

Global network of innovation

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Power Transmission and Distribution

**Virtual Power Plants  
- future requirements  
and outlook of the market**

Dr. Horst Vollmar

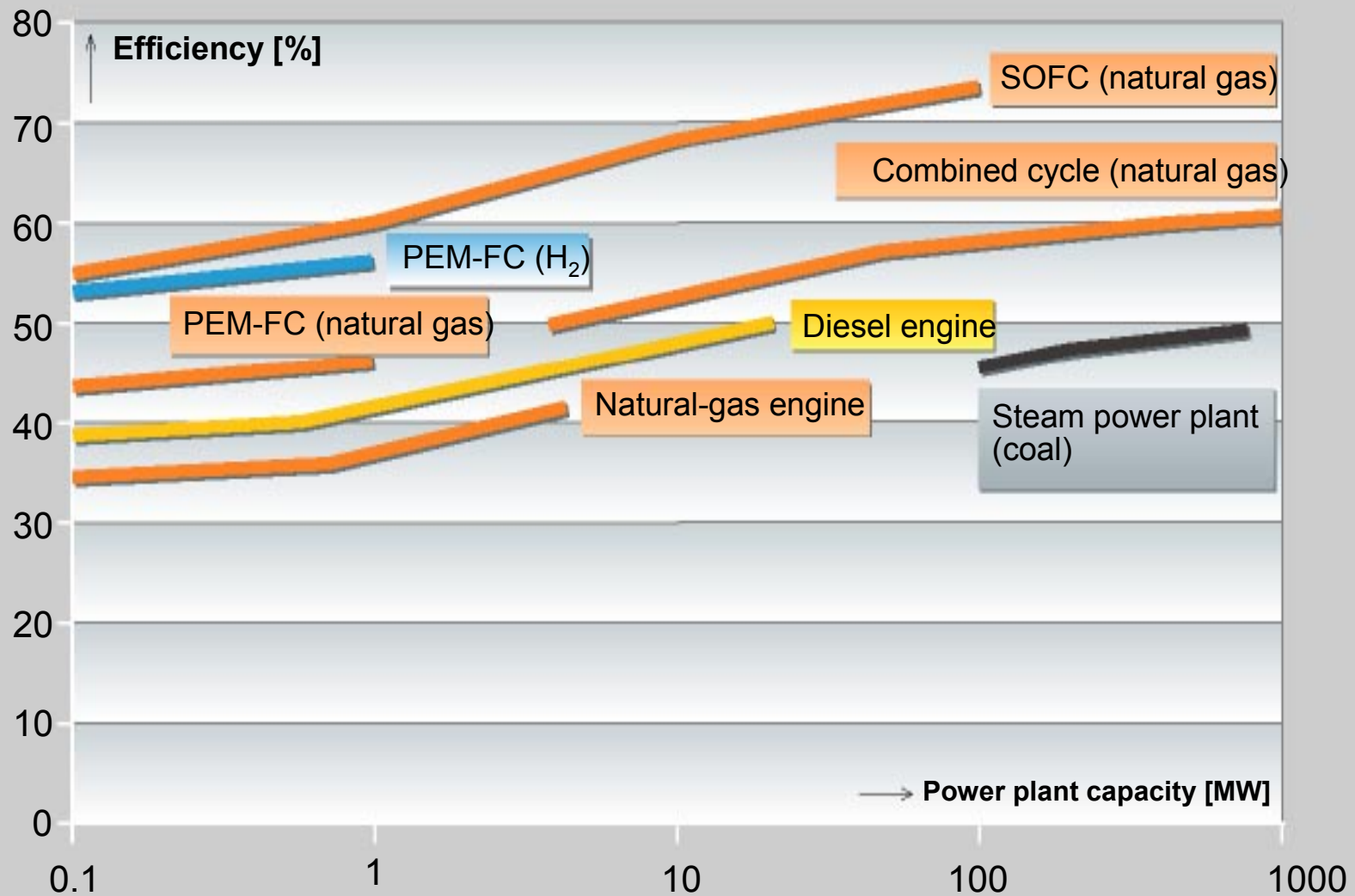


## Virtual Power Plants - future requirements and outlook of the market Agenda

- Efficiency in power generation
- CO<sub>2</sub> reduction potential
- Fuel cell investment costs
- Market penetration model
- Scenario of future distributed generation using fuel cells

