Development and Climate: Gas Power in China?

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Post-Kyoto Impasse?

- Kyoto architecture critique
  - Burden sharing metaphor rejected
  - Non-cooperative equilibrium
    - EU, low cost, and compliance; other Annex 1
  - Credibility of longer term commitments
    - Enforcement; parties not covered
  - Fragmentation of regimes and evolutionary model
    - EU growth model and small group dynamics
    - Differentiated obligations usual; tripartite

Climate Architecture and Development

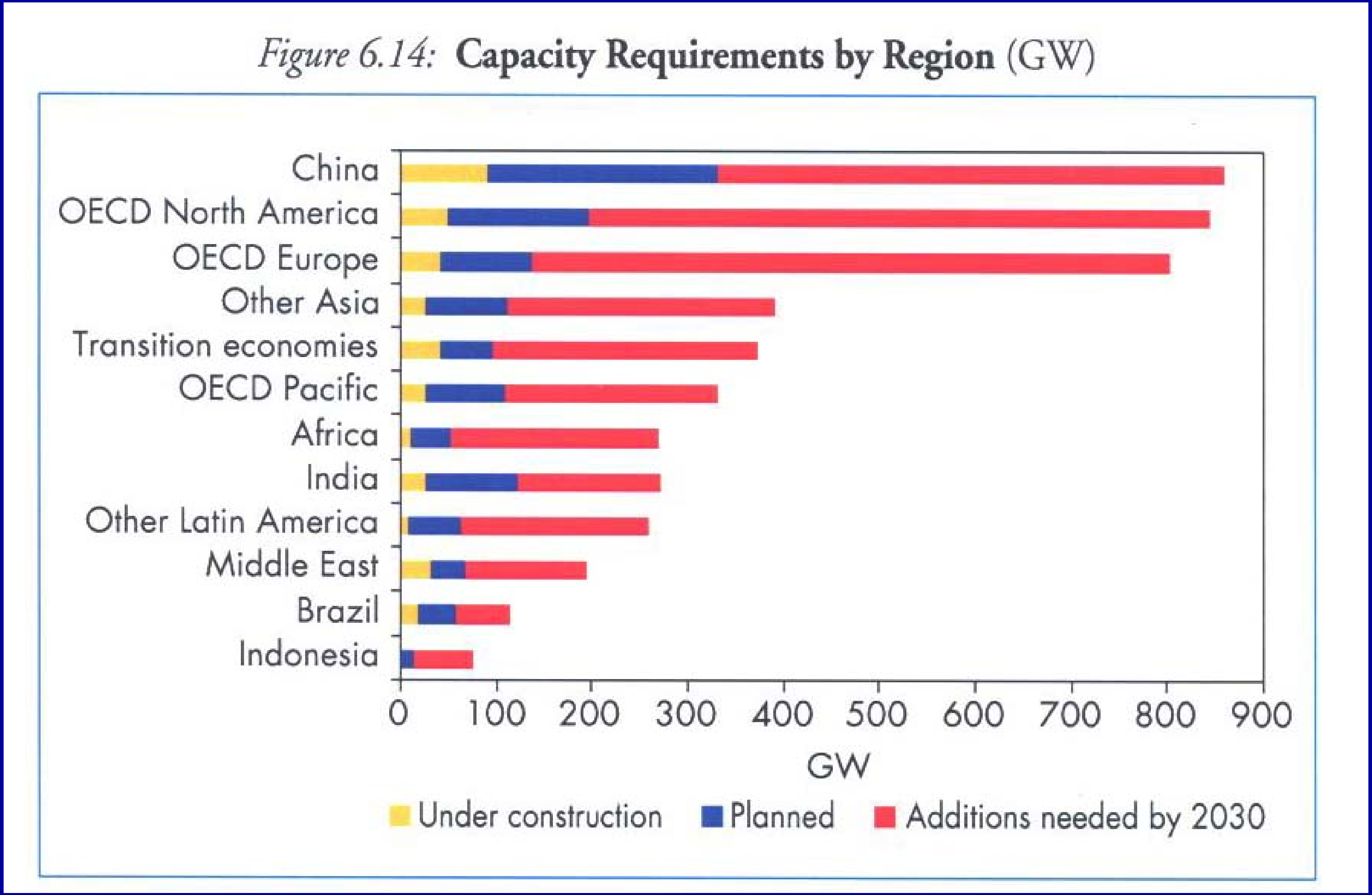
- Regime architecture is climate-centric and flows from output (constraint) to input (development)
- CDM holds only limited prospect of increased or redirected flows
- No assurance of stable assistance from developed to developing countries

