Vinson&Elkins

NEW YORK STRIKES A GREEN NEW DEAL – WITH WHOM?

V&E ENERGY POLICY UPDATE

AUGUST 2019

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INTRODUCTION

On June 29, 2019, the New York State legislature passed the Climate Leadership and Community Protection Act (the "Climate Act"). On July 18, 2019, a Thursday on which New Yorkers prepared for a weekend with temperatures forecast to reach 95 degrees, Governor Andrew Cuomo signed the Climate Act into law. News media described the statute as aggressive, extraordinary and far-reaching, which indeed it is. As the full title of the Climate Act indicates, New York's ambition is to set a benchmark for the whole country, if not beyond, and not shy away from climate measures that impact its economic interactions with other states. This Update first summarizes key elements of the Climate Act, with emphasis on those provisions that will directly alter the production and consumption of energy. It then attempts to assess the feasibility of the legislative goals and the likely impact of their implementation on industry, households and individuals. Consistent with the "Community Protection" part of its title, the Climate Act also includes a number of provisions that fall under the broad rubric of environmental justice. These are not addressed in this Update. Throughout, "New York" refers to the State, not the City.

While the ultimate effect of the Climate Act on the energy, transportation, and real estate industries is in many ways uncertain, this Update will conclude with one clear recommendation: businesses and even individuals should observe the rulemaking process closely and participate in opportunities to submit comments.

HIGHLIGHTS

2030

- Mandatory reduction of statewide greenhouse gas emissions to 60% of 1990 levels.
- Mandate to procure 70% of electricity from renewable sources.

2040

- Mandate to procure all electricity from emissions-free sources.

2050

- Mandatory reduction of statewide greenhouse gas emissions to 15% of 1990 levels.
- Ultimate goal of net zero emissions.

GLOSSARY

DEC: New York State Department of Environmental Conservation.

EIA: US Energy Information Administration.

MMT: Million metric tons.

$MMTCO_{2E}$: Million metric tons of carbon dioxide equivalent.

NYSERDA: New York State Energy Research and Development Authority.

NYISO: New York Independent System Operator.

EMISSIONS GOALS

The Climate Act mandates reduction of statewide greenhouse gas emissions to 60% of 1990 emissions by 2030 and 15% of 1990 emissions by 2050. Targeted emissions include not only greenhouse gases produced within the State, but also those produced outside the State that are associated with the generation of imported electricity and the extraction and transmission of imported fossil fuels. Greenhouse gases are carbon dioxide, methane, and a number of other substances from anthropogenic sources that may contribute to climate change.

The Climate Act contemplates an alternative compliance mechanism for up to 15% of 1990 levels through projects that offset an equivalent quantity of greenhouse gas emissions. Emissions offset projects may include, among others, natural carbon sinks (like reforestation and wetland restoration) and carbon capture and sequestration. Sources in the electric generation sector will not be eligible to participate in offset mechanisms. Offset projects must be approved by the DEC and meet a number of significant criteria. For example, they only count if compliance with the emissions limits is not technologically feasible and if they are located in the county and within 25 miles of the polluting source, to the extent practicable.

The international norm is to use the year 1990 as the baseline for emissions reductions. In 2016, the last year for which comprehensive data are available, emissions in New York had decreased to 205.61 $MMtCO_{2e}$ from 238.32 $MMtCO_{2e}$ in 1990.[1] Translating the statutory limits into million metric tons, the State will have to reduce emissions from 205.61 to at least 143 $MMtCO_{2e}$ by 2030, which is a 30.5% decrease. If the full 15% offset basket is available (which is unlikely), the required real reduction for 2030 would be 13.1%. The 2050 target is more dramatic, requiring a net reduction of 82.6% and a real reduction of 65.2% from current levels. The foregoing figures simply illustrate the scope of the task. The actual 1990 baseline for the mandated reductions will be newly formulated, as explained below.

The declared ultimate goal of the Climate Act is to reduce emissions beyond 85% and achieve net zero emissions in all sectors of New York's economy. The legal nature of the net zero goal and its interaction with the offset mechanism are not clear from the statutory language. While one paragraph (§ 75-0107.4) unambiguously states that a source may use offsets to comply with the 60% and 15% limits, another paragraph (§ 75-0109.4a) provides that offsets may "be used by sources subject to greenhouse gas emissions limits to achieve net zero emissions." If the 15% offset basket can be applied towards the 85% reduction target, how could it then also offset the remaining 15% of emissions? Regulations will have to clarify both the net zero goal and the application of the offset.

ELECTRIC SECTOR GOALS

At least 70% of electricity provided by load-serving entities (utilities and energy service companies) regulated by New York's Public Service Commission must be procured from renewable energy systems by 2030. Renewable energy systems include solar, land and offshore wind, hydroelectric, geothermal, tidal and wave energy, ocean thermal, and fuel cells that do not utilize fossil fuels. They do not include nuclear power.

Note that the 70% minimum applies to load on the grid, not all electricity consumed in the State. Behind-the-meter generation from solar photovoltaic (basically, roof top solar panels) has tripled since 2014, when the EIA first estimated this category, and continues to grow exponentially. It does not count towards the Climate Act's renewable goal.

The entire electricity system must be zero emissions by 2040. "Zero" does not mean "net zero," since, as described above, the power sector may not offset its greenhouse gas emissions. In blunt terms, power generation fired by natural gas or other fossil fuels will be illegal by 2040. However, the 2040 benchmark is expressed as an emissions goal, not a renewable energy target like the 2030 benchmark, which implies that there is a continued role for nuclear power.

The State's load-serving entities must:

- procure at least 6,000 MW of photovoltaic solar generation by 2025;
- support 3,000 MW of energy storage capacity by 2030; and
- procure at least 9,000 MW of offshore wind generation by 2035.

While grid-based photovoltaic solar capacity has steadily increased, albeit at a modest pace, New York does not currently have any bulk-energy storage or offshore wind capacity.

