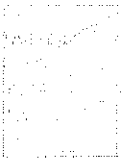
Risk of Death Associated with an Increase of 10 μg per Cubic Meter in $PM_{2.5}$ or an Increase of 10 ppb in Ozone Concentration.

FIGURE 2



Risk of Death Associated with an Increase of 10 μg per Cubic Meter in $PM_{2.5}$ Concentrations and an Increase of 10 ppb in Ozone Exposure, According to Study Subgroups

FIGURE 3



Concentration–Response Function of the Joint Effects of Exposure to $PM_{2.5}$ and Ozone on All-Cause Mortality

Subgroup Analyses

Subgroup analyses revealed that men; black, Asian, and Hispanic persons; and persons who were eligible for Medicaid (i.e., those who had low socioeconomic status) had a higher estimated risk of death from any cause in association with $PM_{2.5}$ exposure than the general population. The risk of death associated with ozone exposure was higher among white, Medicaid-eligible persons and was significantly below 1 in some racial subgroups (Figure 2). Among black persons, the effect estimate for $PM_{2.5}$ was three times as high as that for the overall population (Table S3 in the Supplementary Appendix). Overall, the risk of death associated with ozone exposure was smaller and somewhat less robust than that associated with $PM_{2.5}$ exposure. We also detected a small but significant interaction between ozone exposure and $PM_{2.5}$ exposure (Table S8 in the Supplementary Appendix). Our thin-plate–spline fit indicated a relationship between $PM_{2.5}$, ozone, and all-cause mortality that was almost linear, with no signal of threshold down to 5 μg per cubic meter and 30 ppb, respectively (Figure 3, and Fig. S8 in the Supplementary Appendix).

DISCUSSION

This study involving an open cohort of all persons receiving Medicare, including those from small cities and rural areas, showed that long-term exposures to $PM_{2.5}$ and ozone were associated with an increased risk of death, even at levels below the current annual NAAQS for $PM_{2.5}$. Furthermore, the study showed that black men and persons eligible to receive Medicaid had a much higher risk of death associated with exposure to air pollution than other subgroups. These findings suggest that lowering the annual NAAQS may produce important public health benefits overall, especially among self-identified racial minorities and people with low income.

The strengths of this study include the assessment of exposure with high spatial and temporal resolution, the use of a cohort of almost 61 million Medicare beneficiaries across the entire continental United States followed for up to 13 consecutive years, and the ability to perform subgroup analyses of the health effects of air pollution on groups of disadvantaged persons. However, Medicare claims do not include extensive individual-level data on behavioral risk factors, such as smoking and income, which could be important confounders. Still, our analysis of the MCBS subsample (Table S6 in the Supplementary Appendix) increased our level of confidence that the inability to adjust for these individual-level risk factors in the Medicare cohort did not lead to biased results (Section 5 in the Supplementary Appendix). In another study, we analyzed a similar Medicare subsample with detailed individual-level data on smoking, BMI, and many other potential confounders linked to Medicare claims.[23] In that analysis, we found that for mortality and hospitalization, the risks of exposure to $PM_{2.5}$ were not sensitive to the additional control of individual-level variables that were not available in the whole Medicare population.

We also found that our results were robust when we excluded individual and ecologic covariates from the main analysis (Fig. S2 and Table S2 in the Supplementary Appendix), when we stratified age at entry into 3-year and 4-year categories rather than the 5 years used in the main analysis (Fig. S3 in the Supplementary Appendix), when we varied the estimation procedure (by means of a generalized estimating equation as opposed to mixed effects) (Tables S3 and S4 in the Supplementary Appendix), and when we used different types of statistical software (R, version 3.3.2, vs. SAS, version 9.4). Finally, we found that our results were consistent with others published in the literature (Section 6 in the Supplementary Appendix).[5,17,24-28]

There was a significant association between $PM_{2.5}$ exposure and mortality when the analysis was restricted to concentrations below 12 μg per cubic meter, with a steeper slope below that level. This

association indicated that the health-benefit-per-unit decrease in the concentration of $PM_{2.5}$ is larger for $PM_{2.5}$ concentrations that are below the current annual NAAQS than the health benefit of decreases in $PM_{2.5}$ concentrations that are above that level. Similar, steeper concentration-response curves at low concentrations have been observed in previous studies.[29] Moreover, we found no evidence of a threshold value — the concentration at which $PM_{2.5}$ exposure does not affect mortality — at concentrations as low as approximately 5 μg per cubic meter (Figure 3); this finding is similar to those of other studies.[18,30]

The current ozone standard for daily exposure is 70 ppb; there is no annual or seasonal standard. Our results strengthen the argument for establishing seasonal or annual standards. Moreover, whereas time-series studies have shown the short-term effects of ozone exposure, our results indicate that there are larger effect sizes for longer-term ozone exposure, including in locations where ozone concentrations never exceed 70 ppb. Unlike the American Cancer Society Cancer Prevention Study II,[9,10] our study reported a linear connection between ozone concentration and mortality. This finding is probably the result of the interaction between $PM_{2.5}$ and ozone (Section 7 in the Supplementary Appendix). The significant, linear relationship between seasonal ozone levels and all-cause mortality indicates that current risk assessments,[31-33] which incorporate only the acute effects of ozone exposure on deaths each day from respiratory mortality, may be substantially underestimating the contribution of ozone exposure to the total burden of disease.

The enormous sample size in this study, which includes the entire Medicare cohort, allowed for unprecedented accuracy in the estimation of risks among racial minorities and disadvantaged subgroups. The estimate of effect size for $PM_{2.5}$ exposure was greatest among male, black, and Medicaid-eligible persons. We also estimated risks in subgroups of persons who were eligible for Medicaid and in whites and blacks alone to ascertain whether the effect modifications according to race and Medicaid status were independent. We found that black persons who were not eligible for Medicaid (e.g., because of higher income) continued to have an increased risk of death from exposure to $PM_{2.5}$ (Fig. S4 in the Supplementary Appendix). In addition, we found that there was a difference in the health effects of $PM_{2.5}$ exposure between urban and rural populations, a finding that may be due to compositional differences in the particulates (Table S3 Supplementary Appendix).

Although the Medicare cohort includes only the population of persons 65 years of age or older, two thirds of all deaths in the United States occur in people in that age group. Although our exposure models had excellent out-of-sample predictive power on held-out monitors, they do have limitations. Error in exposure assessment remains an issue in this type of analysis and could attenuate effect estimates for air pollution.[34]

The overall association between air pollution and human health has been well documented since the publication of the landmark Harvard Six Cities Study in 1993.[25] With air pollution declining, it is critical to estimate the health effects of low levels of air pollution — below the current NAAQS — to determine whether these levels are adequate to minimize the risk of death. Since the Clean Air Act requires the EPA to set air-quality standards that protect sensitive populations, it is also important to focus more effort on estimating effect sizes in potentially sensitive populations in order to inform regulatory policy going forward.

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No potential conflict of interest relevant to this article was reported.

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SOURCE INFORMATION

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Irene Watson RAP

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EDITORIALS

Air Pollution and Health — Good News and Bad

C. Arden Pope III, Ph.D.

Early concerns regarding the health-related effects of air pollution originated from severe episodes in Meuse Valley, Belgium, in 1930; Donora, Pennsylvania, in 1948; and London, in 1952. Although the overall effects of these episodes continue to be debated, well-documented, episode-related increases in morbidity and mortality from cardiopulmonary causes provided dramatic evidence that extremely high concentrations of air pollution can have serious adverse effects on health. Early public-policy efforts to improve air quality in the United States, Britain, and elsewhere were largely attempts to avert such "killer" episodes of air pollution. In the United States, a series of national legislative and regulatory efforts to control air pollution were initiated (Fig. 1); National Ambient Air Quality Standards were mandated and established; and dramatic, extremely severe episodes of air pollution were essentially eliminated.

From the 1960s through the 1980s, a few scattered studies continued to suggest that air pollution had adverse effects on health.[1,2] Then, during the relatively short period of 1989 through 1995, several loosely connected epidemiologic studies reported adverse effects of unexpectedly low levels of particulate-matter air pollution.[3-6] Although highly controversial,[7] these results prompted serious reconsideration of the particulate-matter standards and health guidelines (Fig. 1). They also prompted extensive efforts to reanalyze key studies[8] (which were largely confirmatory) and motivated rapid growth in epidemiologic, toxicologic, and other studies of fine particulate matter and other combustion-related air pollutants.

Research has continued to suggest that a level of air pollution that is common in many urban and industrial environments is an important risk factor for various adverse health effects in humans. Although many such studies have focused on respiratory disease, substantial and growing evidence indicates that fine particulate air pollution is also a risk factor for cardiovascular disease.[9,10] Short-term exposure exacerbates existing pulmonary and cardiovascular disease and increases the risk of symptoms, the need for medical attention, and death.[1] Long-term, repeated exposure increases the cumulative risk of chronic pulmonary and cardiovascular disease and death.[9-13]

One notable research effort that began in the early 1990s in the midst of the controversies about air quality was the Children's Health Study. This study prospectively monitored the lung function of schoolchildren from the ages of 10 to 18 years in 12 southern California communities with a relatively wide range of air pollutants. As reported by Gauderman et al. in this issue of the *Journal*,[14] air pollution was significantly associated with deficits in lung development. Within the context of the overall literature on air pollution and human health, this article makes several important and confirmatory contributions.

