

2021 Climate Action Plan Greenhouse Gas (GHG) Emissions Business as Usual (BAU) Methodology

This document presents the planned methodology for developing business as usual (BAU) greenhouse gas (GHG) emission projections for the 2021 Pennsylvania Climate Action Plan (CAP). The BAU will be used as the baseline to estimate the anticipated emission reductions associated with GHG reduction strategies. The BAU will incorporate policies, activity data, trends, and GHG emission factors under the assumption that no additional actions will be taken beyond September 2020 to reduce emissions. Should new policies past this date be rolled out at the federal or state level that may significantly affect the BAU projections DEP and ICF will address them in the CAP qualitatively.

The BAU will be developed through a series of steps, which mostly align with how the BAU for the 2018 CAP and Energy Assessment Report was developed. The exceptions to this methodology and data sources are noted through this document. The steps include:

1. Compile and integrate historical energy and emissions, primarily from the Energy Information Administration (EIA) State Energy Data System (SEDS), Environmental Protection Agency's State Inventory Tool (SIT), and state-specific data sources
2. Project future activity primarily using the EIA Annual Energy Outlook (AEO) Reference Case, making adjustments to align AEO and SEDS geographies. While SEDS data are provided at the state level, AEO data are forecasted at the regional level. To account for this geographical discrepancy, the DEP and ICF will apply the AEO regional growth rate for a particular energy resource to the historical SEDS data to project Pennsylvania Commonwealth-level energy resource data. Other projection methods, such as those based on impacts of COVID-19 and to incorporate state-specific data will also be incorporated as described below.
3. Adjust historical and future activity to ensure consistency, capture available Pennsylvania-specific data, address existing data gaps, and incorporate the Analysis Team's expert input using resources such as ICF's Integrated Planning Model (IPM).
4. Apply emission factors when available to estimate GHG and criteria air pollutant emissions.

Primary Data Sources

The BAU projections will be largely be based on data and assumptions from the following data sources:

- Activity data, emission factors, and methods from the SIT and Greenhouse Gas Reporting Program
- State-specific data, where available
- Historical activity data from the EIA SEDs
- Electricity generation and capacity forecasts from ICF's IPM¹, specific to Pennsylvania
- Forecasted activity data from the Energy Information Administration's (EIA's) Annual Energy Outlook (AEO)
- Emissions factors will come from a variety of sources, such as:
 - [U.S. Environmental Protection Agency's \(EPA\) State Inventory and Projection Tool](#)
 - [EIA's State Energy Data Report, Consumption Estimates, 1960–2015](#)
 - [EPA's U.S. Greenhouse Gas Inventory](#)
 - [2006 IPCC Guidelines for National Greenhouse Gas Inventories](#)
 - [EPA's eGRID 2005, 2007, 2009, 2010, 2012, and 2014 state data files](#)
 - [EPA's Emission Factors for Greenhouse Gas Inventories](#)
 - [EPA AP-42 Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources](#)
 - [Emission Factor Supporting Documentation for the Final Mercury and Air Toxics Standards. Mercury Air Toxic Standards \(MATS\)](#)
 - ICF's IPM results for emissions

EPA State Inventory Tool (SIT) (2017)

DEP and ICF will use data from Pennsylvania's most recent GHG inventory (2017), developed using SIT. These activity data and emissions within the SIT calculation modules will be incorporated into the BAU analysis and cover sectors including electricity generation, industrial, fossil fuel production, residential, commercial, agriculture, waste/wastewater, and land use, land-use change, and forestry (LULUCF). DEP and ICF do not plan to update any of the inventory estimates for the CAP BAU development.

State-Specific Data

Specific resources developed or collected within the Commonwealth and DEP include:

- MOVES (on-road transportation modeling)
- Act 129 reports
- Alternative Energy Portfolio Standard (AEPS) compliance reports

¹ <https://www.epa.gov/airmarkets/epas-power-sector-modeling-platform-v6-using-ipm-january-2020-reference-case>

- Distributed solar data
- Biofuel production data
- Vehicle registration data
- ICF's CHP Database (contains locational information on CHP systems, loads, etc.)
- Facility or project databases, such as the EPA AgStar database

EIA – State Energy Data Systems (SEDS)

The EIA's SEDS contains DOE's comprehensive estimates for state-level energy production, consumption, and prices from 1960-2017. The EPA's SIT incorporates SEDS data, which will be the default source historical energy consumption and production data in this analysis, accounting for any variations from SEDS that are included in the DEP inventory.