The Public Service Commission must initiate energy efficiency measures with the goal of achieving 185 trillion British thermal units (BTUs) of end-use energy savings below the 2025 energy-use forecast. According to NYSERDA, this is equivalent to saving the energy consumed by 1.8 million New York homes.[2] Total New York energy consumption in 2016 was 3,670 trillion BTUs.

IMPLEMENTATION AND TIMELINE

The Climate Act does not mandate any particular strategies to achieve its declared goals. It does create a Climate Action Council, a 22-member body consisting of the heads or designees of various state agencies and experts appointed by the governor and legislative leaders. The realization of the Climate Act relies primarily on an interaction between the Climate Action Council and the DEC under the following timetable.

WITHIN 1 YEAR (2020)

- The DEC must establish the actual statewide greenhouse gas emissions limits based on the percentages of 1990 emissions described above. In addition, the DEC must "consider establishing" a mandatory registry and reporting system from individual sources to obtain data on greenhouse gas emissions exceeding a particular threshold.
- The DEC, in consultation with NYSERDA, must establish a social cost of carbon, expressed in terms of dollars per ton of carbon dioxide equivalent, to serve as a monetary estimate of the value of not emitting a ton of greenhouse gas emissions. The social cost of carbon may be based on global impacts, utilizing a range of appropriate discount rates, including a rate of zero!

WITHIN 2 YEARS (2021)

- The Climate Action Council must prepare a draft scoping plan outlining the recommendations for attaining the statutory limits and for the reduction of emissions beyond 85%. These recommendations must include specific regulatory measures and other governmental actions across a wide spectrum of topics. One of the areas to be covered by the scoping plan are mechanisms to limit emissions leakage, which is defined as a reduction in emissions of greenhouse gases within New York that is offset by an increase in emissions outside the State.

In developing the scoping plan, the Climate Action Council must quantify the economic and social benefits of greenhouse gas emissions reductions, taking into account the social cost of carbon established by the DEC. Outside the social cost of carbon, which is simply a tool to quantify and compare benefits, the Climate Act does not include a carbon-pricing mechanism, whether in the form of a carbon tax or a cap-and-trade system. However, the Climate Action Council could recommend a form (or alternative forms) of carbon pricing in its scoping plan.

- The Public Service Commission must establish a renewable energy program to meet the electric sector goals described above.
- The DEC must issue a comprehensive report on statewide greenhouse gas emissions from all sources in New York. Emissions associated with the generation of imported electricity and the extraction and transmission of imported fossil fuels will be counted as part of the statewide total.

Since NYSERDA already maintains a greenhouse gas inventory going back to 1990, why do it again? Not clear, but it appears that the new baseline will be broader. The methodology underlying the current inventory captures tout-of-state emissions associated with imported electricity, but not those associated with the extraction and transmission of imported fossil fuels. Examples might include flaring of natural gas accompanying oil production and methane leaking from natural gas infrastructure.

WITHIN 3 YEARS (2022)

- After a 120-day comment period and other opportunities for public input on the draft scoping plan, the Climate Council must submit its final plan. The scoping plan must be updated at least every five years.

WITHIN 4 YEARS (2023)

- After mandatory consultation with a number of agencies and groups and at least two public hearings, the DEC must promulgate rules and regulations to ensure legally enforceable compliance with the Climate Act's emissions limits. The scope of the regulations will not be limited to industries. They must also address sources that have a cumulatively significant impact, such as internal combustion vehicles and oil or natural gas boilers and furnaces. Translation for homeowners: that SUV in the garage and that oil or gas burner in the basement might have to go.

Assuming the rulemaking process will use all allotted time periods in full, final regulations can be expected in 2023, which would leave seven years to achieve the first material emissions reduction goals in 2030.

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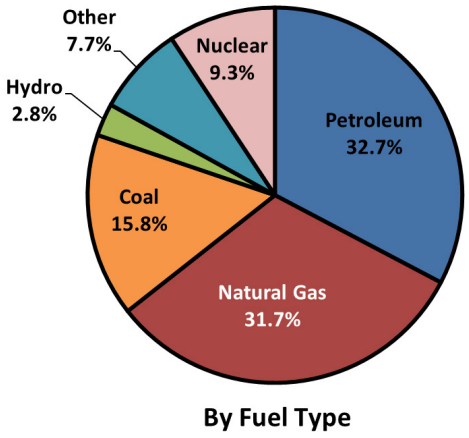
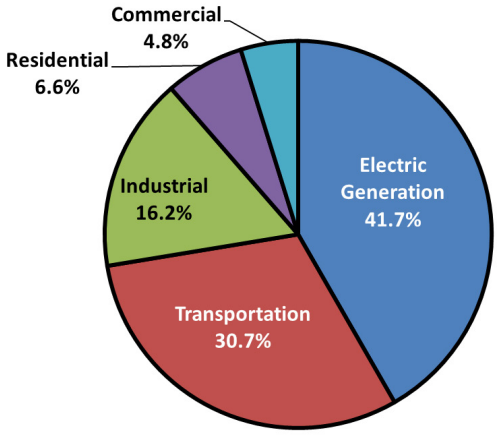
NEW YORK'S ENERGY AND CARBON PROFILE[3]

PRIMARY CONSUMPTION OF ENERGY (2016)



By Fuel Type



By Sector

Source: NYSERDA

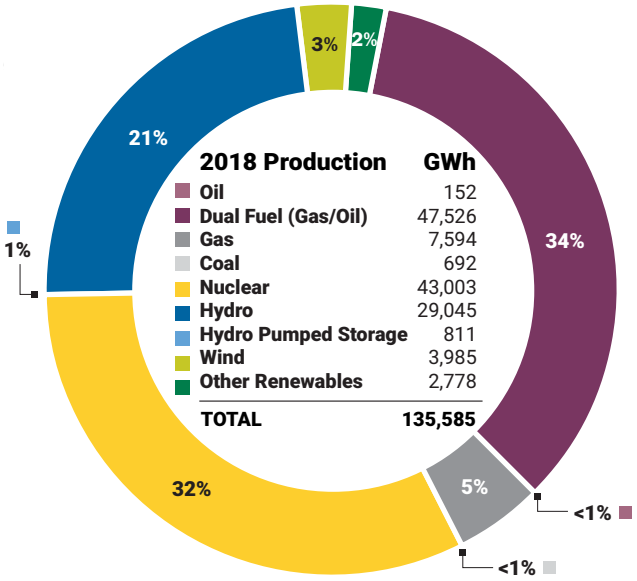
New York is not an energy state. Only 10.7% of energy consumed in New York is produced from sources within the State. Hydroelectric power and biofuels represent 60% and 24%, respectively, of the State's primary energy production.

