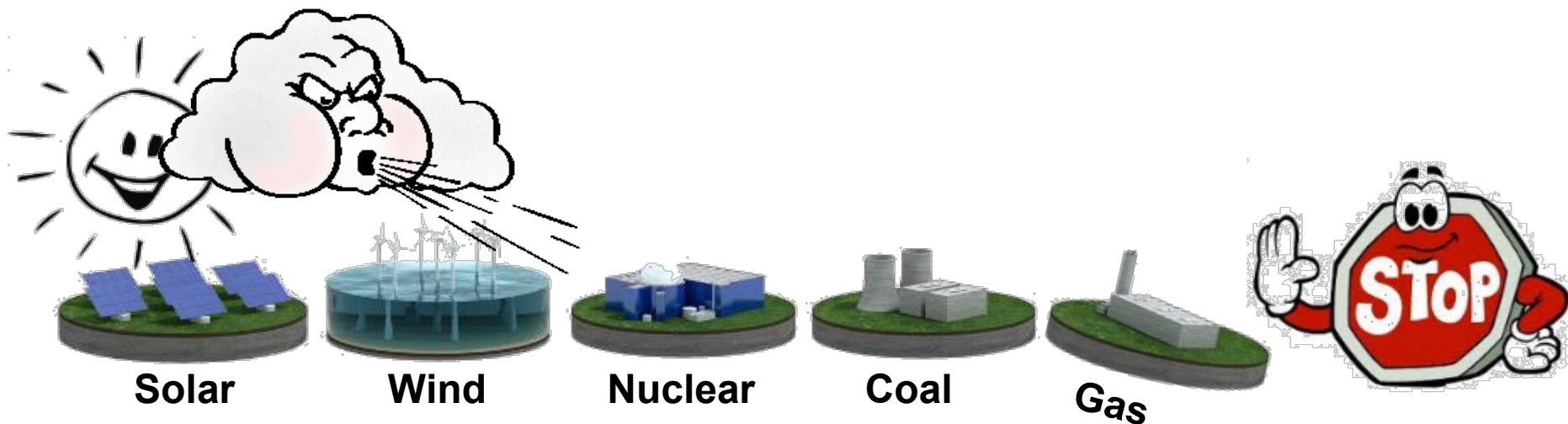


IEA-IEF-OPEC Workshop, 30 October 2014

Coal ~~by~~ and Gas Substitution

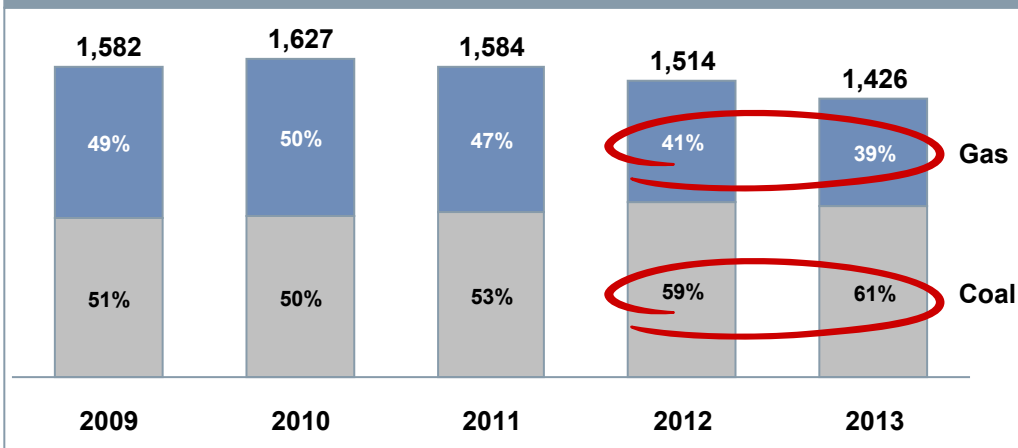
Influence Of Renewables on Fossil Power Plant Business in Europe



