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Additional submitted attachment is included below.

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California Energy Commission
Docket Unit, MS-4
Re: Docket No. 16-OIR-06
1516 Ninth Street
Sacramento, CA 95814-5512

Subject: Written Testimony to Disadvantaged Communities Advisory Group Meeting

I. INTRODUCTION

The Advanced Power and Energy Program (APEP) at the University of California, Irvine would like to thank the members of the Disadvantaged Communities Advisory Group and representatives of the California Energy Commission (CEC) and California Public Utilities Commission (CPUC) who are jointly examining the important issue of disproportionate adverse impacts of COVID-19 on minority communities.

APEP advances the development and deployment of efficient, environmentally sensitive, and sustainable power generation, energy storage, and conservation technologies. APEP is leading research and mentoring graduate students in the technical advancement and techno-economic analysis of many renewable fuels and energy storage technologies including electro-fuels, renewable methane, renewable liquid fuels, battery energy storage, hydrodynamic energy storage, and hybrid energy storage systems.

II. COMMENTS

Even before the COVID-19 epidemic, a body of evidence was growing that local air pollution is more harmful to human health than previously understood. Air pollution exposure is connected to increased risk of brain cancer, increased glaucoma risks, increased risk of ischemic stroke, heart failure, and preterm birth. Chronic exposure to air pollution is equivalent to smoking a pack of cigarettes a day. Attached to this testimony is a more complete list of over 15 new studies on the serious health impacts of locally generated combustion related pollutants. A*ll of these studies were released within the last 18 months*.

An additional and even newer area of evidence involves COVID-19 and its impacts on disadvantaged communities that are impacted disproportionately by locally generated combustion related pollutants. Although the studies have yet to be peer-reviewed and are therefore not yet final, Harvard researchers have recently reported that a long-term air pollution increase of 1 microgram per cubic meter of small particles can raise the risk of dying from COVID-19 by 15%. Separately, University of Siena researchers assert that because air pollution "impairs the first line of defense" of the upper respiratory tract, it likely explains why those who live in areas with higher air pollution fall prey to the disease more than others. Taken together, these findings highlight what we already know – without access to clean air, otherwise at-risk communities are more likely to contract this disease and many other illnesses.

The use of fuel cell systems, biogas, and renewable hydrogen has a significant impact on the reduction of criteria air pollutants and air toxics as well as greenhouse gas emissions (GHG), making these technologies important solutions to advance current California policy priorities related to air quality and environmental justice.

A. Renewable Gas

APEP would like to emphasize the importance of adopting renewable gas policies and projects that have the greatest environmental impact, enabled by the development of the renewable gas market. Fuel cell systems used in commercial, industrial and multi-unit residential buildings today can use these renewable fuels and are only constrained by the availability of the fuels, limiting both the market and the significant GHG, criteria air pollutant and toxic air contaminant emission reductions that can be uniquely achieved by the use of these continuous power fuel cell systems.

The combined impact of the Renewable Fuel Standard (RFS) and the Low Carbon Fuel Standard (LCFS) exacerbates the disadvantage of non-transportation uses of renewable gaseous fuels. APEP supports policies that would allow fair access of stationary fuel cell systems to renewable gas at reasonable market prices. The greatest NOx reducing scenario that provides the best air quality and health impacts in local communities includes using some renewable gas for electricity generation with stationary fuel cell systems. However, this scenario is currently precluded by the high price that RFS and LCFS support for renewable gas use as a transportation fuel. Current renewable gas prices (again, because of the policy support of RFS and LCFS) lead to fuel cell generation that is uneconomical and not competitive with the grid. APEP encourages policies that lead to using some renewable gas in transportation applications and some in stationary fuel cell systems to produce the greatest benefit from use of renewable gas to local community NOx reductions and air quality.

Renewable gas addresses the 2020 IEPR Update Scoping Order stated goal of transitioning "towards zero and near-zero emission fuels and technologies, while protecting

consumers and ensuring disadvantaged communities benefit from this transition."[1] Technologies that increase local air pollution anywhere and especially in disproportionately-impacted disadvantaged communities should be explicitly excluded from CEC programs, consistent with the intent of AB 617[2] and SB 100.[3] Notably, reducing air pollution and toxic emissions is an explicit goal of SB 100, which calls for "Reducing air pollution, particularly criteria pollutant emissions and toxic air contaminants, in the state."[4] This goal has been overlooked in many California policies and programs, which often focus exclusively on SB 100's greenhouse gas emissions goals. This is the case in the 2020 IEPR Update Scoping Order, which reads: "SB 100 (De León, Chapter 310, Statutes of 2018) established a renewable electricity goal of 60 percent by 2030 and codified the state's commitment to developing a *carbon-free electricity sector by 2045*." While this statement is true, we encourage the CEC to also include and focus some attention upon the clean air goal of SB 100.