New York has no coal reserves or mining. Coal usage is limited to the power sector and accounts for less than 1% of in-state electricity generation. The only remaining coal-fired power plants in the State are expected to close in 2020.

New York produces negligible amounts of crude oil. There are no refineries in the State. All finished petroleum products consumed in New York are imported. About 80% are used in transportation and much of the rest for heating.

Since New York banned fracking, natural gas production is negligible, despite the irony of the Marcellus Shale being named after a town in the central part of the State. Gas usage is not. Natural gas fuels 40% of the State's net electricity generation, and nearly 60% of households heat with natural gas.

NET ELECTRICITY GENERATION (2018 / 2019)



Source: NYISO

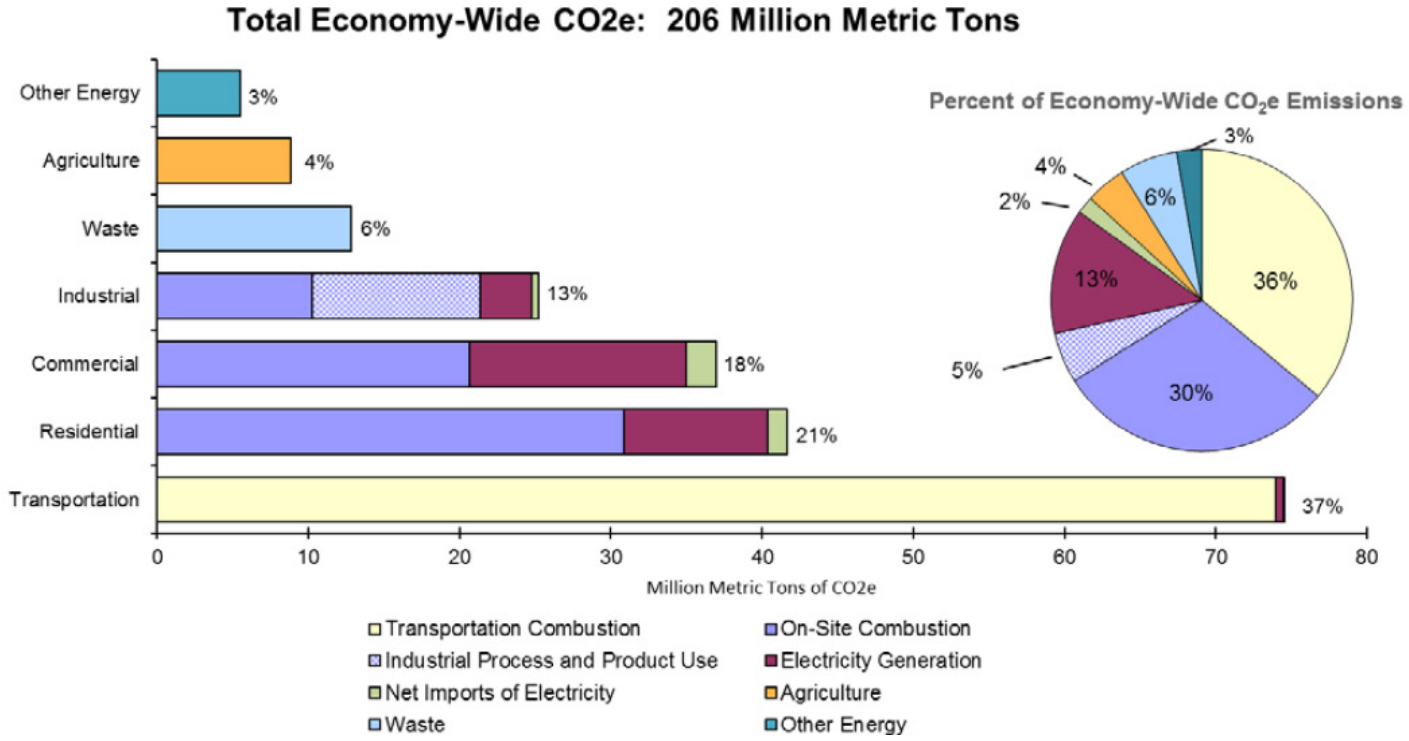
Natural gas, nuclear power and hydroelectricity provide more than 90% of New York's net electricity. Solar and wind pale by comparison. Natural gas is the backbone of the current power system. Most natural gas plants are listed as dual-fuel because they can switch to oil in case of interruptions in gas supply, but gas is the primary fuel. New York has six nuclear power reactors with a capacity of 5,406 MW. In 2017, the State and the owner of the Indian Point nuclear power plant announced its closure in 2020/2021, which will reduce nuclear capacity from 5,400 to 3,349 MW. New York produces more hydroelectric power than any other state east of the Rocky Mountains. The category also includes hydro pumped storage, whereby water is pumped uphill to a reservoir when there is spare power and then used to generate hydropower when needed. The potential for additional hydro capacity, including tidal and wave power, exists but is considered to be modest.