Source: EDF, Öko Institut

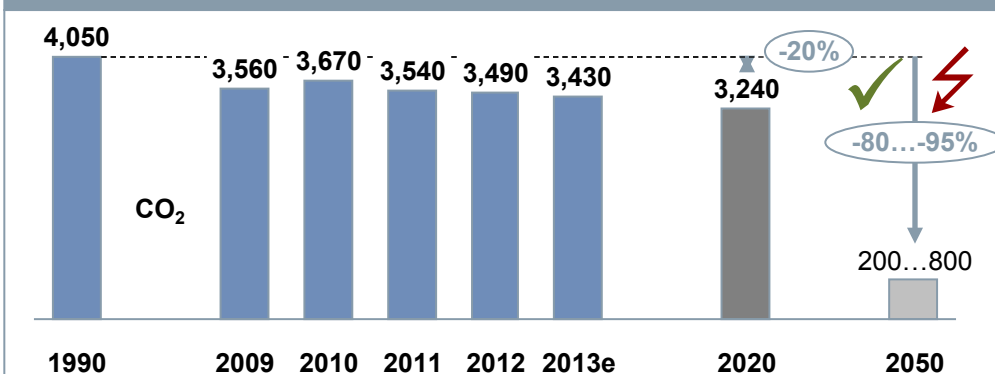
EU28: ... but CO₂ emission reduction is too slow to fulfil long-term decarbonization targets

Shift from gas to coal again in recent past (TWh, gross)



Relative high gas prices and low CO₂ certificate prices **favor** the use of coal instead of CCPPs in power generation in the last two years

CO₂ Emissions and reduction targets (Mt CO₂e)

