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What are the “Standard Scenarios?”

- Suite of forward-looking scenarios (projections) of the U.S. power sector
Why do we do the Standard Scenarios?
DATA

TOOLS

TRANSPARENCY

IDEAS
Scenarios Definitions

- **dGen**: Rooftop PV adoption, Bass diffusion
  - [dGen: https://www.nrel.gov/analysis/dgen/model-access.html](https://www.nrel.gov/analysis/dgen/model-access.html)

- **ReEDS**: Capacity expansion, Minimize total system cost
  - [ReEDS: https://www.nrel.gov/analysis/reeds/request-access.html](https://www.nrel.gov/analysis/reeds/request-access.html)

- **PLEXOS***: Production cost, Minimize production cost
  - *Only a subset of scenarios were run in PLEXOS*

**Cambium**: Output Processing

**Standard Scenario Results**
What is Different this Year?

Model Updates
- New hourly module
- Multiple years of weather data
- Policy updates
- Endogenous Retirements
- Electrification
- ... (see Table A-6)

Output Updates
- Updated scenario viewer
- Hourly outputs from Cambium
  - Generation
  - Emissions
  - Marginal costs
  - More...

Report Updates
- Shorter
- Less analysis but more results
- Follow-on analysis paper forthcoming
The Mid-case Scenario

- Fuel prices: EIA Annual Energy Outlook (AEO) 2020
- Demand growth: AEO 2020
- Technology cost and performance: 2020 Annual Technology Baseline (ATB)
- Current policies as of June 2020
- Current fleet characteristics: EIA NEMS Plant Database
System Evolution by State in the Mid-case
How the Mid-case Compares

Comparisons:
• Bloomberg New Energy Finance (BNEF)
• Energy Information Administration (EIA)
• International Energy Agency (IEA)
Sensitivity Scenarios

- Mid-case uses first entry in each category
- 45 total scenarios using the sensitivities shown at right
Generation by Fuel Type Across the Scenarios
Other Outputs

- Storage
- RE Penetration
- Prices
- Capacity Credit
- Losses
- System Cost
- Emissions
Extending the Standard Scenarios to include hourly emission, cost, and operational metrics
Cambium
A public database of hourly emission, cost, and operational metrics for the U.S. electric sector through 2050

What’s the point?
1) The grid is changing
2) Some metrics useful for planning are forward-looking
3) Useful for comparison
The models

ReEDS
Projects the evolution of the electric grid through 2050

PLEXOS
Simulates the hourly operation of future grids

Cambium
Calculates new metrics; builds the database

Cambium database
Hourly through 2050
Operational metrics
Cost metrics
Emission metrics
Metrics

Load
- Busbar load
- Busbar load for end-use
- End-use load
- Load from storage charging
- Transmission losses
- Net load

Transmission
- Imports
- Exports

Operations
- Average distribution loss rate
- Marginal distribution loss rate
- Operating reserve demand
- Operating reserve shadow price
- Planning reserve margin
- Planning capacity
- Capacity shadow price
- Marginal generator technology
- Marginal energy source technology
- Solar curtailment
- Wind curtailment

Generation
- Hourly generation by technology

Capacity
- Nameplate capacity by technology
- MWh of storage

Portfolio
- RPS and CES shadow prices
- RPS and CES fractions

Costs (busbar and end-use)
- Energy cost
- Capacity cost
- Portfolio cost
- Operating reserve cost

CO₂ Emissions
- Average from in-region generation
- Average induced by in-region load
- Short-run marginal emission rate
- Long-run marginal emission rate
- Total CO₂ emissions

For metric definitions and methods, see Cambium Documentation
Example Marginal Cost Trends

Mid-case, 2050

Marginal Costs ($/MWh)

Energy

Capacity
Geographic Resolution

134 regions covering contiguous United States
The Scenarios

5 scenarios with hourly Cambium metrics:

- Mid-case
- Low Renewable Energy Cost
- High Renewable Energy Cost
- Low Battery Cost
- Low Wind Cost
Marginal CO$_2$ Emission Metrics

**Short-run marginal emission rate**
Emission rate of the generation that would serve a change in electrical load *keeping the capital assets of the grid fixed.*

**Long-run marginal emission rate**
Emission rate of the generation that would serve a change in electrical load *considering the structural changes to the grid that would be induced by a persistent change in load.*
Long-run Marginal CO2 Rate (kg/MWh)
30 Year Levelized Values, National Standard Scenarios 2020, Mid-case
Short-run is ~twice as large as long-run
This is simulated data

The models that underlie this data are necessarily simplifications of reality, and can not capture every relevant detail

See section 2 of the Cambium documentation for a discussion of the limitations of the data