CDM Limits

- Tropical air (CH4 and HFC23)
  - Impact on value of European trading system
- Project scale small with limited range
  - Energy efficiency and fuel source at scale methodologies not approved
- Additionality hard to operationalize: multiplies uncertainty, complexity and transaction costs
- Unbalanced regional distribution
- Market scale: smaller CER supply than expected

Development and Climate

- Climate policy must be *political economy*
  - Decision processes, power, actors
- *Mainstream* climate to development
- Climate best approached through development strategies with *climate benefits ancillary to (sustained) economic growth*



Source: IEA, World Energy Outlook 2004

Supply growth in China

National

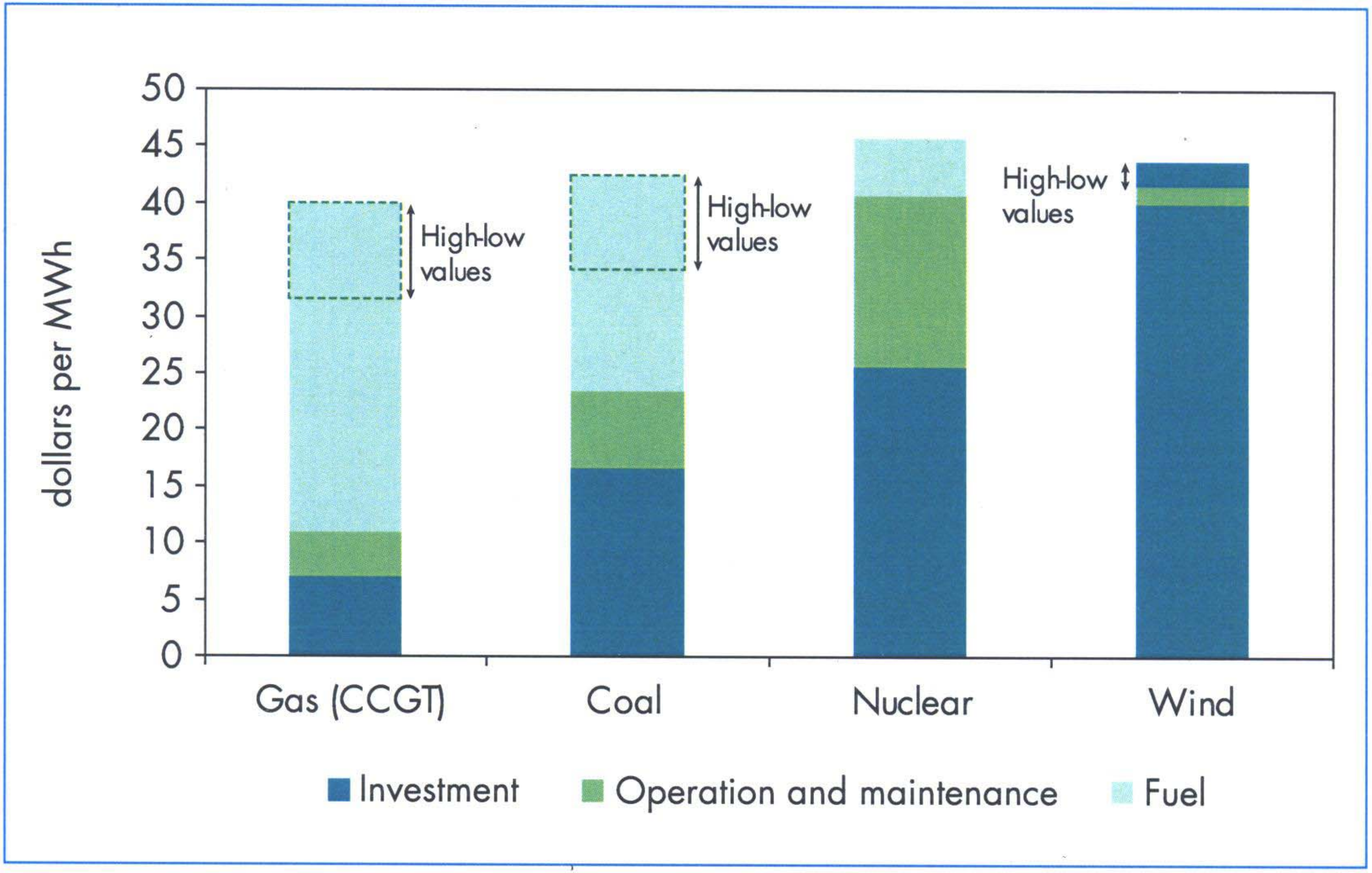
- Current installed capacity about 400 GW; 900 in 2020
- Energy intensity estimates key to demand estimates
- 180 GW approved new capacity (3/4 Gencos)
- 300 GW incremental filed for approval
- 125 GW estimate (low since figures not available?) of unapproved plant being built