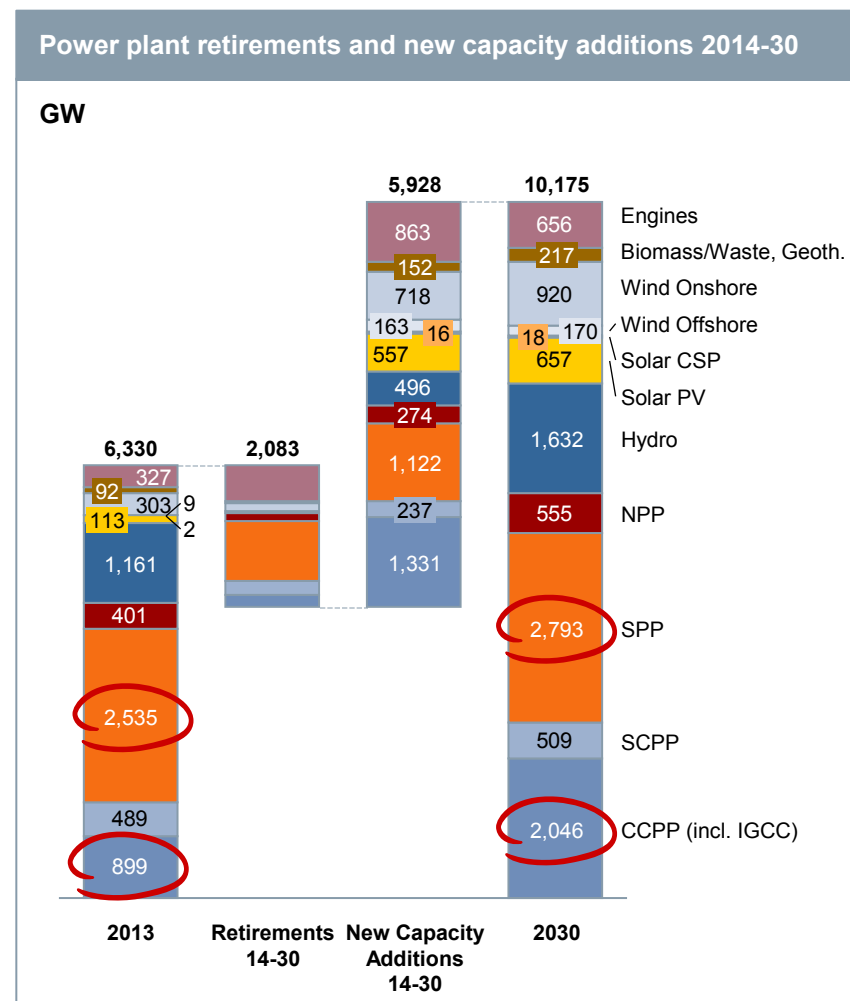
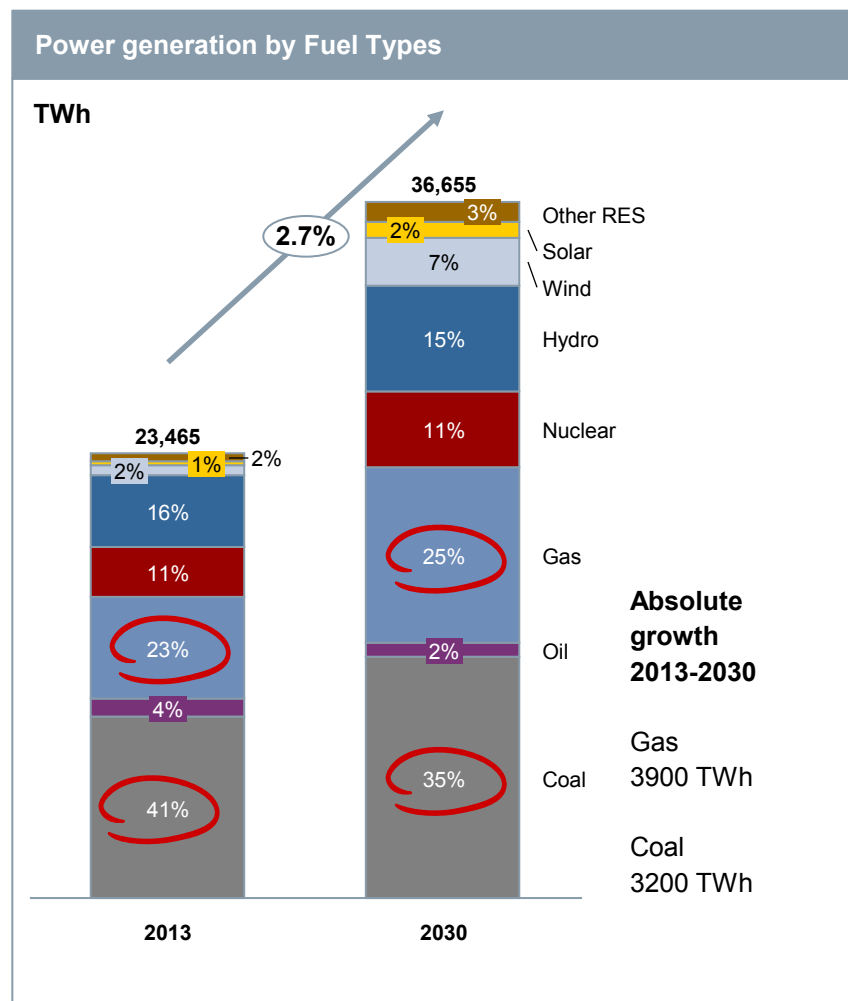


As a consequence the CO₂ emissions especially in power generation increased again. The **long-term CO₂ emission reduction target is at risk**