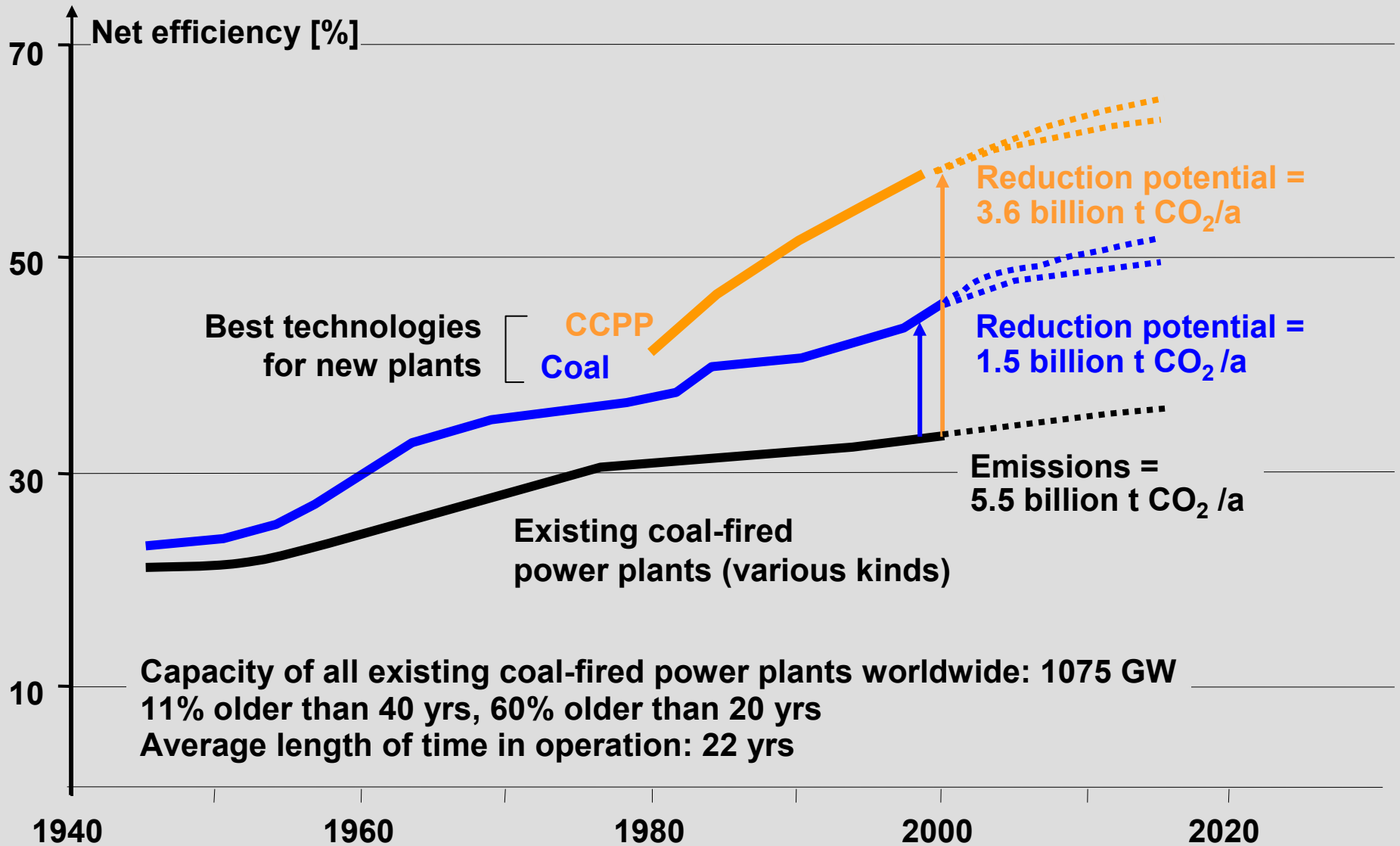


# Net electrical efficiency of various power generation systems



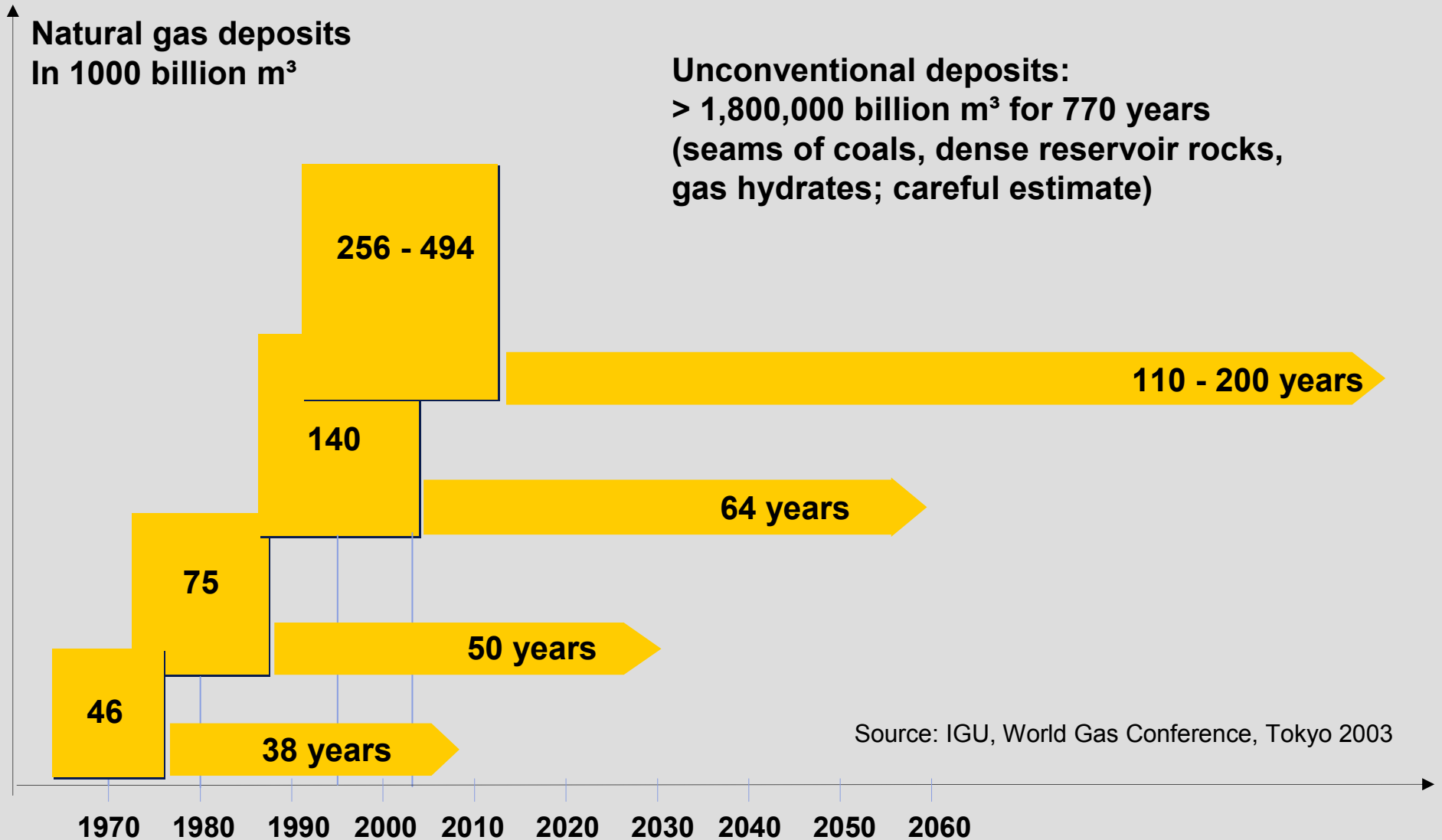


## Greater efficiency of steam and combined-cycle power plants offers great potential for reducing CO<sub>2</sub> emissions



