CO_2 Capture & Storage
Just Do It!

David G. Hawkins, NRDC
August 2005

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CCS: Deployment Must Begin Now

- Further delay will increase climate protection costs.
- Further delay will not reduce technology costs.
- Impacts of CCS on electricity prices are modest.

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Investments Today Drive Climate Impacts Tomorrow

- Investments drive emissions
- Emissions drive concentrations
- Concentrations drive temperature forcing
- Forcing drives climate impacts

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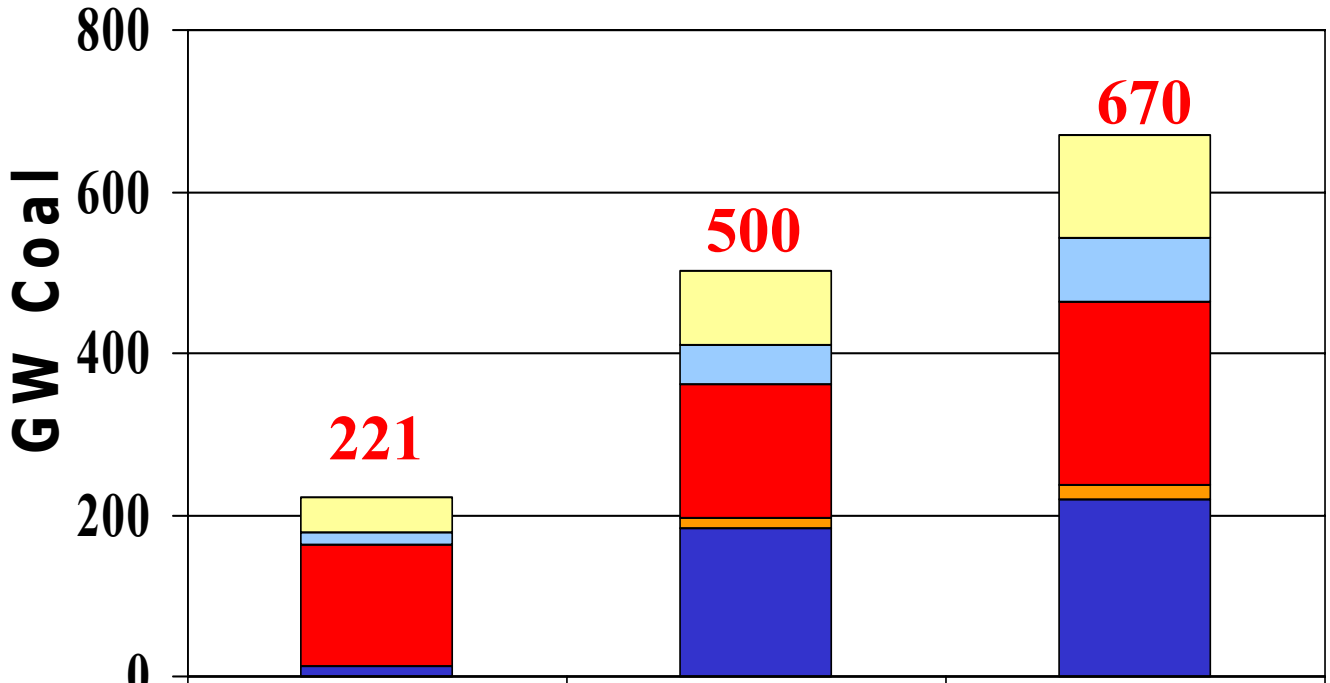
Global New Coal Build by Decade

