JANUARY 17, 2013 | MILFORD, MA

Executive Summary Preliminary Results for 2012 Economic Study Request Specific Scenario Phase

Analysis Based on Synapse Requested Scenarios

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Presentation Overview

- Overview
- Framework for evaluation process
  - Review of 2012 Economic Study requests
  - Review overall request framework
- First Phase of 2012 Economic Study
  - Identification of most resilient areas for load changes
  - Changes to the system
- Second Phase: Development of scenarios for 2012 Economic Study
  - Retire oil, coal and natural gas steam units
  - Investigate doubling of energy efficiency growth rates
  - Investigate photovoltaics and combined heat and power / geothermal

2012 Economic Study Scope of Work
Three Phases

- Economic study requests provide a forum for stakeholder discussions of alternative future system scenarios
  - Results include production costs, load serving entity expenses, congestion, environmental emissions, and other metrics
  - Show potential effects of alternative resource mixes and relieving transmission constraints
- Three phases
  - First Phase: An incremental / decremental analysis
    - Develop representative load shapes to mimic resource types
    - Illustrates the best locations for resource retirements and additions
  - Second Phase: Limited number of scenarios after discussing the First Phase results
  - Third Phase: Determine capital investment supported by simulated energy revenues

Framework for Analysis

- Build off of the 2011 Economic Study
  - Evaluate New England system 2012 - 2021
- Replace coal and heavy oil generation as well as natural gas steam generation older than 40 years in 2021 (e.g. older than 30 years in 2011)
- Replacement supply resources considered
  - Energy Efficiency and Active Demand Resources
  - Wind generation
  - Photovoltaics
  - Combined Heat and Power and Geothermal (CHP/G)
  - New generating resources
    - Combined-cycle resources
    - Combustion turbine resources

First Phase
Evaluations Using Load Increments / Decrements

- Sensitivity analyses that quantifies changes in evaluation metrics
  - Load decreases or increases change evaluation metrics:
    - LSE Energy Expense ($ Million)
    - Production Cost ($ Million)
    - FTR / ARR Congestion ($ Million)
    - Environmental emissions (Tons per year)
  - Metrics can be quantified and compared

Load / Resource Additions or Removals Effectiveness Based on Production Cost

"BASE" MW Added and Impacts Production Cost Compared to Unconstrained ($Million)

		<= Resource Removals <= Load Increases							Resource Additions=> Load Decreases =>						
Sub Area	Most Constraining Interface	-2700	-2100	-1500	-1200	-900	-600	-300	300	600	900	1200	1500	2100	2700
BHE	Orrington South	2	1	1	1	1	1	1	2	4	15	43	143	372	595
ME	Surowiec South	2	1	1	1	2	1	1	2	3	9	24	73	276	499
SME	Maine-New Hampshire	2	1	1	1	2	1	1	2	3	3	7	14	65	229
NH	North/South	2	2	1	1	2	1	1	1	2	2	3	6	18	52
VT	North/South	2	2	1	1	2	1	1	1	1	2	3	5	14	39
WMA	N/A	3	2	2	1	2	1	1	1	1	1	1	1	1	1
CMAN	N/A	3	2	2	1	2	1	1	1	1	1	1	1	1	1
BOST	Boston Import	143	24	3	1	2	1	1	1	1	1	1	1	1	1
SEMA	SEMA/RI	3	2	2	1	2	1	1	1	1	1	1	1	4	9
RI	SEMA/RI	3	2	2	1	2	1	1	1	1	1	1	1	4	9
CT	N/A	2	2	2	1	2	1	1	1	1	1	1	1	1	1
SWCT	SWCT Import	104	4	2	1	2	1	1	1	1	1	1	1	1	1
NOR	Norwalk Import	7828	4675	1549	441	71	5	1	1	1	1	1	1	1	1

Range of “better” places for resource / load addition / removal

Import Limited > $100 Million | Import Limited > $10 Million | Unconstrained < 10 $Milllion | Bottled-in > $10 Million | Bottled-in > $100 Million

Load / Resource Additions or Removals Effectiveness Based on LSE Energy Expense

"BASE" MW Added and Impacts LSE Enery Expense Compared to Unconstrained ($Million)

		<= Resource Removals <= Load Increases							Resource Additions=> Load Decreases =>						
Sub Area	Most Constraining Interface	-2700	-2100	-1500	-1200	-900	-600	-300	300	600	900	1200	1500	2100	2700
BHE	Orrington South	4	1	1	0	2	0	0	8	70	181	229	282	493	662
ME	Surowiec South	4	1	1	0	2	0	0	8	63	127	171	122	154	323
SME	Maine-New Hampshire	4	1	1	0	2	0	0	9	63	103	127	180	178	29
NH	North/South	6	1	-1	-1	4	-1	0	1	19	45	56	74	146	91
VT	North/South	6	1	-1	-1	4	-1	0	1	12	33	40	49	119	75
WMA	North/South	12	5	-1	0						-1	-1	-1	-1	-1
CMAN	North/South	13	7	1	1						-1	-1	-1	-1	-1
BOST	Boston Import	828	56	0	2						-1	-1	-1	-1	-1
SEMA	SEMA/RI	12	6	-1	2						-1	0	5	51	120
RI	SEMA/RI	9	5	-1	0	5	-1	0	0	0	-1	0	5	51	120
CT	N/A	12	4	-1	1	5	-1	0	0	0	-1	-1	-1	-1	-1
SWCT	SWCT Import	477	1	-1	1	5	-1	0	0	0	-1	-1	-1	-1	-1
NOR	Norwalk Import	572	1518	2149	1265	317	6	0	0	0	-1	-1	-1	-1	-1

Range of “better” places for resource / load addition / removal

Import Limited > $100 Million | Import Limited > $10 Million | Unconstrained < 10 $Milllion | Bottled-in > $10 Million | Bottled-in > $100 Million

Note: Unlike the Adjusted Production Cost metric, the LSE Energy Expense metric may not be monotonic. The shape of the curve depends on the relative size of the import constrained area to the entire New England area and the relative effect on prices in the unconstrained area.

