

Climate Change:

CO₂ Projections – Alternative Resource Scenarios

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Outline

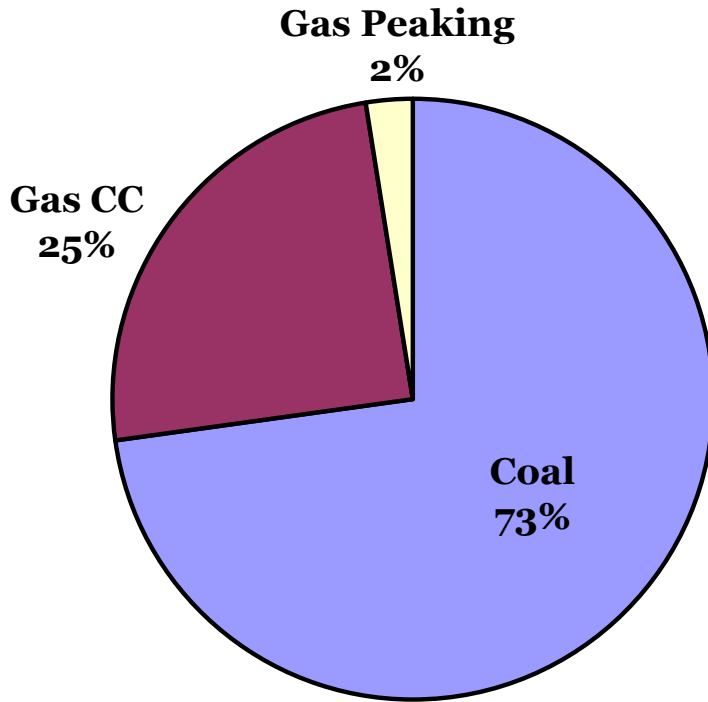
- **Technology Comparisons**
- **Baseline CO₂ Emissions**
- **Near-Term Illustration**
- **Resource Alternative Scenarios**
 - **CO₂ Projections**

CO2 Emissions Comparisons for Resource Technologies

Resource Technology	Average CO2 Emissions (metric tons / MWH)	Comments
Existing Coal Units	0.98	Number represents a projection of fleet-wide average for 2008
New Conventional Coal	0.86	APS' projection for a new, supercritical, pulverized coal unit using hybrid-cooling technology (size is approx. 470 MWs) and without CCS
Existing Gas Combined Cycle	0.43	Projection based upon APS' anticipated utilization patterns for Redhawk plant
Existing Gas Combustion Turbines	0.62	Projection based upon APS' anticipated utilization patterns for Sundance plant
Nuclear	0	
Energy Efficiency	0	
Renewable Sources (wind, solar, geothermal)	0	

