

Reducing CO₂ Emissions in New Jersey
The Imperative of Nuclear Power

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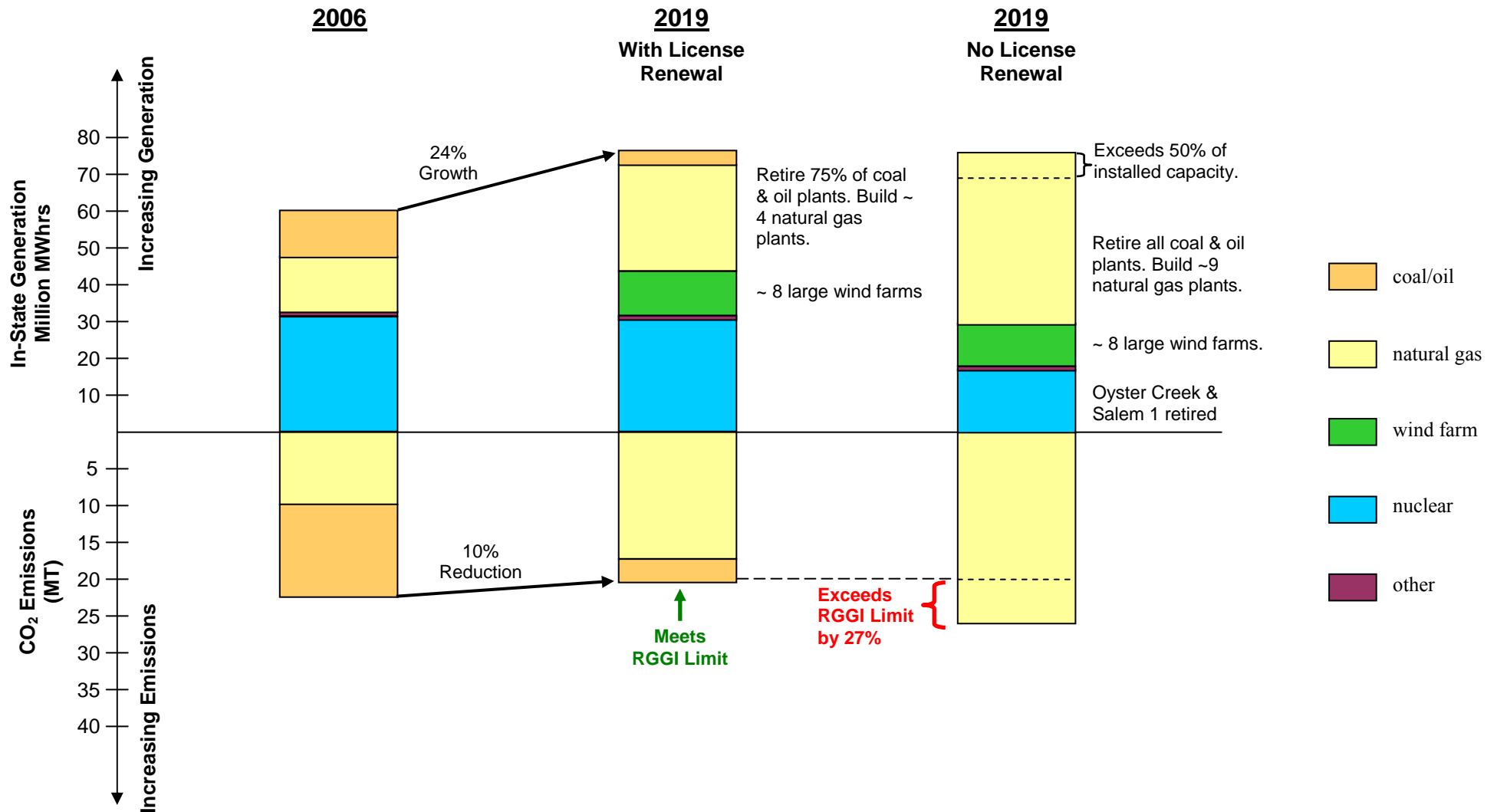
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Summary & Conclusions