One example of a current policy that could support clean air in disadvantaged communities is the Bioenergy Market Adjusting Tariff (BioMAT) program, which supports renewable gas fuel cell projects and could also help keep once-through cooling plants offline,

[1] California Energy Commission Scoping Order for the 2020 Integrated Energy Policy Report Update, Climate Related Energy Policies at 2.

[2] Assembly Bill No. 617, Nonvehicular air pollution: criteria air pollutants and toxic air contaminants. Chaptered July 16, 2017.

[3] Senate Bill No. 100, Chaptered September 10, 2018, Section 2, 399.11: (b) Achieving the renewables portfolio standard through the procurement of various electricity products from eligible renewable energy resources is intended to provide unique benefits to California, including all of the following, each of which independently justifies the program: **(3) Reducing air pollution, particularly criteria pollutant emissions and toxic air contaminants, in the state.**

[4] Senate Bill No. 100, Chaptered September 10, 2018, Section 2, 399.11: (b) Achieving the renewables portfolio standard through the procurement of various electricity products from eligible renewable energy resources is intended to provide unique benefits to California, including all of the following, each of which independently justifies the program: **(3) Reducing air pollution, particularly criteria pollutant emissions and toxic air contaminants, in the state.**

due to capabilities for 24/7 generation. On February 12, 2019, Los Angeles Mayor Eric Garcetti and the Los Angeles Department of Water and Power (LADWP) decided to not repower three of their natural gas fired coastal power plants.[5] The California Independent System Operator (CAISO), however, is concerned that these power plants may be required for resiliency in light of wildfires and public safety power shutoff (PSPS) events.[6] The availability of policies like the BioMAT program for providing 24/7 resilient and low emissions resources at the community level is vital.

B. Fuel Cell Systems

Clean distributed generation, such as that produced by fuel cell systems, has unique features and capabilities to address the need for air quality in geographically diverse communities and serve as alternative power and heat generation sources for users in those communities that are identified as priorities under AB 617. This is clearly delineated in the AB 617 directive which encourages "*Identifying zero and near-zero technologies such as fuel cells, solar, and battery backup systems in the Technology Clearinghouse, will allow users to identify prospective long-term technology solutions.*"[7]

The reductions of carbon and criteria air pollutants from stationary fuel cells can also make a direct positive impact on local communities. While the California utilities have, to this point, procured renewable resources beyond their Renewable Portfolio Standard ("RPS")

[5] LADWP will phase out natural gas operations at three existing coastal plants — Scattergood, Haynes, and Harbor — within a decade to accelerate end of reliance on fossil fuels. https://www.lamayor.org/mayor-garcetti-ladwp-will-phase-out-natural-gas-operations-three-power-plants

[6] CAISO Memo: "Briefing on Once-Through Cooling." http://caiso.com/Documents/090720BriefingonOnce-ThroughCooling-Memo.pdf

[7] California Air Resources Board, *Community Air Protection Program Framework: Concept Paper,* February 7, 2018, pg. 35.

requirements, stationary fuel cells can create additional positive local air quality impacts, provide non-intermittent renewable power (when using renewable gas), and support the state's policies to convert organic waste streams to beneficial use.

Renewable wind and solar power generation, fuel cells operating on natural gas, biogas, and renewable hydrogen, and energy storage technologies can all reduce CO_2 and other greenhouse gas (GHG) emissions. Through the fuel flexibility of fuel cells and the ability to operate continuously and follow fluctuating electrical (and thermal) loads, fuel cell systems can also provide a critical role in enabling increased penetration of renewable solar and wind resources on the grid. These features of fuel cell systems allow them to reduce pollutant emissions and improve air quality over and above the improvements that can be made with solar, wind, and energy storage systems alone.

