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Comparison of New Jersey's Greenhouse Gas Reduction Targets with United States' Nationally Determined Contribution and Projected Global Reduction Pathways Consistent with the Paris Agreement

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Executive Summary

Introduction

Following the latest Intergovernmental Panel on Climate Change IPCC Sixth Assessment Report (AR6) Working Group III *Climate Change 2022 Mitigation of Climate Change* report and associated data (hereafter: AR6-WGIII, IPCC, 2022), and the 2015 Paris Agreement (UNFCCC, 2015), this report evaluates New Jersey emissions targets relative to the goals set forth in the U.S. Nationally Determined Contribution (NDC) and IPCC projections that are consistent with the Paris Agreement of keeping global temperatures well below 2°C relative to preindustrial temperatures by 2100 and pursuing efforts to limit the temperature increase to 1.5°C. Article 4.1 of the Paris Agreement recognizes that to reach the long-term temperature goal of the Agreement, carbon emissions must be cut to a small amount of residual emissions that can be absorbed and stored by nature and other removal measures resulting in zero left in the atmosphere, effectively net-zero emissions (UNFCCC, 2015; United Nations, 2025a). While President Trump notified the Secretary-General of the United Nations of the U.S. withdrawal from the Paris Agreement on January 20, 2025 (Exec Order No. 14162, 2025), under the Agreement the withdrawal does not take effect until one year from the date the withdrawal notice is received (United Nations, 2017). NDCs are submitted every five years to the secretariat of the United Nations Framework Convention on Climate Change by parties to the Agreement; the U.S. goals are set forth in the active U.S. submission (United Nations, 2025b; 2025c; US NDC, 2021). For purposes of this analysis, we use the most recent goals cited in the U.S. NDC for 2035 and, for the remainder of this report, when referring to the U.S. goals, we qualify them as “current NDC” or “recent U.S. goals.”

The 2007 New Jersey Global Warming Response Act (GWRA) established a statewide greenhouse gas (GHG) emissions goal to reduce emissions to 80% below 2006 levels by 2050 (P.L. 2007 c.112). The GWRA was updated in 2019 to address legislative directives; however, the statewide 2050 limit remained the same (P.L. 2019 c.197). Since the GWRA issuance, climate change science and assessment has advanced and there has been more than 15 years of progress in GHG emissions trajectories and policies. In 2021, Governor Phil Murphy adopted Executive Order 274, which set an interim target of reducing New Jersey’s GHG emissions to 50% of 2006’s levels by 2030 (Exec. Order No. 274, 2021). [1] This would represent a reduction of annual net emissions from 121.7 million metric tons of CO_2 equivalent units (MMT CO_2eq) in 2006 to 60.9 MMT CO_2eq by 2030. Using 2021’s net emissions from the New Jersey Greenhouse Gas Inventory (Barry and Barr, 2024), annual emissions reductions would need to be consistently about 4.1 MMT CO_2eq per year between 2021 and 2030. In the 5 years before the COVID 19 pandemic (where emissions dipped and was therefore not included), the average annual emissions reduction from 2014 to 2019 was only 0.9 MMT CO_2eq/yr, indicating that this interim goal will require much more effort in reductions.

For comparison, the current U.S. NDC notes reduction targets of net (accounting for emissions sources and sinks) GHG emissions to 50–52% by 2030 relative to 2005 levels and cites this target as a goal to keep the U.S. on a path to achieving net-zero GHG emissions by 2050 (US NDC, 2021). For this report,

[1] While the New Jersey GWRA and EO274 do not expressly note the emissions limits and targets as “net” reductions, this report in keeping with the State of New Jersey’s assessment of its progress toward the 2050 limits considers these limits in the context of net greenhouse gas emissions (see Barr et al. 2020).

these goals are converted to be relative to a common baseline year of 2015. New Jersey goals then become a 40% reduction by 2030 and a 76% reduction by 2050. U.S. GHG emissions reduction targets become a 44–47% reduction compared to 2015 values and 100% (net-zero GHG emissions) by 2050.

Approach

To evaluate how well New Jersey and recent U.S. GHG emissions reduction goals cited in the current NDC align with the Paris Agreement, projected GHG reductions were calculated for the U.S. using modeled emissions projections from AR6 WG-III that provide global- and country-scale emissions projections for a range of scenarios (IPCC, 2022). Modeled projections do not exist for New Jersey; therefore, a key assumption throughout this report is that New Jersey's emissions reductions would be proportional to the U.S. national reductions (e.g., a 50% reduction in U.S. emissions would correspond to a 50% reduction in New Jersey emissions). The changes in net GHG emissions at the global and U.S. scales across four warming scenarios that limit global warming to 2°C or lower by 2100 were calculated at 2030, 2050 and 2100 to compare with the recent U.S. and New Jersey reduction targets at 2030 and 2050. All assessment of emissions reductions were standardized to the year 2015, which was common across greenhouse gas emissions inventories as well as model projections. Additionally, the projected timing of when net-zero GHG emissions (gross GHG emission balanced by gross carbon sequestration) would occur in each scenario was also calculated (if these would occur before 2100, otherwise it is not reported).

Findings

Projected U.S. emissions reductions are presented in Table ES1. As noted above, New Jersey emissions reductions are assumed to be proportional to the modeled U.S. reductions.

Table ES1. U.S. modeled median net greenhouse gas emissions reduction targets relative to 2015 for four IPCC pathways limiting warming to 1.5°C and 2°C United States scales. Values in parentheses represent the 10th through 90th percentiles of model results. Reduction percentages more than 100% indicate net negative annual emissions (sequestration totals being greater than emission totals).[2]

Year	**U.S. Greenhouse Gas Emission Reduction Analysis**			
	1.5°C (>50% chance) no/limited overshoot	1.5°C (50% chance) high overshoot	2°C (>67% chance)	2°C (50% chance)
2030	49% (38%–62%)	31% (22%–44%)	30% (17%–49%)	25% (8%–40%)
2050	90% (82%–101%)	80% (66%–96%)	72% (56%–87%)	53% (36%–82%)
2100	102% (92%–125%)	119% (103%–132%)	102% (92%–128%)	104% (90%–126%)

[2] Note that projected U.S. emissions reductions are proportionally larger than total projected global emissions reductions as IPCC methods account for unique characteristics of each country such as size and economic policy that can influence its emissions under each warming scenario (see the Technical Documentation for further discussion).

In comparison with projected reductions, the recent U.S. national 2030 target represents a 44–47% decrease from 2015 net GHG emissions levels. The recent U.S. 2030 goals are close to the target that aligns with the scenario that limits warming to 1.5 °C with no or limited overshoot and exceeds the 2030 target that limits warming to 1.5 °C with high overshoot. The recent U.S. 2050 goal is net-zero GHG emissions (representing a 100% reduction in GHG emissions) and aligns with the IPCC pathways consistent with the goals of the Paris Agreement. New Jersey's targets represent a 40% decrease in net GHG emissions by 2030 and a 76% decrease by 2050 from 2015 levels.

New Jersey's 2030 goal is consistent with the warming scenario that limits warming to 1.5°C with high overshoot but not quite reaching the 1.5°C with no or limited overshoot. Overshoot refers to a scenario where global temperatures temporarily exceed a specified target level, in this case, 1.5°C, before eventually returning to below that level by 2100. A high overshoot requires greater effort to reduce emissions and reduce temperatures before 2100 which is corrected with further reductions in emissions and net negative emissions (carbon sequestration greater than GHG emissions) that reduce global temperatures back to 1.5°C by 2100.

However, New Jersey's 2050 goal is most consistent with limiting warming to 2°C and is proportionally less ambitious than the recent U.S. 2050 goal of net-zero GHG emissions. Additionally, New Jersey's 2050 target does not follow the stated goal of the Paris Agreement to limit global warming to "well below" 2°C by 2100. New Jersey's 2050 goal of 80% below 2006 levels is not consistent with recent U.S. goals of achieving net-zero GHG emissions by 2050, and to be in alignment with these goals New Jersey would have to amend its 2050 emission reduction goal to net-zero emissions by 2050. This change would also better align with the Paris Agreement, helping to limit warming to 1.5°C by 2100.

As previously noted, the U.S. has submitted its withdrawal from the Paris Agreement; however, states and other entities continue to be committed to goals and activities aligning with Paris, including a net-zero future. This includes the U.S. Climate Alliance, a coalition of U.S. governors from 24 states and territories (including New Jersey) representing approximately 54% of the U.S. population and 57% of the U.S. economy (https://www.usclimatealliance.org/). Currently, 16 states in the U.S. (including New Jersey's neighbors New York and Delaware) have mandatory net-zero carbon emissions goals in place (Figure ES1); most state net-zero goals have been enacted by statute, while a few have been through executive order or executive directive (see Appendix A). Some states also have policies that explicitly identify the need for net negative emissions. For example, California's statute notes it is the policy of the state both to achieve net-zero GHG emissions as soon as possible, but no later than 2045, and achieve and maintain net negative GHG emissions thereafter, and ensure that by 2045 anthropogenic GHG emissions are reduced at least 85% below 1990 levels (The California Climate Crisis Act, 2022), while Hawaii has a net-negative goal by 2045 (Act 15, Session Laws of Hawai'i, 2018).The Port Authority of New York and New Jersey also has a goal in line with the Paris Agreement of net-zero carbon emissions by 2050, with a pathway set out in its 2023 NetZero Roadmap (Port Authority of New York and New Jersey, 2021; Port Authority of New York and New Jersey, 2023). To be in line with recent national goals that are in alignment with Paris, as well as with the U.S. Climate Alliance aspirations, other states in the Northeast and elsewhere throughout the country, and the Port Authority, New Jersey would need to amend its 2050 emission reduction goal to net-zero emissions by 2050.

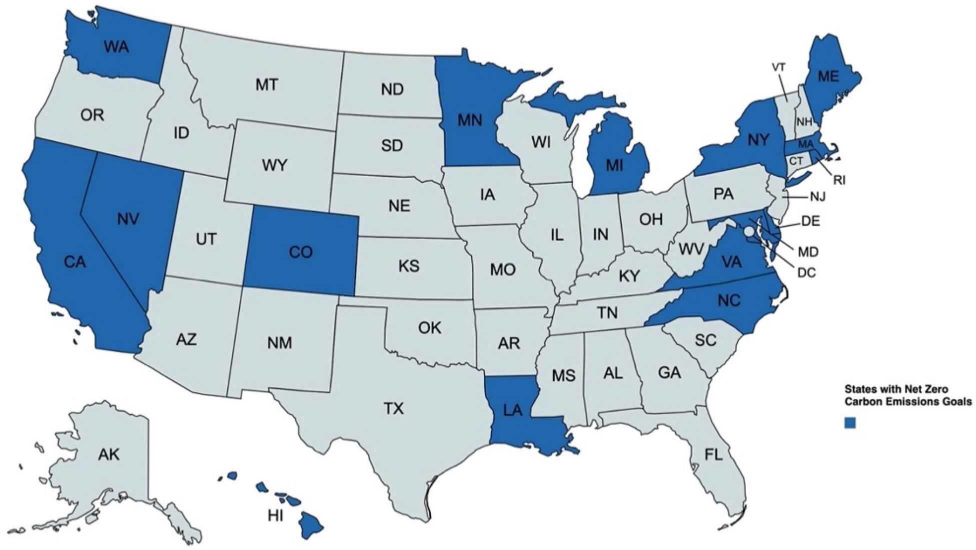

Figure ES1. States with net-zero emissions goals.

Note that this assessment does not account for U.S. action or other policies such as international climate financing for emissions reductions that may be built into the AR6 models and affect global emissions trends. While recent U.S. domestic reduction targets may match with IPCC modeled scenarios, there are other dimensions in which global reductions progress need to be evaluated but is outside the scope of this analysis.

I. Introduction

In 2007, New Jersey adopted the Global Warming Response Act (GWRA) which, among other provisions, established a statewide limit of reducing New Jersey greenhouse gas (GHG) emissions to 80% below state 2006 levels by 2050 (P.L. 2007 c.112). At the time, the statewide 2050 limit was consistent with the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4), which detailed that keeping GHG concentrations below 450 parts per million carbon dioxide equivalent units, thereby limiting warming to between 1.4°C to 3.1°C with a best estimate of 2.1°C by 2100 compared to preindustrial levels, would require that developed countries reduce GHG emissions by 85-95% by 2050 compared to 1990 emissions(IPCC, 2007a, b). The GWRA was updated in 2019 to address legislative directives; however, the statewide 2050 limit remained the same (P.L. 2019 c.197). Since AR4, climate change science and assessment has continued to advance and there has been more than 15 years of progress in GHG emissions trajectories and policies globally. In 2021, Governor Phil Murphy adopted Executive Order 274 that set an interim target of reducing New Jersey's GHG emissions to 50% of 2006's levels by 2030 to track progress towards the 2050 limit (Exec. Order No. 274, 2021).

Given the release of the latest IPCC Sixth Assessment Report (AR6) Working Group III *Climate Change 2022 Mitigation of Climate Change* report and associated data (hereafter: AR6-WGIII, IPCC, 2022), and the 2015 Paris Agreement (UNFCCC, 2015), it is worthwhile to evaluate New Jersey emissions limits and targets relative to recent national goals and IPCC projections that are consistent with the Paris Agreement of keeping global temperatures well below 2°C relative to preindustrial temperatures by 2100 and pursuing efforts to limit the temperature increase to 1.5°C. Article 4.1 of the Paris Agreement recognizes that to reach the long-term temperature goal of the Agreement, carbon emissions must be cut to a small amount of residual emissions that can be absorbed and stored by nature and other removal measures resulting in zero left in the atmosphere, effectively net-zero emissions (UNFCCC, 2015; United Nations, 2025a). While President Trump notified the Secretary-General of the United Nations of the U.S. withdrawal from the Paris Agreement on January 20, 2025 (Exec Order No. 14162, 2025), under the Agreement the withdrawal does not take effect until one year from the date the withdrawal notice is received (United Nations, 2017). NDCs are submitted every five years to the secretariat of the United Nations Framework Convention on Climate Change by parties to the Agreement; the U.S. goals are set forth in the active U.S. submission (United Nations, 2025b; 2025c; US NDC, 2021). For purposes of this analysis, we use the most recent goals cited in the U.S. NDC for 2035 and, for the remainder of this report, when referring to the U.S. goals, we qualify them as "current NDC" or "recent U.S. goals."