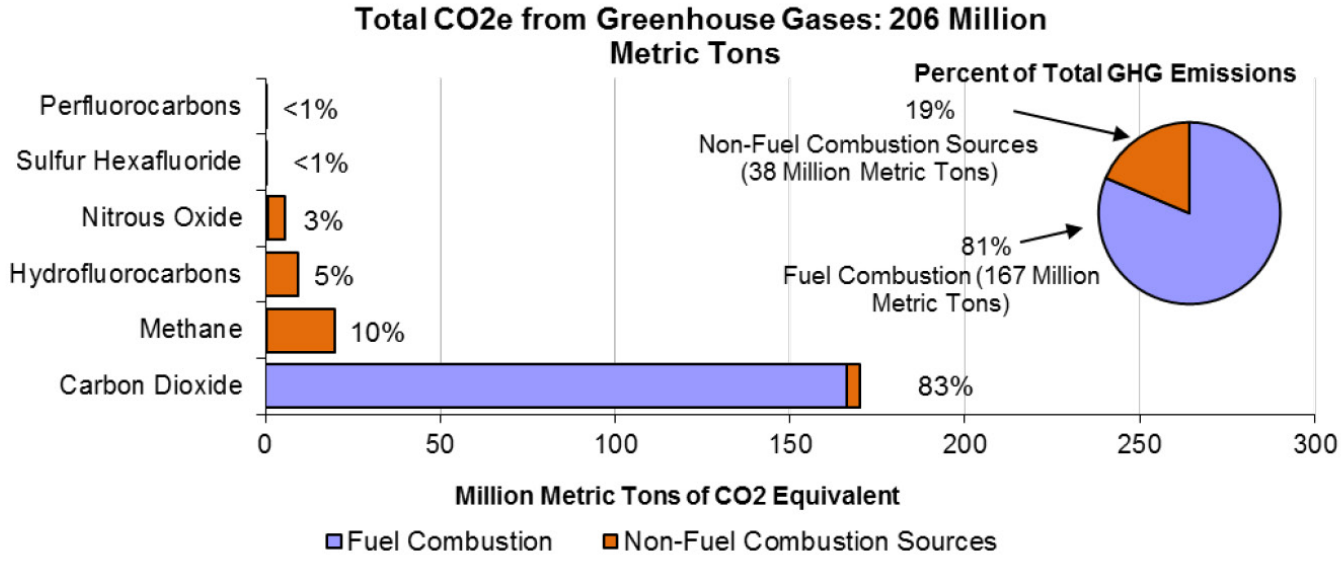
The chart above shows net electricity generation and thus does not identify imports separately. In 2016, 16.2% of consumed electricity was imported from neighboring states and Canada.

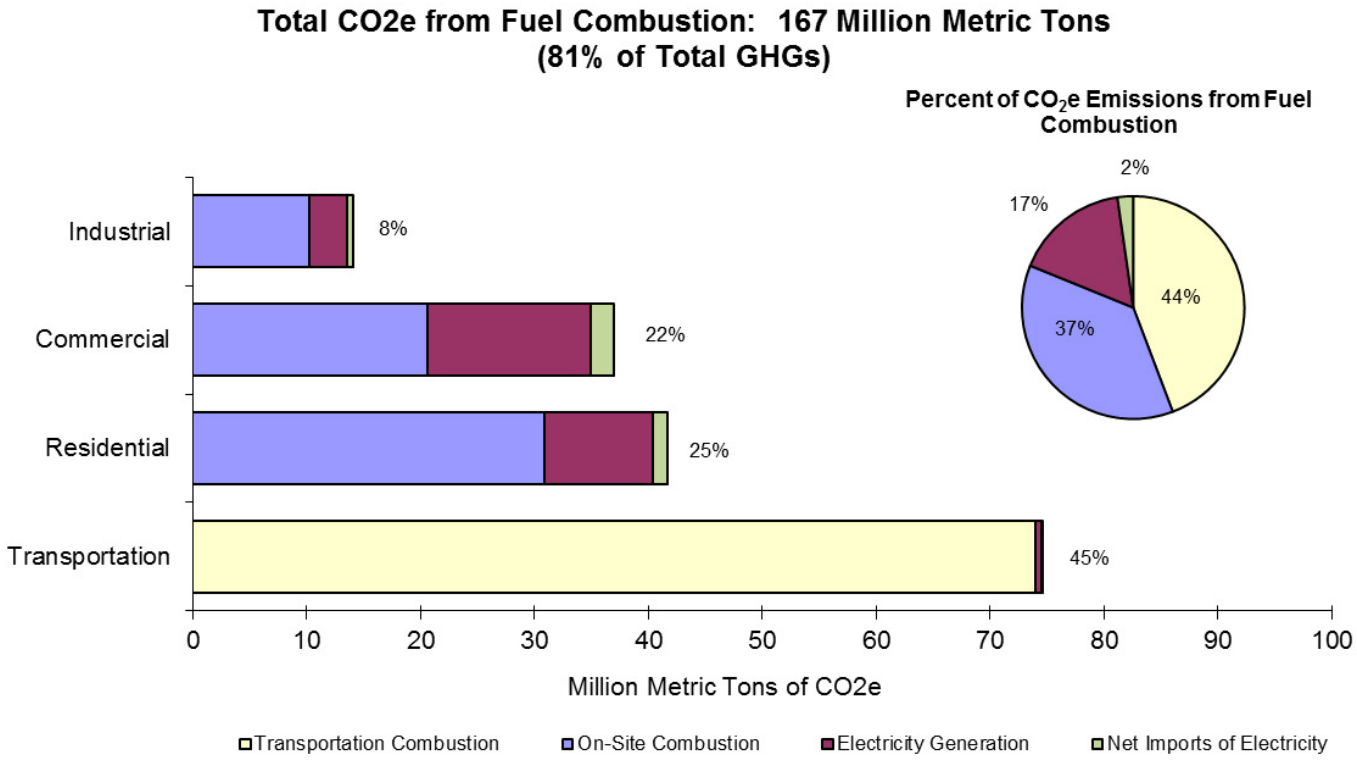
The following table shows statewide capacity (2019) and production (2018) of electricity by fuel type on a *pro forma* basis, reflecting the phase-out of any residual coal and oil plants and the closure of the Indian Point nuclear plant, in each case assuming near-term replacement with natural-gas-fueled power.