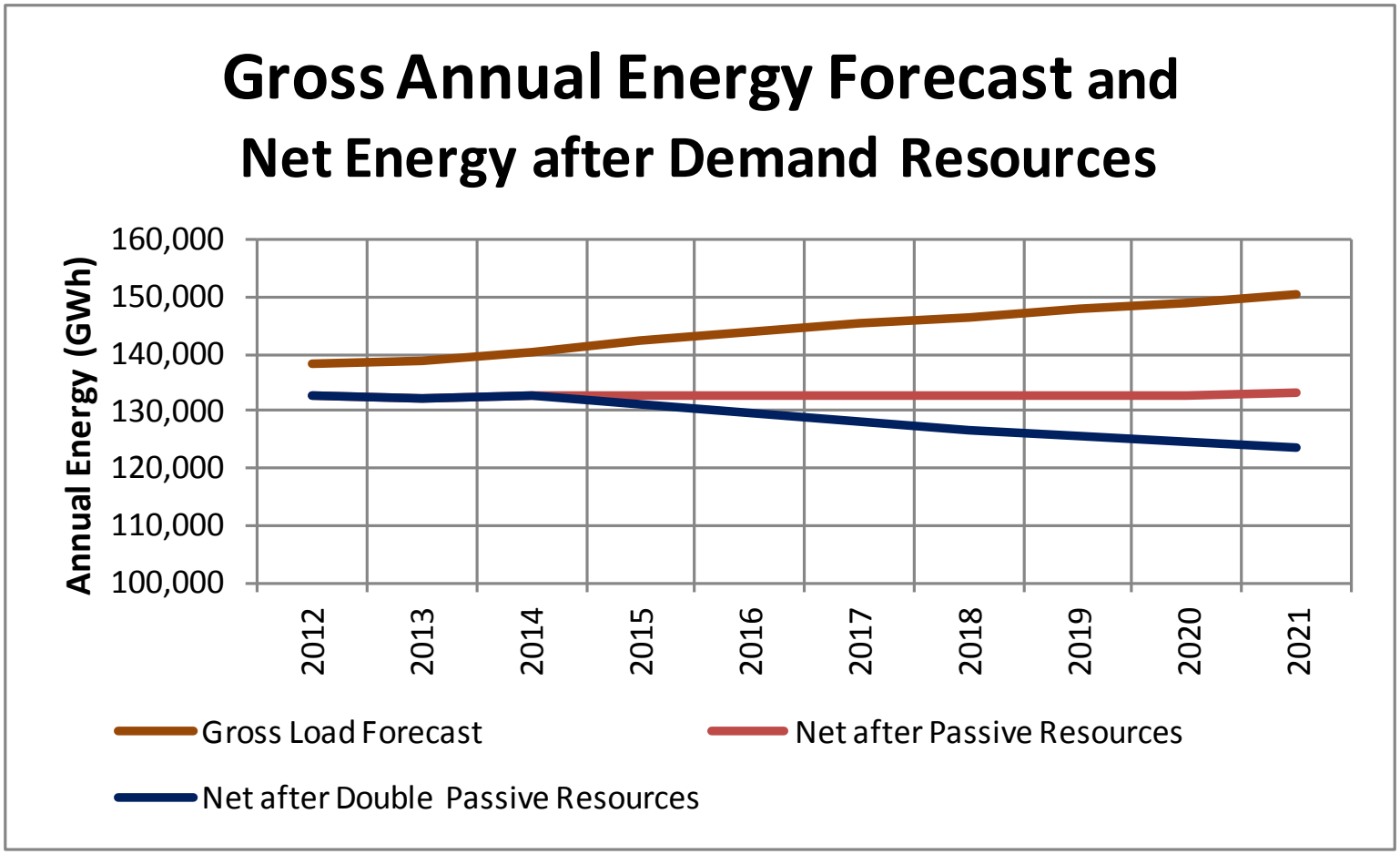
Second Phase

- Developed in discussions with Synapse Energy Economics
  - Primary advocate for this phase of the project
  - Requested that specific renewable technologies be evaluated
- Focused on growth in resources complying with Renewable Portfolio Standards (RPS)
  - Existing RPS resources
    - Inventory of existing RPS resources not available
  - Focused on growth of RPS after 2011
    - Based on 2012 Regional System Plan information
    - Assume
      - Existing RPS resources is sufficient to cover existing RPS requirements
    - Flexibility assumed so that
      - State level requirements
      - Can be summed to estimate an aggregate New England requirement

Second Phase
Resource Expansion Plan

- Resource retirement assumptions
  - Retired resources partially replaced by:
    - Wind
    - Solar PV
    - Combined Heat and Power / Geothermal
  - Created expansion case assuming a 15 percent reserve margin
    - Retired resources replaced with Natural Gas technologies
      - Added 1000 MW of single cycle gas turbine with heat rate of 8600 Btu/kWh
      - Advanced Combined Cycle (ACC) with a heat rate of 6000 Btu/kWh
  - Assume capacity values based on:
    - Full “nameplate” credit for
      - New combined cycle and new simple cycle natural gas technology units
      - Steam / CHP / Geothermal units
    - 39.4% for solar photovoltaic (based on reliability hour calculation)
    - 27.6% for composite wind (based on reliability hour calculation)