Projected Power Production Sources of CO2 Emissions for 2008

Mix Chart

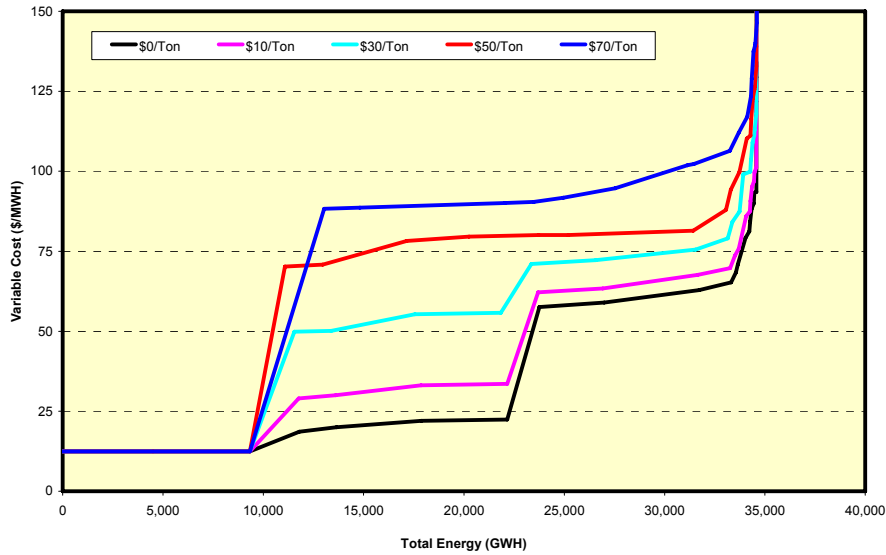


	(MM tons)
Coal	12.0
Gas Combined Cycle	4.1
Gas Peaking	0.4
Total	16.4

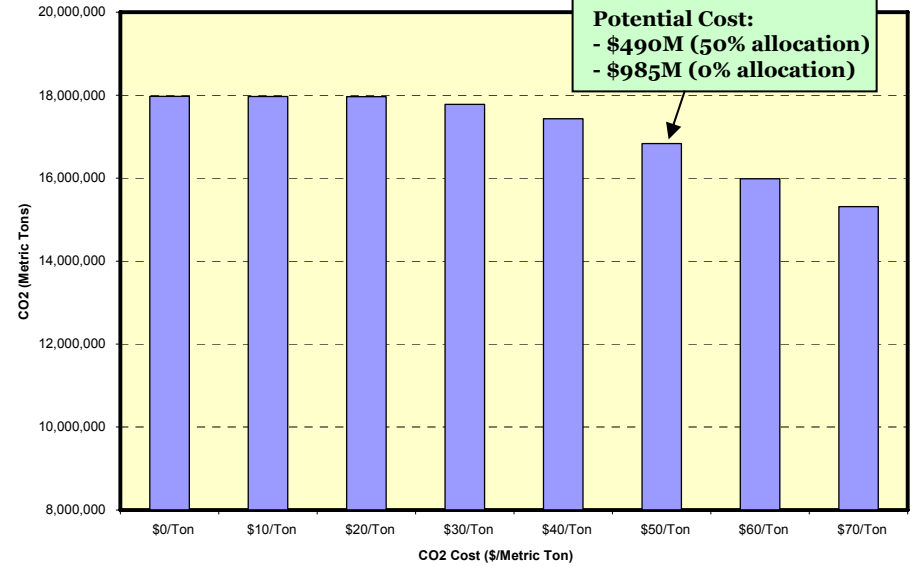
- Includes projected emissions associated with meeting native load requirements,
- Includes projected emissions from energy purchases

Near-Term Illustration (Portfolio Re-Dispatch for 2012)