II. Report Purpose

This report assesses the extent to which New Jersey's 2030 interim emissions reduction target and the 2050 statutory limit are aligned with current scientific assessments of emissions reductions necessary to meet the 2015 Paris Agreement goals. These emissions reduction goals represent checkpoints prior to 2100 that help ensure that New Jersey is contributing to global emissions reductions and helping to prevent global temperatures from reaching dangerously high levels by 2100. Additionally, this report compares New Jersey targets within the context of recent national U.S. GHG emissions reduction goals and how well those U.S. goals align with Paris Agreement targets. Note that while this report focuses on New Jersey and the recent U.S. emissions goals by 2030 and 2050, further reductions culminating in annual net negative greenhouse gas emissions will be necessary through 2100 to meet Paris Agreement targets. Currently, the NJ Department of Environmental Protection (NJDEP) estimates that New Jersey sequesters 8.1 million metric tons of carbon dioxide equivalent units (MMT CO_2eq) per year (about 7.5% of gross emissions in 2015) and could be increased to 10.8 MMT CO_2eq by 2050; however, this increase would effectively require utilizing all available open space for sequestration (Barr et al., 2020).[3] Given the future need for negative emissions, other strategies, such as investing in sequestration activities out-of-state or technological carbon dioxide removal from the atmosphere, may be necessary to meet reduction targets past 2050.

III. Approach

To understand how New Jersey and recent U.S. emissions reduction goals align with the Paris Agreement, the necessary emissions reductions to meet IPCC warming scenarios that result in global temperatures averaging 2°C or less by 2100 were calculated. Projected reductions were calculated at the global scale and the U.S. national scale based on modeled emissions projections from AR6 WG-III (the most current models at the time of writing) that provide global- and country-scale emissions projections for a range of warming scenarios, such as those described in Table 1 (IPCC 2022; Byers et al., 2022). These projections do not exist for New Jersey specifically; therefore, a key assumption throughout this report is that New Jersey's emissions reductions would be proportional to the U.S. national reductions.

Recent U.S. and New Jersey emissions reduction goals were recomputed to be relative to the year 2015. These reductions were aligned relative to 2015 to facilitate a comparison between the U.S. and New Jersey targets and to broadly align with the start of the AR6 emissions projections (Byers et al., 2022). Also, from a practical perspective, 2015 is a year when model projections and emissions reporting from greenhouse gas inventories for the U.S. and New Jersey overlap and are easily accessible (EPA, 2022; NJDEP 2022b). The latest U.S. Nationally Determined Contribution (NDC) from April 2021 identify reduction targets of net (accounting for emissions sources and sinks) GHG emissions to 50–52% by 2030 relative to 2005 levels and note the goal of achieving net-zero GHG emissions for the U.S. (U.S. NDC, 2021). New Jersey has a similar goal for 2030 and a more limited 2050 target, with Executive Order 274 setting a target of reducing New Jersey's emissions to 50% of 2006's levels by 2030 (Exec. Order No. 274, 2021) and the GWRA limit of GHG emissions reduction of 80% by 2050 relative to 2006.[4]

The time range of when net-zero GHG emissions would occur for each warming and emissions scenario were also computed. Net-zero GHG emissions is a condition where the emissions (including CO_2 and other gases such as methane) from a location (such as New Jersey) are balanced by sequestration within its political jurisdiction.[5] At the global scale, net-zero GHG emissions is simpler to understand as the total

[3] The 2019 New Jersey Energy Master Plan and the 2020 80x50 report provide differing annual estimates of sequestration in New Jersey. For the purposes of this report, the more recent 80x50 reports of sequestration will be discussed.

[4] While the New Jersey GWRA and EO274 do not expressly note the emissions limits and targets as "net" reductions, this report in keeping with the State of New Jersey's assessment of its progress toward the 2050 limits considers these limits in the context of net greenhouse gas emissions (see Barr et al. 2020).

[5] Net-zero is often divided into two categories: net-zero CO_2 emissions and net-zero GHG emissions. Net-zero CO_2 occurs when just CO_2 emissions are balanced by sequestration while net-zero GHG occurs when total GHG emissions are balanced by sequestration. For simplicity, this report only discusses net-zero GHG emissions.

emissions from around the world balanced by total sequestration. For the purposes of this report, net-zero GHG emissions will be discussed as the U.S. 2050 goal targets net-zero GHG emissions specifically and the discussion of emissions reductions throughout are in reference to net GHG emissions. The recent U.S. 2050 goal includes net-zero GHG emissions, about 20–25 years earlier than the AR6-WGIII outlines is needed to keep temperatures to 1.5°C by 2100 at the global scale (by year 2070–2075). Implicit in these recent goals is the concept that the U.S. recognizes it will need to take more rigorous action than the global average due to its disproportionate level of emissions and economic ability to make these changes compared to many other countries as modeled in AR6-WGIII (IPCC, 2022). Finally, this report will discuss emissions reduction goals through 2050 to align with recent U.S. targets and New Jersey targets. However, continued reductions past these targets through 2100, which include net-zero GHG emissions, will be necessary to achieve Paris Agreement goals. Net-zero GHG emissions represent a milestone along this trajectory of emissions reductions through 2100, after which net negative emissions (e.g., further carbon sequestration) that remove more GHGs from the atmosphere than are emitted, becomes necessary to meet warming goals.

IV. Emissions Projections

The IPCC net emissions projections from AR6 were accessed for 2015 through 2100 via the IPCC AR6 Scenario Explorer database (Byers et al., 2022) as the combined net 'Kyoto Gases' (CO_2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) reported by each model. The median projected emissions for each year were calculated across the AR6 models for each IPCC warming scenario (Table 1). To ensure that the model projections were comparable between models, modeled emissions from 2015 to 2100 were aligned such that 2015 values matched observed emissions in 2015 through a process called harmonization (discussed in detail in the Technical Documentation section: I*PCC Climate Projections Consistent with the Paris Agreement and Data Analysis Methods*). This process ensures that each model starts from a common emissions level from which its trajectory independently progresses. These emissions projections were then converted into a percent reduction from 2015 levels at three key years: 2030 and 2050, to correspond to recent U.S. and New Jersey targets by those years, and 2100 to correspond to the Paris Agreement target year of 2100.

This report analyzes four different climate warming scenarios provided by AR6 models that limit warming to 1.5°C and 2°C by 2100 relative to preindustrial conditions, which broadly align with the bounds of the Paris Agreement of keeping global temperatures well below 2°C by 2100. These scenarios are presented in Table 1.

Table 1. Assessed IPCC warming scenarios that limit global warming to 1.5°C and 2°C above preindustrial conditions by 2100 with a brief description of each retrieved from Byers et al. (2022).

Warming Scenario	Description
Limit warming to 1.5°C by 2100 with no or limited overshoot with a greater than 50% likelihood	In this scenario, emission reductions are large enough and early enough in the century such that global warming generally does not exceed 1.5°C by 2100. In some modeled cases, temperatures briefly exceed 1.5°C before 2100 and are subsequently returned to 1.5°C due to emissions reductions and carbon sequestration. This scenario is an average of two sub scenarios that consider the necessary trajectory with and without net-zero GHG emissions. Please refer to AR6-WGIII for more detail on these sub scenarios (see IPCC, 2022).
Return global temperatures to 1.5°C by 2100 after a high overshoot with a greater than 50% likelihood	In this scenario, emission reductions are still relatively large throughout the century, but not great enough to limit global warming before the end of the century and temperatures exceed 1.5°C prior to 2100. This scenario incorporates greater action later in the century through emissions reductions and carbon capture and sequestration to return temperatures to 1.5°C by 2100 after global temperatures have greatly overshot the 1.5°C mark earlier in the century. While still meeting the Paris Agreement goal, this scenario is considered less favorable to meet 1.5°C by 2100 because of the reliance on much stronger action in the latter part of the 21st century.
Limit warming to 2°C by 2100 with a greater than 67% likelihood	This scenario limits warming to 2°C by 2100 (the upper threshold of the range discussed in the Paris Agreement) with a 67% or roughly a 2 in 3 likelihood of occurrence. Note that meeting 2°C is not in accordance with the Paris Agreement of keeping temperatures by 2100 well below 2°C but does serve as an upper limit of that framework.
Limit warming to 2°C by 2100 with a greater than 50% likelihood	This scenario limits warming to 2°C by 2100 (the upper threshold of the range discussed in the Paris Agreement) with a 50% or a 1 in 2 likelihood of occurrence. Note that meeting 2°C is not in accordance with the Paris Agreement of keeping temperatures by 2100 well below 2°C but does serve as an upper limit of that framework.

The scenarios that limit warming to 1.5°C discuss the concept of "overshoot." In these scenarios, an overshoot occurs when global average temperatures exceed the target of 1.5°C (i.e., overshooting the target warming). However, in these scenarios, this overshoot is corrected with further reductions in emissions and net negative emissions (carbon sequestration greater than GHG emissions) that reduce global temperatures back to 1.5°C by 2100. A high overshoot represents a greater departure from the 1.5°C goal and requires greater effort to reduce emissions and reduce temperatures before 2100.

Analysis

The changes in net GHG emissions at the global and U.S. scales across the four warming scenarios were calculated at 2030, 2050 and 2100 relative to 2015 to compare with recent U.S. and New Jersey reduction targets by 2050 and projected further reductions needed through 2100. In particular, the primary goal was to determine how New Jersey Executive Order 274's interim 2030 target of reducing emissions to 50% below 2006 levels and the New Jersey GWRA 2050 target of 80% emissions reductions relative to 2006 compare with the reductions necessary to achieve scenarios that limit warming to 2°C or lower. New Jersey goals were also compared to recent U.S. national emission policy targets.

The year ranges when net-zero GHG emissions would occur in each scenario were also calculated (if these would occur before 2100, otherwise it is not reported). Each model in each scenario provides a time series of emissions through 2100 at both the U.S. and global scales, though values were only reported every 10 years after 2050 in most models. To determine net-zero GHG ranges, the time range when emissions in each model crossed from being positive to negative were found and the 10-year time range when net-zero-occurred within the model was reported. This range is compared to the recent U.S. 2050 target to evaluate how well it aligns with these timings.

Caveat

To facilitate analysis, it was assumed that reported net emissions are broadly comparable between sources; however, the methods of accounting for land use sequestration may differ. Different entities (e.g., IPCC, governments) may account for what can be considered "managed" land use (and, by extension, human-mediated carbon sequestration in greenspaces) differently. It is unclear from official documentation if the IPCC, U.S., and New Jersey GHG inventories share a common methodology to determine sequestration from land use, land cover, and forestry (LULCF) and what lands would be considered in those calculations. It is beyond the scope of this report to evaluate these potentially differing methods, but it is noted here that this may be a potential limitation of the analysis. Additionally, the model outputs of sequestration from the IPCC models were not consistent, with some models apparently not providing land use sequestration values and others providing values an order of magnitude different from reported historical U.S. values. Despite these potential differences in GHG accounting, this analysis assumes all net GHG emissions reported across all entities are comparable to evaluate and compare emission reductions targets. Future detailed analyses should work to account for these uncertainties.

Analysis Results

Modeled Reductions

Modeled emissions reductions are presented In Table 2 for ease of comparison. Table 2 provides both median estimates of emissions reductions as well as the 10^{th}–90^{th} percentile range of the models from Byers et al (2022). Throughout the text, only median estimates will be discussed to aid in readability. To limit warming to 1.5°C by 2100 with no or limited overshoot, global net GHG emissions would need to be reduced by 42% by 2030, 83% by 2050, and 96% by 2100 compared to 2015 (Figure 1). To limit warming to 1.5°C by 2100 with a high overshoot, global net GHG emissions would need to be reduced by 22% by 2030, 74% by 2050, and 110% by 2100 compared to 2015. This scenario necessitates greater effort in the second half of the century to reduce emissions and sequester carbon to bring temperatures back down to 1.5°C and net-zero GHG emissions would be necessary before 2075. To this end, emission reductions would need to be greater than 100% annually by 2100 (i.e., more sequestration needs to occur than emissions). To limit warming to 2°C with a >67% likelihood, global net GHG emissions would need to be reduced by 19% in 2030, 65% by 2050, and 92% by 2100. To limit warming to 2°C with a >50% likelihood, global net GHG emissions would need to be reduced by 9% in 2030, 50% by 2050, and 94% by 2100.

In the warming scenario that limits warming to 1.5°C by 2100 with no or limited overshoot, net U.S. GHG emissions would need to be reduced by 49% by 2030, 90% by 2050, and 102% by 2100 compared to 2015 (Figure 2). To limit warming to 1.5°C by 2100 with a high overshoot, the projection indicates that U.S. net GHG emissions would need to be reduced by 31% by 2030, 80% by 2050, and 119% by 2100 compared to 2015. As above, this scenario necessitates greater effort in the second half of the century to reduce emissions and sequester carbon to bring temperatures back down to 1.5°C and net-zero GHG emissions would be necessary before 2070. To limit warming to 2°C with a >67% likelihood, net U.S. GHG emissions would need to be reduced by 30% in 2030, 72% by 2050, and 102% by 2100. To limit warming to 2°C with a >50% likelihood, net U.S. GHG emissions would need to be reduced by 25% in 2030, 53% by 2050, and 104% by 2100.

