

GENERATION TASK FORCE

May 28th 2014



Presented by Michael J Osborne

GENERATION TASK FORCE

The Austin Generation Resource Planning Task Force shall examine and make recommendations regarding the Generation Plan 2024, consistent with meeting or exceeding the goals established in the Generation Plan 2020.

The Task Force shall dissolve upon the Council's adoption of an updated generation plan or on December 21, 2014, whichever occurs first.

GENERATION TASK FORCE

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF AUSTIN:

The City Council establishes a goal of reaching net zero community-wide greenhouse gas emissions by 2050 and prefers to achieve this goal as soon as it is feasible. The City Council also recognizes that emissions reductions accomplished sooner are more important and valuable for our city's climate protection efforts.

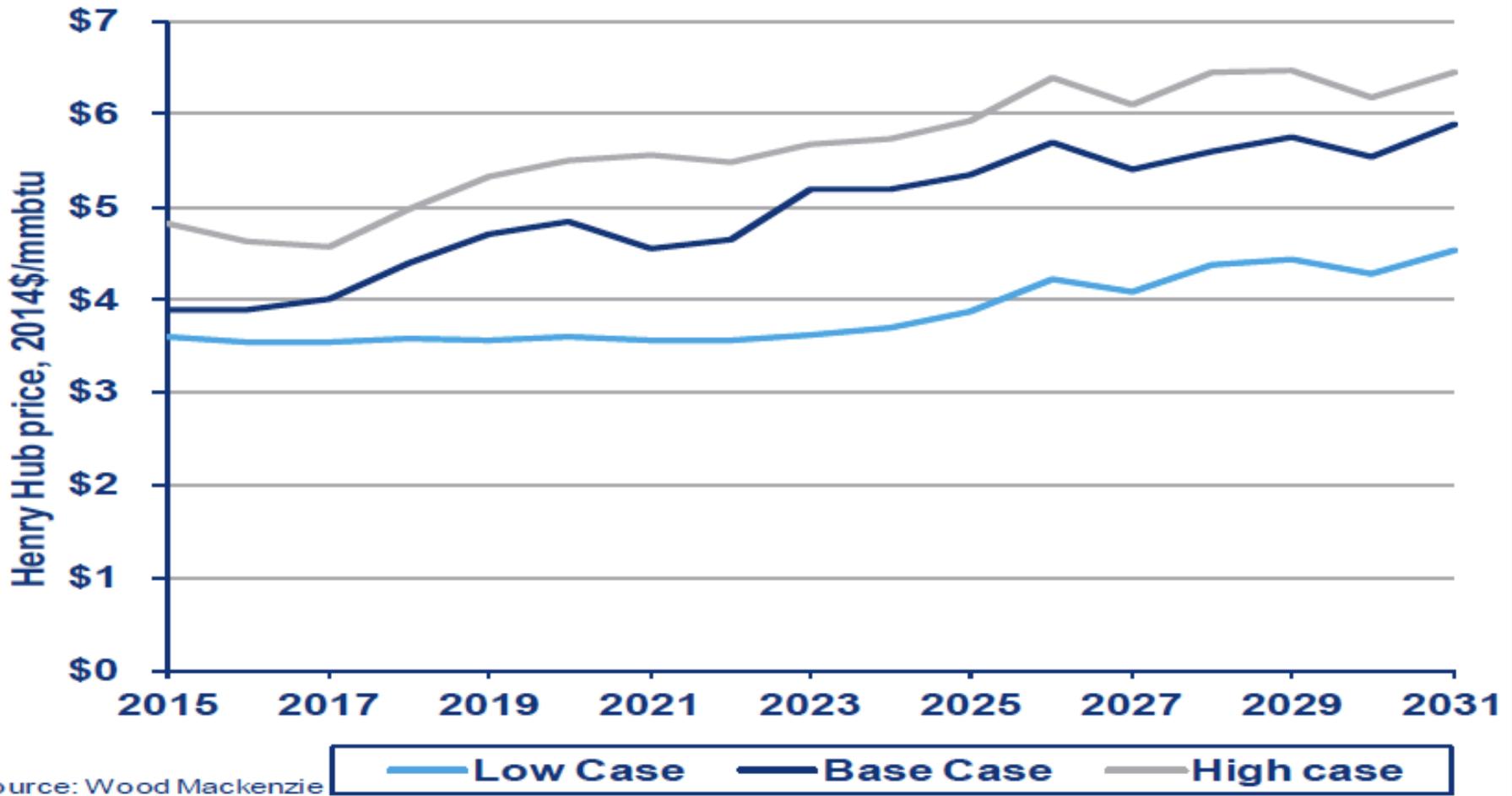
ENERGY UNIFICATION



THE BIG PICTURE

- **What is the future for gas prices?**
- **Will the price of Large Scale Solar continue to decrease?**
- **When and how will carbon be priced in the market?**
- **When will Distributed Solar and Smart Grid demand reduction erode load growth?**
- **Water**

AE GAS PRICE FORECAST



Source: Wood Mackenzie

ACTUAL HENRY HUB PRICES

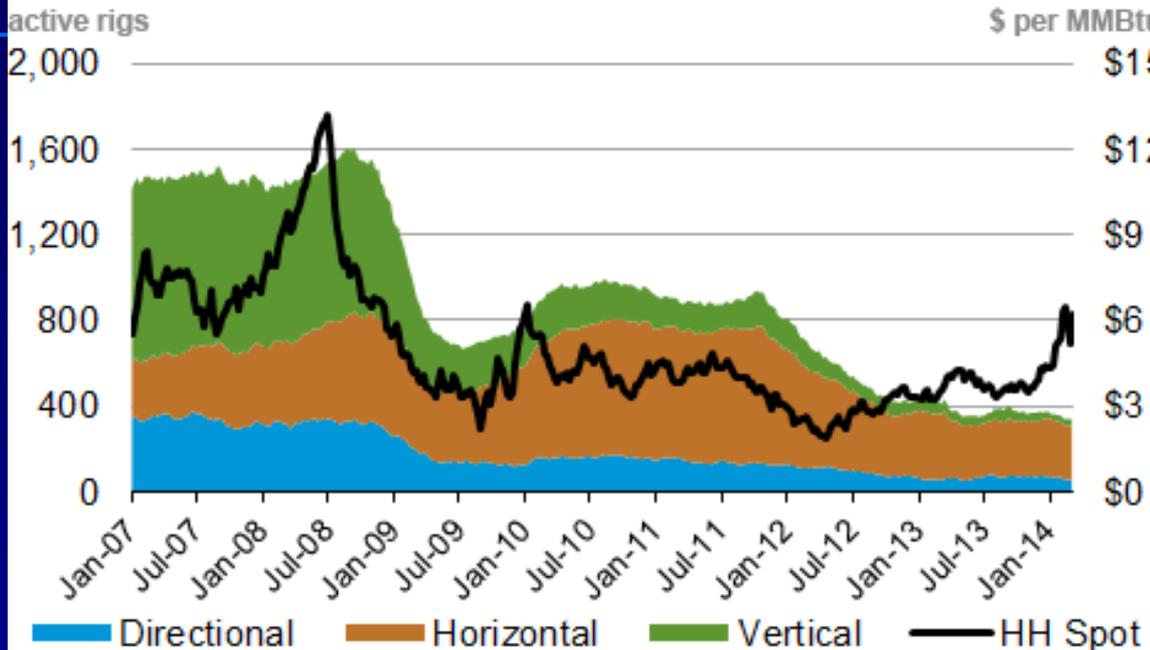
Natural gas spot prices (Henry Hub)

