Delaware Climate Action Plan Supporting Technical Greenhouse Gas Mitigation Analysis Executive Summary

August 31, 2020

Submitted to:
DNREC Division of Climate, Coastal and Energy

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Executive Summary

In response to the growing effects of climate change, and to further Delaware's efforts to reduce greenhouse gas (GHG) emissions, Delaware's Department of Natural Resources and Environmental Control (DNREC) is developing a statewide climate action plan (CAP). DNREC engaged ICF Incorporated, LLC (ICF) to support the planning process through technical analyses to characterize and model GHG emission sources and potential reductions. This report focuses on the key technical components of the climate action planning process, which include:

- **Component 1.** Understand the current landscape within Delaware in terms of current levels of GHG emissions and existing mitigation efforts ("Delaware's GHG Inventory and Existing Mitigation Efforts").
- **Component 2.** Understand a "business as usual" (BAU) trajectory, or the forecast of GHG emissions if no additional action were taken to reduce emissions in Delaware beyond what is happening today ("BAU Projections").
- **Component 3.** Identify and analyze a set of feasible actions that can be taken in Delaware to reduce GHG emissions in the short-, mid-, and long-term future ("Mitigation Actions Selection and Analysis").

Component 1. Delaware's GHG Inventory and Existing Mitigation Efforts

The first component of the climate action planning process is to understand the current GHG emissions and existing efforts to reduce those emissions. To understand current GHG emissions DNREC's Division of Air Quality (DAQ) conducts an annual GHG emissions inventory. The 2016 GHG Inventory, released in July 2019, includes GHG emissions from 1990 to 2016 for the following sectors: electric power, transportation, industrial, residential, commercial, agriculture, and waste. In the 2016 GHG Inventory, transportation was the largest source of emissions followed by the industrial and electric power sectors, respectively.

Figure 1. Breakout of Emissions in the 2016 Delaware GHG Inventory

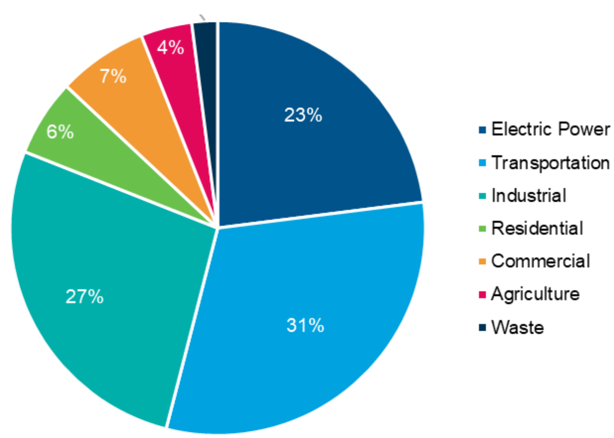


Figure 1 shows the results of Delaware's 2016 GHG Inventory by these sectors. The Delaware GHG inventory only accounts for emissions generated within the state. More specifically, GHG emissions sourced from the electric power sector are only those associated with electricity generated by in-state power generation facilities. Because not all electricity used in Delaware is generated in-state, the inventory also separately reports emissions as a result of electricity consumed in Delaware; however, these emissions are not accounted towards the state total.

A range of programs and policies, such as energy efficiency incentives and a requirement for renewable energy procurement and generation across the state ("a Renewable Portfolio

Standard") are being used right now to reduce GHG emissions in the state and provide various environmental, health, and economic benefits to Delawareans.

Component 2. BAU Projections

The second key component of the climate action planning process is to develop a "Business as Usual" (BAU) scenario for the state's current and projected GHG emissions. The BAU represents a GHG emissions scenario through 2050 under the assumption that no additional actions will be taken, nor new policies put in place in the future to reduce emissions, i.e., business will proceed as usual. The BAU serves as reference for both understanding whether Delaware will meet GHG emission goals and for estimating the GHG emission reductions that could be achieved if GHG mitigation measures are taken.

ICF conducted an analysis to develop a BAU for the state (Figure 2). The BAU provides data for the years 2005 - 2050; reported values from the year 2018 and beyond are projections. This analysis takes into consideration existing policies and programs at the state and federal level and makes assumptions about future economic conditions. The BAU analysis relies on a modified GHG accounting approach as compared to the GHG inventory presented in Figure 1 above. This modified approach focuses on the amount of electricity *consumed* in Delaware and estimates GHG emissions from electricity generated both in-state and out of state to meet Delaware's demand.

BAU Sector Descriptions

Below are brief descriptions of the types of emissions attributed to each sector. Note that the electric power sector accounts for all emissions related to electricity used within Delaware, a different approach than that used for the state GHG inventory.

Agriculture: Includes all emissions from agricultural activities including fuel use, fertilizers, and livestock emissions.