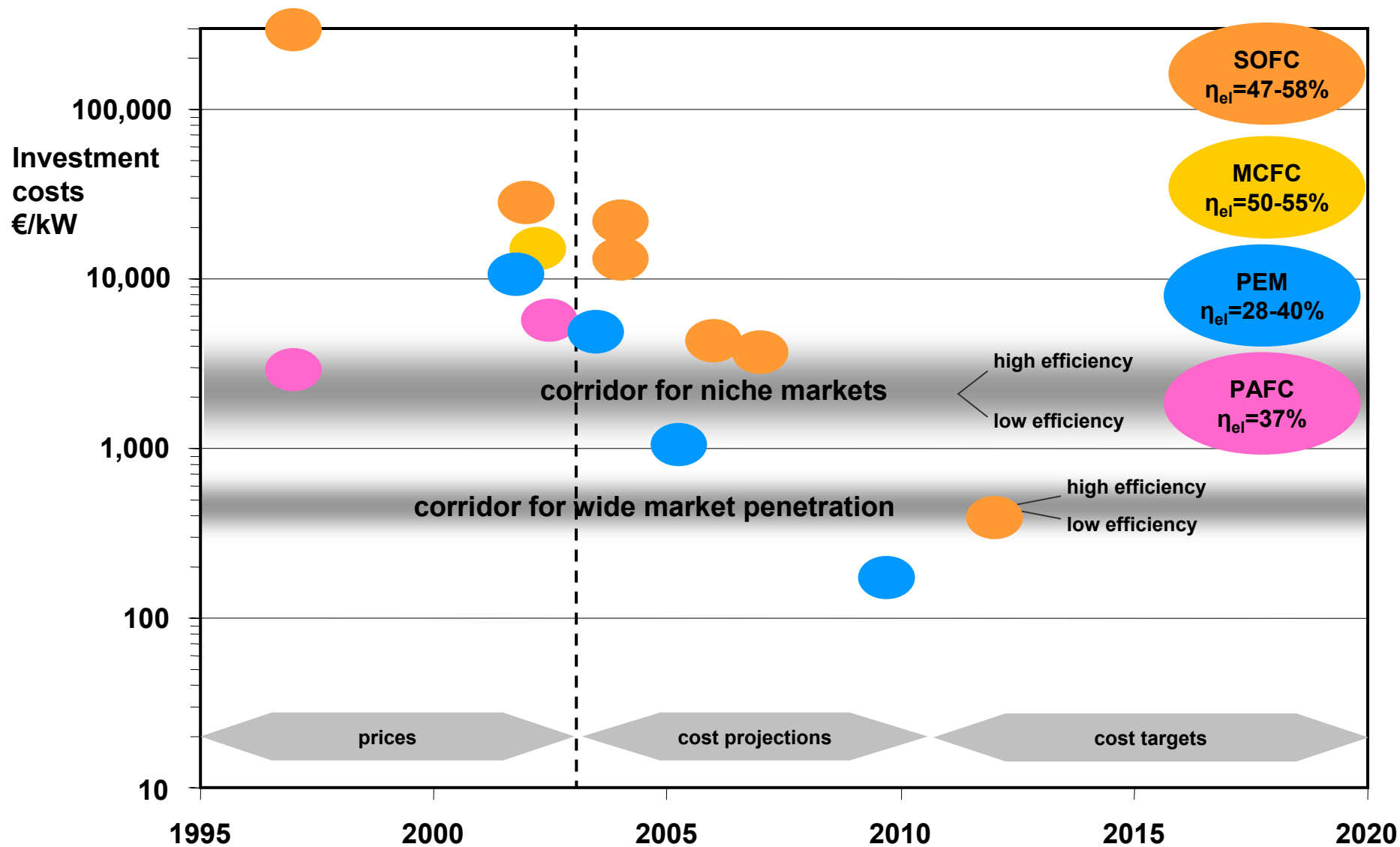


## Our Knowledge on resources to generate electrical energy is continuously growing





# Fuel cells might reach the target costs for a wide market