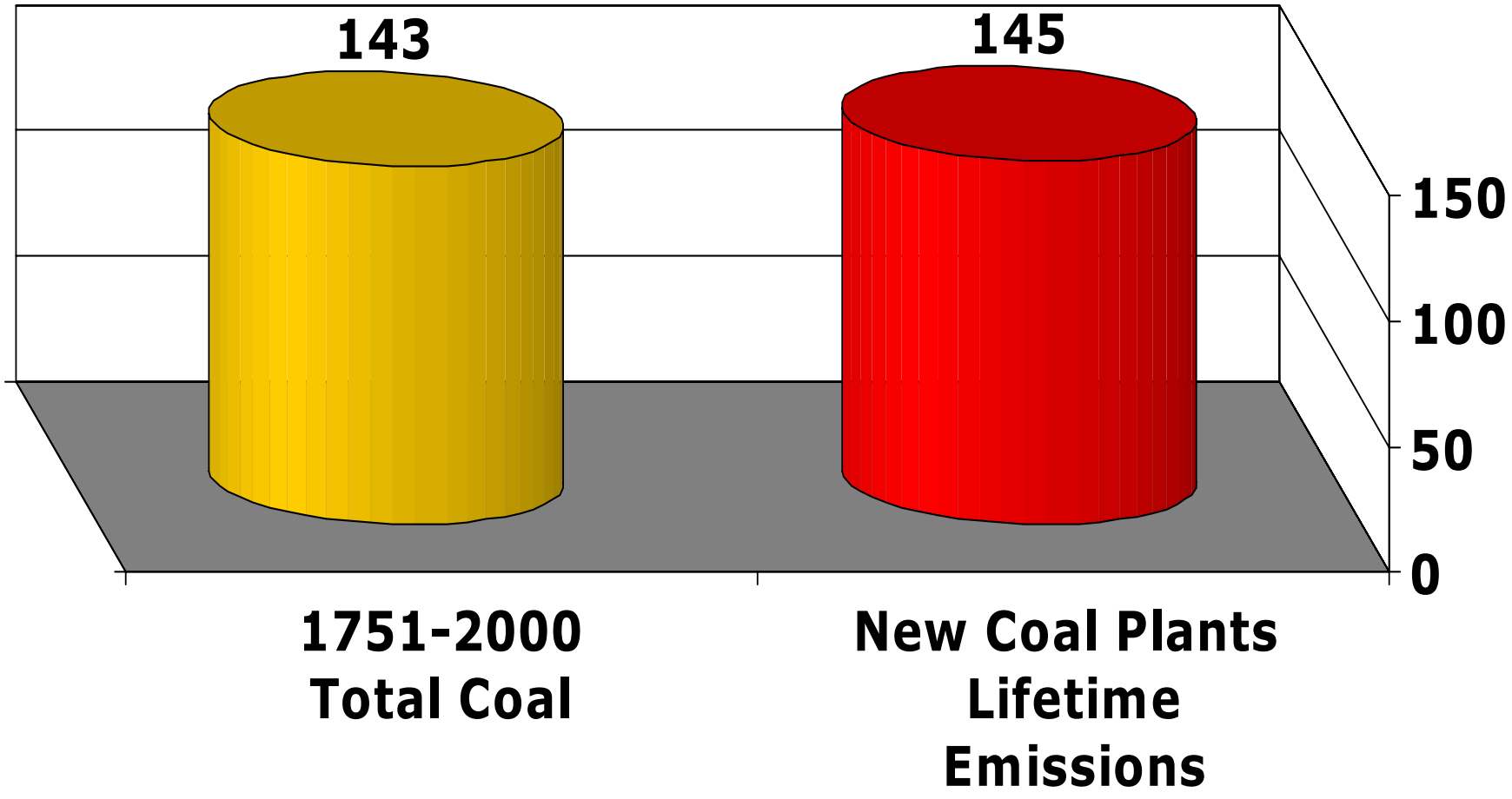


	2003-2010	2011-2020	2021-2030
Other Developing	43	90	128
India	16	48	79
China	150	168	226
Transition	1	11	19
OECD	12	184	218

Incremental new coal capacity by decade

Source: IEA, WEO 2004

New Coal Plant Emissions Equal All Historic Coal CO_2



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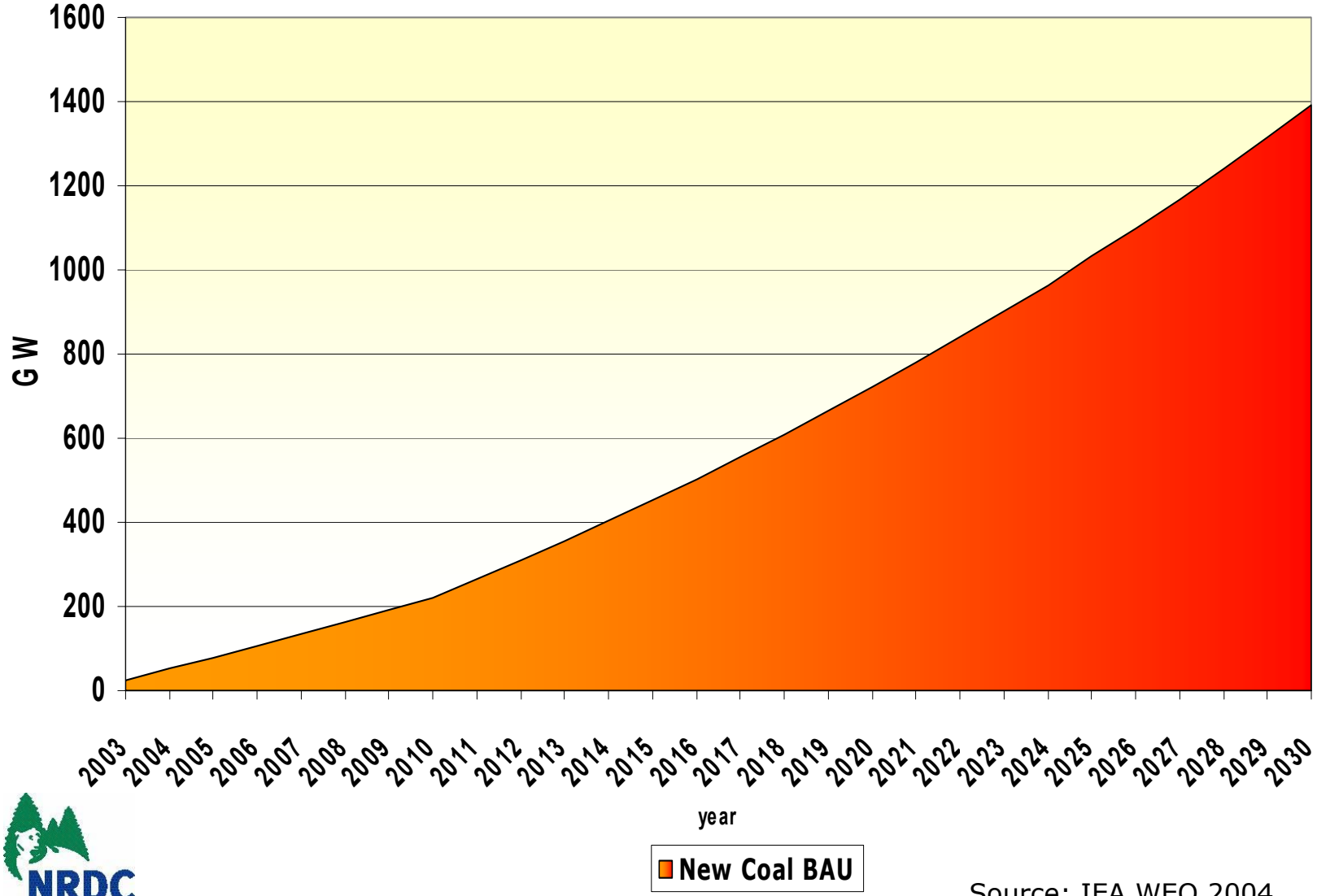
Source: ORNL, CDIAC; IEA, WEO 2004