Commercial Buildings: Includes emissions from commercial building activities, such as office building and on-site fuel combustion for heating.

Electric Power: Includes all emissions associated with electricity generated for consumption (both from in-state and out-of-state generation sources).

Industry: Includes emissions associated with industry activities, such as physical and chemical material processing and manufacturing.

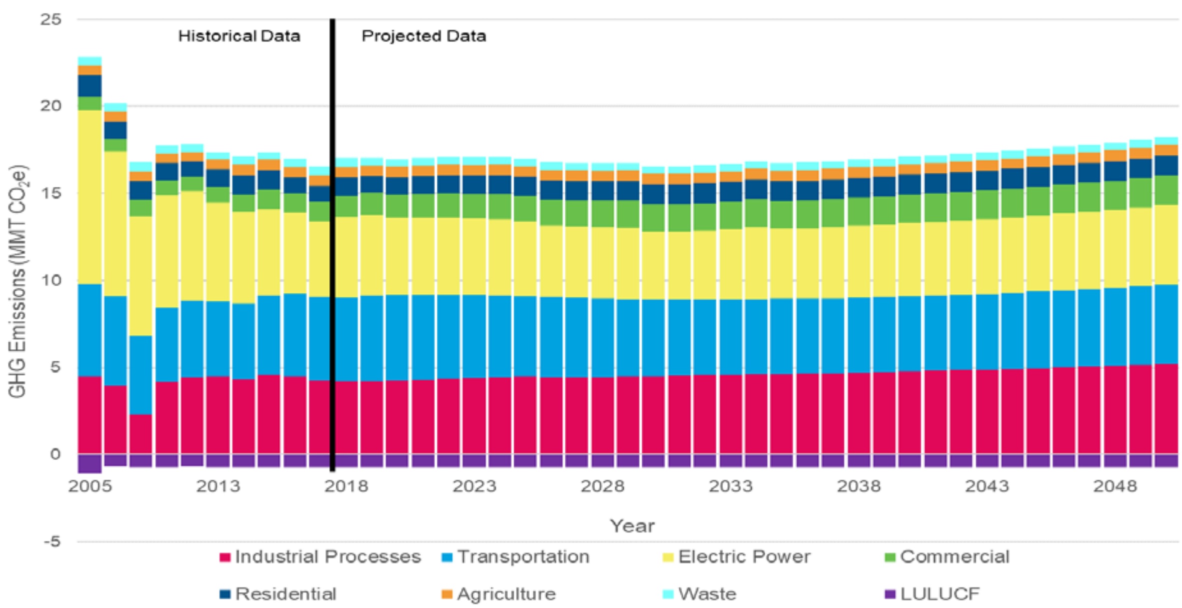
Land Use/Forestry (LULUCF): Includes emissions from land use and forestry activities, where carbon is either captured (sequestered) or released depending on land use.

Residential Buildings: Includes emissions from home residences, such as on-site fuel combustion for heating.

Transportation: Includes emissions generated from the transportation of goods, people, and services, particularly burning fuel for combustion engines.

Waste: Incudes emissions from waste disposal activities, including methane released from landfills.