Coastal region supply growth

Guangdong province

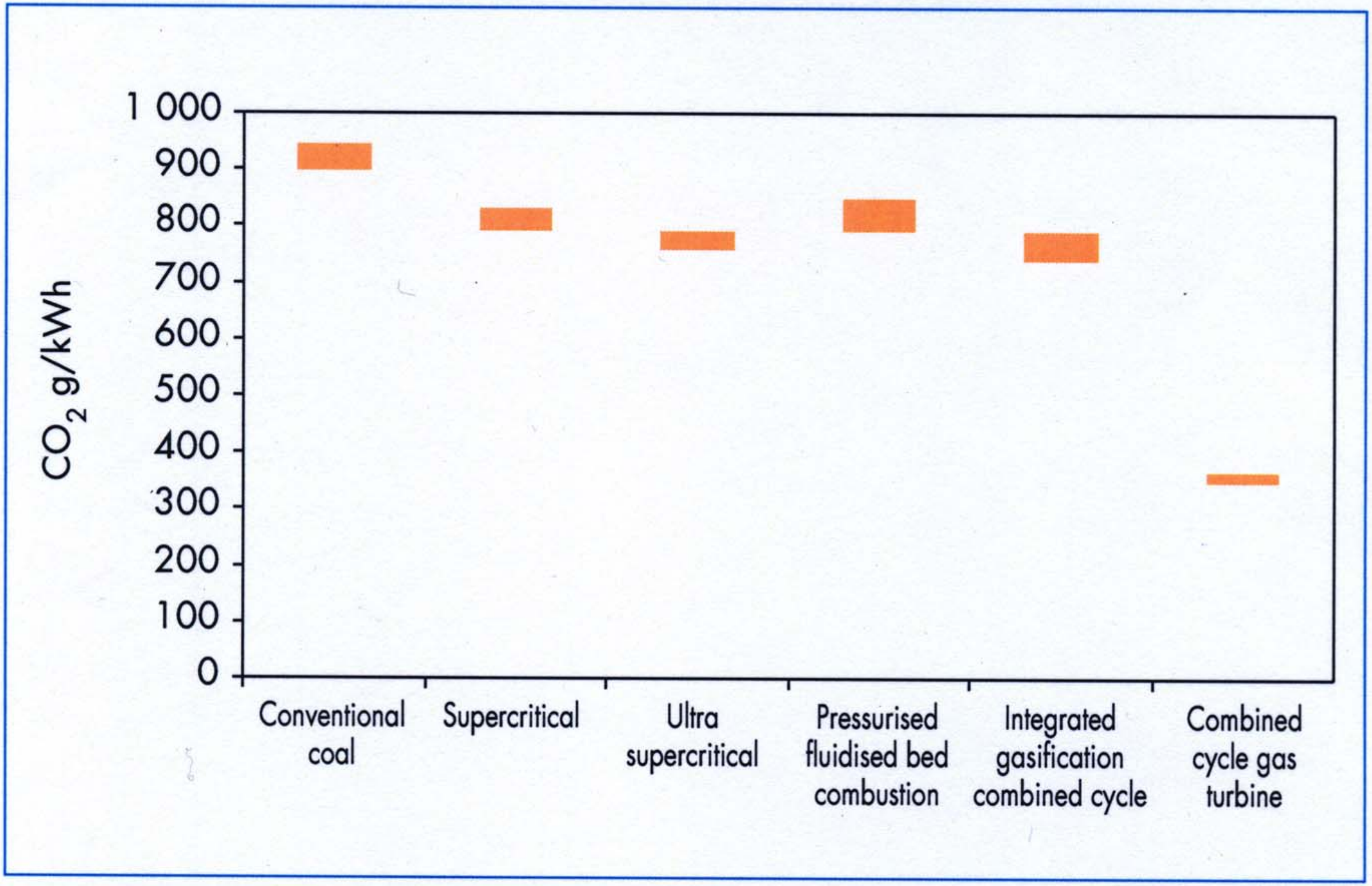
- Current 40 GW projected to 100 GW (2020)
- 9 units nuclear @ 1 GW per
- 7 or 8 (4x600) MW coal plants being built (17-20+GW)
- 11 gas units (online 2006) or 3.3 GW of planned 30-40 units (10 GW gas fired power total) by 2020
- Hydro contracts from West and Three Gorges (11-18GW)