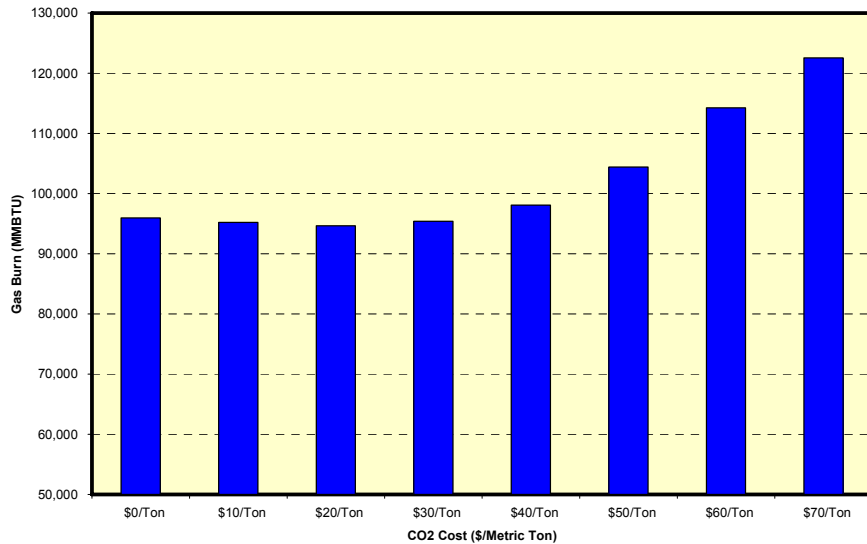
Supply Curve for 2012



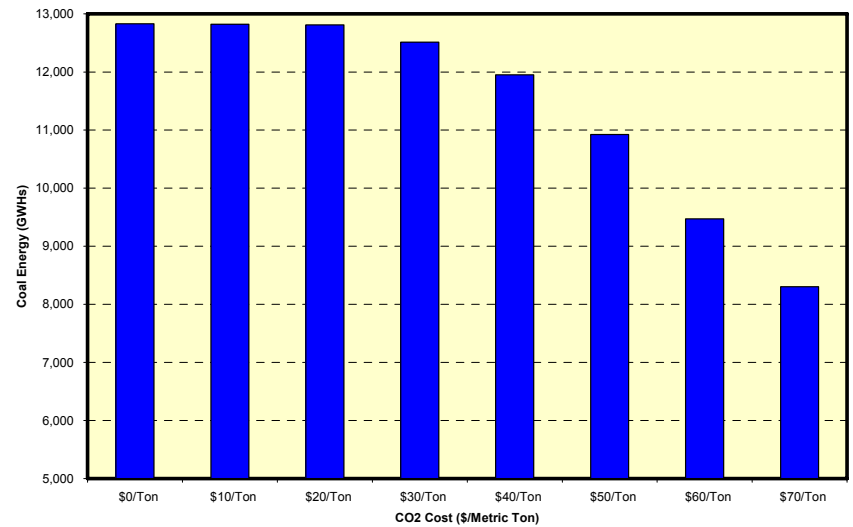
CO2 Metric Tons



Annual Gas Burn



Coal Energy

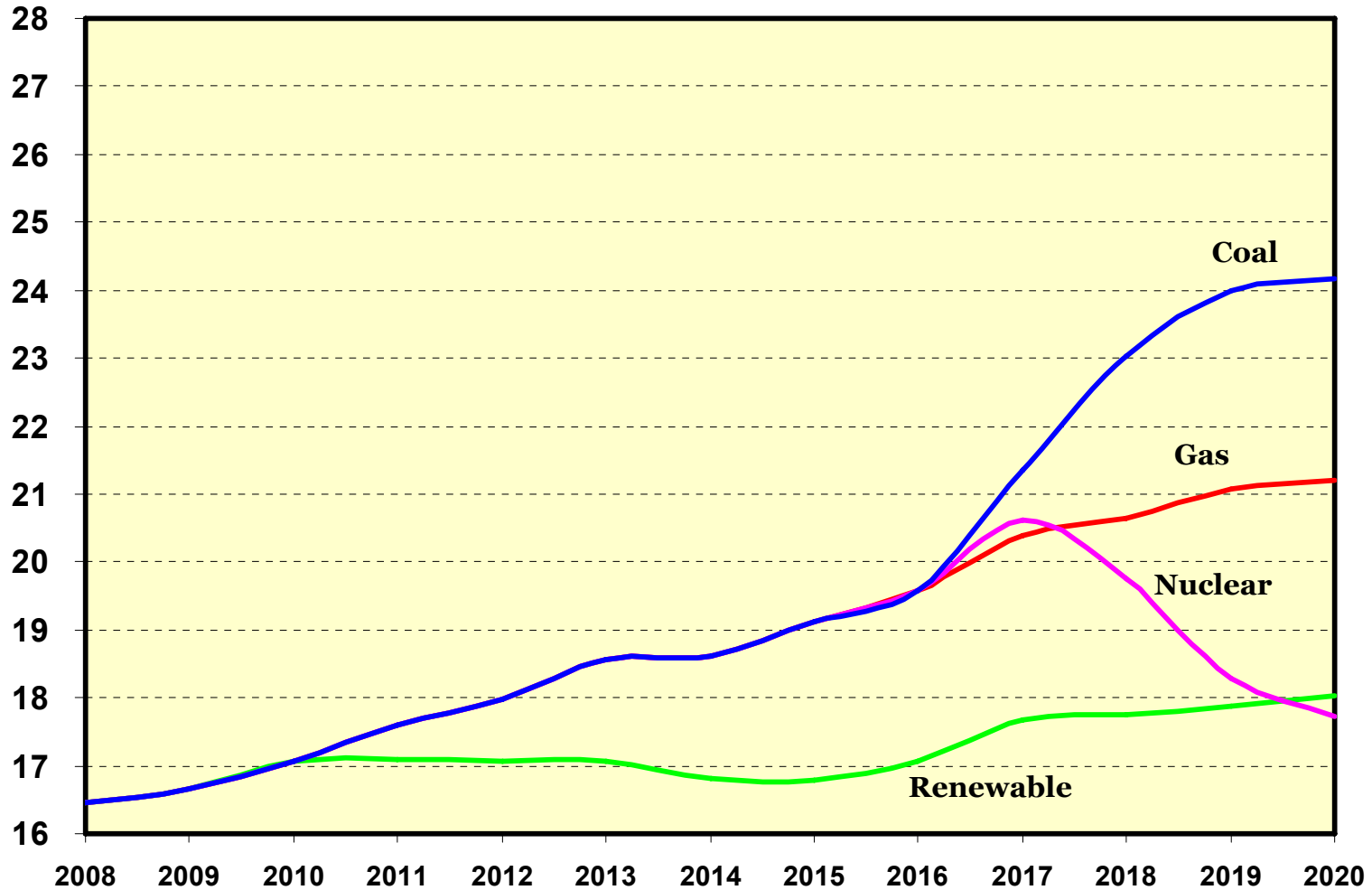


Resource Alternative Scenarios

- **Four Alternative Resource Scenarios Presented in the Report:**
 - Gas Scenario
 - Combination of Natural Gas Resources (combined cycle and peaking) Used to Meet Future Resource Needs
 - Assumptions common to all four scenarios include:
 - Renewable resources to meet RES targets
 - Energy efficiency based upon \$25 M annual level (in 2007 \$'s)
 - Existing generation portfolio is unchanged for forecast period
 - Renewable Scenario
 - Additional renewable resources included:
 - Ramp-up over the 2011 to 2020 time period
 - Assumes additional 200 MWs geothermal and 1,350 MWs solar thermal
 - Approximately 6,700 GWHs per year (added by 2020)
 - Nuclear Scenario
 - Total of 934 MWs of nuclear added (half in 2018, half in 2019)
 - Coal Scenario
 - Total of 934 MWs of coal added (half in 2017, half in 2018)
 - Conventional pulverized coal technology (supercritical units with hybrid cooling)
- **Energy Efficiency Case:**
 - EE investment increased to \$75 M annual level (in 2007 \$'s)
 - Compared to reference case without any future EE investment
 - Energy needs reduced by 1,908 GWHs in 2020

CO2 Projections – Alternative Resource Scenarios

(MM Tons)