POWER SOURCE	PERCENT OF CAPACITY	PERCENT OF PRODUCTION
Natural Gas	71.7%	53.3%
Nuclear	8.5%	19.7%
Hydro	10.8%	21.4%
Hydro Pumped Storage	3.6%	0.6%
Wind	4.4%	2.9%
Other Renewables	0.9%	2.1%
TOTAL	100%	100%

GREENHOUSE GAS EMISSIONS (2016)







Source: NYSERDA

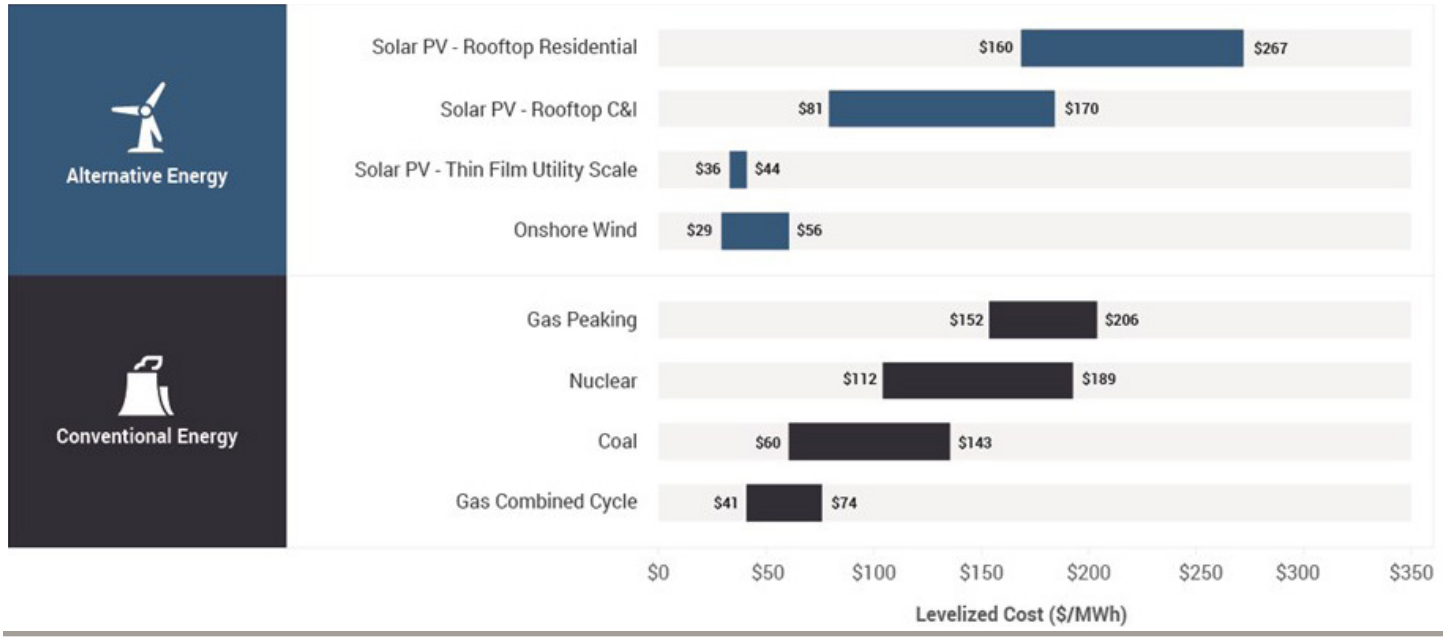
The main culprits among greenhouse gases are CO_2 and methane. The primary contributors are transportation, on-site combustion in the residential, commercial and industrial sectors, and electricity generation. At the core are CO_2 emissions from fuel combustion. Most methane emissions have sources other than fuel combustion, including landfills, natural gas infrastructure leakage and agricultural animals. The variable among these is leakage, which is expected to decrease as overall natural gas consumption is phased out.

LEVELIZED COST OF ENERGY

In order to place the State's energy ambitions into an economic context, here are highights from Lazard's most recent (2018) levelized cost of energy comparison on an unsubsidized basis.[4] Levelized cost of energy or electricity represents the average revenue per unit generated that would be required to recover the costs of building and operating a plant during an assumed life cycle ranging from 20 (gas, wind) to 40 (nuclear) years. Lazard assumes 60% debt at 8% interest and 40% equity at 12% cost of capital. Federal subsidies in the form of tax credits remain in force but are being phased down or out, which makes it more meaningful to use unsubsidized costs as a baseline for a longer time horizon.

Lazard shows a continued decline in the cost of generating electricity from alternative energy technologies, especially utility-scale solar and wind. For example, the low end levelized cost of onshore wind-generated energy is $29/MWh, compared to a low end of $41/MWh for gas combined cycle. There are several important qualifiers that impact the efficient energy mix, though. One is that offshore wind is much more expensive than onshore wind. The estimated implied midpoint of the levelized cost of offshore wind-generated energy is $92/MWh. Another one is that the marginal costs of operating fully depreciated conventional power plants can be very low. Lazard shows a midpoint of the marginal costs of operating fully depreciated nuclear facilities of $28/MWH, although this raises the question why a substantial number of plants closed, announced their closure, or avoided threatened closure through state-imposed ratepayer bailouts. All remaining reactors in New York have been in service since the 1960s and 1970s.

The levelized cost of energy analysis does not include the cost of storage. Wind and solar are intermittent sources of electricity. As their portion of total electricity production grows, the capacity of storage needed to maintain reliable power supply increases disproportionately. Additional storage capacity is likely to come from batteries. Battery storage is expensive and quickly becomes the dominating capital cost item in the switch from fossil fuels to renewables.[5] More on storage below.



OBSERVATIONS AND QUESTIONS

The basic path towards a carbon-free world is simple: Electrify everything and produce all electricity from emissions-free sources. The challenges arise from the pace and details of the implementation. Can a state government incapable of managing a functioning subway system transform the entire electricity and transportation sectors of the third largest state economy in the U.S.? There is reason to be skeptical, and time will tell whether the State can adhere to its own timetable. In this Update, though, we take the Climate Act at face value and ask what needs to change to realize its goals.

