Global Gas Demand Prospective: Is the End of Gas Boom in Sight…?

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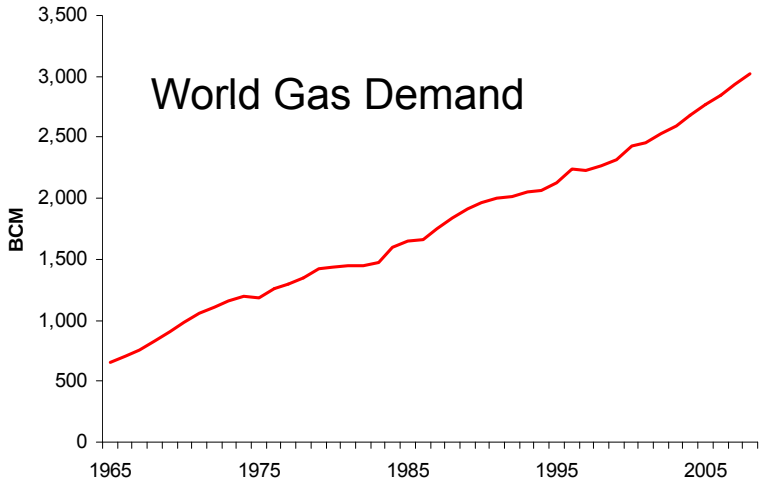
10 October 2009

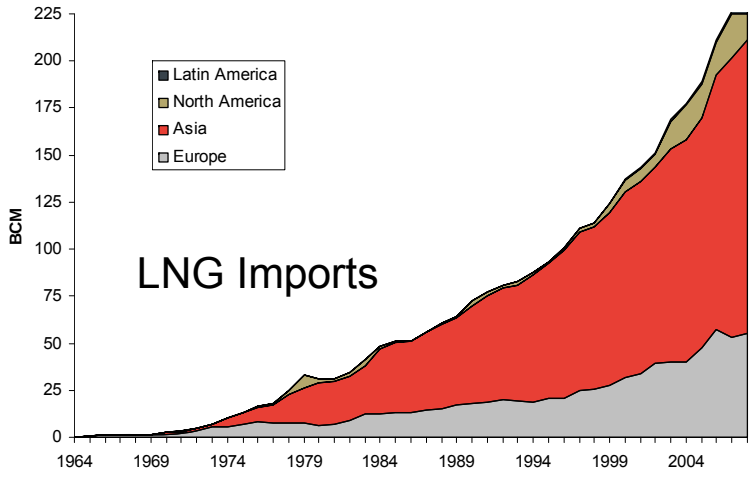
- Introduction
- Model description
- Selected results

Introduction: World gas demand – status quo

40 years of success

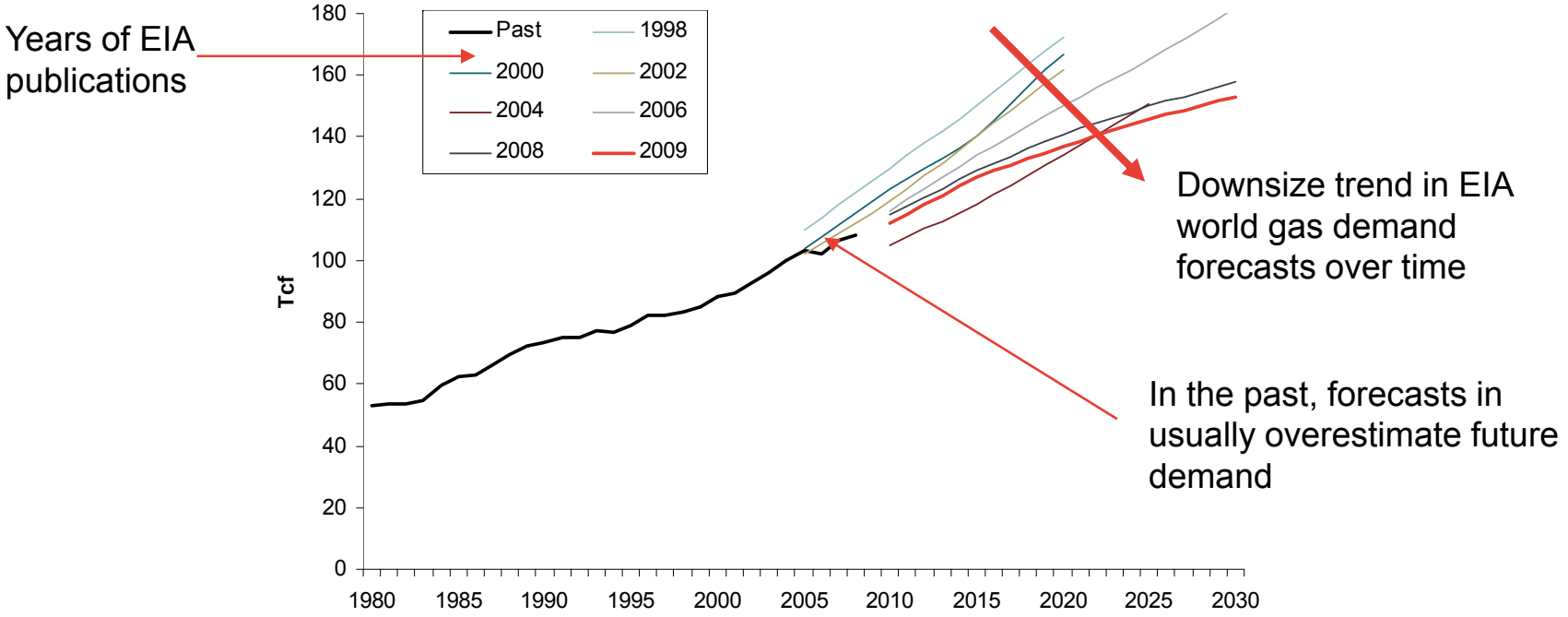
- Gas was (and is) one of the fastest growing energy sources
- In 2008 global gas demand reached 3 TCM which was again a new all time high
- Will this success story continue?
- There are some aspects in the statistics that are somehow curious compared to the past:
  - Total demand increase is mainly driven by regions with strong resource base – namely Middle East and Africa, and of course China
  - No growth of LNG imports in 2008 – compared to growth rates up to 12% in the last years
- Is this something to be concern about?





