Hydrogen Powered Vehicles for Transport

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FOSSIL FUEL RESERVES

(Proven reserves based on current production)

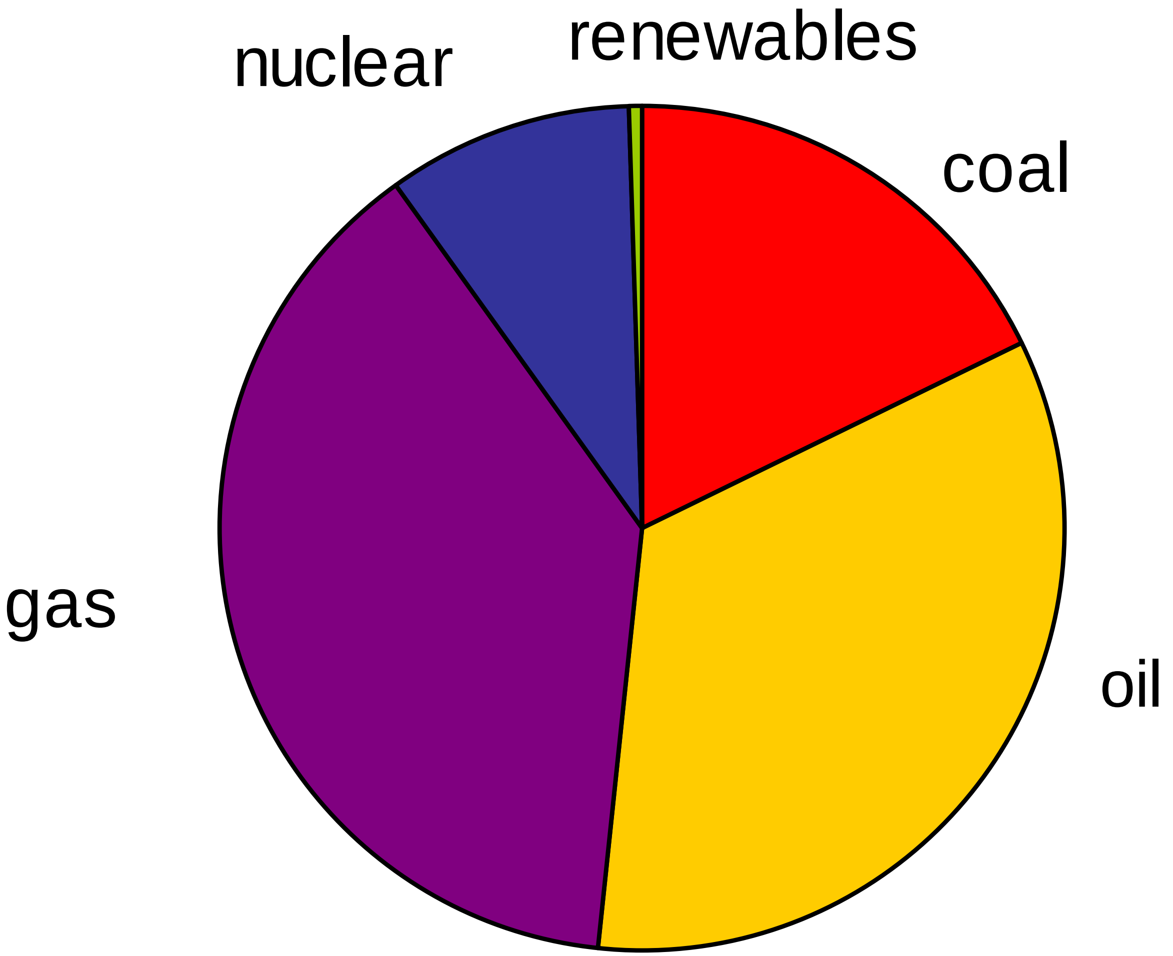
Coal: 164 years

Gas: 67 years

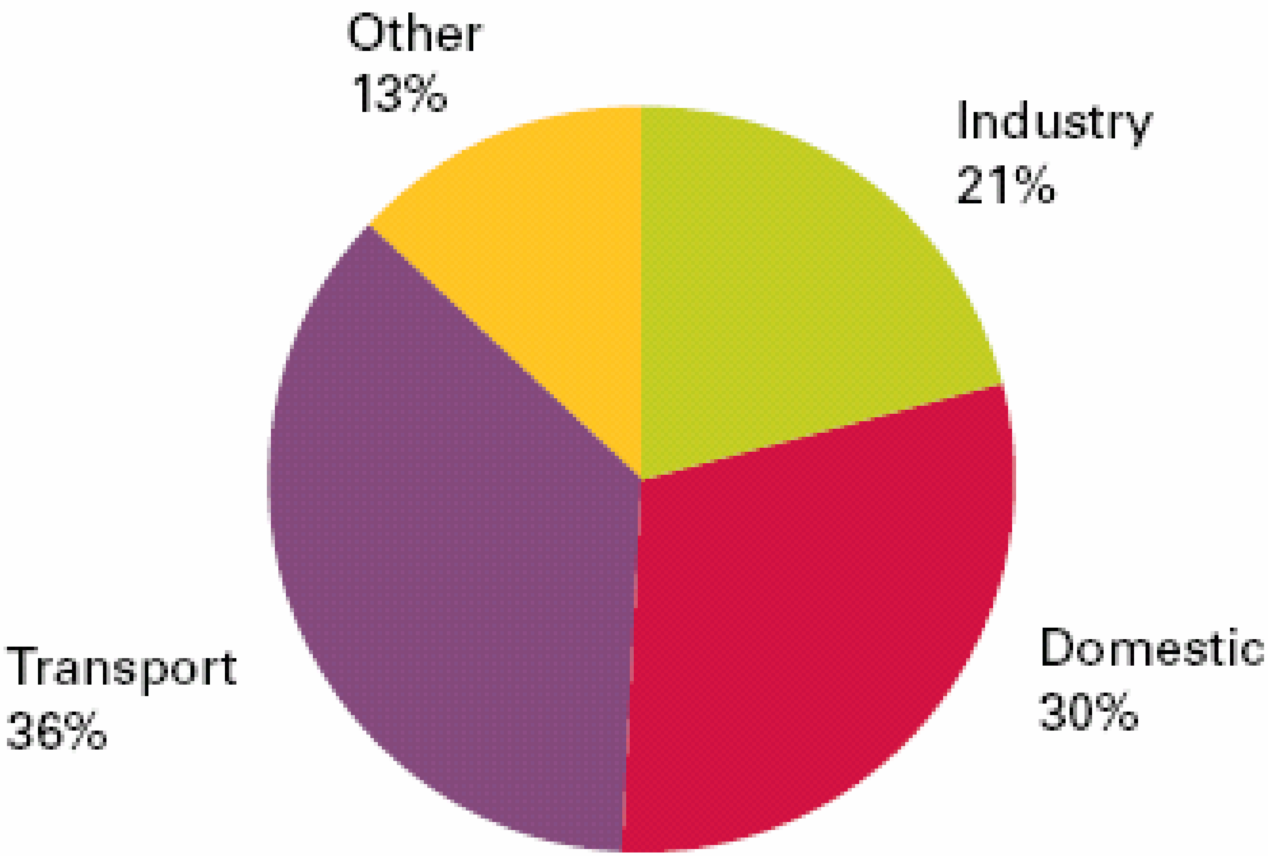
Oil: 41 years

(Source: World Coal Institute)