\$/MMBtu



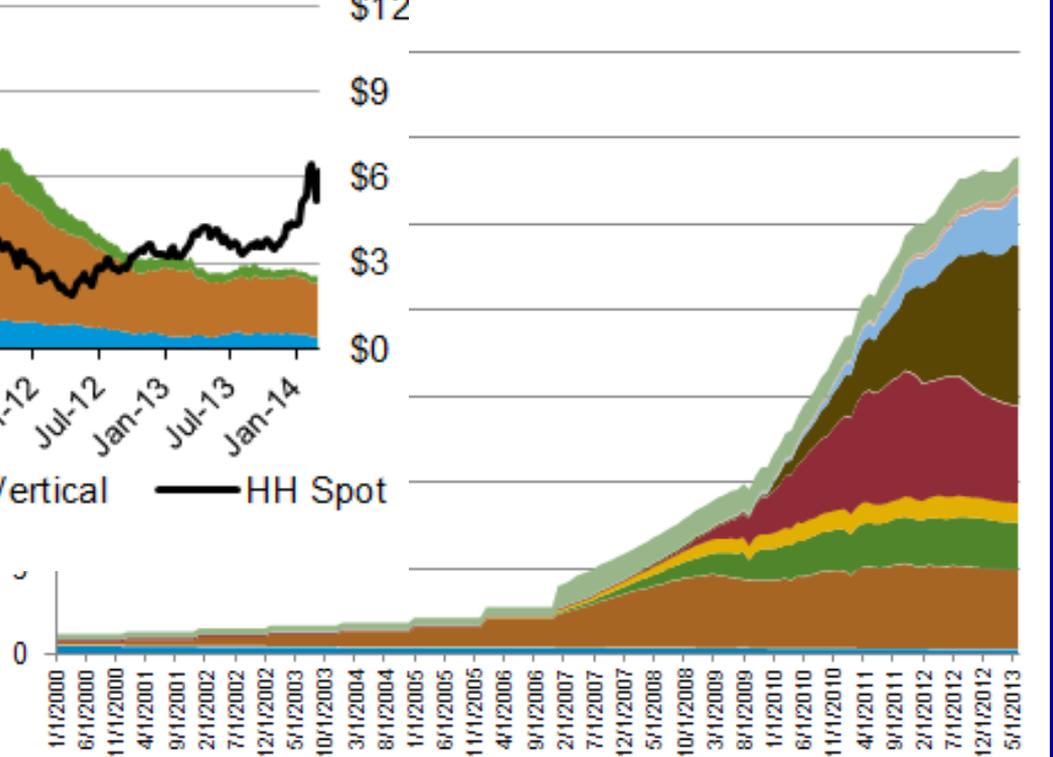
EIA NATURAL GAS

Weekly natural gas rig count and average spot Henry Hub



eia Source: Baker Hughes

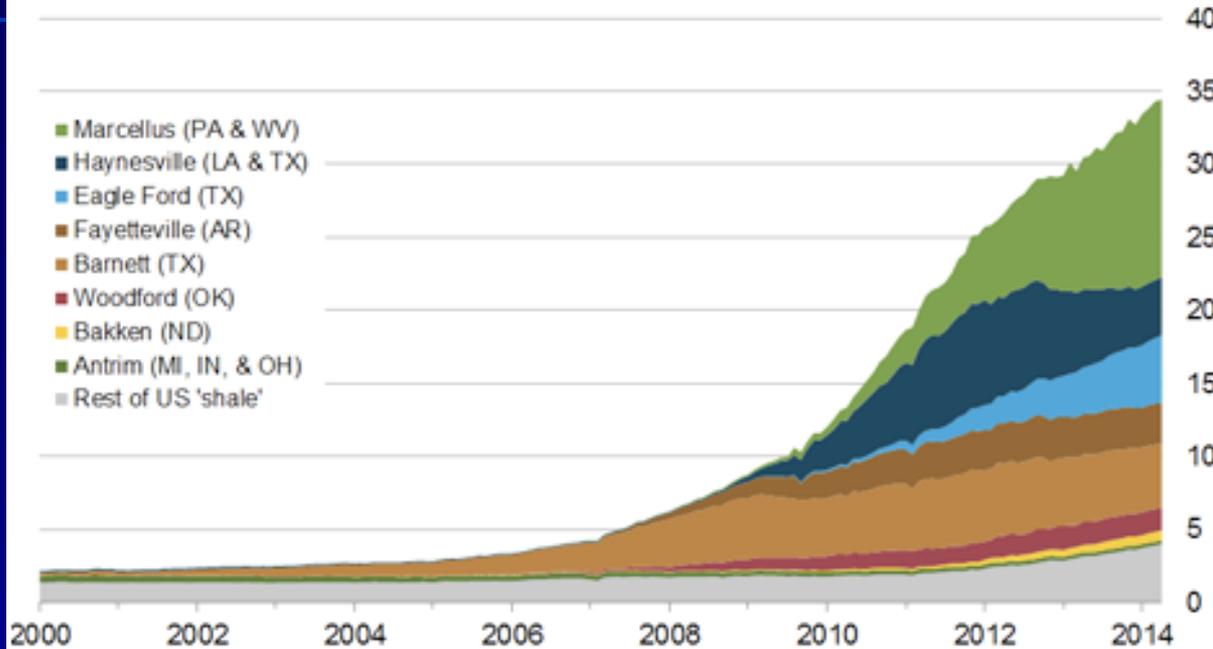
Production



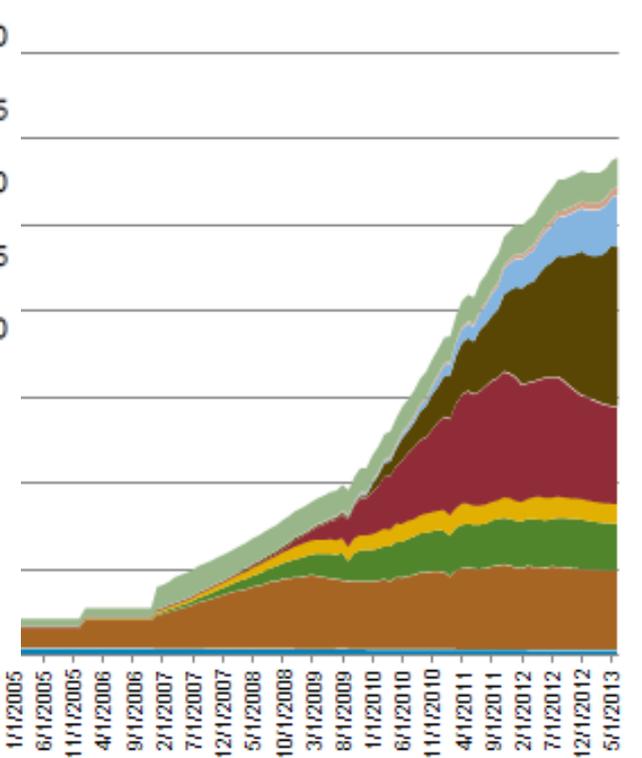
- Antrim (MI, IN, and OH)
- Barnett (TX)
- Fayetteville (AR)
- Woodford (OK)
- Haynesville (LA and TX)
- Marcellus (PA and WV)
- Eagle Ford (TX)
- Bakken (ND)

EIA NATURAL GAS

Monthly dry shale gas production
billion cubic feet per day



Production



Source: EIA derived from state administrative data collected by DrillingInfo Inc. Data are through April 2014 and represent EIA's official shale gas estimates, but are not survey data. State abbreviations indicate primary state(s).



SOLAR IS THE NEW WIND



SOLAR IS THE NEW WIND

According to the latest data, [solar power](#) capacity installed around the world this year will beat [wind power](#) for the first time ever. "Photovoltaic plants will add about 36.7 GW globally in 2013 and wind farms 35.5 GW