Source: BP, Statistical Review, 2009

Introduction: How about the future?



- Around 2000 a “gas boom” was forecasted in all common studies and projections
- Gas was often labelled as “fuel of choice” for heating, power generation, cars and other applications
- Liberalization in Europe, strong growth of LNG capacities worldwide and new field discoveries created a very optimistic or euphoric atmosphere
- Finally also beginning of CO2 regime seems to favour gas as comparably low carbon fuel
- However, reality lacks behind ambition and in addition also future seems not that bright as before

Source: EIA, International Energy Outlook, various years

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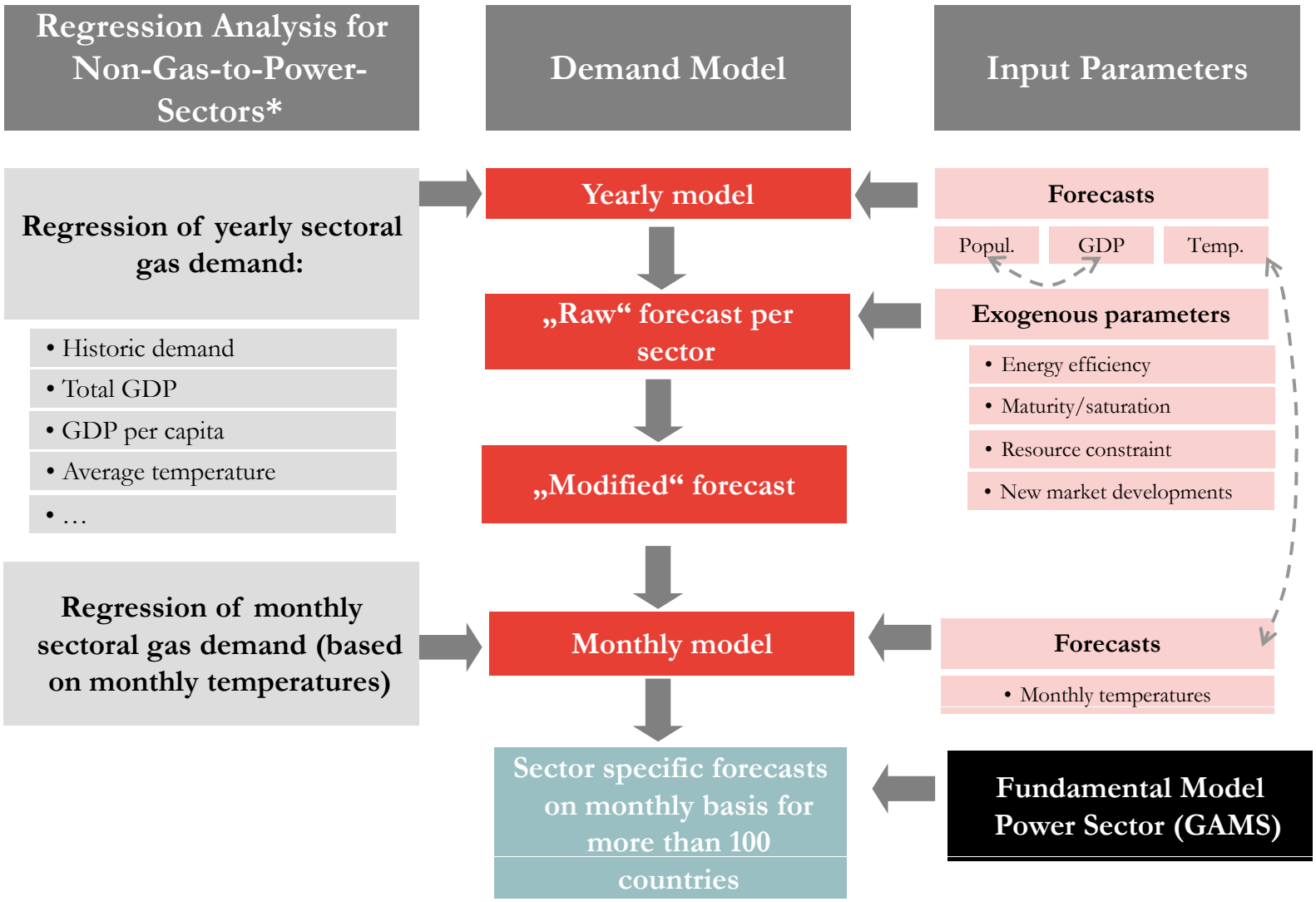
Forecasting World Gas Demand – Model Structur



