Austin Energy
Scenario Review

June 29, 2009

PACE

Agenda

- Scenario Introduction
  - Case Definitions
  - Key Conclusions
- Analysis Findings for Scenarios
  - Waxman-Markey Emissions Reductions Beyond 2015
  - Impact of Electrification of Transportation Sector
  - Solar Technology Breakthrough
  - Nuclear Addition
  - Pecan Street Renewable Plan
- Comparisons and Conclusions
- Risk Analysis Preview

Scenario Analysis Summary

	Meets 30% Renewable Energy Goal	Meets 100 MW Solar Goal	Includes 700 MW DSM	Includes Existing Generation Units & Contracts	No Replacement of Existing Units before 2020	Meets AE Peak Demand and Energy Requirements	Allows any combination of supply and demand side options	Phased Replacement of FPP, 300 MW 2014, 300 MW 2020	Adds 200 MW Nuclear PPA in 2017	Eliminates Sand Hill CC addition planned for 2015	Assumes 400,000 plug-in vehicles by 2020	Assumes solar technology breakthrough (60% reduction in capital costs by 2020)
Draft Energy Resource Plan "*Strawman*"	✓	✓	✓	✓	✓	✓						
No Additional Generation			✓	✓	✓	✓				✓		
Lowest Bill Impact			✓	✓	✓	✓	✓					
Lowest Bill Impact Meeting Council Goals	✓	✓	✓	✓	✓	✓	✓					
Replace FPP **: Renewables**	✓	✓	✓	✓		✓		✓				
Replace FPP **: Low Cost, Low Carbon**			✓	✓		✓	✓	✓				
Waxman-Markey Draft CO2 Bill	✓	✓	✓	✓	✓	✓						
Strawman with Impact of the Electrification of the Transportation Sector	✓	✓	✓	✓	✓	✓					✓	
Strawman with Solar Technology Breakthrough	✓	✓	✓	✓	✓	✓						✓
Strawman with Nuclear Addition	✓	✓	✓	✓	✓	✓			✓	✓		
Pecan Street Renewable Plan	✓	✓	✓	✓		✓	✓			✓		

Overall Conclusions

- Scenarios around *Strawman* that maintain the combined cycle addition in 2015 do not significantly impact portfolio costs, given Reference Case assumptions
  - *Waxman-Markey Emissions Reductions Beyond 2015* can be achieved with new wind capacity additions with minimal impact to portfolio costs
  - *Impact of Electrification of the Transportation Sector* scenario analysis concludes that wind capacity additions (and solar beyond 2020) can meet portfolio requirements with minimal impacts to costs per MWh, even though revenue requirements are higher due to additional demand
  - *Solar Technology Breakthrough* scenario analysis indicates that incremental solar capacity additions become cost effective around 2018-2020, but impact on overall portfolio costs is not significant
- Scenarios around *Strawman* that replace the combined cycle impact costs more significantly
  - Replacement of the combined cycle with a nuclear PPA in 2017 raises costs by about $3-4/MWh above *Strawman*
    - In order to achieve parity with combined cycle in 2017, gas prices would have to be around $15/MMBtu or nuclear capital costs would have to decline significantly
  - *Pecan Street* scenario with rooftop solar PV additions is competitive in cost to *Strawman* due to customer contributions (25% customer owned, 75% AE) and declining solar cost assumptions

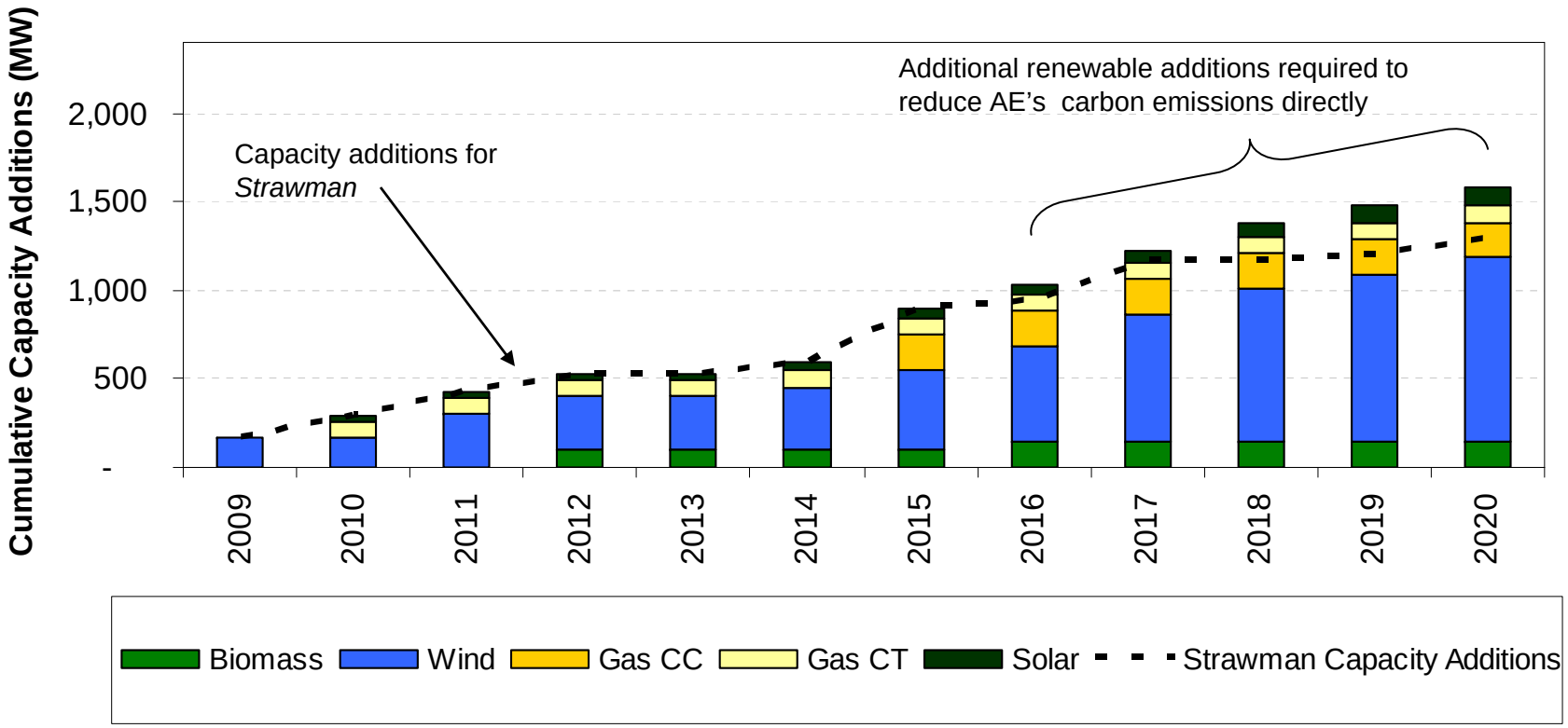
Strawman with Waxman-Markey Emissions Reductions Beyond 2015

Strawman with Waxman-Markey Emissions Reductions Beyond 2015

- *Strawman* plan forms the basis for the scenario's expansion plan
- Emission reductions beyond 2015 to be met directly by Austin Energy
  - 10% below 2005 levels by 2016
  - 17% below 2005 levels by 2020

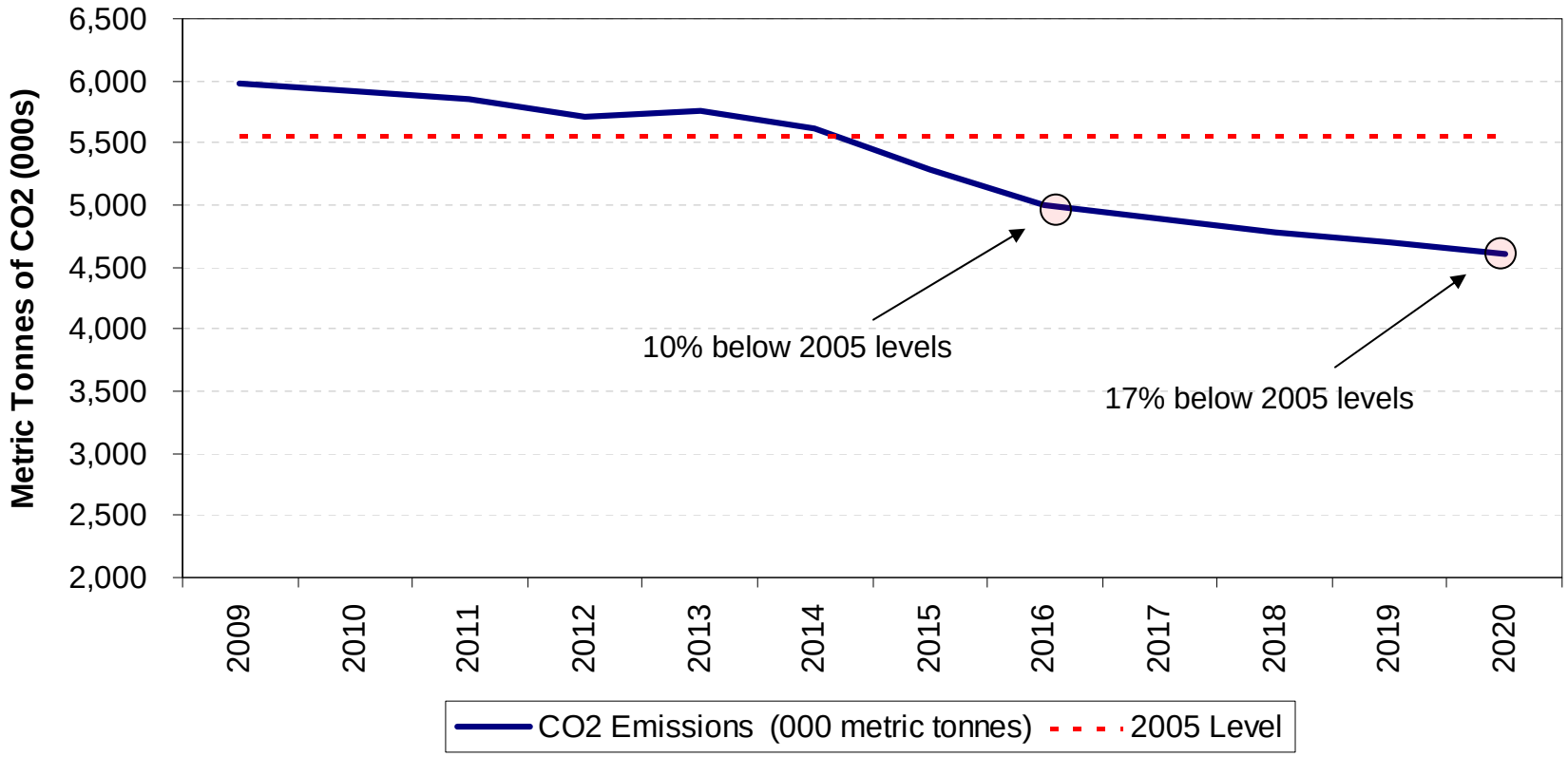
Strawman with Waxman-Markey Emissions Reductions Beyond 2015
Annual Capacity Expansion Plan

- Strawman expansion plan is the starting point, with an additional 285 MW of wind capacity in 2016 and beyond
- Expansion plan totals 300 MW of natural gas, 1,035 MW of wind, 100 MW of solar, and 150 MW of biomass

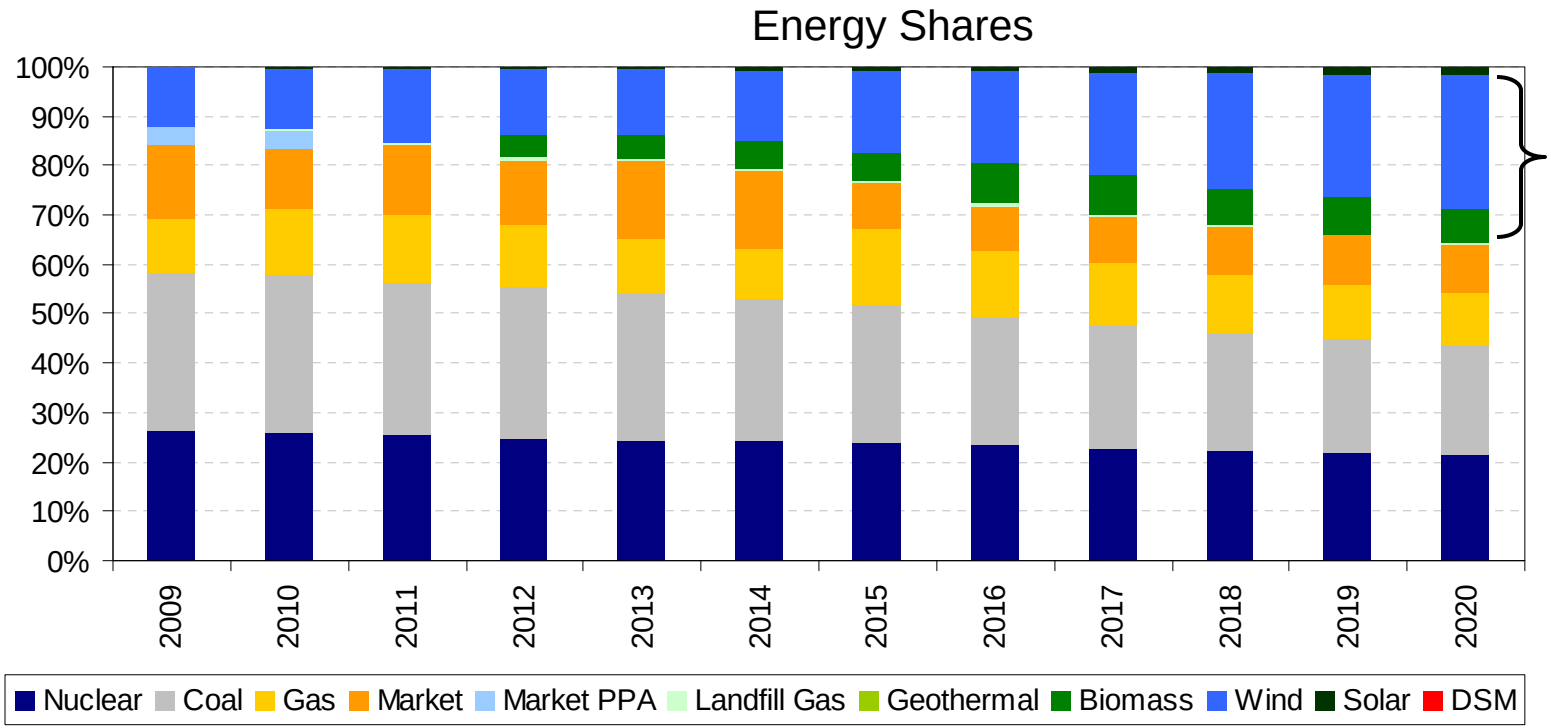


Strawman with Waxman-Markey Emissions Reductions Beyond 2015
CO2 Emissions

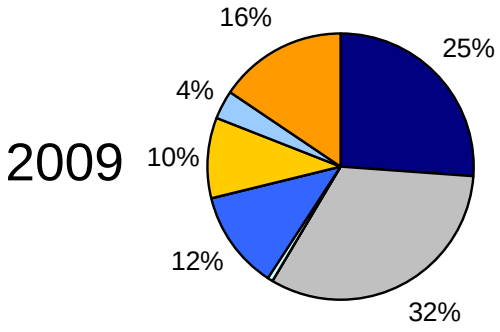
- Emission reductions beyond 2015 achieved directly by Austin Energy in line with target levels in the Waxman-Markey legislation

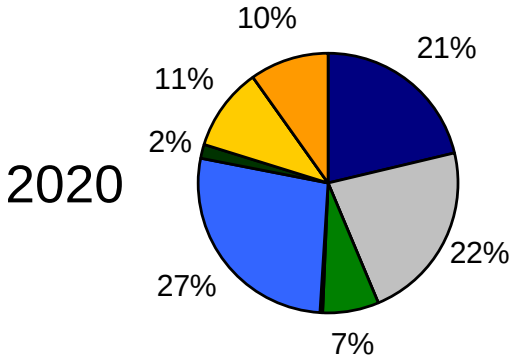


Strawman with Waxman-Markey Emissions Reductions Beyond 2015
Annual Generation for Native Load



