

Scenario Analysis – Final Modeling Assumptions

Resource Assumptions (Revised based on Stakeholder Meeting 4/2/07)

April 4, 2007

Comments Received

- **IGCC Plant Capital costs should be higher**
- **Nuclear Plant Capital costs should be higher**
- **CHP and fuel cells data do not reflect dual energy use**
- **Wind energy is high and onshore and offshore not differentiated enough**
- **IGCC and CHP NO_x emissions should reflect current MA permitting requirements**
- **CO₂ allowance prices should have a wider range**
- **SO₂ emission prices are not clear if based on emissions or allowances**

SA New Power Plant Assumptions

Technology	MW	Heat Rate (Btu/hr)	Equipment Availability %	Total Plant Costs (2006\$/kW)	Sources
IGCC w/o CO ₂ Capture	600	8,600	80	2500-3500	EPA, EPRI, MIT, DOE
IGCC with 90% CO ₂ Capture	500	9,750	80	2900-3900	EPA, EPRI, UN, MIT
NG Combined Cycle	400	6,500	90	800-1000	GE
NG Comb Turbine	100	8,500	90	500-700	GE
Nuclear	1080	10,000	90	3000-5000	Westinghouse, NEI
Fuel Cell*	1	8,000	95	3500-4000	Fuel Cell Energy
Biomass	40	14,000	90	2500-3500	CT Plants, NH DES
Hydro	5	N/A	90	3000-4000	NE Developer
Landfill Gas	5	10,500	90	2000-2500	NE Plants
CHP*	5	9,750	90	1000-1500	Solar Turbines
Photovoltaics	1	20%**	98	4000-6000	UMASS RERL
Wind On-shore	1.5	N/A	90	1500-2000	UMASS RERL Levitan
Wind Off-shore	3.5	N/A	90	2000-2500	UMASS RERL Levitan

*Data is for electric production only **PV Conversion Efficiency: sunlight to AC power

SA New England Energy Efficiency Costs

- **The New England states recent energy efficiency program results show annual costs from 110 to 400 \$/kW/yr. These are levelized costs based on a typical energy efficiency measure life of 13 years and a 7% return yielding an annual charge rate of 12%.**
- **With this annual charge rate these program costs translate to an equivalent capitalized cost of 920 to 3300 \$/kW of demand reduction**

SA New Power Plants Emission Rate Assumptions

Technology	MW	Heat Rate (Btu/kWh)	SO ₂ (lb/MBtu)	NO _x (lb/MBtu)	CO ₂ (lb/MBtu)	Sources
IGCC w/o CO ₂ Capture	600	8,600	0.03	0.01	210	EPA, EPRI, MA DEP
IGCC w/ 90% CO ₂ Capture	500	9,750	0.03	0.01	21	EPA, EPRI, MA DEP
NG Combined Cycle	400	6,500	0.0006	0.01	120	GE
NG Combustion Turbine	100	8,500	0.0006	.03	120	GE
Nuclear	1080	10,000	0	0	0	Westinghouse, NEI
Fuel Cell*	1	8,000	0.0006	0.0088	120	Fuel Cell Energy
Biomass	40	14,000	0.02	0.075	170**	NE Plants, NH DES
Hydro	5	N/A	0	0	0	NE Developer
Landfill Gas	5	10,500	0.2	0.03	0	NE Developer, Solar Turbines
CHP*	5	9,750	0.0006	0.014	120	Solar Turbines, MA DEP
Photovoltaics	1	20%	0	0	0	UMASS RERL
Wind	1.5-3.5	N/A	0	0	0	UMASS RERL, Levitan

