Before the Senate Environment and Energy Committee and the Assembly Telecommunications and Utilities Committee

Testimony Regarding New Jersey's Nuclear Power Plants

Armond Cohen
Executive Director
Clean Air Task Force
armond@catf.us
Mobile: 617.690.0341

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Thank you for the opportunity to testify today regarding New Jersey's existing nuclear plants.

My name is Armond Cohen, and I am Executive Director of the Clean Air Task Force, a non-profit environmental organization[1] founded in 1996 to advocate for policies to fight air pollution and climate change. We have worked closely for two decades with leading environmental groups in New Jersey and other states to promote state and federal policies to curb harmful air emissions from power plants.

Today, I will focus on the role that New Jersey's power plants play in avoiding carbon emissions and climate change, and why reasonable policies should be considered to keep them operating in the coming decade.

Let's start with this fact: the world's climate, and New Jersey's, is changing rapidly. Whether directly caused or amplified by climate change or not, Superstorm Sandy was an example of extreme weather we can expect from our warming of the oceans.[2] Global warming has increased the probability and severity of extremely hot and wet weather worldwide. At present rates of change, half the world's population can expect, by 2030, to experience much different climates than we experienced in the late 20th century.[3]

While political shouting continues, there is a broad scientific consensus that these climatic changes are driven by the heating of Earth's atmosphere from carbon dioxide released by the burning of fossil fuels: oil, gas and coal.[4] If we are going to limit extreme climate change, we need to make every effort to utilize every non-fossil energy source we have. And timing matters.

Every molecule of carbon dioxide put in the atmosphere today will continue to warm the earth for centuries. So every molecule we emit today matters - essentially forever. And because carbon simply accumulates in the atmosphere, accelerating warming, the only way to avoid the worst climate change scenarios is, ultimately, to avoid emitting carbon altogether: We need a zero carbon energy system by 2050 or soon after and maximum feasible reductions possible until then.[5]

Figure 1 illustrates why. Consider the atmosphere as a bathtub. We are filling it quickly with carbon, approaching the spillover limit at which the atmosphere changes in ways that may alter Earth's climate beyond human experience – a limit generally reckoned to be two degrees Celsius increase above pre-industrial levels; this temperature correlates to about 450 parts per million of carbon dioxide in the atmosphere (we are at roughly 400 parts per million today). There is some draining of carbon through uptake in trees and the oceans, but it is occurring at a far slower rate than we are

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[1] See www.catf.us. CATF is financed entirely by charitable donations, and receives no funds from private sector companies or the U.S. government.

[2] See Trenberth, Kevin E., John T. Fasullo, and Theodore G. Shepherd. "Attribution of climate extreme events." *Nature Climate Change* 5.8 (2015): 725-730.

[3] See Diffenbaugh, Noah S., et al. "Quantifying the influence of global warming on unprecedented extreme climate events." *Proceedings of the National Academy of Sciences* 114.19 (2017): 4881-4886.

[4] See Intergovernmenal Panel on Climate Change, *Understanding and Attributing Climate Change* (2007), http://www.ipcc.ch/publications_and_data/ar4/wg1/en/spmsspm-understanding-and.html

[5] See Rockström, Johan, et al. "A roadmap for rapid decarbonization." *Science* 355.6331 (2017): 1269-1271.

putting carbon in. There is even some evidence that these "sinks" are becoming saturated and therefore the drain is becoming smaller or non-existent.[6]

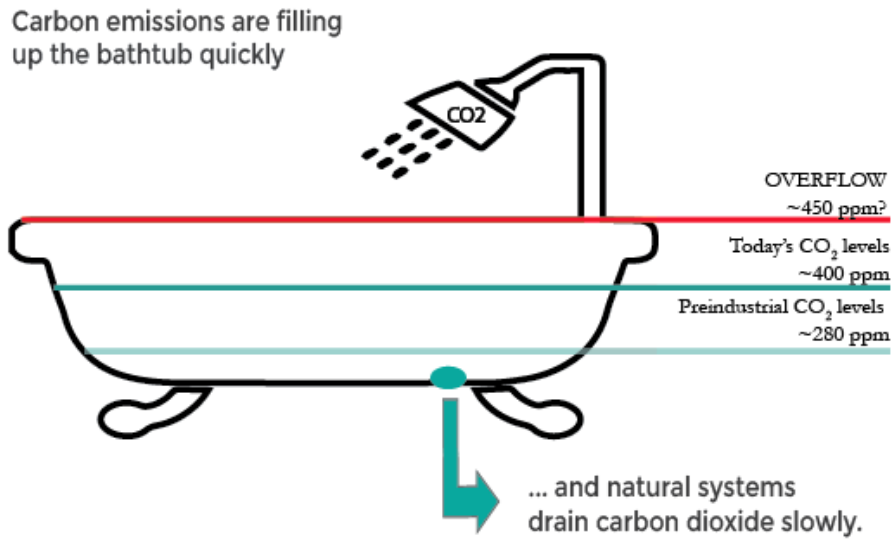

Figure 1: Carbon accumulates and disappears very slowly. Illustration source: Center for Carbon Removal.