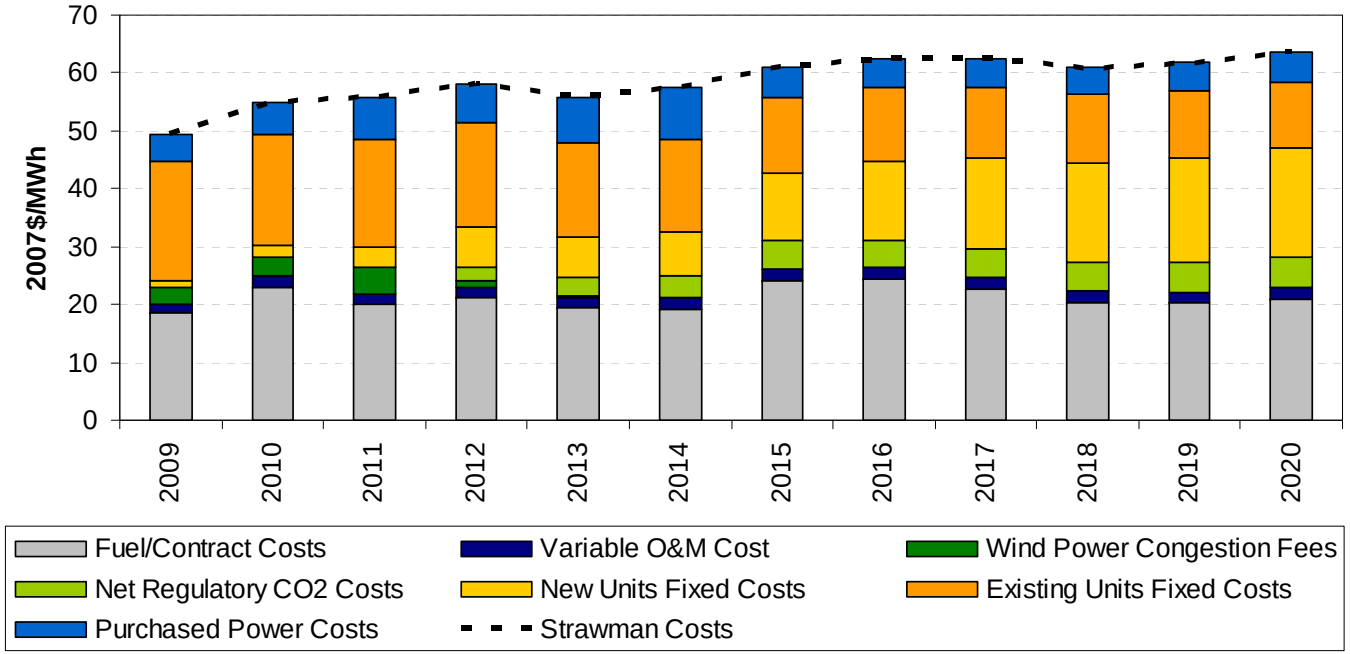
Renewable share at 36% due to wind capacity additions

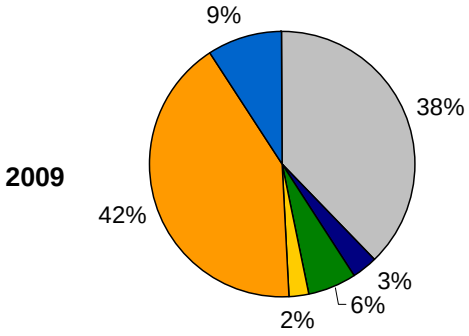


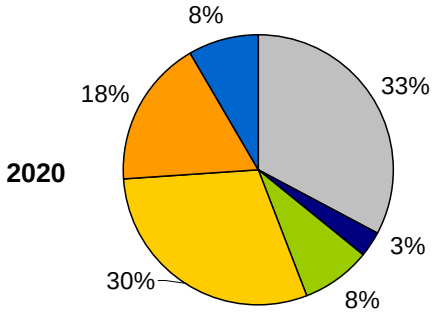


Strawman with Waxman-Markey Emissions Reductions Beyond 2015
Total Portfolio Costs

- Costs are only slightly higher than those in the Strawman, as capital expenditures associated with wind additions are offset by few market purchases and lower exposure to CO2 costs



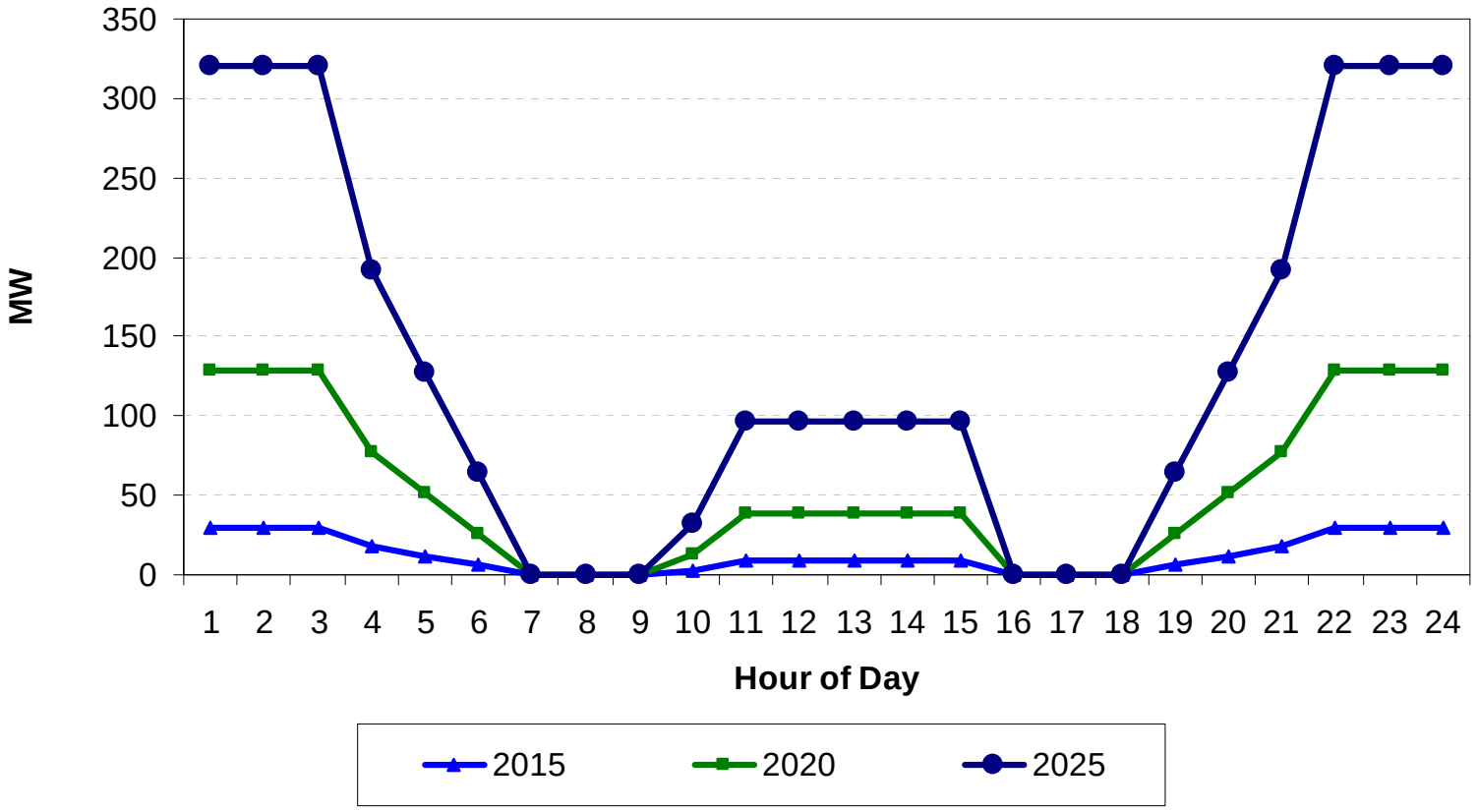




Strawman with Impact of Electrification of Transportation Sector

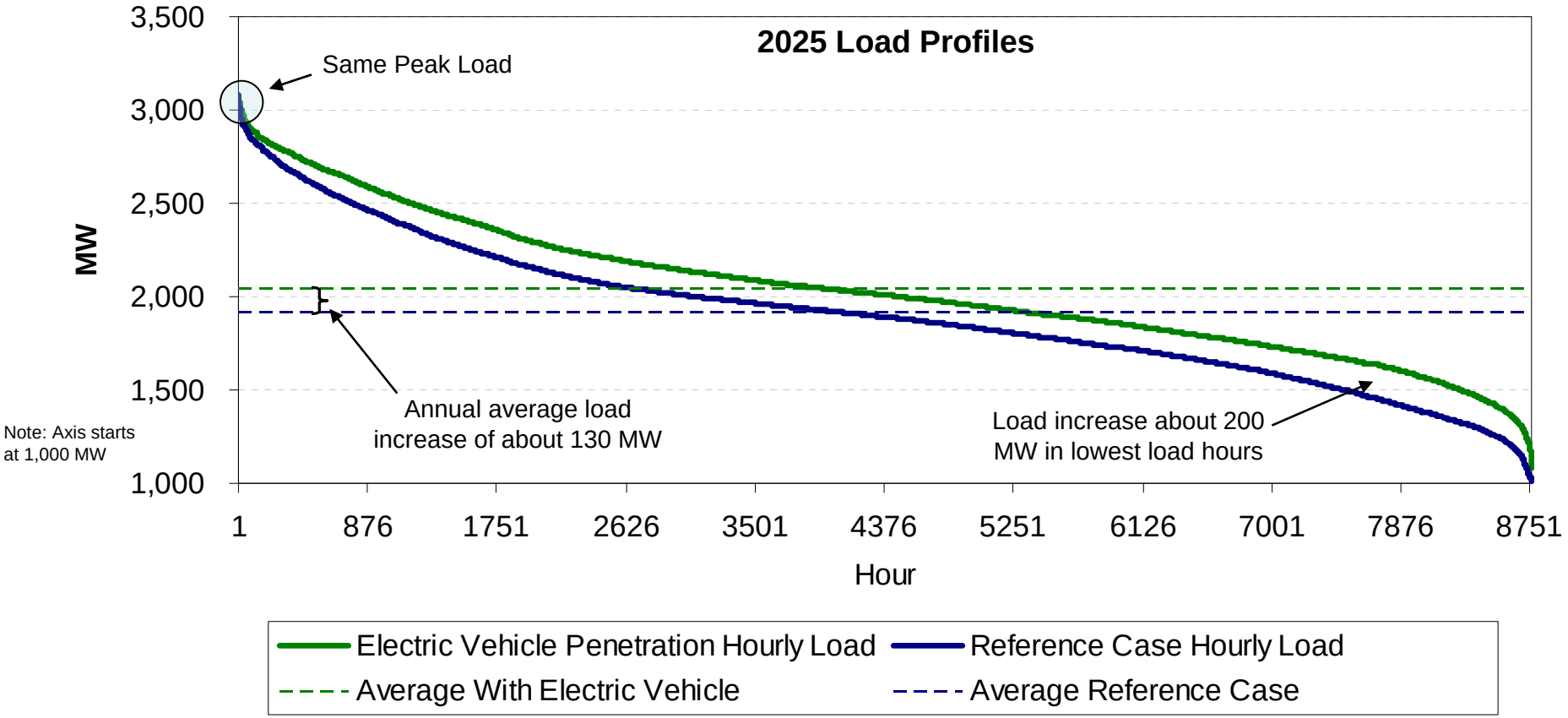
Increased Vehicle Penetration Changes Hourly Load Shape

- By 2025, full vehicle penetration is assumed, which is expected to result in over 300 MW of additional load expected off-peak and about 100 additional MW during on-peak hours
- By 2020, impact is expected to be about 130 MW off-peak and about 40 MW on-peak



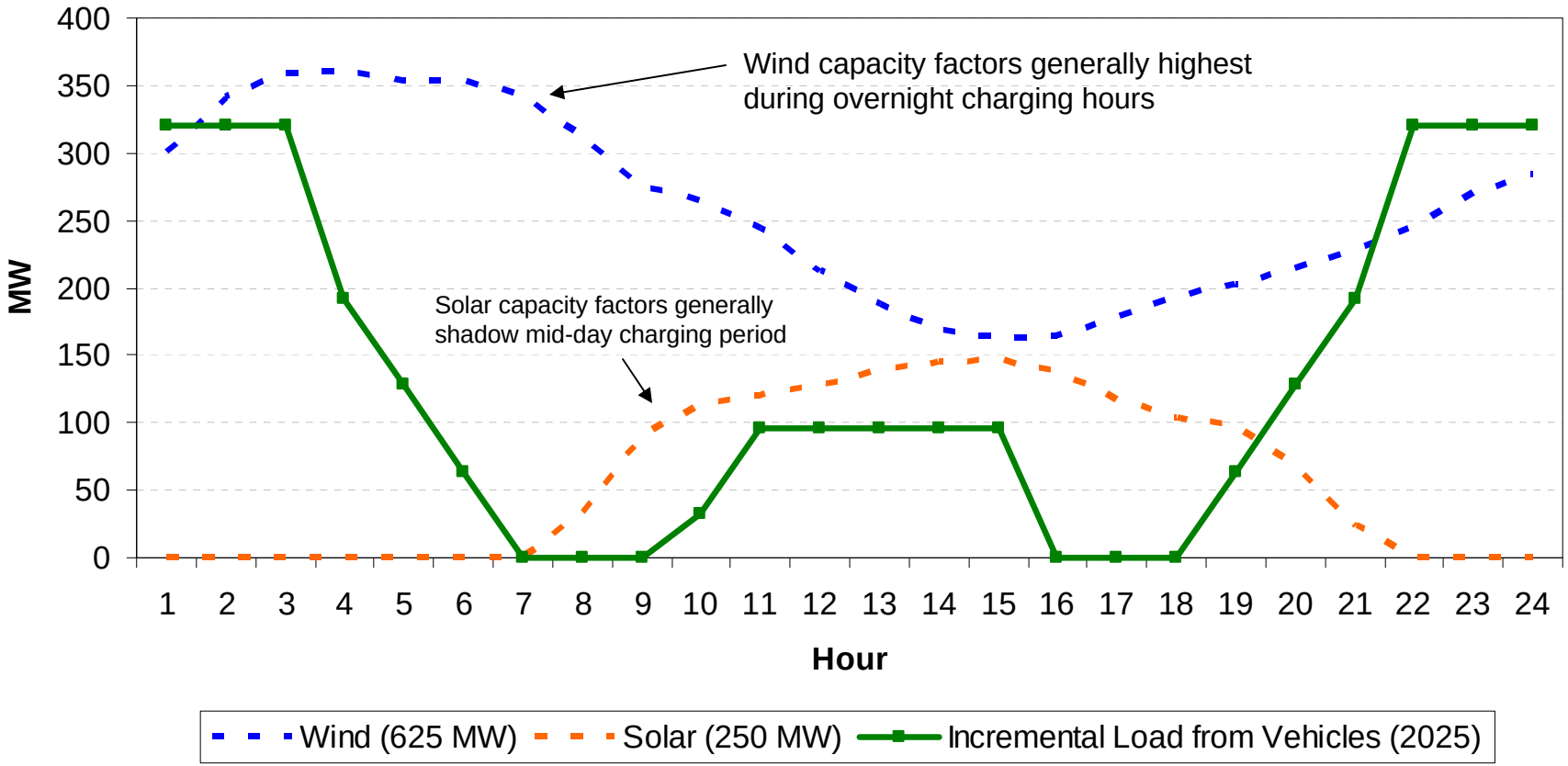
Electric Vehicles Change Load Profile

Electric vehicles flatten load profile by raising overall average demand (especially in off-peak hours), but maintaining same peak



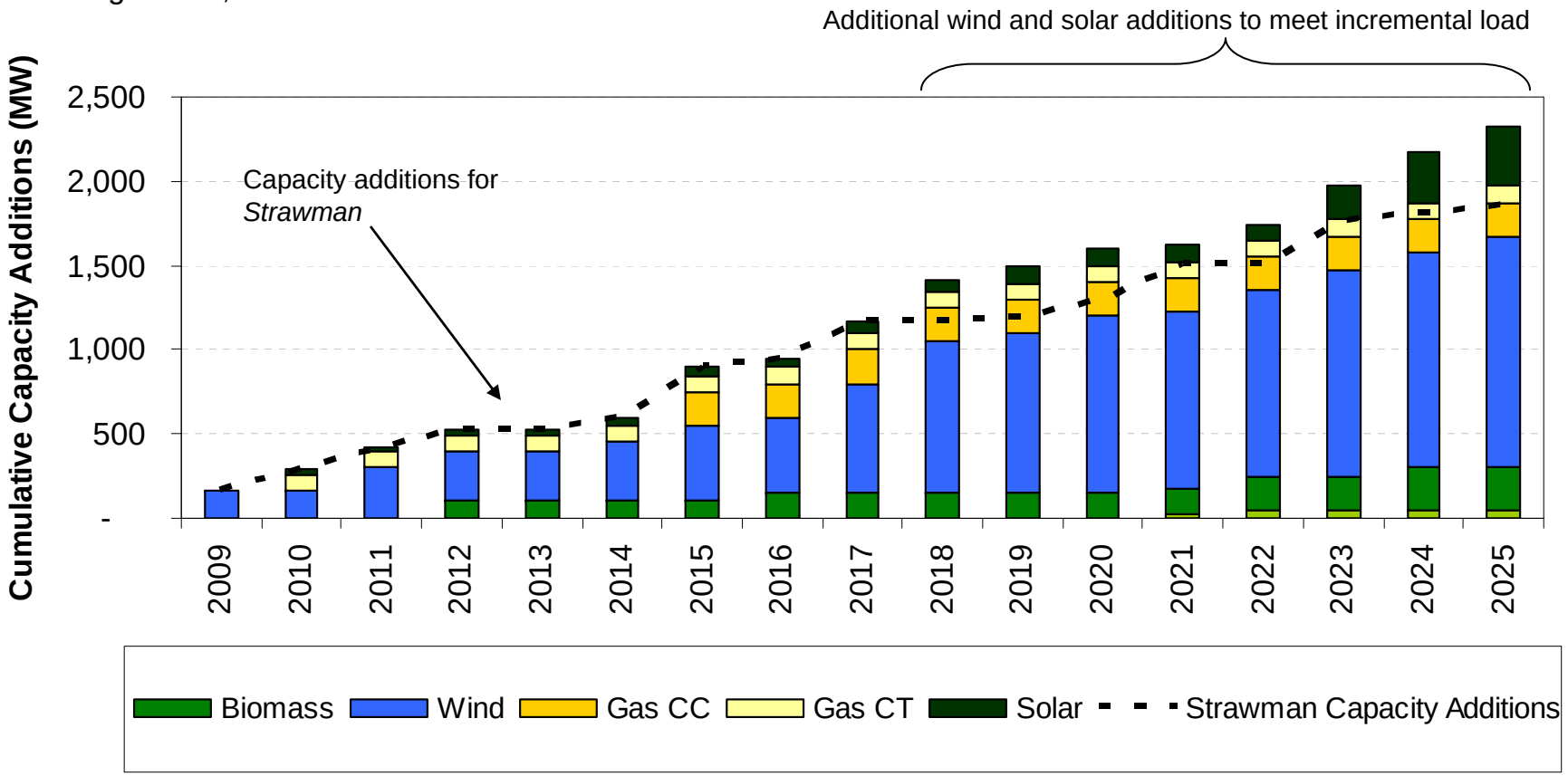
Wind (and Solar) Have Natural Synergies with Additional Load