Figure 6.3: **Indicative Mid-Term Generating Costs of New Power Plants**



Source: IEA, World Energy Outlook 2004

Figure 6.4: **CO_2 Emissions by Type of Plant**



Source: IEA, World Energy Outlook 2004

IEA Reference Scenario	2002	2010	2020	2030
Total Capacity (GW)	360	566	855	1187
Coal	247	394	560	776
Gas	8	23	67	111
Oil	17	20	21	17
Nuclear	4	10	22	35
Hydro	82	109	165	210
Renewables	2	10	20	38
Total Capacity (Cumulative)	100.00%	100.00%	100.00%	100.00%
Coal	68.61%	69.61%	65.50%	65.37%
Gas	2.22%	4.06%	7.84%	9.35%
Oil	4.72%	3.53%	2.46%	1.43%
Nuclear	1.11%	1.77%	2.57%	2.95%
Hydro	22.78%	19.26%	19.30%	17.69%
Renewables	0.56%	1.77%	2.34%	3.20%
Assumed Utilization Rate (Total)	0.531139	0.5350775	0.5364629	0.5359623
Coal	0.5975819	0.5881603	0.5931996	0.5935779
Gas	0.7134703	0.2729799	0.3339467	0.3239541
Oil	0.1141553	0.336758	0.3533377	0.3558958
Nuclear	0.7134703	0.9360731	0.9339975	0.913242
Hydro	0.4009355	0.4011143	0.3998893	0.3989998
Renewables	0.1141553	0.5022831	0.5079909	0.4686373
Total Electricity Generation (TWh)	**1675**	2653	4018	5573
Coal	1293	2030	2910	4035
Gas	17	55	196	315
Oil	50	59	65	53
Nuclear	25	82	180	280
Hydro	288	383	578	734
Renewables	2	44	89	156

High Gas Scenario	2002	2010	2020	2030
Total Capacity (GW)	360	566	855	1187
Coal	247	384	480	612
Gas	8	33	147	275
Oil	17	20	21	17
Nuclear	4	10	22	35
Hydro	82	109	165	210
Renewables	2	10	20	38
Total Capacity (Cumulative)	100.00%	100.00%	100.00%	100.00%
Coal	68.61%	67.84%	56.14%	51.56%
Gas	2.22%	5.83%	17.19%	23.17%
Oil	4.72%	3.53%	2.46%	1.43%
Nuclear	1.11%	1.77%	2.57%	2.95%
Hydro	22.78%	19.26%	19.30%	17.69%
Renewables	0.56%	1.77%	2.34%	3.20%
Assumed Utilization Rate (Total)	0.531139	0.5350775	0.5364629	0.5359623
Coal	0.5975819	0.5963681	0.6364084	0.66583
Gas	0.7134703	0.2729799	0.3339467	0.3239541
Oil	0.1141553	0.336758	0.3533377	0.3558958
Nuclear	0.7134703	0.9360731	0.9339975	0.913242
Hydro	0.4009355	0.4011143	0.3998893	0.3989998
Renewables	0.1141553	0.5022831	0.5079909	0.4686373
Total Electricity Generation (TWh)	**1675**	2653	4018	5573
Coal	1293	2006.087	2675.9701	3569.5946
Gas	17	78.913043	430.02985	780.40541
Oil	50	59	65	53
Nuclear	25	82	180	280
Hydro	288	383	578	734
Renewables	2	44	89	156