The Children's Health Study evaluated the cumulative exposure to various pollutants over an eight-year period. Deficits in the growth of lung function over the eight-year period were associated with a correlated set of pollutants that included fine particulate matter with an aerodynamic diameter of less than 2.5 μm, nitrogen dioxide, acid vapor, and elemental carbon. These results are consistent with those of previous epidemiologic studies that have implicated fine particulate matter and associated combustion-related air pollutants as being largely responsible for the observed health effects of air pollution.[1,2,5,11-13] Various physiological and toxicologic findings suggest that exposure to fine particulate matter may be an important pub-

lic health concern. Such matter, which can be breathed deeply into the lungs, includes sulfates, nitrates, acids, metals, and carbon particles with various chemicals adsorbed onto their surfaces. Furthermore, fine particulate matter is ubiquitous because it is largely derived from common combustion processes (such as engines in motor vehicles, manufacturing, power generation, and burning of biomass) and because it is transported over long distances and readily penetrates indoors.

Understanding the shape of the exposure–response relationship and determining whether there are safe thresholds are important for the formulation of public health policies for pollution control. Mortality studies suggest that the exposure–response relationships for particulate-matter pollution in the case of both short-term[15] and long-term[11] exposures are nearly linear, with no discernible safe thresholds within relevant ranges of exposure. Likewise, in the Children's Health Study, the exposure–response relationships appear to be nearly linear, without discernible safe thresholds.

An issue with clinical implications concerns the identification of groups that are most at risk or that are most susceptible to the effects of pollution. One evaluation of the literature[1] suggests that the proportion of a given population that is at risk for death, hospitalization, or life-threatening conditions owing to short-term exposure to air pollution is very small and limited to the elderly, infants, and persons with chronic cardiopulmonary disease, influenza, or asthma. There appears to be a much broader susceptibility to small, transient changes in lung function, low-grade pulmonary inflammation, or other subclinical physiological changes in response to short-term exposure.

With regard to the cumulative effects of long-term, repeated exposure, there is little evidence of a unique, well-defined, susceptible subgroup. The Children's Health Study reports pollution-related deficits in the development of lung function in boys and girls, children with asthma and those without asthma, and smokers and nonsmokers — results "suggesting that most children are susceptible to the chronic respiratory effects of breathing polluted air." The authors of the current study also note that reduced lung function is a risk factor for complications and death during adulthood and suggest that the effect of these pollution-related deficits in lung function may occur later in life. In fact, studies have shown that long-term, repeated exposure to air pollution is associated with an increased risk of death from cardiopulmonary causes in broad-based cohorts or samples of adults.[5,6,9,11,13]

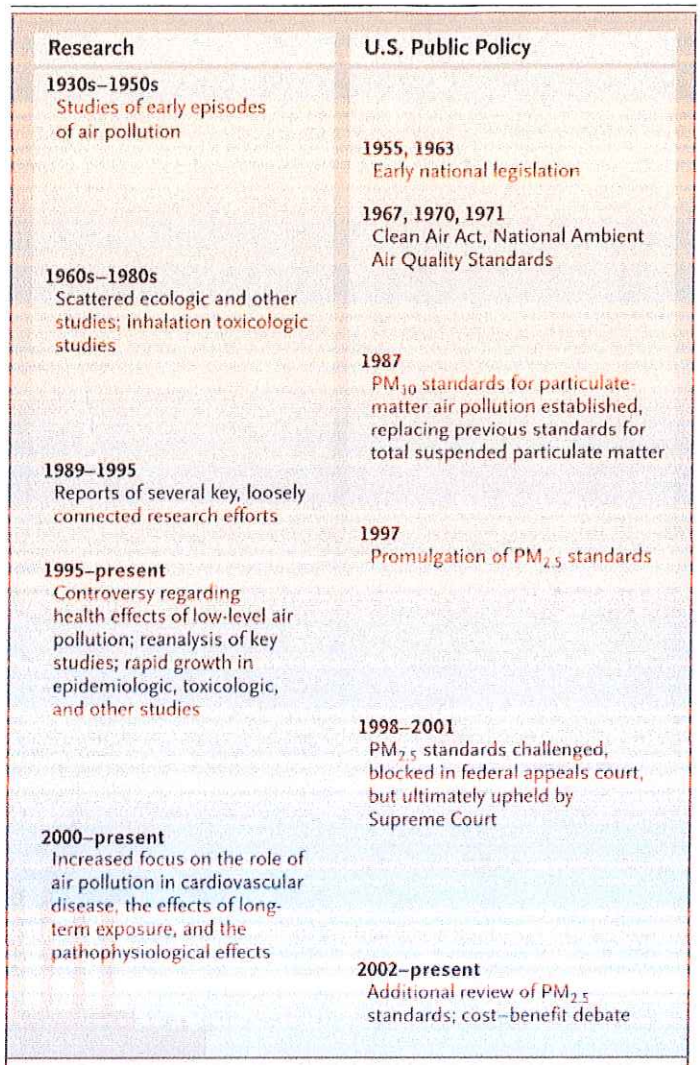

Figure 1. Research and Public Policies Concerning Particulate-Matter Air Pollution.

PM_{10} and $PM_{2.5}$ denote particulate matter with an aerodynamic diameter of less than 10 μm and 2.5 μm, respectively.

Much additional research is required to understand the biologic mechanisms that link exposure to fine particulate matter with increases in morbidity and mortality from cardiopulmonary causes. However, several recent studies suggest that general mechanistic pathways probably include pulmonary and systemic oxidative stress and inflammation, enhanced initiation and progression of atherosclerosis, and altered cardiac autonomic function.[9,10]

Secondhand cigarette smoke has also been shown to promote inflammation and atherosclerosis and to be a risk factor for illness and death from cardiopulmonary causes — suggesting that exposure to fine particles from common outdoor sources of combustion and from tobacco smoke may invoke similar pathophysiological processes.[9,10] The Children's Health Study does not provide direct evidence regarding the mechanisms of air-pollution effects, but the authors suggest a role of airway inflammation, such as that observed in smokers and persons who have lived in polluted environments. Although there has been much interest recently in the importance of pulmonary inflammation, atherosclerosis, and cardiovascular disease, the Children's Health Study reminds us not to forget or ignore potentially important effects of pollution on pulmonary function.

From at least one perspective, the overall results of research involving air pollution are good news — the control of air pollution represents an important opportunity to prevent disease. Air pollution is just one of many risk factors for pulmonary and cardiovascular disease, but it is one that can be modified. In the United States and elsewhere, commendable progress has been made on improving air quality and, with regard to fine particulate pollution, new standards have been implemented (Fig. 1). Extremely high concentrations of air pollution remain in many areas of the world, and decreasing these concentrations offers substantial opportunities for disease prevention. As efforts to reduce air pollution progress, debates over the relative benefits and costs associated with additional marginal improvements are inevitable. Nevertheless, continued efforts to improve our air quality are likely to provide additional health benefits.

From Brigham Young University, Provo, Utah.

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Allergen Avoidance to Reduce Asthma-Related Morbidity

Albert L. Sheffer, M.D.

Central to the reduction of the severity of allergic disease is a decrease in — and preferably the removal of — the offending environmental allergen. Such allergen avoidance is particularly relevant to the successful treatment of allergic asthma. However, statistically significant reductions in such asthma-inducing allergen concentrations have been difficult to accomplish. Until recently, strategies to reduce exposure to environmental allergens have not decreased asthma-related morbidity. In fact, a meta-analysis failed to demonstrate the efficacy of any environmental-control measures in reducing the severity of asthma.[1] Such interventions, however, have usually focused on a single maneuver[2] — for example, the use of semipermeable bedcovers to exclude dust mites, floor polishing, or the use of high-efficiency particulate air filters — but have not been accompanied by detailed educational pro-

Good evening. My name is Denise Potvin, and I live at 85 Glendale Meadow Lane in Harrisville, RI.

I believe this plant isn't needed, and it will cause unacceptable harm to the environment, and it isn't WANTED.

I am sure you are aware that the Connecticut Siting Council has recently denied a proposal for the Killingly Energy Center as it was deemed not necessary for the reliability of the electric power supply in our region, and *therefore not needed.*

That proposed facility did not have a CSO, *just like CREC unit #2 does not have a CSO.*

The Connecticut Siting Council noted in its decision that if the **market** does not give a proposed unit a CSO, then that unit is **by definition** not needed for reliability of the electric power supply.

Similarly, Invenergy's unit #2 lacks a CSO and is unlikely to get one in the near term, thus it is not needed for reliability of the electric power supply.

As Burrillville's expert witness, Mr. Walker, testified, ISO is proposing to reduce the dynamic de-list bid threshold. This indicates that ISO is expecting bid prices to move *lower*, and *not higher.*

Since CREC unit #2 did not clear the market at a capacity price in FCA 11 of $5.30 per kilowatt month, it does not appear that CREC will be able to clear the market at a lower price in the range of the new proposed dynamic de-list price of only $4.30 per kilowatt month, either.