SOLAR POWER PLANT COSTS

Cost	Insolation								
	2400	2200	2000	1800	1600	1400	1200	1000	800
	kWh/ kWp·y	kWh/ kWp·y	kWh/ kWp·y	kWh/ kWp·y	kWh/ kWp·y	kWh/kWp·y	kWh/kWp·y	kWh/kWp·y	kWh/kWp·y
200 \$/kWp	0.8	0.9	1.0	1.1	1.3	1.4	1.7	2.0	2.5
600 \$/kWp	2.5	2.7	3.0	3.3	3.8	4.3	5.0	6.0	7.5
1000 \$/kWp	4.2	4.5	5.0	5.6	6.3	7.1	8.3	10.0	12.5
1400 \$/kWp	5.8	6.4	7.0	7.8	8.8	10.0	11.7	14.0	17.5
1800 \$/kWp	7.5	8.2	9.0	10.0	11.3	12.9	15.0	18.0	22.5
2200 \$/kWp	9.2	10.0	11.0	12.2	13.8	15.7	18.3	22.0	27.5
2600 \$/kWp	10.8	11.8	13.0	14.4	16.3	18.6	21.7	26.0	32.5
3000 \$/kWp	12.5	13.6	15.0	16.7	18.8	21.4	25.0	30.0	37.5
3400 \$/kWp	14.2	15.5	17.0	18.9	21.3	24.3	28.3	34.0	42.5
3800 \$/kWp	15.8	17.3	19.0	21.1	23.8	27.1	31.7	38.0	47.5
4200 \$/kWp	17.5	19.1	21.0	23.3	26.3	30.0	35.0	42.0	52.5
4600 \$/kWp	19.2	20.9	23.0	25.6	28.8	32.9	38.3	46.0	57.5
5000 \$/kWp	20.8	22.7	25.0	27.8	31.3	35.7	41.7	50.0	62.5