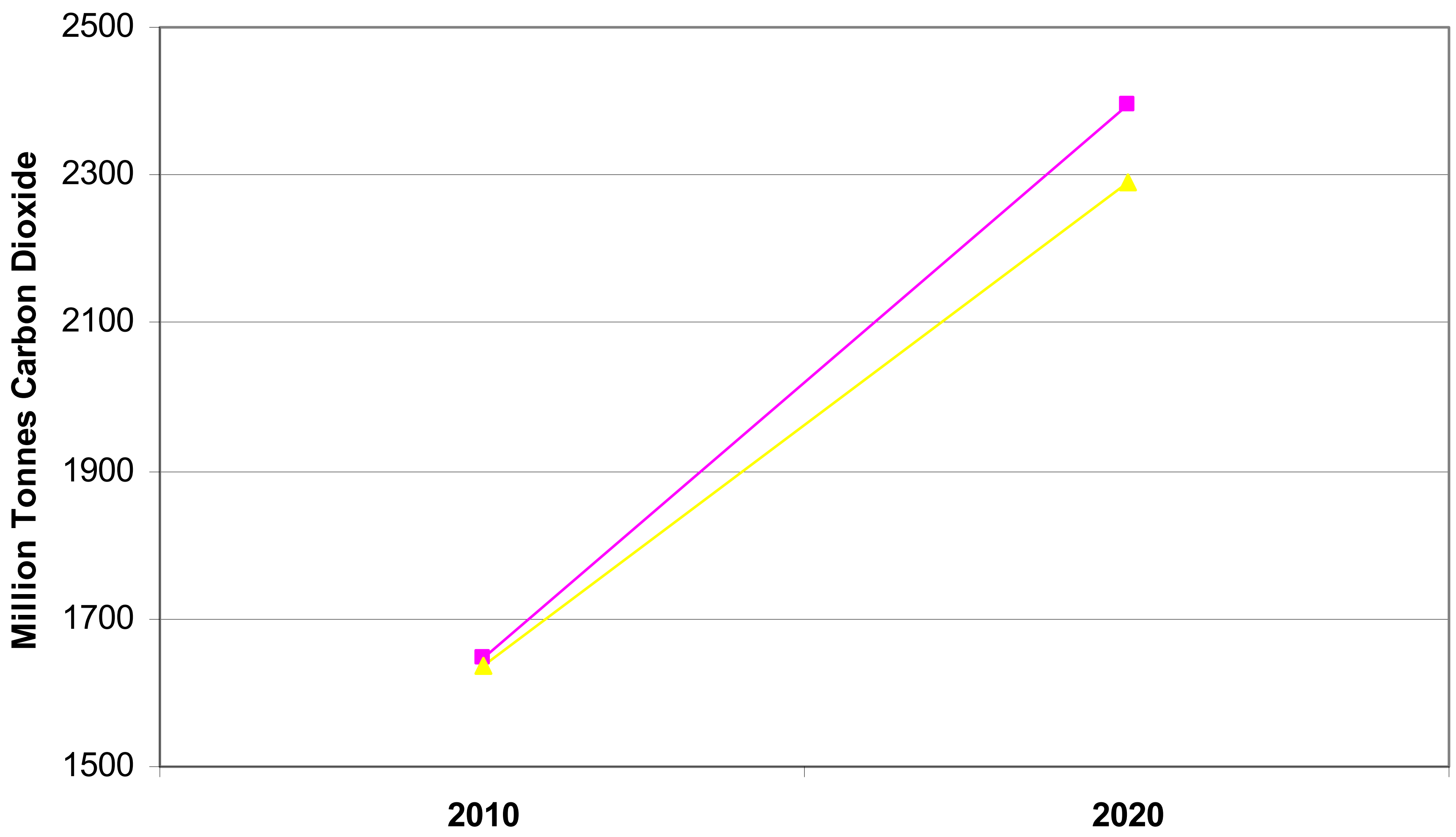
Carbon Dioxide Emissions (Tonnes) From Coal and Natural Gas in Electric Power Generation