UK Energy Consumption

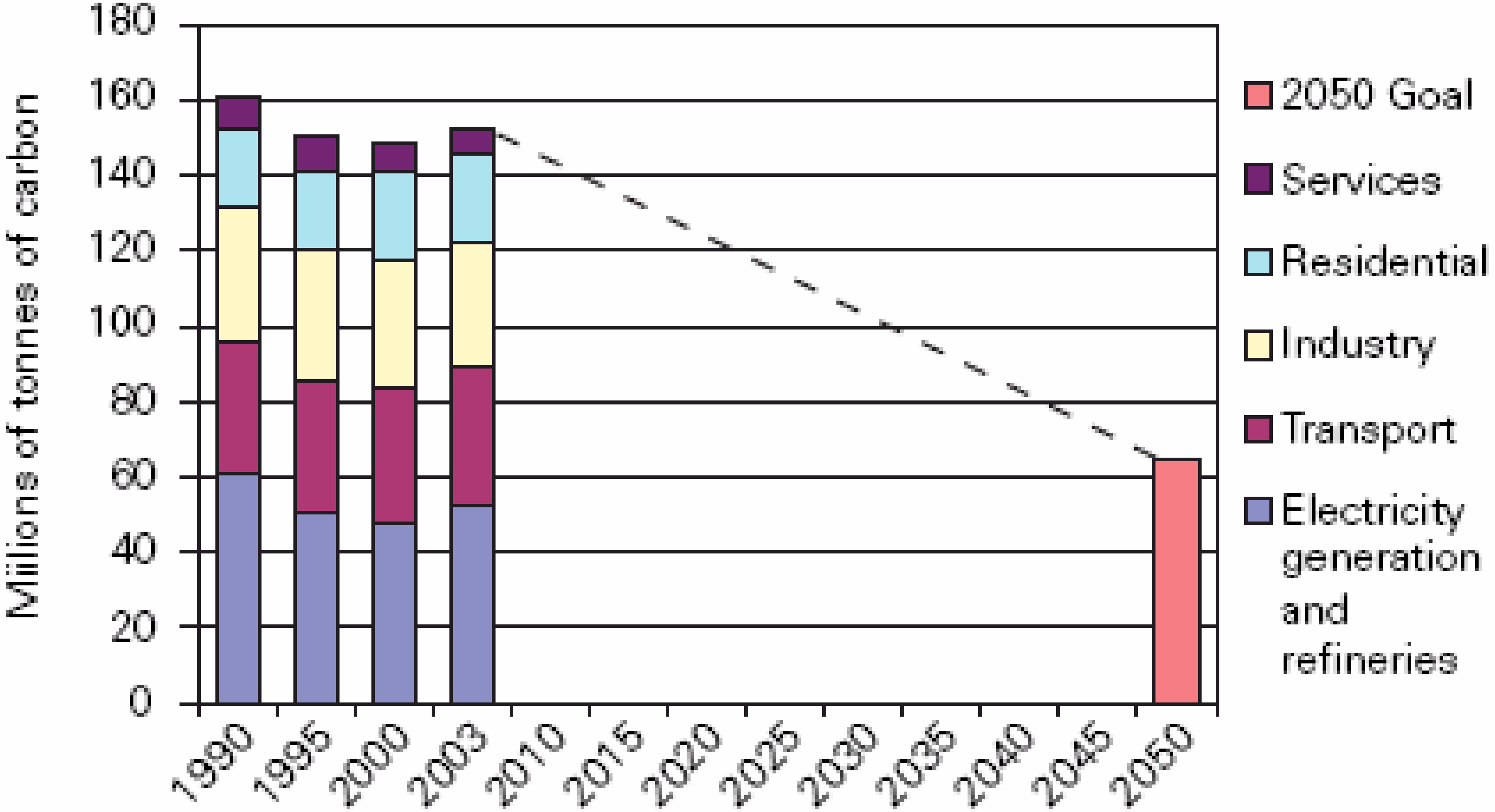


End use of energy by sector of the economy in 2004



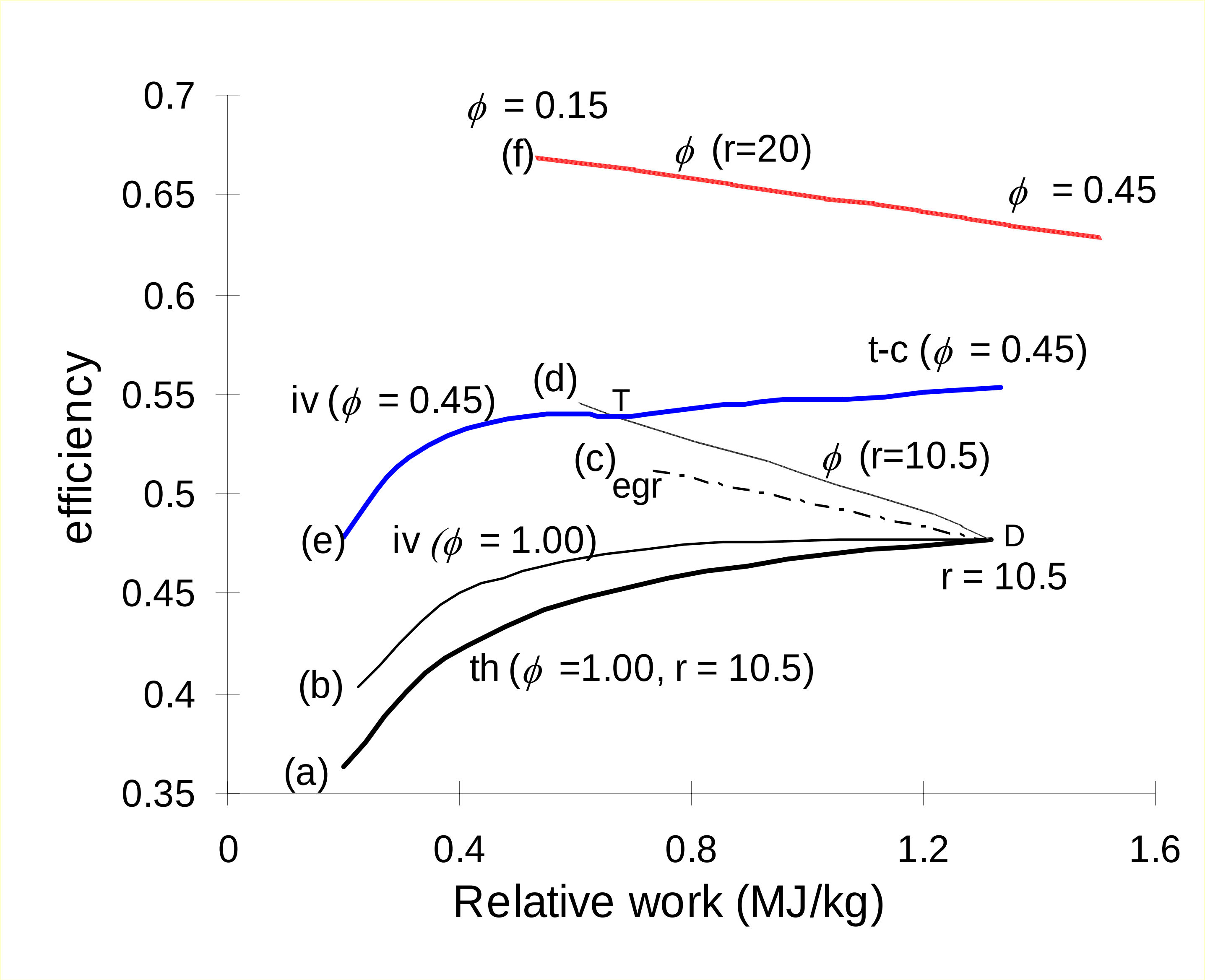
Source: DTI, DUKES 2005