Gross Annual Energy Forecast and Net Energy after Passive Demand Resources



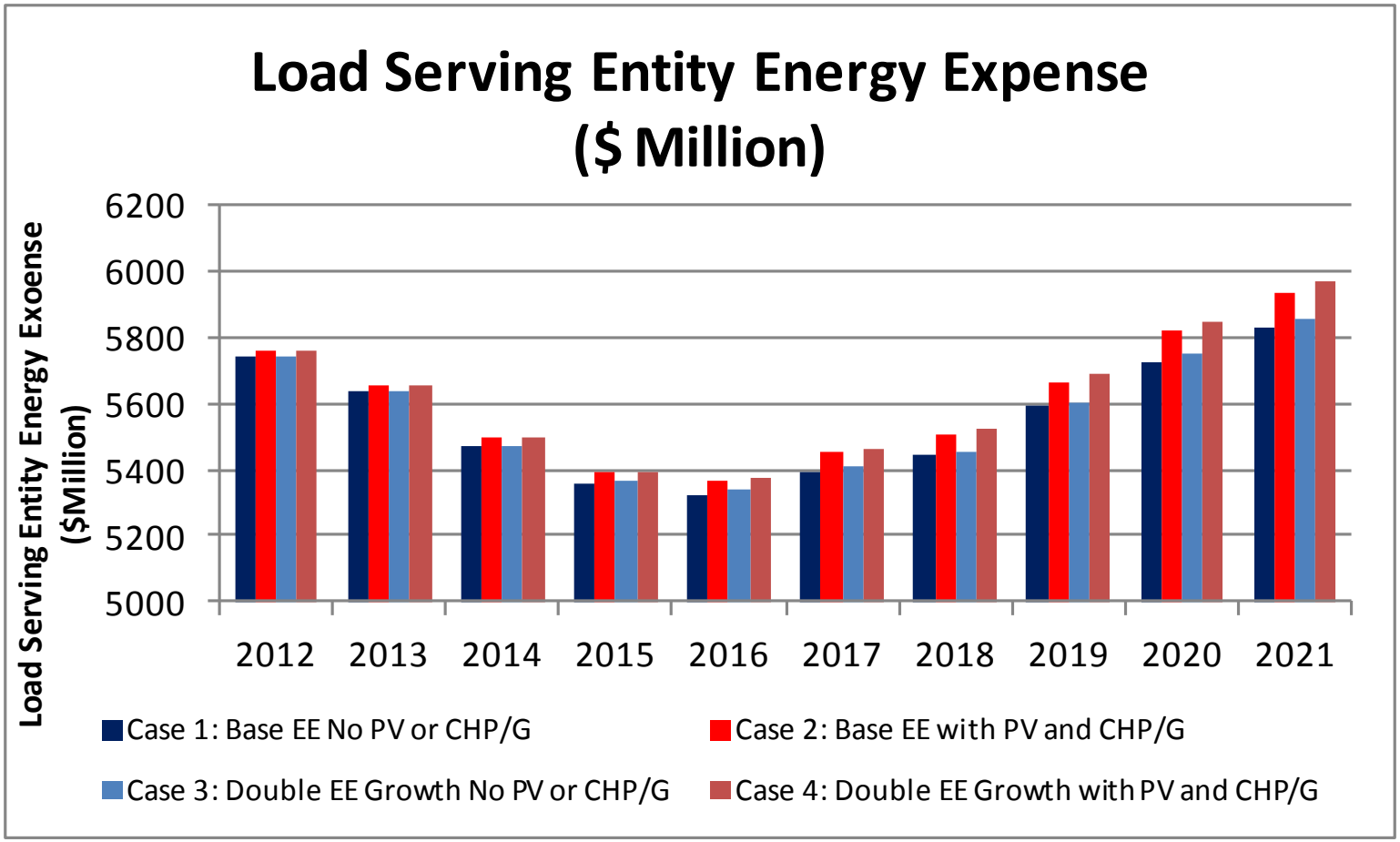
Scenarios to be Analyzed

- Four cases to be analyzed
  - Case 1) Base Energy Efficiency with no additional renewables
  - Case 2) Base Energy Efficiency with:
    - 3000 MW of Photovoltaics
    - 340 MW of Combined Heat and Power / Geothermal
  - Case 3) Double Energy Efficiency Growth with no additional renewables
  - Case 4) Double Energy Efficiency Growth with
    - 3000 MW of Photovoltaics
    - 340 MW of Combined Heat and Power / Geothermal