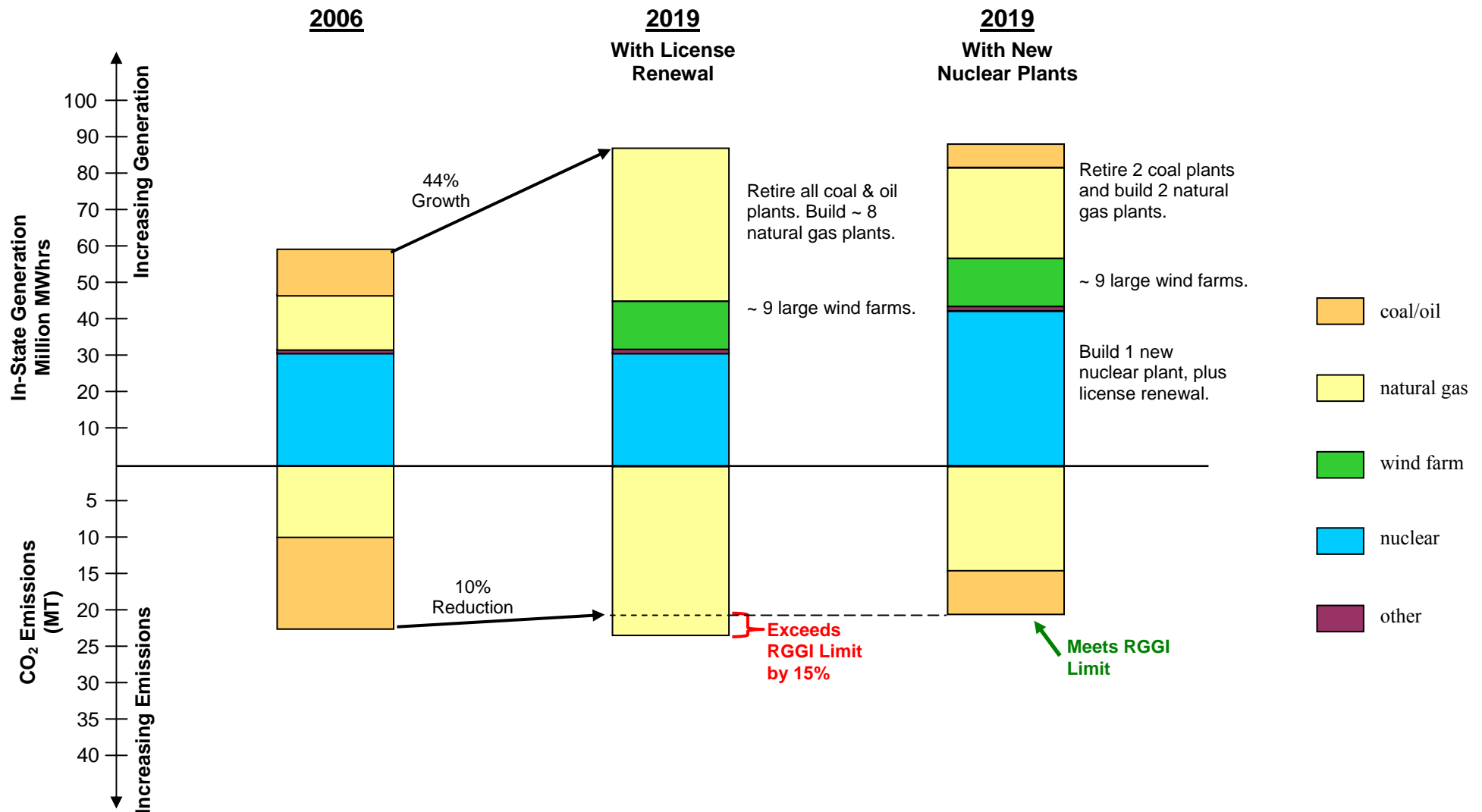
- This assessment demonstrates the strategic importance of nuclear energy in meeting New Jersey's commitment to reduce greenhouse gas emissions under the Regional Greenhouse Gas Initiative (RGGI). Specifically, this assessment demonstrates the importance of renewing the licenses of the state's four operating nuclear power plants, and building new nuclear generating capacity, if New Jersey hopes to meet its RGGI CO₂ emissions limit (10% reduction from 2006 levels) by the 2019 deadline.
- New Jersey faces a particularly daunting challenge: Simultaneously reducing CO₂ emissions, complying with grid reliability standards and meeting growth in electricity demand. This assessment considers the implications of a low-growth scenario (24% increase in electricity demand by 2019) and a high-growth scenario (44% increase in electricity demand by 2019).
- It is not possible to achieve the desired CO₂ emission reductions without nuclear power. Even with unprecedented levels of new renewable generating capacity, increased reliance on natural gas and premature closure of oil- and coal-fueled plants, it is necessary to renew the licenses of Oyster Creek and Salem 1 just to meet the RGGI limit in the low-growth scenario. In the high-growth scenario, achieving the RGGI goal will require license renewal of existing nuclear capacity plus the addition of a new nuclear plant.
 - **Low-Growth Electricity Demand Scenario:** Meeting the RGGI CO₂ emissions limit would require aggressive efficiency/conservation measures, shutdown of three-quarters of the state's oil- and coal-fired plants, construction of four 500-megawatt natural gas plants and eight 400-megawatt wind farms, *plus* license renewal of both Oyster Creek and Salem 1. Without license renewal, meeting the RGGI limit is impossible: Even if it shuts down all oil- and coal-fired power plants, and builds large amounts of new wind and gas-fired capacity, New Jersey's CO₂ emissions would be 27% over the RGGI limit.
 - **High-Growth Electricity Demand Scenario:** Meeting the RGGI CO₂ emissions limit would require license renewal of existing nuclear plants *plus* the construction of one new nuclear plant and nine large wind farms. (The new nuclear unit and wind farms would be necessary just to meet new electricity demand.) Two coal-fired units must also be retired and two gas-fired plants built. The combination of coal plant retirements and natural gas plant construction would be necessary to achieve the required reduction in CO₂ emission levels.