Carbon emissions by sector and the 2050 goal

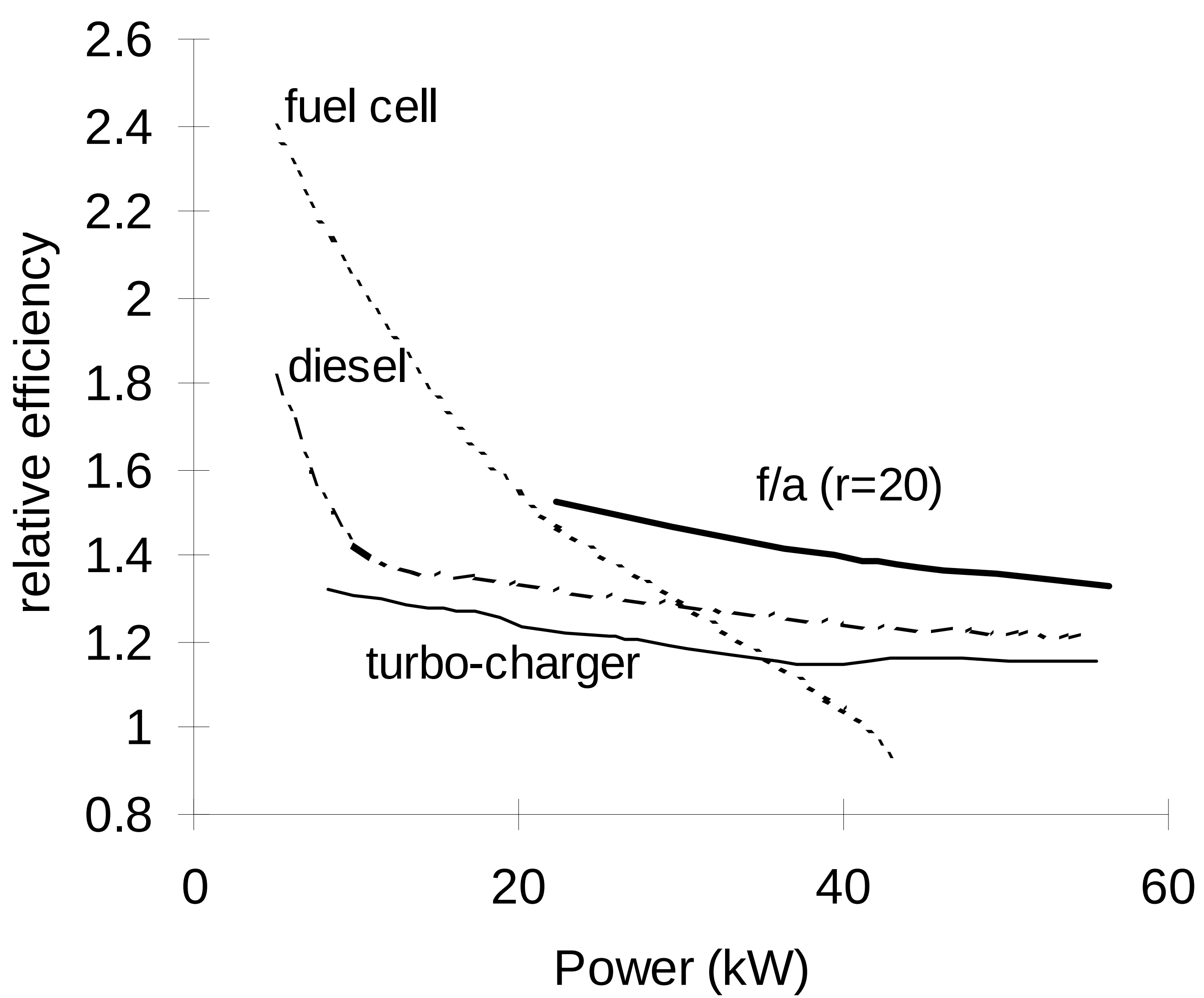


Source: DTI

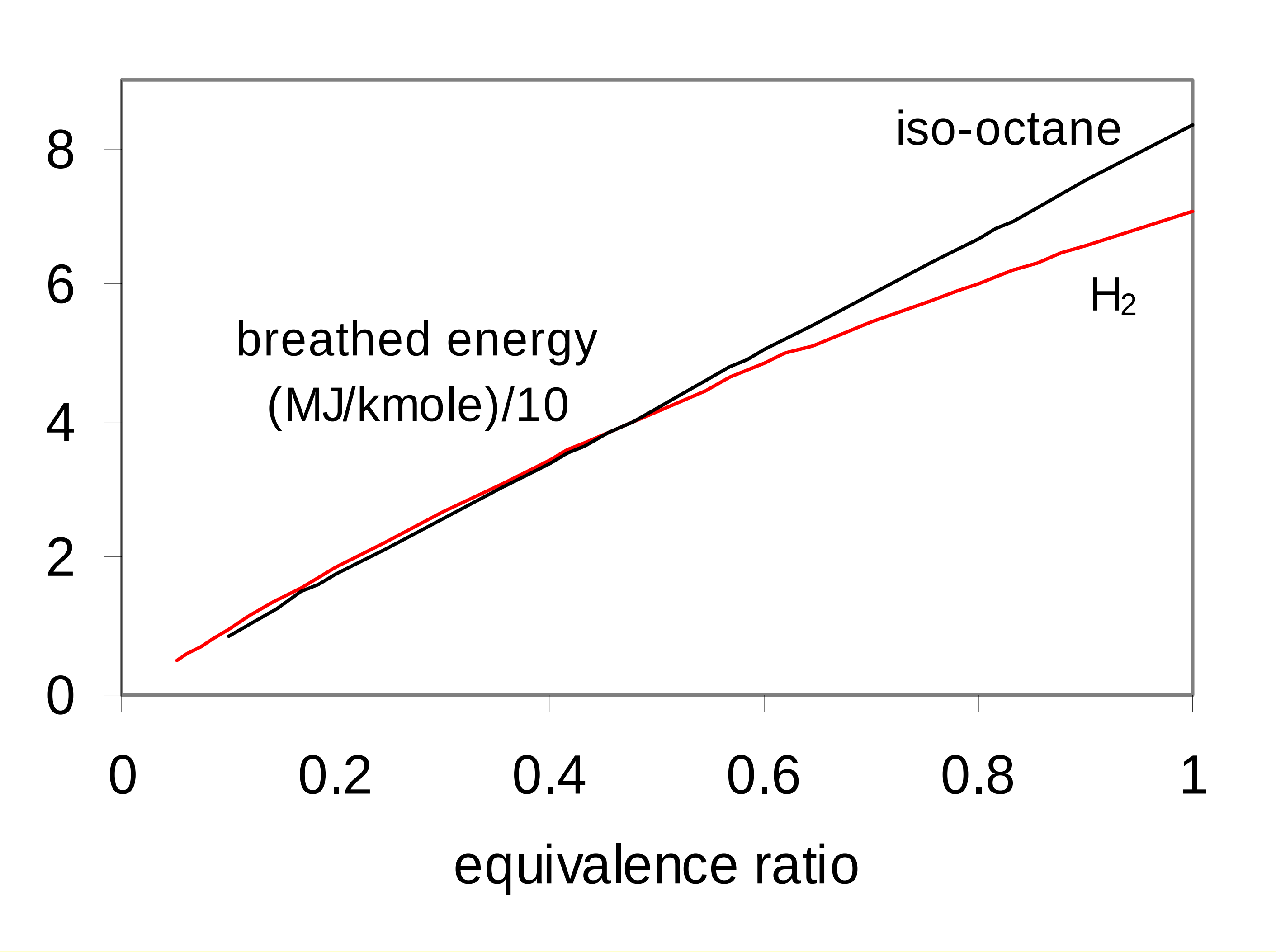
Otto Cycle Efficiencies



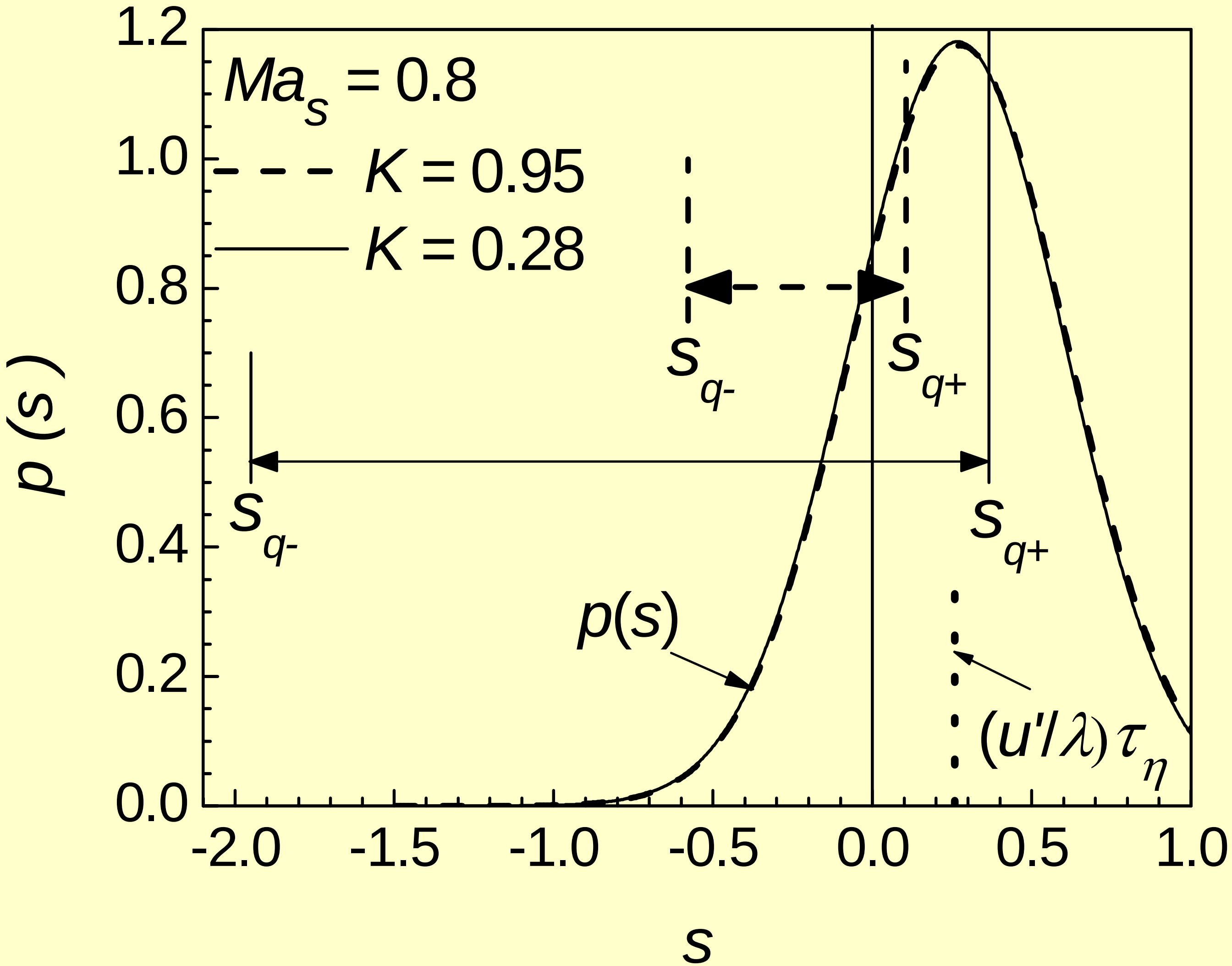
Practical Cycle Efficiencies