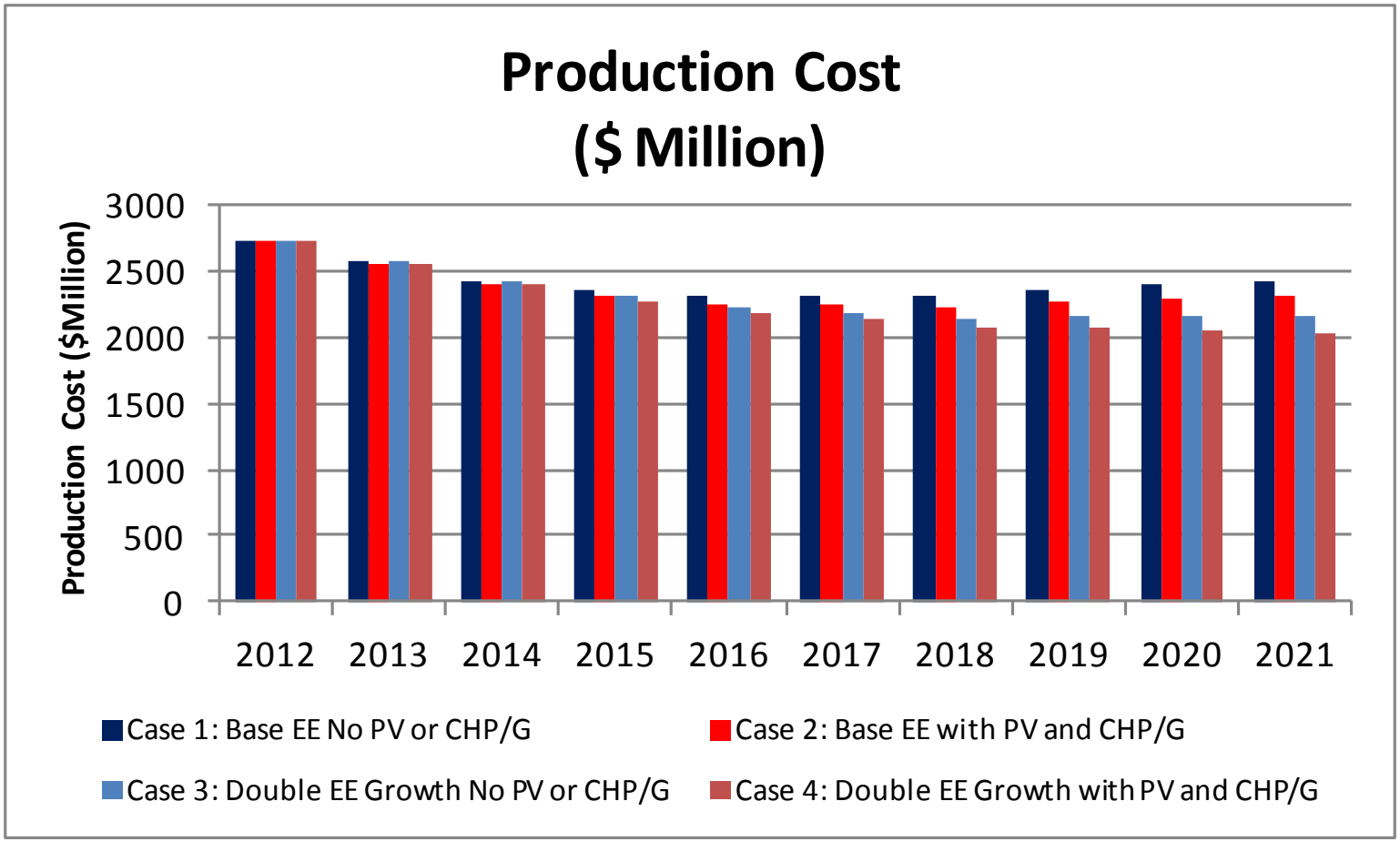
Metrics and Sensitivities

- Metrics
  - Economic (Production Cost, LSE Energy Expense)
  - Fuel consumption/energy by fuel type
  - Environmental

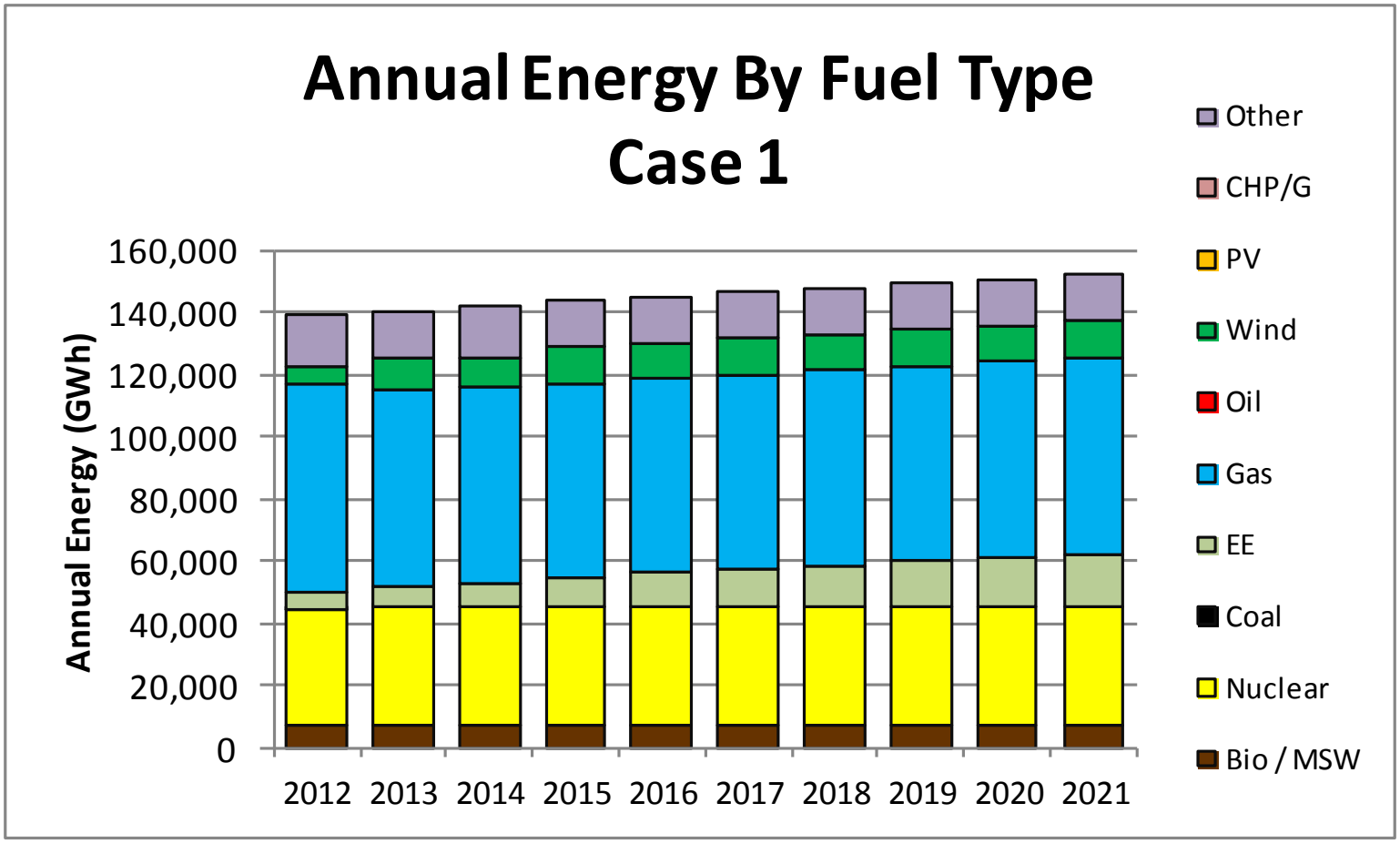
Economic Metric
Load Serving Entity Energy Expense (Million 2008$)