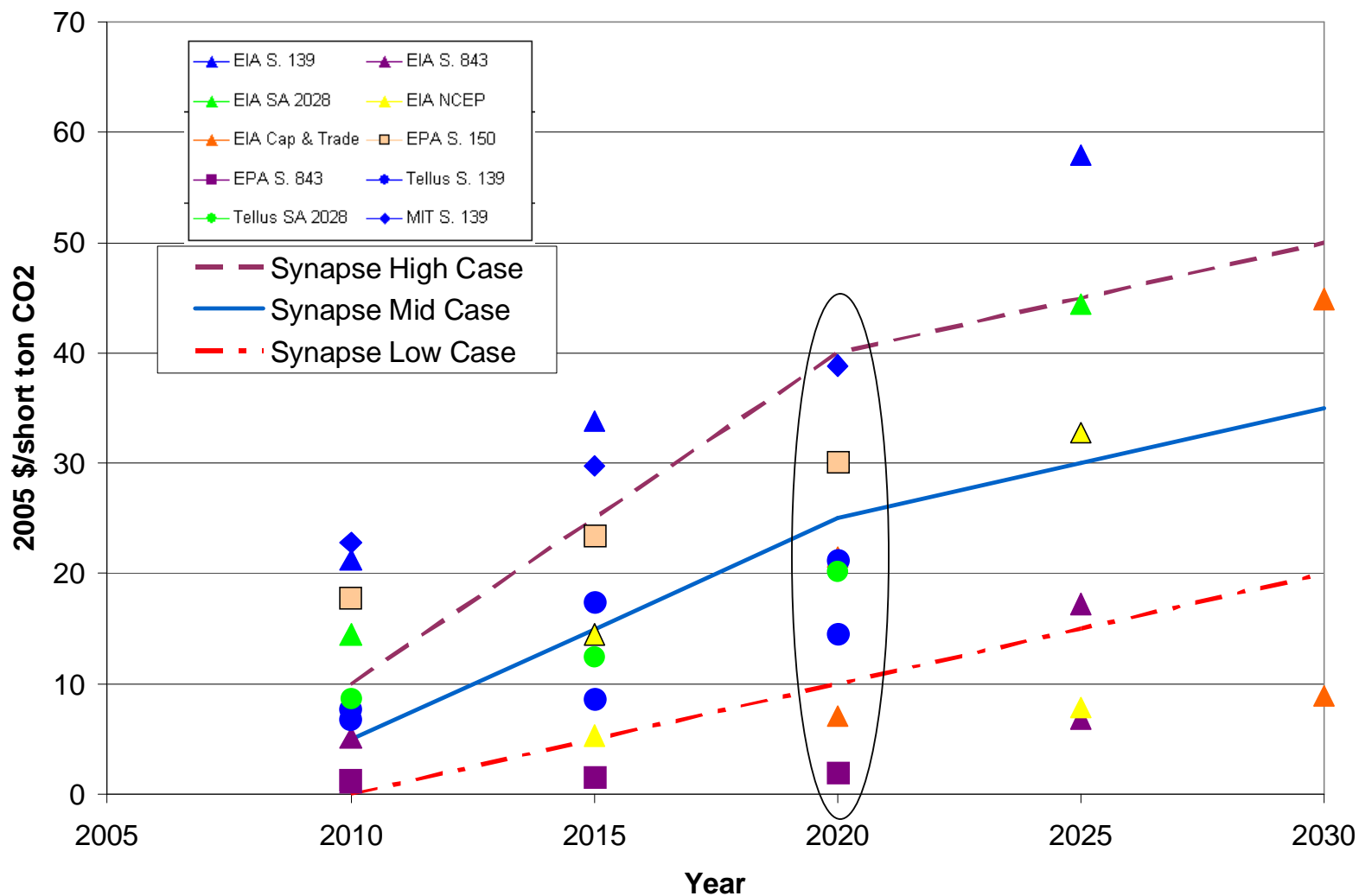
*Data is for electric production only

**Biomass fuel cycle is considered carbon neutral

SA Emission Values Assumptions in 2020 (2006\$)

Type Emission	Emission Value (\$/ton)	Source
SO ₂	969	EIA AEO 2006
NO _x	2,345	EIA AEO 2006
CO ₂	3, 20, 40	Synapse Report
Mercury	[not considered in the dispatch]	

Suggested SA CO₂ Price Range (Synapse)



SA New Power Plants Variable Costs: Fuel & Emission Values (2006\$)

Technology	Size MW	Heat Rate Btu/kWh	Fuel Prices \$/MWh	Emission Values \$/MWh	Total Fuel & Emissions \$/MWh
PV and Wind, on and off-shore			0	0	0
Landfill Gas	5	10,500	0	1.4	1.4
Nuclear	1080	10,000	17.0	0	17.0
IGCC w/ 90% CO ₂ capture	500	9,750	19.5	2.3	21.8
IGCC w/o CO ₂ capture	600	8,600	16.0	17.1	33.1
NG Combined Cycle	400	6,500	40.1	7.9	47.9
Fuel Cell*	1	8,000	49.3	9.4	58.7
NG Comb Turbine	100	8,500	52.4	10.5	62.9
Biomass**	40	14,000	46.6	25.2	71.8
CHP*	5	9,750	60.1	12.0	72.1

*Data is for electric production only

**Biomass fuel cycle is considered carbon neutral

SA Other Environmental Assumptions

- **CO₂ Sequestration costs**
 - 5400 MW of IGCC with 90% CO₂ capture yields 34.9 million tons of CO₂ annually for sequestration
 - CO₂ capture costs reflected in a \$400/kW higher IGCC capital cost and higher heat rate
 - CO₂ transportation, monitoring and storage assumed to be \$25/short ton or \$872 million annually
- **Cooling water requirements – Assume cooling towers to be required for large thermal plants**
- **Land requirements are under development**
 - Developing acres/MW for generation types
 - Determine transmission and distribution land needed as appropriate