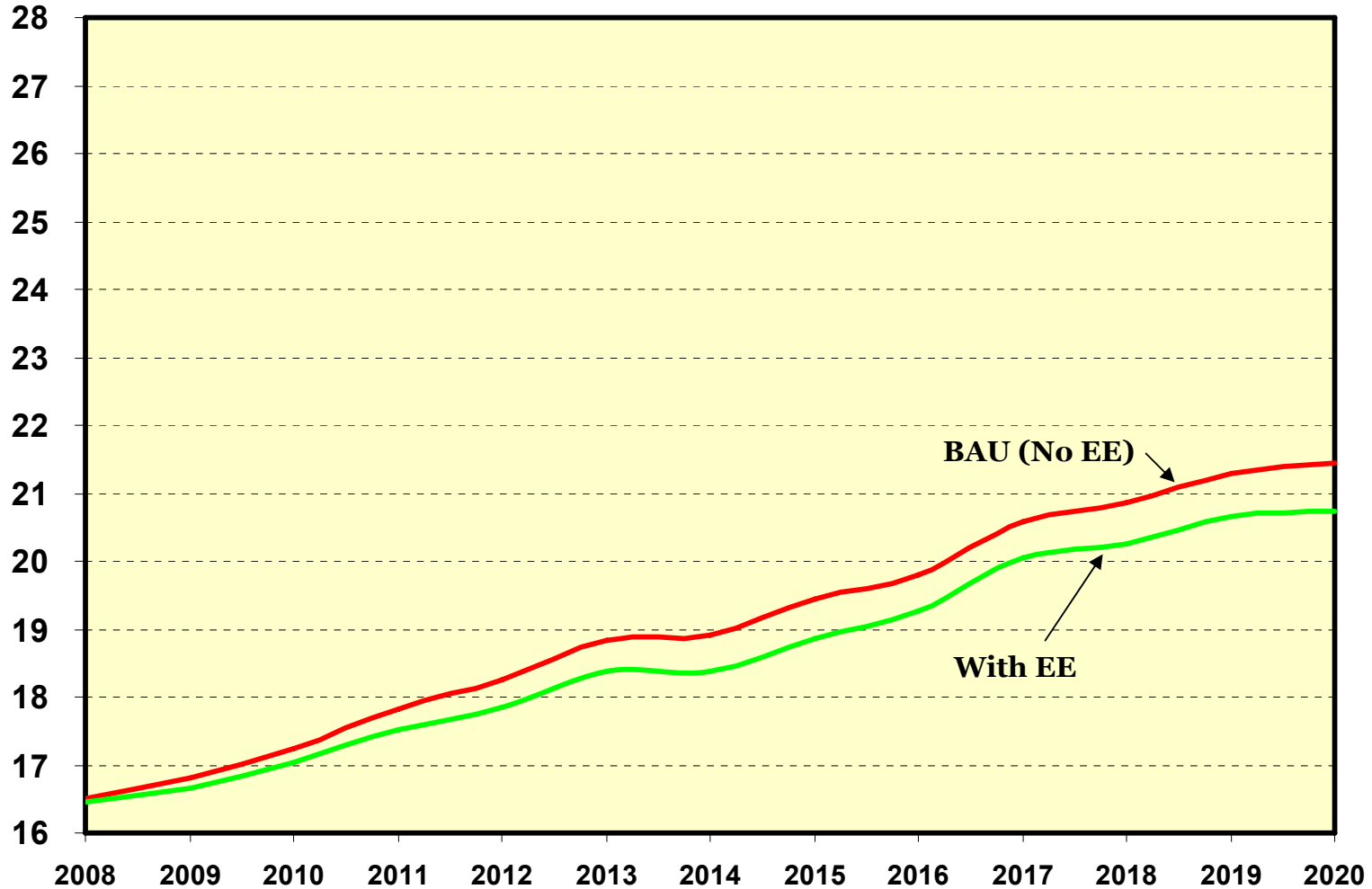
- Includes projected emissions associated with meeting native load requirements,
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Growth is a Key Driver

- **All Four Scenarios Show a Net Increase in CO₂ Emissions by 2020:**
 - Even Renewable Scenario Shows 10% Increase in CO₂ Emissions from 2008 to 2020:
 - Despite adding over 11,000 GWHs of clean energy sources (EE, RE + DE) by 2020
 - This scenario adds 1,350 MWs of solar thermal and 200 MWs of geothermal by 2020 (over and above the renewable resources assumed in the other scenarios)