The consequence is that to stabilize atmospheric temperature at 2 degrees Celsius beyond pre-industrial levels, we will need to effectively cut off the spigot, and limit our emissions during this century to no more than 1 trillion additional tons of carbon, as illustrated in Figure 2 below. The lesson: ***we must avoid if possible any emissions we can today to reduce the burden in the coming decades.***

[6] See, e.g. Baccini, A., et al. "Tropical forests are a net carbon source based on aboveground measurements of gain and loss." *Science* 358.6360 (2017): 230-234.

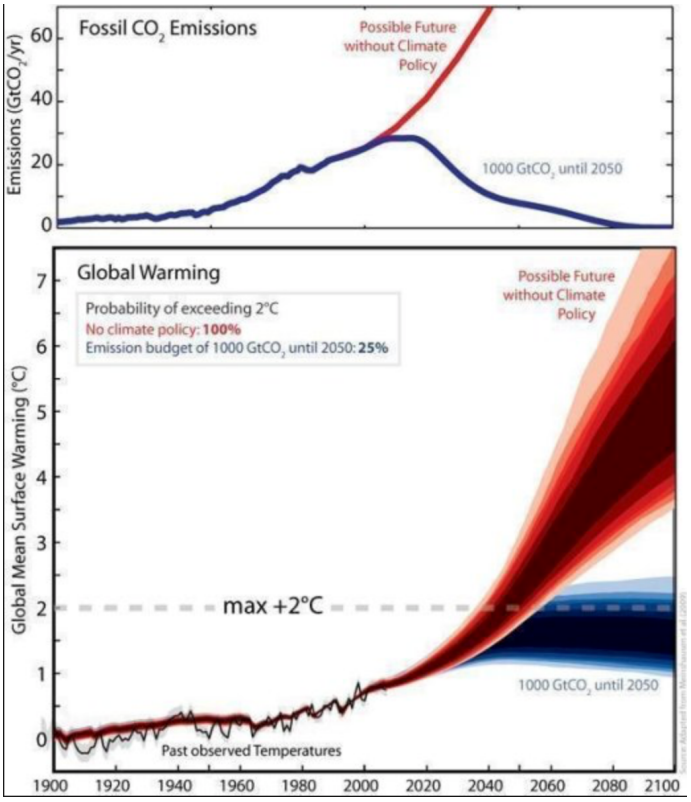

Figure 2: The century's "carbon budget" of 1 trillion tons: the bathtub only has so much space. Illustration source: Science Daily.

What does this have to do with New Jersey's nuclear plants? A lot.

Electricity production is the single largest industrial source of carbon dioxide emissions in New Jersey and the world. And, fortunately, in recent years, roughly half of New Jersey's electricity has come from a carbon dioxide-free source: nuclear power. That put New Jersey among the top three states in zero-carbon electricity share among those that lack large hydroelectric dams. Turning these plants off prematurely would substantially accelerate rather than slow the rate at which the atmospheric bathtub is filling with carbon.

Looking ahead, we can envision a future in which nuclear energy in New Jersey is joined at scale by other zero carbon electric sources such a wind, solar, and carbon capture and storage. But that will take time. Today, wind and solar account for about 5 percent of the state's electricity mix. They can and should be expanded, but this cannot be done overnight.

Consider that, just to ***replace*** the electricity output of the Hope Creek and Salem nuclear plants with other carbon-free electricity, and not even lower emissions from today, New Jersey would need to site 12 of the largest offshore windfarms operating in the world today, or 10 copies of California's largest onshore wind farm. (It is worth noting that America's only offshore wind farm operating today, off Rhode Island, would produce less than 1 percent of the electricity as Salem). Or the state would need to increase solar energy output by 15 times present levels, which took more than two decades to reach.