Meeting the RGGI CO₂ Limit Under Low-Growth Electricity Demand



New Jersey can meet its RGGI limit under the conditions shown in the middle bar: License renewal of the existing nuclear plants, premature retirement of three-quarters of its existing oil- and coal-fired capacity, and construction of eight new wind farms and four new gas-fired power plants. Without license renewal (right-hand bar), meeting the RGGI limit is impossible. Even with construction of new wind farms and gas-fired capacity, and retirement of all oil- and coal-fired capacity, the state exceeds its RGGI CO₂ limit by 27%.

Meeting the RGGI CO₂ Limit Under High-Growth Electricity Demand



In the high-growth scenario, New Jersey cannot meet the RGGI CO₂ limit (see middle bar) even by renewing the licenses of its operating nuclear plants, retiring all oil- and coal-fired capacity, and building large numbers of new wind farms and gas-fired power plants. The RGGI limit can be reached (right-hand bar) with license renewal of the nuclear plants, construction of one new nuclear plant, substantial expansion of wind capacity, modest expansion of gas-fired capacity, and retirement of two coal-fired plants.

Introduction

- The Regional Greenhouse Gas Initiative (RGGI) is a cooperative effort by 10 northeastern states to reduce greenhouse gas emissions from the generation of electricity. Last year, a “model rule” or limit was established to reduce these emissions by 10% from their current levels by 2019.
- New Jersey generates about 80% of its electricity in-state. The remainder is imported from surrounding states with higher CO₂ emissions per unit of electricity produced. Imported electricity is exempt from the RGGI limit.
- This analysis evaluates the challenge facing New Jersey in meeting the RGGI limit for CO₂ emissions while meeting two other fundamental criteria:
 - **Meeting electricity demand growth:** Over the past nine years, electricity demand has grown by ~2.9% per year in New Jersey. If this pace continues, demand will be 44% higher in 2019 than it is today. Since 1990, however, electricity demand has averaged a more reasonable increase of 1.8 % per year. This rate, which is more in line with the projections of regional transmission organizations, would require 24% more electricity by 2019.
 - **Ensuring reliability:** This assessment assumes that near-term renewable generating resources will be large wind farms, which operate intermittently and, like all intermittent resources, require back-up generating capacity. Several independent assessments have found that grid reliability can be compromised if intermittent sources of electricity represent more than 15-20% of installed capacity. In addition, relying on natural gas to fuel more than 50% of installed electric generating capacity could also compromise grid reliability because gas pipeline capacity may not be adequate to deliver enough gas to meet electric sector gas demand during peak demand periods.

Summary of Nuclear Power Plants in New Jersey

Nuclear Plant	2004 to 2006 Average Capacity Factor¹ (%)	Annual Average Generation (MWh)²	Current License Expiration	Comment
Hope Creek	80.1	7,430,748	April 2026	
Oyster Creek	91.4	4,956,110	April 2009	Submitted application for license renewal in 2005
Salem 1	87.8	9,029,562	August 2016	Application for license renewal to be submitted in 2009
Salem 2	90.1	8,918,818	April 2020	Application for license renewal to be submitted in 2009

- Calculations by the Nuclear Energy Institute show that the four nuclear power plants operating in New Jersey avoided the emission of 28.2 million metric tons of CO₂ in calendar year 2006, compared to the fossil fuels that would have been used to generate electricity in the absence of nuclear power.
- Nuclear energy currently accounts for more than 50% of New Jersey's in-state electricity generation.