penetration after 2010

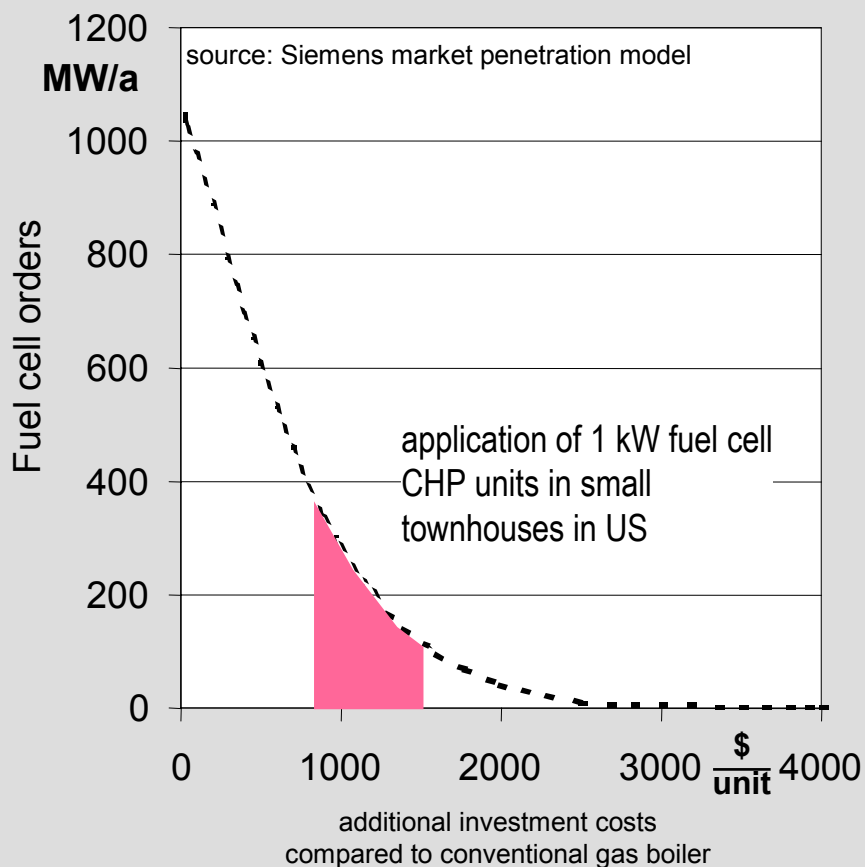




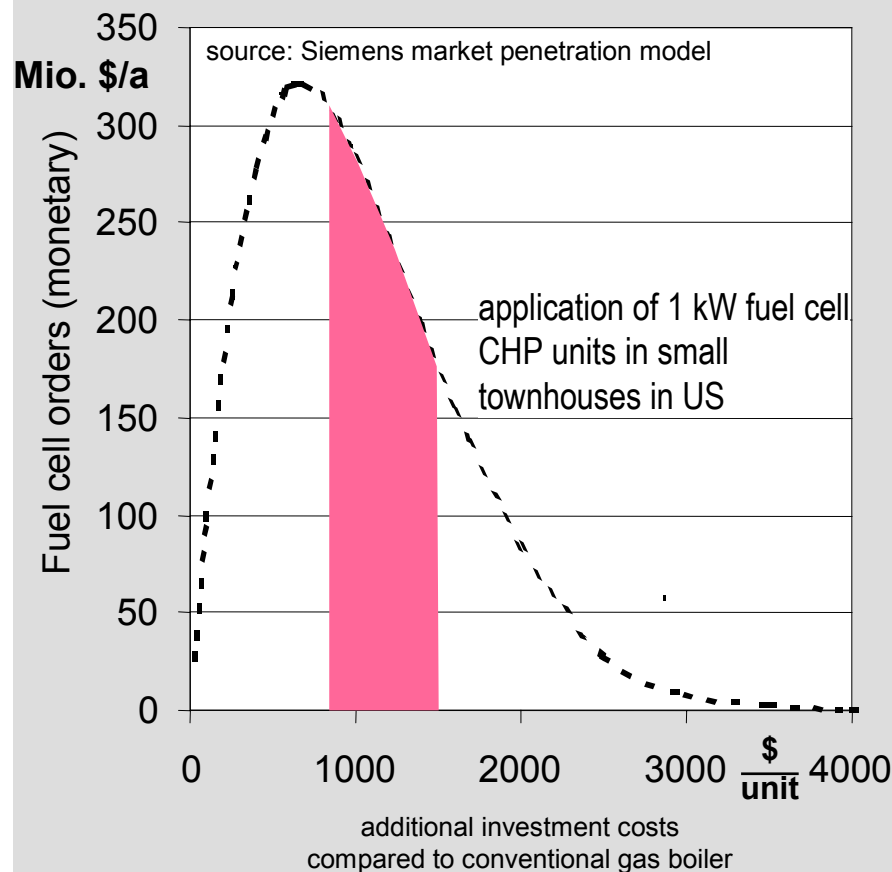
# Broad market penetration for distributed generation is very price sensitive (1 kW units)