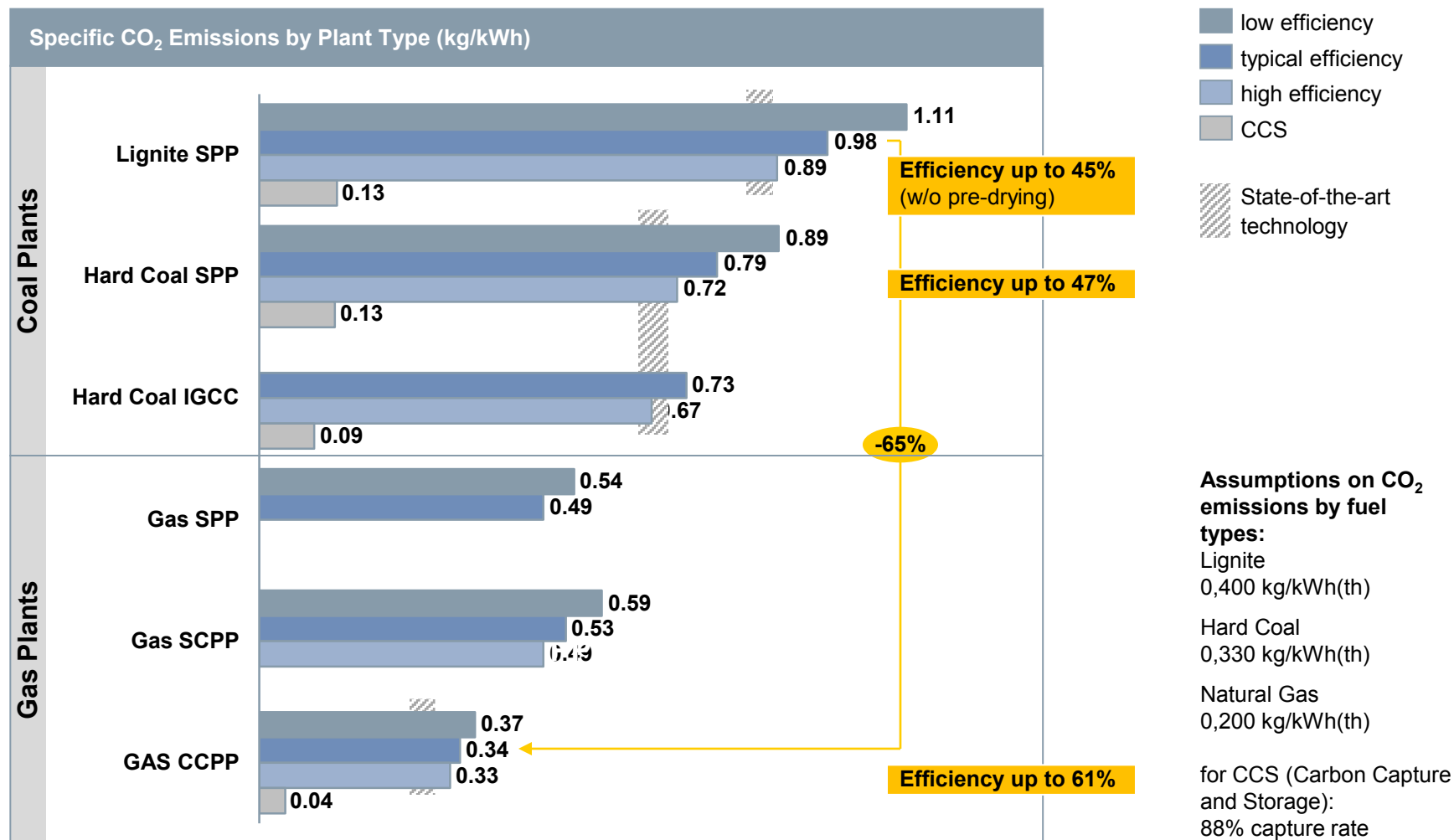
Source: BMWi, UBA

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Higher growth for Gas than for Coal expected in global power generation up to 2030



Replacement of Coal plants by CCPP would be an effective lever for reduction of CO₂ emissions