As Mr. Walker has also explained, although a number of plants are shown as being "at risk" for retirement by ISO New England, *very few of those*

Good evening. My name is Bill Lacey, and I live at 105 Town Farm Road in Pascoag.

I am opposed to the licensing of this proposed power plant first, because it is not needed, and also because it will cause unacceptable harm to the environment of the state and the Town of Burrillville, as shown by testimony and advisory opinions that have already been filed with the Board.

The advisory opinions of the Town's Building Inspector Joseph Raymond and his surrebuttal testimony confirm that this proposed facility is incompatible with the Town's land use ordinances.

The advisory opinion of the Planning Board makes it clear that this proposed facility is incompatible with the Town's comprehensive plan.

The advisory opinion of the Zoning Board makes it clear that the site is incompatible with the Town's zoning ordinances.

For example:

The Building Inspector has stated that there are variances that would be required for the use of this site by CREC, both in terms of a use variance for two generating units and for an apparent conflict with the Town's aquifer overlay district, which protects the Town's subsurface water supplies. Yet Invenergy has not even applied for these variances.

Our Planning Board unanimously concluded that the CREC would be inconsistent with Burrillville's comprehensive plan in many ways, including with regard to the Plan's provisions dealing with natural and cultural resources, community facilities and services, circulation, economic development, recreation, conservation and open space, and land use. Moreover, the Planning Board concluded that CREC would not be consistent with a number of provisions of the Rhode Island Comprehensive Planning and Land Use Regulation Act, all of which are set forth in detail in the Planning Board advisory opinion.

The advisory opinion of the Zoning Board also rendered a negative advisory opinion upon Invenergy's application for a special use permit because Invenergy failed to provide sufficient information for the members to know what they were being asked to vote upon. The Zoning Board unanimously voted that granting a special use permit for the CREC facility *in an F5 residential zone* would not be in compliance with the Town's comprehensive plan, would disrupt the general characteristics of the community, would

not be harmonious with the environment, would not be for the convenience and welfare of the public, and would only serve the profit motives of Invenergy.

Even the supplemental advisory opinion issued by Statewide Planning stated that the forested lands that would be impacted by this project are some of the ***highest quality within the state.*** These lands are part of a core natural area in DEM's Rhode Island Wildlife Action Plan and are part of the initial and future land conservation priorities and DEM's *2010 Rhode Island Forest Resources Assessment and Strategies*.

Statewide Planning therefore encouraged the taking of appropriate steps to mitigate the negative impacts that can result from the proposed level of deforestation, including utilizing the existing access road rather than constructing a new one.

And lastly, MY advisory opinion is that Invenergy's permit be denied. (<---okay, I added that one myself).

Good evening. My name is Terri Lacey, and I live at 105 Town Farm Road in Pascoag.

I am opposed to the licensing of this proposed power plant first, because it is not needed, and also because it will cause unacceptable harm to the environment of the state and the Town of Burrillville, as shown by testimony and advisory opinions that have already been filed with the Board.

For example:

DEM's advisory opinion concluded that substantial forest clearing and fragmentation will negatively impact wildlife and plants in the vicinity, and will inhibit DEM's ability to enhance landscape resiliency and mitigate the loss of biodiversity. DEM also stated in its advisory that fragmentation of the forest will have negative impacts upon fish and wildlife and that the facility will bring stressors to wildlife in the forms of added noise and light pollution and potential changes to air and water quality, as well as water quantity.

DEM expressed in its advisory opinion that the location of the facility adjacent to substantial state holdings of conservation land is not consistent with the conservation priorities that informed these state conservation plans.

DEM also concluded that fragmentation of one of the largest remaining intact forests in the state will negatively impact fish and wildlife, including interior forest species listed as species of greatest conservation need.

DEM's supplemental advisory opinion concluded that the CREC facility, and I quote, "certainly has the ability to negatively impact state conservation priorities and plans, fish and wildlife habitats, and rare species, including those identified in the Rhode Island Natural Heritage Database."

DEM's supplemental advisory opinion also concluded that the permitting processes under DEM's jurisdiction and outside of the EFSB process do not address some of the most severe impacts that would result from construction of the proposed facility. DEM listed various examples such as forest biodiversity impacts, impacts on forest interior birds, such as the black throated blue warbler, forest loss and fragmentation, loss of upland habitat, and the impacts to state listed or otherwise at-risk species outside of wetlands. Therefore, DEM concluded that DEM's freshwater wetland application and the Federal Clean Water Act Review will not be sufficient to determine adverse environmental impacts to such things as wildlife habitat.

Additionally, DEM's supplemental advisory opinion also concluded that "mitigation might not be possible" regarding the negative wildlife impacts and that "***the best course of action is to avoid further fragmentation to the greatest extent practicable . . . rather than to continue to fragment landscapes and look for mitigation elsewhere.***"

The DEM supplemental advisory opinion concluded that ***the site is a parcel of high value for wildlife with a diverse number of plants and animals and a larger than typical number of state listed species.***

If we continue putting progress before preservation, & ask yourself what kind of world are we leaving to our children!!

Mary Pendergast, R.S.M.

EFSB Oct 10, 2017

My name is Mary Pendergast from the Sisters of Mercy. I would like to speak to you of some of the deep ecology teaching available today from Joanna Macy and others. I think it demonstrates the deep change that has happened here in Burrillville and indeed throughout Rhode Island since August 2015.

We are in the essential adventure of our time: **the shift from the Industrial Growth Society to a life-sustaining civilization.**

The ecological and social crises we face are caused by an economic system dependent on accelerating growth, or corporate profits...

in other words by how fast materials can be extracted from Earth and turned into consumer products, weapons, and waste.

We've joined a revolution!... because we realize that our needs can be met without destroying our world. We have the technical knowledge and material resources to grow enough food, to ensure clean air and water, and to meet our energy needs.

if there is a livable world for Future generations, they will look back at the epic transition we are making to a life-sustaining society. And they may well call this the time of the Great Turning. It is happening now.

There are Three Dimensions of the Great Turning:

1. We perform Actions to slow the damage to Earth and its beings.

these activities include all the political, legislative, and legal work required to reduce the destruction, as well as direct actions—civil disobedience, and other forms of refusal.

We've certainly been there! At least ten people have been arrested. Another 30 Walked from Providence to Burrillville to speak to Governor Raimondo, who was met with an over capacity crowd! We were led those three days by Mark Baumer, who lost his life in service to raising awareness of the ecological devastation that is happening!
We have engaged the absolute best lawyers in Michael McElroy, Max Greene and Jerry Elmer
Every bit of work of this kind buys time.

The second dimension of the Great Turning is deep analysis of the current system... and creating alternatives.

Our national and state politicians have to catch up with us, because we have banded together, taking action in our own state. Our creativity and our collaboration on behalf of life and this forest, hold the seeds for the future.

One great example of the deep analysis was spearheaded by Paul Roselli in the Learn the Facts Program and the countless teach ins. But we, all of us, have been relentless: you have no idea of the study we have done...most of us can talk about ISO New England and know that there is no need for this power plant! We've studied the health issues, the air pollution, the noise, the light. We have studied the Rhode Island

species of plants and animals that are already are threatened and will be severely stressed if this construction decimates more forest.

We have handed out flyers, done phone banking, gone to countless meetings, we wrote letters to the editor and to social media, We've had candlelight vigils, We had the No Power Plant Sign campaign where signs appeared everywhere!.... We've been on tv and radio. We have had tremendous publicity from Steve Ahlquist, Tim Faulkner and Go Local Prov

We show up at the Governor's events with signs.., We have attended city Council meetings, We have spoken with Senator Whitehouse, Senator Reed, Councilman Cicilline and Councilman Langevin... We have written to each one of you!

We expect that our participation has made a difference if there is any truth at all to a government for the people, by the people. We are the people!

3. The third dimension of the Great Turning is a Shift in Consciousness

And believe me, We are shifting.....Some of us are at the stage where we believe we are in a living Universe ....that this forest and this Clear River are alive ... that there actually is a web of life, and that you can't keep pulling on one strand without destroying the whole. We know its all interconnected, but

What if nothing is separate from anything else? Not Nature, not one another, not a God. What if it is all one?

This changes deeply how we relate to Earth and how we relate to eachother. We are awakening to Earth as a sacred whole and we are dedicating ourselves to its service.

We have demonstrated to you that We do not want to further diminish the "commons," what belongs to all of us... the clean air, the clean water, the healthy forest ecosystem, the beings and creatures that have lived here in generations for millions of years. Rhode Island is home to over 800 native and non-native wildlife species. Have they no rights at all?

Governor Gina Raimondo refers to EFSB decision making as "the process" and asks us all to trust in it, but what is the intent of the process: to serve us or to serve Invenergy?

"Sen. Victoria Lederberg, the 1986 sponsor of the Energy Facility Siting Board bill, said the bill streamlines the approval process required for obtaining licenses to build major energy facilities for generation of electricity, treatment of liquefied natural gas, oil refineries and the like..."

So which is it.....Will we witness the Great Turning? Where everything is changed because we have changed, because our understanding of everything has changed?

Or will we witness "Business as usual, Rhode Island style?" It appears to be up to you.