WILL SOLAR PRICES DECLINE?

- Solar tax credit expires in 2016



SOLAR PRICES VS GAS



New Generation/DSM Technology Costs

Estimated 30 Year Levelized Cost of New Dispatchable Resources, 2015 (\$/MWh)

Plant type	Average Capacity Factor (%)	Fuel Type	Overnight Capital Cost 2014\$ (\$/KW)	Heat Rate Btu/kWh	Base				Low	High
					Levelized Capital Cost	Levelized O&M	Levelized Fuel	Levelized Total		
Dispatchable Technologies										
Advanced Coal	85%	Coal	3,059	8,800	55.23	10.83	27.39	102.79	92.83	114.00
Advanced Nuclear	85%	Uranium	5,765	10,000	104.09	18.35	7.47	129.91	116.92	155.89
Biomass	85%	Wood Waste	3,002	13,500	54.21	24.32	49.81	128.33	102.67	154.00
Geothermal	50%	Heat	3,183	N/A	97.70	28.56	0.00	126.26	101.01	151.51
Natural Gas-Fired										
Advanced Combined Cycle	55%	Natural Gas	1,066	6,430	29.76	8.08	32.15	69.99	61.53	91.38
Advanced Combustion Turbine	10%	Natural Gas	705	9,750	108.16	23.02	48.75	179.93	167.10	212.36
Combined Heat/Power (CHP)	85%	Natural Gas	2,133	6,430	44.64	12.12	32.15	88.91	74.39	97.44
Compressed Air Energy Storage (CAES)	40%	Gas/Air	1,000	4,300	38.37	32.72	21.50	92.59	76.27	111.11
Fuel Cell	85%	Natural Gas	7,410	9,500	133.79	53.78	47.50	235.08	207.07	268.09

Estimated 30 Year Levelized Cost of New Non-Dispatchable Resources, 2015 (\$/MWh)

Plant type	Average Capacity Factor (%)	Fuel Type	Overnight Capital Cost 2014\$ (\$/KW)	Heat Rate Btu/kWh	Base				Low	High
					Levelized Capital Cost	Levelized O&M	Levelized Fuel	Levelized Total (Base)		
Non-Dispatchable Technologies										
Onshore Wind (West Texas)	40%	Wind	See Note 1	N/A	27.94	7.06	0.00	36.75	26.25	61.55
Onshore Wind (South Texas)	30%	Sun	See Note 1	N/A	30.59	9.41	0.00	44.00	36.00	75.41
Photovoltaic (>50 MW West Texas)	30%	Sun	See Note 1	N/A	46.38	5.88	0.00	52.26	45.00	114.23
Photovoltaic (<20 MW Local)	20%	Sun	See Note 1	N/A	93.10	19.81	0.00	112.91	90.33	213.30
Solar Thermal	50%	Sun	3,697	N/A	141.87	24.01	0.00	165.88	132.70	199.06
Demand-Side	30%	N/A	See Note 1	N/A	70.00	0.00	0.00	70.00	56.00	84.00

Notes:

(1) Source of Technology Cost per Energy Information Administration (EIA) April 2013 Update, except:

- Demand-Side Management per AE estimates
- Wind and Photovoltaic per AE estimates (Range includes & excludes Tax Credit)
- CAES per AE estimates within ERCOT

(2) Levelized capital cost estimates assumes 50% Debt / 50% Equity, 35% tax rate, Nominal After-Tax Weighted Cost of Capital (WACC) of 10.00%, 30-yr book life