BAU Means Carbon Lock-In

IEA New Coal Forecast



Source: IEA,WEO 2004

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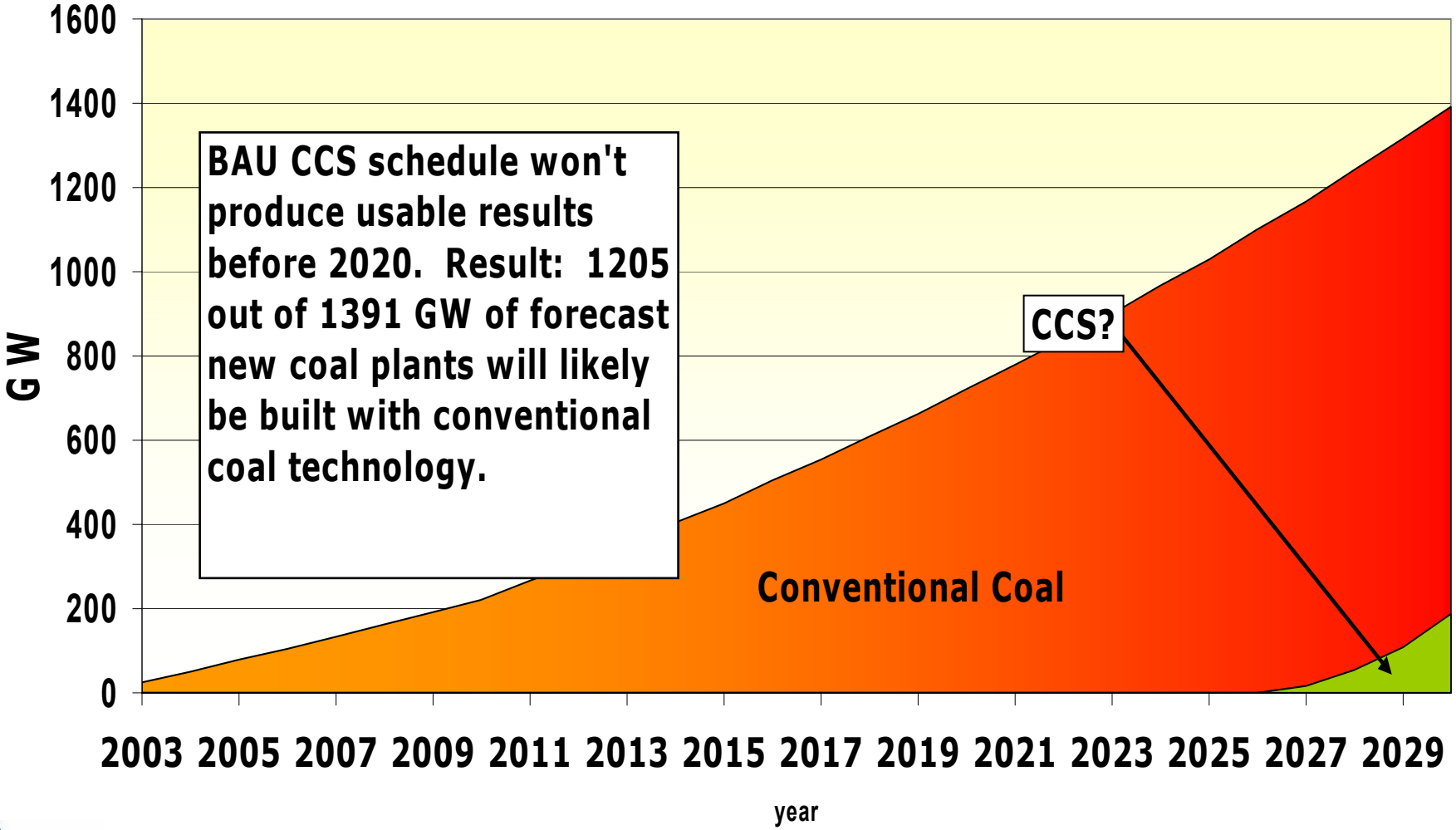