Figure 2. Net BAU Emissions (MMTCO2e) by Sector Through 2050



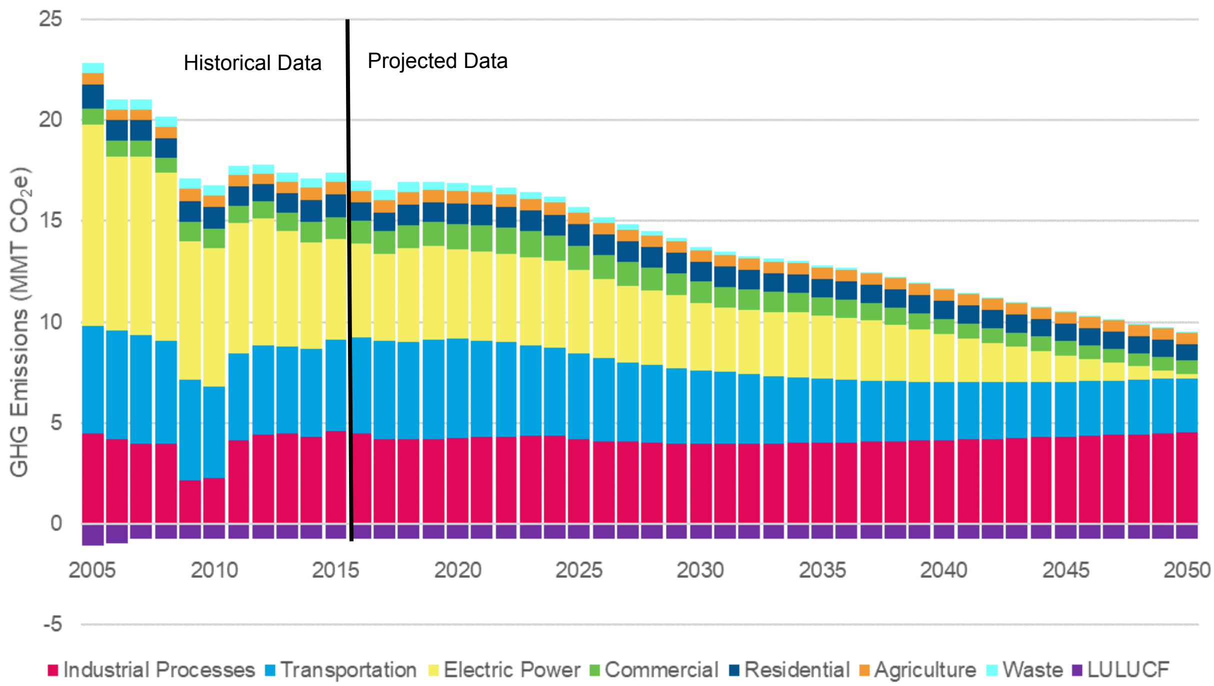
The BAU analysis indicates Delaware's GHG emissions will be reduced by 25.4% in 2025 and by 19.6% in 2050 from 2005 levels (Figure 2). The projection indicates that Delaware is close to meeting its goal of 26-28% emissions reductions by 2025 from 2005 levels. The trend of decreasing state GHG emissions through 2025 results from current state policies and past and anticipated regional energy trends, primarily due to a shift from coal to natural gas-powered electricity. The analysis also indicates that without additional action, GHG emissions will decrease until 2032, when they will begin to rise again as a result of projected population and economic growth.

The BAU analysis indicates that Delaware is at a critical point in its progress towards GHG mitigation. The state has the opportunity to meet or exceed its climate goals for 2025 while also evaluating and putting into place mid and long-term strategies to ensure further emissions reductions after 2025. The Intergovernmental Panel on Climate Change (IPCC) indicates that worldwide CO_2 emissions must reach net zero by 2050 to stop warming beyond 1.5°C and to avoid the worst consequences of climate change (IPCC 2018). Given this, DNREC and ICF modeled emissions through 2050.

Component 3. Mitigation Actions Selection and Analysis

The third component of the climate action planning process is to select and analyze mitigation actions for GHG reduction effectiveness and, for some of the selected actions, their costs and economic benefits. Using feedback and input from technical experts and the public, ICF and DNREC developed a list of 20 mitigation actions for which to model emission reduction potential. These actions are varied and include actions such as energy efficiency, clean transportation, renewable energy, and waste reduction. A smaller subset of actions was selected for economic analysis. These actions, along with many others, may be considered for incorporation into the State's CAP.

Figure 3. Net GHG Mitigation Action Analysis Results for 2005-2050

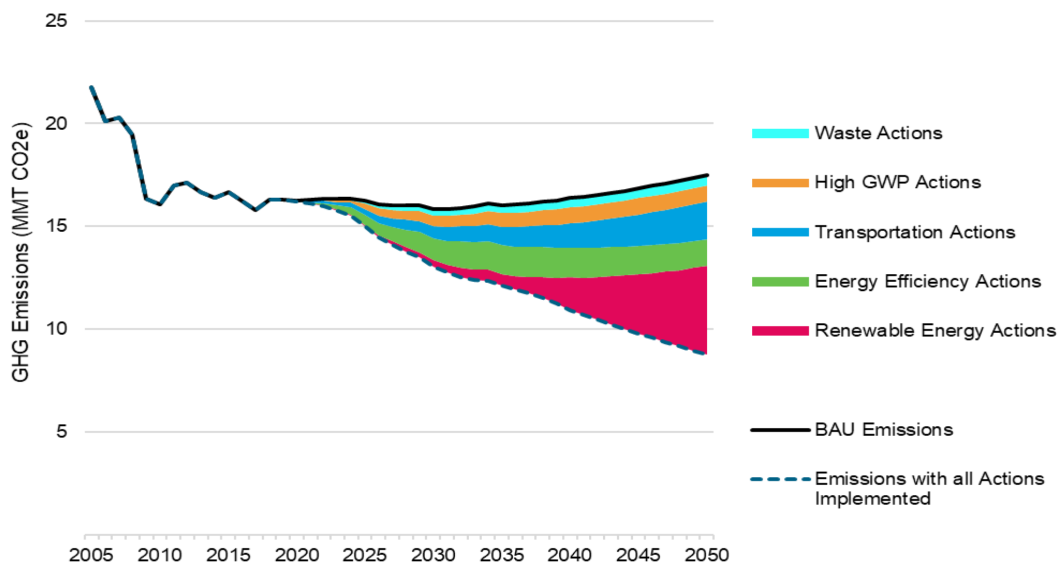


The GHG mitigation analysis shows that if all modeled actions were fully implemented, Delaware's net GHG emissions will decline from 2005 levels by 31.1% in 2025 and 59.7% in 2050 in the GHG mitigation scenario (Figure 4). This represents a decrease in emissions by an additional 5.7% and 40.1% from 2005 levels in 2025 and 2050, respectively, compared to the BAU scenario.