* i.e. commercial, households and industry

Power Market Model – Whirlygig Plus

- Fuel prices
- CO2 prices or volume caps
- Existing plants
- Phase-out of existing plants
- Deveopment of renewables and CHP
- Yearly power demand
- Monthyl profiles of demand
- Monthly duration curves
- Technical parameters (sample below)
- …

- Minimization of generation costs per world region
- Several constraints (some optional):
  - Min./Max. fuel consumption
  - Min./Max. shares for fuel type or technology
  - Exogenous construction of power plants
  - Min./Max. power imports from other regions
  - …

- Fuel consumption
- Power generation
- Generation costs
- Prices
- Plant additions or deconstructions
- Structure and total size of generation park
- …

Technology	Typical unit size	Net Efficiency LHV	Availability	annual capital costs	Fixed O&M per year	other variable costs	CCS filter efficiency	CCS transport and storage costs	emission factor	WACC	Depreciation time	specif. Overnight Inv.-costs	specif. Inv.-costs (effective)
	in MW	%	%	USD/MWa	USD/MWa	USD/MWh	in %	USD/t	t CO2/MWh_th	in %	in a	in USD/MW	in USD/MW
Tech	blocksize	eta	avail	inv_costs_a	OM	ovar	CCS_eff	CCS_Trans	Em_fac				
Lignite	1000	37%	80%	375,376	26,000	2	0%	0	0.40	10%	30	2,800,000	3,538,633
Nuclear	1500	33%	80%	856,558	91,000	1.5	0%	0	0.00	15%	40	4,500,000	5,689,066
Coal_1	300	33%	80%	348,860	26,000	2	0%	0	0.34	10%	30	2,500,000	3,288,677