There will be substantial siting, financial and other challenges to achieving this level of wind and solar buildout, lasting decades. And, even then, New Jersey would have only just replaced the zero-carbon electricity capability that already exists; the feat would need to be doubled to supply the rest. Meanwhile, as this lengthy buildout occurs, without New Jersey's nuclear plants, carbon dioxide will pour into the atmosphere from gas and coal plants that replace them.

The magnitude of this problem can be seen in Figure 3. Governor-elect Murphy has indicated his intent[7] to have New Jersey join the Regional Greenhouse Gas Initiative (RGGI), a regional compact that today includes the six New England states plus New York, Maryland and Delaware. RGGI is committed to a relatively modest 10% reduction in CO2 emissions by 2020 from present levels. But retiring Salem and Hope Creek, and optimistically replacing them only with gas fired energy and no coal, regional emissions would grow by about 11 million tons annually. This increase will substantially increase the difficulty of meeting the 2020 cap, even if the cap baseline is adjusted to incorporate the state's current CO2 emissions.

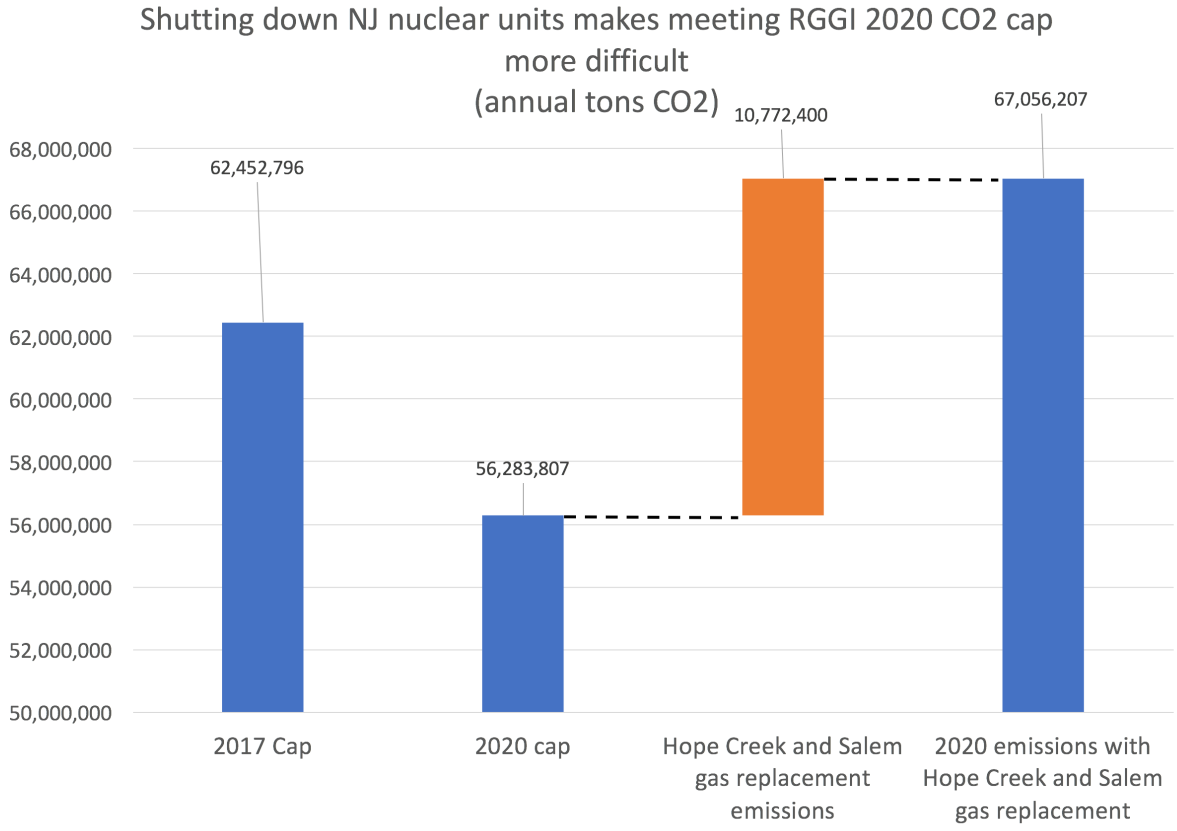

Figure 3: Consequences of turning off New Jersey nuclear plants to achieving CO2 emission caps under the Regional Greenhouse Gas Initiative. Source of figure: CATF, using cap data from RGGI, https://www.rggi.org/design/overview/cap and calculations on NJ nuclear output from FERC filings. It is assumed here that gas power plants replace lost nuclear output at an emissions rate of .4 tons CO2 per/MWH.