(3) Low and High estimates includes emission cost of \$12 to \$25 per metric ton for annual CO2 emissions, if applicable to technology

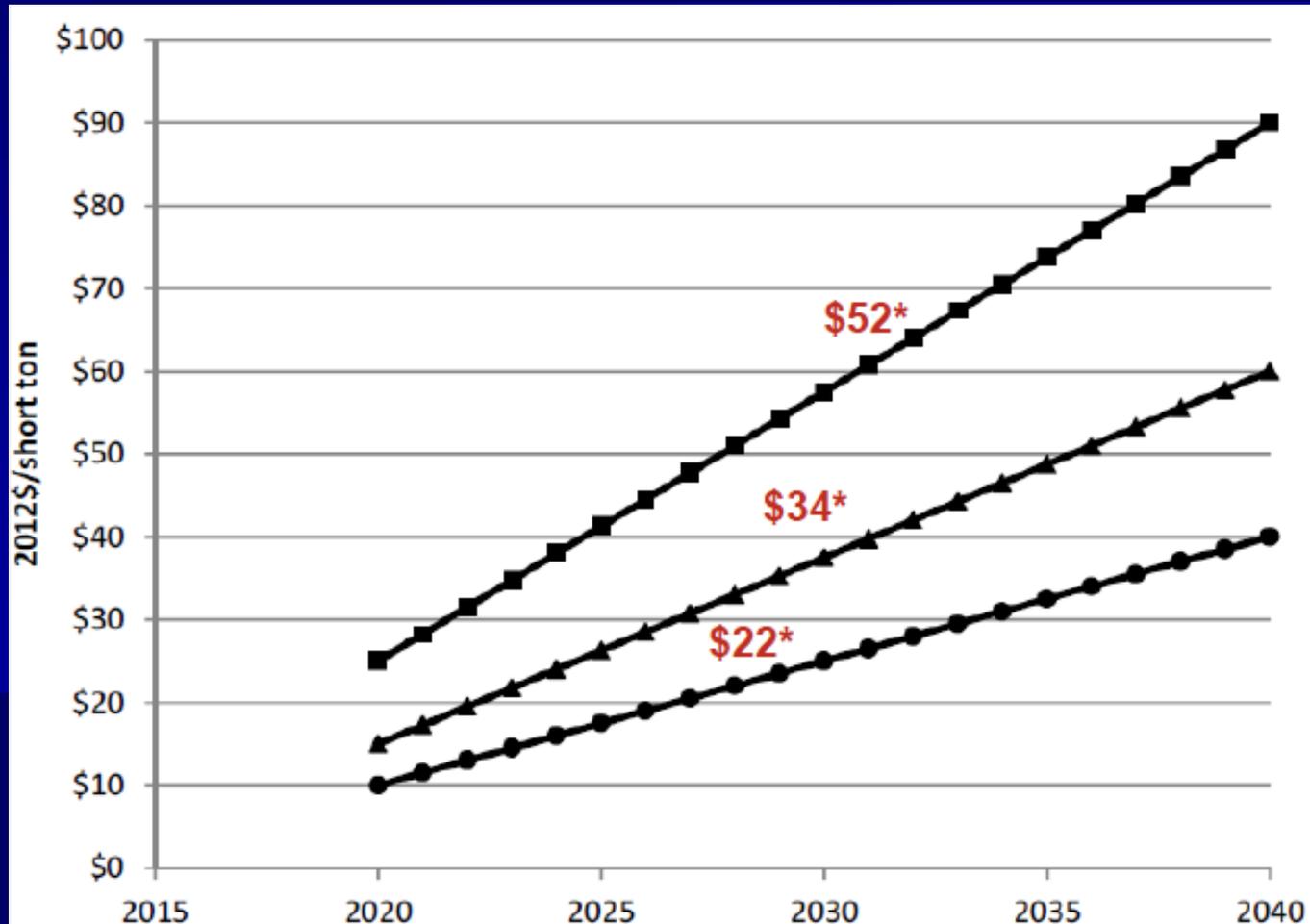
(4) Natural Gas Price \$5.00 per Mbtu, low \$3.00 - high \$7.00 per Mbtu, Coal Price \$2.50 per Mbtu escalating 2.5% per year, Uranium price \$0.6 escalating 2.5% per year, Biomass \$40 per MWh escalating 2.5%, All others +/- 20%