Micro-Generation: Fuel cell combined with gas boiler to supply small townhouses in the US

assumed CHP unit costs and resulting orders

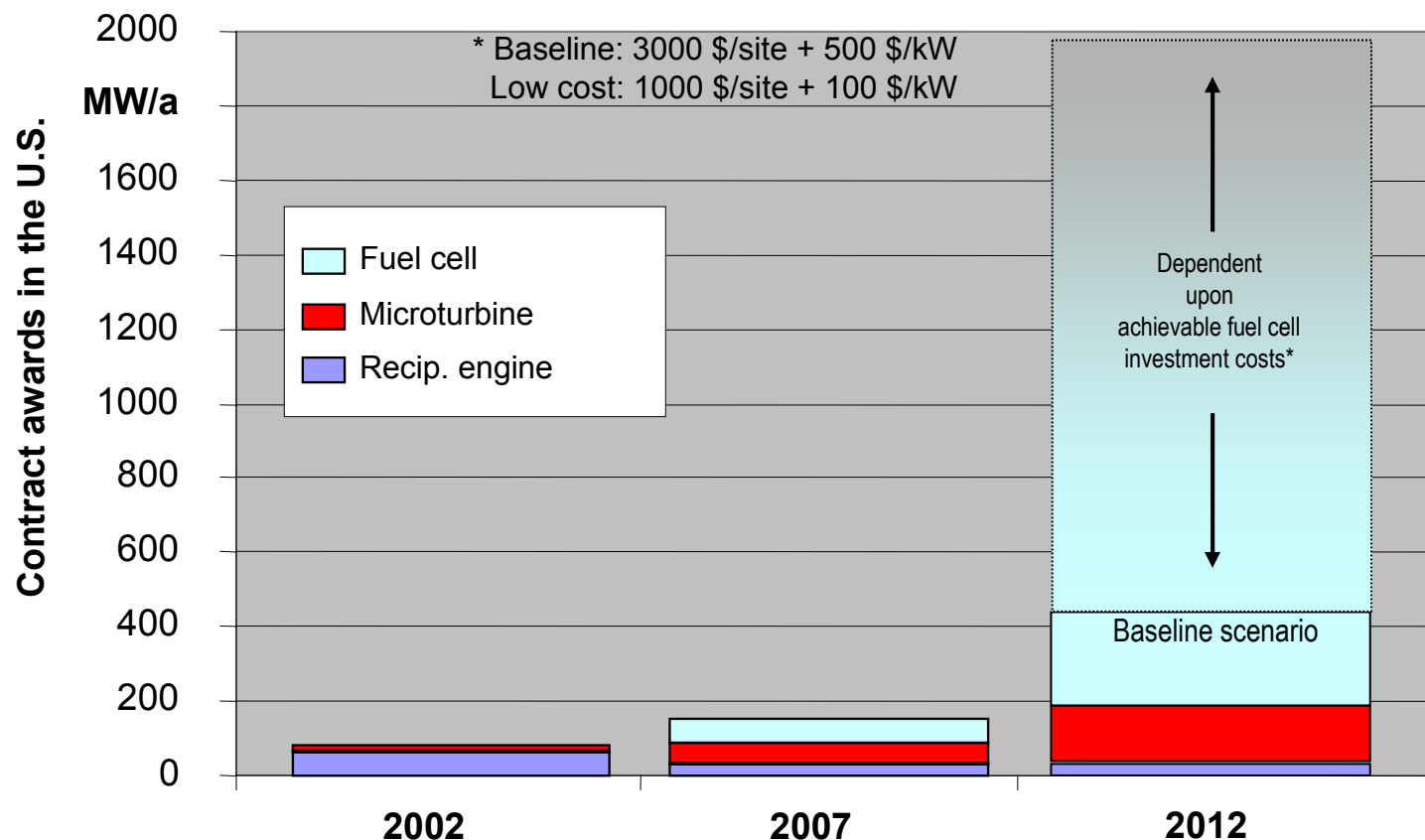


assumed CHP unit costs and resulting revenues





## Market penetration for distributed generation in the U.S. (< 500 kW units)



### U.S. distributed generation market, units < 500 kW, residential and commercial applications with gas supply

If fuel cells in stationary application only approximately approaches the target costs, it will dominate the volume of orders placed.

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# Scenario of future decentralized power supply with fuel cells