Fuel cell systems also displace traditional emergency backup generators (almost exclusively diesel combustion generators) that emit criteria air pollutants and GHG. This feature is especially critical given that the majority of California currently suffers from poor air quality and faces major challenges in achieving clean air for the many citizens that live and work within these areas, especially including economically disadvantaged communities that are often disproportionately burdened by air pollution and risks of COVID-19. By providing always-on zero criteria pollutant emission power, fuel cells can increase adoption of intermittent renewable wind and solar resources throughout the state while significantly increasing the generation of decarbonized and pollutant-free electricity.

C. Renewable Hydrogen

Renewable hydrogen, including hydrogen as a blend stock or secondary component with methane can be produced from many renewable sources including biogas, other renewable gas derivatives, and by renewable solar or wind powering of water electrolysis in power-to-gas applications. Hydrogen is critically needed to address both the stationary power and the transportation air quality and GHG reduction goals of the State, for many reasons. First, hydrogen offers one of the only economic, modular, and geographically flexible means for zero emission long-duration (e.g., seasonal) storage of renewable power. Second, hydrogen can be produced in much larger quantities than all other renewable gases to meet a much larger fraction of the otherwise difficult to electrify end-uses (such as long-haul freight, aviation, marine transport, and district heating). Third, hydrogen offers zero GHG and zero criteria pollutant conversion options in both its production and end-use. Fourth, there are fuel cell systems available today that can use these renewable fuels and are only constrained by the availability of these fuels, which limits both the market and the significant GHG, criteria air pollutant and toxic air contaminant emission reductions that can be uniquely achieved by the use of continuous power fuel cell systems. Organic feedstocks are more limited than solar and wind resources, which are technically able to produce large amounts of renewable hydrogen via a power-to-gas electrolysis process.

Significant reductions in upstream short-lived climate pollutants (SLCP) are possible by hydrogen production from dairy digester gas because methane that would otherwise be released into the atmosphere is captured and utilized. This pathway leads to very significant emission reductions, especially in agricultural communities. If solar, wind, or other zero

SLCP emitting power generation is used to produce hydrogen for power generation in a fuel cell, then upstream SLCP that would otherwise have been associated with the gas and electric power systems used to produce that same power are eliminated. If the same renewable hydrogen is used as vehicle fuel in fuel cell electric vehicles, then upstream SLCP emissions are reduced that would otherwise have been associated with the petroleum extraction, transport, refining, and end-uses that it displaced. Other pathways by which hydrogen could be used to reduce SLCP emissions are available as well.

An example of meeting California's requirement for sustainable energy systems at the community level is underway at the Port of Long Beach (POLB).[8] This project is a critical demonstration of how one can address community-level air quality, specifically in ports and adjacent communities, as well as the reduction of greenhouse gas ("GHG") emissions, with a hydrogen-based energy system. The Advanced Power and Energy Program at the University of California, Irvine has conducted multiple studies on the potential impacts of fuel cells and hydrogen at the Port of Long Beach[9,10] and this project led by Toyota and FuelCell Energy is a culmination of multi-agency efforts to realize these air quality improvements.

Addressing combustion-based heavy-duty vehicle emissions remains a priority in California, and for compliance with the AB 617 Community Health Protection Program several air districts have an immediate need for long-range, zero-emission heavy duty vehicles to address one of their largest sources of criteria air pollutant and air toxic

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[8] Greentech Media Article on Toyota Hydrogen Facility https://www.greentechmedia.com/articles/read/toyota-fuelcell-energy-renewable-power-hydrogen-plant%23gs.we4tfe

[9] Assessment of Fuel Cell Technologies to Address Power Requirements at the Port of Long Beach. MacKinnon, M and Samuelsen, S. Advanced Power and Energy Program, University of California Irvine, June 28, 2016. http://polb.com/environment/energyisland.asp

[10] *Supplemental Report: The Science of Fuel Cells; Assessment of Fuel Cell Technologies to Address Power Requirements at the Port of Long Beach.* MacKinnon, M and Samuelsen, S. Advanced Power and Energy Program, University of California Irvine, April 31, 2016

emissions. The Port of Long Beach is adjacent to West Long Beach, a priority community in the AB 617 program. Through the use of a tri-generation stationary fuel cell system,[11] onsite hydrogen will be generated for commercial use in Toyota's heavy-duty fuel cell electric vehicles, with an estimated volume of over one ton of hydrogen.