(5) Non-indicative bid Renewable Technologies (i.e. Solar Thermal, Biomass, Geothermal) assumes tax credit

SOLAR VS GAS VS WIND

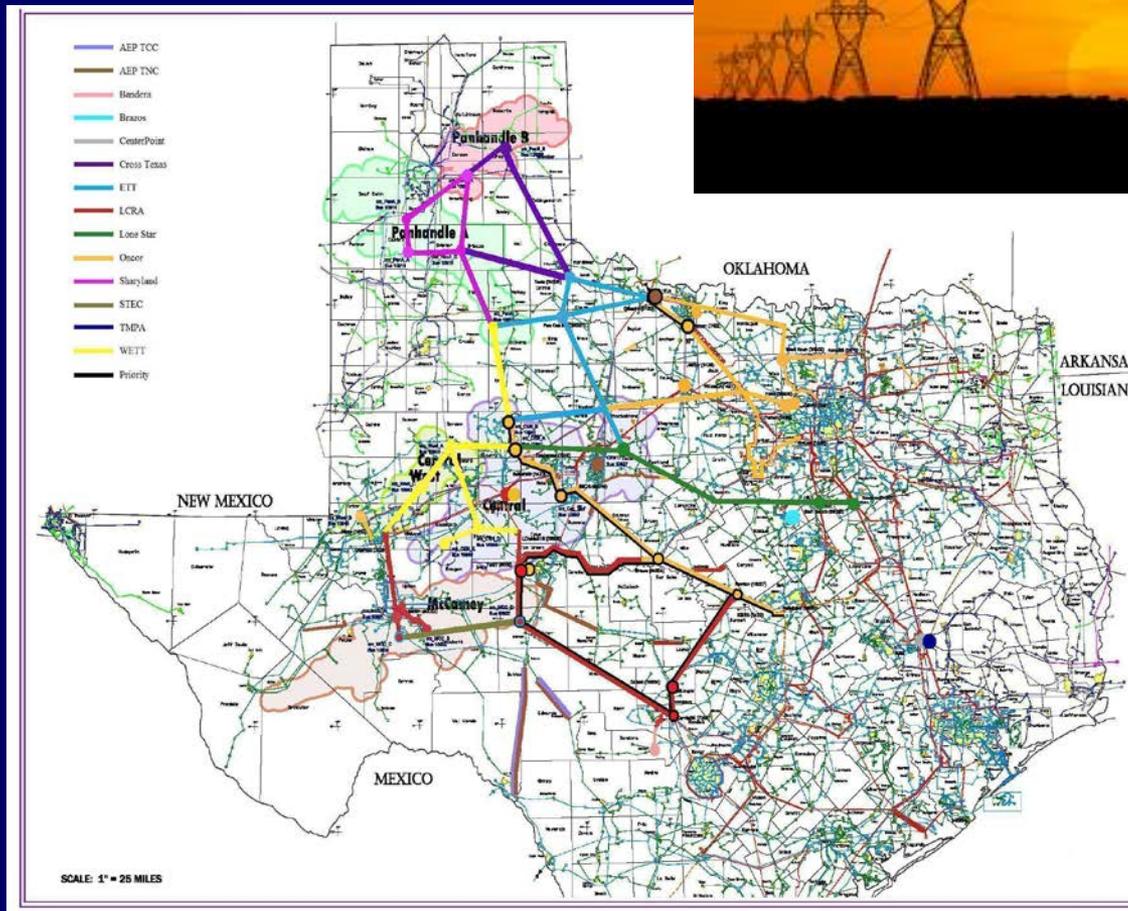
Natural Gas-Fired	
Advanced Combined Cycle	61.53
Advanced Combustion Turbine	167.10
Combined Heat/Power (CHP)	74.39
Compressed Air Energy Storage (CAES)	76.27
Fuel Cell	207.07
Plant type	
Non-Dispatchable Technologies	
Onshore Wind (West Texas)	26.25
Onshore Wind (South Texas)	36.00
Photovoltaic (>50 MW West Texas)	45.00
Photovoltaic (<20 MW Local)	90.33
Solar Thermal	132.70
Demand-Side	56.00