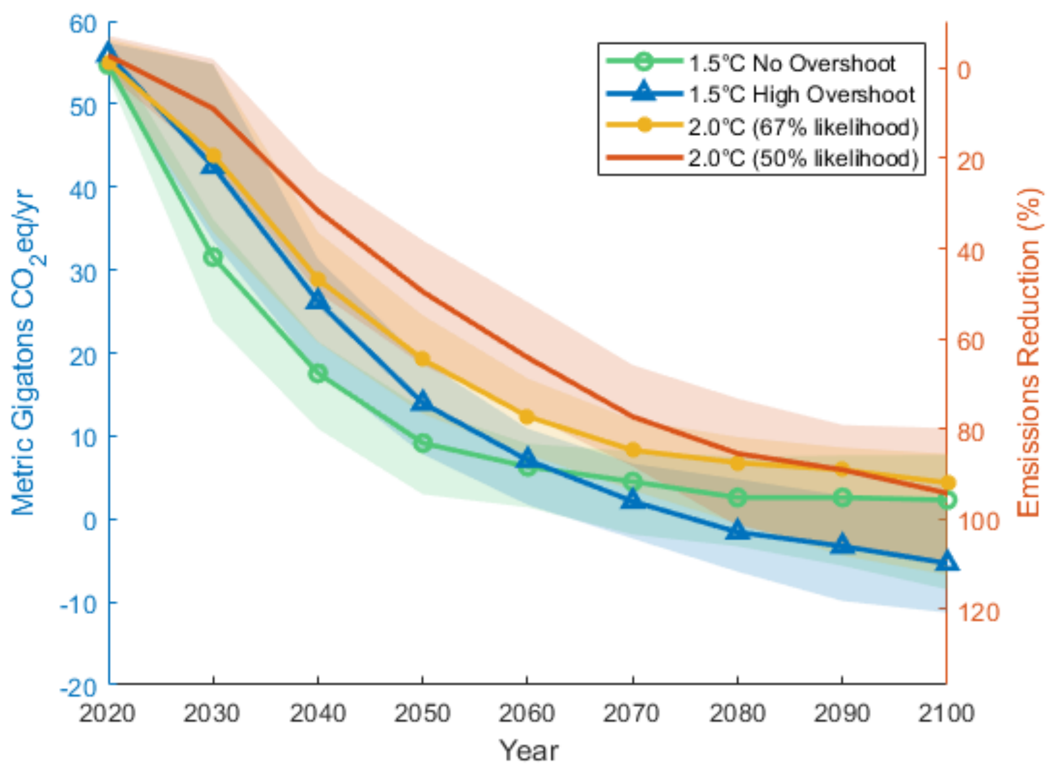

Figure 1. Modeled reduction in global net greenhouse gas emissions for the four explored emissions scenarios that limit warming at or below 2°C by 2100 relative to preindustrial conditions (Byers et al., 2022). The left axis presents these as absolute emissions in MMT CO_2eq per year while the right axis displays this information as a percent reduction from 2015 global emissions levels derived from Byers et al. (2022). The lines represent the median projected emission by scenario for the given year and shaded regions represent the 10th–90th percentiles of model projections. Emissions are harmonized to the same 2015 base year emissions.

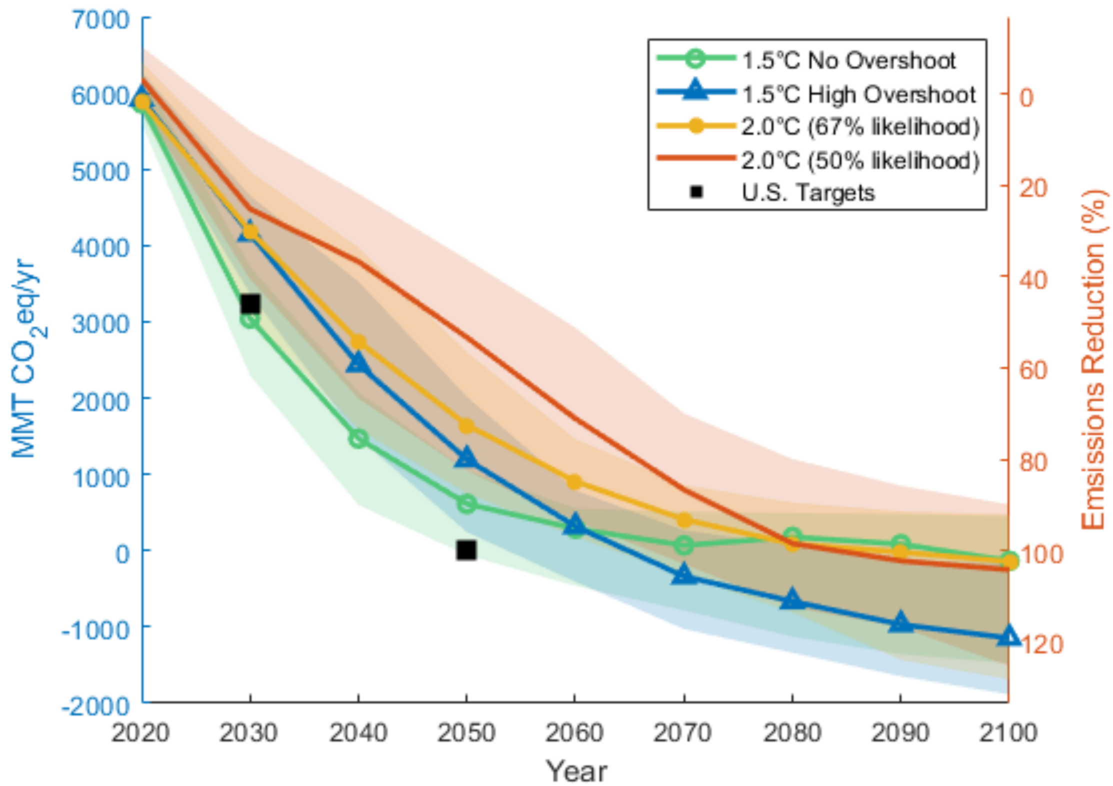

Figure 2. Modeled reduction in United States net greenhouse gas emissions for the four explored emissions scenarios that limit warming at or below 2°C by 2100 relative to preindustrial conditions (Byers et al., 2022). The left axis presents these as absolute emissions in MMT CO_2eq per year while the right axis displays this information as a percent reduction from 2015 U.S. emissions levels as reported by in the U.S. Biennial Transparency Report (2024). The lines represent the median projected emission by scenario for the given year and shaded regions represent the 10^{th}–90^{th} percentiles of model projections. Emissions are harmonized to the same 2015 base year emissions. The black boxes represent the approximate timing and magnitude of U.S. emission goals by 2030 and 2050.

National and State Goals

The recent U.S. national 2030 target represents a 44–47% decrease from 2015 net GHG emissions levels (U.S. NDC, 2021; U.S. EPA, 2022). The recent U.S. 2050 goal is net-zero GHG emissions (representing a 100% reduction in GHG emissions) (U.S. NDC, 2021; Figures 3, 4). New Jersey's targets represent a 40% decrease in net GHG emissions by 2030 and a 76% decrease by 2050 from 2015 levels (P.L. 2007 c.112; Exec. Order No. 274, 2021; NJ DEP 2022). New Jersey does not have a stated, economy-wide net-zero GHG emissions goal at the time of writing. Again, while these goals are limited to 2030 and 2050, further emissions reductions and sequestration throughout the remainder of the 21^{st} century will be required to limit warming to 2°C or lower by 2100 (Table 2).

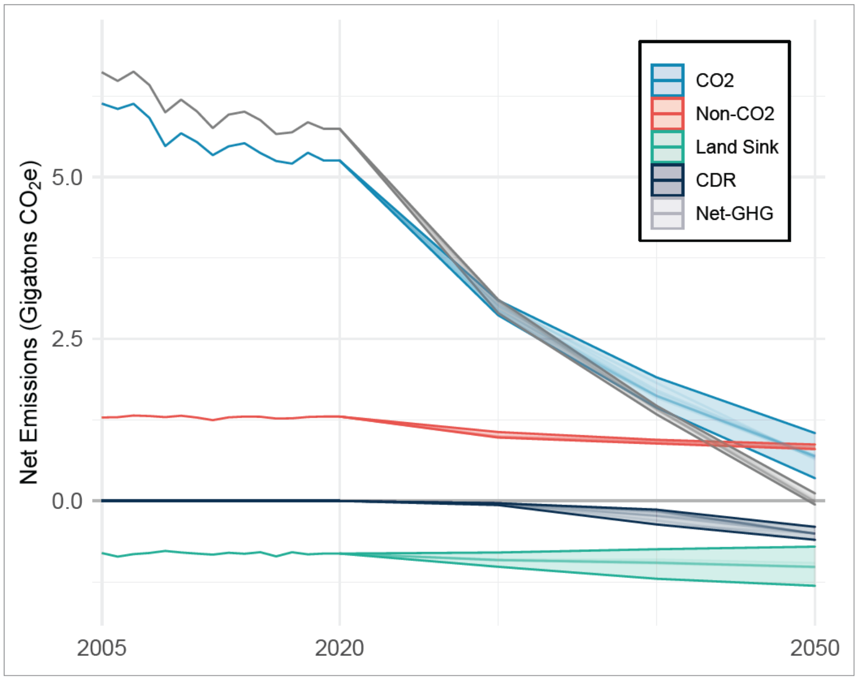

Figure 3. Reproduced from US Long-Term Strategy (U.S. DOS and EOP, 2021), Figure 17. U.S. emissions consistent with national targets**.** Reductions in carbon dioxide emissions (blue), non-carbon dioxide emissions (orange), and net greenhouse gas emissions (beige), along with land sink (green) and carbon dioxide removal (CDR) sequestration (grey) consistent with the U.S. 2030 and 2050 targets.

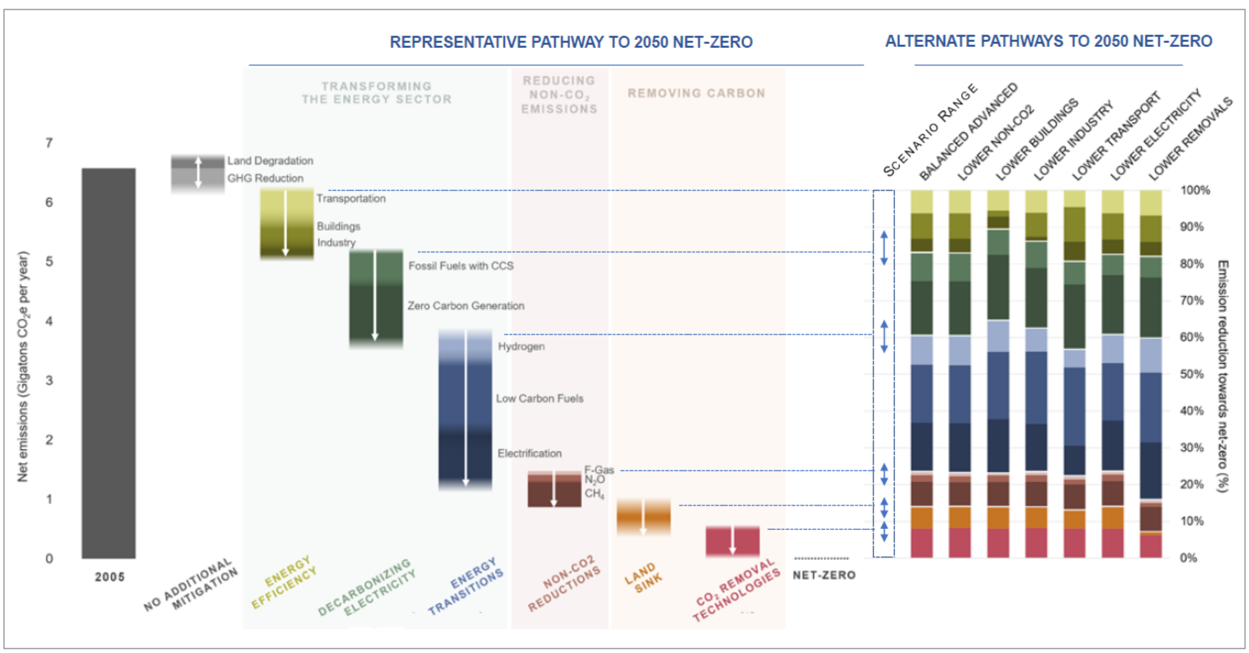

Figure 4. Reproduced from U.S. Long-Term Strategy (U.S. DOS and EOP, 2021), Figure 3. Emissions reduction pathways to achieve 2050 net-zero GHG emissions in the United States.

Table 2. Comprehensive table of IPCC net greenhouse gas emissions reduction scenarios that limit warming to 2°C or lower by 2100 and necessary global and U.S. emissions reductions at 2030, 2050, 2100 relative to 2015 to achieve these scenarios. Note that a reduction of more than 100% indicates net negative emissions (sequestration).