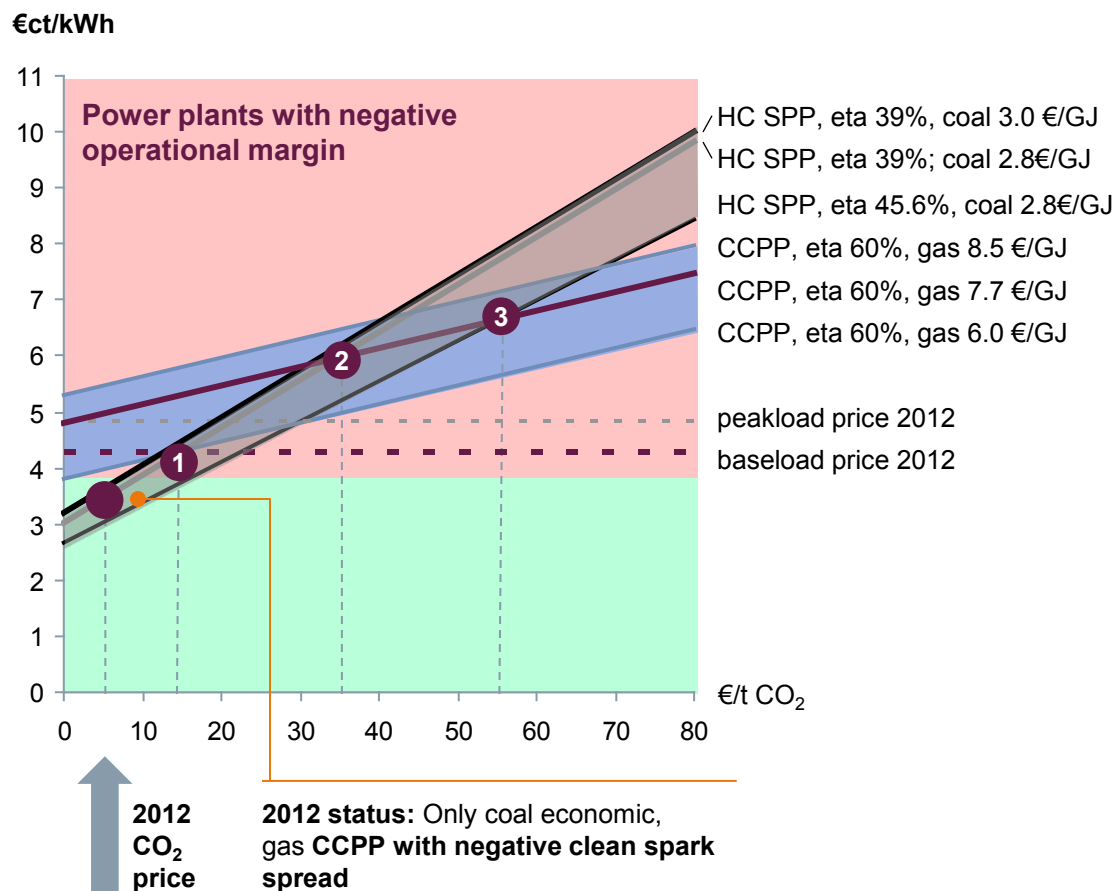


Source: Siemens, status April 2014

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Dispatch decision based on marginal cost comparison, coal-to-gas switch influenced by many factors

Marginal cost comparison



Comments

- 1 ~€15 €/t coal-to-gas switch at **current coal prices and lower gas prices**; with 39% efficiency of coal-fired power plants
- 2 ~€35 €/t coal-to-gas switch at **low gas prices and current coal prices** (39% coal efficiency)
- 3 ~€55 €/t coal-to-gas switch at **current gas and coal price levels**
 - Although **gas with lower LCoE than coal**, still **negative operational margin** due to low wholesale price (based on 2013 wholesale price)

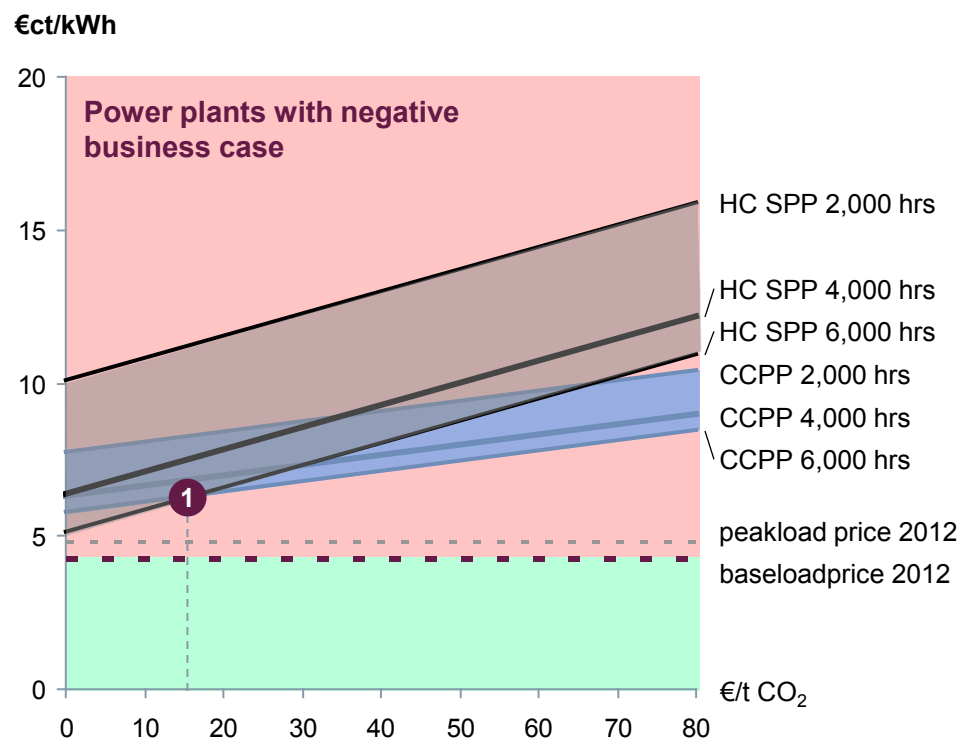
Note: 2012 German fuel price. Coal 2.8 €/GJ; Gas 7.7 €/GJ; Source: E ST MC