- Wind's generation profile matches well with incremental load additions during the off-peak, while expected solar profile coincides with mid-day vehicle charging time

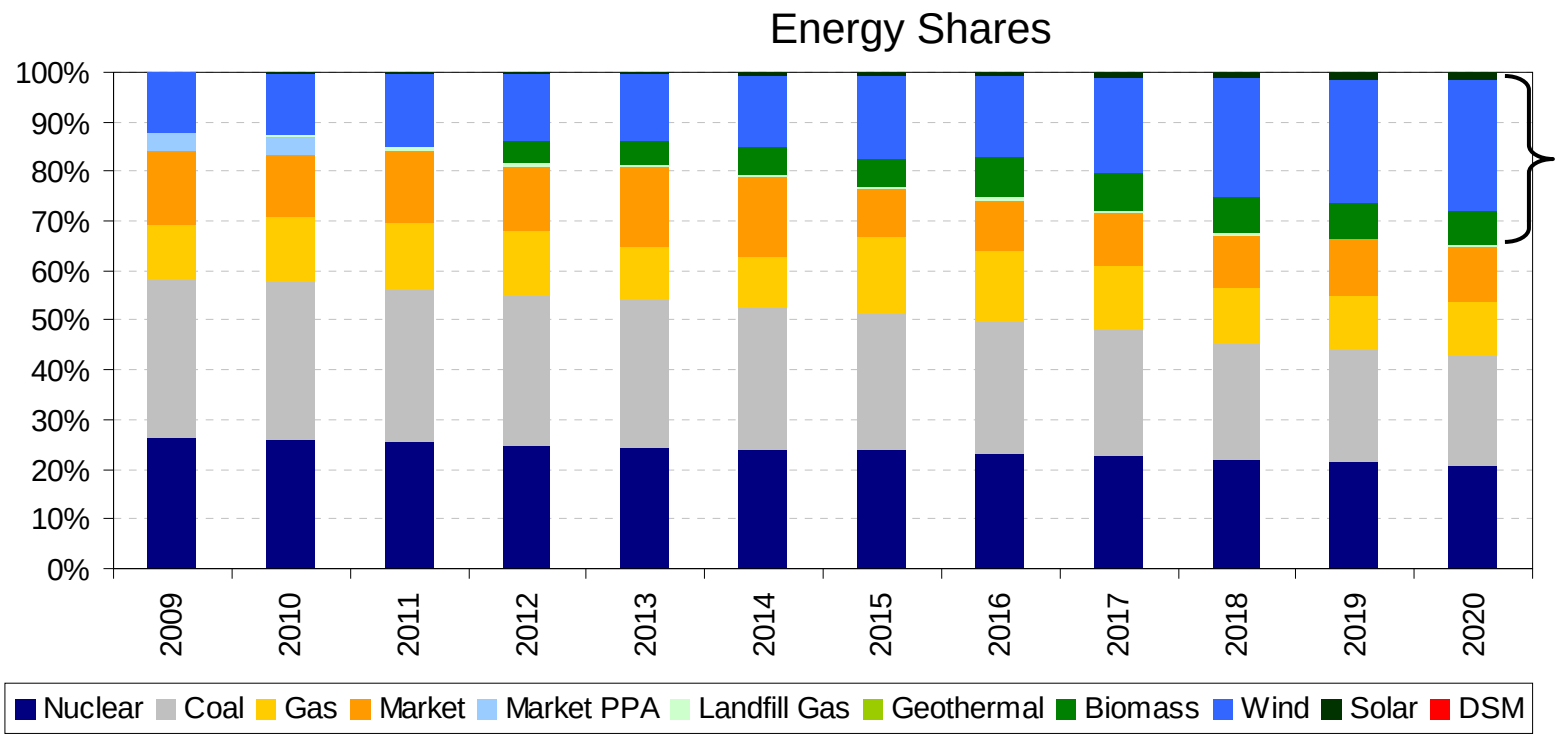


Strawman with Impact of Electrification of Transportation Sector
Annual Capacity Expansion Plan

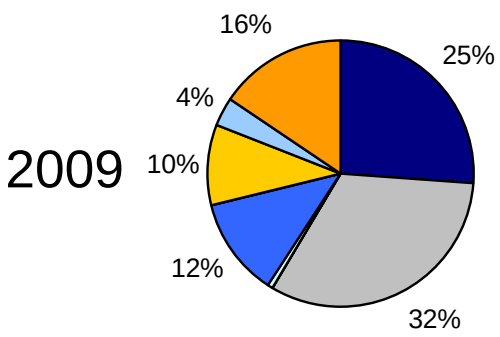
- Strawman expansion plan is the starting point, with an additional 300 MW of wind capacity to meet off-peak demand increases through 2020
- Through 2020, expansion plan totals 300 MW of natural gas, 1,050 MW of wind, 100 MW of solar, and 150 MW of biomass
- Through 2025, more wind and solar additions

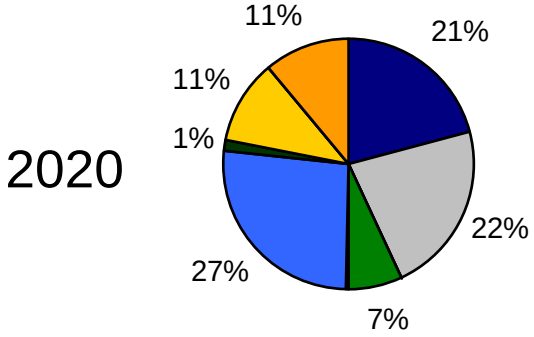


Strawman with Impact of Electrification of Transportation Sector
Annual Generation for Native Load



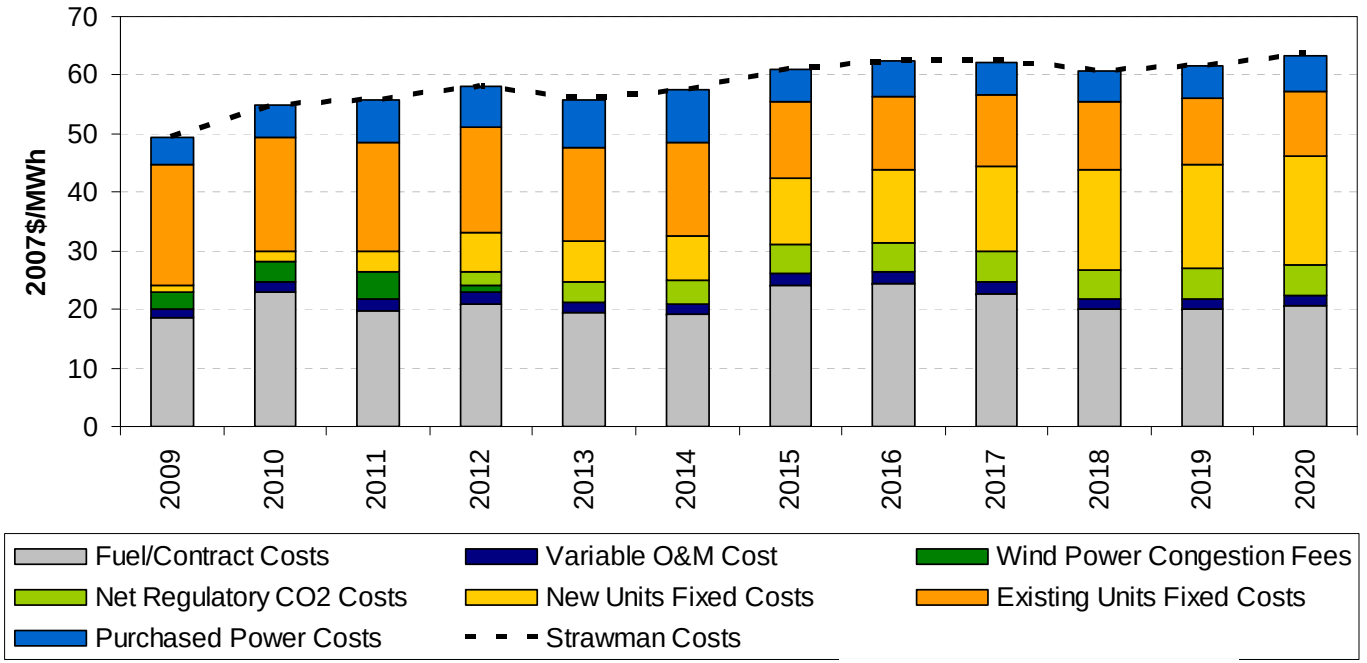
Renewable share at 35% due to wind capacity additions fully meeting incremental load

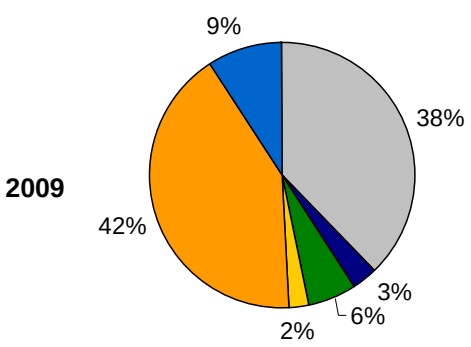


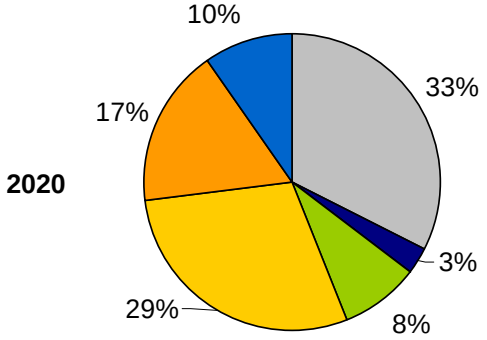


Strawman with Impact of Electrification of Transportation Sector
Total Portfolio Costs

- Revenue requirements are greater due to additional capacity additions, but costs per MWh are very close to the Strawman because they are spread out over more load



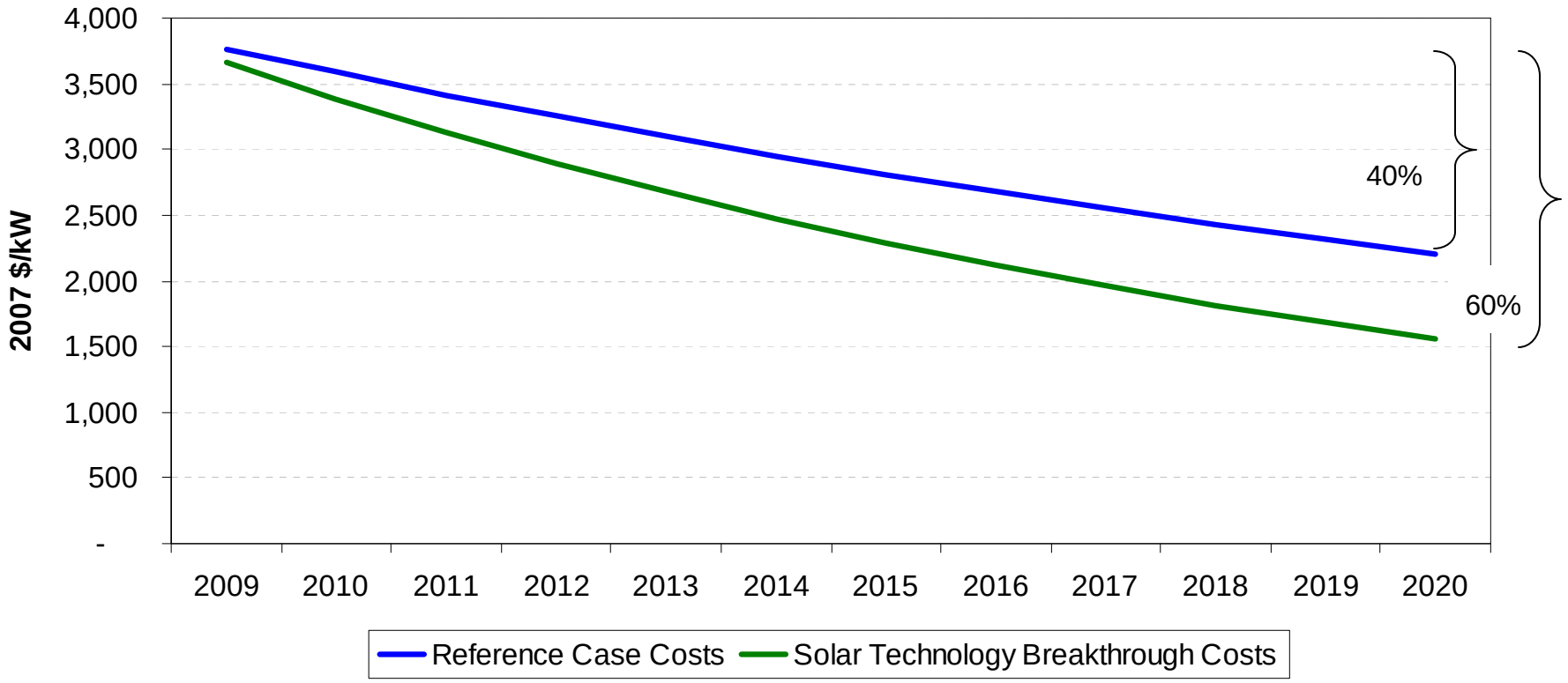




Strawman with Solar Technology Breakthrough

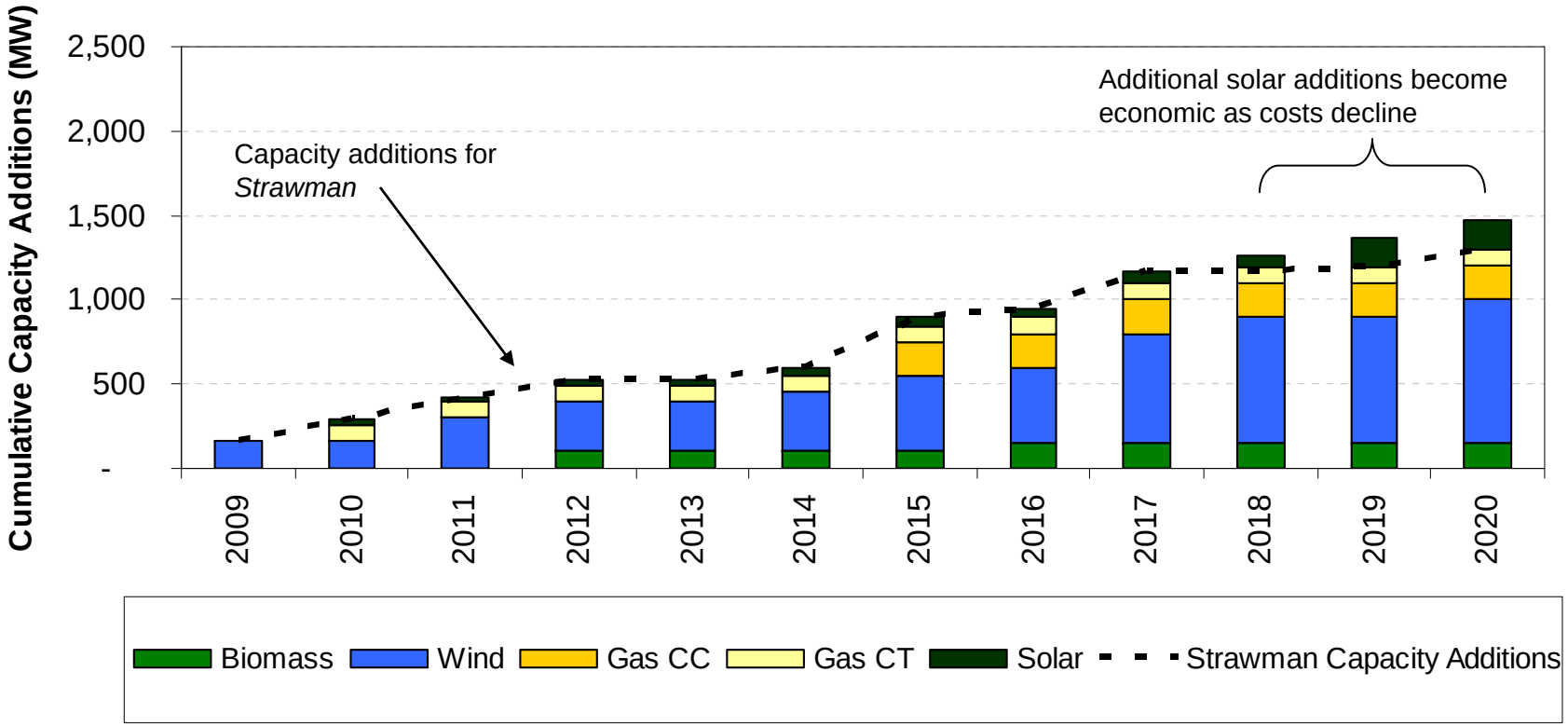
More Aggressive Solar Cost Declines Assumed