2015 Paris Agreement			
Limit global temperatures to well below 2°C relative to preindustrial levels by 2100 and pursue efforts to limit global temperature increase to 1.5°C			
IPCC AR6 (2021) Modeled Net Emissions Reductions Relative to 2015 for Four Warming Scenarios *Median estimates with 10th–90th percentile range in parentheses*			
Limit warming to 1.5°C by 2100 with no or limited overshoot with >50% likelihood			
	2030	2050	2100
Global Emissions Reductions	42% (34%–56%)	83% (76%–95%)	96% (86%–116%)
U.S. Emissions Reductions	49% (38%–62%)	90% (82%–101%)	102% (92%–125%)
Return global temperatures to 1.5°C by 2100 after a high overshoot with >50% likelihood			
	2030	2050	2100
Global Emissions Reductions	22% (-1%–38%)	74% (65%–86%)	110% (96%–121%)
U.S. Emissions Reductions	31% (22%–44%)	80% (66%–96%)	119% (103%–132%)
While this scenario presents fewer emission reductions by 2050 to achieve 1.5°C compared to the first warming scenario, more reductions and carbon sequestration are required by 2100 to pull temperatures back to 1.5°C			
Limit warming to 2°C by 2100 with a greater than 67% likelihood			
	2030	2050	2100
Global Emissions Reductions	19% (-1%–36%)	65% (55%–77%)	92% (86%–112%)
U.S. Emissions Reductions	30% (17%–49%)	72% (56%–87%)	102% (92%–128%)
Limit warming to 2°C by 2100 with a greater than 50% likelihood			
	2030	2050	2100
Global Emissions Reductions	9% (-2%–21%)	50% (38%–66%)	94% (80%–111%)
U.S. Emissions Reductions	25% (8%–40%)	53% (36%–82%)	104% (90%–126%)

Recent U.S. Net Greenhouse Gas Emissions Reductions Goals Relative to U.S. 2015 Emissions		
U.S. Nationally Determined Contribution target reduces greenhouse gas emissions to 50–52% of 2005 levels by 2030; and cites a target of net-zero greenhouse gas emissions by 2050		
	2030	2050
U.S. Emissions Reductions	44–47%	100% (net-zero GHG emissions)

New Jersey Net Greenhouse Gas Emissions Reductions Goals Relative to N.J. 2015 Emissions		
New Jersey Global Warming Response Act (2007 & 2019) limits statewide emissions reduction by 80% below 2006 levels by 2050; Governor Murphy's Executive Order 274 (2021) targets emissions reductions of 50% below 2006 levels by 2030		
	2030	2050
NJ Emissions Reductions	40%	76%

**Reduction baselines differ between entities and therefore are presented relative to 2015 greenhouse gas emissions for ease of comparison. (IPCC AR6 - 2019; New Jersey - 2006; the U.S. - 2005)*
***All calculated reductions are computed as CO_2 equivalent (CO_2eq) units*
**** Reductions in excess of 100% indicate net negative annual emissions from sequestration*

Assessment

While as previously noted, the U.S. has submitted its withdrawal from the Paris Agreement, states and other entities continue to be committed to goals and activities aligning with Paris, including a net-zero future. This includes the U.S. Climate Alliance, a coalition of U.S. governors from 24 states and territories (including New Jersey) representing approximately 54% of the U.S. population and 57% of the U.S. economy (https://www.usclimatealliance.org/). Currently, 16 states in the U.S. (including New Jersey's neighbors New York and Delaware) have mandatory net-zero carbon emissions goals in place (Figure 4); most state net-zero goals have been enacted by statute, while a few have been through executive order or executive directive (see Appendix A). Some states also have policies that explicitly identify the need for net negative emissions. For example, California's statute notes it is the policy of the state both to achieve net-zero GHG emissions as soon as possible, but no later than 2045, and achieve and maintain net negative GHG emissions thereafter, and ensure that by 2045 anthropogenic GHG emission are reduced at least 85% below 1990 levels (The California Climate Crisis Act, 2022), while Hawaii has a net-negative goal by 2045 (Act 15, Session Laws of Hawai'i, 2018).. The Port Authority of New York and New Jersey also has a goal in line with the Paris Agreement of net-zero carbon emissions by 2050, with a pathway set out in its 2023 NetZero Roadmap (Port Authority of New York and New Jersey, 2021; Port Authority of New York and New Jersey, 2023).

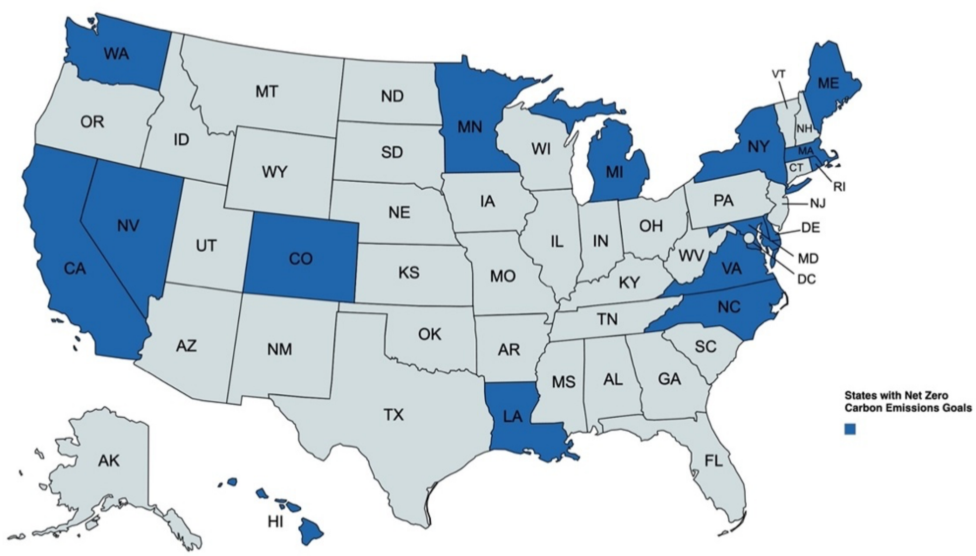

Figure 4. States with net-zero emissions goals.

This report assumes that New Jersey's GHG emissions reductions can be viewed as proportional to the larger U.S. national emissions (i.e., the same percent reductions modeled for the U.S. are applied to New Jersey). Recent U.S. targets for 2030 are close to meeting the IPCC modeled pathways that limit warming within the range of 1.5°C to 2°C depending on potential land use changes. The recent U.S. 2050 goal of net-zero GHG emissions aligns with IPCC pathways consistent with the goals of the Paris Agreement.

New Jersey's 2030 goal is consistent with the warming scenario that limits warming to 1.5°C with high overshoot but not quite reaching the 1.5°C with no or limited overshoot. However, New Jersey's 2050 goal is most consistent with limiting warming to 2°C and is proportionally less ambitious than the recent U.S. 2050 goal of net-zero GHG emissions (i.e., the recent NDC goal). Additionally, New Jersey's 2050 target does not follow the stated goal of the Paris Agreement to limit global warming to "well below" 2°C by 2100 (UNFCCC, 2015). Therefore, New Jersey would have to amend its 2050 emission reduction goal to net-zero emissions by 2050 to be in alignment with the NDC, the U.S. Climate Alliance (of which New Jersey is a member), 16 other states in the U.S. with net zero goals (including New Jersey's neighbors New York and Delaware) and the Port Authority of New York and New Jersey. This change would also better align with the Paris Agreement, helping to limit warming to 1.5°C by 2100.

New Jersey's Progress Toward 2030

In 2021, Governor Phil Murphy adopted Executive Order 274 that set an interim target of reducing New Jersey's GHG emissions to 50% of 2006 levels by 2030 (Exec. Order No. 274, 2021). [6] This would represent a reduction of annual net emissions from 121.7 million metric tons of CO_2 equivalent units (MMT CO_2eq) in 2006 to 60.9 MMT CO_2eq by 2030. Using 2021's net emissions from the New Jersey Greenhouse Gas Inventory (Barry and Barr, 2024), annual emissions reductions would need to be consistently about 4.1 MMT CO_2eq per year between 2021 and 2030. In the 5 years before the COVID 19 pandemic (where emissions dipped and was therefore not included), the average annual emissions reduction from 2014 to 2019 was only 1.0 MMT CO_2eq, indicating that this interim goal will require much more effort in reductions.

[6] While the New Jersey GWRA and EO274 do not expressly note the emissions limits and targets as "net" reductions, this report in keeping with the State of New Jersey's assessment of its progress toward the 2050 limits considers these limits in the context of net greenhouse gas emissions (see Barr et al. 2020).

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Appendix A. State Net-zero Goals

Currently, 16 states in the U.S. have mandatory net-zero carbon emissions goals in place. These states include several in the Northeast including New Jersey's neighbors, New York and Delaware. While New Jersey does have emissions reduction goals, the state does not currently have any net-zero goals in place. Most state net-zero goals have been enacted by statute, while a few have been through executive order or executive directive.

State	Name of Bill/Law/ Executive Order	Net-zero Goal Year	Signed into Law	Governor at Time of Bill Passing	Link
CA	AB-1279 Chapter 337, Statutes of 2022 The California Climate Crisis Act	2045	September 16, 2022	Gov. Gavin Newsom	link
CO	SB23-016 Greenhouse Gas Emission Reduction Measures	2050	May 11, 2023	Gov. Jared Polis	link
DE	HB 99 Delaware Climate Change Solutions Act of 2023	2050	August 3, 2023	Gov. John Carney	link
HI	HB 2182 Hawai'i Revised Statutes §225P-4 (Act 15, Session Laws of Hawai'i (SLH) 2018	2045	June 4, 2018	Gov. David Ige	link
LA	EO JBE 2020-18 Climate Initiatives Task Force	2050	August 19, 2020	Gov. John Bel Edwards	link

MA	S. 9 Chapter 8 of the Acts of 2021 An Act Creating A Next-Generation Roadmap For Massachusetts Climate Policy	2050	March 26, 2021	Gov. Charlie Baker	link
MD	SB0528 CH0038 Climate Solutions Now Act of 2022	2045	April 9, 2022	Gov. Larry Hogan	link
ME	H.P. 1045 - L.D. 1429 Sec. 1. 38 MRSA §576-A, sub-§2-A	2045	March 29, 2022	Gov. Janet Mills	link
MI	Executive Directive 2020-10 Building a Carbon-Neutral Michigan	2050	September 23, 2020	Gov. Gretchen Whitmer	link
MN	Sec. 61 Section 216H.02, subdivision 1 HF2310 SF2438	2050	May 24, 2023	Gov. Tim Walz	link
NC	EO 246 North Carolina's Transformation to a Clean, Equitable Economy	2050	January 7, 2022	Gov. Roy Cooper	link
NV	SB 254 Chapter 323	2050	June 3, 2019	Gov. Steve Sisolak	link

NY	S. 6599 A. 8429 Climate Leadership and Community Protection Act (Climate Act)	2050	July 18, 2019	Gov. Andrew Cuomo	link
RI	R.I. Gen. Laws § 42-6.2-2 Act on Climate	2050	April 14, 2021	Gov. Dan McKee	link
VA	HB714 SB94 Article 3 § 45.2-1706.1. Commonwealth Clean Energy Policy	2045	April 11, 2020	Gov. Ralph Northam	link
WA	HB 2311 Chapter 79, Laws of 2020 RCW 70A.45.020	2050	March 19, 2020	Gov. Jay Inslee	link

Appendix B. Technical Documentation

Background, Concepts, and Definitions

The GWRA law was updated in 2019, tasking the NJ Department of Environmental Protection with assessing emissions and working with other agencies to provide recommendations for meeting the emission reduction target of at least 80% relative to 2006 levels by 2050. The October 2020, New Jersey's Global Warming Response Act 80x50 Report (hereafter: 80x50) utilizes the 2019 New Jersey Energy Master Plan (EMP) to determine recommendations for emissions reductions by sector (such as transportation and industrial emissions) along a least-cost pathway to meet the 2050 target (Barr et al., 2020). The overarching purpose of this report is to assess how New Jersey's emissions reduction targets detailed in the GWRA and 80x50 comport with the stated goal of the 2015 Paris Agreement to limit warming by 2100 to well below 2°C. Additionally, this report compares New Jersey's GHG emissions reduction targets with recent U.S. NDC targets regarding GHG emissions reductions by 2030 and 2050. While President Trump notified the Secretary-General of the United Nations of the U.S. withdrawal from the Paris Agreement on January 20, 2025 (Exec Order No. 14162, 2025), under the Agreement the withdrawal does not take effect until one year from the date the withdrawal notice is received (United Nations, 2017). NDCs are submitted every five years to the secretariat of the United Nations Framework Convention on Climate Change by parties to the Agreement; the U.S. goals are set forth in the active U.S. submission (United Nations, 2025b; 2025c; US NDC, 2021). For purposes of this analysis, we use the most recent goals cited in the U.S. NDC for 2035 and, for the remainder of this report, when referring to the U.S. goals, we qualify them as "current NDC" or "recent U.S. goals."

There are a few concepts to define in comparing emissions targets. The first is the concept of carbon dioxide equivalent (CO_2eq) emissions. This is a unit of measure that relates to the amount of CO_2 emissions that would cause the same temperature change over a given time horizon as an emitted amount of another GHG or a mix of GHGs (Barr et al., 2020). Under the rules adopted by Paris Agreement parties, the CO_2eq of a particular gas is computed by multiplying the emission of a GHG by its GWP for a 100-year time horizon. In short, it allows for the comparison of and evaluation of many different GHGs, whose impact may vary, within the same context. When discussing GHG emissions reductions throughout this report, the values will be in reference to CO_2eq units to account for all greenhouse gases as an aggregate number.

The second concept is net-zero GHG emissions. Net-zero GHG emissions occur when metric-weighted anthropogenic GHG emissions (all emissions, including CO_2 and others such as methane) are balanced by metric-weighted anthropogenic GHG removals over a specified period (mainly just CO_2 sequestration). Quantifying net-zero GHG emissions depends on the emission metric chosen to compare different gases, generally in reference to an individual gas's global warming potential (GWP) compared to CO_2 (IPCC 2021). Effectively, different GHGs have different strengths and time horizons for their contributions to global warming, which is quantified by its GWP. Stabilizing global average temperatures requires achieving net-zero or a sharp reduction in GHG emissions at a global scale. Net-zero U.S. GHGs before 2100 becomes necessary in warming scenarios that meet Paris Agreement goals of limiting warming to well below 2°C. However, the necessary timing of net-zero changes depending on emissions earlier in the century. Greater reductions earlier in the century can lead to a smaller degree of warming and thus net-zero is not necessary until later in the century to limit warming to 2°C. Conversely, more emissions earlier in the century would necessitate steeper emissions cuts and an earlier net-zero timing within the century to meet Paris Agreement goals.

A discussion of net-zero GHG emissions for these entities would be considered geographically, bound to all sectors within the reasonable control of the country or state. Often, net-zero emissions are considered a milestone to be achieved by a certain year to reduce warming and are integral in warming scenarios that meet the Paris Agreement standard of limiting warming to well below 2°C by 2100. Net-zero emissions represent a stage when the timeseries of net emissions transitions from positive to negative, making it an important step. After net-zero, net negative emissions (more sequestration than GHG emissions) would need to occur to help remove GHGs from the atmosphere and limit warming by 2100. IPCC projections include expected periods where net-zero GHG emissions would occur at global and national scales based on model projections for various warming scenarios. These net-zero GHG projections, and emissions reduction overall, vary by country as IPCC models consider economic, social, and political dimensions that may make emissions reductions for a country more or less difficult compared to others. While the IPCC does provide a modeled analysis of when net-zero GHG emissions would occur, it is important to note that individual countries may set their own policy of whether they will aim for net-zero emissions, and the timing of those policies may differ from IPCC projections.