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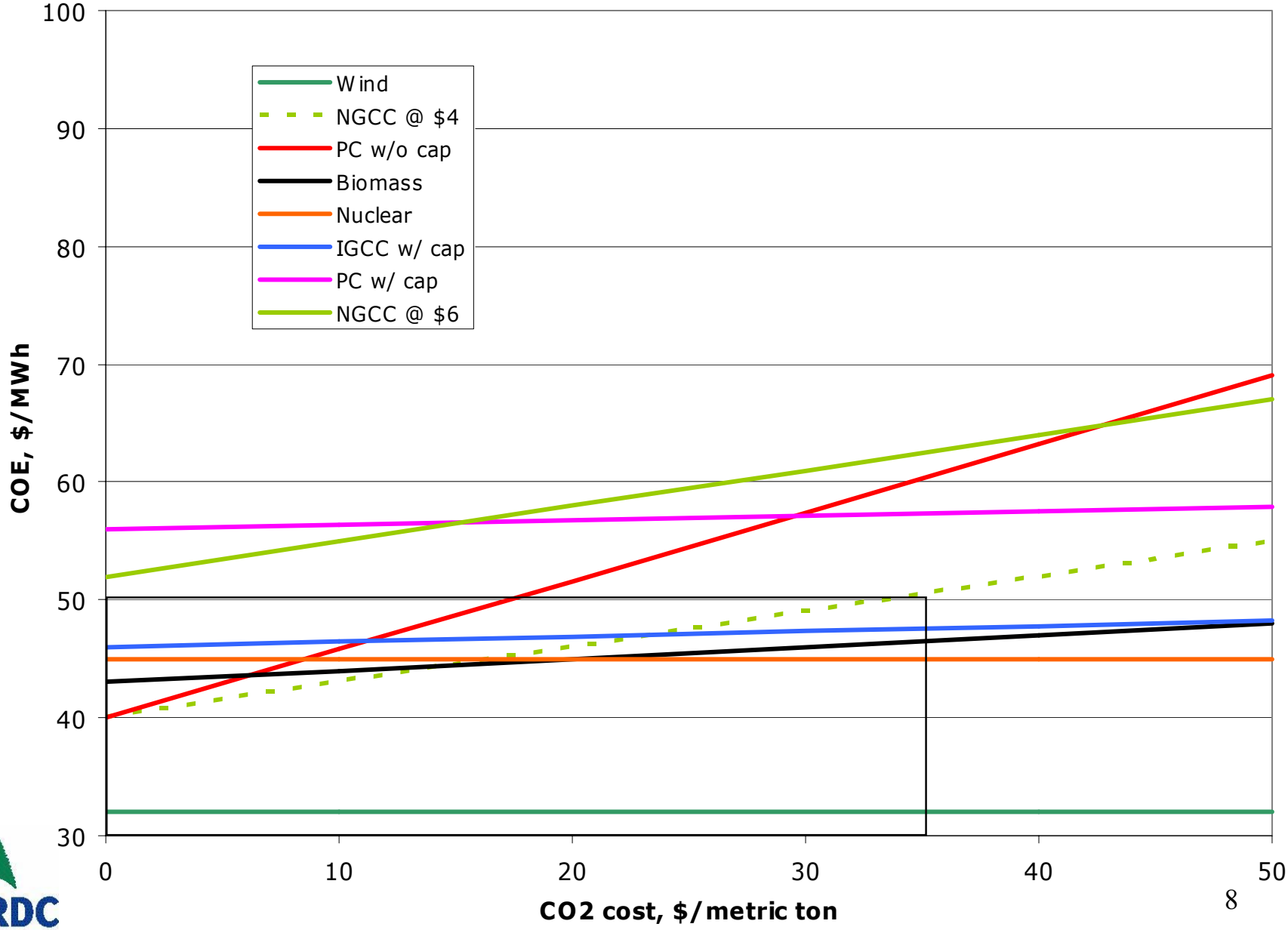
EPRI--Comparative Costs 2020



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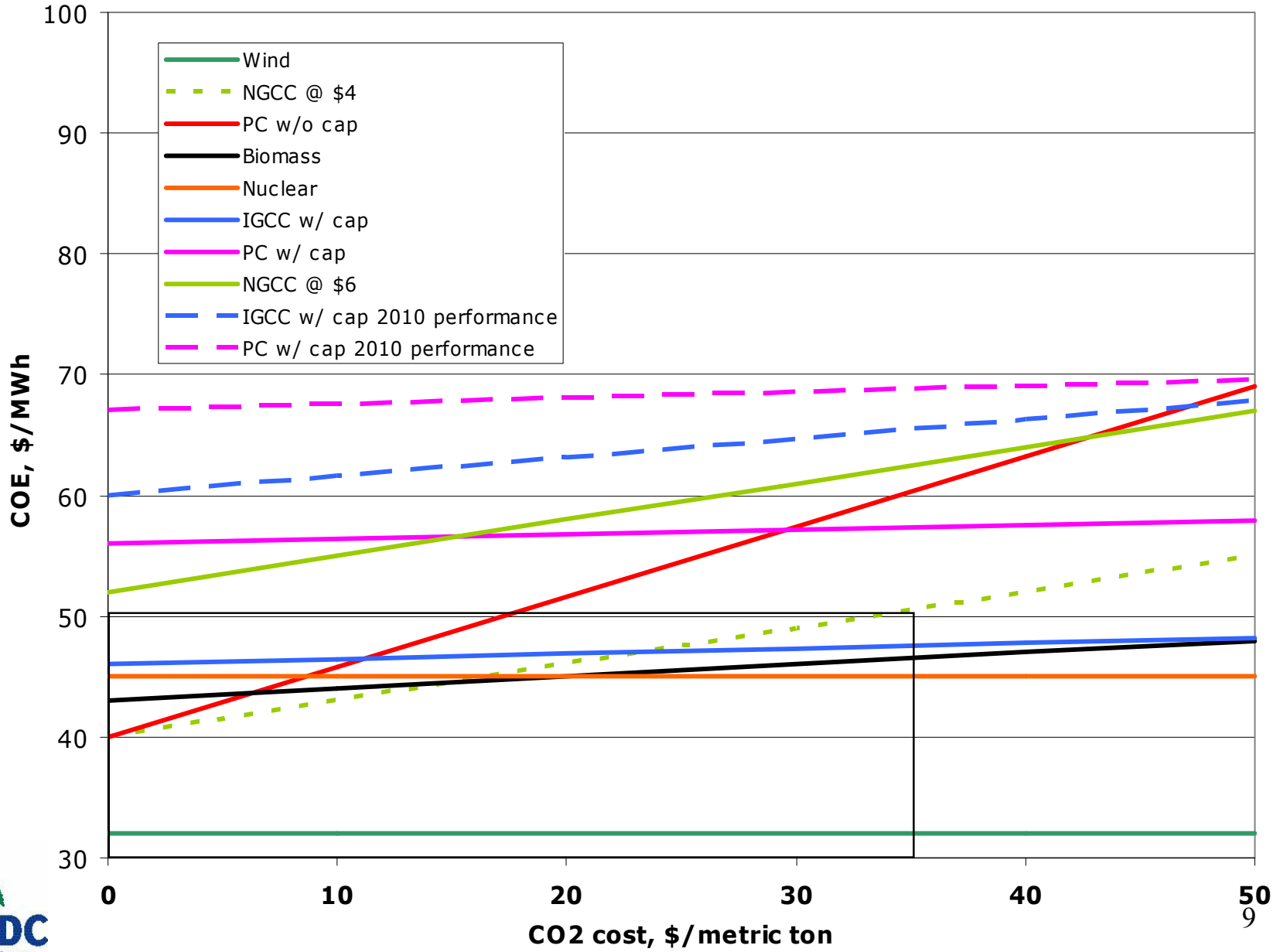
Source: EPRI, Aug. 2005

EPRI--Comparative Costs Now (2010)



Source: EPRI, Aug. 2005

Low CO2 Generation Obligation

- Starting 5-7 years from now, require a growing fraction of U.S. electricity sales to come from generation with a CO_2 intensity about 250 lbs/MWh.
- Set the required fraction to equal U.S. ref. case coal build to 2020.