D. Microgrids

The 2020 Integrated Energy Policy Report (IEPR) Update Scoping Order calls for "an assessment of microgrids and put forward policy recommendations on how microgrids can best be used to increase grid reliability while supporting a clean and affordable energy future in California."[12] Many fuel cell systems are currently powering microgrids, and all of these installations are providing clean and resilient power that is increasingly important as climate-caused and planned electric grid disruptions and natural disasters intensify. Alternative community generation microgrids are comprised of non-combustion resources that do not emit criteria pollutants and air toxics like solar, fuel cells, and battery energy storage devices. The increased use of these technologies can allow California to protect its citizens against the inevitable Public Safety Power Shutoff (PSPS) events and other electric grid outages and reduce the use of diesel generators across the State at the local level.

As an example, a fuel cell-powered microgrid in the Parkville neighborhood of Hartford, Connecticut provides 100% of electricity for a senior center, elementary school and library, facilities that each can serve as a refuge for residents during emergencies or bad weather. In the event of a major grid outage, the microgrid provides emergency power to the

[11] Roadmap for the Deployment and Buildout of Renewable Hydrogen Production Plants in California, California Energy Commission Clean Transportation Program, June 2020 at A-22.

[12] California Energy Commission Scoping Order for the 2020 Integrated Energy Policy Report Update, Scope of the 2020 IEPR Update: Microgrids at 3.

senior center, elementary school and library, as well as to an adjacent supermarket and gas station. Another microgrid with a fuel cell providing baseload and resilient power in Woodbridge, Connecticut supplies power to the grid during regular operation and maintains power during outages for six critical town buildings, including a town hall, a senior center, a public works department, a police department, a fire department and a library.

Fuel cell systems have additionally been installed as part of the Brooklyn Queens Demand Management Demand Response Program that allows ConEdison to plan for and maintain their infrastructure, while supplying reliable energy during peak periods of high demand in densely populated areas.[13] The program ultimately avoided nearly $1 billion in ratepayer costs through the use of targeted DER installations. One project in Brooklyn, New York uses solar, storage, and fuel cell technologies together in a microgrid of a low-income housing development to optimize the efficiency, reliability, and affordability of the project.

III. Conclusion

APEP again thanks the Disadvantaged Communities working group and CEC and CPUC representatives for your time, and emphasizes the importance of renewable fuels, hydrogen and fuel cell systems in addressing - first and foremost - short-term and long-term air quality impacts in disproportionately impacted communities.

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[13] Brooklyn Queens Demand Management Demand Response Program Overview, available at: https://www.coned.com/en/business-partners/business-opportunities/brooklyn-queens-demand-management-demand-response-program

ATTACHMENT A

Air Pollution Studies

Various studies have already described that combustion-related Particulate Matter, including Black Carbon, is associated with lower birth weight[14,15], preterm birth[16,17], and intrauterine growth restriction[18,19].

As if this body of evidence for the deleterious effects of combustion related pollution wasn't enough to spur action a new, and growing body of research now suggest they are more harmful than ever before understood.

- "By optimizing for both [reduction in climate forcing gases and criteria air pollution], energy planners can better prioritize specific power plant retirements and unlock even greater health benefits than with climate policy alone. Rather than creating health benefits as a "co-benefit" of climate action, this kind of co-optimized energy policy can unite the two goals intentionally."[20]

- Researchers, looking to explain the observed detrimental effects of combustion related pollutants on fetal development over and above that which is accounted for by simple maternal exposure, found that Black Carbon crosses the placental barrier, even concentrating at detrimental levels in the earliest stages of pregnancy.[21,22] Ultrafine black carbon particulates are spawned by coal-fired power plants, diesel engines and other sources that burn fossil fuels; inhalation is linked to cancer, respiratory problems and birth defects, according to an EPA website.[23]