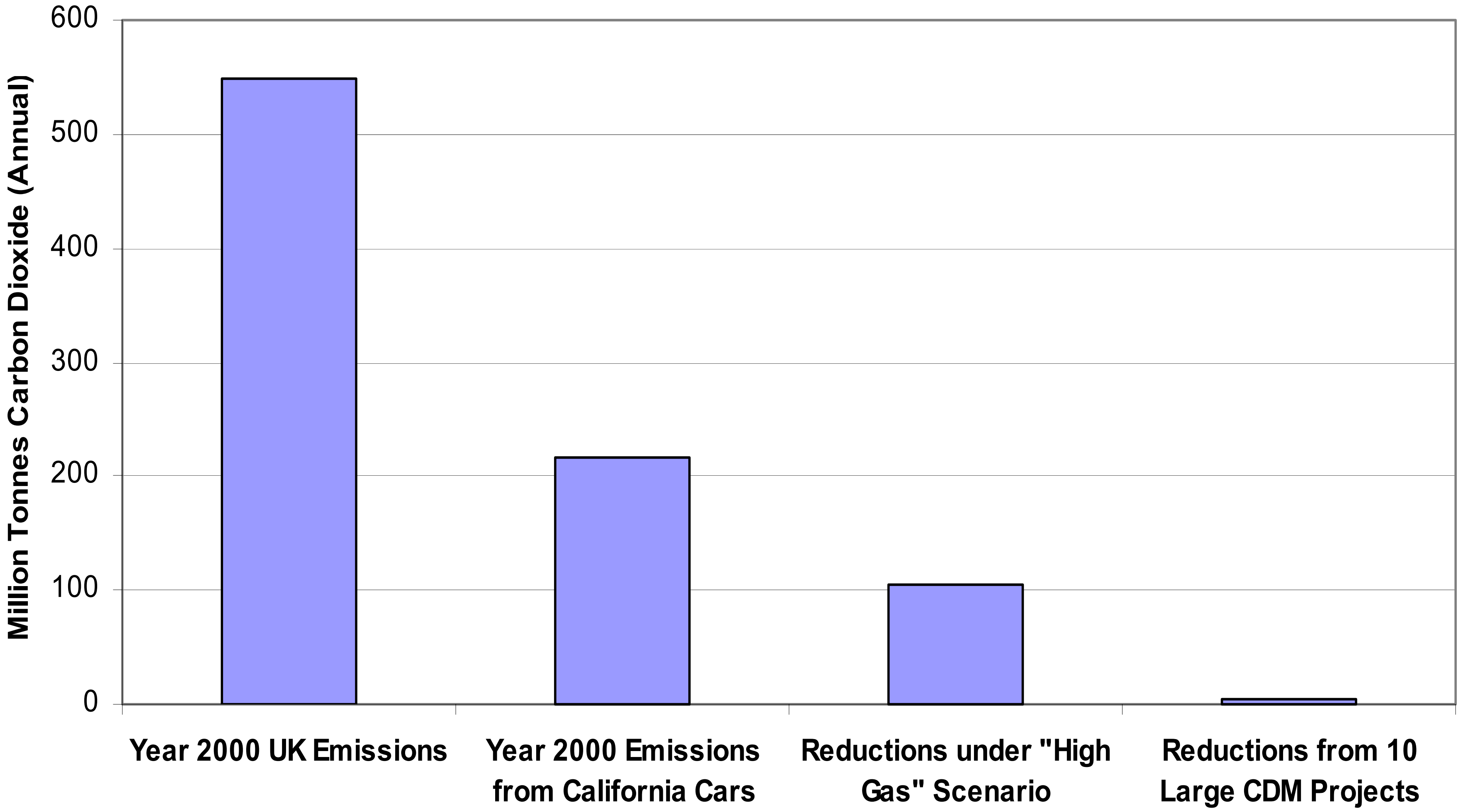
	2002	2010	2020	2030
Reference Case Coal	1.034E+09	1.624E+09	2.328E+09	3.228E+09
Reference Case Natural Gas	6800000	22000000	68600000	110250000
High Gas Scenario: Coal	1.034E+09	1.605E+09	2.141E+09	2.856E+09
High Gas Scenario: Natural Gas	6800000	31565217	150510448	273141892

Difference (MTCO2E)	**0**	**9.56522**	**105.313**	**209.432**

China gas savings

- IEA forecast: 560GW (coal) and 67GW (gas) installed capacity in China in 2020
- What happens if you switch 80GW from coal to natural gas combined cycle?
  - Saves 105 Million Tonnes CO_2 per year
- Between 2000 and 2003, 110 GW of CCGT capacity built in the U.S.


2500
2300
2100
1900
1700
1500
Million Tonnes Carbon Dioxide
2010
2020


Million Tonnes Carbon Dioxide (Annual)
600
500
400
300
200
100
0
Year 2000 UK Emissions
Year 2000 Emissions from California Cars
Reductions under "High Gas" Scenario
Reductions from 10 Large CDM Projects