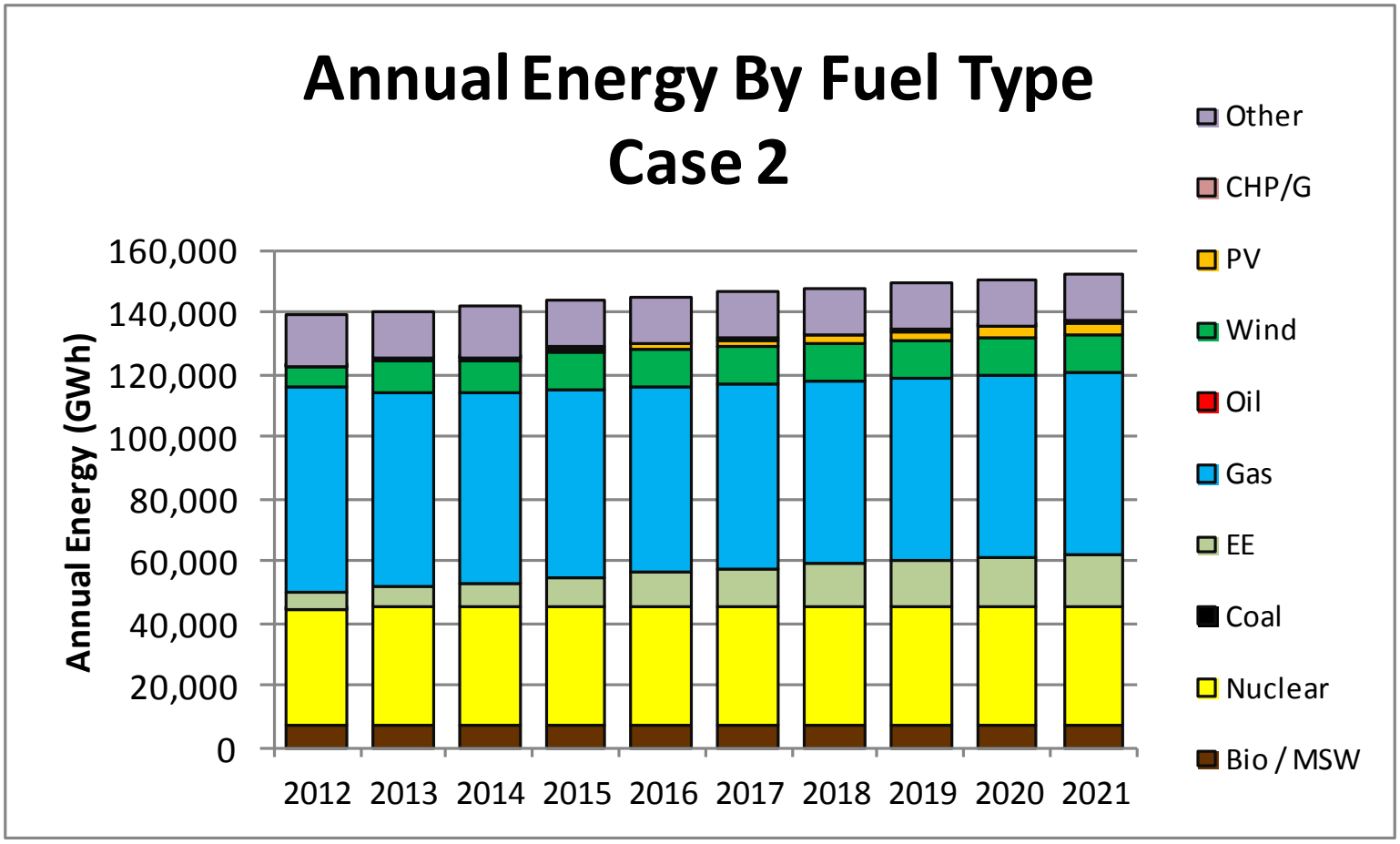
Economic Metric
Production Cost (Million 2008$)



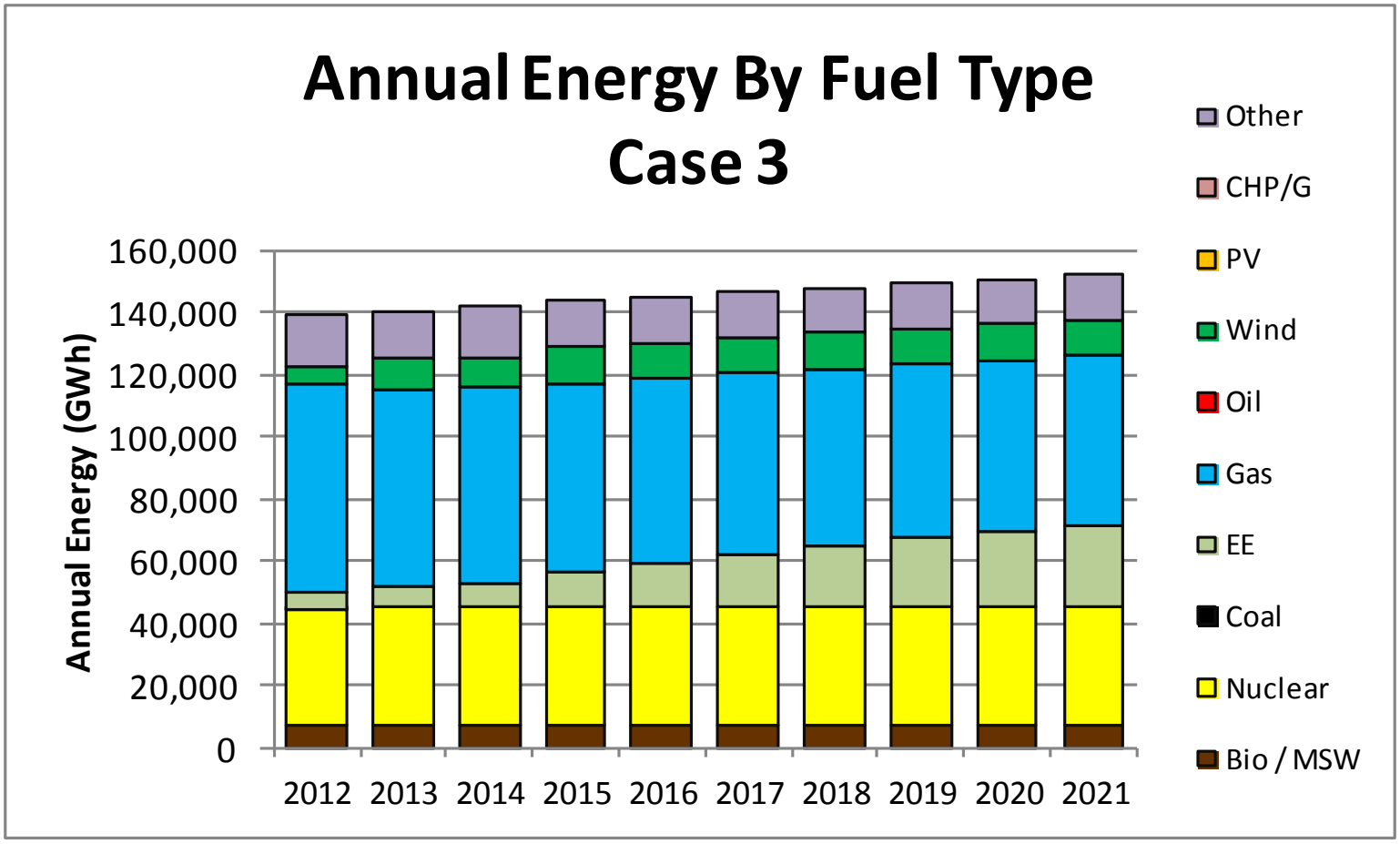
Fuel Consumption Metric
Case 1: Base EE No PV or CHP/G