Most relevant model assumptions

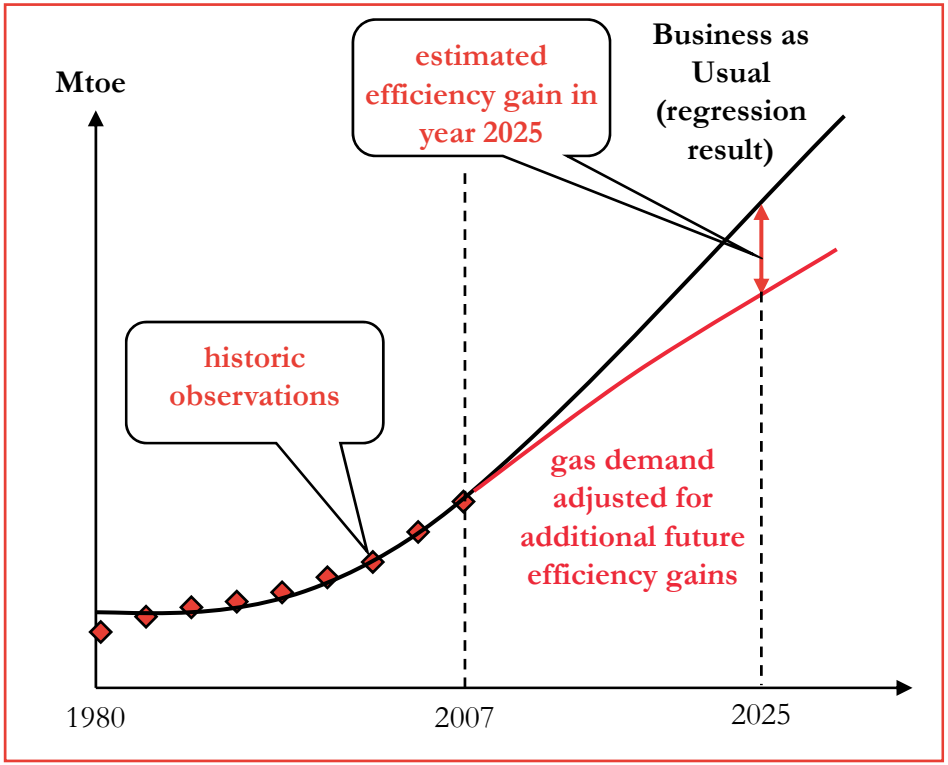
	Key parameters
Macro data	• GDP • Population • Temperature
Price assumptions	• Oil price (Brent) • Coal prices (import and domestic coal) • Gas prices (different for Europe, America, Asia) • CO2 prices (regional)
Power market specific data	• Power demand • Standard power plant parameters • Power plant database: existing and planned plants • Renewables and nuclear policies

Assumptions on other gas demand drivers

	Key parameters*
New demand / applications	• GTL expansion • Gas cars • Others
Energy efficiency	• Commercial sector • Residential sector • Industrial sector
Gas market saturation	• Demand cap 1: sectoral demand/population ratio • Demand cap 2: sectoral demand/GDP ratio • Demand cap 3: absolute cap (e.g. limitation of import capacity)

* These gas demand drivers are incorporated in the model as „ex-post“ modifications of the results of the “raw” model

Efficiency factors are needed to capture future efficiency trends not reflected in regression results



- Regression results only captures historic trends (i.e. historic efficiency gains)
- Efficiency factors account for additional effects on demand by future technology and policy development (e.g. efficiency requirements for buildings).
- Starting points are IEA estimates in *IEA Energy Technology Perspectives 2008*:
  - Potential Gas demand reduction in buildings - for commercial and residential.
  - Potential CO2 emissions reduction for different industry sectors (steel, chemical, ect.)

Annual efficiency factors:

country specific efficiency factors for industrial gas demand,

regional efficiency factors for commercial and residential gas demand

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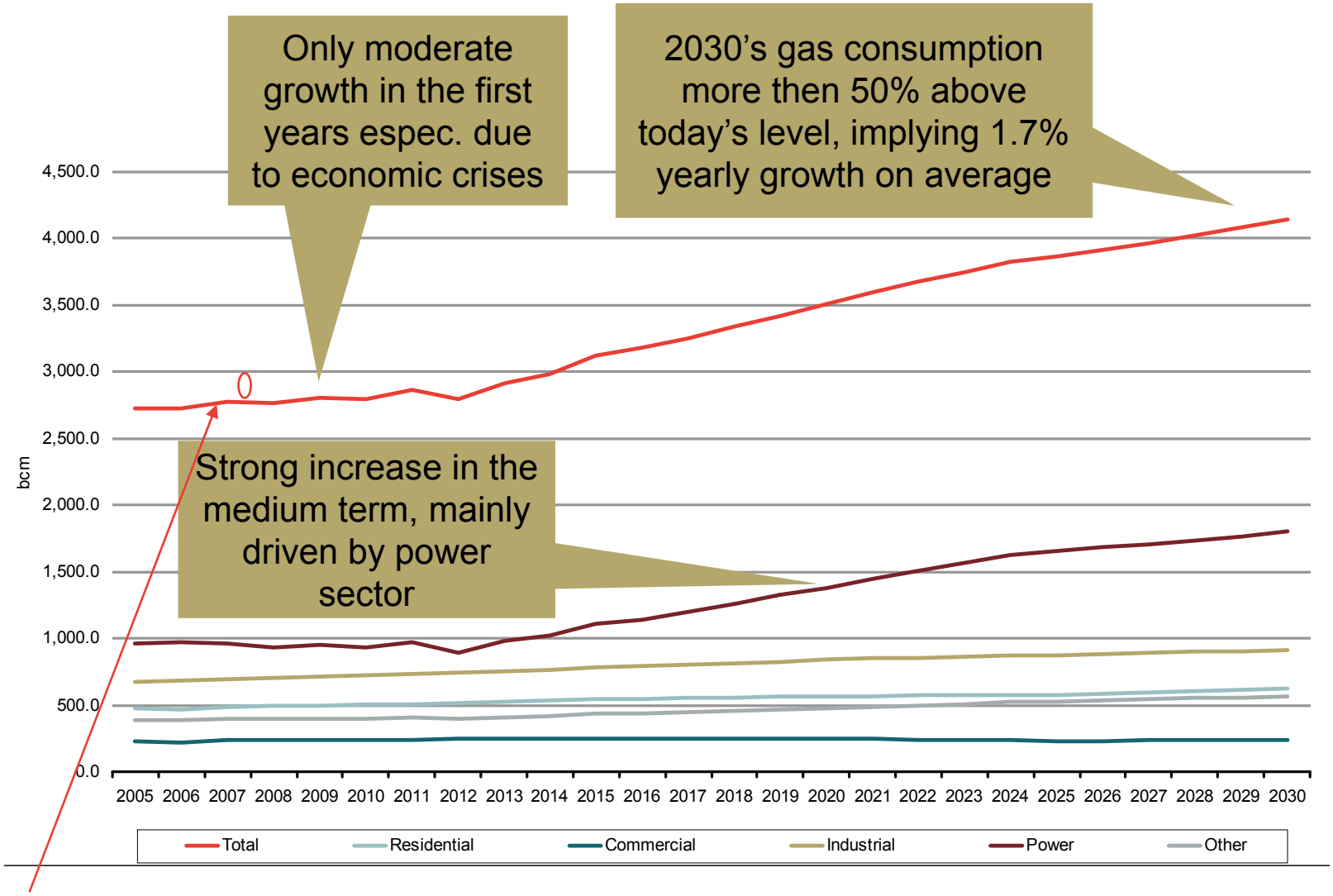
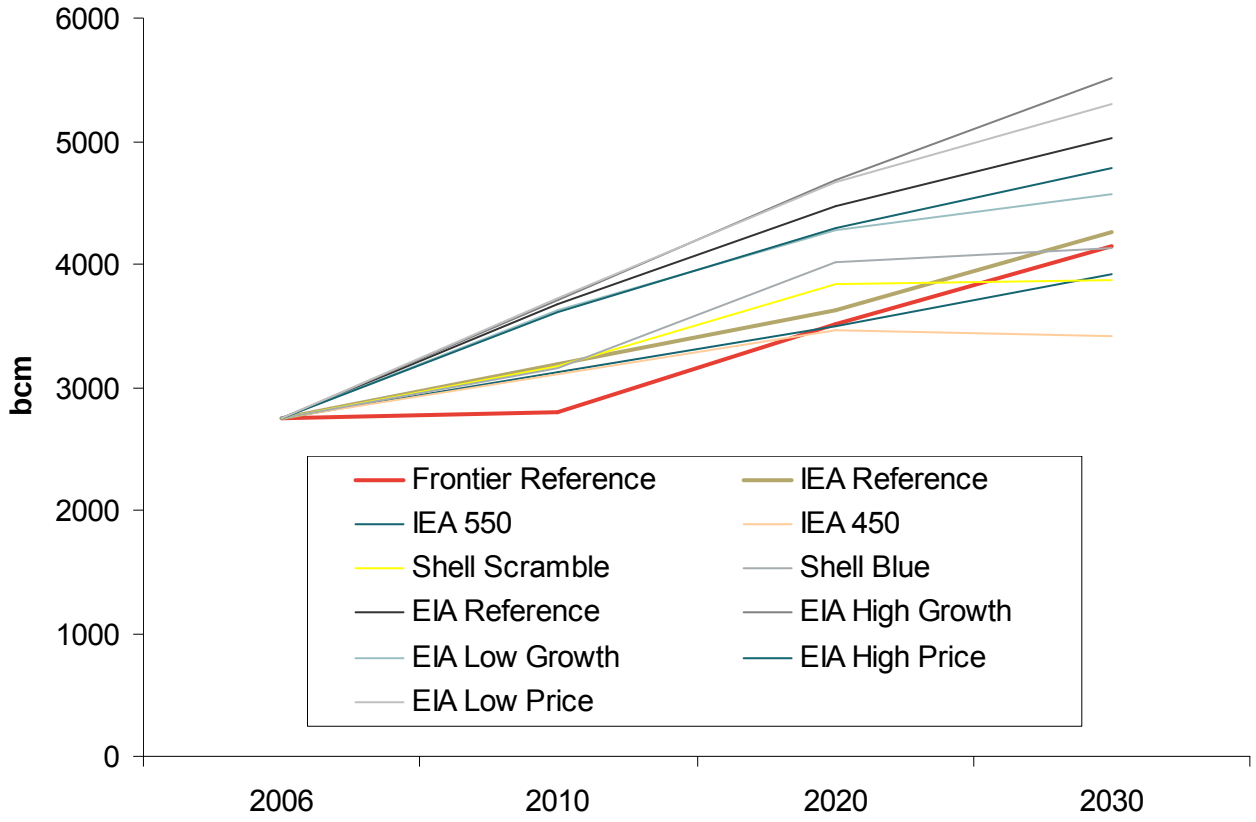
World gas demand - the Frontier reference case