- Pace's Reference Case cost projections assume a significant decline
- For solar technology breakthrough case, assumed solar costs would decline by 60% from current levels by 2020

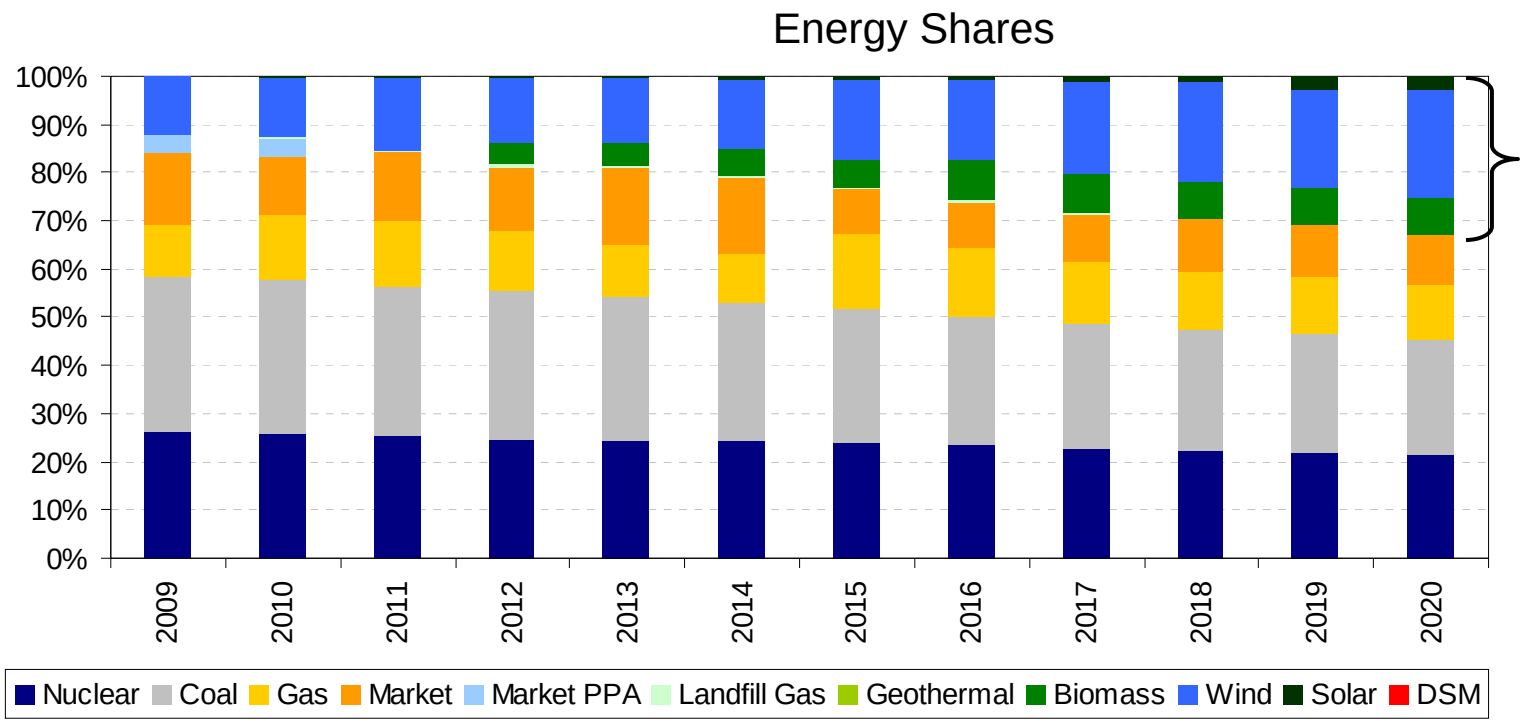


Strawman with Solar Technology Breakthrough
Annual Capacity Expansion Plan

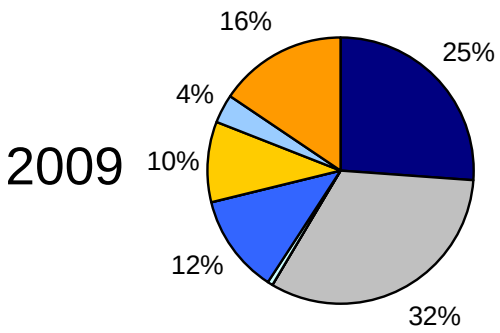
- Strawman expansion plan is the starting point, with an additional 75 MW of solar capacity and an additional 100 MW of wind capacity to complement the intermittent solar profile
- Expansion plan totals 300 MW of natural gas, 850 MW of wind, 175 MW of solar, and 150 MW of biomass

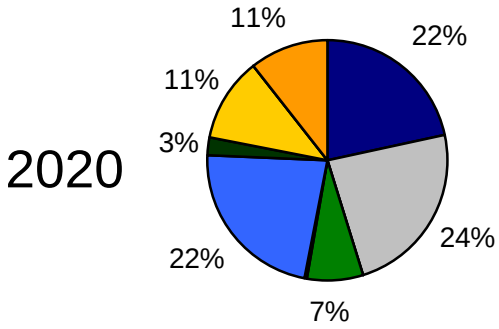


Strawman with Solar Technology Breakthrough
Annual Generation for Native Load



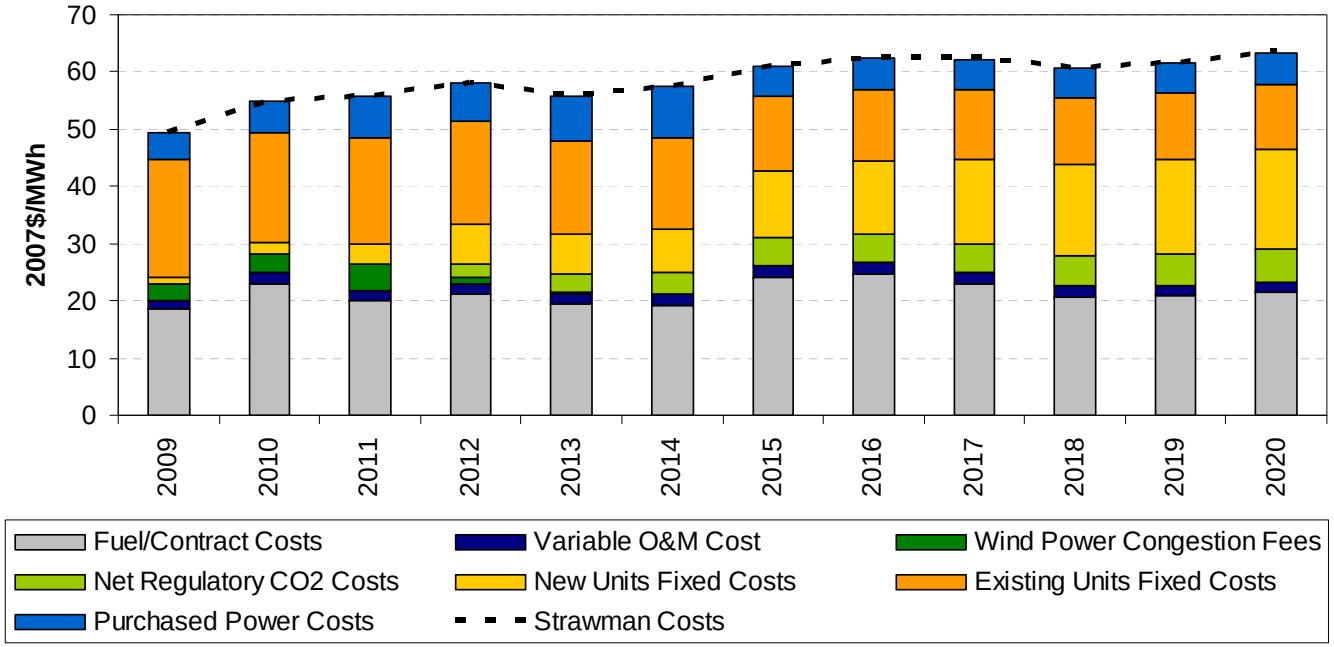
Renewable share at 33% due to more capacity additions

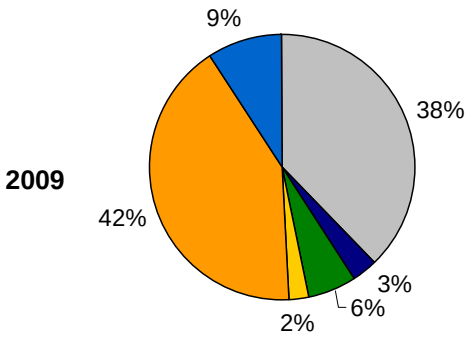


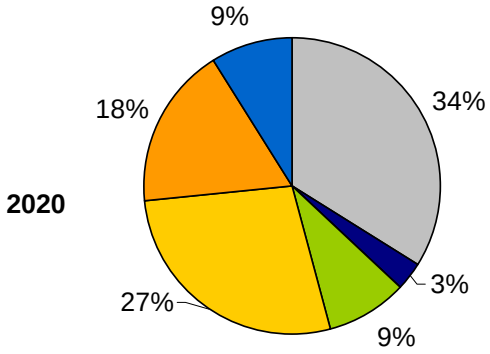


Strawman with Solar Technology Breakthrough
Total Portfolio Costs

- Costs are very slightly lower than in the Strawman, due to lower capital costs for new solar additions



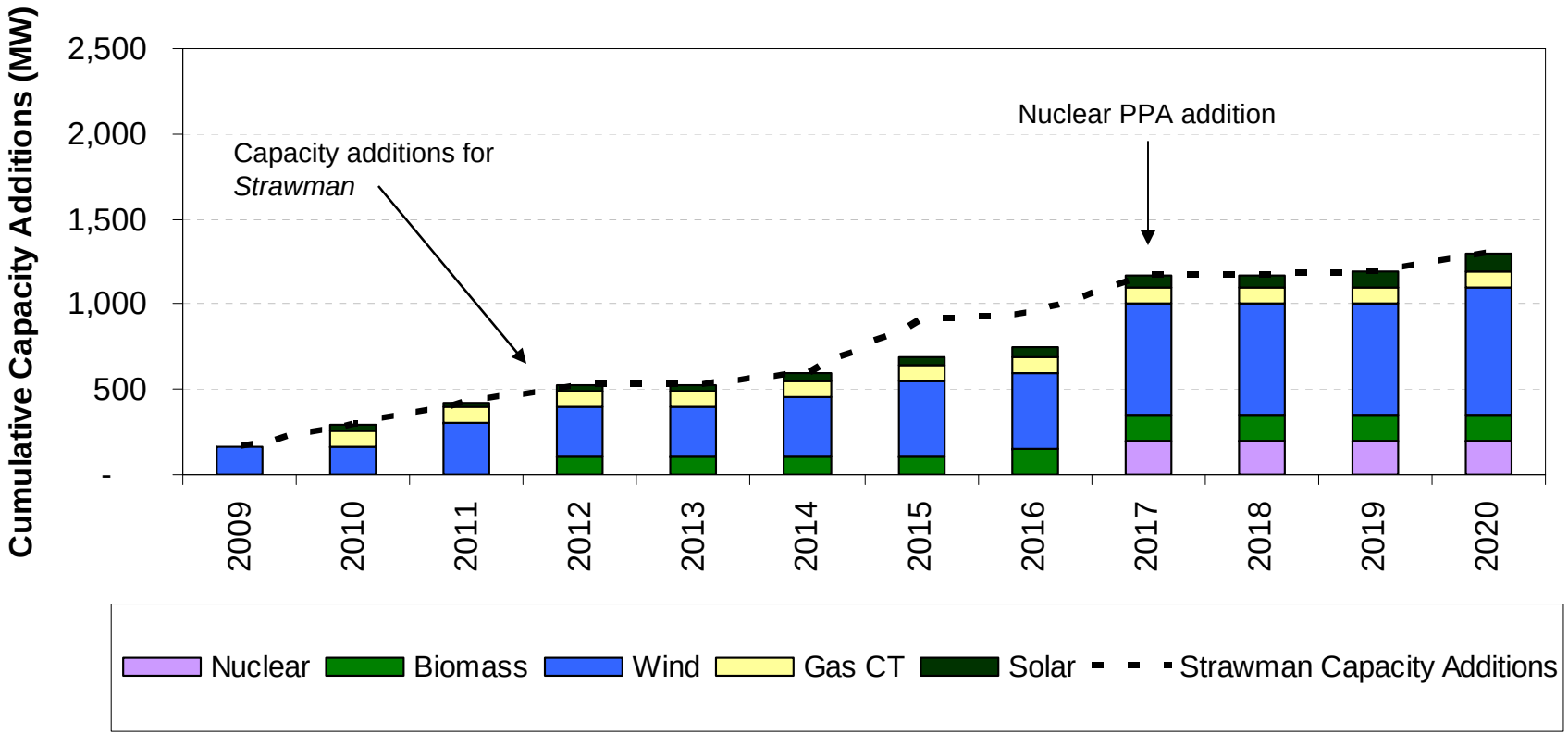




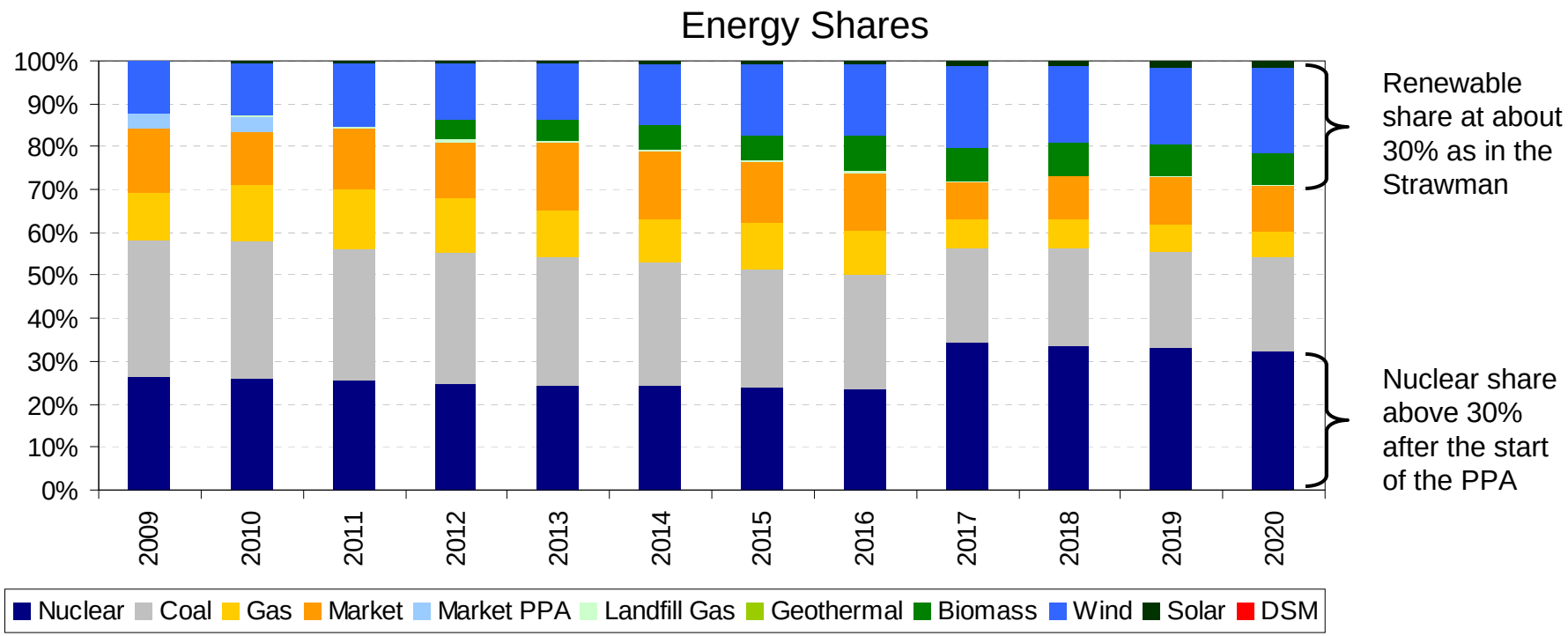
Strawman with Nuclear Addition

Strawman with Nuclear Addition
Annual Capacity Expansion Plan

- Strawman expansion plan minus the combined cycle expansion in 2015, with a nuclear PPA in 2017
  - Nuclear PPA costs assume private ownership structure for plant construction and a 15% price premium
- Expansion plan totals 100 MW of natural gas, 750 MW of wind, 100 MW of solar, 150 MW of biomass, and 200 MW of nuclear PPA