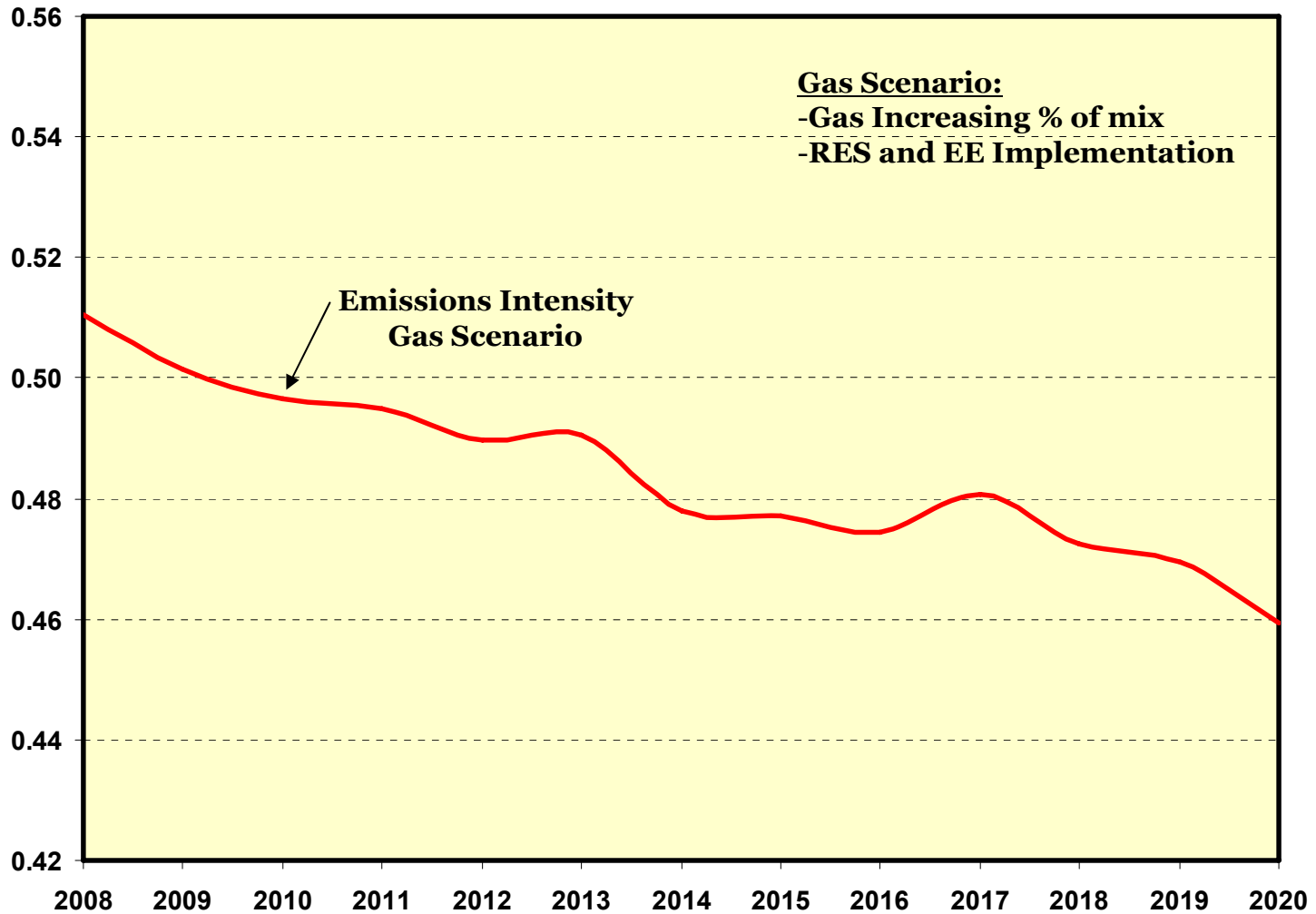
CO2 Projections – Impact of Energy Efficiency

(MM Tons)