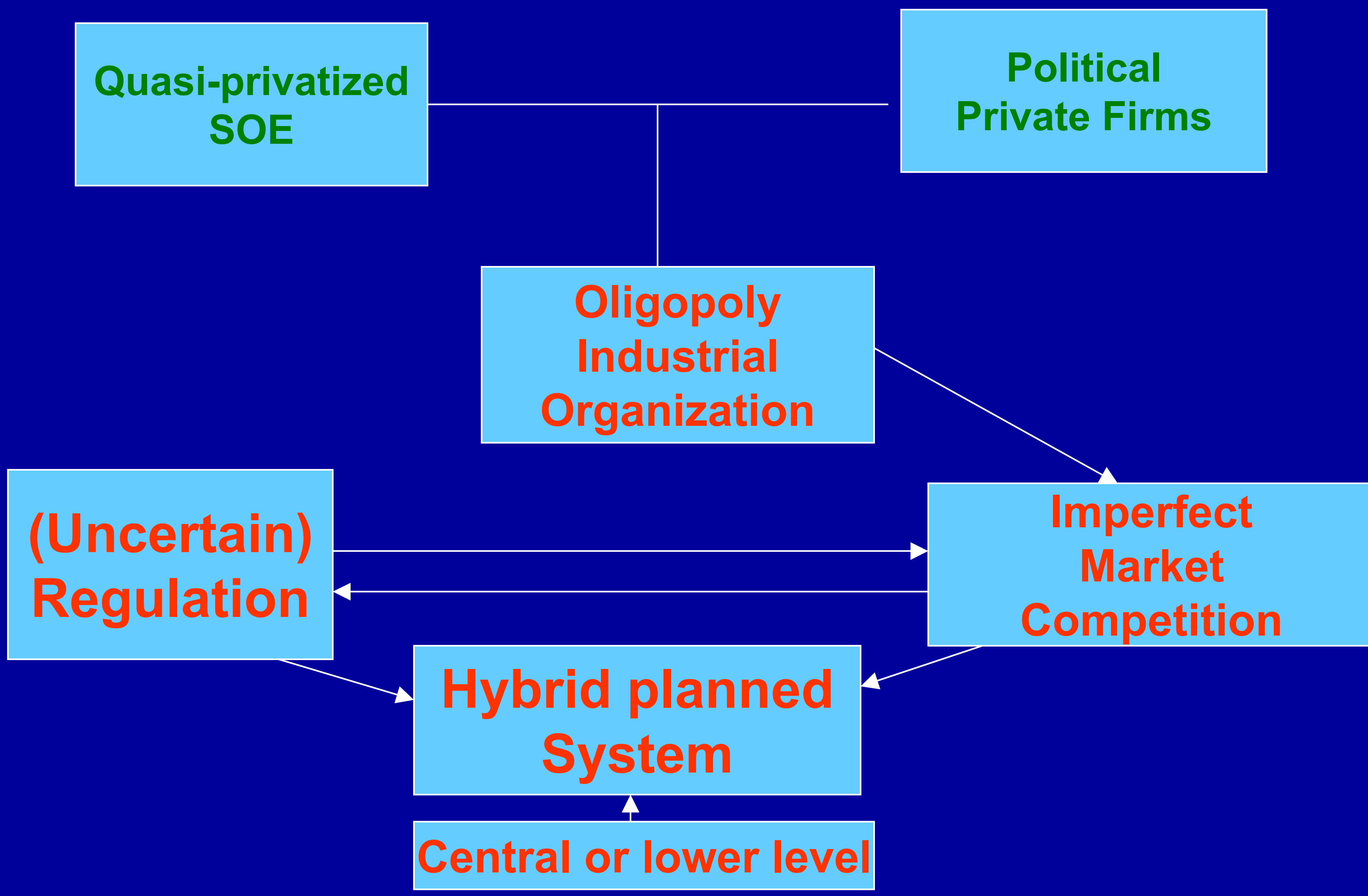
Relative Fuel Source Prices: Summer 2004

- **Levelized costs of alternative plants in Guangdong: Has the standard story changed?**
  - 32-34 for hydro
  - 37 coal without FGD;
  - 40 coal with FGD;
  - 43 for LNG;
  - 47-50 nuclear

