Scenario Summary
Renewables with and without Storage Scenarios (requested by Cyrus Reed)

Assumptions:

- DSM costs are $500 expected value (range of $350-$750)
- Distributed solar (50 MW) costs assumed to be shared 75% by owner and 25% by AE
- Energy storage systems (3, 25 MW systems) are paired with wind and modeled to shift energy from wind at off-peak periods to peak periods uniformly throughout the year; costs for energy storage are modeled by adding CAES storage system capital costs using the California Energy Commission's levelized cost model
- Use Pace's capital costs (mid-years), levelized costs (2020), projected load (close estimate) and capacity factor assumptions. Note that these values not used in model provided to Task Force, but are similar.
- All other assumptions as defined by the Austin Energy Resource Portfolio Simulator user's guide

Table 1
Scenario Summaries

Metric	Staff Recommendation (Pace)	Staff Recommendation (AE)	Staff Recommendation (LBJ)	Cyrus Plan with Storage	Cyrus Plan w/o Storage
Capacity Additions (MW)	1575	-	1580	1402	1402
Replacements (MW)	0	-	0	607	607
Real Increase from 2009 to 2020 (residential)	28%	20%	26%	23%	23%
Nominal Increase from 2009 to 2020	69%	57%	-	-	-
CO2 Emissions (2014, metric tons)	5,160,000	-	5,086,358	5,009,440	4,911,724
CO2 Emissions (2020, metric tons)	4,580,000	-	4,330,865	3,265,899	3,139,033
2020 CO2 Percent Reduction from 2005	18%	-	22%	41%	44%
Renewable Percentage of Gen. in 2020	36%	-	34.9%	33.10%	34.90%
% of Peak Demand Met (2020)	100%	-	100%	98%	96%
Total Capital Expenditures (million$)	2,677	-	2,700	2,514	2,512
Fuel Costs (2020, million$)	344	-	382	487	487

Table 2
Renewables without Storage

Schedule of power generation additions and subtractions (net MW)														CF (%)	CO_2 EF (metric tons/MWh)		
Power Source	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020				
Coal	607				-120		-120		-120		-120		-127	78%	0.95		
Nuclear	422													87%	0.00	Max CF (%)	Min CF (%)
Natural Gas Turbines - Sand Hill 1-4	189		100											19%	0.53	25%	10%
Natural Gas Combined Cycle - Sand Hill 5	312							200						60%	0.39	70%	60%
Natural Gas Steam Turbines - Decker 1 & 2	741													3%	0.65	20%	1%
Natural Gas Turbines - Decker	193													2%	0.70	10%	1%
Onshore Wind	274	165		23		50	50	100		-26			100	41%	0.00		
Offshore Wind	0													42%	0.00		
Biomass	0				100									86%	0.00		
FPP w/ biomass co-firing	0													89%	0.00		
Landfill Gas	12													79%	0.00		
Solar PV - Centralized	0		30				20			20		30		26%	0.00		
Solar PV - Distributed	3			5	5	5	5	5	5	5	5	5	5	26%	0.00		
Concentrated Solar	0						50				50			32%	0.00	Parabolic Trough	
IGCC w/ CCS	0													84%	0.13		
IGCC w/o CCS	0													84%	0.87		
Geothermal	0								25					95%	0.00		
Storage	0													0%	0.00	Storage Type	0
Accelerated Conservation	0		10	10	20	20	20	20	20	20	20	20	20	100%	-	Meet conservation demand?	Yes
Purchased Power	0													100%	0.59		

Scenario Output Summary

System Reliability in 2020			Costs and Economic Impacts through 2020		Staff Recommendation
% of Annual Electricity Demand Met	92%		Total Expected Capital Costs through 2020 ($ million)	2,510	2,650
% of Peak Hourly Demand Met	96%		Annual Expected Fuel Costs in 2020 ($ million)	490	344
Carbon Impacts in 2020			Expected Increase in Cost of Electricity in 2020 (¢/kWh)	2.3	2.7
Carbon Emissions (metric tons)	3,139,000	4,272,700			
% Generation from Renewables in 2020	33.2%	35.30%			
% Capacity from Renewables in 2020	34.3%	33.10%			
		Staff recommendation			

Issues:

- Inability to meet annual and peak hourly demand from own generation sources (increased cost risks from market purchases)
- High usage requirements for natural gas facilities as demonstrated by annual fuel costs (increased cost risks from fuel price volatility)
- Cost competitive and significantly lowers CO_2 emissions, but does not provide an adequate amount of resources to meet AE's load and ensure competitive, reliable electric service

Table 3
Renewables with Storage

Schedule of power generation additions and subtractions (net MW)														CF (%)	CO_2 EF (metric tons/MWh)		
Power Source	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020				
Coal	607				-120		-120		-120		-120		-127	78%	0.95		
Nuclear	422													87%	0.00	Max CF (%)	Min CF (%
Natural Gas Turbines - Sand Hill 1-4	189		100											19%	0.53	25%	10%
Natural Gas Combined Cycle - Sand Hill 5	312							200						60%	0.39	70%	60%
Natural Gas Steam Turbines - Decker 1 & 2	741													3%	0.65	20%	1%
Natural Gas Turbines - Decker	193													2%	0.70	10%	1%
Onshore Wind	274	165		23		25	25	100		-26	-25		100	41%	0.00		
Offshore Wind	0													42%	0.00		
CAES with wind						25	25				25			26%	0.00		
Biomass	0				100									86%	0.00		
FPP w/ biomass co-firing	0													89%	0.00		
Landfill Gas	12													79%	0.00		
Solar PV - Centralized	0		30				20			20		30		26%	0.00		
Solar PV - Distributed	3			5	5	5	5	5	5	5	5	5	5	26%	0.00		
Concentrated Solar	0						25				50			32%	0.00	Parabolic Trough	
IGCC w/ CCS	0													84%	0.13		
IGCC w/o CCS	0													84%	0.87		
Geothermal	0								25					95%	0.00		
Storage	0					25	25				25			15%	0.39	Compressed Air	8
Accelerated Conservation	0		10	10	20	20	20	20	20	20	20	20	20	100%	-	Meet conservation demand?	Yes
Purchased Power	0													100%	0.59		

Scenario Output Summary

System Reliability in 2020		Costs and Economic Impacts through 2020		Staff Recomm	Cyrus Without Storage
% of Annual Electricity Demand Met	91%	Total Expected Capital Costs through 2020 ($ million)	2,510	2,650	2,510
% of Peak Hourly Demand Met	98%	Annual Expected Fuel Costs in 2020 ($ million)	490	344	490
Carbon Impacts in 2020		Expected Increase in Cost of Electricity in 2020 (¢/kWh)	2.2	2.7	2.3
Carbon Emissions (metric tons)	3,265,900	4,272,700	3,139,000		
% Generation from Renewables in 2020	33.1%	35.30%	33.20%		
% Capacity from Renewables in 2020	33.0%	33.10%	34.30%		
		Staff recommendation	Cyrus Without Storage		

Issues:

- Same issues as renewables without storage still exist
- Energy storage helps to meet peak demand, but not at a significant scale (% of peak hourly demand met moves from 96-98% with 75 MW of storage)
    - Modeling of energy storage provides a general representation and may not be wholly accurate