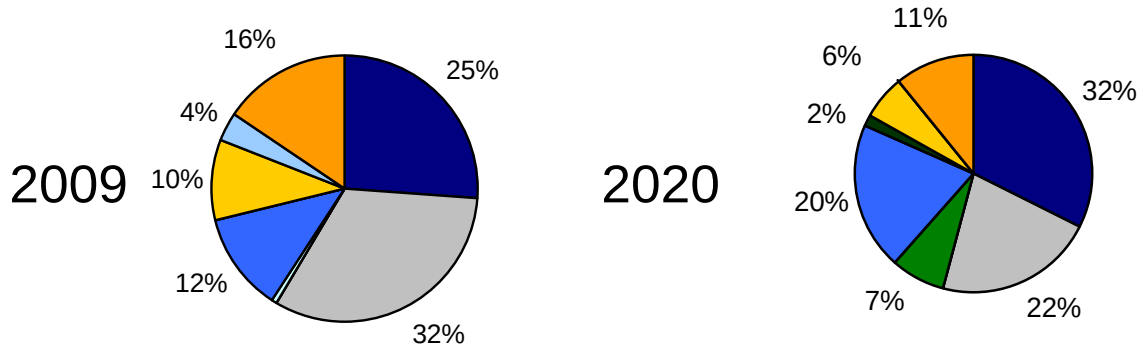


Strawman with Nuclear Addition
Annual Generation for Native Load



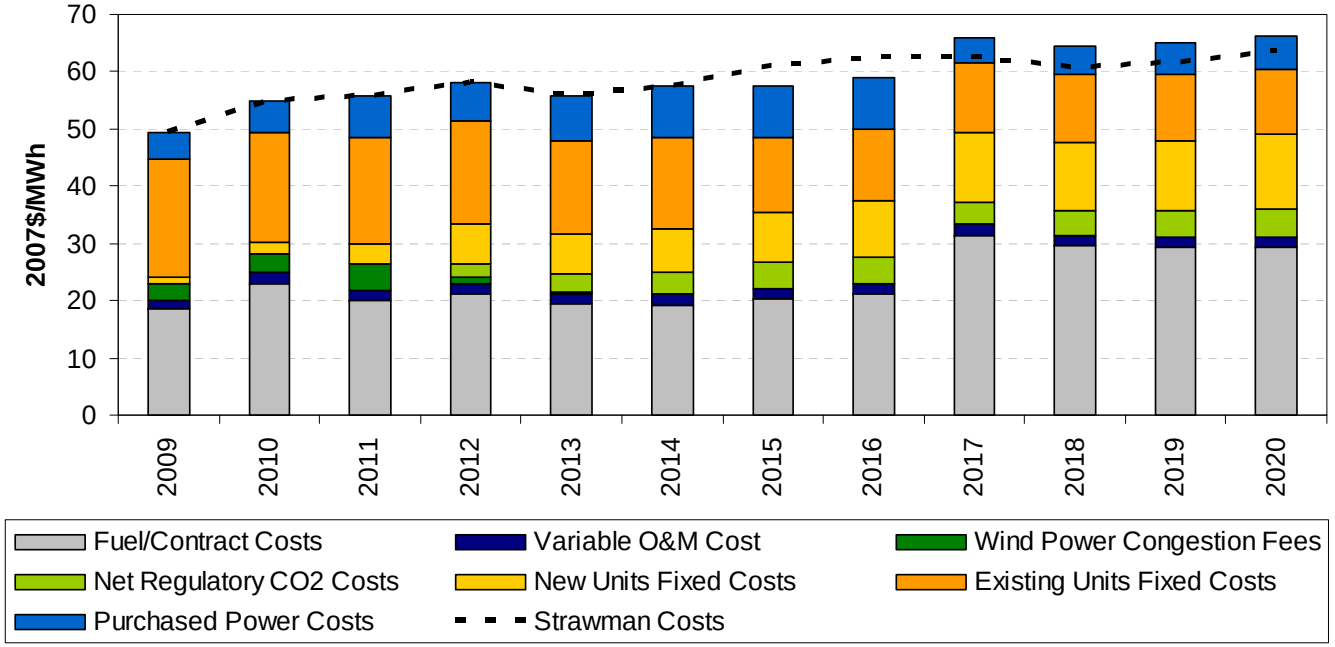
Renewable share at about 30% as in the Strawman

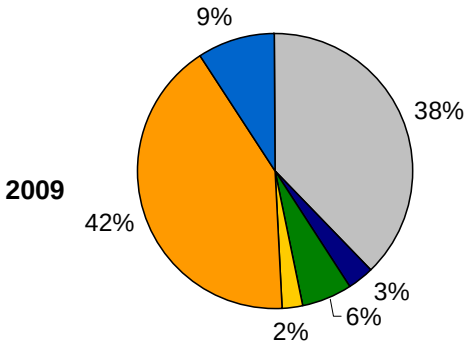
Nuclear share above 30% after the start of the PPA

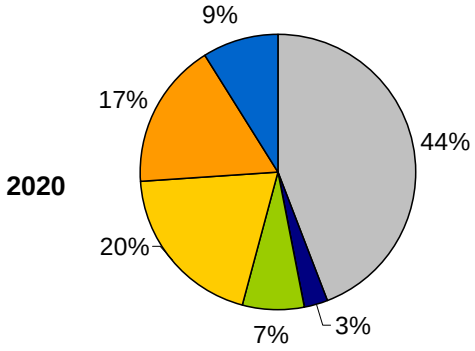


Strawman with Nuclear Addition
Total Portfolio Costs

- Costs are higher than those in the Strawman after the nuclear PPA enters into service
- Nuclear PPA costs are categorized as “Fuel/Contract Costs”

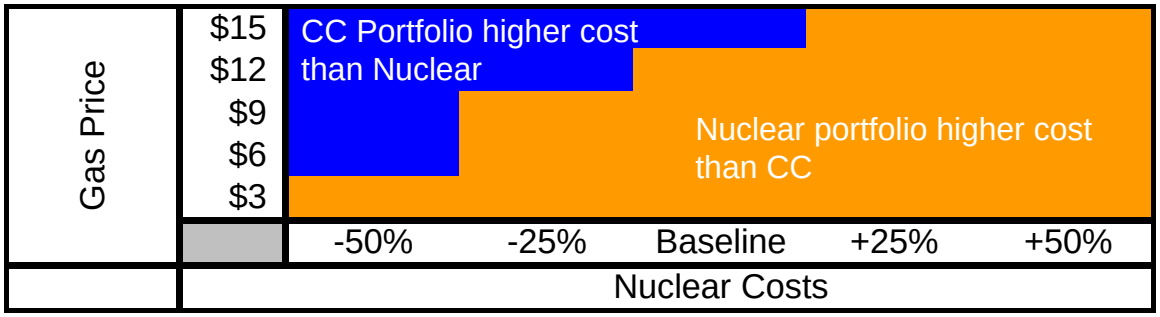




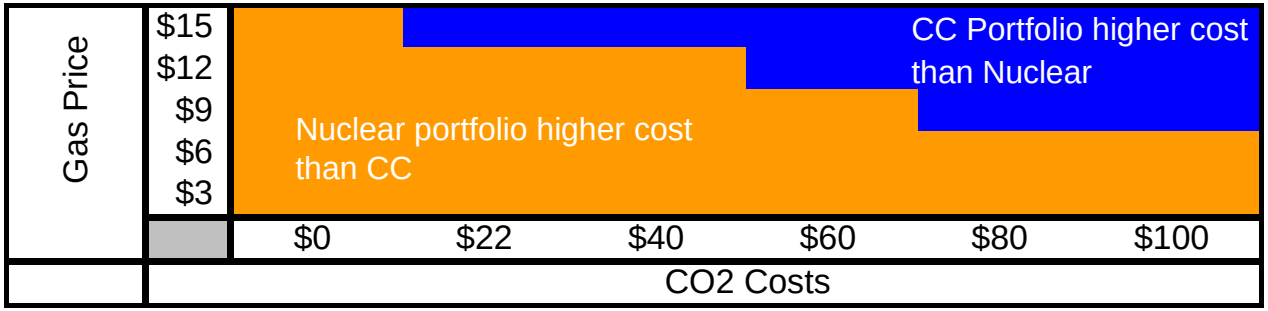


Nuclear Costs and Natural Gas Prices Affect Portfolio Attractiveness

- With higher natural gas prices, nuclear addition to the portfolio is more cost-effective
- At baseline PPA cost level (Private ownership of plant plus 15% premium), natural gas prices need to be around $15/MMBtu for the nuclear option to look better



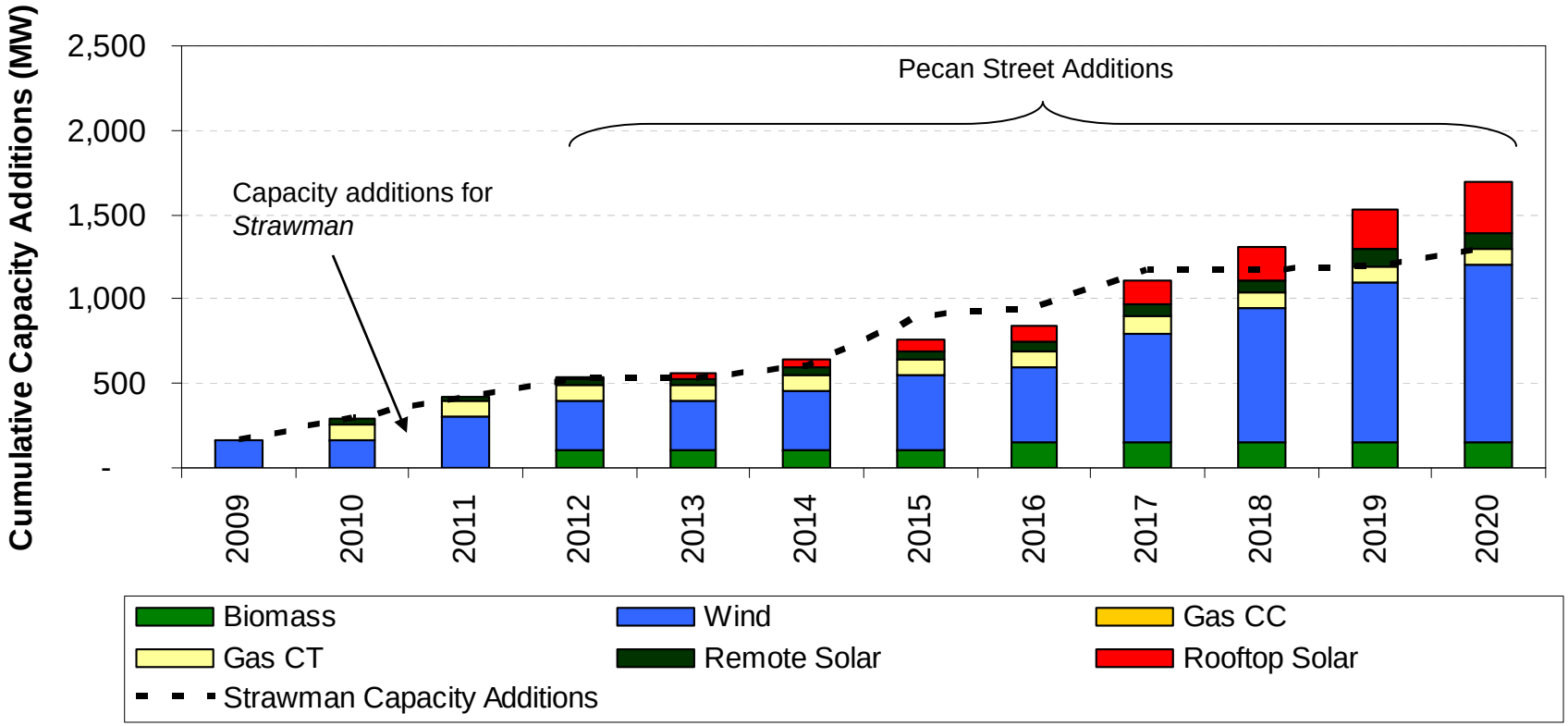
- As CO_2 prices increase, nuclear capacity also looks more attractive



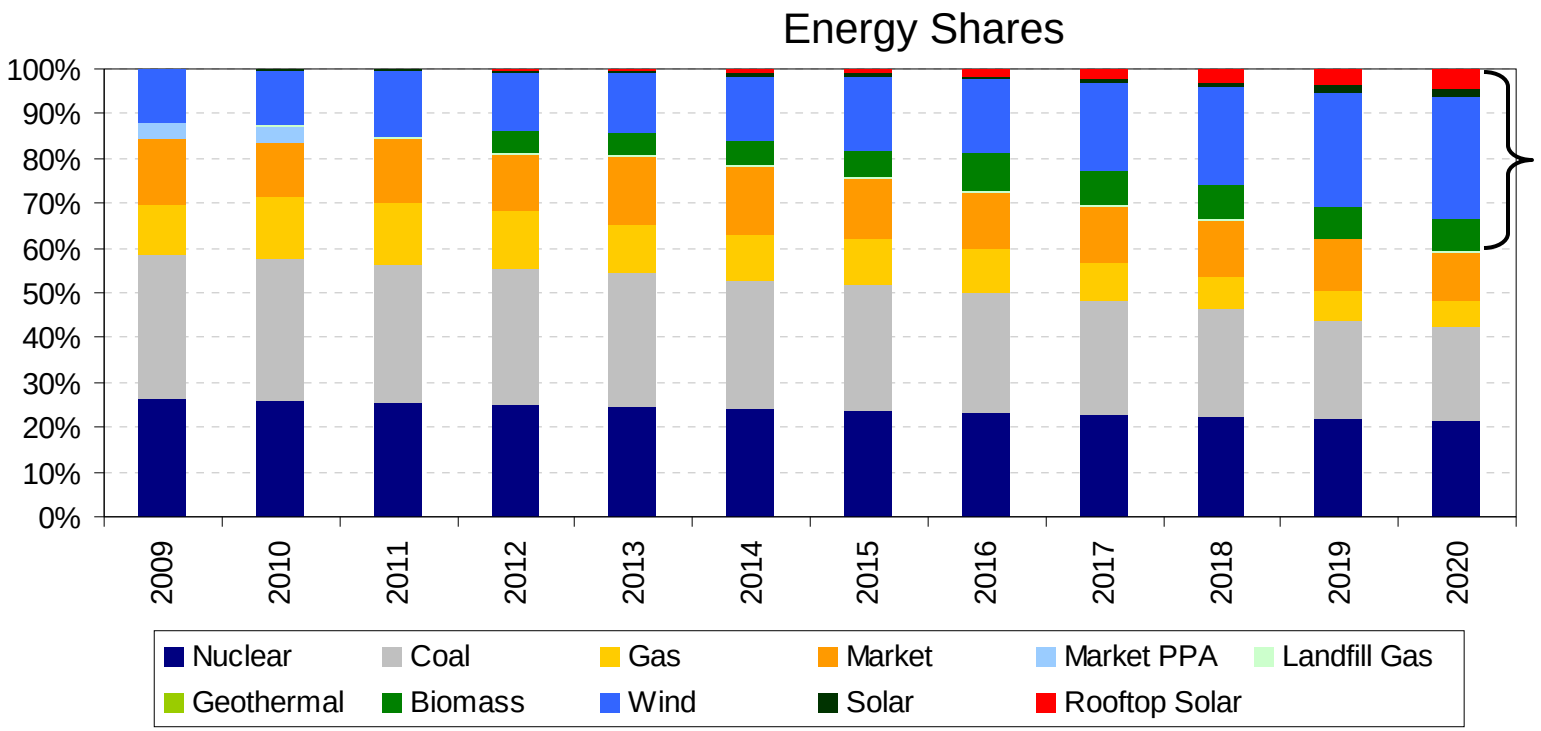
Strawman with Pecan Street Renewable Plan

Strawman with Pecan Street Renewable Plan
Annual Capacity Expansion Plan

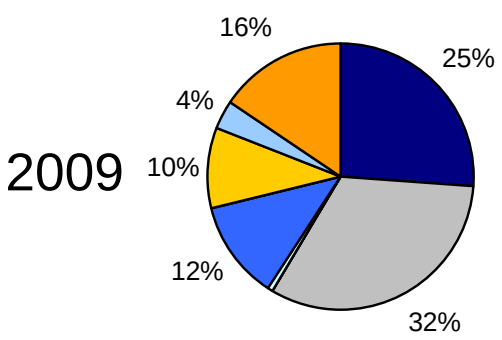
- Strawman expansion plan minus the combined cycle expansion in 2015 and with a total of 300 MW of distributed rooftop solar (25% owned by customer and 75% by AE)
- Expansion plan totals 100 MW of natural gas, 1,050 MW of wind, 100 MW of solar, 150 MW of biomass, and 300 additional MW of rooftop solar