Small gap to real world gas demand as some countries are not modelled (so far)

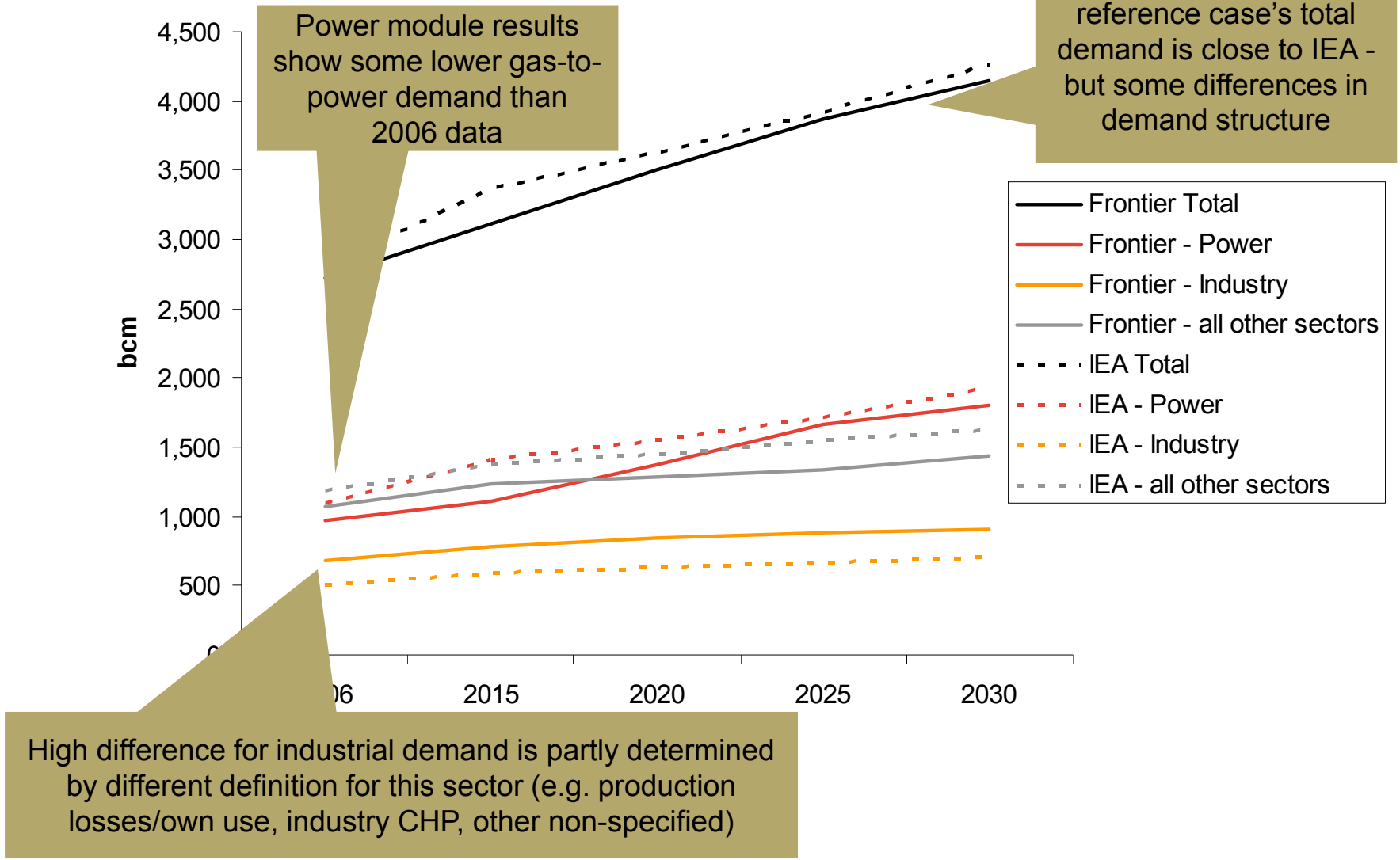
World gas demand - Frontier case vs. other forecasts