Mary Pendergast,RSM

Tonight, you will hear many testimonies of good reasons why this power plant should not be built here in Burrillville. They will include the fact that it is not needed, that 10,000 tons of carbon dioxide will be emitted into the atmosphere per day, and most importantly, if the EFSB determined this site was inappropriate thirty years ago, it is even less appropriate now. I will take a different yet very important reason for opposing this plant

I am the principal of Community Christian School at 113 Church Street, in Pascoag. Church Street is part of Route 100 along which Invenergy plans to transport building materials as well as materials necessary for the plant's operation. The school is less than two miles from the proposed power plant site and is located on a blind corner. There have been many accidents at this location. A car has landed in the historic cemetery that is part of our property; a tree is partially dead and is bent over from one accident; and we have had electricity shut off to the school in order to replace the telephone pole on the edge of the property.

By the third day of the current school year, a car ended up on our play yard fence. Three weeks later, another car hit the same telephone pole that had been replaced a couple of years ago. These accidents are significant because if the power plant is built, trucks carrying water, diesel, and especially ammonia will pass by the school on a regular basis. To make matters worse, we often have as many as four school buses lined up for pick up at the end of the day. What will happen if one of these loaded trucks comes barreling around the blind corner when school buses are lined up for student pick up? A fully loaded truck cannot stop quickly. The potential for a four bus pile up is a viable possibility as well as students becoming injured.

What if that truck is carrying ammonia? Several ammonia trucks a month will pass by this corner. When Invenergy had its information meeting at Burrillville Middle School, I asked two of its engineers and Mr. Nyland, the head of this project, what I could do to ensure the safety of my students should an ammonia truck be compromised. Not one of them could give me an answer. Mr. Nyland tried to lie to me by saying that is why the company would be using 19% ammonia. It is common knowledge that the company intends to use 19% ammonia in order to avoid more regulations required

when the concentration of ammonia reaches 20%.

The conclusion one must draw then is that there is no way to protect my students or anyone else in this residential neighborhood should there be an accident with an ammonia carrying vehicle.

If this scenario is not bad enough, there is one more area a mile from the school on the way to the plant site that has had just as many accidents including a fatality. This area is also in a residential area.

Unfortunately, if an accident occurs with a truck transporting materials, Invenergy is off the hook. The business owning the truck will be liable and would possibly or even likely go out of business once all the litigation is settled. How could this be good for Rhode Island?

In conclusion, this power plant does not belong here. It is not needed, it can't comply with the RI Resilient Act, it puts the residents of Burrillville in danger, and it is a poor choice for location as determined by the EFSB thirty years ago.

Mary Jane Bailey

Bill Eccleston
3 Allison Avenue
North Providence, RI
02911

Testimony before the RI Energy Facilities Siting Board: 10/10/17

"What's wrong with this picture?"

My name is Bill Eccleston, from North Providence, and I was co-chair of Burrillville's first Comprehensive Plan.

I am holding a photograph---the theme of which must be, "What's wrong with this picture?"

In this picture you see an organge tape on the ground, the property line dividing the power plant site from the George Washington Wildlife Management Area.

Straddling the tape is a man holding a poster-board in each hand. In his right, Invenergy's drawing of the powerplant. In his left, the pictures of eight wildlife species found on the power plant site. They include a state-endangered bird, three state-threatened birds, a state-threatened mammal, two state-protected turtle species, and a dragonfly species of State concern.

Yet, these eight are only one-sixth of the 47 species found on the power plant site, by Invenergy's own consultant, that are designated in DEM's 2015 Wildlife Action Plan as, quote, "Species of Greatest Conservation Need."

Let me repeat,---47 species, designated as species greatest conservation need by DEM, were found on the power plant site by Invenergy's consultant, ESS Group, in the report filed with you on August 2nd..

And that is not all that is wrong with this picture.

George Washington is one of six state forests contiguous with the power plant site, that together with the Boy Scout land, total 25 square miles of some of the most valuable conserved wildlife habitat in southeast New England---not to mention its recreation value to the taxpayers who paid for it, and use it by the tens-of-thousands in each year.

Yet, DEM's supplemental opinion ignores this greater context.

On 7 / 1 / 16, you requested that DEM provide you with data indicating QUOTE "the impact of the proposed facility on state conservation priorities and plans, fish and wildlife habitats, and rare species, including those identified in the Natural Heritage database."

But none of this requested data is found in DEM's Supplemental opinion. None concerning the larger ecological context of the power plant site, despite decades of inventory work done in these forests by the Natural Heritage Program and the Nature Conservancy---the latter having developed their own special preservation plan for this region called the "Northwest Corner Conservation Plan."

The result is this: The exceptional biodiversity of the power plant site is presented to you in isolation from its greater ecological context---the forested context within which, could be operating, for the next half century, a major industrial facility, far from any industrially zoned land...

A noisy, glaring, 1,000 megawatt power plant emitting 3.6 million tons of CO2 each year.

What indeed is wrong with this picture?

Thank you.

Bill Eccleston

October 10, 2017

Good evening. My name is Lynn Clark, and I live at 370 Wallum Lake Road in Pascoag.

I am opposed to the licensing of this proposed power plant first, because it is not needed, and also because it will cause unacceptable harm to the environment of the state and the Town of Burrillville, as shown by testimony and advisory opinions that have already been filed with the Board.

For example:

As shown by the testimony of the Town's expert air quality witness, Mr. Eric Epner, CREC's positive impact on air quality in the New England region will be minimal. Regional reductions from 2019 to 2022 are projected to be less than 1% for CO2 (carbon dioxide) and NOx (nitrogen oxide), and less than 3% for SO2 (sulphur dioxide). However, this minimal regional reduction is more than offset by the negative impacts of the huge amounts of new air pollution that would be produced in Rhode Island. In terms of carbon dioxide alone, which is a primary driver of global warming. CREC would emit 7.2 billion pounds per year of CO2 into the air above Burrillville. It would also emit 546,000 pounds annually of nitrogen oxides, 446,000 pounds annually of carbon monoxide, 156,000 pounds annually of volatile organic compounds, 310,000 pounds annually of particulate matter, and 104,000 pounds annually of sulfur dioxide.

As Mr. Epner pointed out, Invenergy's air model is completely dependent on a revision to the air permit for the adjacent Algonquin compressor station. Yet this revision has *not been approved* and is under review by DEM. It is not even known if the Algonquin compressor 3 station's proposed revisions **will be** approved. Algonquin could even withdraw them. Unless the Algonquin amendments are approved, *then the assumptions made in Invenergy's air model would be completely incorrect.*

As Mr. Epner also testified, forest land captures carbon dioxide and emits oxygen. Carbon dioxide, which is a greenhouse gas and causes global warming, is absorbed by forest land at a rate of between 2,000 and 4,000 pounds per acre per year, depending on the trees and soil type. If the land is cleared for CREC, *this benefit will be greatly diminished.*

And although CREC has agreed to commit to meeting the Town's noise limits, the Town's expert, Mr. Hessler, is skeptical that Invenergy will be able to do so based on his experience with similar units. Therefore, *if sited*, we believe invenergy's noise commitment should be backed by a performance bond which should be a condition of any license issued by the EFSB.

As another of the Town's experts, Mr. Coogan, has testified, during the construction period, which is projected to last 3 or more years, there will be increases in traffic with as many as 450 vehicles per hour during the afternoon peak hours. This traffic will cause adverse impacts with regard to traffic delays on Church and Main Street. In addition, damage will also be caused to the Town's roads. A particular concern is the intersection of Pascoag Main Street and South Main Street, which is a sharp turn that will require large trucks to travel in opposing lanes, creating traffic hazards. *If sited*, this intersection should be redesigned and reconstructed at the expense of Invenergy.

Traffic problems are also outlined in detail in the memorandum from Burrillville Sergeant William Lacey dated August 1, 2017, which is attached to the testimony of Mr. Coogan, the Town's traffic engineer. As Sergeant Lacey stated, "large commercial motor vehicles will have a difficult time navigating the nearly one mile stretch of road from the South Main and High Street intersection to the curve near Serio's Pizza. With the small lanes of travel almost every commercial vehicle which will pass through the area will have to violate traffic laws to navigate these intersections."

This is an unacceptable environmental harm to the Town.

Comments of David Brunetti
935 Sherman Farm Road, Harrisville, RI 02830
401-568-2559
RI Energy Facilities Siting Board Public Hearing
On the Proposed Invenergy Power Plant in Burrillville, RI
Tuesday, October 10, 2017

Members of the RI Energy Facilities Siting Board:

My name is David Brunetti, of 935 Sherman Farm Road in Harrisville, RI.
I am opposed to the construction of the proposed Clear River Energy Center Power Plant and have many reasons for this, however, at this time I will focus on two items:

1. The results of the biological surveys of the site and
2. Why mitigation should not be considered as a viable reason or option for approval of this project.

First, the findings from the August 2017 Biological Survey for the proposed site, which was commissioned by Invenergy and conducted by ESS Group, Inc., include, but are not limited to:
"Seventeen (17) state-listed species – including one state endangered species – the Cerulean Warble, four state-threatened species – consisting of the Northern Parula, the Blackburnian Warbler, the Black-Throated Blue Warbler, and the Bobcat, two state protected species – the Eastern Box Turtle and the Spotted Turtle - ten species of concern, and 47 Species of Greatest Conservation Need."