[7] See https://www.murphy4nj.com/issues/protecting-the-environment/

Looking toward 2050, many considerations will drive which mix of technologies can best eliminate carbon from electricity in New Jersey. Wind and solar are, as noted, coming down in price but face many challenges at very high levels of penetration, including the need for some form of on-demand back-up power for the weeks and months when wind and sun are scarce in the Garden State (today's batteries, even at zero cost, won't do the job because they can only store a day's worth of energy at best). Technologies that use gas with no carbon dioxide emissions are being demonstrated today and could well be part of the solution.[8] And advanced nuclear plants that depart radically from today's designs and can be manufactured at lower cost are on the horizon.[9]

While maintaining New Jersey's nuclear power capability may require a transitional subsidy, that is true of nearly all zero carbon energy sources today, which must all compete against cheap natural gas power. While CATF does not offer an opinion on the particular mechanisms New Jersey should consider to maintain its nuclear fleet, Figure 4 shows that recent nuclear power subsidies enacted in New York and Illinois have been in the range of $15/MWH, which is substantially less than current effective state and federal subsidies for wind and solar.

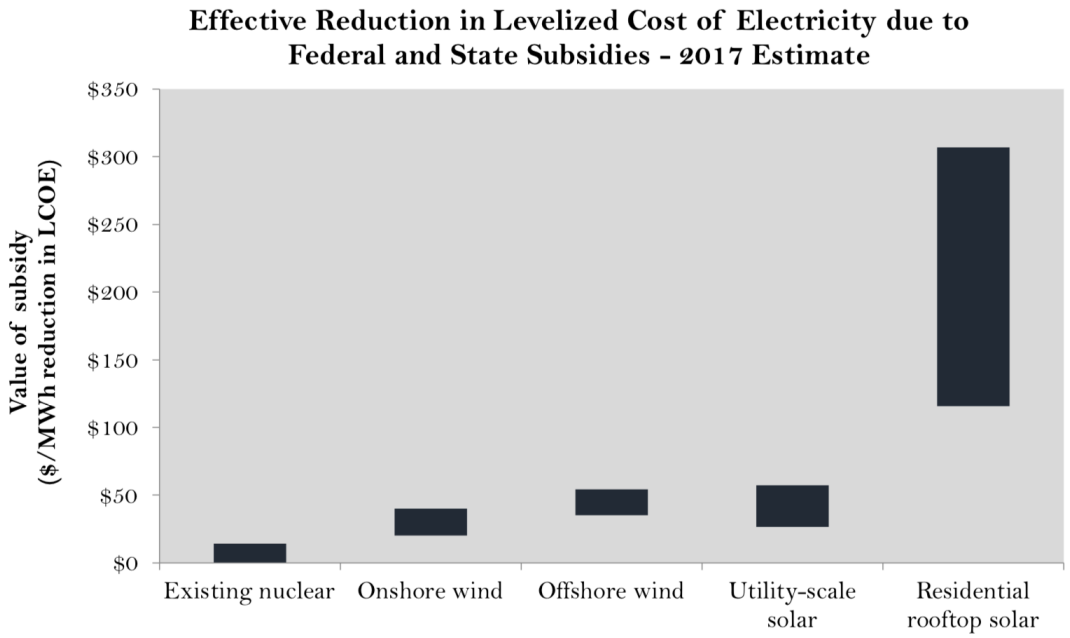

Figure 4: Effective subsidies for nuclear in recent NY and Illinois policies compared with state and federal subsidies for renewable power. Source: CATF calculations, from publicly available data.

[8] See http://www.sciencemag.org/news/2017/05/goodbye-smokestacks-startup-invents-zero-emission-fossil-fuel-power

[9] See Clean Air Task Force, *Advanced Nuclear Energy: Need, Characteristics, Projected Costs and Opportunities,* http://www.catf.us/resources/publications/files/Advanced_Nuclear_Energy.pdf; and Energy Innovation Reform Project, *What Will Advanced Nuclear Power Plants Cost?* (July 2017), http://innovationreform.org/wp-content/uploads/2017/07/Advanced-Nuclear-Reactors-Cost-Study.pdf

We can't know the future of energy technology for certain. But we do know that, over the next two decades, every molecule of carbon will matter. Whatever one's view of the state's ideal energy mix in 2050, one thing is clear: At least during the transition, New Jersey should find a way to maintain a very large climate-protection tool - nuclear energy.

Thank you for your attention, and I look forward to answering your questions.