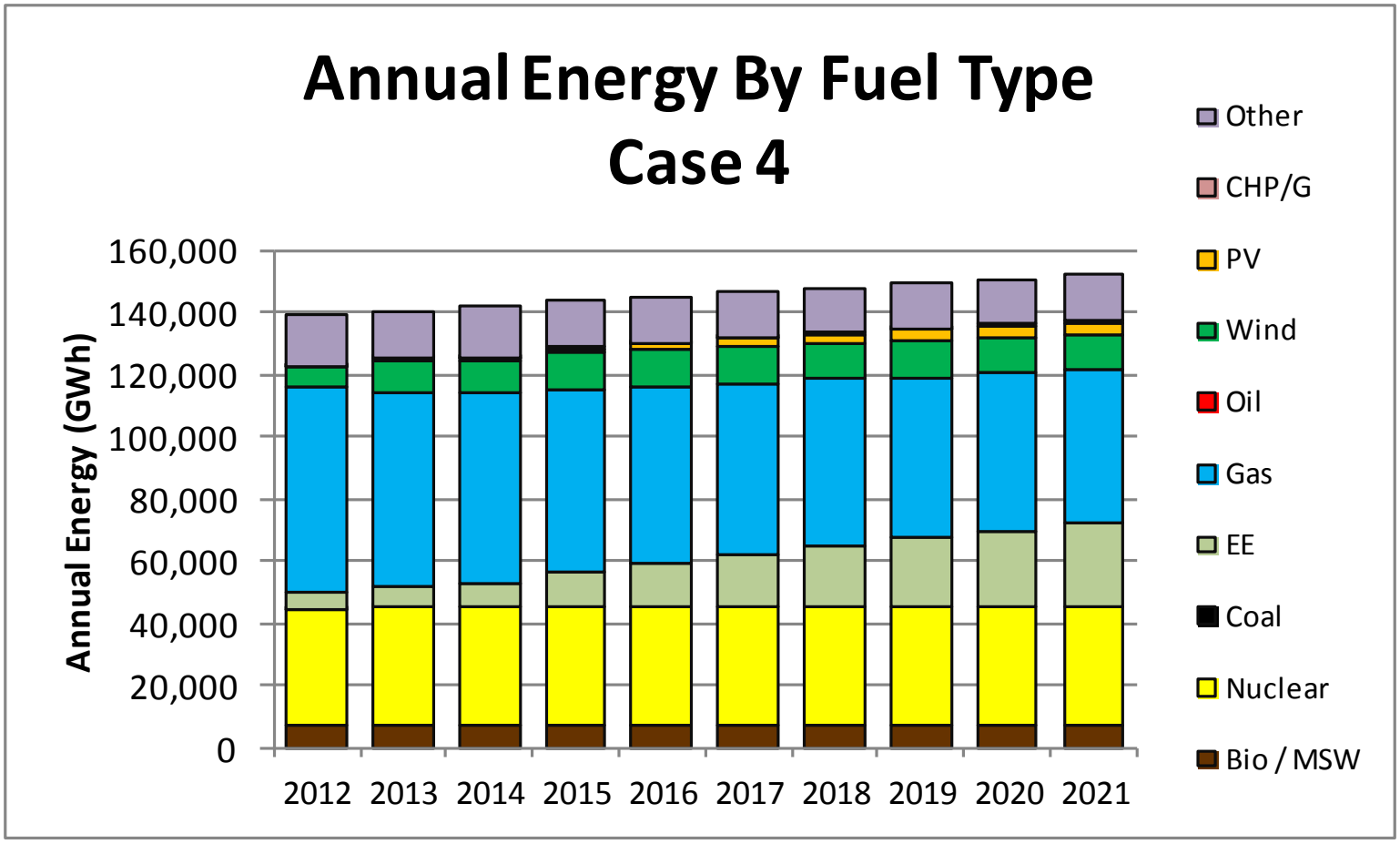
Fuel Consumption Metric
Case 2: Base EE with PV and CHP/G