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[14] Pedersen, M. et al. Ambient air pollution and low birthweight: a European cohort study (ESCAPE). *Lancet Respir. Med.* **1**, 695–704 (2013).
[15] Slama, R. et al. Traffic-related atmospheric pollutants levels during pregnancy and offspring's term birth weight: a study relying on a land-use regression exposure model. *Environ. Health Perspect.* **115**, 1283–1292 (2007).
[16] Ritz, B., Wilhelm, M., Hoggatt, K. J. & Ghosh, J. K. C. Ambient air pollution and preterm birth in the environment and pregnancy outcomes study at the University of California, Los Angeles. *Am. J. Epidemiol.* **166**, 1045–1052 (2007).
[17] Rudra, C. B., Williams, M. A., Sheppard, L., Koenig, J. Q. & Schiff, M. A. Ambient carbon monoxide and fine particulate matter in relation to preeclampsia and preterm delivery in western Washington State. *Environ. Health Perspect.* **119**, 886–892 (2011).
[18] Liu, S., Krewski, D., Shi, Y., Chen, Y. & Burnett, R. T. Association between maternal exposure to ambient air pollutants during pregnancy and fetal growth restriction. *J. Expo. Sci. Environ. Epidemiol.* **17**, 426–432 (2007).
[19] Winckelmans, E. et al. Fetal growth and maternal exposure to particulate air pollution-More marked effects at lower exposure and modification by gestational duration. *Environ. Res.* **140**, 611–618 (2015).
[20] Olson, Erik In Climate Action, Don't Neglect Air Pollution, The Breakthrough Institute (2019)
[21] Bové, H., Bongaerts, E., Slenders, E. et al. Ambient black carbon particles reach the fetal side of human placenta. Nat Commun 10, 3866 (2019). https://doi.org/10.1038/s41467-019-11654-3
[22] Royal College of Physicians. Every breath we take: the lifelong impact of air pollution. Report of a working party. London: RCP, https://www.rcplondon.ac.uk/file/2914/download (2016).
[23] EPA, Black Carbon Research, https://www.epa.gov/air-research/black-carbon-research, (Site Accessed Jan 2020)

- Colorado State University Study Finds Short-term Exposure to air pollution is Strongly Linked with Violent Behavior. The research results show a 10 microgram-per-cubic-meter increase in same-day exposure to PM2.5 is associated with a 1.4% increase in violent crimes, nearly all of which is driven by crimes categorized as assaults. Researchers also found that a 0.01 parts-per-million increase in same-day exposure to ozone is associated with a 0.97% increase in violent crime, or a 1.15% increase in assaults. [24]

- Personal Exposure to Particulate Matter Is Associated with Worse Health Perception in Adult Asthma.[25]

- National Institutes of Health, finding that Local Air Pollution Increases Preterm Birth Risk. Researchers examined exposure to sulfur dioxide, ozone, nitrogen oxides, nitrogen dioxide, carbon monoxide and particles. For nearly all pollutants, exposure was more likely to decrease over time, but 7 to 12% of women in the study experienced a higher exposure to air pollution during their second pregnancy. The highest risks were with increasing exposure to carbon monoxide (51%) and nitrogen dioxide (45%), typically from emissions from motor vehicles and power plants; ozone (48%), a secondary pollutant created by combustion products and sunlight; and sulfur dioxide (41%), mainly from the burning of fossil fuels that contain sulfur, such as coal or diesel fuel. [26]

- University of Minnesota Study finds Inequity in consumption of goods and services adds to racial–ethnic disparities in air pollution exposure. On average, non-Hispanic whites experience a "pollution advantage": They experience ∼17% less air pollution exposure than is caused by their consumption. Blacks and Hispanics on average bear a "pollution burden" of 56% and 63% excess exposure, respectively, relative to the exposure caused by their consumption. The total disparity is caused as much by how much people consume as by how much pollution they breathe. Differences in the types of goods and services consumed by each group are less important. PM2.5 exposures declined ∼50% during 2002–2015 for all three racial–ethnic groups, but pollution inequity has remained high. [27]

- Air Pollution May Be As Harmful To Your Lungs As Smoking Cigarettes, Long-term exposure to ambient air pollutants, especially O_3, was significantly associated with increasing emphysema assessed quantitatively using CT imaging and with worsening lung function. Emphysema is considered a smoker's disease. But it turns out, exposure to air pollution may lead to the same changes in the lung that give rise to emphysema. "We found that an increase of about three parts per billion [of ground-level ozone] outside your home was equivalent to smoking a pack of

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[24] Jesse Burkhardt et al. The effect of pollution on crime: Evidence from data on particulate matter and ozone, Journal of Environmental Economics and Management (2019). DOI: 10.1016/j.jeem.2019.102267

[25] Maestrelli, P. et al. Personal Exposure to Particulate Matter Is Associated With Worse Health Perception in Adult Asthma. *J Investig Allergol Clin Immunol* 2011; Vol. 21(2): 120-128

[26] Mendola, P. et al. Air pollution and preterm birth: Do air pollution changes over time influence risk in consecutive pregnancies among low-risk women? International Journal of Environmental Research and Public Health, 2019.