ICF's Integrated Planning Model (IPM)

ICF's IPM provides integration of wholesale power, system reliability, environmental constraints, fuel choice, transmission, capacity expansion, and all key operational elements of generators on the power grid in a linear optimization framework. The IPM will be used to determine the least-cost means of meeting electric generation energy and capacity requirements while complying with specified constraints, including air pollution regulations, transmission constraints, and plant-specific operational constraints. ICF will use a consistent method and set of assumptions as were developed by DEP for the purposes of RGGI modeling. Emissions for GHGs and CAPs associated with electricity generation will also come from IPM where available (some historical and all future years; historical emission factors will be aligned with eGrid factors).

EIA – Annual Energy Outlook (AEO)

The EIA's AEO is DOE's forecast for domestic energy markets which includes production, consumption and prices into the future. The 2020 AEO forecasts data from 2019 through 2050. This analysis will use the AEO's reference case. We will use EIA data to supplement data from the SIT and SEDS, specifically for energy consumption and production trends through 2050. Information for the reference case is readily available on EIA's AEO website.

GHG Accounting Methods

The BAU assessment will follow the GHG accounting methods applied within the existing state GHG inventory. Notably, the BAU will estimate and incorporate emissions from electricity generation in total emissions estimates for the Commonwealth. Emissions from electricity consumption (e.g., from the residential and commercial sectors) will be reported for informational purposes. This is consistent with the request from the CCAC and will make accounting for policies, such as the Regional Greenhouse Gas Initiative, more transparent and

consistent. It will also allow for future goal tracking to be done consistently with the SIT. Data for the SIT and other resources will be adjusted and aligned with state-specific data, where available and feasible.

Policies and Trends to Incorporate

The BAU will incorporate policies on the books as of September 2020. More specifically, this includes all policies and regulations as outlined in the Department of Energy Annual Energy Outlook assumptions book: <https://www.eia.gov/outlooks/aeo/assumptions/pdf/summary.pdf> Assumptions about any new or modifications to regulations will not be made.

Notable additions that are specific to Pennsylvania that will be incorporated within the BAU are:

- New Pennsylvania methane regulations for oil and gas systems
- RGGI
- Light Duty ZEV regulation
- HFC rulemaking

DEP and ICF realize that many of the data sources available for future projections and trends do not incorporate the impacts of COVID-19 on activity and emissions. For example, transportation-related fuel use is significantly decreased in 2020 as compared to projections from the AEO published in January of 2020. To address this issue the BAU adjust growth trends DEP and ICF will consider if growth in specific time periods (e.g., through 2025 or 2030) should be modified to account for COVID-19 recovery. Proxy or analogous trends could be used from different time periods, most likely historical growth trends seen during the economic recovery starting in 2008. Additionally, DEP and ICF will review the new AEO modeling results expected to be published in January of 2021 to determine if any additional adjustments will need to be made to the BAU.

Intended Results

Results will be provided for all activity data (e.g., energy supply and use), GHG emissions, and emissions of criteria air pollutants (SO_x, NO_x, and Hg) where emission factors are available (i.e., direct fuel use, electricity generation, on-road transportation).

Note that a separate BAU scenario will be developed within REMI as part of modeling the costs and benefits of GHG reduction strategies. This modeling step is not addressed in this document.

Base and Projection Years

The BAU scenario will incorporate activity and emissions data through 2050. DEP and ICF will model the BAU starting in 2005, as this is the baseline year for Pennsylvania's 80x50 GHG

reduction goal. Historical SIT data will be used and displayed in the BAU trends. The last year for which SIT data is available is 2017. Projections will be developed annually starting in 2018, for each year through 2050, and then displayed in 5 year increments.

Historical and Projection Methods

The following sections outline the anticipated data sources used to develop historic BAU estimates and projections by sector.