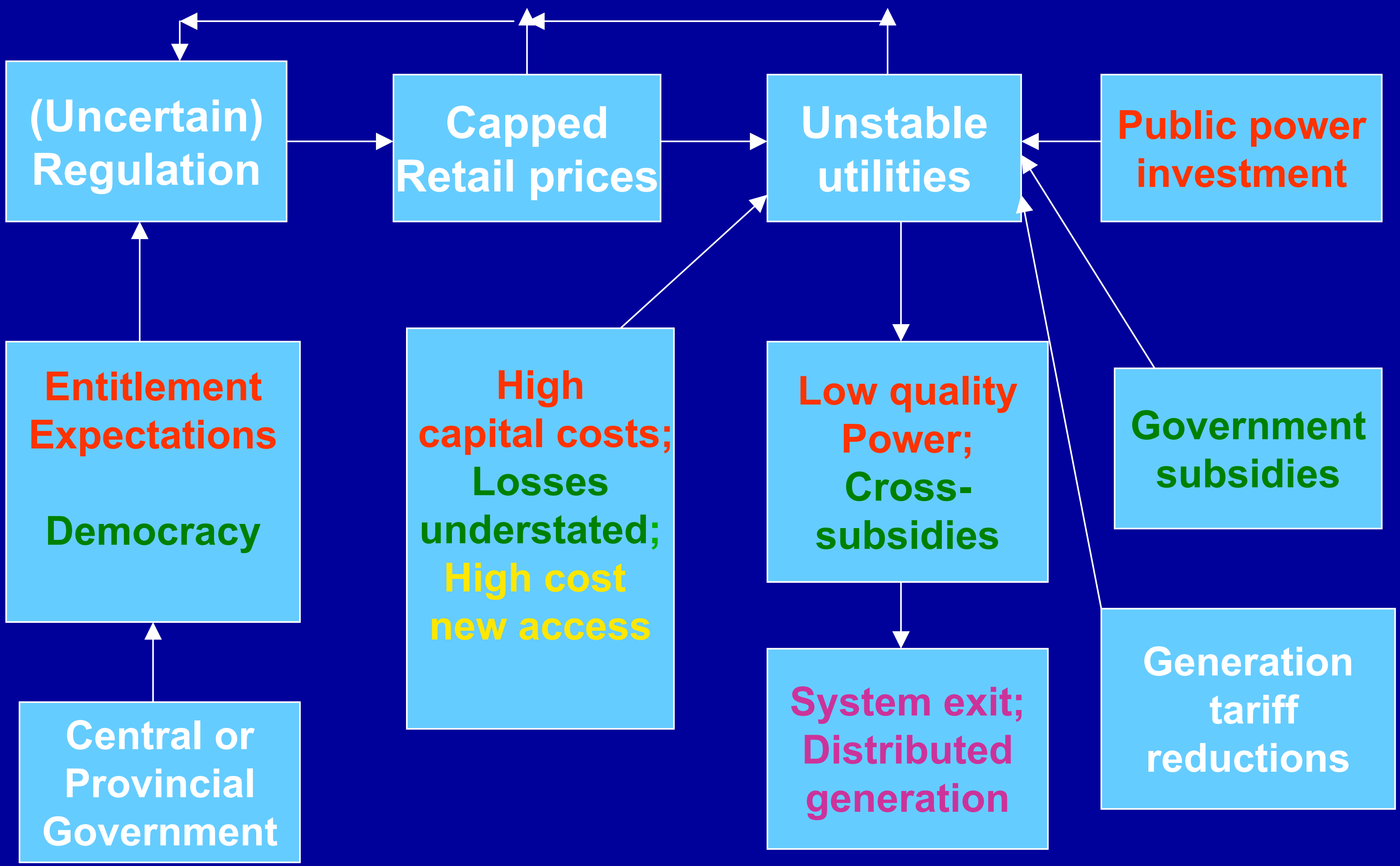
Gas development in coastal provinces

- **Gas prospects**
  - LNG in coastal areas (as opposed to northern pipeline)
  - 60%-40% power use for infrastructure
  - Competitive if peak pricing allowed (load curves)
  - Future exchange rate shifts' effects on relative fuel costs
  - Capital market reforms could shift relative gas/coal prices
  - Local autonomy preferences and supply security
  - Reliability and distributed power
  - Investment capital from Chinese oil majors

Electricity Reform Experience



Regulatory Instabilities



Infrastructure aid beyond Projects

- Transform development paths for sustainable commercial markets
- Gas infrastructure costs historically paid in part by national governments
  - Clean energy, like rural energy, requires collective contribution to infrastructure provision
- Infrastructure (T&D; pipelines, LNG terminals) lag generation reforms
  - Organization and price reforms uncertain for market provision

Infrastructure aid beyond Projects

- One-time investments: subsidize infrastructure investment and not its use
  - Subsidies must not become entitlements
- Decentralize infrastructure decisions
  - Energy portfolio diversification
- Focus governance reforms on program performance
  - Rules and corruption

International cooperation

- Gas infrastructure as collective good (first mover costs) close to commercial margin
- Public-private coalition
- Decentralized public partners with diverse demand
- Beyond current CDM rules or scope
  - Bilateral or regional program funds/credits
  - Multilateral Climate Trust or Auction