Notably, two of the four state-threated bird species – the Black-throated Blue Warbler and the Blackburnian Warbler - both forest interior species, were assessed as being probable breeders on-site.

According to the RI Department of Environmental Management[1], this survey added substantially to the list of previously undocumented wildlife on the CREC property and "further support[s] the conclusion that the forest interior habitat provided on [this] site is quite valuable".

I would like to highlight the findings of two of these species – the state-listed as endangered Cerulean Warbler, which is also a candidate for Federal listing, and the state-listed as threatened Black-throated Blue Warbler.

In order to provide you with some visual impact of what we are talking about and what we could/would be losing if this project is approved, I have pasted an image of each of these beautiful species, as well as those of the three other spectacular state-listed as threatened species – the Blackburnian warbler, the Northern Parula, and the Bobcat - below:

[1] As reported in their August 15th, 2017 Supplemental Advisory Opinion.

Cerulean Warbler (state-listed as endangered):

Black-throated Blue Warbler (state-listed as threatened):

Blackburnian warbler (state-listed as threatened):

Northern Parula (state-listed as threatened):

Bobcat (state-listed as threatened):

<u>In regard to the incredible finding of the Cerulean Warbler,</u> not only was there a detection of this species at this site as part of this survey, but there were eight sightings of this species in an area nearby this site[2] by five people last year between May and July, so during the breeding season for this species.

In fact, not only was the Cerulean warbler observed, **but it was photographed and its song was recorded on two consecutive outings during that period** by Dylan Pedro, a recognized expert in birdsong recording who is also currently working as a technical specialist on the latest edition of the Rhode Island Bird Atlas.

Notably, the above documentation of the Cerulean Warbler on two different dates in 2016 was the first confirmed siting of this **endangered species** in Rhode Island **in ten years**.

[2] The Buck Hill Management Area, in a location that was approximately one and a half miles from the detection of a Cerulean warble last May on the power plant site by Invenergy's environmental consultant, ESS group.

Because they are severely declining across much of their range, habitat management for the Cerulean warbler is a high priority[3]. One of the regions with the greatest rate of decline is occurring in the northeastern U.S., including a population pocket which consists of eastern Connecticut and Northwestern RI, the area which would be directly impacted by the construction of this power plant.

The effect of habitat loss on Cerulean warbler populations probably has been intensified by the species apparent preference for large forest[4] and the Cerulean's breeding success has been shown to fall by 50% in forests less than 1,750 acres in extent[5].

Some might consider the presence of the Cerulean warbler in this location to be the Rhode Island equivalent of the Pacific Northwest's Northern Spotted Owl.

As stated in the most recent edition of the Rhode Island Wildlife Action Plan[6],
The "last territorial" Cerulean warbler was "reported in 1995". "Throughout their range, this species is considered [to be] area-sensitive" and "is most likely detected in large forest tracts, which provide critical habitat for other rare species. Therefore, identifying and protecting large stands of mature deciduous forest is an appropriate conservation measure for Cerulean warblers and many other forest-nesting birds."

"Throughout their current breeding range in eastern North American, annual trends suggest a rapidly declining population with an annual decline of 3.0%. Until last year, "the last valid reported siting of a Cerulean warbler was in 2006"[7].
In regard to the Black-throated Blue Warbler, during the survey, the Black-throated Blue Warbler was detected a total of 64 times across the thirteen survey station, and no less than 7 times at any of these survey stations. The fact that this species was also detected in the previous survey by ESS Group in May of last year[8] indicates that it is an established species in this area.

As stated in the Rhode Island Wildlife Action Plan, "the Black-throated Blue Warbler is one of Rhode Island's rarest and most localized nesting species", and their presence "indicate[s] high-quality forest habitat".

In summary, "even without the presence of the Cerulean warbler, the concentration of forest interior species found [through this survey] serves to prove the importance of this area in supporting high biodiversity" and "demonstrates that this location is the best in Rhode Island for preserving interior forest biota and to find forest interior birds".[9]

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[3] As noted by the Cerulean Warbler Technical Group, from a study funded by the U.S. Fish and Wildlife Service, (USFWS) Northeast region Division of Migratory Birds.
[4] As reported in the Conservation Assessment for the Cerulean Warbler, by the USDA Forest Service, Eastern Region. Here it was stated that the minimum area requirement estimated for nesting Cerulean warblers [in the Middle Atlantic States] was 1730 acres.
[5] Saving the Cerulean Warbler, by the American Bird Conservatory.
[6] 2006.
[7] Until 2016, when it was discovered in Burrillville, RI by Dylan Pedro.
[8] Also commissioned by Invenergy for its original application.

Prior to these two biodiversity surveys conducted by ESS Group, Inc., it was known that the construction of this power plant at this site would "undermine the integrity of **one of the most** intact forested habitats" in this state and in this region.

Based on this updated inventory, we can now say that this is "**the most significant** tract of forested habitat in the state"[9].

Regarding the topic of mitigation, if you accept mitigation as a reason for approval of the construction of this plant at this location, then you are accepting the displacement and potential decimation of multiple state-listed threatened, state-listed protected, and state-listed species of concern, and likely the re-extirpation of a species – the state-listed as endangered Cerulean Warbler - which, until now, had not been seen in this state in ten years but has now been confirmed to be present during its breeding season.

Simply speaking, "this rather large chunk of forest is the best that we have, as evidenced by a concentration of rare species. As such, it cannot be duplicated, nor can the loss of it be mitigated"[9].

You will not find another such large tract of suitable, intact, and unfragmented forest in this state!

As affirmed by the RI Department of Environmental Management[1], "substantial forest clearing and fragmentation from the project will negatively impact area-sensitive wildlife (and plants) in the site and that, at a broader spatial scale, this Project will inhibit DEM's attempts to enhance landscape resiliency to mitigate the loss of biodiversity through habitat fragmentation and climate change."

Therefore, I ask, please do not take an action that would significantly compromise the biodiversity value of this area, especially for a power plant that it not needed.

Thank you for the opportunity to provide you with my comments.

Sincerely,

David A. Brunetti

RHODE ISLAND
Business Coalition

Via Electronic Mail **(todd.bianco@puc.ri.gov)**

October 10, 2017

Todd Anthony Bianco, Coordinator
Energy Facility Siting Board
89 Jefferson Boulevard
Warwick, Rhode Island 02888

RE: Docket No. SB-2015-06 – Invenergy Thermal Development LLC's Application to Construct the Clear River Energy Center in Burrillville, Rhode Island

Dear Mr. Bianco:

We have enclosed the Rhode Island Business Coalition's comments regarding Docket No. SB-2015-06 – Invenergy Thermal Development LLC's Application to Construct the Clear River Energy Center in Burrillville, Rhode Island.

Please do not hesitate to contact the Rhode Island Business Coalition (communications@ribusinesscoalition.com) should you have any questions or require additional information. Thank you.

Sincerely,

The Rhode Island Business Coalition

Enclosure

RHODE ISLAND
Business Coalition

TO: The Rhode Island Energy Facility Siting Board

FROM: The Rhode Island Business Coalition

DATE: October 10, 2017

SUBJECT: Docket No. SB-2015-06 – Invenergy Thermal Development LLC's Application to Construct the Clear River Energy Center in Burrillville, Rhode Island

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The undersigned members of the Rhode Island Business Coalition[1] wish to express our support for Invenergy Thermal Development LLC's (Invenergy) application to construct the Clear River Energy Center in Burrillville, Rhode Island. Approving Invenergy's application is critical to maintaining an adequate, reliable and affordable supply of electricity in Rhode Island and the surrounding New England region.

Rhode Island has the second highest average electricity rate for all sectors in the contiguous US, according to January 2017 data from the U.S. Energy Information Administration.[2] Residential electricity rates in Rhode Island were more than 25 percent above the national average, commercial rates were more than 30 percent higher, and industrial rates were nearly double, according to the most recent monthly data available.[3] These high rates place a heavy burden on Rhode Island residents and businesses. Thus making the state a less attractive and competitive place to live, work, and do business.

The high cost of electricity in Rhode Island is driven by high prices in the regional energy market. Which are, in turn, partly driven by the recent retirement of several major power plants in New England. These retirements reduce the region's energy generating capacity, leading to an increase in wholesale electricity prices. According to ISO-New England (ISO-NE):

> More than 42,000 megawatts (MW) – an amount equal to almost 15% of the region's current generating capacity – will have shut down between 2012 and 2020…The upcoming closures of just two of those resources…will remove 2,220 MW of non-gas-fired capacity. Over 5,500 MW of additional oil and coal

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[1] The Rhode Island Business Coalition is a diverse group of business and employer associations, committed to the adoption and implementation of public policies that improve Rhode Island's economic competitiveness and the overall business climate.

[2] U.S. Energy Information Administration, State Electricity Profiles, January 17, 2017, https://www.eia.gov/electricity/state/.

[3] U.S. Energy Information Administration, Rhode Island State Profile and Energy Estimates, June 15, 2017, https://www.eia.gov/state/?sid=RI#tabs-5.