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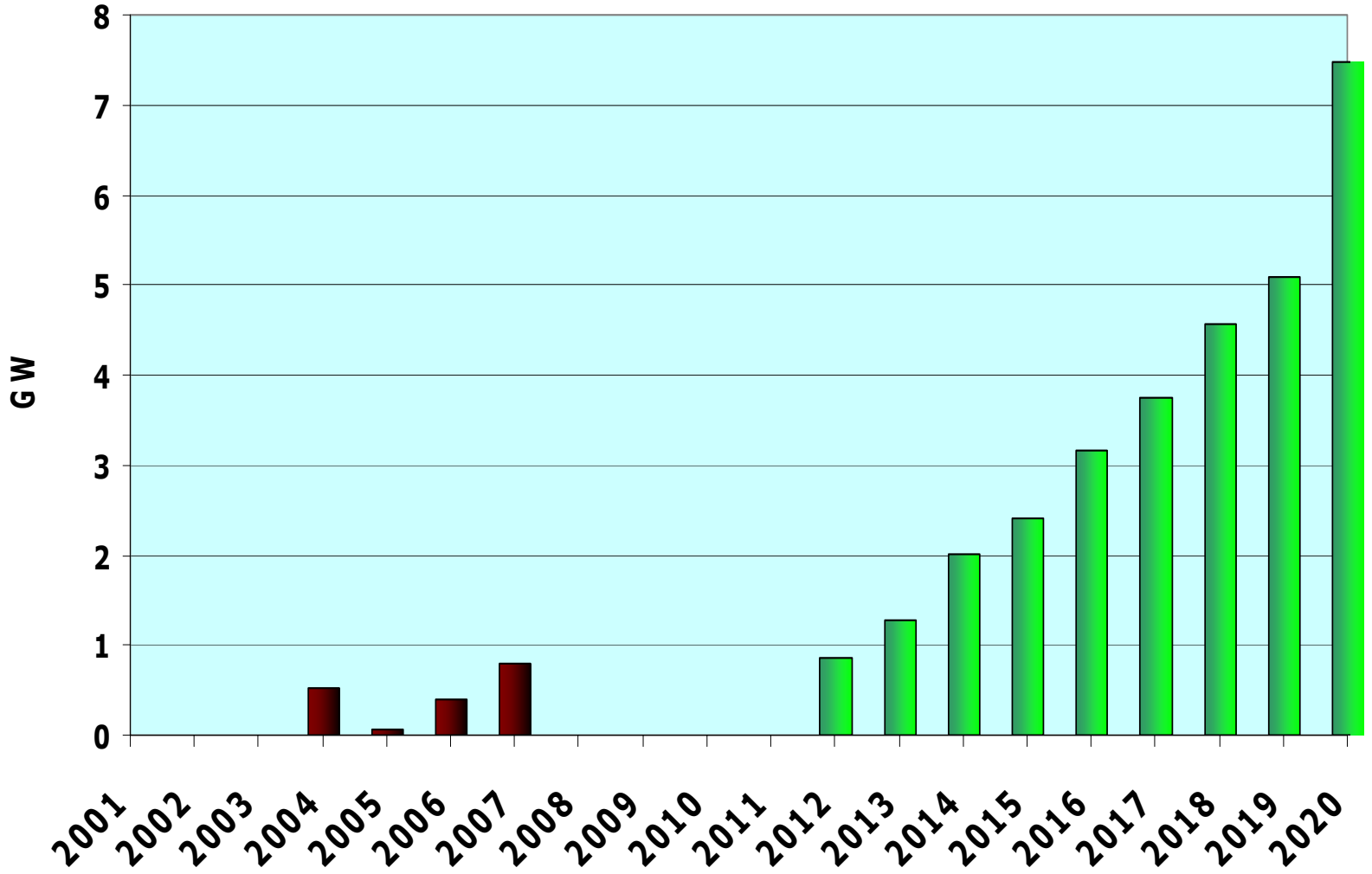
Possible U.S. CCS Deployment Schedule



Coal build from EIA, AEO 2005

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Costs of CCS Deployment

- Based on AEP cost estimates for Ohio PUC IGCC application: CCS increases unit generation costs by 2.4 cents/kwh. (ref. unit=PC BIT)
- Assuming NO learning and 50% SUB-BIT use, levelized discounted costs of CCS program to 2020 are $2 billion annually.
- Retail price of electricity increase in 2020 = 1.35 mills/kwh (1.9%).