CO2 Projections – Emissions Intensity

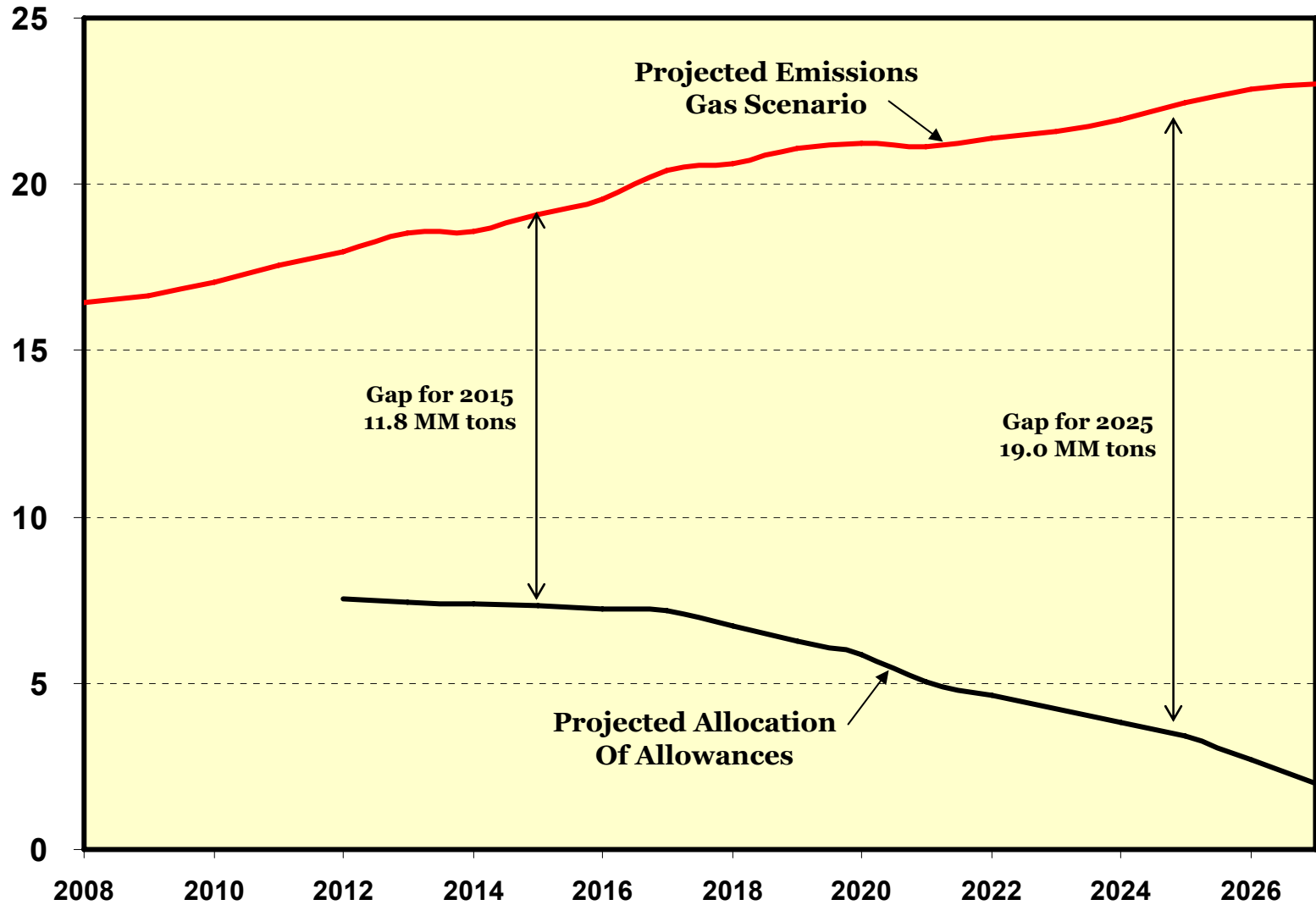
(M Tons/ MWH)