Thirdly, most discussion of emissions within this report will be net emissions, that is the total emissions after considering emissions sources and removal of GHGs from the atmosphere by sinks (such as a forest removing CO_2 from the atmosphere for photosynthesis). Net emissions for each entity discussed may be calculated in slightly different ways by the authoritative sources, often due to how emissions are tracked and assumptions regarding changes to land use, land cover, and forestry (LULCF) (IPCC, 2022). For the purposes of this report, it is assumed that these potential differences in methodology would result in relatively small differences in net GHG emissions and therefore that net GHG emissions from each entity are comparable.

Finally, reduction baselines differ between entities. New Jersey places its reduction targets relative to emissions in 2006 while the U.S. utilizes emissions in 2005. The IPCC AR6 Working Group III *Climate Change 2022 Mitigation of Climate Change* (hereafter: AR6-WGIII) analysis of reductions uses a baseline of GHG emissions in 2019. To aid in comparison, these targets are recalculated to be relative to emissions in 2015, where there are reported values for each and to coincide with climate model results discussed further in the next section.

IPCC Climate Projections Consistent with the Paris Agreement and Data Analysis Methods

The latest IPCC AR6-WGIII Report provides modeled projections of how much global GHG emissions would need to be reduced from 2019 levels to result in a number of warming levels by 2100 (IPCC, 2022 Table SPM.2), including those that are consistent with the 2015 Paris Agreement. The various emission scenarios explored by the IPCC assume that individual countries will have different reduction targets that may not be proportional to the overall global median reductions. Some countries may require stronger reductions versus others based on a number of factors, such as developed vs developing country. To this end, IPCC modeled GHG emissions for the U.S. and the world overall consistent with limiting warming to or below 2°C were accessed via the IPCC AR6 Scenario Explorer database (Byers et al., 2022). The specific data field accessed was the 'Kyoto Gases' field which provides aggregate net emissions in CO_2eq for CO_2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride as reported by each model. The Explorer database provides climate model projections for the globe and countries under specific IPCC warming scenarios. Country level projections account for unique characteristics of each country such as size or economic policy that can influence its emissions under each warming scenario. For each warming scenario that limits warming to 2°C or less (nominally consistent with the Paris Agreement goals), the proportional U.S. emissions reductions are larger than the global reductions, with the U.S. reductions being 3–8% greater by 2050 and 6–10 % greater by 2100, depending on the scenario. The rationale is that the U.S., being a wealthy country, has the resources to reduce its emissions more dramatically than other countries on average. Additionally, the U.S. is a large emitter of GHGs compared to most countries, so a proportionally larger reduction would be necessary to meet Paris Agreement warming targets.

Table TD1. Assessed IPCC warming scenarios that limit global warming to 1.5°C and 2°C above preindustrial conditions by 2100 with a brief description of each.

Warming Scenario	Description
Limit warming to 1.5°C by 2100 with no or limited overshoot with a greater than 50% likelihood	In this scenario, emission reductions are large enough and early enough in the century such that global warming generally does not exceed 1.5°C by 2100. In some modeled cases, temperatures briefly exceed 1.5°C before 2100 and are subsequently returned to 1.5°C due to emissions reductions and carbon sequestration. This scenario is an average of two sub scenarios that consider the necessary trajectory with and without net-zero GHG emissions. Please refer to AR6-WGIII for more detail on these sub scenarios (see IPCC, 2022).
Return global temperatures to 1.5°C by 2100 after a high overshoot with a greater than 50% likelihood	In this scenario, emission reductions are still relatively large throughout the century, but not great enough to limit global warming before the end of the century and temperatures exceed 1.5°C prior to 2100. This scenario incorporates greater action later in the century through emissions reductions and carbon capture and sequestration to return temperatures to 1.5°C by 2100 after global temperatures have greatly overshot the 1.5°C mark earlier in the century. While still meeting the Paris Agreement goal, this scenario is considered less favorable to meet 1.5°C by 2100 because of the reliance on much stronger action in the latter part of the 21st century.
Limit warming to 2°C by 2100 with a greater than 67% likelihood	This scenario limits warming to 2°C by 2100 (the upper threshold of the range discussed in the Paris Agreement) with a 67% or roughly a 2 in 3 likelihood of occurrence. Note that meeting 2°C is not in accordance with the Paris Agreement of keeping temperatures by 2100 well below 2°C but does serve as an upper limit of that framework.
Limit warming to 2°C by 2100 with a greater than 50% likelihood	This scenario limits warming to 2°C by 2100 (the upper threshold of the range discussed in the Paris Agreement) with a 50% or a 1 in 2 likelihood of occurrence. Note that meeting 2°C is not in accordance with the Paris Agreement of keeping temperatures by 2100 well below 2°C but does serve as an upper limit of that framework.

The scenarios that limit warming to 1.5°C discuss the concept of "overshoot." In these scenarios, an overshoot occurs when global average temperatures exceed the target of 1.5°C (i.e., overshooting the target warming). However, in these scenarios, this overshoot is corrected with further reductions in emissions and net negative emissions (carbon sequestration greater than GHG emissions) that reduce global temperatures back to 1.5°C by 2100. A high overshoot represents a greater departure from the 1.5°C goal and requires greater effort to reduce emissions and reduce temperatures before 2100.

Modeled emissions time series between 2015 and 2100 were accessed for four IPCC warming scenarios (listed in Table TD1) from the IPCC AR6 Scenario Explorer database (Byers et al., 2022). Of all the reported variables, the projected timeseries of total GHG emissions and CO_2 emissions were extracted for this analysis. The IPCC models output net GHG emissions (considering sources and sinks emissions) and include net negative values from increased sequestration in some model and scenario combinations. Modeled emissions trajectories for individual model runs were harmonized, a process that aligns emissions from the selected models to a common historical emission value such that they effectively start from the same, real-world emissions value. For this process, 2015 was selected as the year in which to harmonize the models, after which each model follows its own unique trajectory through the rest of the century from this starting point. This harmonization was calculated by first subtracting the difference between the individual model and historic 2015 emission value. This difference was applied in a linearly decreasing fashion between 2015 to 2050, such that by 2050, the model emissions trajectories retrieved from the IPCC AR6 Scenario Explorer database were unmodified from 2050 through 2100, following the methodology of Forester et al. (2018) (Figure TD1). It should be noted that the AR6-WGIII report utilized a more nuanced and intensive approach to harmonize trajectories between model runs and does provide harmonized projections of global emissions but not country-scale emissions (IPCC, 2022), necessitating the harmonization calculations for the U.S.-scale projections conducted here. For the purposes of this report, the linearly decreasing offset method was judged to be adequate for this broad-scale comparison, and the both the global and U.S. specific projections were harmonized in this way to ensure maximum comparability.

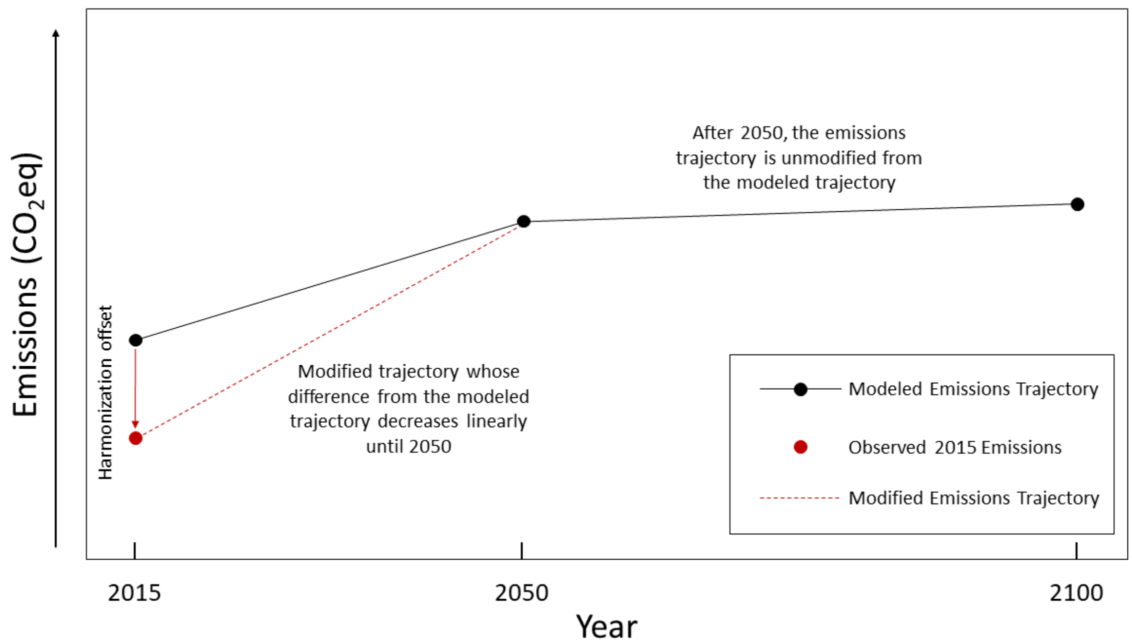

Figure TD1. Schematic diagram showing the emissions harmonization process for a simplified climate model to align with observed emissions in 2015. The red dashed line indicates the new emissions trajectory from 2015 to 2050 in which the difference between the new trajectory and the original modeled emissions trajectory linearly decreases until the lines converge at 2050.

Median emissions projections were calculated for each reported year where more than 70% of the models reported an annual value, resulting in a median estimate every 5 years from 2020 to 2050 and an estimate every 10 years from 2060 to 2100. For global emissions, the 2015 estimated total net GHG emissions were 54,308.5 MMtCO_2eq taken from the AR6 world scenarios database of infilled global emissions (Byers et al., 2022). U.S. 2015 net GHG emissions of 5,916.0 MMtCO_2eq, were taken from the Environmental Protection Agency's (EPA's) U.S. Greenhouse Gas Inventory (EPA, 2024).

Different entities (e.g., IPCC, governments) may account for what can be considered "managed" land use (and, by extension, human-mediated carbon sequestration in greenspaces) differently. It is unclear if the IPCC, U.S., and New Jersey GHG inventories share a common methodology to determine sequestration from LULCF and what lands would be considered in those calculations. For analysis, this potential difference is acknowledged. However, to facilitate the comparison between the AR6-WGIII projections and U.S. and New Jersey GHG emissions, it was assumed that this difference in methodology would be relatively small and reported net GHG emissions from each entity were utilized without modification. Future detailed studies could work to elucidate if and at what scale these differences may exist.

Table TD2. Modeled median net greenhouse gas emissions reduction targets relative to 2015 for four IPCC pathways limiting warming to 1.5°C and 2°C at the global and United States scales. 2030 values represent interim targets along the emissions trajectory resulting in the 2050 and 2100 reduction amounts. Values in parentheses represent the 10th through 90th percentiles of model results.

Year	IPCC WGIII Emissions Reduction Analysis			
	1.5°C (>50% chance) no/limited overshoot	1.5°C (50% chance) high overshoot	2°C (>67% chance)	2°C (50% chance)
Global Emissions				
2030	42% (34%–56%)	22% (-1%–38%)	19% (-1%–36%)	9% (-2%–21%)
2050	83% (76%–95%)	74% (65%–86%)	65% (55%–77%)	50% (38%–66%)
2100	96% (86%–116%)	110% (96%–121%)	92% (86%–112%)	94% (80%–111%)
United States Emissions				
2030	49% (38%–62%)	31% (22%–44%)	30% (17%–49%)	25% (8%–40%)
2050	90% (82%–101%)	80% (66%–96%)	72% (56%–87%)	53% (36%–82%)
2100	102% (92%–125%)	119% (103%–132%)	102% (92%–128%)	104% (90%–126%)

**Percentages in each warming scenario title are the likelihood of limiting warming to the associated temperature.*
*** Percentages greater than 100 indicate negative emissions through sequestration.*

Median global and U.S. specific emission reductions for IPCC warming scenarios that limit warming to 2°C or less (broadly laid out by the Paris Agreement) are presented in Table TD2 for 2030, 2050, and 2100 to coincide with New Jersey and recent U.S. reduction targets discussed in the following sections and the Paris Agreement 2100 warming target. Some of the scenarios (primarily the 1.5°C (>50% chance) no/limited overshoot) have sub scenarios accounting for variations in action. For the purposes of this report, only the overarching scenarios, their emission reductions, and the median estimate of each reported value will be discussed.

While the emissions reductions for the 1.5°C (50% chance) with high overshoot scenario are smaller by 2050 compared to the 1.5°C (>50% chance) with no/limited overshoot scenario, greater reductions and effort would be needed after 2050 to reduce temperatures back to 1.5°C with high overshoot resulting in a 110% reduction in annual emissions by 2100. While the short-term emissions reductions for the 1.5°C (50% chance) with high overshoot scenario appear smaller than the 1.5°C (>50% chance) with no/limited overshoot scenario by 2050, the need for more aggressive emissions reductions and carbon removal after 2050 means that this scenario is less favorable in achieving the Paris Agreement goal.