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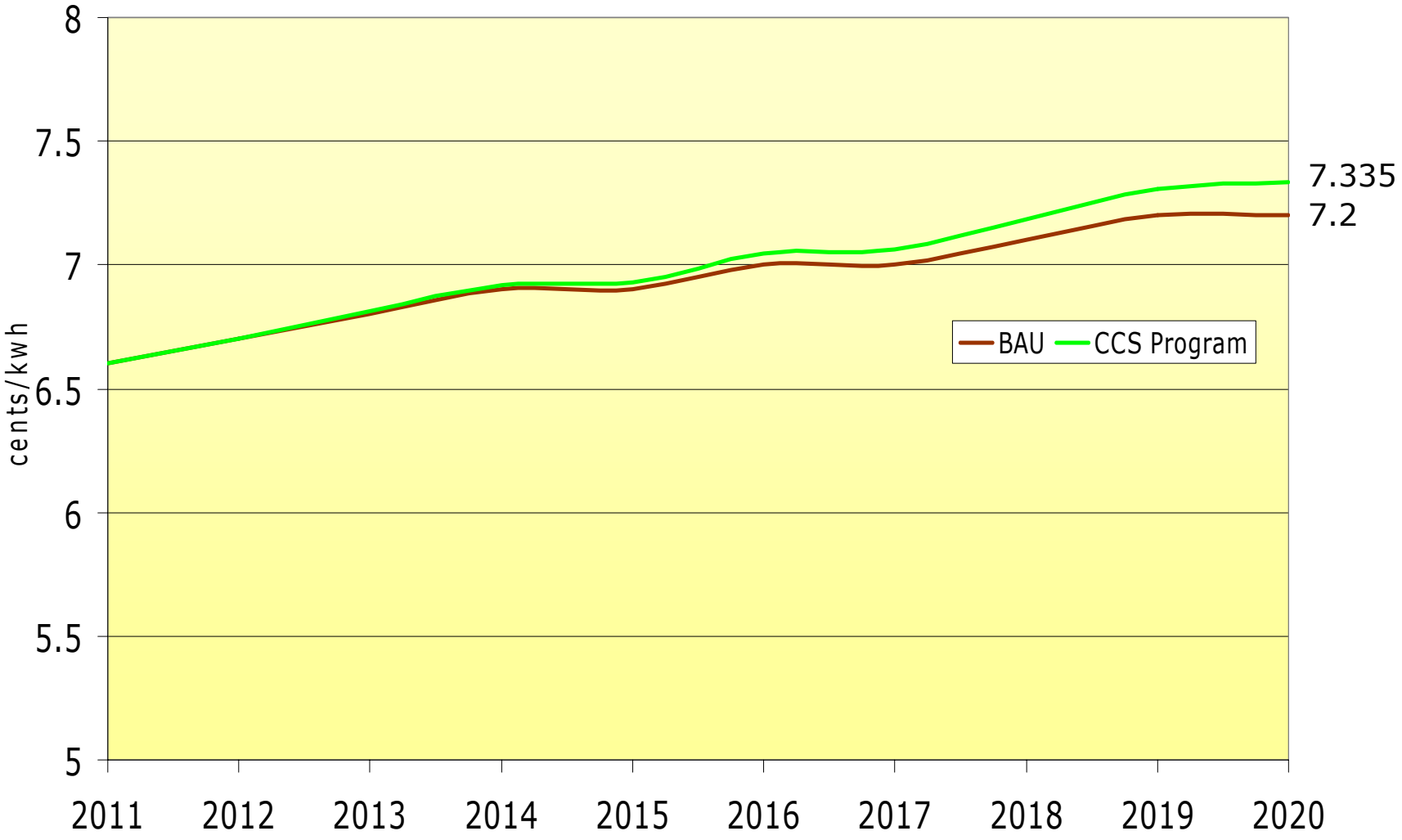
Impact of CCS Proposal on Retail Rates

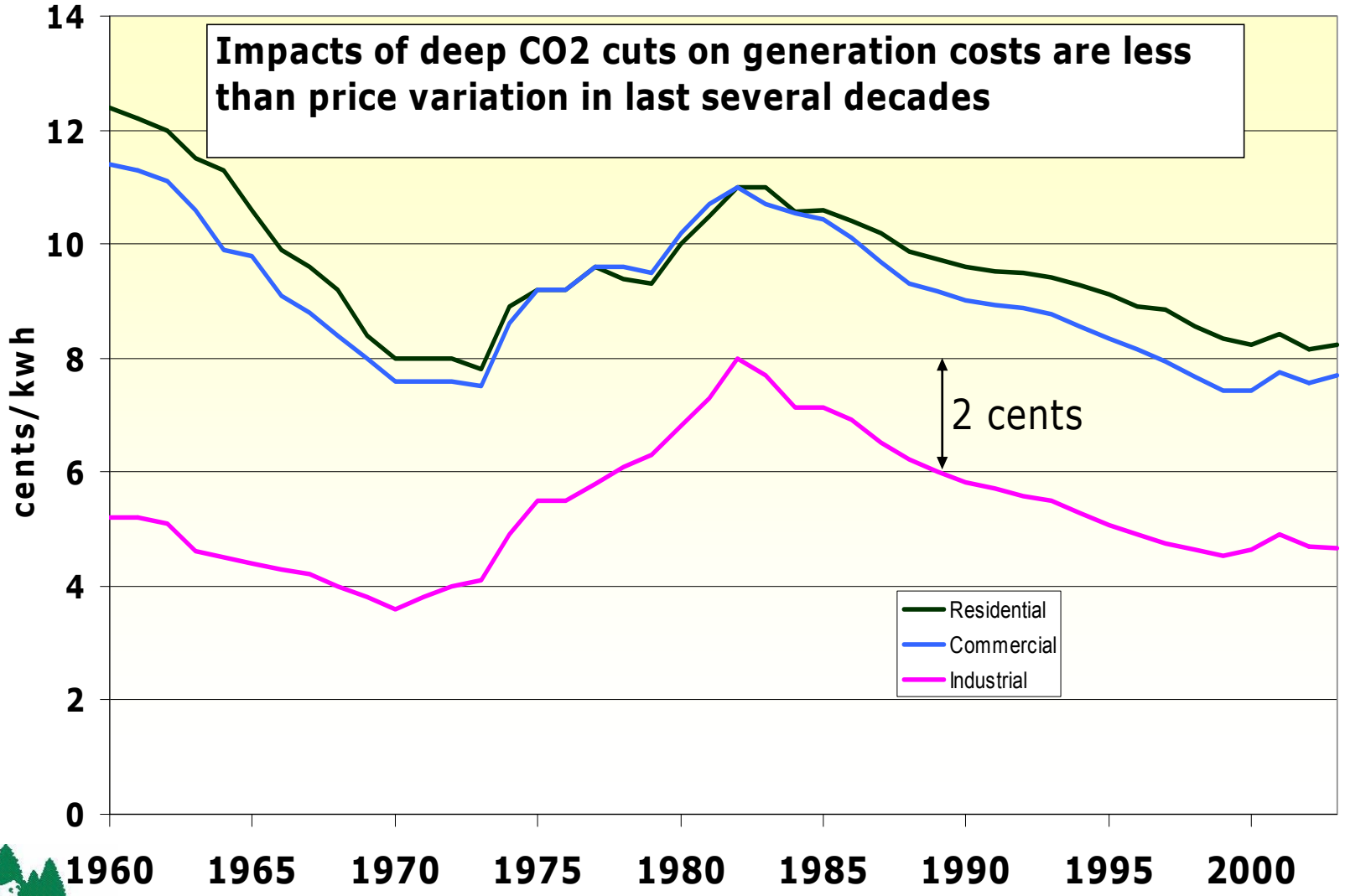
(assumes 50% use of sub-bituminous and no learning)