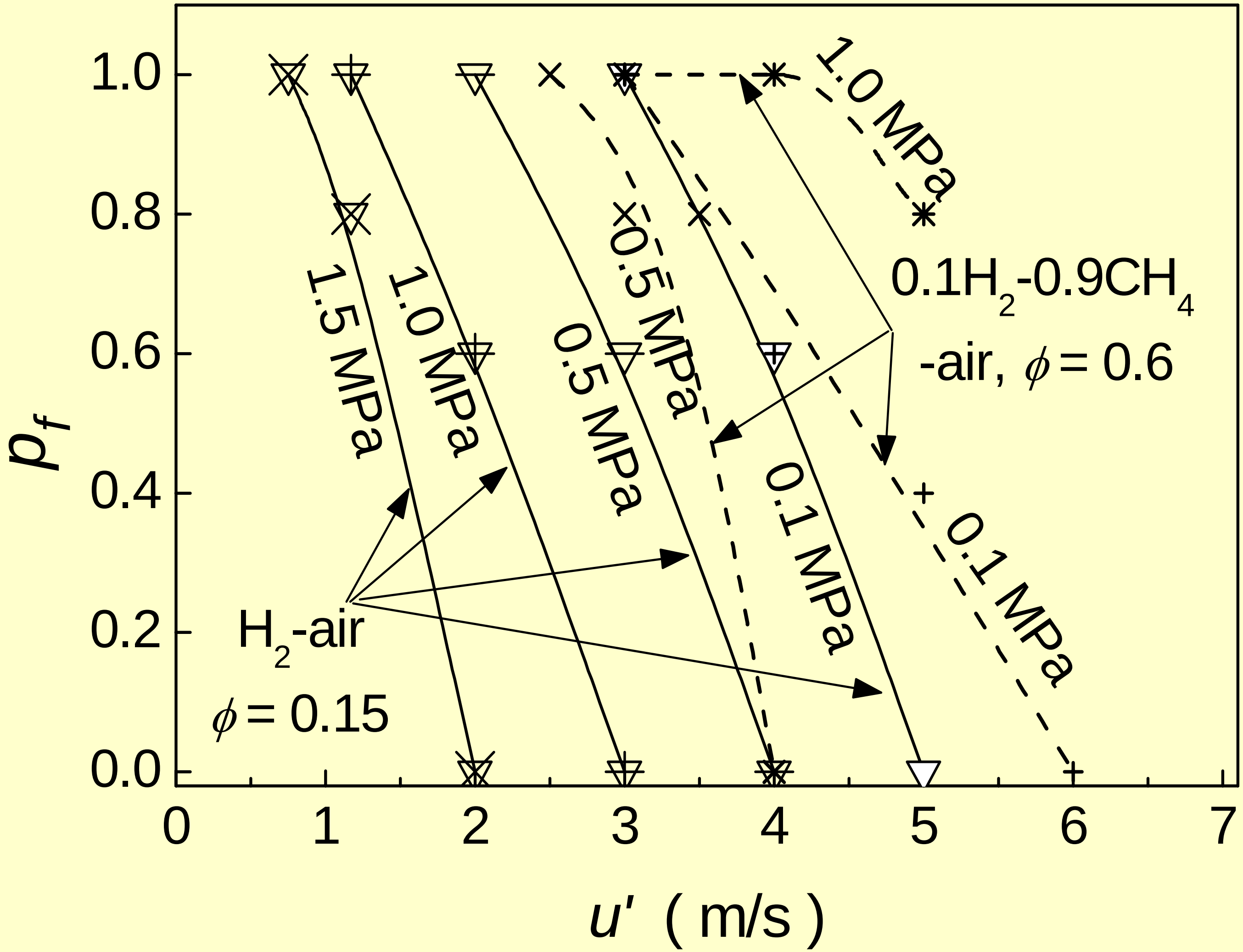
Breathed Energy



Distribution of Flame Stretch Rates



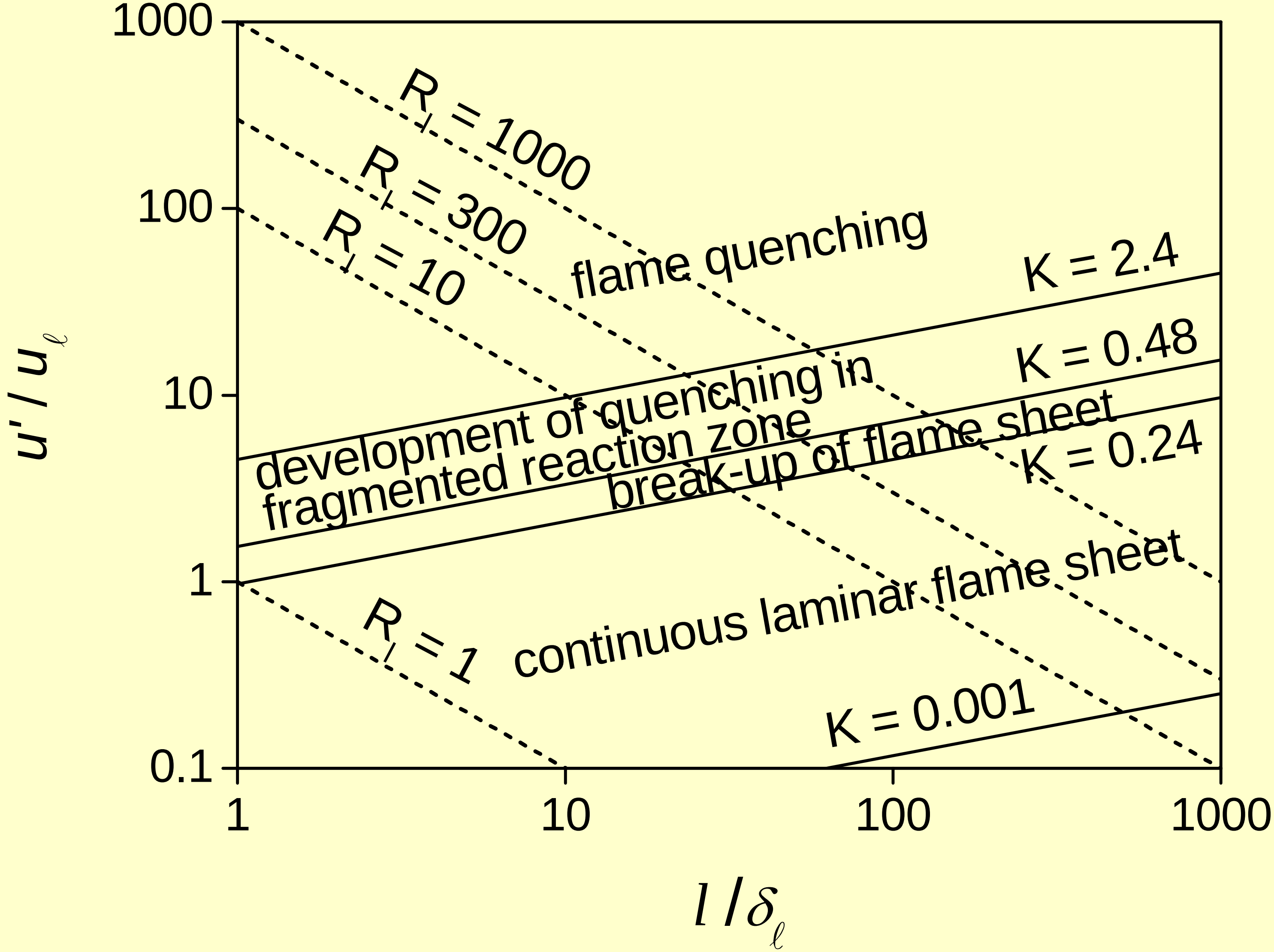
Experimental Probabilities of Flame Propagation