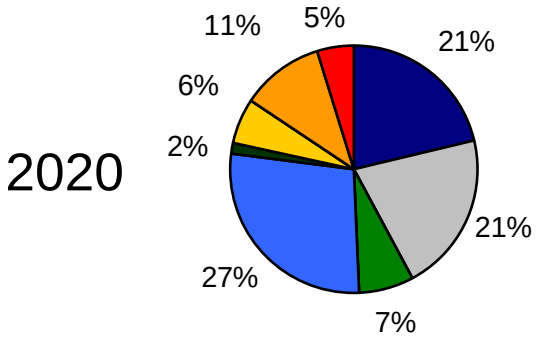


Strawman with Pecan Street Renewable Plan
Annual Generation for Native Load



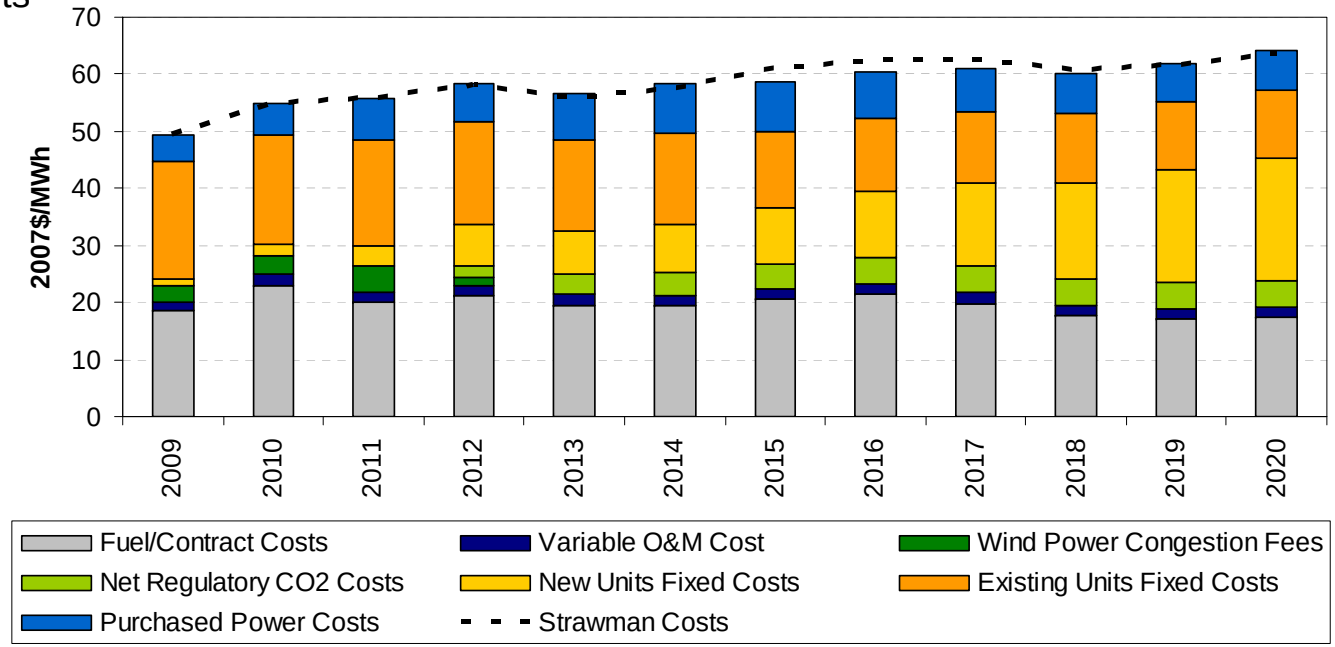
Renewable share at 40%, counting 75% of the rooftop solar

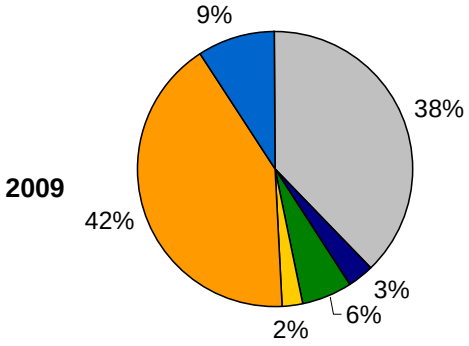


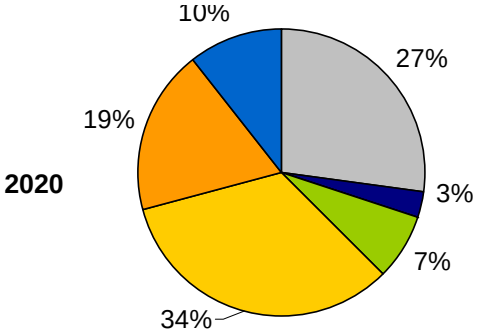


Strawman with Pecan Street Renewable Plan
Total Portfolio Costs

- Compared to Strawman, additional rooftop solar has only slightly higher costs in last years
- With significant distributed solar generation, there is less load over which to apportion revenue requirements







Scenario Comparison Summary

Scenario Summary

Description		Units	*Strawman*	*Lowest Bill Impact Meeting Council Goals*	*W-M Emissions Reductions*	*Nuclear PPA*	*Electric Vehicles*	*Solar Breakthrough*	*Pecan Street*
Capacity Additions (MW)	**Early (09-12)**	MW	525	390	525	525	525	525	540
	Middle (13-16)	MW	420	307	505	220	420	420	305
	Late (17-20)	MW	350	726	550	550	650	525	850
Replacements		MW	0	0	0	0	0	0	0
Levelized NPV of Portfolio Costs		2007 $/MWh	57.97	56.01	58.02	58.33	58.02	57.65	57.68
Real Increase from 2009 to 2020		%	29%	20%	29%	35%	29%	29%	30%
Nominal Increase from 2009 to 2020		%	69%	57%	70%	77%	70%	69%	71%
CO2 Emissions 2020		Tonnes (000s)	5,238	4,686	4,608	4,371	4,889	4,914	4,282
2020 CO2 Percent Reduction from 2005		%	-6%	-16%	-17%	-21%	-12%	-12%	-23%
Renewable Percentage in 2020		%	30%	35%	36%	29%	35%	33%	40%
Total Capital Expenditures		$MM	1,796	2,175	2,391	1,629	2,501	2,179	3,178
Incremental Capacity Additions		Share							

Gas Nuke Wind Solar LFG Geo Bio DSM/Rooftop Solar

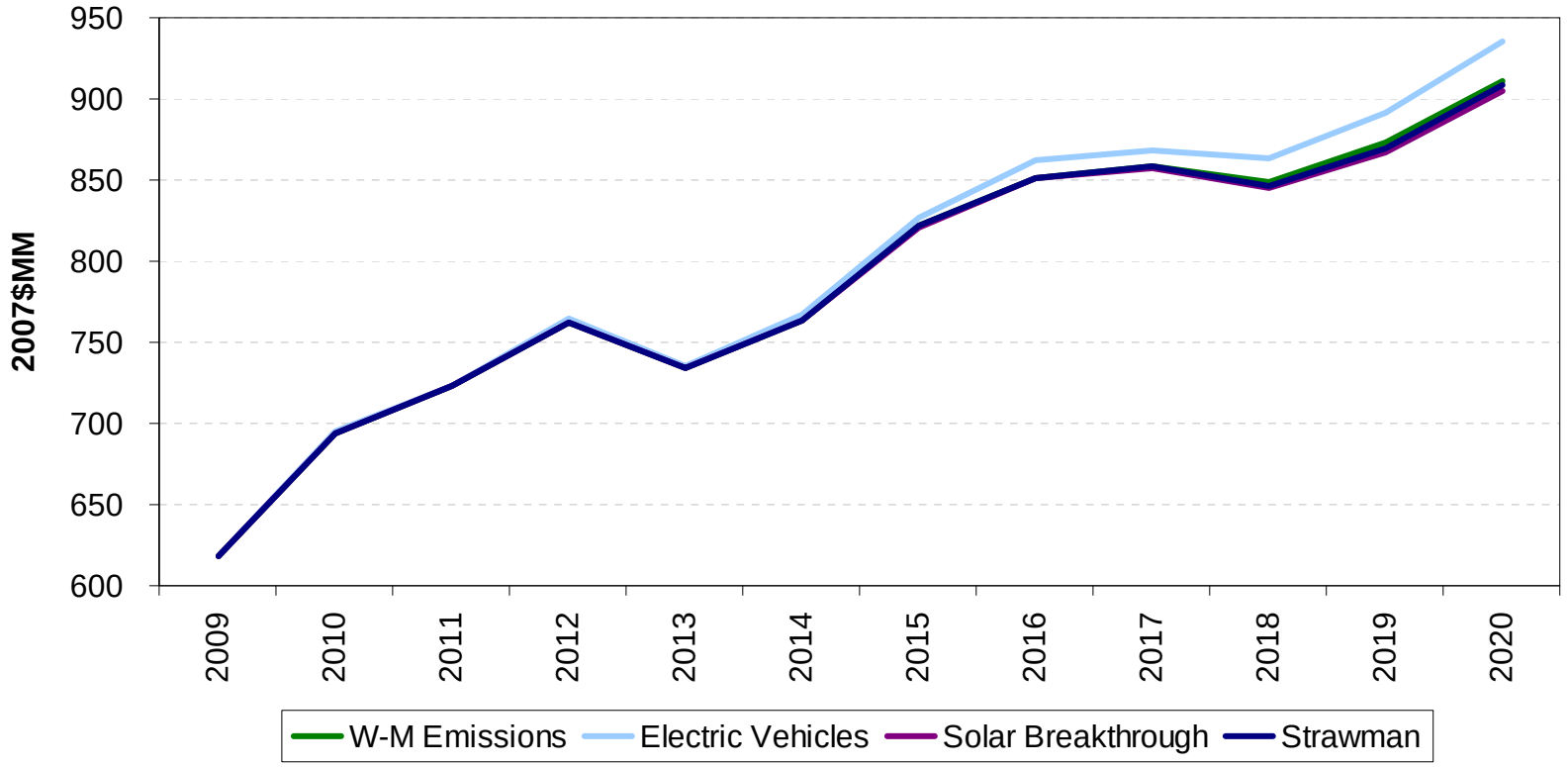
Previous Scenario Summary – From May 27 Meeting

Description		Units	*Strawman*	*No Additional Generation*	*Lowest Bill Impact*	*Lowest Bill Impact Meeting Council Goals*	*Replace FPP*
Capacity Additions (MW)	**Early (09-12)**	MW	525	390	390	390	390
	Middle (13-16)	MW	420	0	307	307	807
	Late (17-20)	MW	350	0	656	726	1,006
Replacements		MW	0	0	0	0	600 (Coal)
Levelized NPV of Portfolio Costs		2007 $/MWh	57.97	56.51	56.01	56.07	57.96
Real Increase from 2009 to 2020		%	29%	25%	20%	20%	31%
Nominal Increase from 2009 to 2020		%	69%	64%	57%	57%	72%
CO2 Emissions 2020		Tonnes (000s)	5,238	7,034	4,784	4,686	2,086
2020 CO2 Percent Reduction from 2005		%	-6%	27%	-14%	-16%	-62%
Renewable Percentage in 2020		%	30%	11%	34%	35%	54%
Total Capital Expenditures		$MM	1,796	76	2,012	2,194	3,949
Incremental Capacity Additions		Share					

Gas
Wind
Solar
LFG
Geo
Bio
DSM

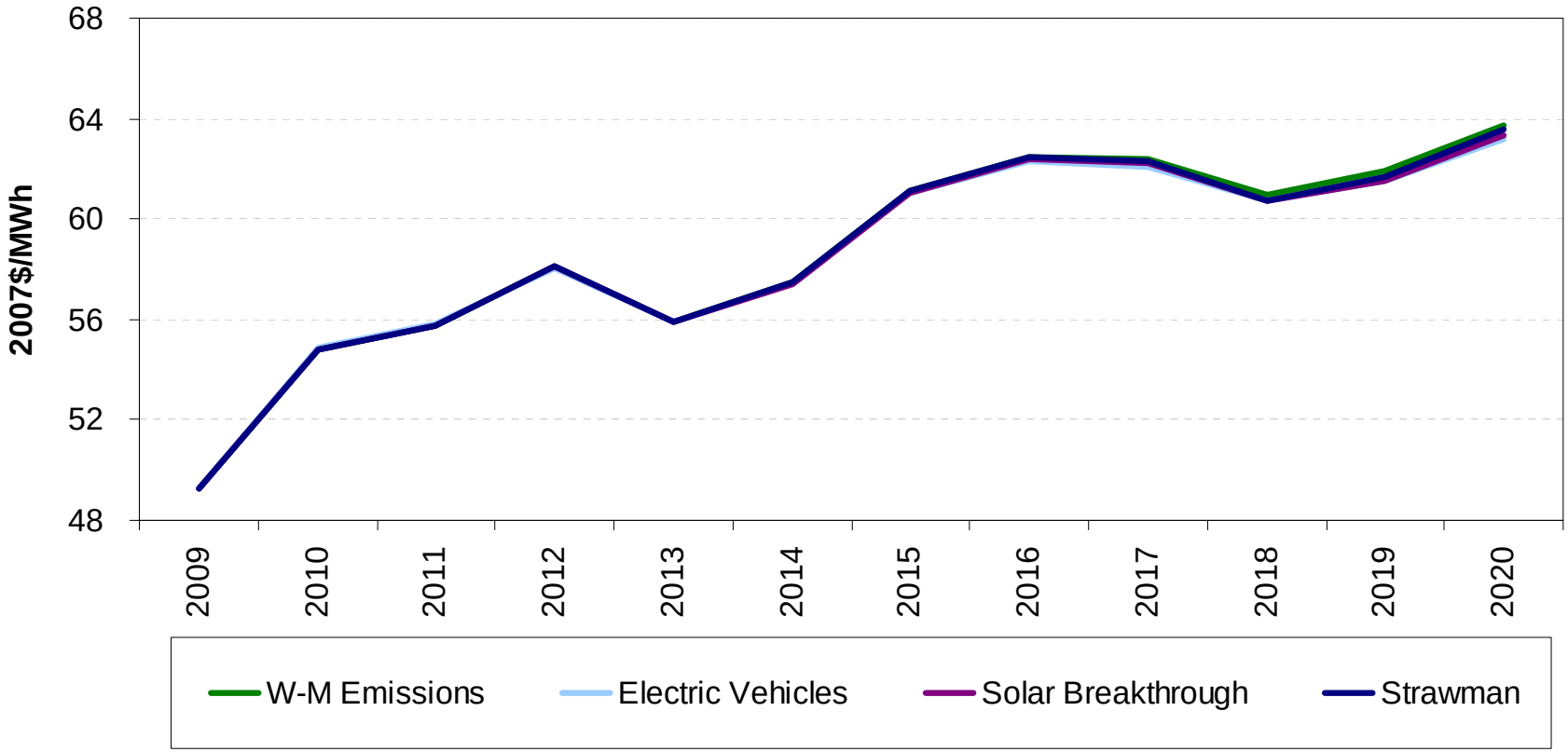
Revenue Requirement Comparison of Cases

- The *Electrification of the Transportation Sector* scenario requires significant capacity additions and hence has higher revenue requirements
- The *Waxman-Markey* scenario has slightly higher revenue requirements than the *Strawman*, while the *Solar Breakthrough* scenario is slightly lower



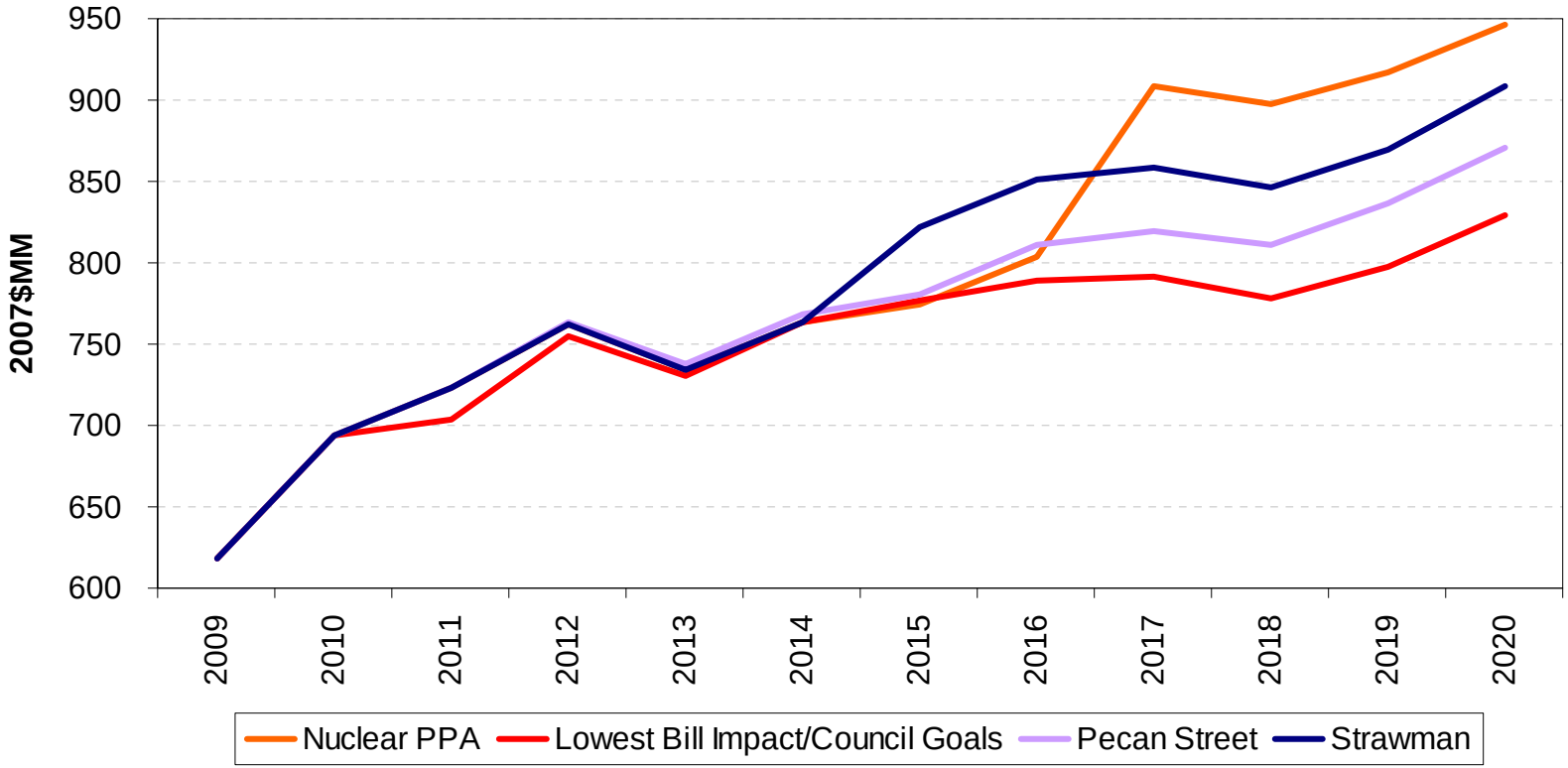
Cost per MWh Comparison of Cases

- In terms of $/MWh portfolio costs, all scenarios are very close in costs
  - The *Electrification of the Transportation Sector* scenario has higher revenue requirements, but has more load over which to spread out costs