> capacity are at risk for retirement in the coming years, and uncertainty surrounds the future of 3,300 MW from the region's remaining nuclear plants.[4]

The power plant retirements have a direct impact on wholesale electricity prices in the New England region, especially in Rhode Island and Southeastern Massachusetts. According to ISO-NE, a capacity shortfall materialized in the Southeastern Massachusetts and Rhode Island (SEMA/RI) zone prior to the 2015 Forward Capacity Market auction to acquire the power system resources necessary to meet projected 2018-2019 demand. As a result of SEMA/RI's inadequate supply, administrative pricing rules were triggered. Under these rules, new resources in the SEMA/RI zone that qualified during the 2015 auction (totaling 353 megawatts) will receive $17.73 per kilowatt-month, while qualified existing resources in the zone (totaling 6,888 megawatts) will receive $11.08 per kilowatt-month, for the 2018-2019 period. By contrast, competitive bidding in the rest of the New England region, which did not face a capacity shortfall prior to the 2015 auction, resulted in a substantially lower clearing price of $9.55 per kilowatt-month for the same 2018-2019 period.[5]

In the 2016 auction, 1,302 megawatts of new generating capacity cleared the auction from three proposed power plants, including 485 megawatts from Invenergy's proposed Burrillville plant. The Burrillville plant, along with a second proposed plant located in Sandwich, Massachusetts, will contribute over 800 additional megawatts in the former SEMA/RI zone in 2019-2020, where resources are needed most. According to ISO-NE, this "new generating capacity…will help replace recently retired and retiring generators." Due to this increased capacity, competition in the 2016 auction was robust, resulting in a lower price for 2019-2020. The auction closed with sufficient resources to meet demand in 2019-2020, at a clearing price of $7.03 per kilowatt-month for the entire New England region. This 2016 clearing price is 60 percent lower than the 2015 price for new resources in the SEMA/RI zone, 37 percent lower than the 2015 price for existing resources in the SEMA/RI zone and 26 percent lower than the 2015 clearing price for the rest of the region.[6] According to ISO-NE:

> The lower clearing price demonstrates strong competition among resources and also illustrates that the capacity market is continuing to work: higher prices resulting from resource shortfalls in earlier auctions provided the incentives for developers to bring new—and needed—resources to the market.[7]

Prices dropped even further in the 2017 auction, with a clearing price of $5.30 per kilowatt-month for the 2020-2021 period. This is "the lowest clearing price since the floor was

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[4] ISO-New England, "Regional Electricity Outlook: Retirement of Non-Gas-Fired Power Plants," https://www.iso-ne.com/about/regional-electricity-outlook/grid-in-transition-opportunities-and-challenges/power-plant-retirements.
[5] ISO-New England Press Release, "Annual Forward Capacity Market Auction Acquires Major New Generation Resources for 2018-2019," February 4, 2015, https://www.iso-ne.com/static-assets/documents/2015/02/fca9_initialresults_final_02042015.pdf.
[6] ISO-New England Press Release, "ISO-NE Capacity Auction Secures Sufficient Power Systems Resources, At a Lower Price, for Grid Reliability in 2019-2020," February 11, 2016, https://www.iso-ne.com/static-assets/documents/2016/02/20160211_fca10_initialresults_final.pdf.
[7] Ibid.

eliminated in the 2013 auction."[8] According to Robert Ethier, vice president of market operations at ISO-NE:

> The lower clearing price and surplus capacity are indicative of a market that works. In previous auctions, a supply shortfall pushed up prices after more than 3,000 MW of resources announced their retirements in 2013; the higher prices have attracted new competition, which has helped lower prices while keeping the lights on in New England.[9]

As the results of the last three Forward Capacity Market auctions demonstrate, reductions in New England's generating capacity drive up wholesale electricity prices in the region. New capacity, by contrast, increases competition, therefore lowering prices. Invenergy's proposed power plant in Burrillville is critical to addressing the resource shortfall that emerged in Rhode Island and Southeastern Massachusetts prior to the 2015 auction, and it has already helped to drive down the price of electricity for the 2019-2020 and 2020-2021 years.

Addressing the issue of declining energy generating capacity in the New England region, and in Rhode Island in particular, is critical for ensuring a stable, reliable and affordable supply of electricity in the Ocean State. Rhode Island already has among the highest electricity prices in the nation, and the Public Utilities Commission just approved National Grid's request for a 53 percent electric rate hike, which will increase Rhode Islander's average monthly electric bill by an estimated 16 to 21 percent.[10] Failing to address our energy infrastructure needs only ensures that energy prices will continue to rise for individuals, families and businesses in Rhode Island.

Therefore, the Rhode Island Business Coalition respectfully urges the Energy Facility Siting Board to approve Invenergy's application to construct the Clear River Energy Center in Burrillville. Furthermore, the Coalition urges the Board to work with the Public Utilities Commission, the Division of Public Utilities and Carriers, the state Department of Energy Resources, as well as other key stakeholders and policymakers to develop and implement a comprehensive energy policy that will immediately begin to address Rhode Island's energy infrastructure needs, namely, increased generating and natural gas pipeline capacity. It is imperative that the state work to ensure a stable, reliable, and affordable energy supply to safeguard the health and well-being of Rhode Island residents and families, as well as the success of Rhode Island's businesses and economy.

Sincerely,

The Energy Council of Rhode Island – Doug Gablinske, Executive Director

National Federation of Independent Business – Christopher Carlozzi, State Director

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[8] ISO-New England Press Release, "Auction Acquires Power System Resources Needed for 2020-21 At a Lower Price," February 9, 2017, https://www.iso-ne.com/static-assets/documents/2017/02/20170209_FCA11_initial_pr.pdf.

[9] Ibid.

[10] Alex Kuffner, "Electric bills in R.I. to go up 16 to 21 percent," *The Providence Journal*, August 22, 2017, http://www.providencejournal.com/news/20170822/electric-bills-in-ri-to-go-up-16-to-21-percent.

Northern Rhode Island Chamber of Commerce – John C. Gregory, President/CEO

Rhode Island Manufacturers Association – David M. Chenevert, Executive Director

Rhode Island Small Business Economic Summit – Gary Ezovski, Regulations Committee Chairman

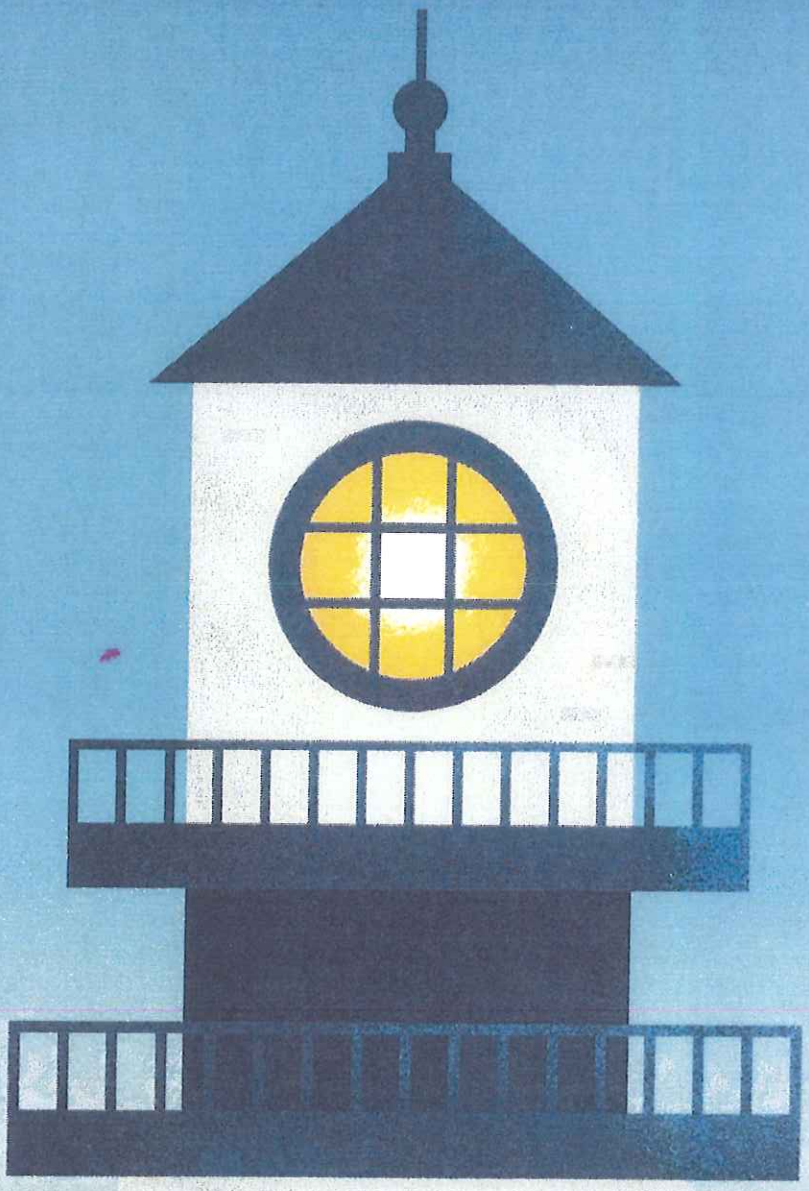
Rhode Island Association of Mortgage Bankers – Dean Harrington, President

Rhode Island Society of Certified Public Accountants – Robert A. Mancini, President

Smaller Business Association of New England (SBANE) – Robin L. Main, Chair; Ralph Coppola, Chair SBANE RI Government Affairs Committee

Rhode Island Small Business Economic Summit – Grafton Willey, Tax and Budget Committee Chairman

ISO new england | 20 years



2017 Regional Electricity Outlook

From the CEO

Gordon van Welie
has been president and chief executive officer of ISO New England since 2001. Read his full bio at **www.iso-ne.com/about**.