- Gas demand in the Frontier reference case is in the short run below other forecasts
- In the long-run, the reference case is
  - broadly in line with the IEA Reference case and the Shell "Blue scenario" and
  - above some „pessimistic" scenarios (for gas) like the Shell Scramble scenario and IEA 450
  - but below the most pessimistic forecast of EIA and more then 20% below the EIA High Growth case

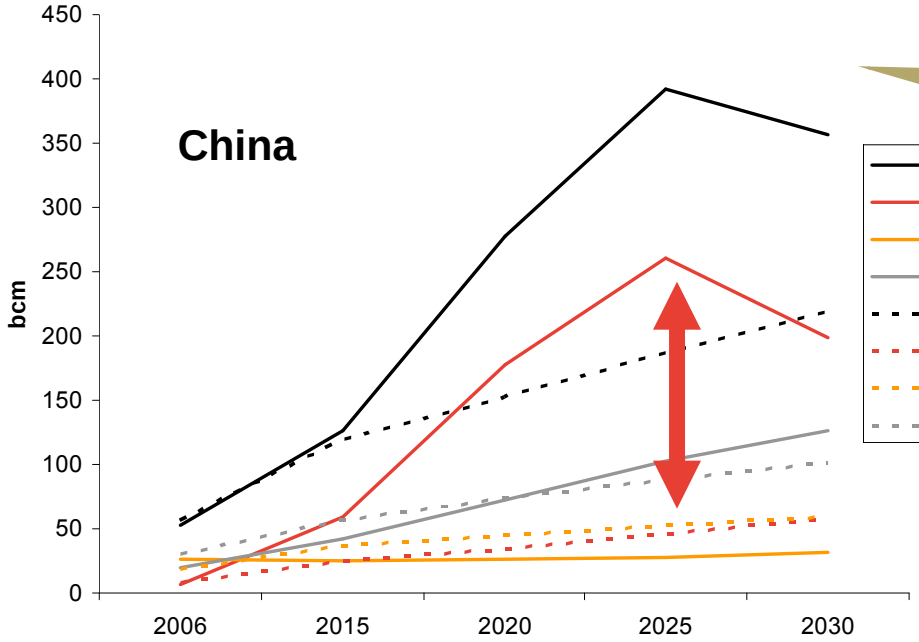
Sources: IEA, World Energy Outlook, 2008
EIA, International Energy Outlook, 2008
Shell, Energy Scenarios to 2050, 2008