In this analysis, it is assumed that net global GHG emissions in 2015 were approximately 54 gigatons (Gt) of CO_2eq (Byers et al., 2022). Reported values of net GHG emissions can vary from source to source. AR6-WGIII report utilizes global bookkeeping models rather than calculating aggregate emissions from national GHG inventories. The net emissions from managed lands in 2019 estimated by AR6-WGIII are about 5.5 GtCO_2eq greater than the summation of the global 2019 national inventories (IPCC, 2022). IPCC model results incorporate anthropogenic sources and sinks of GHG emissions, including net emissions from managed land. However, what is considered an anthropogenic sink can vary between reporting mechanisms. For example, the U.S. considers a different methodology to quantify what fractions of its lands are “managed” and a potential anthropogenic sink of GHGs compared to New

Zealand (Ogle et al., 2018). Therefore, in discussing comparisons with IPCC results, the AR6 modeled emissions reductions can be used as general guidance, but it should be noted that AR6 considerations of sequestration from LULCF (and therefore what constitute net GHG emissions) may be different from how U.S. and New Jersey net GHG emissions inventories are computed based on what is considered managed land at the national and state scale. This potential mismatch in accounting means that U.S. and New Jersey policy makers may wish to consider if their GHG inventories under- or overestimate sequestration compared to AR6 methodologies before establishing or modifying emissions targets.

To facilitate comparison, all emissions reductions in this report are scaled to the year 2015 (which is common across all models and GHG inventories accessed). There can be reasonable debate on which global 2015 emissions should be considered for harmonization between models, but for the purposes of this report, the 54 $GtCO_2eq$ value reported by the models analyzed in AR6-WGIII (IPCC, 2022) is used. For the U.S., the national inventory was used, at 5,916.0 $MMtCO_2eq$ in 2015, though it is likely that the IPCC bookkeeping models produce a somewhat different value. Finally, New Jersey's reported statewide net GHG inventory emissions estimates were used, 100.6 $MMtCO_2eq$ in 2015 (NJDEP, 2022a; Barry and Barr, 2024).

Approximate modeled timings of median net-zero total GHG emissions (measured in CO_2eq) from these harmonized datasets are reported in Table TD2. Net-zero GHG emissions timings are approximated by determining the time period in which the median projected emission value reaches zero. This value is not explicitly modeled but inferred by the change in annual net emissions from positive to negative across projections. Finally, for context, the IPCC estimates that each 1000 $GtCO_2$ of cumulative CO_2 emissions results in an approximate 0.45°C increase in global surface temperatures, with a likely range of 0.27°C to 0.63°C (IPCC, 2021). This relation differs for other GHGs and combinations of GHGs and is not addressed in this report.

Summary

- AR6-WGIII and its model repository provides projections of global and U.S.-specific GHG emission reductions needed to result in likely warming levels consistent with the 2015 Paris Agreement or meet 2°C.
- The IPCC GHG accounting methods may be somewhat different from other methods, but IPCC reported numbers are utilized in this report and are relative to 2015 emissions.
- Emissions reductions necessary to limit warming are assumed to be proportionally different between countries (as per AR6 methods) based on external factors that influence emissions and capacity to adopt emissions reduction measures (technology, policy, etc.).

This report uses a simplified approach to calculate emissions reductions milestones across the models to harmonize 2015 emissions globally, nationally, and for New Jersey across the models that linearly decreases by 2050, after which the projected trajectories are unmodified.

Global and U.S. Climate Model Results

To limit warming to 1.5°C with no or limited overshoot would require an interim 42% reduction in global emissions by 2030, an 83% reduction in global emissions by 2050, and a 96% reduction in global emissions by 2100; reductions of 22% by 2030, 74% by 2050, and 110% by 2100 for the 1.5°C would be necessary for the high overshoot scenario (Figure TD2; Table TD2). These goals are in conjunction with deliberate anthropogenic removal of CO_2 from the atmosphere resulting in a greater than 100%

emissions reduction (i.e., negative emissions) by 2100 in the latter scenario (Byers et al., 2022). Net-zero greenhouse gas emissions would occur under the 1.5°C high overshoot scenario by 2070–2075 (IPCC, 2022) followed by continued negative CO_2 emissions through 2100 to meet 1.5°C by then. Net-zero total GHG emissions do not occur before 2100 in the 1.5°C with no or limited overshoot scenario due to more aggressive CO_2 reductions earlier in the century and due to one of its underlying sub-scenarios specifically tracking this scenario without net-zero GHG emissions. The sub-scenario that includes net-zero GHG emissions projected that net-zero GHG would be achieved by 2070–2075 (IPCC, 2022).

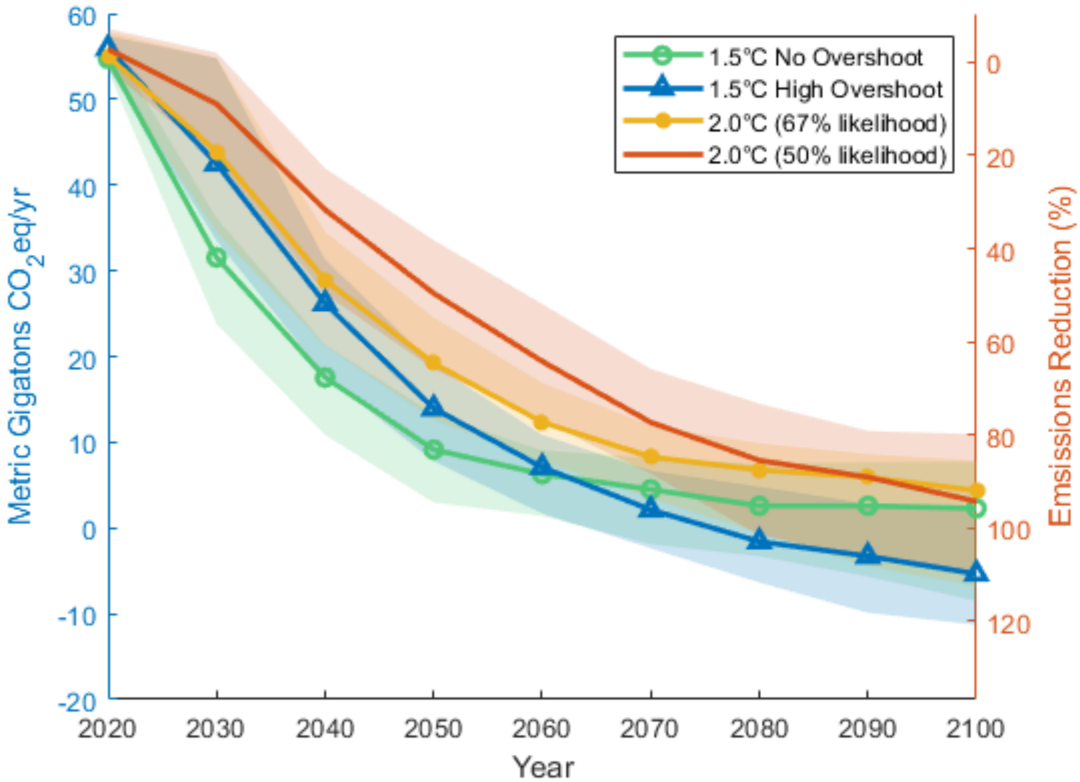

Figure TD2. Modeled reduction in global net greenhouse gas emissions for the four explored emissions scenarios that limit warming at or below 2°C by 2100 relative to preindustrial conditions (Byers et al., 2022). The left axis presents these as absolute emissions in MMT CO2eq per year while the right axis displays this information as a percent reduction from 2015 global emissions levels derived from Byers et al. (2022). The lines represent the median projected emission by scenario for the given year and shaded regions represent the 10th–90th percentiles of model projections. Emissions are harmonized to the same 2015 base year emissions.

To limit warming to 2°C with a more than 67% likelihood, global GHG emissions would need to decrease by 19% in 2030 and increase to a cumulative reduction of 65% by 2050 and 92% by 2100 (Figure TD2; Table TD2). Under this pathway, net-zero GHG emissions would likely not occur before the end of the century. Negative CO_2 emissions are still required under this pathway later in the century, but much less so than for limiting warming to 1.5°C. Finally, to limit warming to 2°C with a more than 50% likelihood, global emissions would need to decrease from 2015 levels by 9% in 2030 and increase to 50% by 2050 and 94% by 2100 (Table TD2). Net-zero GHG emissions would not be achieved before the end of the century.

The modeled U.S. emissions reductions are more aggressive than the global median. To limit warming to 1.5°C with no or limited overshoot, the U.S. would need to reduce net GHG emissions by 49% by 2030 and further reduce emissions by 90% of 2015 levels by 2050 and 102% by 2100. For 1.5°C with high overshoot, these reductions become 31% by 2030 with a cumulative increase to 80% by 2050 and 119% by 2100 (Figure TD3; Table TD2). In the first case, net-zero GHG emissions would occur between 2090 and 2100 (Table TD3). For limiting warming to 1.5°C with high overshoot, a more aggressive target of net-zero GHGs by 2060–2070 becomes necessary. Limiting warming to 2°C with a more than 67% likelihood would necessitate a 30% reduction by 2030 with an increase to 72% reduction by 2050 and 102% by 2100. This would lead to net-zero GHGs being achieved by 2080–2090. To secure 2°C of warming with a 50% likelihood, U.S. emissions would need to decrease by 25% by 2030 with an increase to 53% by 2050 and 104% by 2100, with net-zero GHG emissions occurring in 2080–2090 (Figure TD3; Table TD2; Table TD3). A caveat in the timings of net-zero emissions is that the analysis performed here is less sophisticated than the IPCC methodology for the global analysis.

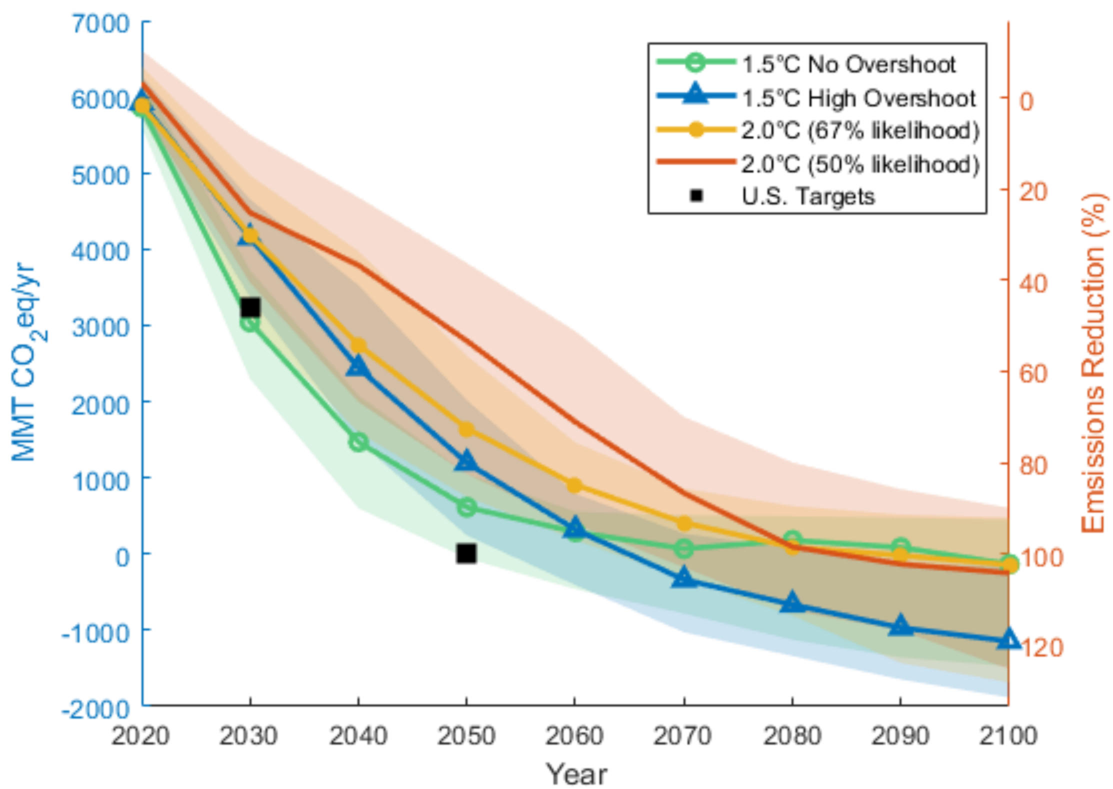

Figure TD3. Modeled reduction in United States net greenhouse gas emissions for the four explored emissions scenarios that limit warming at or below 2°C by 2100 relative to preindustrial conditions (Byers et al., 2022). The left axis presents these as absolute emissions in MMT CO2eq per year while the right axis displays this information as a percent reduction from 2015 U.S. emissions levels as reported by the U.S. EPA (2024). The lines represent the median projected emission by scenario for the given year and shaded regions represent the 10th–90th percentiles of model projections. Emissions are harmonized to the same 2015 base year emissions. The black boxes represent the approximate timing and magnitude of U.S. emission goals by 2030 and 2050.

Summary

- To limit warming to 1.5°C, global emissions would need to be reduced by 42% by 2030 with an increase to 83% by 2050 and 96% by 2100 for limited to no overshoot; for high overshoot but still limiting warming to 1.5°C by 2100, emissions would need to be reduced by 22% by 2030 with an increase to 74% by 2050 and 110% by 2100.
- To limit warming to 2°C, emissions would need to be reduced by 9-19% in 2030 with an increase to 50-65% by 2050 and 92–94% by 2100.
- U.S. emissions would need to decrease by 49% by 2030 with an increase to 90% by 2050 and 102% by 2100 from 2015 levels to limit warming to 1.5°C with no or limited overshoot and 31% by 2030, 80% by 2050, and 119% by 2100 with high overshoot.
- In limiting warming to 2°C with a >67% likelihood, the U.S. would need to reduce GHG emissions by 30% by 2030 with an increase to 72% by 2050 and 102% by 2100; for 2°C with a 50% likelihood, reductions would need to be 25% by 2030, 53% by 2050, and 104% by 2100 from 2015 levels.