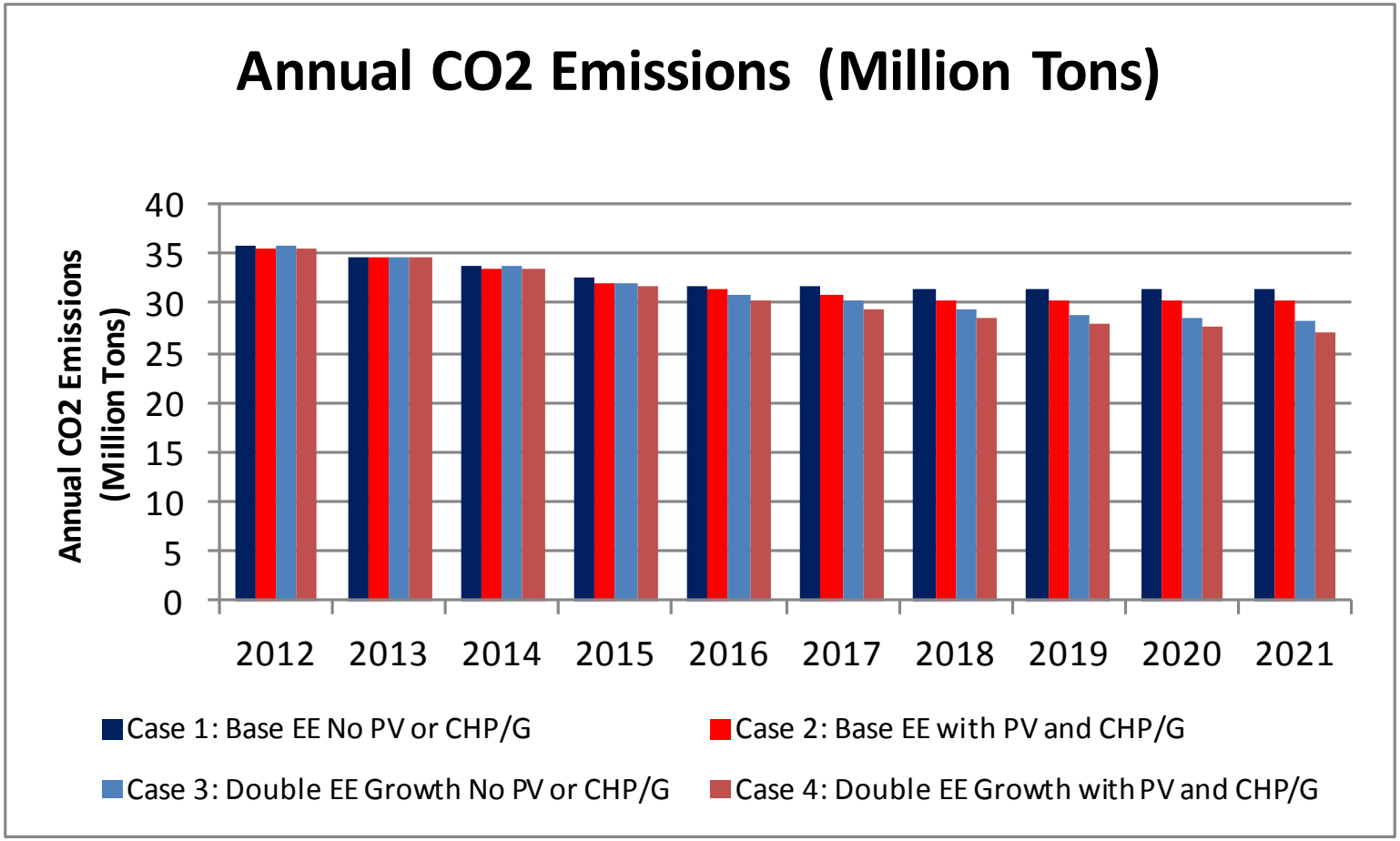
Fuel Consumption Metric
Case 3: Double EE Growth No PV or CHP/G



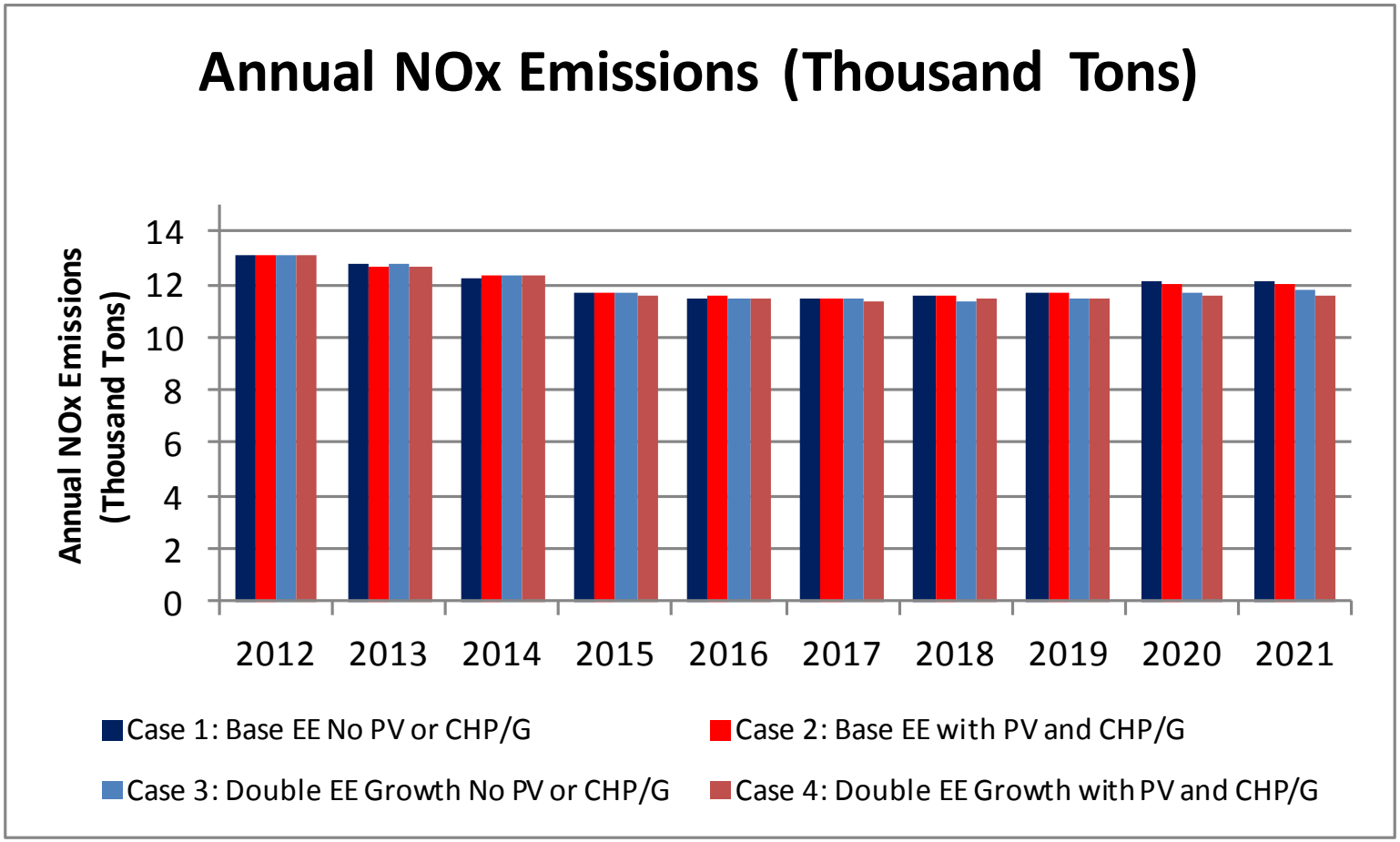
Fuel Consumption Metric
Case 4: Double EE Growth with PV and CHP/G