2030: 70% OF ELECTRICITY FROM RENEWABLE SOURCES

How much dispatchable electricity will New York need in 2030? Projections generally assume that energy efficiency gains and behind-the-meter resources (like rooftop solar panels) will reduce current demand, while the increasing adoption of electric vehicles will add demand. NYISO, the independent system operator of New York's grid, forecasts a modest decline in power use and peak demand over the next ten years.[6] On a nationwide basis, the EIA projects modest growth in electricity demand of 1% per year in the reference case.[7]

For simplicity, we assume here that electricity demand will remain stagnant through 2030. We also assume that existing production from nuclear and hydro sources will continue at current levels. Recall that nuclear power is not classified as a renewable source, but it is practically emissions-free, which matters for the 2040 goal. Adjusting the pro forma figures shown above, the electricity mix on the grid needs to look as follows to meet 2030 procurement goals.

POWER SOURCE	PERCENT OF PRODUCTION
Natural Gas	10.3%
Nuclear	19.7%
Hydro	22%
Wind, Solar & Other Renewables	48%

This is a massive shift from natural gas to wind, solar and potentially other renewables.

How much additional capacity is needed to produce 70% of current output from renewable sources? Switching from one power source to another does not translate into equivalent capacity, because different types of plants have different capacity factors. In 2018, the capacity factors for utility-scale generators were 57.6% for natural gas, 37.4% for wind, and 26.1% for photovoltaic.[8] Generously assuming wind's higher capacity factor across all renewable categories, New York would require a total of 19,865 MW of capacity to produce 48% of its projected 2030 power from renewables. With only 2,097 MW in place, 17,768 MW additional capacity needs to be built by 2030. On July 18, 2019, at the signing ceremony for the Climate Act, Governor Cuomo also announced two offshore wind agreements for 1,700 MW, which was described as the single largest renewable energy procurement by any state in U.S. history. One down, nine more to go towards 17,768 MW.

The State entering into an offshore wind agreement is a metaphor for subsidies borne by ratepayers. The two agreements constitute the first awards under the solicitation for offshore wind projects launched by NYSERDA in 2018.

Once the awarded projects reach commercial operation, NYSERDA will purchase from them Offshore Wind Renewable Energy Certificates (ORECs) associated with energy production. NYSERDA will then resell the ORECs to load-serving entities in proportion to the amount of electricity provided.

What kind of storage capacity is needed to support intermittent sources that account for 48% of statewide power? Nobody seems to know, because projections are typically based on a wide range of assumptions about the flexibility of the existing grid. One metastudy of 17 studies on storage expansion concluded that "(w)hen considering all evaluated studies, no general conclusion can be drawn regarding the impact of grid modeling on storage requirements."[9] If there is any consensus, it is that further technology and cost improvement is needed to facilitate widespread storage deployment. Electrical energy storage technology has not enjoyed the compounded growth rates we have become accustomed to in the digital world. Of the total capacity in the U.S., 96% is in the form of pumped hydroelectric storage, most of which was installed in the 1970s.[10] The limits are of a physical, not just economic, nature. NYISO, which as the operator of New York's grid should know best, warns somewhat exasperatedly that "battery storage is insufficient to fully meet peak demand, even at penetration levels envisioned by policymakers over the next decade, due to technological constraints."[11]

This leaves us with two elephants in the room.

One is nuclear power, a term not mentioned once in the Climate Act. Even within the crude projections laid out here, it is apparent that nuclear power must remain in the energy mix if emissions reduction is a priority. New York committed ratepayers to subsidize its upstate nuclear plants through 2029.[12] The bigger question is whether the State should facilitate new nuclear power plants to meet its own climate goals. As so often, energy policy faces a profound trade-off: subsidize renewable energy and storage, with uncertain adaptation rates, or subsidize controversial nuclear power, arguably the most reliable power source.

The other one is the continued role of natural gas. New York has over 70 power plants that use natural gas as their primary fuel. Eight of these went into service during the last 10 years, not to mention that gas capacity is still being added in the State. For example, about 75 miles north of New York City, a natural-gas-fired power plant with 1,100 MW is currently under construction. Cricket Valley Energy Center is scheduled to go online in 2020. Wind and solar projects have no fuel costs and are dispatched ahead of fossil fuel plants, but gas plants typically meet the shortfalls arising from sudden fluctuations in wind or sunlight. The baseload supply function of natural gas will remain essential, but poses challenges to operators as they are forced to compete with subsidized forms of energy with zero short run marginal costs.[13]

In 2013, a Stanford/Cornell team presented a plan to convert New York's all-purpose energy infrastructure to one using solely wind, water and sunlight (WWS).[14] Under the plan, New York's 2030 end-use power would be provided by a precise combination of sources that specified the contribution of each category to the decimal point. The plan anticipated that by 2020, all new generators would be WWS generators. In reality, the energy event of 2020 will be the opening of the Cricket Valley Energy Center. One of many lessons is that New York will not be able to achieve its goals pursuant to a central "plan" that attempts to control multiple variables. "Decarbonization policies should create a level playing field that allows all low-carbon generation technologies to compete on their merits."[15]

2030: REDUCTION OF GREENHOUSE GASES TO 60% OF 1990 LEVELS

Based on currently available data, New York needs to eliminate 62.6 $MMtCO_{2e}$ of emissions on a net basis. Where will it come from? We will only focus on CO_2.

Current electricity generation contributes 17% of statewide CO_2 emissions, or 27.7 MMt. Simply on a prorated basis, reducing natural gas power as sketched out above to meet the 2030 renewable goal would correspondingly decrease CO_2 emissions by 22.4 MMt.