BAU rates from EIA AEO 2005

US Real Electricity Prices (2000 $)

(EIA, AER 2003)



After
David Keith,
U. Calgary

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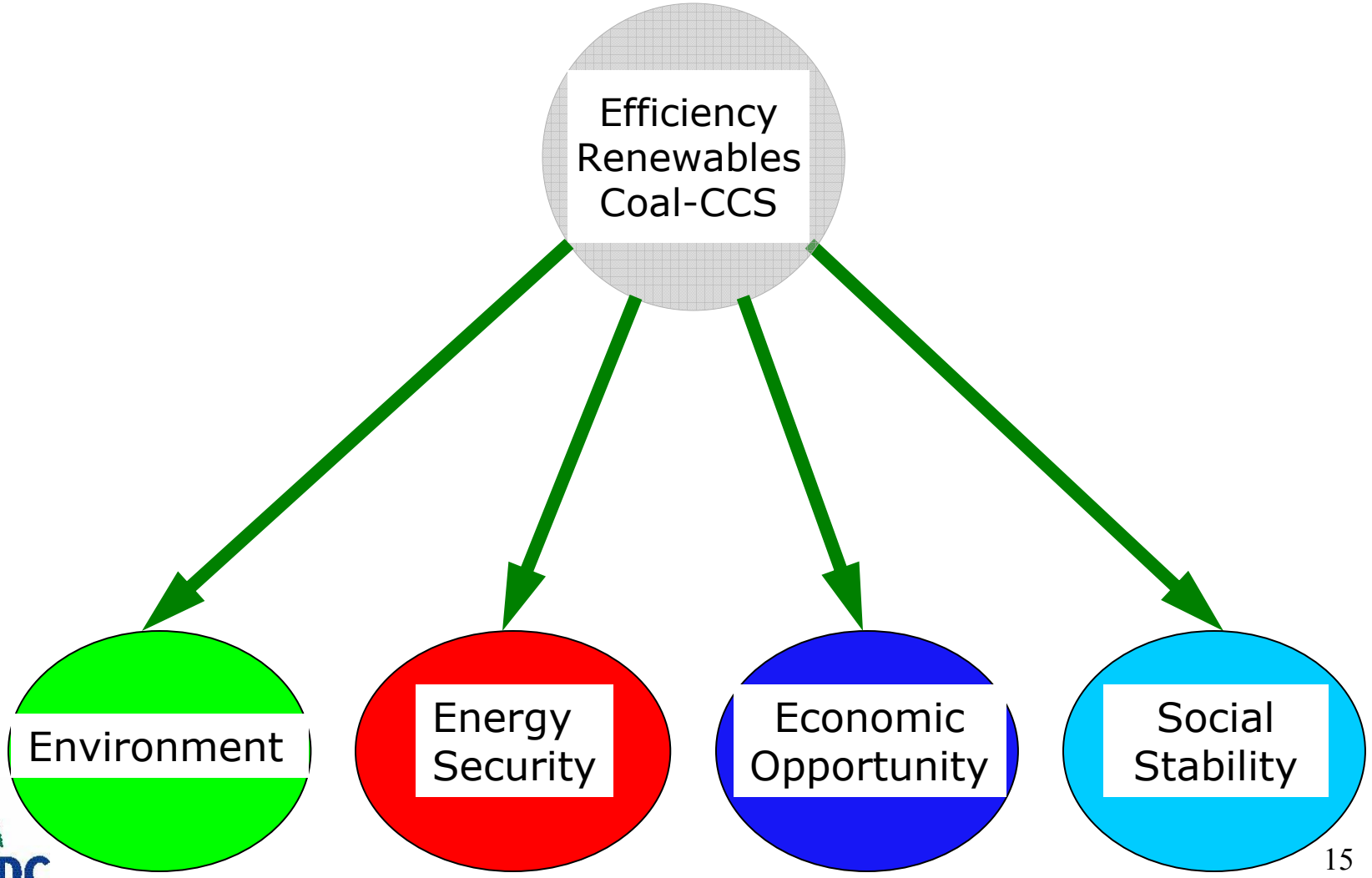
Multiple Benefits of New Energy Path