World gas demand - Frontier reference case vs. IEA World Energy Outlook 2008

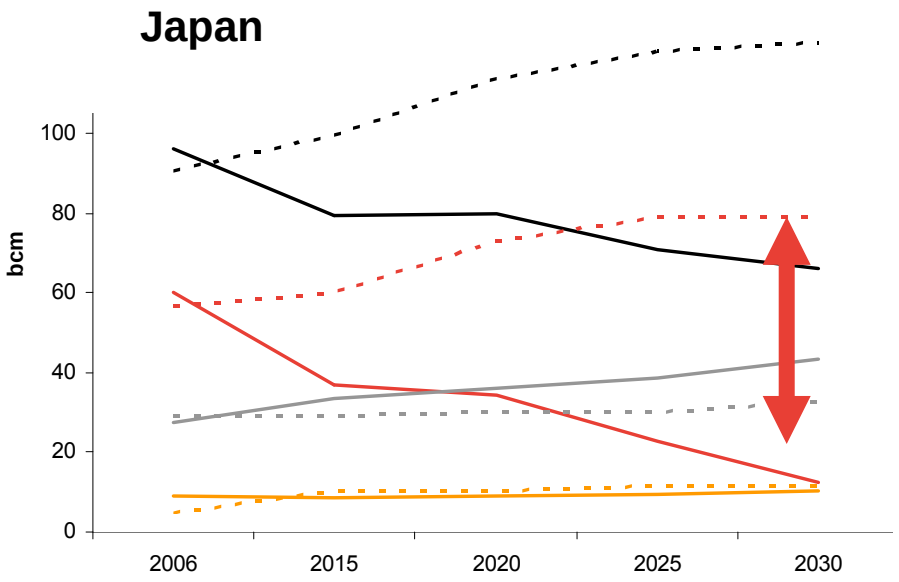


Source: IEA, World Energy Outlook, 2008

Gas demand of selected countries - China and Japan

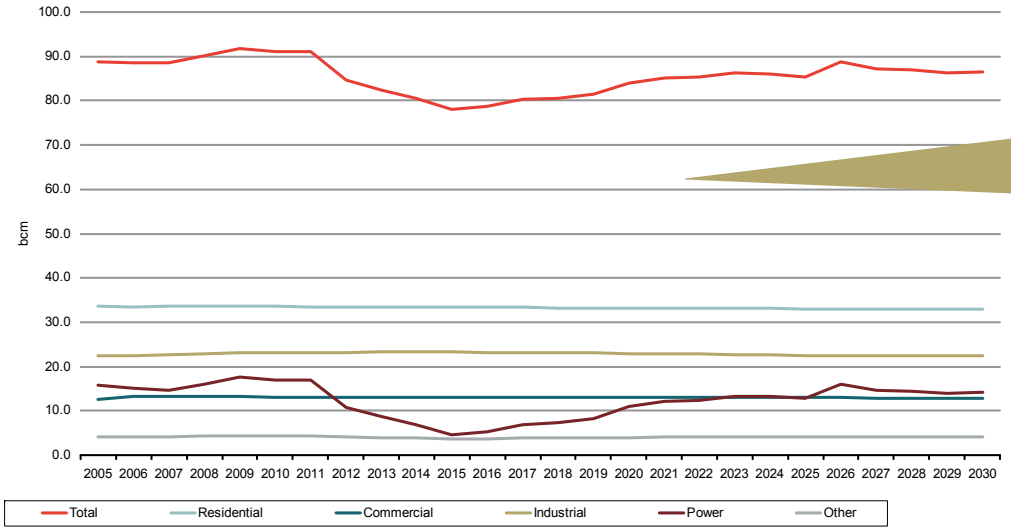


- Gas demand in the power sector is very sensitive to coal/gas price spread variations (incl. CO2 price)
- Further more, assumptions about nuclear power and renewable generation have a major impact on results



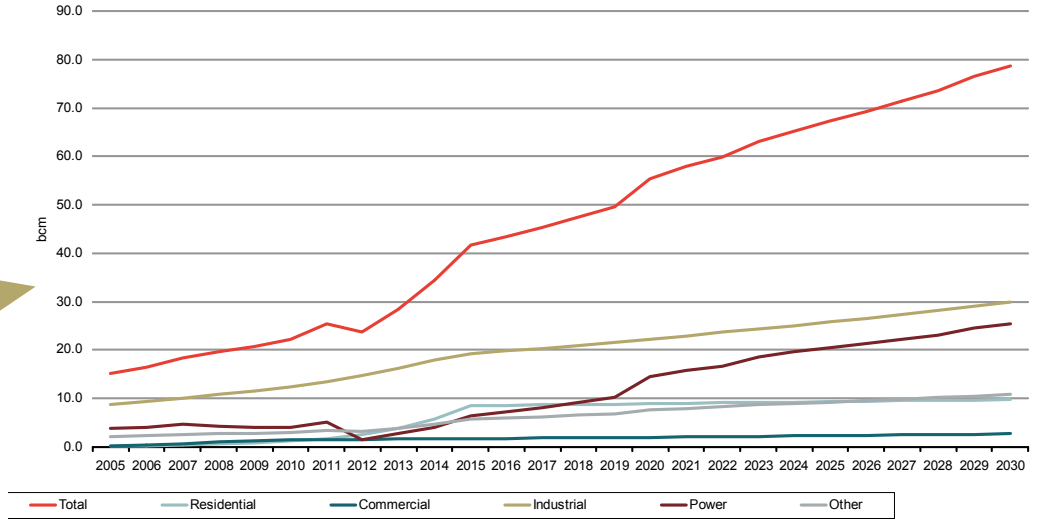
- In the long-run, especially gas demand of the power sector can deviate significantly from other forecasts mainly driven by
  - differences in the model structure and
  - and differing assumptions (parameters)

Gas demand of selected countries – Germany and Brazil



Germany is an example for a more or less saturated gas market – potential growth of demand would be mainly driven by the power sector (however, not in this model run…)

Demand caps prevent **Brazil**'s industrial and residential demand to increase exponentially – which would happen if pure regression was applied (due to high growth rates in the past on a very low level)



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