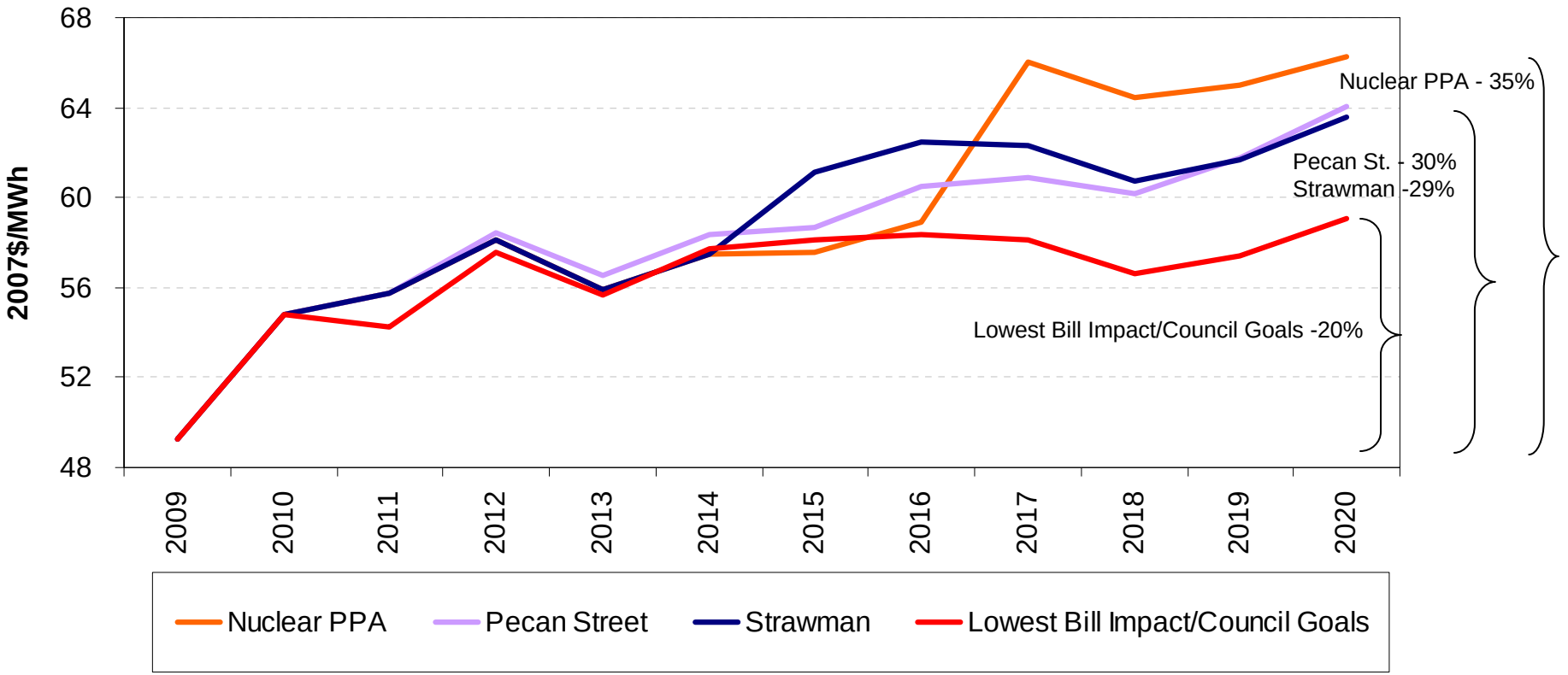
Revenue Requirement Comparison of Cases Without Combined Cycle

- The *Nuclear PPA* scenario delays expected increases in revenue requirement above *Strawman* beyond 2017
- The *Pecan Street* scenario replaces the combined cycle, but solar additions are higher in cost than renewable additions in the *Lowest Bill Impact* scenario



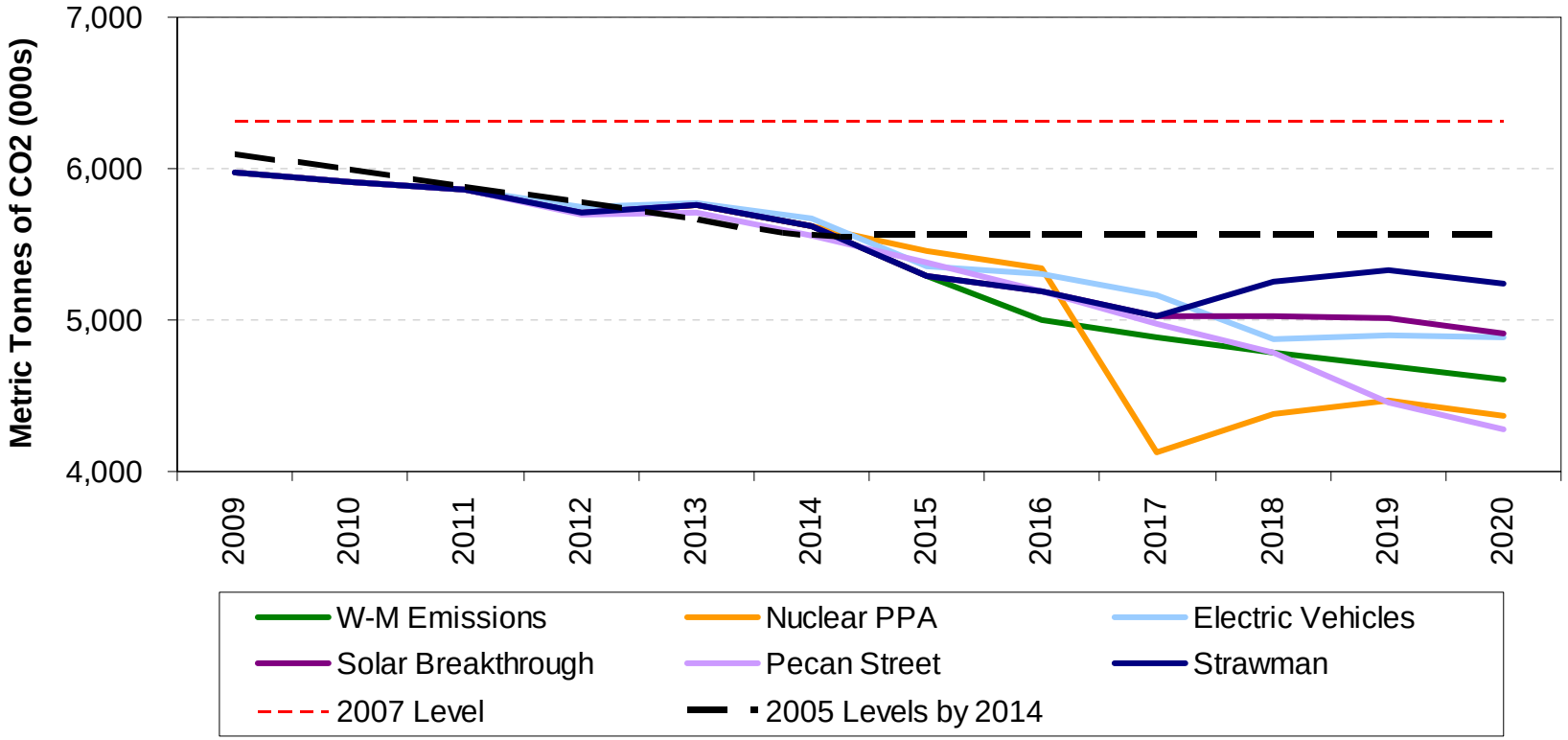
Cost per MWh Comparison of Cases Without Combined Cycle

- The *Nuclear PPA* scenario increases in cost in 2017 and beyond
- The *Pecan Street* scenario benefits from declining solar costs and customer contributions to the installation cost, but is slightly higher than Strawman in 2020



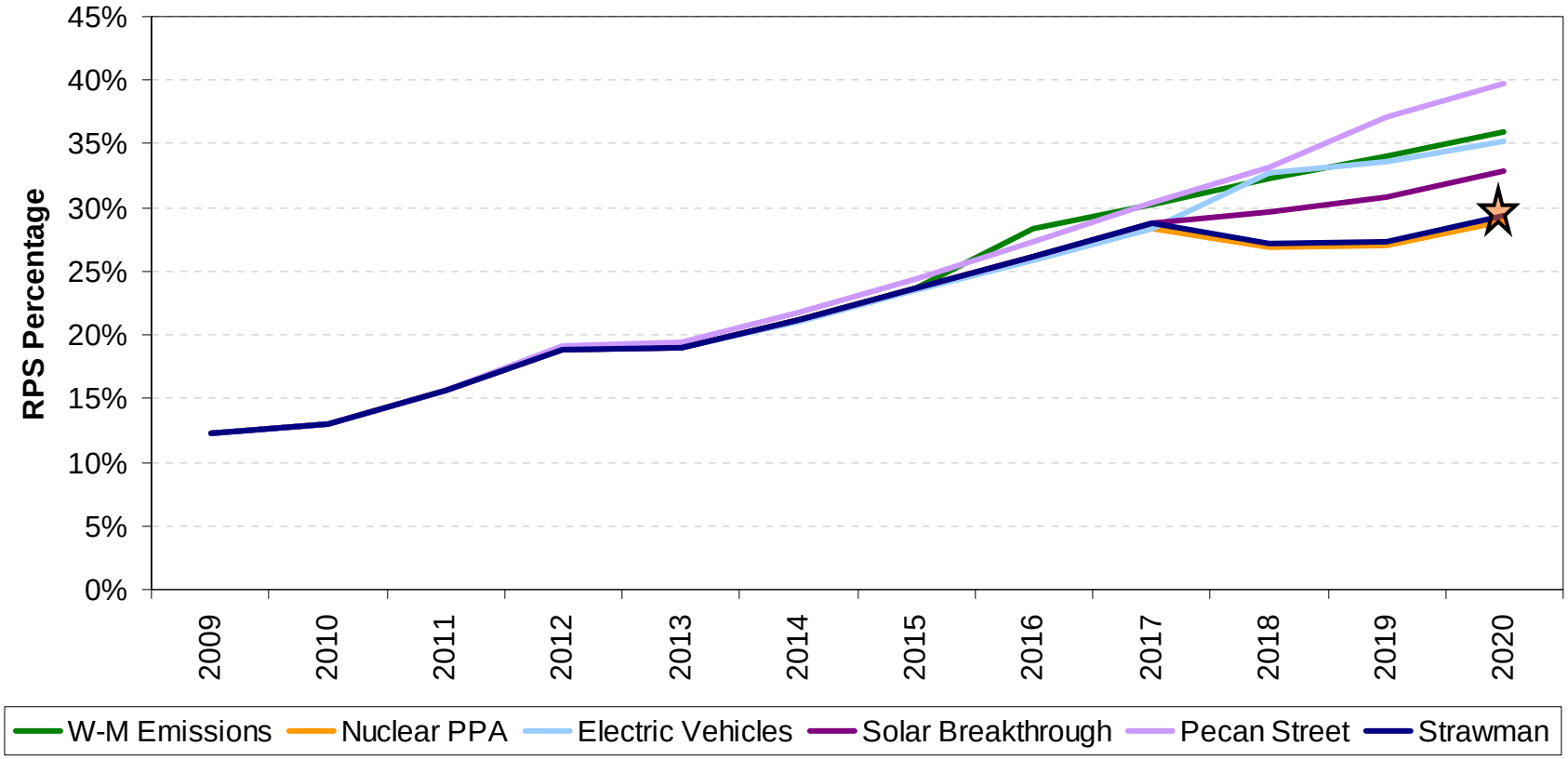
Case Comparison: CO_2 Emissions

- All scenarios achieve emissions below 2005 levels by 2015
- The *Nuclear PPA* scenario has emissions even lower than those meeting the physical reductions in Waxman-Markey beyond 2017
- The *Pecan Street* scenario's additional wind and local solar capacity additions also achieve emission reductions below Waxman-Markey targets



Case Comparison: RPS

- The *Nuclear PPA* scenario is close to the *Strawman*, whereas the other scenarios achieve higher than 30% RPS compliance by 2020
- The *Pecan Street* scenario counts 75% of the rooftop solar generation towards RPS, and achieves 40% by 2020