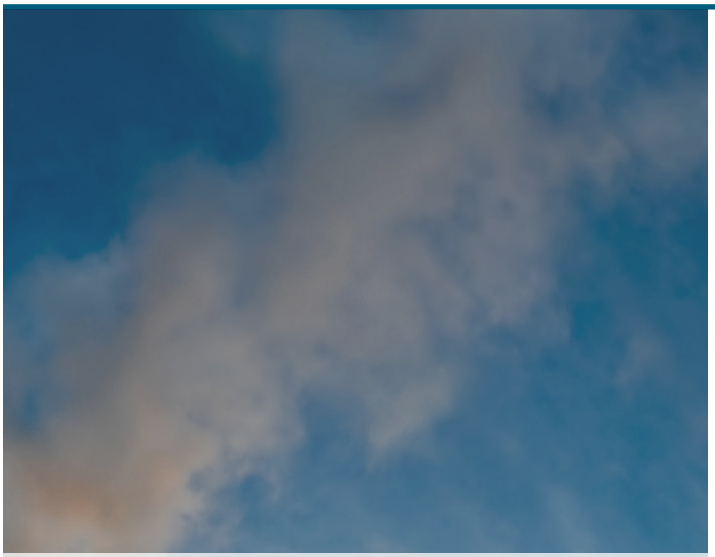
Transportation is responsible for 73.2 MMt of CO_2, of which 47.1 MMt results from burning gasoline, thus originating mainly from standard cars and light trucks. The remainder is primarily caused by diesel fuel and aviation fuel. Any meaningful adoption of electric heavy-duty vehicles or airplanes by 2030 is unrealistic. Electric cars are approaching price parity with internal combustion vehicles and their sales volumes are projected to grow rapidly over the next 10 years. However, impressive sales figures do not quickly translate into high penetration rates, since cars have average lives in excess of 11 years. The Edison Electric Institute forecasts that 7% of cars and light trucks on U.S. roads in 2030 will be electric.[16] Again applying a very simplistic proration, this could reduce CO_2 emissions in New York by 3.3 MMt. State incentives might create adoption rates and corresponding emissions reductions above the national average, but will not shift the foregoing figures significantly.

We now have 36.9 MMt in required reductions left. It can only come from residential, commercial and industrial on-site fuel combustion. The biggest single contributor to CO_2 emissions after the transportation sector is residential fuel combustion to serve heating and hot water needs. It is also a category in which emissions have increased since 1990, while, for example, emissions from electricity dropped 51% during this same period. The ramifications are clear. New York must look inside its residential and commercial buildings and change the practice of burning gas or oil to heat space and water, process materials, and cook. Renewable heating and cooling (RH&C) technologies, such as air source heat pumps, exist, but they are not competitive with conventional methods. State incentives and gradual phase-in through new building requirements will not accomplish the massive transformation required by 2030. Only regulatory mandates will. New York's arm-chair environmentalists who blame climate change solely on Big Oil will face a wake-up call if, in addition to switching to electric cars, they have to spend heavily on new appliances in their homes, which will test the State's political will. Even NYSERDA admits that "RH&C technologies are characterized by high first costs" and that "the nature of RH&C as an emerging market in New York State places constraints on the extent to which mandates are a viable policy option at this stage."[17]

The analysis up to this point ignored offsets. The electricity industry does not qualify, and the dispersed nature of transportation sources makes it practically impossible to place them within offset requirements. We cannot imagine the DEC processing offset applications by individual car owners claiming that it is technologically not feasible to switch to an electric car. The same is conceptually true for on-site combustion, but it is conceivable that the DEC will stretch the requirements to permit offsets by natural gas utilities, even though the actual emission sources are the end-users. If the full offset basket is available, the emissions reductions required in on-site fuel combustion would be only 1.2 MMt. Considering this dramatic difference to the required net reduction, the application of the offset mechanism to residential natural gas usage will be one of the interesting aspects to watch in the implementation of the Climate Change Act.

2040: ZERO EMISSIONS FROM ELECTRICITY

The primary consequence is that all natural gas-fueled power plants must deactivate. While the 2030 goals present a daunting task already, realization of the zero emissions target without adding new nuclear power plants will require fundamental penetration of bulk-storage capacity to replace the baseload from natural gas. If incremental nuclear power or storage at scale, or both, were to put the grid on a path towards zero emissions by 2040, the State could find itself in an unexpected position with respect to legacy natural gas plants. The combination of looming forced retirement and competition against power sources with no or low marginal costs may result in premature exits by natural gas plants, thus jeopardizing grid reliability. Joskow warns that "(t)he mandates, subsidies and contracting obligations will just spread as the market fails to deliver adequate retention and entry of generating capacity and storage needed to manage intermittency."[18]



"New York's arm-chair environmentalists who blame climate change solely on Big Oil will face a wake-up call if, in addition to switching to electric cars, they have to spend heavily on new appliances in their homes, which will test the State's political will."

2050: REDUCTION OF GREENHOUSE GASES TO 15% OF 1990 LEVELS

The ability to achieve this goal will depend on the trajectory towards the earlier targets and beyond. There is no need to repeat the above analysis. However, we do want to point out one aspect that could be relevant for end-users.

We should assume that the remaining 15% of greenhouse gas emissions will be taken up by a multitude of sources that the State cannot address or that cannot be abated through carbon capture. Examples are agricultural animals, air transportation, possibly heavy-duty trucks and machinery, and combustion engine vehicles from other states travelling in New York. If that is the case, all other vehicles on the road would have to be electric, because the offset mechanism by virtue of its requirements cannot be used for transportation. Gas stations, those iconic fixtures of the American landscape, may indeed go the way of the phone booth. All automobiles sold in 2050 and thereafter could be electric, but that does not get non-electric cars off the road. They need to be banned. According to the Bureau of Transportation Statistics, the average age of light vehicles in operation in the U.S. is 11.6 years, a number that continues to increase.[19] If the Climate Act is effectively a mandate that all cars and light trucks on New York's roads in 2050 be electric, and if the State does not want to force its residents to jettison the value of their conventional cars at that time, it should stop accepting registrations of combustion engine vehicles at least 10-15 years earlier.

CONCLUSION

For over 100 years, energy research and policy debates have left an astonishing trail of wrong predictions. It is entirely possible that by 2050, adoption of new technologies or advancement of existing technologies, such as hydrogen fuel cells, will make many of the questions raised above moot. This prospect does not absolve us from analyzing the application of current law to the current state of affairs, though.

The interplay of emissions reduction goals, renewable energy targets and alternative offset mechanisms created by the Climate Act has the potential to affect industries and individuals in fundamental but disproportionate ways. The regulatory process over the next four years will determine how and at what costs businesses and households in New York, far beyond the energy industry, need to transform themselves. All stakeholders should follow this process closely and use opportunities to comment on the proposed implementation of the Climate Act.