Like many at ISO New England, I am concerned about keeping the lights on in coming winters. We prepare year-round and years ahead for challenging winter conditions because we know that New England depends on the constant flow of electricity that drives the economy and keeps families warm and safe. But the fact is that reliable winter operations are becoming increasingly difficult, particularly during cold snaps.

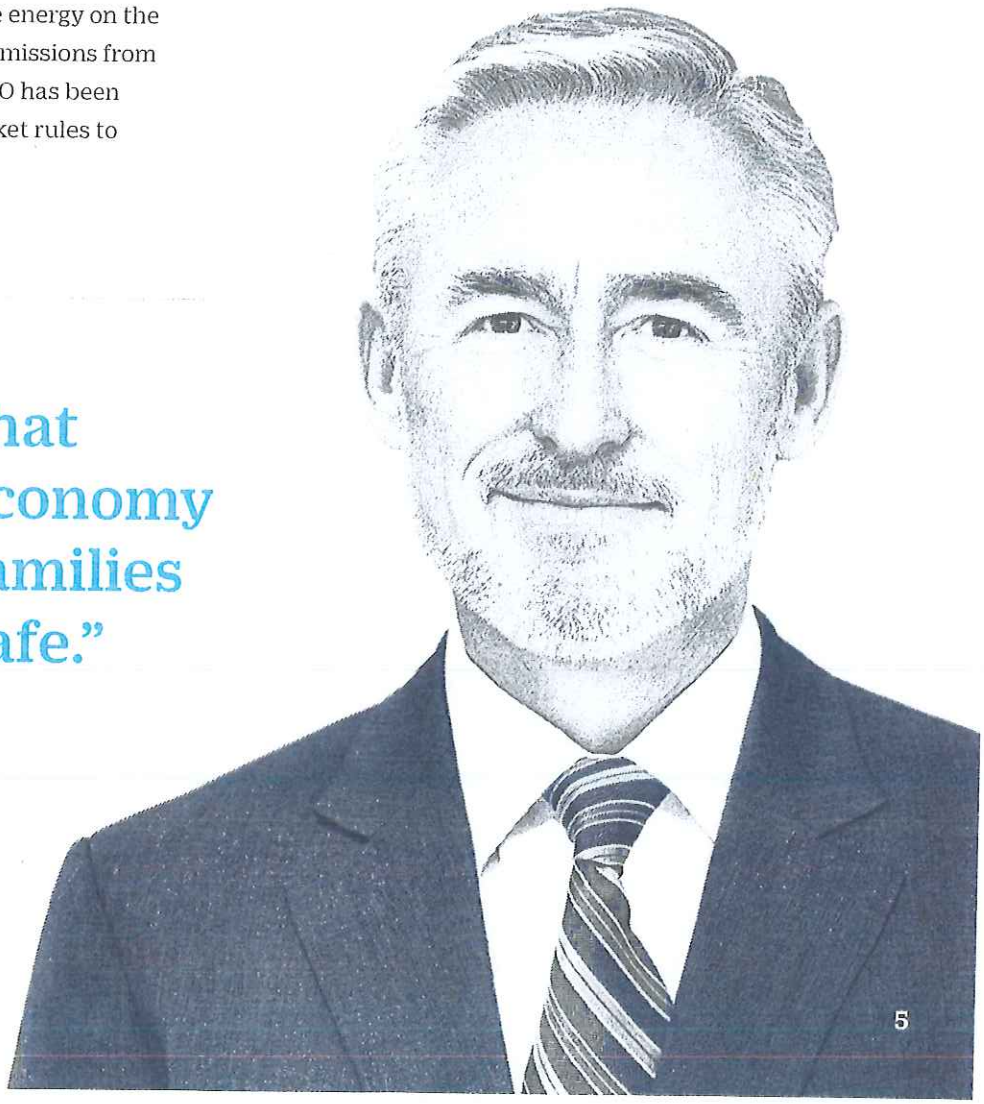
At the heart of the problem are factors that the ISO has been warning about for some time now but does not have the authority to directly address. On the coldest days of the year, natural-gas-fired power plants can't always access adequate gas because natural gas transportation and storage infrastructure hasn't kept pace with demand from the electricity sector. This is a real risk to reliability—nearly half the region's current electric generating capability and roughly half the proposed new capability

"We prepare year-round and years ahead for challenging winter conditions because we know that New England depends on the constant flow of

runs primarily on this fuel type. During the winter, generation that is not fueled by natural gas has been used to fill the gap, including resources that run on nuclear power, oil, and coal—the latter two of which have caused upticks in winter air emissions. However, these resources have begun to close down and leave the system because they are either less efficient, less profitable, or both. Replacing them will be even more natural-gas-fired generation, to a large extent.

Renewable power resources have also been coming on line quickly, and a number of New England states are moving to significantly increase the amount of renewable energy on the grid, as well as to further reduce emissions from fossil-fuel-fired generators. The ISO has been actively refining systems and market rules to integrate renewable resources, which currently make a valuable, and growing, contribution to offset some of the region's reliance on natural gas and will become integral to achieving a clean-energy future. Still, the region is decades away from installing enough renewable resources and grid-scale energy storage to allow for complete independence from fossil fuels. Connecting additional remote clean-energy resources is also going to require improvements on the transmission system.

electricity that drives the economy and keeps families warm and safe."



Gordon van Welie
President and CEO

"The region is decades away from installing enough renewable resources

For the foreseeable future, the region will require resources such as natural-gas-fired units that can do what wind and solar resources cannot: make large contributions to meeting regional electricity demand; run in any type of weather and at any time of day; quickly change output levels; and provide essential grid-stability services. On frigid winter days in particular, the region has no alternative but to depend on fossil fuels and the remaining nuclear power stations, while also working to improve fuel accessibility for natural-gas-fired generators. The latter will be particularly vital after the summer of 2019, when two more major non-gas-fired generators will have retired.

Improvements to fuel accessibility will require investments in natural gas infrastructure (including the possibility of forward procurement of liquefied natural gas to ensure its availability during the winter months) or greater flexibility to switch to oil as a backup fuel. Ideally, this will be achieved through market incentives, but as a last resort, the ISO may have to retain some non-gas-fired power plants.

For more than a decade, the ISO has been grappling with the fuel-security issue. But now we're also weighing options for managing an emerging complication—how to harmonize the region's competitive marketplace with state environmental goals.

The wholesale markets are designed to reveal the most cost-effective set of resources to meet the demand for electricity. They have served the region very well over the past two decades, attracting billions in private investment and creating a competitive environment that has helped drive down wholesale prices, spur innovation, and create one of the most efficient generation fleets in the country. Nevertheless, the efficacy of these markets is vulnerable to the unintended consequences of long-term state contracts for clean-energy projects.

The states view long-term contracts as the most expeditious way to promote the development of clean-energy resources and the transmission investments needed to deliver that energy. Because clean-energy resources typically have higher development costs and New England's wholesale markets do not price carbon, these resources are currently not competitive in the wholesale marketplace without some form of subsidy.

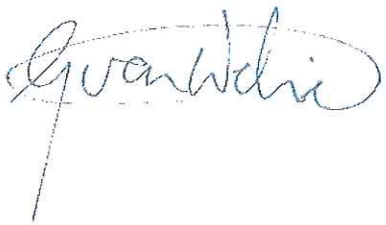
and grid-scale energy storage to allow for complete independence from fossil fuels."

Another perspective the region must also consider is the effects of these contracts on long-term reliability and the structure of the marketplace. As more renewable resources come on line, energy market prices will decrease significantly because of renewables' low fuel costs and state subsidies. As a result, other types of power resources will become even more dependent on revenues from the capacity market, which procures power resources to meet the region's future electricity needs. The participation of large quantities of state-subsidized renewables in the capacity market, however, will also undermine accurate capacity market prices—thereby accelerating the retirement of the very power plants that the region still needs to ensure a reliable electricity supply. Additionally, the capacity market will lose its ability to incentivize investment in, and retention of, efficient and innovative infrastructure and technologies, thereby forcing a return to long-term contracting for all resources.

This leads to a thorny market-design challenge: given that state policymakers are taking action to reduce emissions, how does the wholesale marketplace account for state-sponsored resources without compromising reliability and investment through the markets?

Many questions remain about how best to balance the region's two overarching policy objectives of securing reliability through competitive markets and meeting state carbon-reduction goals, as well as how to solve the pressing fuel-security issue. The ISO is applying its decades of expertise and firsthand experience to developing effective, efficient, and innovative solutions to these challenges in collaboration with our stakeholders. As the ISO commemorates its 20th year of service to New England and leadership in managing its highly reliable, cutting-edge grid, I look forward to working with our stakeholders with the confidence that, together, we will find answers to these questions.