[27]Tessum et al. Inequity in consumption of goods and services adds to racial–ethnic disparities in air pollution exposure. *PNAS March 26*, 2019 116 (13) 6001-6006; first published March 11, 2019 https://doi.org/10.1073/pnas.1818859116

cigarettes a day for 29 years," "And so as climate change progresses, we expect that vulnerable populations and — even healthy populations — are going to see increased effects," Brigham says. Chronic respiratory disease (which includes chronic obstructive pulmonary disease and emphysema) is a leading cause of death in the U.S. The World Health Organization estimates that each year 7 million premature deaths around the world are linked to air pollution.[28]Thurston says if these long-term cumulative effects were to be included in policymakers' cost-benefit calculations, "the benefits will even more so outweigh the cost of moving forward on cleaning the air." [29, 30]

- Air pollution may have killed 30,000 people in a single year, study says. Those deaths came even as almost every county in the United States remained within federal air quality standards. That suggests more stringent regulations are needed to protect human health, researchers say. "I think the big conclusion is that lowering the limits of air pollution could delay in the US, all together, tens of thousands of deaths each year," said Majid Ezzati, the study's lead author and a professor of global environmental health at Imperial College London. While researchers were confident in the link between air pollution and death rates, they found that the effect was greatest in areas with lower incomes, in places with a higher proportion of black Americans and in regions where fewer people graduated from high school. This "inequality in mortality burden," researchers wrote, may be explained by systematic challenges faced by those demographic groups, including higher rates of preexisting medical conditions. [31]

- Study Finds MORE THAN 100,000 Americans each year die of heart attacks, strokes and other illnesses caused by air pollution spewed from factories, motor vehicles and even bucolic-seeming farmland, according to a new report that contradicts an EPA panel whose members downplayed the risks during a public meeting last month. "We estimate that anthropogenic $PM_{2.5}$ was responsible for 107,000 premature deaths in 2011, at a cost to society of $886 billion." [32]

- European Society of Cardiology finds that Air pollution causes 8.8 million extra early deaths a year. As a result of these findings, the researchers say that national governments and

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[28] World Health Organization, 7 million premature deaths annually linked to air pollution, https://www.who.int/mediacentre/news/releases/2014/air-pollution/en/, March 25, 2014 (Site Accessed May 2020)

[29] Wang M, Aaron CP, Madrigano J, et al. Association Between Long-term Exposure to Ambient Air Pollution and Change in Quantitatively Assessed Emphysema and Lung Function. *JAMA.* 2019; 322(6):546–556. doi:10.1001/jama.2019.10255

[30] NPR, All Things Considered, August 13, 2019, https://www.npr.org/sections/health-shots/2019/08/13/750581235/air-pollution-may-be-as-harmful-to-your-lungs-as-smoking-cigarettes-study-finds

[31] Bennett JE, Tamura-Wicks H, Parks RM, Burnett RT, Pope CA III, et al. (2019) Particulate matter air pollution and national and county life expectancy loss in the USA: A spatiotemporal analysis. PLOS Medicine 16(7): e1002856. https://doi.org/10.1371/journal.pmed.1002856

[32] Andrew L. Goodkind, Christopher W. Tessum, Jay S. Coggins, Jason D. Hill, Julian D. Marshall Proceedings of the National Academy of Sciences, Fine-scale damage estimates of particulate matter air pollution reveal opportunities for location-specific mitigation of emissions, Apr 2019, 116 (18) 8775-8780; DOI: 10.1073/pnas.1816102116

international agencies must take urgent action to reduce air pollution, including re-evaluating legislation on air quality and lowering the EU's current limits on the annual average levels of air pollution to match the WHO guidelines. [33]

- The Evidence Is Strong: Air Pollution Seems to Cause Dementia [3435]

[33] European Society of Cardiology. "Air pollution causes 8.8 million extra early deaths a year." ScienceDaily. ScienceDaily, 12 March 2019. <www.sciencedaily.com/releases/2019/03/190312075933.htm>.
[34] Carey IM, Anderson HR, Atkinson RW, et al Are noise and air pollution related to the incidence of dementia? A cohort study in London, England BMJ Open 2018;8:e022404. doi: 10.1136/bmjopen-2018-022404
[35] Arron Reuben, Wired, The Evidence Is Strong: Air Pollution Seems to Cause Dementia, May 2019, https://www.wired.com/story/air-pollution-dementia/