¹ Data from Nuclear Energy Institute

² Calculated by Polestar based on average capacity factor from 2004 to 2006.

To Meet the RGGI Limit Under the Low-Growth Scenario ...

- **Increased conservation/efficiency:** In this scenario, the state must reduce growth in electricity demand from its recent trend (over the last 9 years) of 2.9% per year to 1.8% per year (consistent with the state's average growth since 1990). This would be a significant challenge.
- **Build eight large (400 MW) wind farms:** These new wind farms would produce eight times more electricity than is currently generated by renewable facilities in the state, and account for most of the new growth in electricity supply. A new wind farm would need to come online every 20 months – an unprecedented rate of siting, permitting and construction.
- **Build new gas-fired plants, retire older fossil-fueled plants:** Two new natural gas-fired plants (500 MW each) must be built to meet the growth in electricity demand not covered by the wind farms. Because even high-efficiency combined-cycle natural gas plants have CO₂ emissions, coal- and oil-fired plants must be retired to offset the increased CO₂ emissions from the new gas-fired plants. As a result, two additional natural gas plants must be built to replace the coal and oil fired plants that shut down. In short, to meet the RGGI emissions limit, most of the existing coal and oil plants in the state must be retired prematurely and four new gas-fired plants built.
- **License renewal of nuclear plants:** All four nuclear plants in New Jersey must continue operating for the RGGI limit to be met. Of the four, Oyster Creek and Salem 1 would require license renewal as the original 40-year operating licenses for the Salem 2 and Hope Creek plants do not expire until after the 2019 RGGI compliance deadline.

However ...

- **Without license renewal:** In the absence of license renewal, Oyster Creek and Salem 1 would close before 2019. In that case, the state would need: eight large wind farms and nine new gas-fired plants. This would cause natural gas to exceed 50% of the state's installed generating capacity, which is undesirable. On top of this new construction, the state would have to shut down all existing oil- and coal-fired capacity. Even with these extreme measures, the RGGI CO₂ limit would be exceeded by 27%.

To Meet the RGGI Limit Under the High-Growth Scenario ...

- **Build nine large wind farms:** A new 400-MW facility would have to come on-line once every 18 months – an unprecedented rate of siting, permitting and construction.
- **Build one new nuclear power plant:** The substantial growth in electricity demand cannot be met in this scenario without new nuclear capacity, in addition to license renewal and continued operation of existing nuclear plants.
- **Retire two coal-fired plants and build two gas-fired power plants:** Shutdown of two coal-fired facilities would be required to reduce CO₂ emissions from current levels and meet the RGGI limit. New gas-fired plants would be required to meet the demand growth that would not be met by the wind farms and the new nuclear plant.

However ...

- **Without new nuclear generating capacity:** In the absence of additional nuclear generating capacity, even with continued operation of existing plants, the state would not meet the RGGI limit. Even nine large new wind farms, retirement of all oil- and coal-fired plants and construction of eight new gas-fired plants would not be sufficient.

Methodology & Assumptions

- This assessment employs the methodology used in a 2005 study of the RGGI states. That study, *The Role of Nuclear Energy in Reducing CO₂ Emissions in the Northeastern United States*, remains a useful reference for background information and perspective.
- The analysis does not attempt to simulate dynamic market conditions or economic considerations. It simply adds new renewable, gas-fired and nuclear capacity as necessary to meet new demand, and retires oil- and coal-fired capacity as necessary to achieve reduction in CO₂ emissions.
- Several key assumptions were made in performing this assessment. These assumptions are intended to be pragmatic and generally favor non-nuclear options to achieve the RGGI emission limit:
 - Existing hydro and other renewable generation remain at their current levels of production with no CO₂ emissions.
 - A relatively high capacity factor of 40% was assigned to new wind farms, with new construction limited to 15% of in-state installed capacity minus existing renewable generation (hydro was not considered as part of the 15% installed capacity limit).
 - The analysis maximized construction of wind farms when forecasting new construction and power plant retirements. Nuclear plant license renewal and new nuclear plant construction were only applied if the RGGI goal or grid reliability criteria could not be met.
 - The license renewal of Salem 2 (its license expires in April 2020) was not factored into the assessment since it falls outside the 2019 RGGI goal.
 - New Jersey's electricity generation and CO₂ emissions for 2005 (the most recent data available) were used as a proxy for 2006, which is the starting point of this assessment.