U.S. National Goals

The U.S. Nationally Determined Contribution (NDC) sets reduction targets of net GHG emissions to 50–52% by 2030 relative to 2005 levels (U.S. NDC, 2021, U.S. Biennial Transparency Report, 2024), with total net emissions being 3162–3323293 million metric tons (MMt) of CO_2eq. The NDC also cites this target as a goal to keep the U.S. on a path to achieving net-zero GHG emissions by 2050 as outlined in the 2024, U.S. Biennial Transparency Report (Figure TD4). U.S. net emissions were 6645.0 in 2005 and 5988.9 MMtCO_2eq in 2015 (EPA, 2022). The recent 2030 U.S. emission target is 3162–3293 MMtCO_2eq, representing a 44–47% decrease from 2015 levels. The goal of net-zero GHG emissions by 2050 represents a 100% decrease in net GHG emissions (Figure TD5).

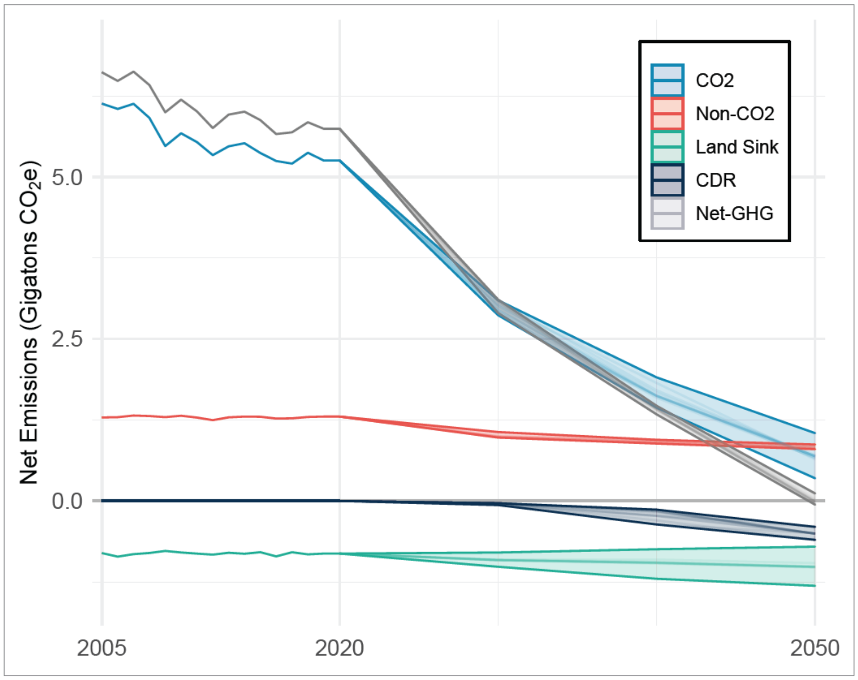

Figure TD4. Reproduced from US Long-Term Strategy (U.S. DOS and EOP, 2021), Figure 17. U.S. emissions consistent with national targets**.** Reductions in carbon dioxide emissions (blue), non-carbon dioxide emissions (orange), and net greenhouse gas emissions (beige), along with land sink (green) and carbon dioxide removal (CDR) sequestration (grey) consistent with the U.S. 2030 and 2050 targets.

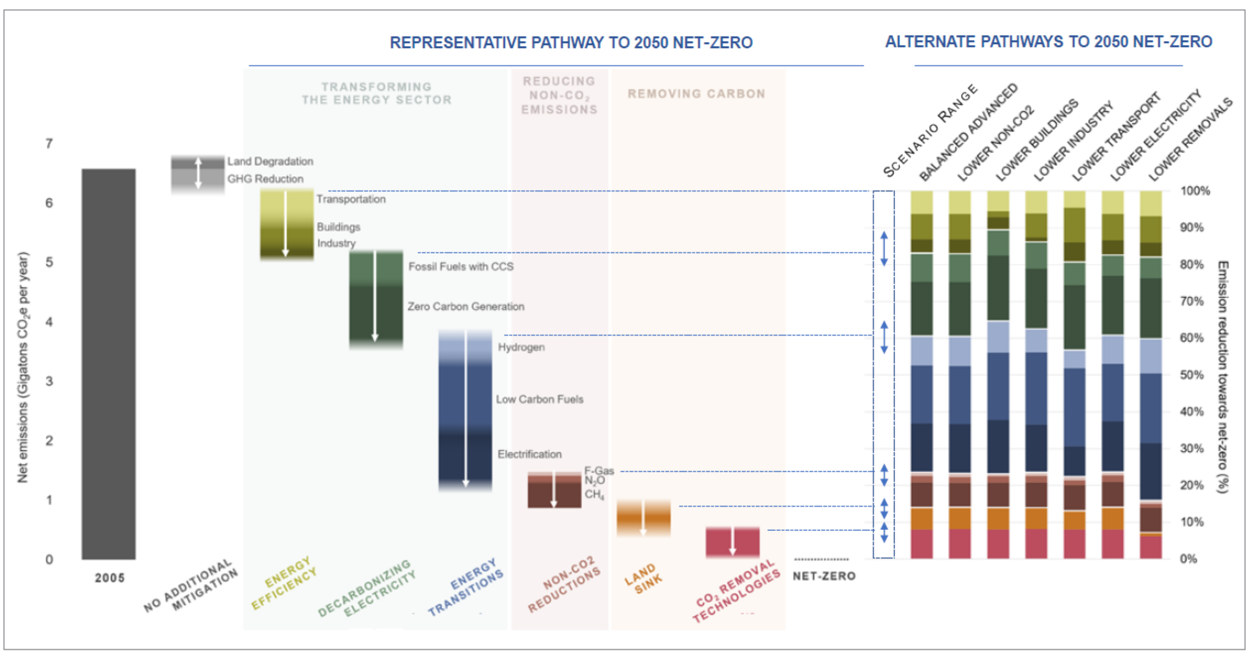

Figure TD5. Reproduced from U.S. Long-Term Strategy (U.S. DOS and EOP, 2021), Figure 3. Emissions reduction pathways to achieve 2050 net-zero GHG emissions in the United States.

Summary

- The U.S. goals for emissions reduction listed in its recent Nationally Determined Contribution is 50-52% below 2005 levels by 2030.
- The 2024 U.S. Biennial Transparency Report outlines a goal of net-zero U.S. GHG emissions by 2050 (a 100% reduction).
- These goals result in a range of projected GHG reductions relative to 2015 of 45–47% by 2030 and 100% (net-zero GHGs) by 2050.

New Jersey Goals

New Jersey's net GHG emissions in 2006 were 121.7 MMtCO_2eq and 100.6 MMtCO_2eq in 2015 (NJDEP 2022a; Barry and Barr, 2024). Reducing net GHG emissions by 50% of 2006 levels by 2030 and increasing that reduction to 80% by 2050 results in 60.9 MMtCO_2eq and 24.3 MMtCO_2eq, respectively. Relative to 2015 GHG emissions, these goals necessitate reductions of 40% by 2030 and 76% by 2050. The 80x50 report specifies that following the least cost recommended pathway from the 2019 EMP reduces emissions, without considering CO_2 sinks, to 29.8 MMtCO_2eq by 2050 (Barr et al., 2020). It also projects increasing sequestration to 10.8 MMtCO_2eq per year (up from 8.1 MMtCO_2eq in 2015) by 2050 to result in net GHG emissions of 19 MMtCO_2eq, achieving and exceeding the 2050 target. NJDEP estimates carbon sequestration using state-specific data regarding biomass carbon density and soil carbon density, using biomass carbon density factors developed by Lathrop et al. (2011) and other working assumptions (Barr et al., 2020). Small increases in sequestration in recent years can be attributed to the maturation of New Jersey forests and wetlands, despite a decrease in the land area of carbon sinks. Projections of increased sequestration rely on reforestation, natural land restoration, and conservation of existing carbon sinks throughout New Jersey, with preliminary evaluations using these land use changes of an additional 2–3 MMtCO_2eq of sequestration per year by 2050. The 80x50 report notes, however, that this projection is optimistic and would require the use of all existing open space for sequestration, a shift in land use laws and practices, and may not account for environmental changes from external forces like sea-level rise, increased forest fires, or invasive forest pests that will alter sequestration environments (Barr et al., 2020). Similarly, at the global-scale, large scale net negative emissions cannot be achieved through LULCF sequestration along, likely needing to be supplemented though carbon dioxide removal technologies (IPCC, 2022).

Summary

- New Jersey goals are to reduce net emissions by 50% of 2006 levels by 2030 (60.9 MMtCO_2eq), and 80% by 2050 (24.3 MMtCO_2eq).
- Relative to 2015 emissions, these represent a 40% decrease by 2030 and a 76% decrease by 2050.
- The GWRA: 80x50 report accounts for 29.8 MMtCO_2eq of gross GHG emissions from the EMP by 2050 and a projected 10.8 MMtCO_2eq of sequestration by 2050. The resulting net GHG emissions are then projected to be 19 MMtCO_2eq meeting the 2050 goal.

Emissions Reduction Goals Comparison

Table TD3. Year of Projected U.S. Net-Zero Greenhouse Gas Emissions for Four IPCC Pathways Limiting Warming to 1.5°C and 2°C in comparison with U.S. National and New Jersey Goals

<table>
<tr><th rowspan="2"></th><th colspan="4">IPCC WGIII Emissions Reduction Analysis 10-Year Median Intervals (U.S. Emissions)</th><th rowspan="2">U.S. Goals*</th><th rowspan="2">New Jersey Goals**</th></tr>
<tr><th>1.5°C (>50% chance) no/limited overshoot</th><th>1.5°C (50% chance) high overshoot</th><th>2°C (>67% chance)</th><th>2°C (50% chance)</th></tr>
<tr><td>Net-Zero All GHG Year</td><td>2090 – 2100</td><td>2060 – 2070</td><td>2080 – 2090</td><td>2080 – 2090</td><td>2050</td><td>-</td></tr>
</table>

*** As reported in the 2024 U.S. Biennial Transparency Report*
**NJ does not have a net-zero goal published at time of writing*

Table TD4. Recent U.S. and New Jersey Net Greenhouse Gas Reduction Goals Relative to 2015 Levels. Note Reduction Percentages for the U.S. are Presented as a Range to Mirror the 2030 Nationally Determined Contribution Goals.

Year	U.S. Reduction Goals	New Jersey Reduction Goals
2030	44–47%	40%
2050	100%	76%

U.S. Goals

The recent U.S. emissions reduction goals from U.S. NDC (2021) and U.S. Biennial Transparency Report (2024) are listed in Table TD2, recalibrated to 2015 emissions. The recent U.S. 2030 goals (44–47% decrease from 2015 values) are not quite in line with 1.5°C with a >50% chance no/limited overshoot (modeled 49% decrease from 2015 values) but do exceed the targets for the other Paris Agreement-consistent scenarios (see Table TD2 compared to TD4). The NDC cited 2050 goal of 100% net emissions reductions by 2050, does exceed every reduction benchmark derived from the modeling (Table TD2, Table TD4). It is not the purpose of this report to assess how feasible these goals are.

Considering a narrow scope only accounting for recent domestic emissions targets, it is likely that the recent U.S. goals are consistent with the scenario limiting warming to the 1.5°C (50% chance) with high overshoot and the scenario limiting warming to 2°C (>67% chance). This is comparable to the evaluation of the U.S. 2030 NDC domestic target by the Climate Action Tracker as consistent with holding temperatures at or slightly below 2°C (CAT, 2022). However, it should be noted that the Climate Action Tracker methodology also evaluates a “Fair Share Target” that incorporates an analysis of other policies (such as climate financing), and finds that the U.S. NDC goals are more consistent with limiting warming to 3°C. The Climate Action Tracker "fair share" analysis considers both the national domestic targets for emissions reductions, which it deems as average for the U.S., as well as financing for emissions reductions, including for international aid for developing countries, which the Climate Action Tracker lists as critically insufficient for meeting Paris Agreement goals (CAT, 2022). For the purposes of this analysis, the U.S. domestic targets are only compared to the modeled reductions in the AR6 models, and do not include evaluating other assumptions regarding the U.S.'s contributions to global climate financing and policy that may be built into the AR6 models and affect global emissions trends. What is clear is that while the recent U.S. domestic reduction targets may match with IPCC modeled scenarios, there are other dimensions in which global reductions progress need to be evaluated, including the U.S. international and policy contributions, that can affect warming levels.

Finally, the U.S. net-zero GHG emissions goal of 2050 is consistent with limiting warming to 1.5°C (>50% chance) with no or limited overshoot. The Climate Action Tracker does note that this net-zero goal excludes emissions from international aviation and shipping (CAT, 2022).

New Jersey Goals

In this section, New Jersey's stated goals are compared to the model national reductions and the U.S.'s recent emissions reduction targets. It is assumed that New Jersey's reductions would be proportional to the U.S. reductions, but it is important to note that each state in the U.S. has a varying contribution to the U.S. total. For a larger comparison, New Jersey is responsible for 1.7% of national emissions, and 0.3% of global emissions (NJDEP, 2024).

New Jersey's emissions reduction goals are proportionally less ambitious than the U.S. national goals and the AR6 modeled U.S. reduction trajectories for limiting warming to 1.5°C. New Jersey's emissions goals relative to 2015 are a 40% reduction in net GHG emissions by 2030 and a cumulative 76% by 2050. The NDC national reduction goal is 4–7% greater by 2030 and 24% greater by 2050 as the U.S. 2050 goal is to reach net-zero GHG emissions (i.e., 100%). Compared to the AR6 modeled trajectories for the U.S. (whose trajectories are scaled to New Jersey emissions in Figure TD6), New Jersey's 2030 goal would be consistent with limiting warming to 1.5°C (50% chance) with high overshoot but not quite reaching the 1.5°C with no or limited overshoot threshold. The 2050 goal is comparatively less ambitious, being most consistent with limiting warming to 2°C (>67% chance).