PRICING CARBON

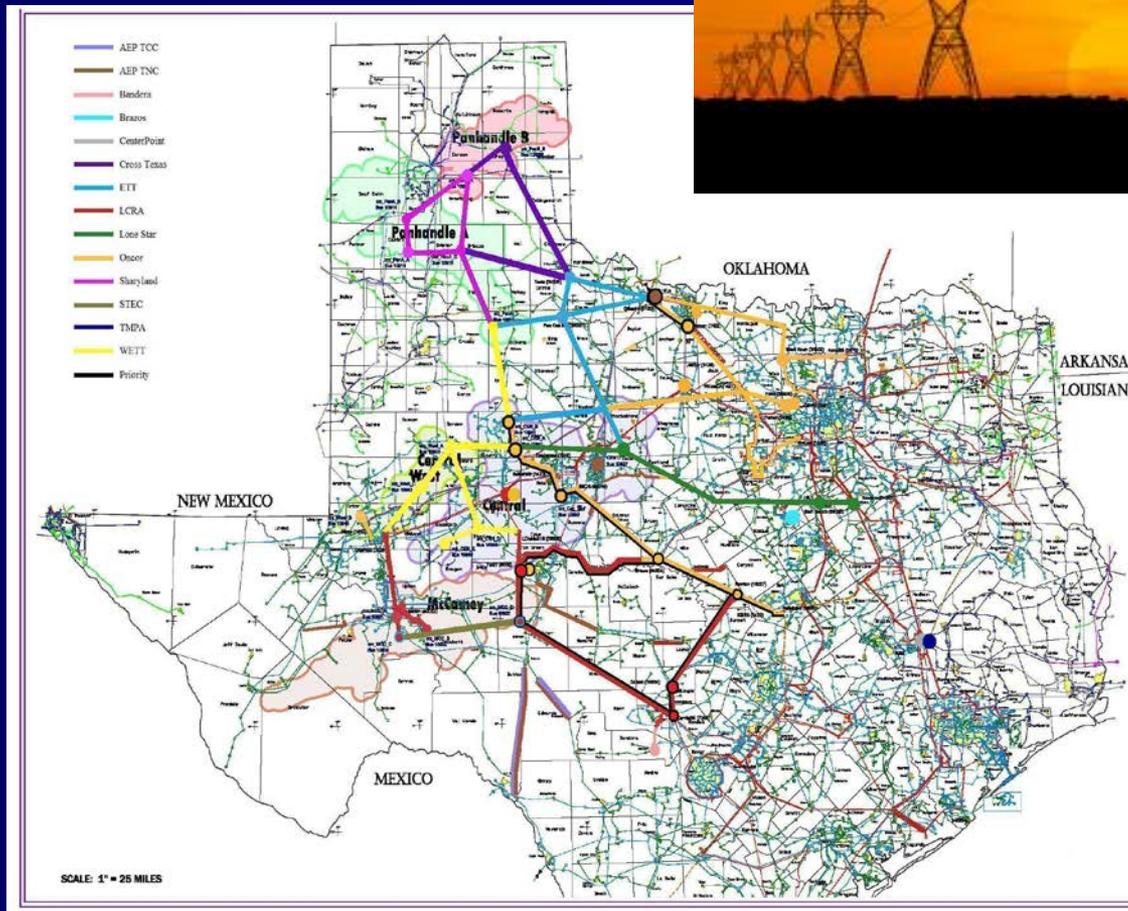


* 2020-2040 Levelized Price

LARGEST MACHINE ON EARTH



LARGEST RE MACHINE ON EARTH



TO POWER AUSTIN

- Solar provides .3 TWhs/section
- Austin Energy makes 14 TWhs/year
- Total area to power Austin..45 sections
- Total area of Austin...300 sections
- Usable rooftop area ...10 sections
- Existing Power Plants...35 sections

REPURPOSING FAYETTE

- 10 square miles
- 2400 acre lake
- One gigawatt of solar
- 500 MWs at reduced density
- Replace sequestered coal fuel with renewable fuel
- Build New advanced plant
- Establish non AE task force

TOMORROW WILL CHANGE

US



EXCEPT