It should be noted that each mitigation measure was assumed to have a different implementation start date, resulting in the 20 actions being phased in over time throughout the analysis. ICF assumptions regarding market factors and available technology guided estimations for when each action is implemented.

The GHG mitigation analysis can also be examined in terms of types of action (Figure 4). Mitigation actions were grouped into the following "type" categories: Waste (waste sector emissions), High Global Warming Potential (GWP) (commercial and industrial sector emissions), Transportation (transportation sector emissions), Energy Efficiency (residential and other commercial sector emissions), and Renewable Energy (centralized and distributed generation-related emissions for all electricity-using sectors) (see Figure 4).

Figure 4. Net GHG Emissions Mitigation (MMTCO$_2$e) by Mitigation Action Category



Key takeaways from the mitigation analysis include:

- Decarbonizing the electricity grid has the greatest potential for reducing GHG emissions in the medium and long terms and drives emission reductions for many actions. Decarbonizing other energy sources may also play a larger, longer-term role in Delaware.
- Electrification of transportation and buildings can also lead to notable GHG reductions over time, but are dependent on decarbonizing the grid for full effectiveness.
- Energy efficiency is an important strategy that can be implemented in the short-term and is a relatively lower cost strategy for reducing GHGs.

Mitigation actions have varying levels of GHG reduction effectiveness over time and when integrated. For example, energy efficiency, which is implemented earlier and consistently through 2050 in the modeling is effective, but gets more effective in reducing emissions when paired with renewable energy actions during later periods of time through 2050.

ICF modeled 7 of the 20 actions for costs and savings, based on readily available data and information. The results of the cost and savings analysis for the subset of actions indicate varying cost-effectiveness of actions. Energy efficiency actions result in net savings due to relatively lower capital investment compared to other actions and higher energy savings, whereas actions with larger investments (e.g., those with larger infrastructure needs and changes) tend to have higher costs. The cost estimates presented in this report are high-level and indicative. In-depth cost analyses may be beneficial for various actions separate from this analysis as the State considers moving into either policy or program design or implementation of a CAP.

Key Terms in Emission Reductions

Decarbonization: Long-term strategies to reduce CO_2 emissions by phasing out the use of carbon-emitting processes and technologies, primarily by eliminating the combustion of fossil fuels as an energy source, with the end goal of a carbon-free global economy.

Electrification: The process of replacing technologies that use fossil fuels as an energy source with technologies that use electricity instead, with the expectation that the electricity is generated using a cleaner energy mix. For example, by electrifying cars, gasoline and diesel-powered engines are replaced with batteries powered by electricity from the grid, which likely includes a mix of renewable and/or clean energy sources that result in less GHG emissions than burning gasoline.

Energy Efficiency: The replacement of older or less energy efficient appliances, vehicles, building materials, and other technologies with newer, more efficient designs that require less energy. Efficiency improvements can provide both emission and cost savings in the short-term.

Together, decarbonization, electrification, and energy efficiency interact closely as major drivers of emission reductions. Efficiency improvements reduce energy demand, electrification drives efficiency and creates opportunity to shift to potentially cleaner energy sources via renewable electricity, and decarbonization reduces emissions from energy.

Summary and Next Steps

Implementing the mitigation actions modeled in the analysis would enable Delaware to exceed its goal of 26-28% emissions reductions by 2025. Moreover, the GHG mitigation analysis can be used to support the development of long-term climate goals and specific mitigation actions to include in the Delaware CAP.

With the BAU Projections and Mitigation Actions Selection and Analysis now developed, DNREC can consider how to use these resources for planning and implementation. The BAU Projections provide the foundation of baseline emissions and can be readily updated to reflect for changes in emission sources and additional data. The Mitigation Actions Selection and Analysis maps out a pathway for reducing emissions and can be adjusted for assumptions, modeling approaches, and mitigation actions. Moving towards implementation will require DNREC, other state agencies, and key stakeholders to collaborate in considering mitigation action timelines; mechanisms for implementation, including tracking emissions and progress on actions; policy or program design elements; costs to the state or its consumers; health and economic benefits; and equity in terms of benefits and impacts. Such considerations will ensure that DNREC and Delaware can successfully achieve long-term emissions reductions, while providing valuable benefits to stakeholders.