Sincerely,



U.S. Energy Information Administration

Electric Power Monthly

Data for July 2017 | **Release Date:** September 26, 2017 | **Next Release:** October 24, 2017

Previous Issues

Issue: September 2017 Format: pdf Go

Table 5.6.A. Average Price of Electricity to Ultimate Customers by End-Use Sector,

by State, July 2017 and 2016 (Cents per Kilowatthour)

	Residential		Commercial		Industrial		Transportation		All Sectors	
Census Division and State	July 2017	July 2016	July 2017	July 2016	July 2017	July 2016	July 2017	July 2016	July 2017	July 2016
New England	**19.30**	**18.30**	**15.69**	**15.10**	**12.62**	**12.25**	**7.81**	**7.71**	**16.74**	**16.01**
Connecticut	20.23	19.76	16.33	15.53	13.76	13.05	10.52	9.95	17.87	17.16
Maine	15.96	15.87	12.20	11.86	8.95	9.21	--	--	12.95	12.83
Massachusetts	19.88	18.20	16.20	15.74	13.75	13.24	5.42	5.64	17.28	16.35
New Hampshire	18.98	18.00	14.63	13.99	12.19	12.10	--	--	16.03	15.29
Rhode Island	17.19	17.11	15.20	14.19	14.85	13.45	20.08	19.26	16.06	15.42
Vermont	17.74	17.29	14.71	14.60	10.18	10.27	--	--	14.65	14.53
Middle Atlantic	**16.46**	**15.96**	**13.39**	**13.31**	**6.88**	**6.95**	**11.97**	**11.25**	**13.41**	**13.25**
New Jersey	16.02	16.16	12.97	13.23	10.91	11.03	9.06	9.21	14.17	14.40
New York	18.82	17.94	16.11	15.68	5.90	5.56	13.62	12.55	15.96	15.42
Pennsylvania	14.31	13.76	8.90	9.04	6.65	6.84	6.79	7.44	10.24	10.20
East North Central	**13.12**	**12.87**	**9.98**	**9.87**	**7.04**	**7.04**	**7.80**	**6.58**	**10.22**	**10.14**
Illinois	12.07	12.06	8.83	8.98	6.29	6.46	7.65	6.37	9.34	9.43
Indiana	11.85	11.27	10.17	9.55	7.43	7.00	10.75	8.90	9.70	9.18
Michigan	15.69	15.37	10.91	10.66	7.38	7.25	11.94	11.63	11.70	11.53
Ohio	12.59	12.25	9.75	9.63	6.56	6.90	7.30	8.14	9.88	9.88
Wisconsin	14.65	14.54	11.20	11.35	8.19	8.17	13.81	13.68	11.33	11.43
West North Central	**13.39**	**12.76**	**10.78**	**10.24**	**8.23**	**8.02**	**10.75**	**10.79**	**11.06**	**10.62**
Iowa	14.60	14.07	11.57	10.97	8.40	8.04	--	--	11.13	10.77
Kansas	13.61	13.06	10.74	10.42	7.81	7.51	--	--	11.17	10.85
Minnesota	14.02	13.20	11.43	10.10	8.11	7.62	9.97	10.20	11.31	10.44
Missouri	13.16	12.28	10.77	10.38	8.30	8.00	11.57	11.44	11.60	10.98
Nebraska	12.00	12.10	9.57	9.56	8.25	8.90	--	--	9.91	10.21

Census Division and State	Residential		Commercial		Industrial		Transportation		All Sectors	
	July 2017	July 2016	July 2017	July 2016	July 2017	July 2016	July 2017	July 2016	July 2017	July 2016
North Dakota	11.70	11.26	9.55	9.36	8.66	8.43	--	--	9.64	9.40
South Dakota	12.48	12.19	9.86	9.92	7.99	7.89	--	--	10.39	10.30
South Atlantic	**12.18**	**11.80**	**9.49**	**9.27**	**6.91**	**6.96**	**8.10**	**8.00**	**10.38**	**10.15**
Delaware	12.71	12.99	9.43	9.45	7.42	7.95	--	--	10.56	10.77
District of Columbia	12.23	12.30	11.13	11.30	8.45	8.62	9.12	9.02	11.30	11.38
Florida	11.93	11.18	9.49	8.87	8.05	7.97	8.50	8.03	10.75	10.11
Georgia	12.59	12.29	10.09	10.00	6.68	6.70	6.19	6.30	10.54	10.45
Maryland	13.59	14.05	10.33	10.74	8.08	7.47	8.02	7.79	11.70	12.14
North Carolina	11.20	11.19	8.82	8.98	6.90	7.04	8.46	7.76	9.59	9.65
South Carolina	12.79	12.58	10.71	10.46	6.50	6.65	--	--	10.31	10.30
Virginia	12.41	11.71	8.32	7.86	6.78	6.71	7.65	7.88	9.89	9.35
West Virginia	11.60	11.19	9.21	9.06	6.60	6.69	--	--	8.95	8.93
East South Central	**11.31**	**10.83**	**10.59**	**10.11**	**6.25**	**6.20**	**--**	**--**	**9.61**	**9.34**
Alabama	12.53	12.08	11.54	11.11	6.60	6.59	--	--	10.26	10.07
Kentucky	10.64	10.28	9.66	9.29	5.73	5.77	--	--	8.68	8.52
Mississippi	11.10	10.21	10.12	9.25	6.32	6.15	--	--	9.36	8.77
Tennessee	10.83	10.45	10.67	10.24	6.31	6.17	--	--	9.83	9.56
West South Central	**10.79**	**10.47**	**8.43**	**7.79**	**5.85**	**5.38**	**8.27**	**5.63**	**8.73**	**8.36**
Arkansas	10.67	10.28	8.70	8.24	6.55	6.50	13.38	9.46	8.77	8.58
Louisiana	9.99	9.06	9.16	8.14	6.12	4.80	9.66	8.68	8.45	7.44
Oklahoma	10.29	9.99	8.27	8.01	5.58	5.18	--	--	8.51	8.25
Texas	11.04	10.86	8.29	7.65	5.70	5.41	8.16	5.40	8.82	8.55
Mountain	**12.29**	**12.09**	**10.22**	**9.98**	**7.17**	**7.11**	**10.00**	**9.78**	**10.27**	**10.04**
Arizona	12.74	12.70	11.54	11.24	7.43	6.69	11.24	10.61	11.63	11.32
Colorado	12.45	12.44	10.36	10.01	7.66	7.43	9.70	9.78	10.44	10.28
Idaho	10.58	10.81	8.21	8.12	7.36	7.09	--	--	8.53	8.39
Montana	11.59	11.60	10.25	10.32	5.52	5.55	--	--	9.20	9.19
Nevada	11.64	10.72	7.92	7.70	7.59	8.42	9.19	8.60	9.53	9.20
New Mexico	13.57	12.51	11.24	10.45	6.29	5.97	--	--	10.57	9.87
Utah	11.91	11.72	9.32	9.13	7.03	7.05	10.35	9.89	9.72	9.51
Wyoming	12.15	11.88	9.77	9.49	6.81	6.78	--	--	8.28	8.19
Pacific Contiguous	**16.33**	**15.96**	**15.18**	**14.63**	**10.59**	**10.50**	**9.33**	**9.16**	**14.61**	**14.16**
California	18.85	18.49	17.69	16.94	14.47	14.05	9.34	9.18	17.53	16.93

Census Division and State	Residential		Commercial		Industrial		Transportation		All Sectors	
	July 2017	July 2016	July 2017	July 2016	July 2017	July 2016	July 2017	July 2016	July 2017	July 2016
Oregon	10.94	10.78	8.90	8.83	6.44	6.50	9.29	9.17	8.98	8.87
Washington	9.87	9.60	8.46	8.33	4.68	4.73	8.69	7.59	7.80	7.67
Pacific Noncontiguous	**26.63**	**25.52**	**23.40**	**22.04**	**21.12**	**19.87**	**--**	**--**	**23.58**	**22.30**
Alaska	22.30	21.42	19.51	18.61	16.94	16.52	--	--	19.72	18.96
Hawaii	29.25	28.04	26.50	24.80	22.63	21.01	--	--	25.78	24.20
U.S. Total	**13.12**	**12.68**	**11.00**	**10.62**	**7.33**	**7.23**	**10.19**	**9.63**	**11.02**	**10.71**

See Technical notes for additional information on the Commercial, Industrial, and Transportation sectors.
Notes: - See Glossary for definitions. - Values are preliminary estimates based on a cutoff model sample.
See Technical Notes for a discussion of the sample design for the Form EIA-826.
Utilities and energy service providers may classify commercial and industrial customers based on either NAICS codes or demands or usage falling within specified limits by rate schedule.
Changes from year to year in consumer counts, sales and revenues, particularly involving the commercial and industrial consumer sectors, may result from respondent implementation of changes in the definitions of consumers, and reclassifications.
Totals may not equal sum of components because of independent rounding.
Source: U.S. Energy Information Administration, Form EIA-861M (formerly EIA-826), Monthly Electric Power Industry Report.