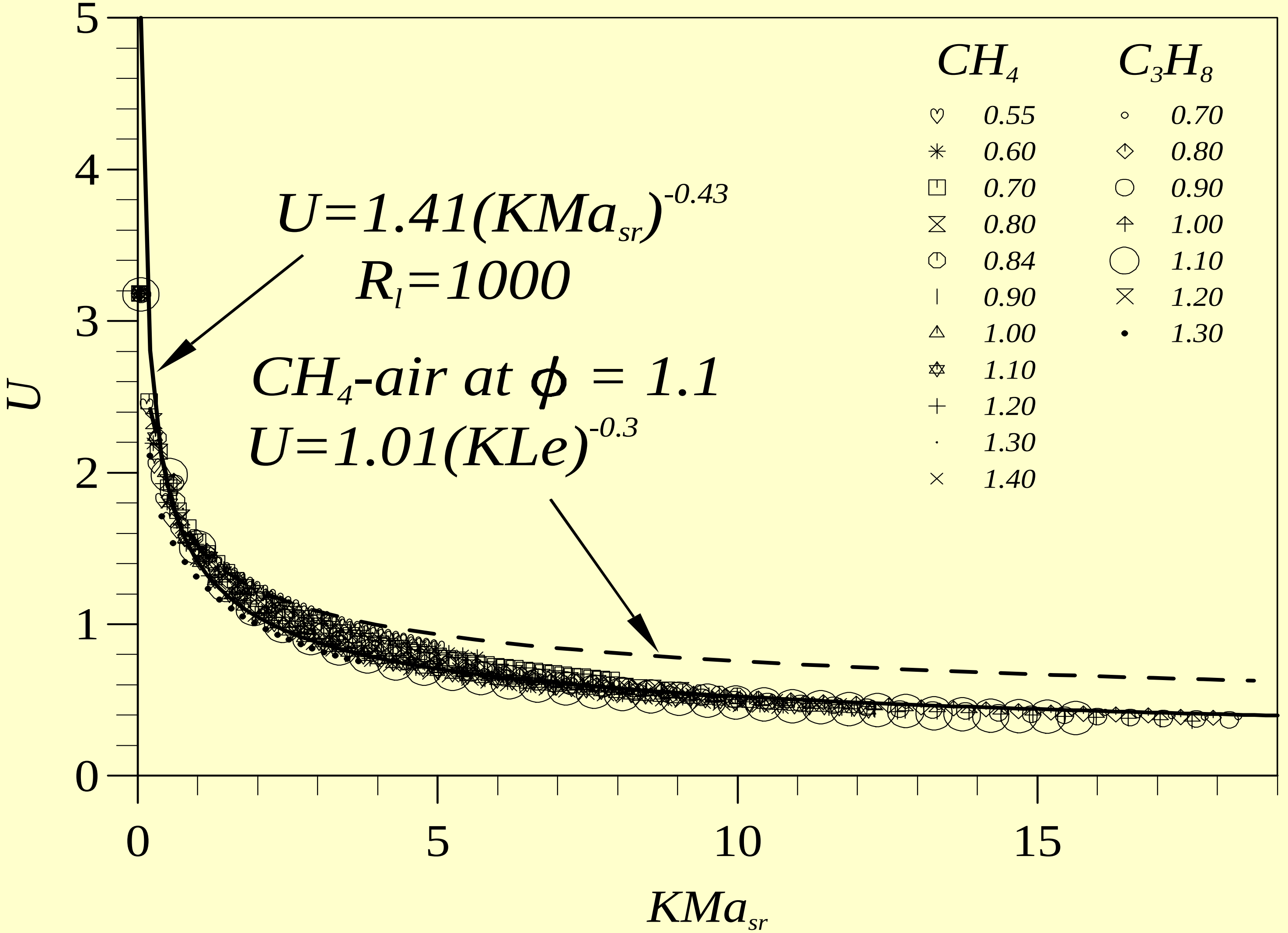
Probabilities of Flame Quenching in Bomb and Engines

Mixture	ϕ bomb	ϕ engine	Ma_s	u_ℓ (m/s)	NO_x ppm	Ind. thermal eff. (%)
i-octane-air	0.78	0.71	0.8	0.150	LNT	unknown
CH_4-air	0.57	0.62	-2.2	0.017	20	41.1
H_2-air	0.17	0.20	-2.5	0.030	0	33.2

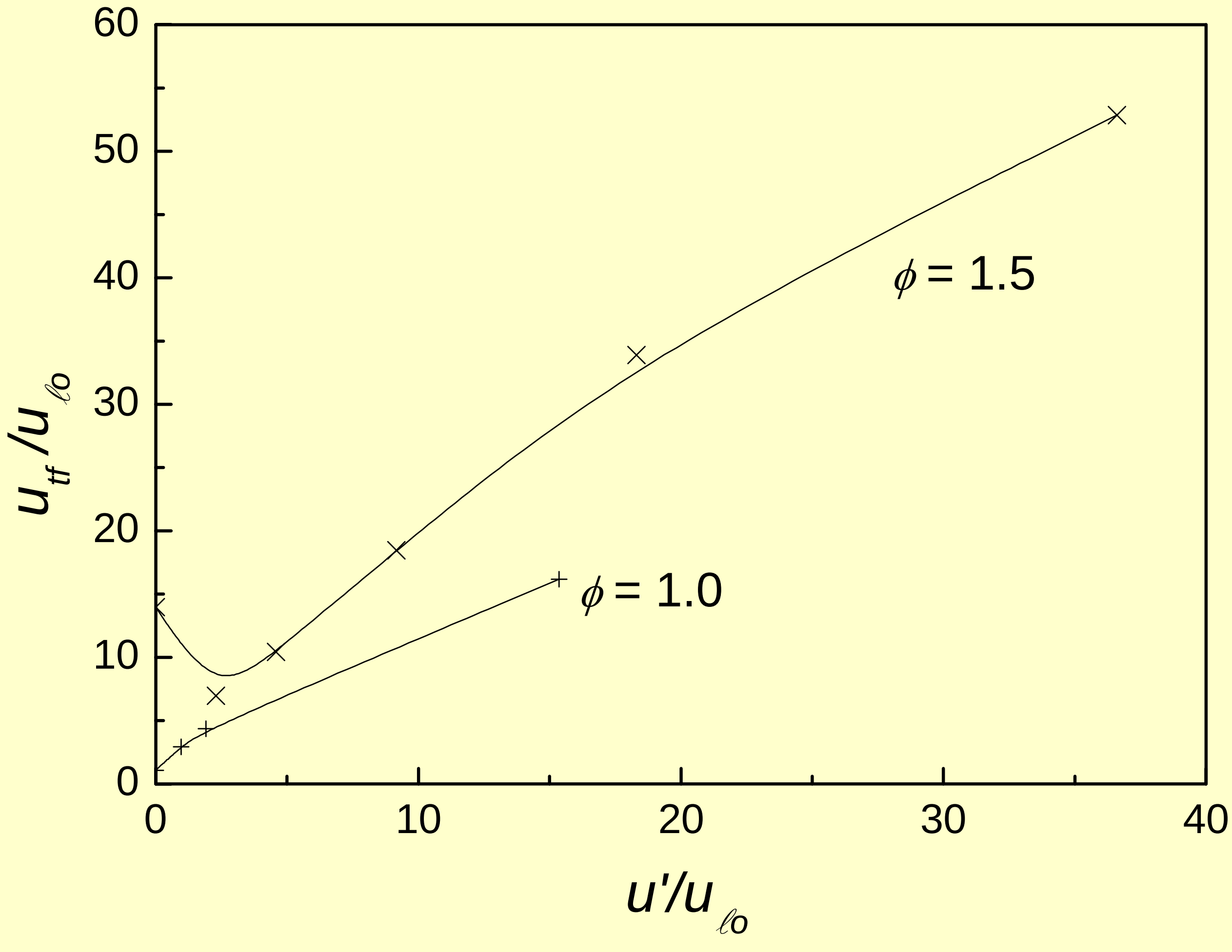
Regimes of Premixed Turbulent Combustion