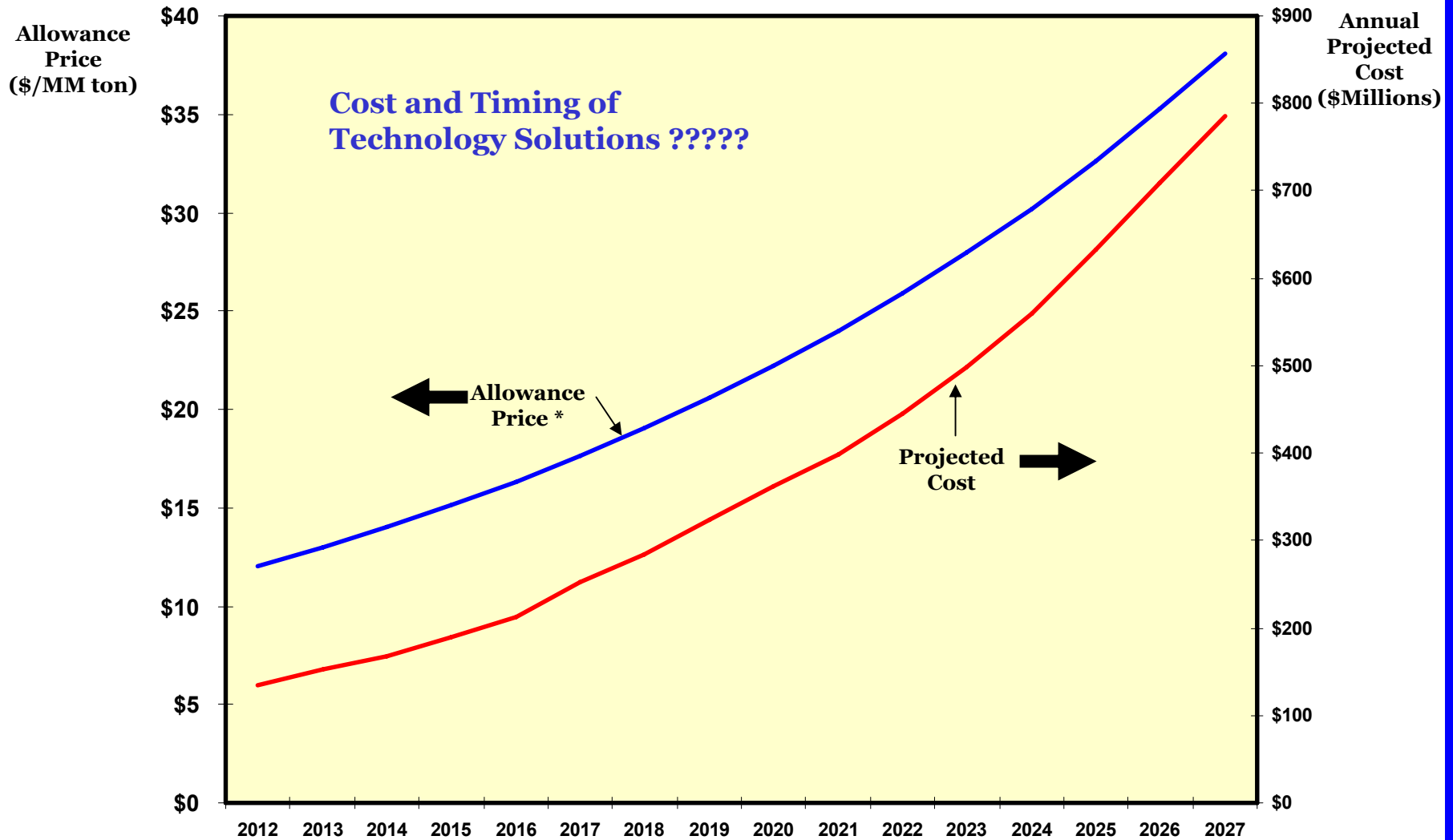
* Calculation method is total emissions divided by BAU own load energy

Projected Impact of Lieberman-Warner Bill

(MM Tons)



Projected Impact of Lieberman-Warner Bill



• Allowance price is based upon TAP price from Bingaman-Spector Bill (L-W did not include safety valve price provisions)

Summary

- **Near-Term CO2 Emissions are Set By the Composition of the Existing Resource Portfolio**
 - Very high emissions price required to create sizeable emissions reductions in the near-term
- **Wide Range of Potential Future CO2 Emissions Dependent Upon Future Resource Choices**
 - By 2020, the difference between the nuclear (or renewable) scenarios and the coal scenario is over 6 MM tons per year
- **Growth in Customer Energy Needs is a Key Driver**
- **Potential Costs Impacts are Significant**
 - Costs will be largely dependent upon:
 - Allocation schemes
 - Emissions allowance (or carbon tax) prices
 - **Development and commercialization of new technologies**