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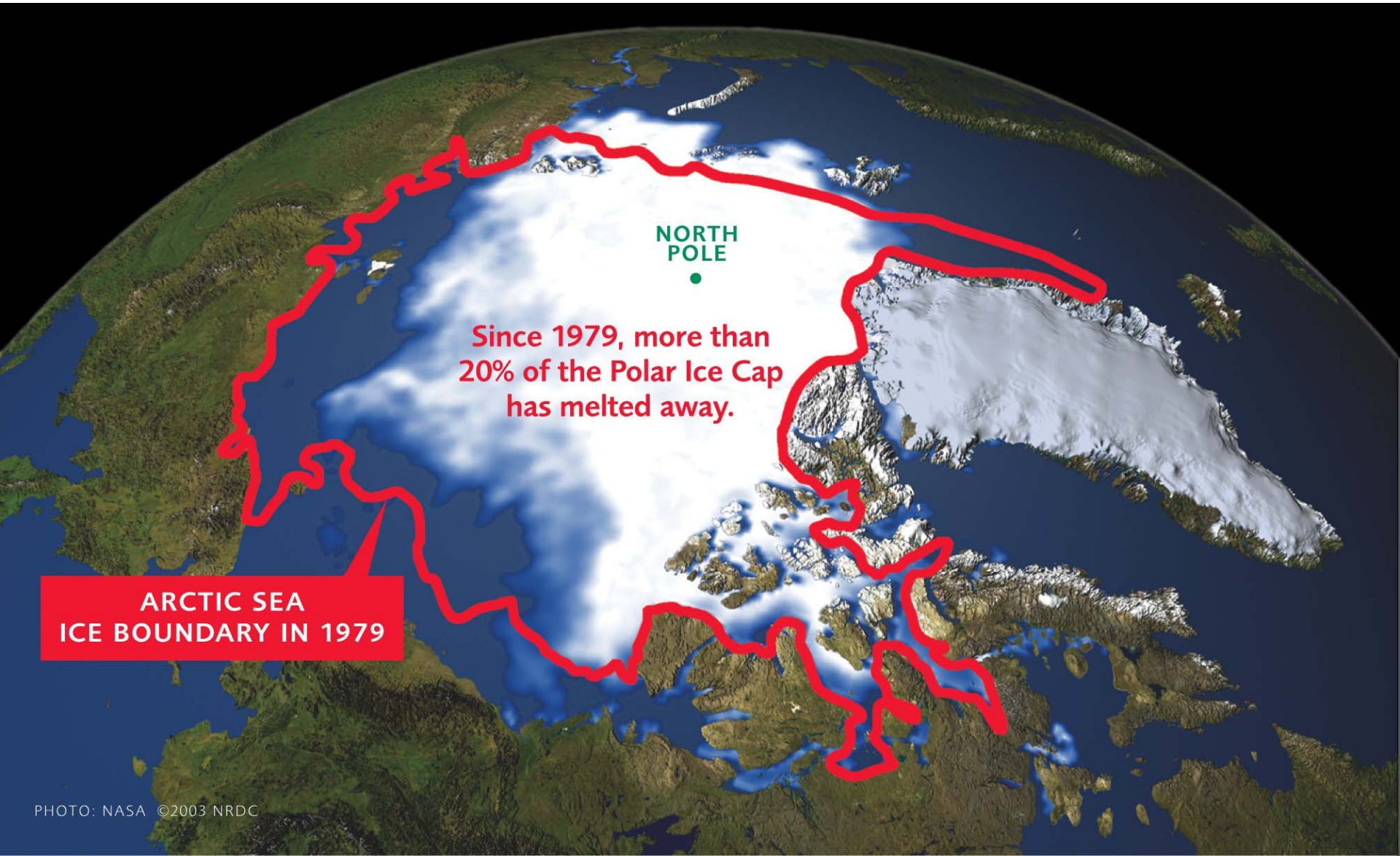
Warming Won't Wait. Will We?



CCS Capacity and CO2 stored (megatonnes CO2)

	capacity w/ CCS		CO2 stored (megatonnes)		
Year	annual	cumulative	new annual	total annual	cumulative
2010		0	0.0	0.0	0.0
2011	0	0	0.0	0.0	0.0
2012	0.9	0.9	5.9	5.9	5.9
2013	1.2	2.1	7.8	13.7	19.5
2014	2	4.1	13.0	26.7	46.2
2015	2.4	6.5	15.6	42.3	88.4
2016	3.2	9.7	20.8	63.1	151.5
2017	3.8	13.5	24.7	87.8	239.2
2018	4.5	18	29.3	117.0	356.2
2019	5.1	23.1	33.2	150.2	506.4
2020	7.5	30.6	48.8	198.9	705.3

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CCS COSTS

	AEP, Braine & Mudd, 2005				IEA, Foster-Wheeler, 2003	
Total gen cost	SCS, Current		IGCC, Current		IGCC, Current	
	VENT	CCS	VENT	CCS	VENT	CCS
Actual values c/kwh	4.154	7.123	4.573	6.534	4.082	5.584
Relative to SCS/VENT	1	1.71	1.14	1.57	1?	1.37

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Electricity Costs for Supercritical Steam (SCS) and IGCC Power Plants [*based on AEP IGCC White Paper (Braine and Mudd, 2005) for Current Technologies but with EPRI TAG IOU Financing*]				
Technology and status	SCS, Current		IGCC, Current	
Fate of CO_2	VENT	CCS	VENT	CCS
Capacity factor, %	85	85	85	85
Efficiency, %, HHV	39.3	30.2	39.2	31.9
OCC (overnight construction cost), 10^6 $	774	989	930	1033.5
Total plant cost, $/kW$_e$	1290	2150	1550	1950
Total plant investment, $/kW$_e$	1404	2340	1687	2122
Annual levelized capital charge rate (ALCCR)	0.1204	0.1204	0.1204	0.1204
Capital charge	2.270	3.783	2.727	3.431
Coal @ $1.3/GJ, HHV	1.192	1.550	1.193	1.467
O&M (assumed to be 4%/y of OCC)	0.693	1.155	0.833	1.048
Total generation cost	4.154	6.487	4.753	5.946
CO_2 transport and storage cost[b], $/t $_{CO2}$	-	6.89	-	6.74
CO_2 transport and storage cost, ¢/kWh	-	0.635	-	0.588
Total generation cost with $_{CO2}$ capture + storage, ¢/kWh	-	7.123	-	6.534
Relative to IGCC/VENT	-	-	-	1.781
Relative to SCS/VENT	-	2.968	-	2.380

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