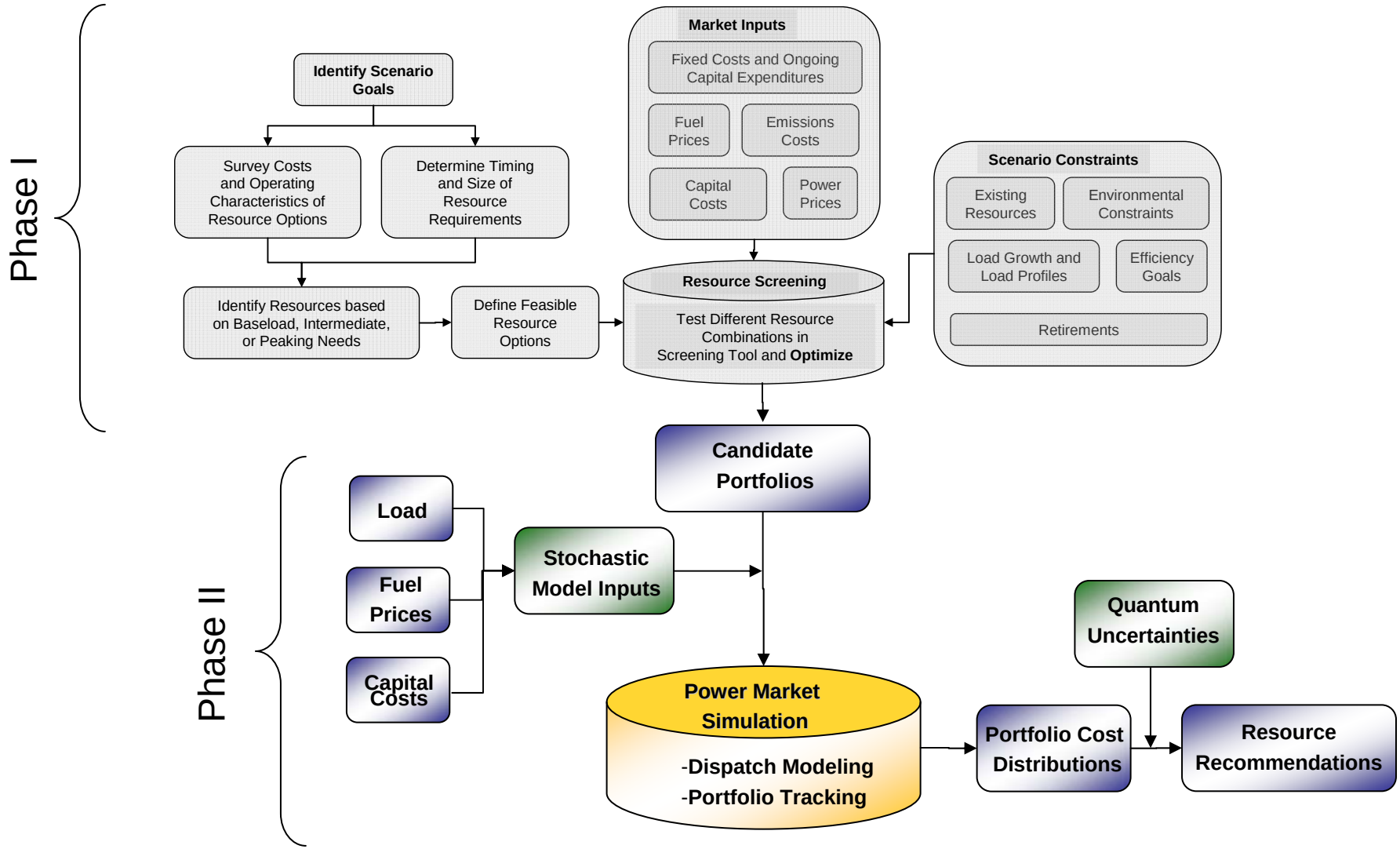


Overall Conclusions

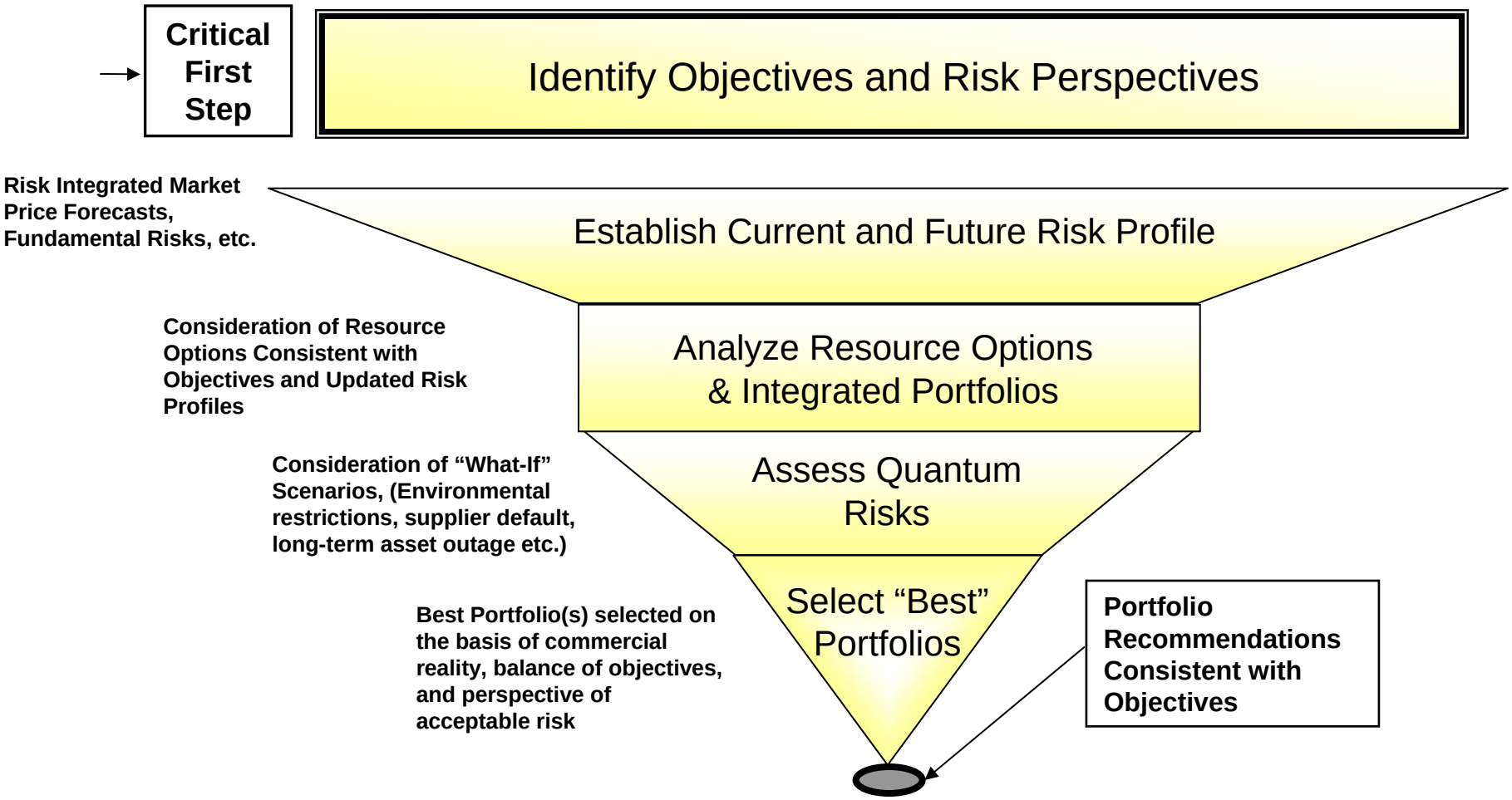
- Scenarios around *Strawman* that maintain the combined cycle addition in 2015 do not significantly impact portfolio costs, given Reference Case assumptions
  - *Waxman-Markey Emissions Reductions Beyond 2015* can be achieved with new wind capacity additions with minimal impact to portfolio costs
  - *Impact of Electrification of the Transportation Sector* scenario analysis concludes that wind capacity additions (and solar beyond 2020) can meet portfolio requirements with minimal impacts to costs per MWh, even though revenue requirements are higher due to additional demand
  - *Solar Technology Breakthrough* scenario analysis indicates that incremental solar capacity additions become cost effective around 2018-2020, but impact on overall portfolio costs is not significant
- Scenarios around *Strawman* that replace the combined cycle impact costs more significantly
  - Replacement of the combined cycle with a nuclear PPA in 2017 raises costs by about $3-4/MWh above *Strawman*
    - In order to achieve parity with combined cycle in 2017, gas prices would have to be around $15/MMBtu or nuclear capital costs would have to decline significantly
  - *Pecan Street* scenario with rooftop solar PV additions is competitive in cost to *Strawman* due to customer contributions (25% customer owned, 75% AE) and declining solar cost assumptions

Risk Analysis – Next Step

Approach to Resource Decision Still Driven by Phase I



Pace Risk Integrated Decision Making Approach

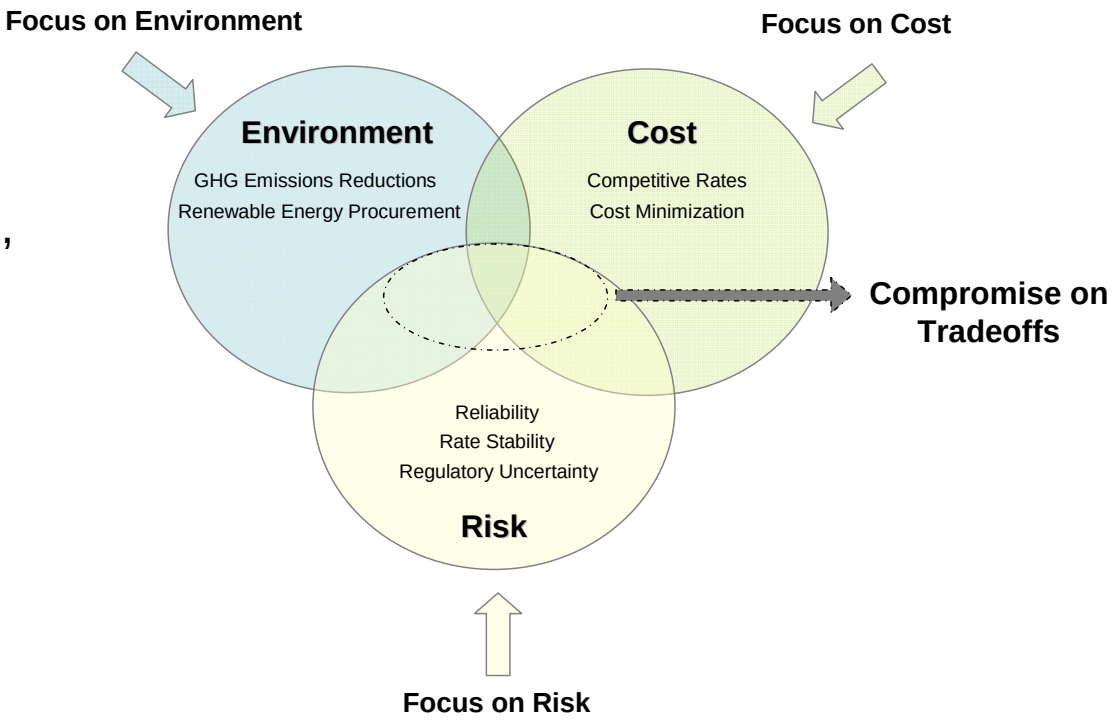


Pace Approach

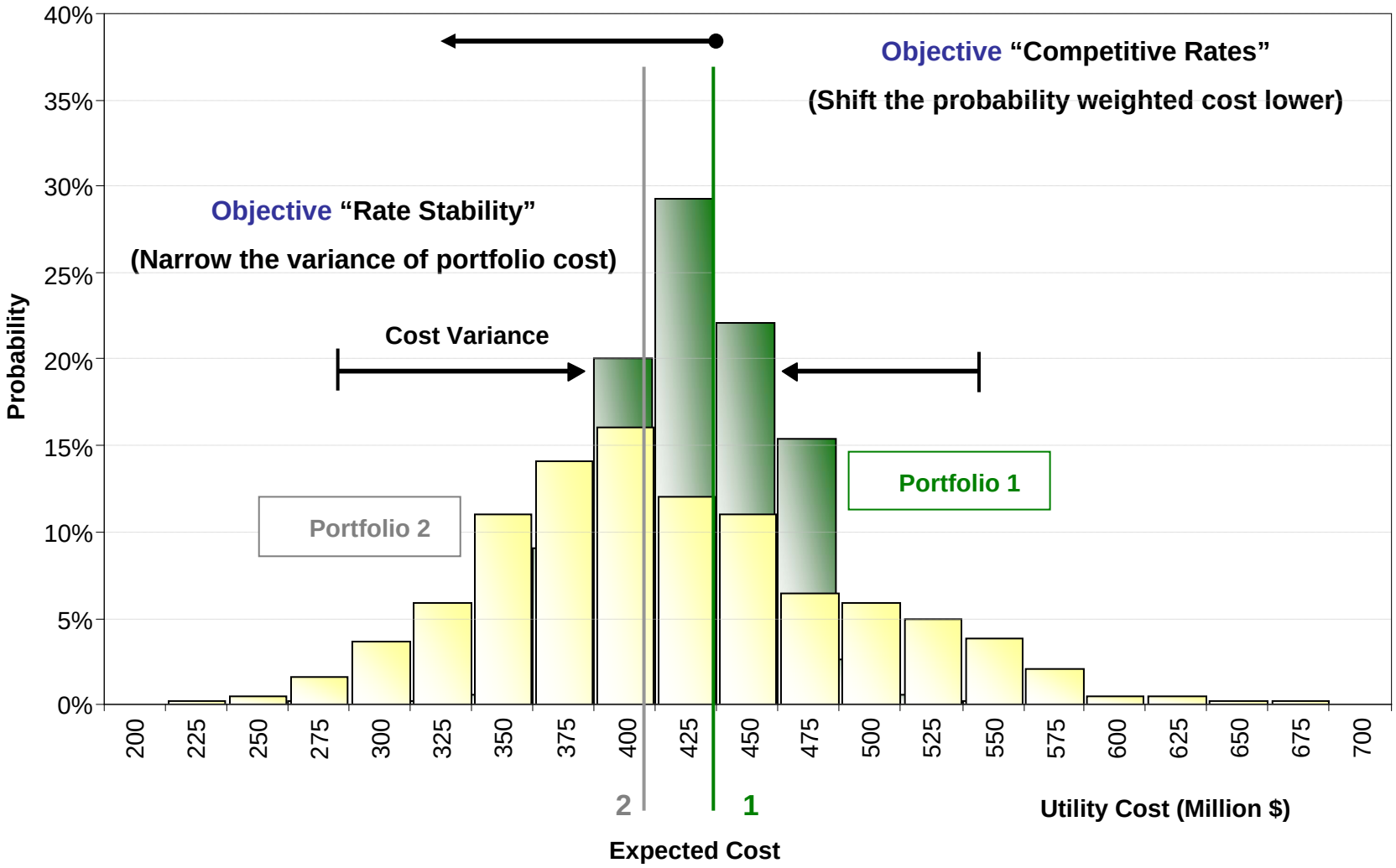
- Selects criteria (Might be lowest cost, environmental stewardship, rate stability, avoid unacceptable risk, reliability or other criteria)
- Determine relevant options
- Develops distribution of all relevant risks
- Sets risk profile for reference (status quo) decision (do nothing case)
- Then evaluate options over full range of risks.
- Select portfolio that best meets all objectives over range of risks

Pace Approach

- Austin Energy has selected as criteria the following objectives:
  - lowest cost,
  - environmental stewardship,
  - rate stability,
  - avoid unacceptable risk,
  - reliability,
  - exposure to market
- AE wishes to select the portfolio that best meets all objectives over range of risks



Risk Integrated Portfolio Design



Potential Portfolios for Risk Analysis

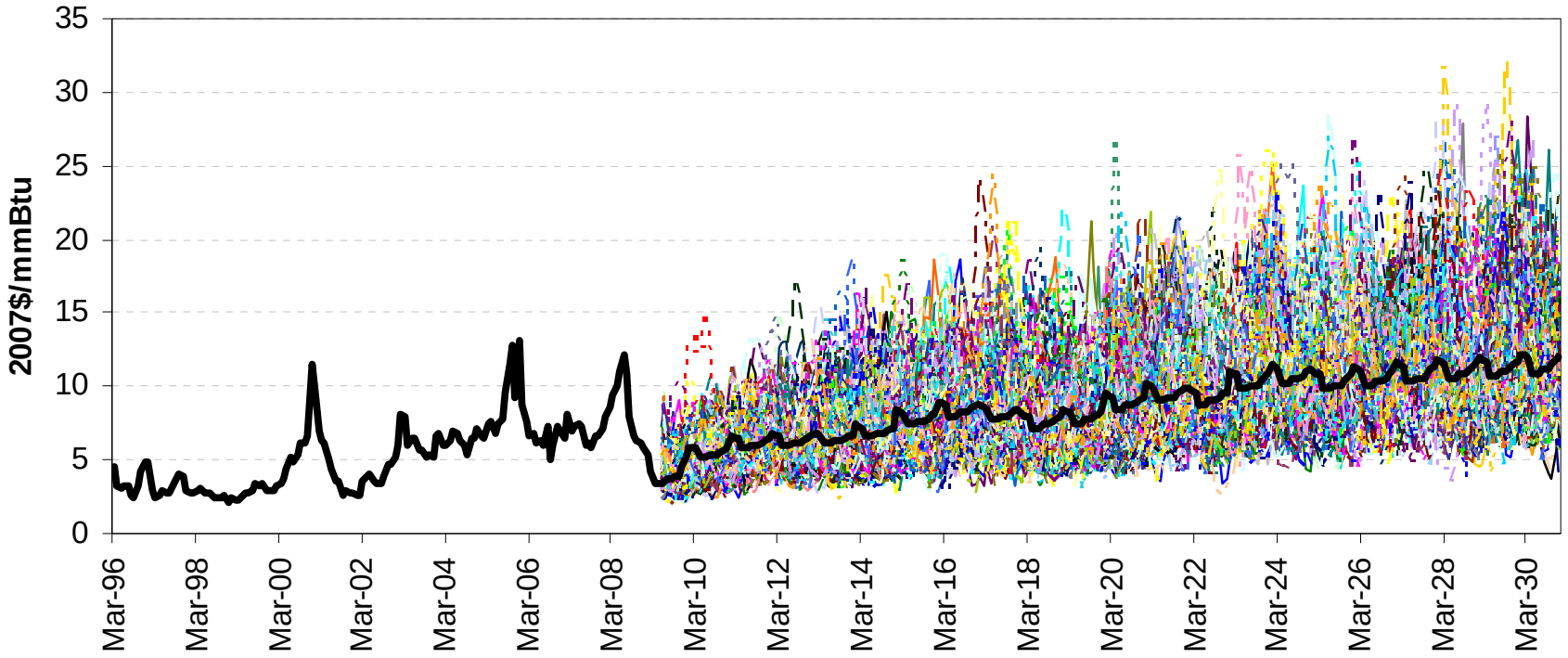
- Draft Energy Resource Plan (“Strawman”)
- No Additional Generation (for comparison)
- Lowest Cost Impact meeting Council Goals
- Replace FPP with Renewables
- Replace FPP with Nuclear
- Physical Emission Reductions in line with Waxman-Markey
- Pecan Street

Market Risks

- CO2 Costs and Regulations
  - Significant uncertainties exist for cost of CO2 allowances and timing and stringency of regulations
- Fuel Prices
  - Natural gas prices are highly volatile and expected prices heavily impact power market prices, plant dispatch, and renewable expansion economics. Coal is also volatile and will be considered.
- Electricity Demand
  - Load forecast impacts required capacity additions (timing and type) for Austin as well as wider market price projections
- Power Market Prices
  - Power market prices highly dependent on fuel prices and supply-demand balance in wider market area
- Capital Cost Uncertainty
  - Materials costs and capital costs have been volatile in recent years
  - Solar PV costs are expected to decline significantly, but if such a decline is not realized, portfolios could face different costs. Nuclear, wind, solar, IGCC uncertainties are very different.
- Resource Availability
  - Many scenarios are heavily dependent on significant renewable capacity additions, which may not be available to AE in full or at the assumed price
  - Transmission risk for significant wind expansion also exists. This could either limit wind procurement or raise the costs, due to transmission charges.

Prices of Natural Gas (and Coal)

- Approach: Create a distribution of gas and coal prices based on our latest projections and based on historical market volatility.



Portfolio Cost and Risk Tradeoffs

- Portfolios can be examined not only based on least cost, but also based on the range of potential cost outcomes
- Display allows for representation of cost and risk tradeoffs
  - Ex: Portfolio 6 has higher expected cost than Portfolio 5, but a lower "worst case" outcome based on the 95th percentile of the cost distribution. Is the extra expected cost worth the risk mitigation?
  - Portfolios above and to the right of those on the line are higher cost and higher risk