Sector Approach and Data Sources

The following sections outline the anticipated approaches and accompanying data sources used in to develop historic BAU estimates and projections.

Transportation

DEP and ICF will use transportation fuel use data from SEDS and emission factors from the SIT to analyze historical transportation emissions. Transportation fuel use growth rates from AEO will be used to project fuel use and then emissions (applying appropriate emission factors) through 2050. This data will be supplemented or replaced by state-specific data and assumptions for required production and use levels for biodiesel.

Residential and Commercial Buildings

Historical building energy consumption data will be pulled from SEDS, along with emission factors from the SIT, to calculate past GHG emissions. Our team will use AEO data and trends, along with historical data, to project residential and commercial building energy use through 2050. Emissions associated with electricity use will not be included in total emissions, but reported separately for informational purposes.

Industrial (Not Including Oil and Gas)

Similar to the residential and commercial sectors, industrial sector energy use and emissions will be taken from SEDS and the SIT. To project activity and emissions, AEO growth trends and then related emission factors will be applied. Emissions associated with electricity use will not be included in total emissions, but reported separately for informational purposes.

HFCs emissions will be extrapolated linearly using historical estimates. This methodology will allow emissions from HFCs to be categorized by end-use application and sector. As a result, we will apportion total HFC emissions to the Transportation, Residential and Commercial Buildings, and Industrial sectors according to end-use.

Oil and Gas Systems

Historical natural gas and crude oil data are available from SEDS; future natural gas and crude oil production (and therefore emissions) will be estimated using a mix of sources. To determine future production of natural gas and crude oil in Pennsylvania, DEP and ICF will use historical SEDS data, ICF's Gas Markets Model (GMM®), and AEO projections to allocate AEO regional growth in natural gas production to Pennsylvania. GHG emissions estimates from natural gas production will be based on the number of wells and associated emission factors, where the number of wells historically will be taken from the SIT and the future numbers of wells will come from the GMM in the form of annual well completion numbers, assuming a well abandonment rate of 2 percent per year.

Oil production activity and emissions are minimal, and therefore will be held constant throughout the time series.

Renewable and Alternative Energy (Non-Electricity)

Biogas (including agricultural waste, wastewater, and landfill gas) estimates are only available for the industrial sector in the EIA data sources. DEP and ICF will therefore rely on biogas supply/consumption information from a mix of sources, including the EPA's Landfill Methane Outreach Program (LMOP) and AgSTAR project databases, a listing of wastewater sites in Pennsylvania (WEF 2015), and a database of CHP projects maintained by ICF. This information is readily available and recently compiled by ICF through our work with the American Gas Foundation to assess renewable gas supply in the United States. Modest growth in these sources will be applied in the BAU; more aggressive growth of this supply may be considered in the GHG reduction analysis.

Electricity Generation

Historical electricity generation will be pulled from SEDs, along with emission factors. Future annual electricity load projections (aggregate for all sectors) will be fed in to IPM, which will then solve for future generation mixes and emissions through 2050. DEP and ICF will work to align the SEDS historical and future IPM projections to ensure consistency.

Waste and Wastewater

Both waste and wastewater emissions reflect non-energy sources in the BAU, as the SIT does not allocate emissions from electricity consumption in these sectors. The BAU model will not include CO₂ from landfills in waste emissions estimates, as this is considered biogenic. DEP and ICF will use the Landfill Gas Emission Model (LandGEM) data to project future emissions from landfills.

For wastewater, similar to waste, the BAU model will not include biogenic CO₂ from treatment plants. The BAU projection will include emissions for municipal wastewater from increased flows from population growth and industrial wastewater will be projected linearly from the historic activity data and baseline SIT emission factors.

Agriculture

Projections for the agricultural sector will include CH₄, N₂O, and CO₂ emissions using data from the SIT. Future non-energy emissions from agriculture will be held constant from 2017 values.

LULUCF

DEP and ICF will estimate net carbon sequestration/emissions from LULUCF using data from the SIT, this is based on data from the US Forest Service. Projections for LULUCF will be held constant to latest year of available data for the BAU. Additional changes on forest cover and natural sequestration may be addressed through the GHG reduction analysis.