Conservatively, New Jersey's targets by 2050, when assessed as a relative portion of the U.S. targets and modeled scenarios, are consistent with the scenarios that limit warming to a maximum of 2°C. Though it should be noted that the Paris Agreement states the goal of limiting global temperature increase by 2100 to "well below" 2°C, which New Jersey's reduction goals do not seem to reflect. Finally, New Jersey, at the time of writing, does not have an established net-zero GHG emissions target (Table TD3). To be in line with the Paris Agreement and U.S. goals, future amendments to New Jersey's emission reduction goals would have to provide either projections or targets of statewide net-zero emissions. Currently, the 80x50 report targets net-zero emissions for a few individual sectors (such as reporting a trajectory from the 2019 EMP that follows Governor Murphy's goal of net-zero GHG emissions from electricity generation by 2050 [Exec. Order No. 28, 2018, Barr et al., 2020]), but a statewide net-zero strategy has not been established. As previously noted, sixteen states have net-zero goals (Appendix A), the U.S. Climate Alliance (a coalition of governors from 24 states and territories (including NJ)) has net-zero aspirations, and the Port Authority of NJ and NJ has a goal of net-zero carbon emissions by 2050 and a 2023 NetZero Roadmap. Therefore, a net-zero target would be consistent with other states' efforts, the U.S. Climate Alliance, and help position New Jersey as part of this national-scale emissions reduction cohort.

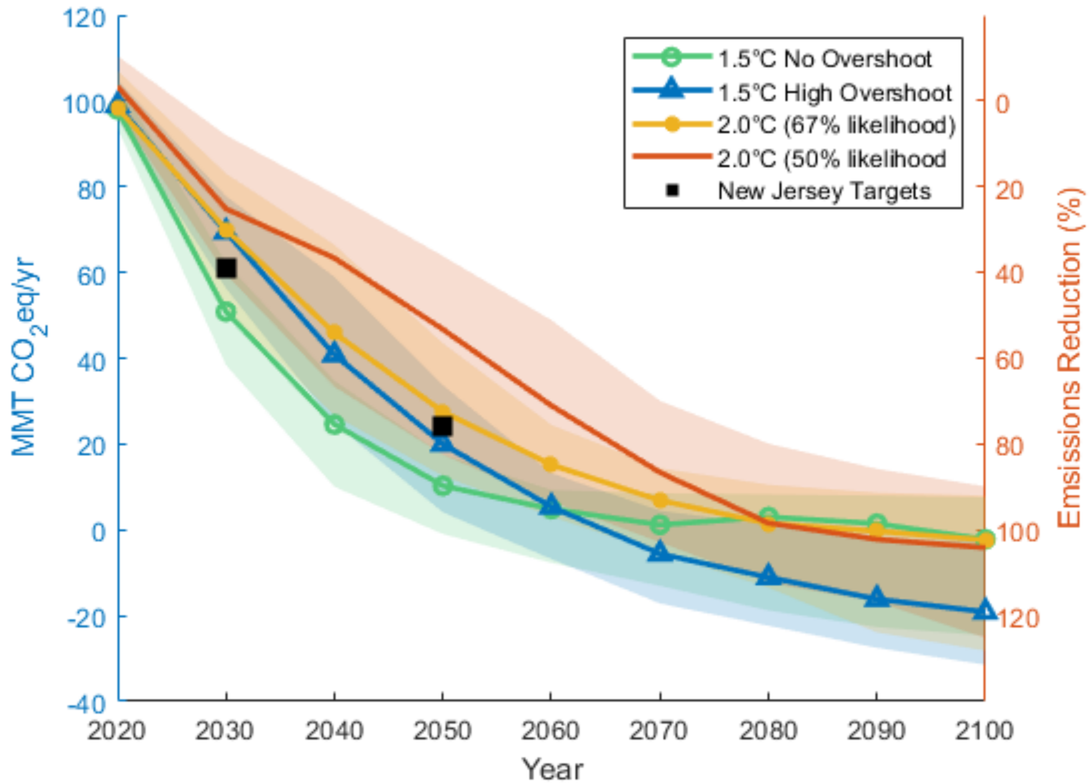

Figure TD6. Reduction in New Jersey net greenhouse gas emissions for the four explored emissions scenarios that limit warming at or below 2°C by 2100 relative to preindustrial conditions assuming a proportional reduction to modeled U.S. emission reductions (Byers et al., 2022). The left axis presents these as absolute emissions in MMT CO_2eq per year while the right axis displays this information as a percent reduction from 2015 emissions levels as reported by NJDEP (2024). The lines represent the median projected emission by scenario for the given year and shaded regions represent the 10^{th}–90^{th} percentiles of model projections. The black boxes represent the approximate timing and magnitude of New Jersey emission goals by 2030 and 2050. These emissions trajectories are not explicitly modeled but instead assume the U.S. emissions reductions percentage would apply for New Jersey state-scale emissions.

Caveats

This comparison analysis is limited for the following reasons. The first is that the analysis of the modeled global-scale and U.S. emissions reduction trajectories is based on a simpler analysis than can be found in the AR6-WGIII report (IPCC, 2022). As mentioned previously, this report uses a less intensive harmonization scheme than the AR6-WGIII report and the years between model output were not infilled, leading to the decadal intervals to define when net-zero emissions would occur. The baseline of 2015 was selected as all the datasets utilized had reported 2015 values, but agreement on which reported values to use and from which source could be debatable. For global scale emissions, the 2015 emissions values used in model harmonization were again used in this simpler harmonization scheme (Byers et al., 2022). For the U.S., the reported 2015 net emissions from the EPA greenhouse gas inventory were utilized in harmonization (EPA, 2024). Ultimately, this analysis helps to contextualize New Jersey's proportional reduction goals compared to the national goals and modeled national emissions trajectories consistent with the Paris Agreement, but it is ultimately an approximation.

Summary

- The most recent U.S. reduction targets are more ambitious than New Jersey's. U.S. recent targets by 2030 are close to the target that aligns with the scenario that limits warming to 1.5°C with limited overshoot and more than meets the 2030 target that limits warming to 1.5°C with high overshoot.
- New Jersey's 2030 goal is consistent with limiting warming to 1.5°C (50% chance) with high overshoot. It's 2050 goal is most consistent with limiting warming to 2°C (>67% chance) as can be seen in the projections described in TD6.
- New Jersey's proportional 2050 emissions target is less than the most recent national goal and what the IPCC models for the U.S. would project to try and keep temperature as close to 1.5°C as possible in line with the 2015 Paris Agreement.
- Missing from New Jersey's goals is a net-zero year for GHGs and not in line with recent national goals, as well as the goals of 16 other states in the U.S., the NY and NJ Port Authority and the aspirations of the U.S. Climate Alliance of which NJ is a member.
- Note this analysis is somewhat simplistic compared to the IPCC Working Group III report and is meant to inform approximate emissions reduction trends, goals, and how well each goal comports with the intent of the Paris Agreement.

New Jersey Emissions Progress and Next Steps

The 80x50 report provides least cost pathways from the EMP (NJBPU, 2019) to reduce emissions to achieve the target of <24.2 MMtCO_2eq emission across multiple sectors by 2050 (Figure TD7). Quoting Barr et al., (2020):

"If New Jersey implements the pathways proposed in this [the 80x50] *report, which incorporates the strategies of the 2019 EMP, GHG emissions can be reduced to 29.8 MMT CO_{2e} by 2050. This level of reductions, combined with a projected 10.8 MMT additional reduction from carbon sequestration, would bring net emissions in 2050 to 19 MMT CO_{2e}, achieving the 80x50 goal."*

The 80x50 report includes detailed strategies across the transportation, residential and commercial, electricity generation, industrial, waste and agriculture, and short-lived climate pollutant sectors to provided more specific guidance beyond the 2019 EMP. Additionally, the 80x50 report incorporates estimates for changes in carbon sequestration that can help realize the 2050 reduction in New Jersey net GHG emissions by 80% of 2006 levels.

Critically, it is important to note that this pathway was established before EO 274 (2021), marking the interim goal of reducing annual emissions to 50% of 2006 emissions which is equivalent to 60.9 $MMtCO_2eq$ by 2030. When compared to the 80x50 least cost pathway by 2030, Figure TD7 shows annual gross emissions to be approximately 80 $MMtCO_2eq$. Assuming a continued carbon sequestration rate of 8.1 $MMtCO_2eq$ per year [NJDEP, 2022b], the net emissions of the least cost pathway would be approximately 72 $MMtCO_2eq$. Therefore, the 80x50 least cost pathway appears to be 12 $MMtCO_2eq$ higher than the interim goal of reducing emissions by 50% of 2006 levels by 2030. Considering this change in New Jersey policy, the pathways described in the 80x50 report can be reassessed to determine which sectors can help target the more ambitious goal of reducing emissions by 50% of 2006 levels (equivalent to 40% of 2015 levels) by 2030 as well as which actions could address a potentially more ambitious 2050 target to align with national guidance of net-zero GHGs. Sixteen states have net-zero goals (Appendix A); therefore, a net-zero target would be consistent with other states' efforts and help position New Jersey as part of this national-scale emissions reduction cohort.

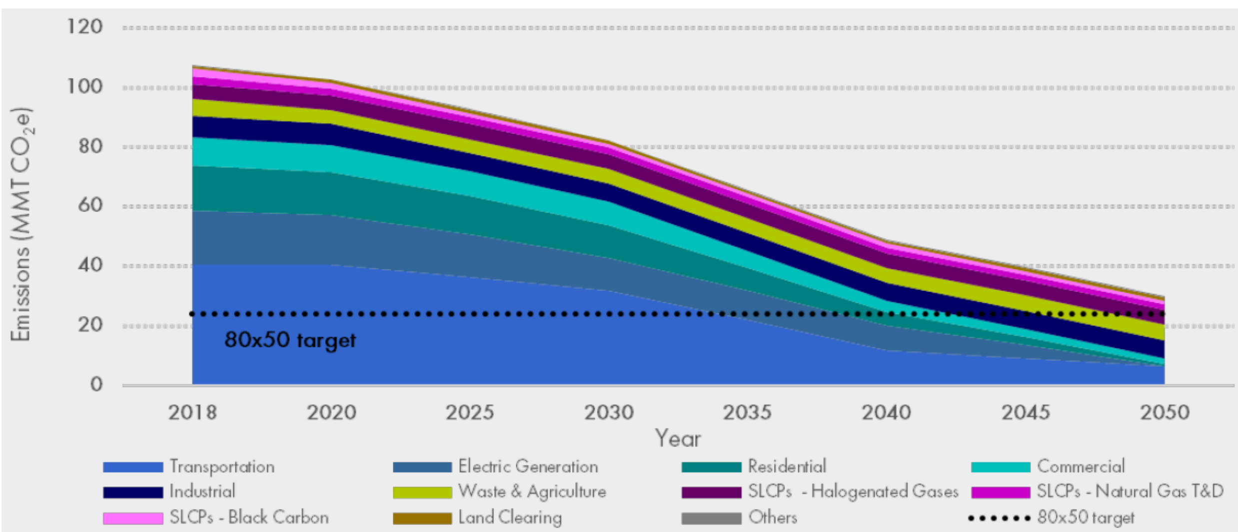

Figure TD7. Reproduced from Barr et al. (2020), Figure ES.3. The 2019 New Jersey Energy Master Plan least cost pathway combined with non-energy sector strategies to reduce gross emissions by 2050. This graphic does not include carbon sequestration, which, however, is incorporated in the evaluation of the 80x50 target.

Using the most recent New Jersey greenhouse gas inventory data available at time of writing (Barry and Barr, 2024), the 2030 goal of 60.9 $MMtCO_2eq$ per year would necessitate a reduction in net emissions of 4.1 $MMtCO_2eq$ each year from 2021 to 2030, roughly a 4.1% reduction from 2021 levels annually. It is not the purpose of this report to evaluate the feasibility of these metrics, but in 2021, net emissions in New Jersey were reduced to 97.6 $MMtCO_2eq$, representing a 1.9 $MMtCO_2eq$ decrease from pre-pandemic 2019 levels, much less than the annual emissions reductions needed to achieve the 2030 goal. And when considering the average rate of emissions reductions before the pandemic between 2014 and 2019 (5 years), the average annual reduction rate was only 1.0 MMT CO_2eq. The year 2020 represents the height of the COVID-19 pandemic, which reduced activity and emissions (Tollefson, 2021); globally, emissions rebounded to higher levels in 2021 (IEA, 2022), and it appears New Jersey emissions similarly rebounded to be similar to pre-pandemic levels. Given this rebound and comparison to pre-pandemic values, more extensive annual reductions will be necessary to meet the 2030 interim goal.

Additionally, a comprehensive and granular survey of current and planned activities to reduce emissions in New Jersey would be helpful in assessing current action toward achieving these goals. This would include assessing, sector-by-sector, current actions and accounting for each project's projected impact to New Jersey's net emissions. This approach would provide a "real world" check on progress to the pathways laid out in the 80x50 report.

For a larger comparison, using NJDEP's 2021 emissions values, New Jersey annually emits an average of 11.4 metric tons of CO_2eq per capita (Barry and Barr 2024), much lower than the national average of approximately 19.1 metric tons of CO_2eq per capita (Barry and Barr, 2024). Compared internationally, New Jersey's per capita emissions are roughly double the international average of 4.7 metric tons of CO_2eq per capita (Barry and Barr, 2024). Note, these estimates of New Jersey's emissions do not include emissions generating activities from out-of-state due to imported goods and services but do include emissions from out-of-state solid waste disposal and electricity importation (Barry and Barr, 2024).

Summary

- The establishment of New Jersey Governor Phil Murphy's Executive Order 274 modifies the trajectory of the emission reduction pathway provided in the 80x50 report to be more ambitious by 2030, resulting in the Energy Master Plan least-cost pathway needing to be reassessed in context of this new stated milestone.
- A reassessment of ongoing and planned projects, initiatives, and other activities to reduce New Jersey's emissions can help New Jersey keep track of year-over-year progress to the 80x50 goal and its continued feasibility.
- While New Jersey emissions reductions were greater from 2019 to 2020 than in preceding years, emission values rebounded in 2021 to COVID-19 pre-pandemic levels and given the trend in emissions before the pandemic, more extensive annual reductions will be necessary to meet the 2030 interim goal.
- Finally, New Jerseyans emit less CO_2eq per capita compared to the national average but still emit more than double the world average per capita.