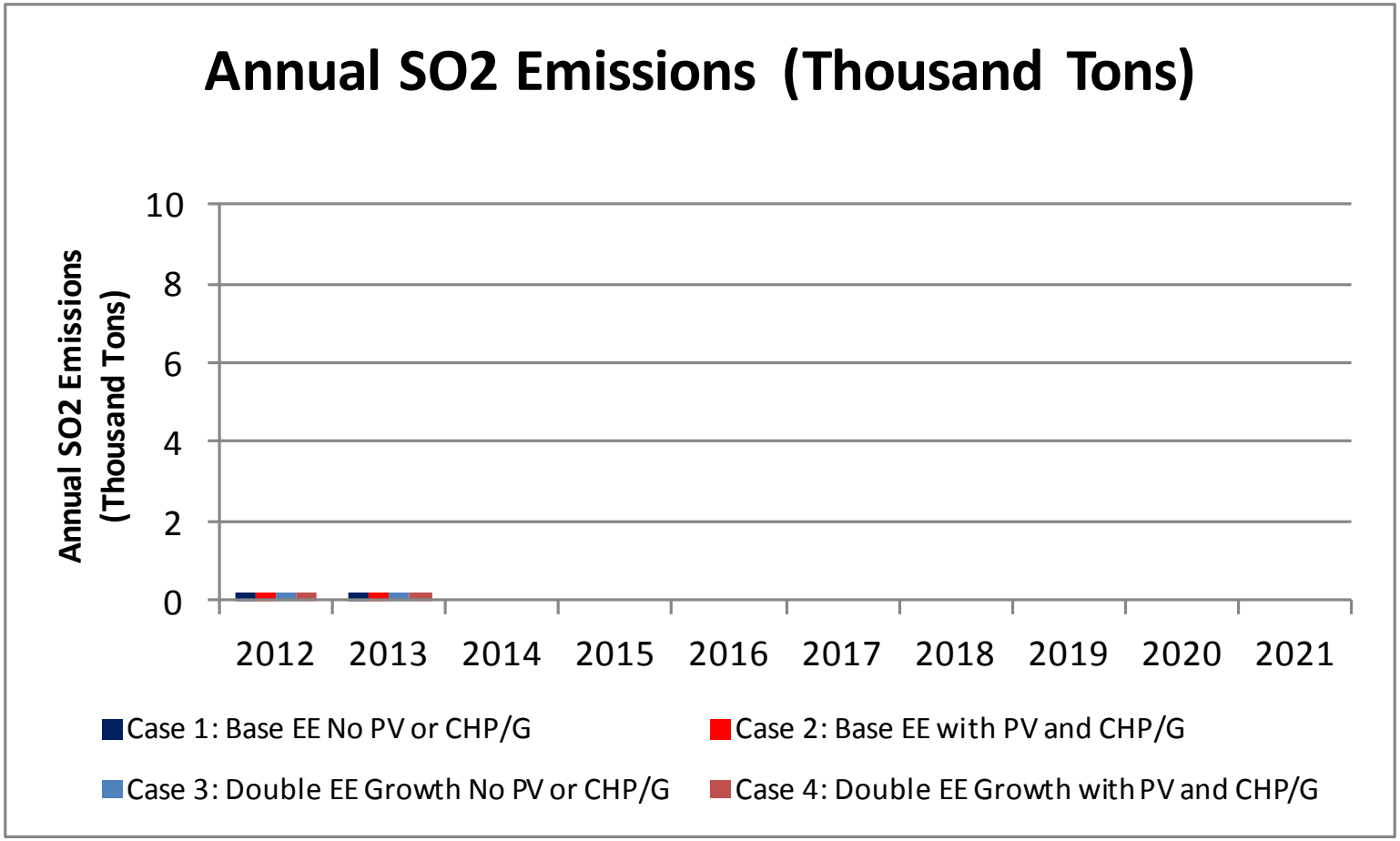
Environmental Emissions Metric
Annual CO2 Emissions



Environmental Emissions Metric
Annual NOx Emissions



Environmental Emissions Metric
Annual SO2 Emissions



Questions