ENDNOTES

1 NYSERDA, *New York State Greenhouse Gas Inventory: 1990 – 2016* (July 2019).

2 NYSERDA, *New Efficiency: New York,* p. 2 (April 2018).

3 All data in this chapter can be found on the websites of the EIA, NYSERDA and NYISO. The sources for tables are identified.

4 Available at www.lazard.com/perspective/levelized-cost-of-energy-and-levelized-cost-of-storage-2018/.

5 Geoffrey Heal, *What Would It Take to Reduce U.S. Greenhouse Gas Emissions 80 Percent by 2050?*, Review of Environmental Economics and Policy, Vol. 11/2, pp. 319-335, p. 325 (Summer 2017).

6 NYISO, *Reliability and a Greener Grid: Power Trends 2019*, pp. 12-15.

7 EIA, *Annual Energy Outlook 2019*, p. 90.

8 EIA, *Electric Power Monthly* (May 2019), Tables 6.7 A and B.

9 Felix Cebulla et al., *How much Electric Energy Storage do we need? A synthesis for the U.S., Europe and Germany*, Journal of Cleaner Production, Vol. 181, pp. 449-459, p. 458 (2018).

10 Department of Energy, *Global Energy Storage Database* (2019).

11 NYSERDA, *Reliability and a Greener Grid: Power Trends 2019*, p. 29.

12 The subsidies were challenged as unconstitutional but upheld in *Coalition for Competitive Electricity, et al. v. Zibelman, et al.*, 903 F.3d 41 (2d Cir. 2018).

13 *See* Paul J. Joskow, *Challenges for Wholesale Electricity Markets with Intermittent Renewable Generation at Scale: The U.S. Experience*, MIT CEEPR Working Paper 2019-001.

14 Mark Z. Jacobson et al., *Examining the feasibility of converting New York State's all-purpose energy infrastructure to one using wind, water and sunlight*, Energy Policy 57, pp. 585-601 (2013).

15 MIT, *The Future of Nuclear Energy in a Carbon-Constrained World*, p. 14 (2018).

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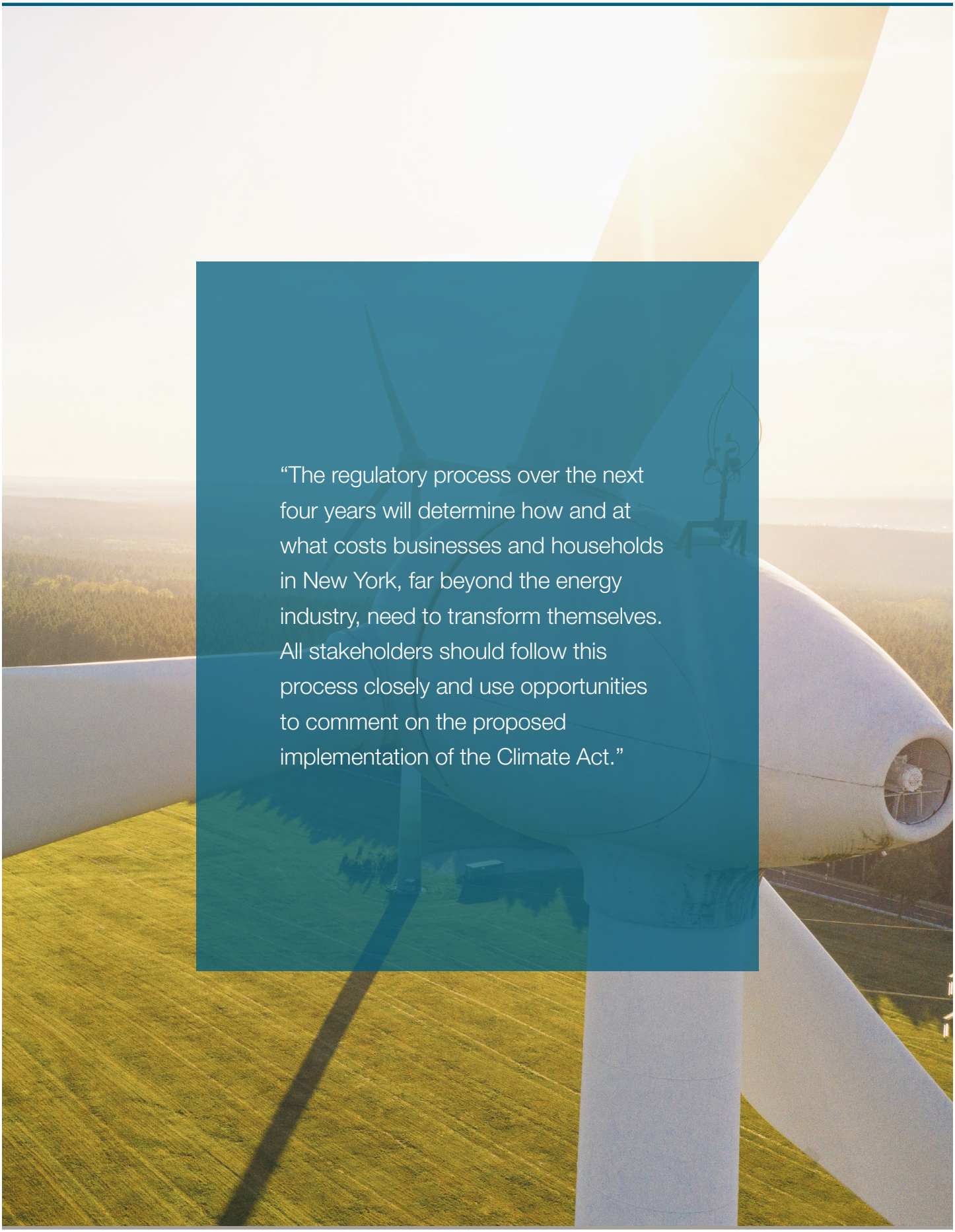

"The regulatory process over the next four years will determine how and at what costs businesses and households in New York, far beyond the energy industry, need to transform themselves. All stakeholders should follow this process closely and use opportunities to comment on the proposed implementation of the Climate Act."

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