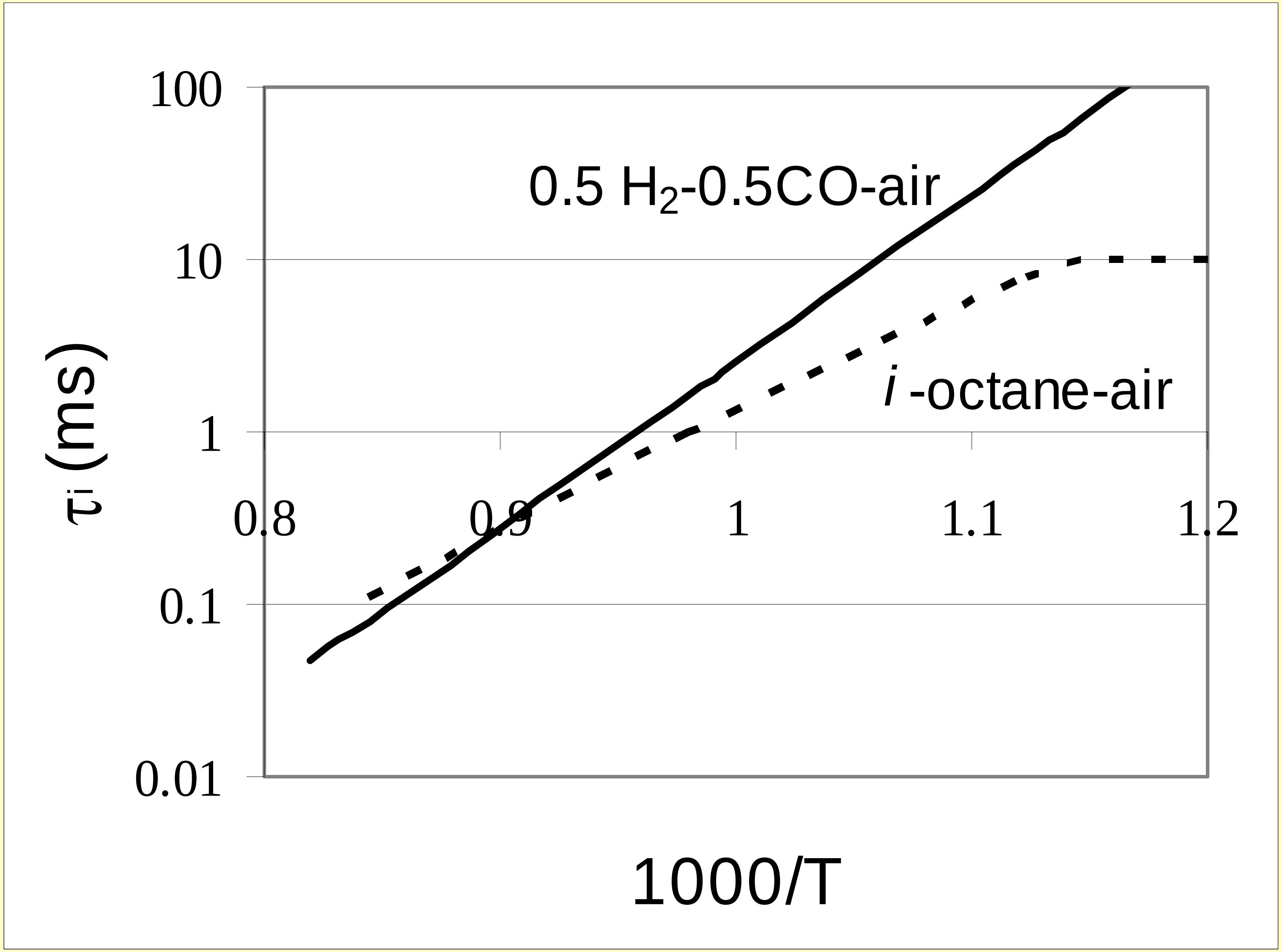
Variations in Turbulent Burning Velocity