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New-build decision based on full cost comparison

Negative business case!

Full cost comparison



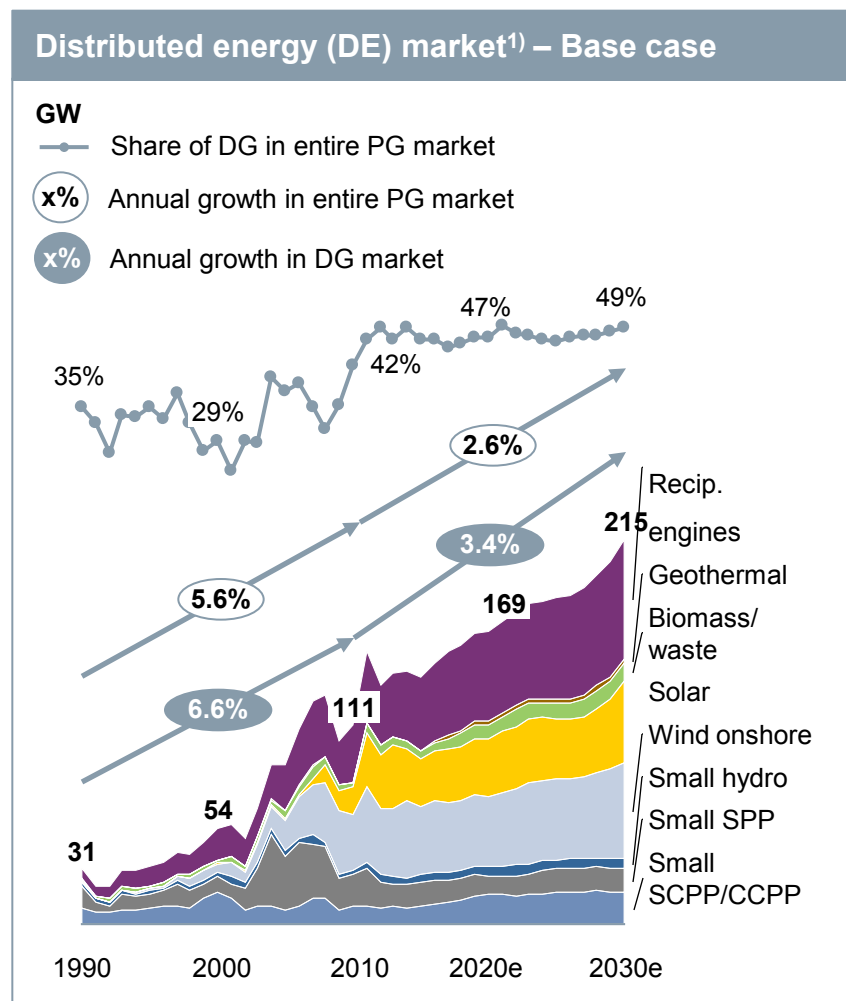
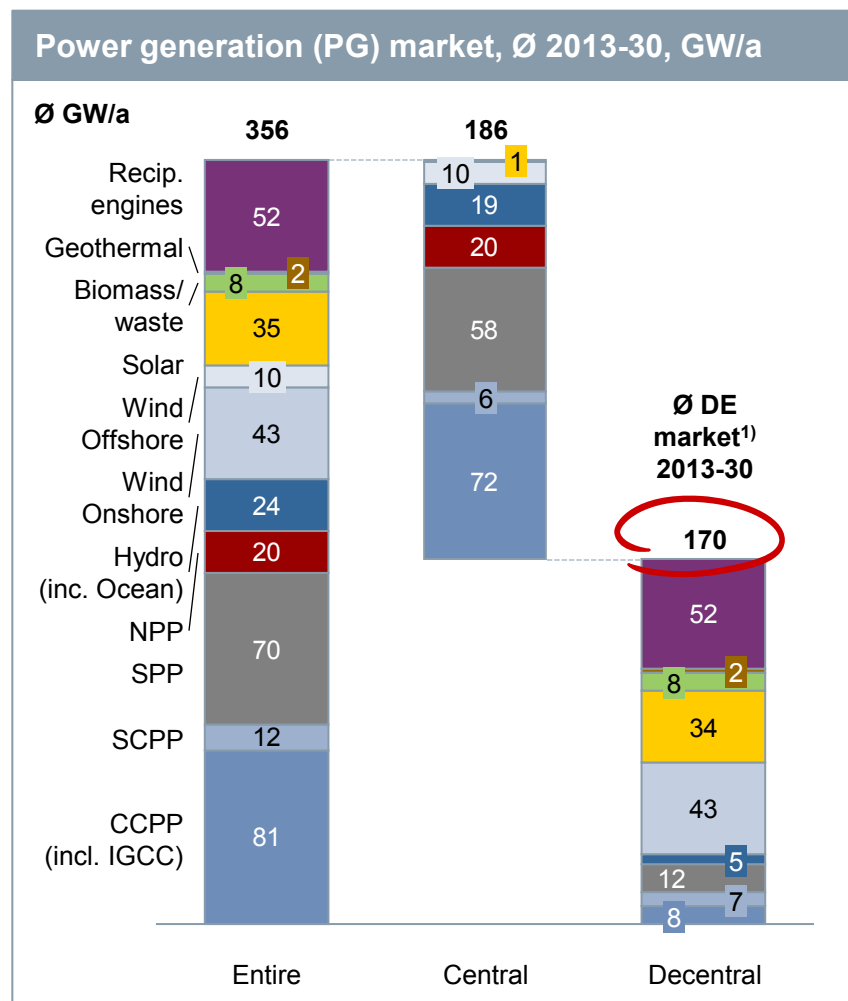
Comments

- Based on current wholesale price, both gas and coal have negative business cases
- For new-build decision, gas CCPP has favorable conditions (lower LCoE than coal SPP)
- 1** In normal operation conditions, coal SPP running longer hours than gas, ~€10-20 €/t coal-to-gas switch when CCPP running 4000flh and SPP running base load (6000flh)

Note: 2012 German fuel price. Coal 2.8 €/GJ; Gas 7.7 €/G, WACC: 5.6%, HC=hard coal; Source: E ST MC

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Strong trend towards Decentral Energy will affect Coal power generation adversely



1) Incl. SCPP/CCPPs with GT <60 MW and SPPs with ST <250 MW

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Market Trends disfavor large central Coal SPP, while flexible CCPP are required as secured capacity

Market Trends

Fuel Diversification

- Gas trade is getting more global
- LNG supply levelized regional price levels

Efficiency

- Tighter emissions standards drive efficiency requirements
- Expected higher CO₂ prices in mid-term support low-carbon fossils

Flexibility

- High share of fluctuating Renewables need flexible backup power
- Cross-border trading of electricity forces flexible plant operation

Decentralization

- High installations Renewables worldwide
- Trend towards decentral auto-production in systems with high levies
- Overall efficiency improvement through de-central CHP applications

Thank you