Negative Ma_s and Turbulent Burning Velocity



Variations in Ignition Delay Time

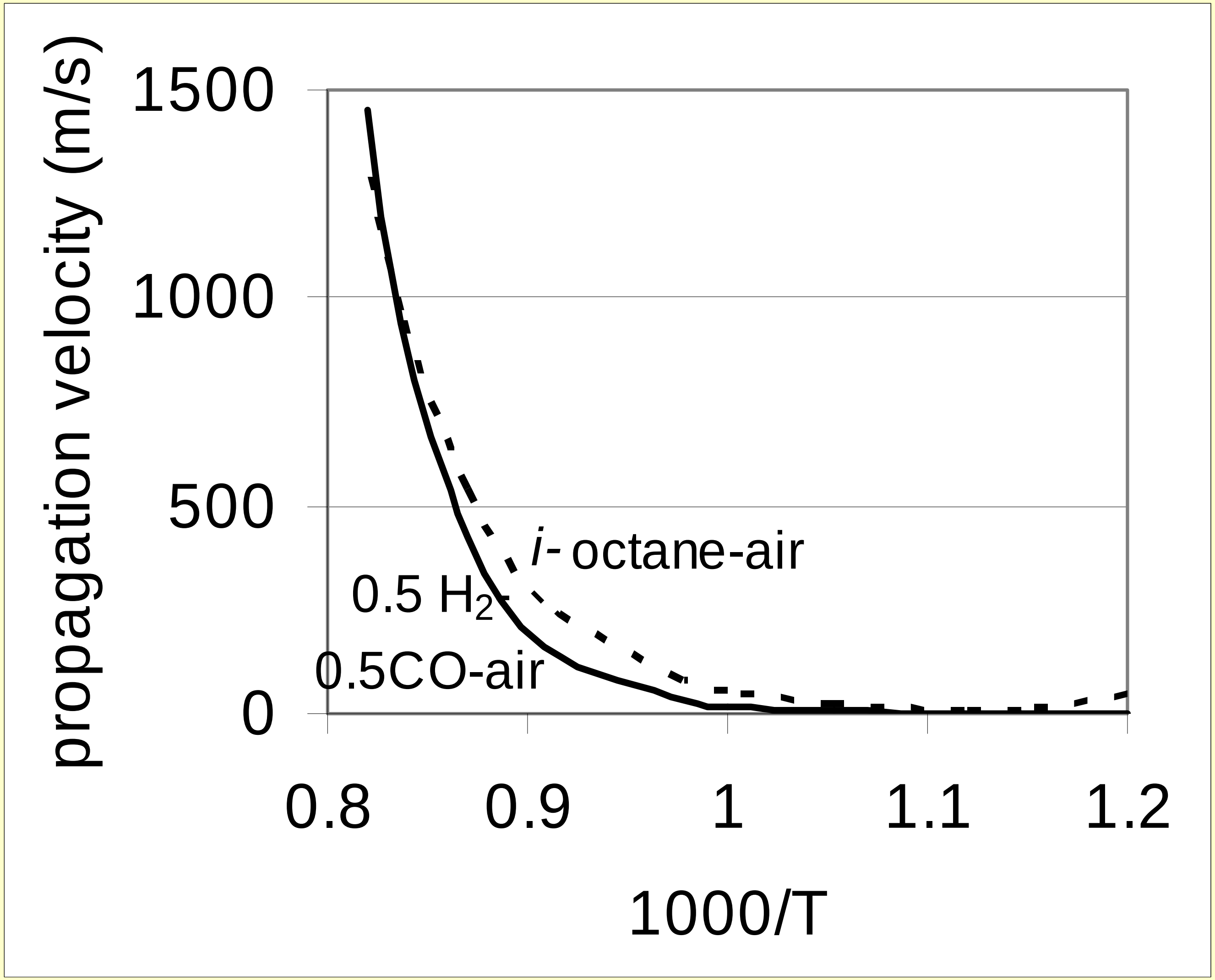


Propagation Velocity from Hot Spot

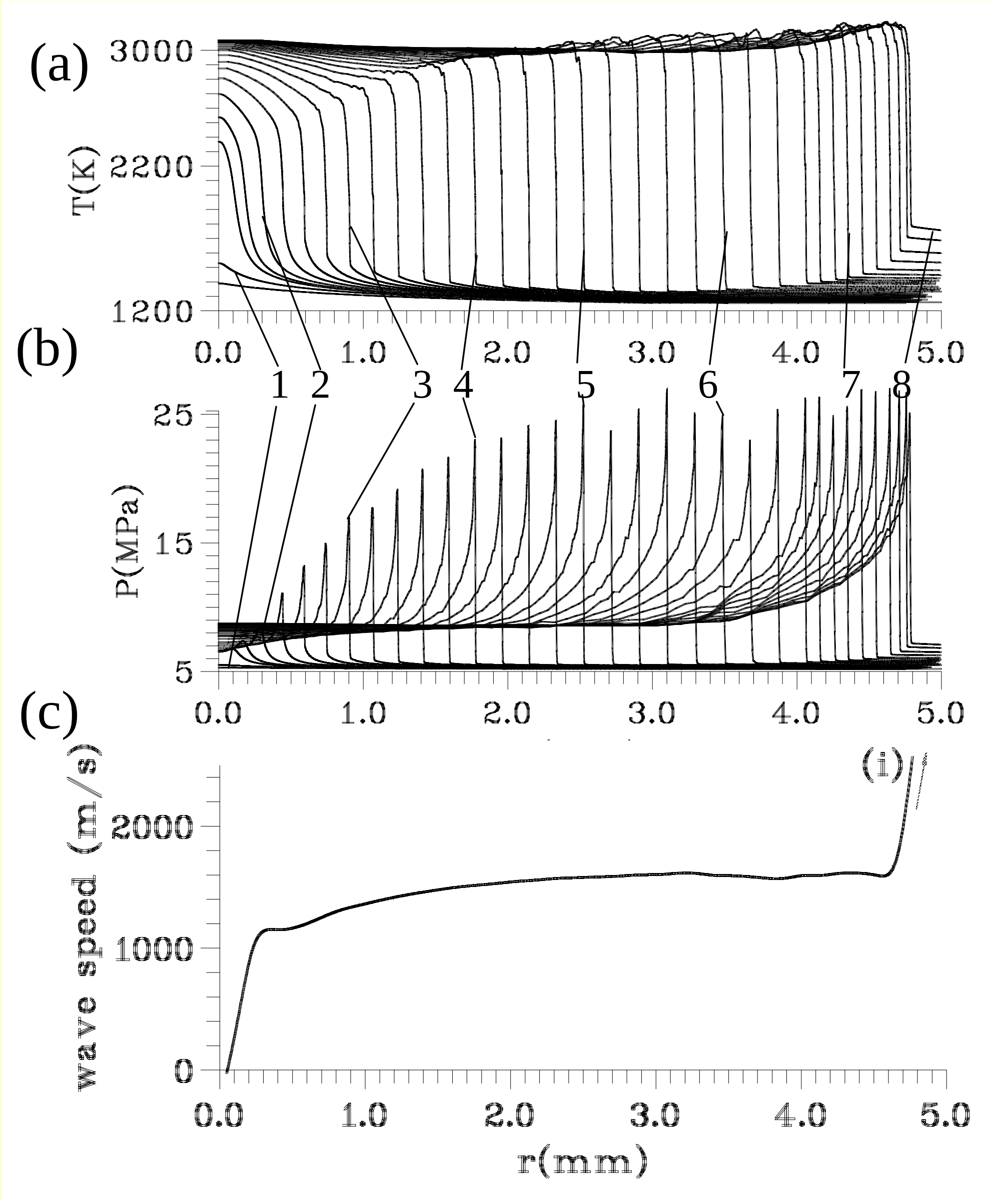
$$u_a = \left(\frac{\partial r}{\partial T}\right)\left(\frac{\partial T}{\partial \tau_i}\right)$$

$$\left(\frac{\partial T}{\partial r}\right)_c = \frac{1}{a\left(\partial \tau_i / \partial T\right)}$$

Propagation Velocity from Hot Spot



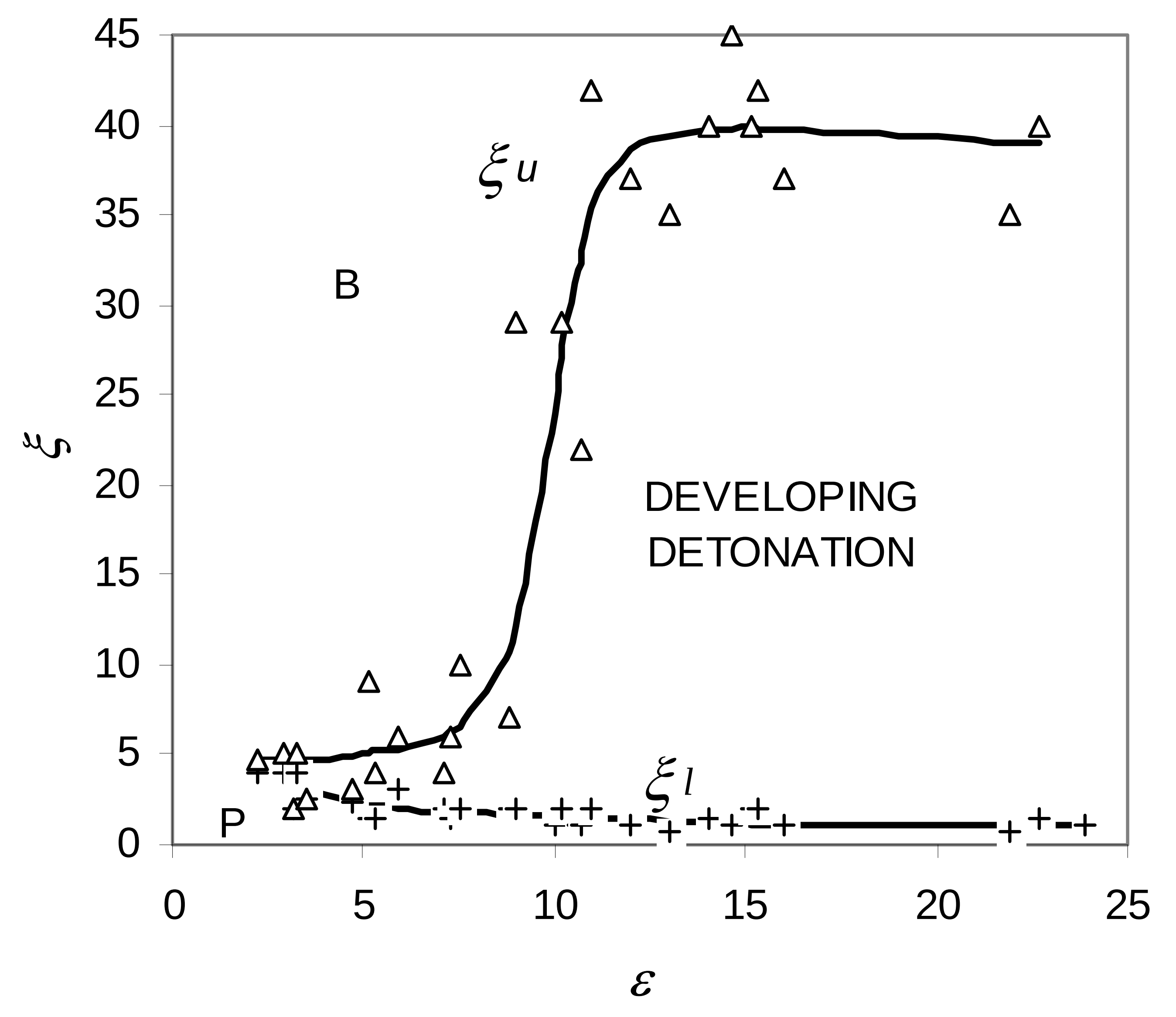
Developing Detonation



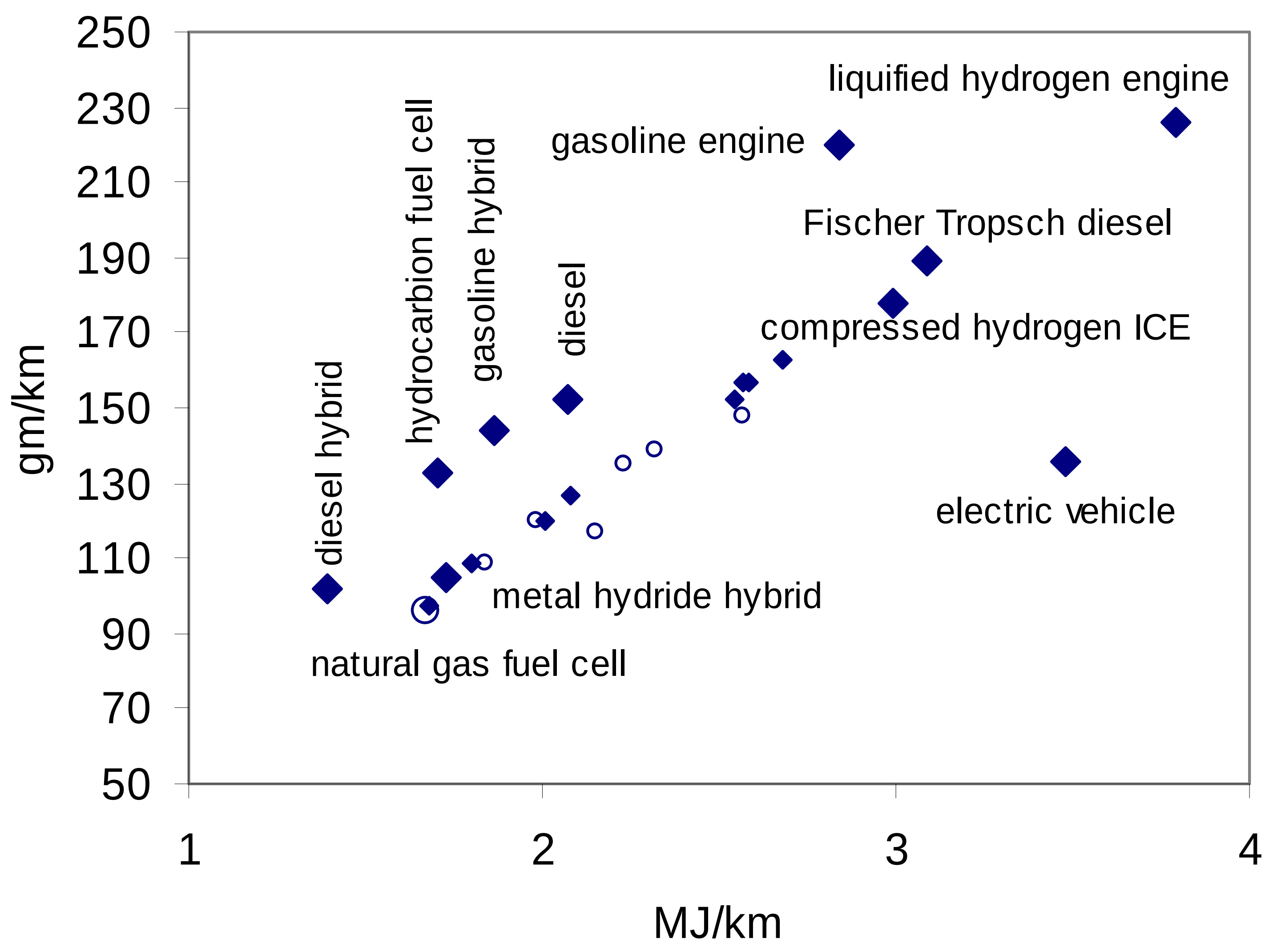
Developing Detonation

$$\xi = \left(\frac{\partial T}{\partial r}\right)\left(\frac{\partial T}{\partial r}\right)_c^{-1}$$

$$\varepsilon = \left(r_o / a\right) / \tau_e$$



Well to Wheel Energy and CO_2 Emissions



Well to Wheel CNG and H_2 Compared

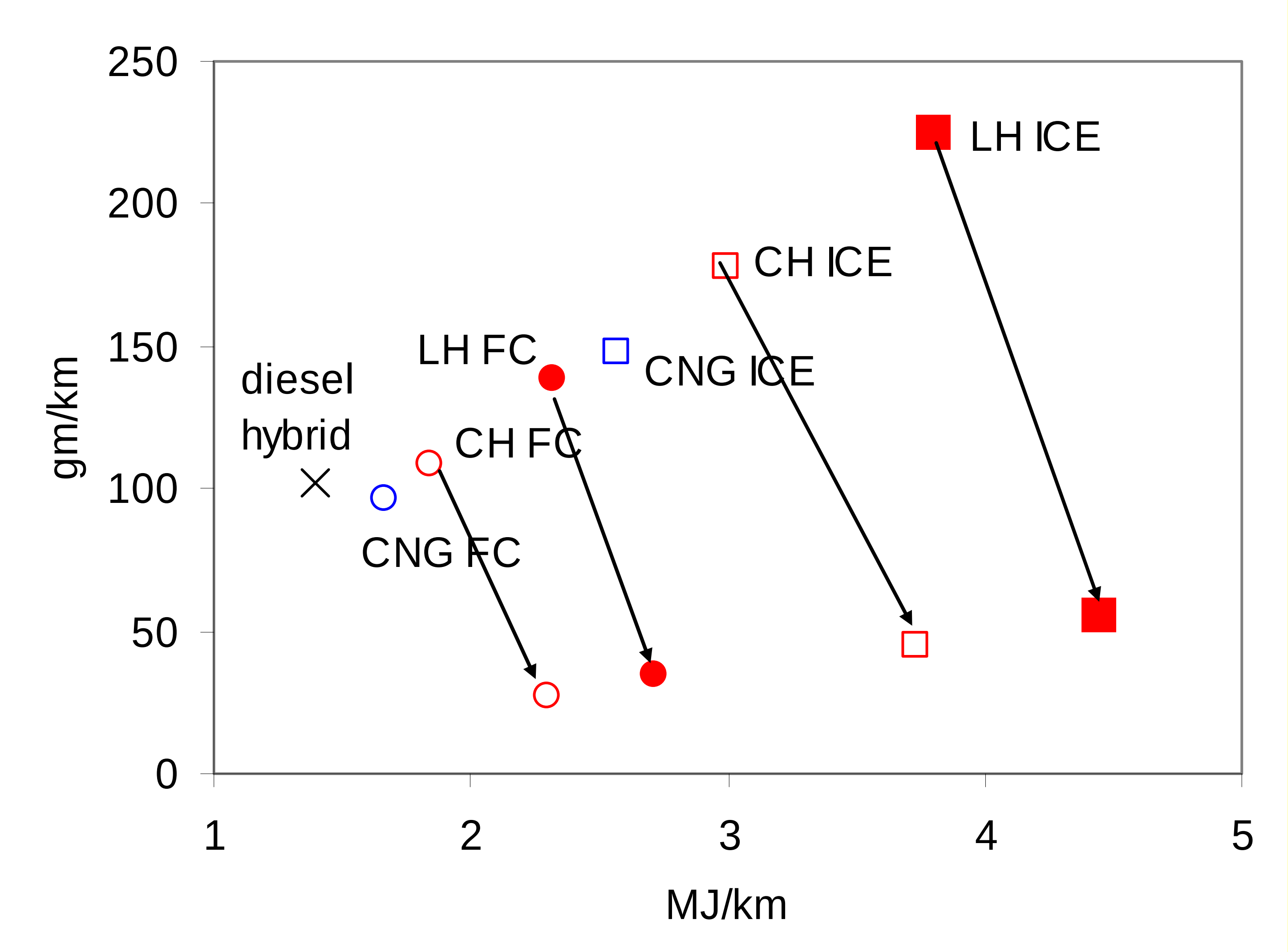
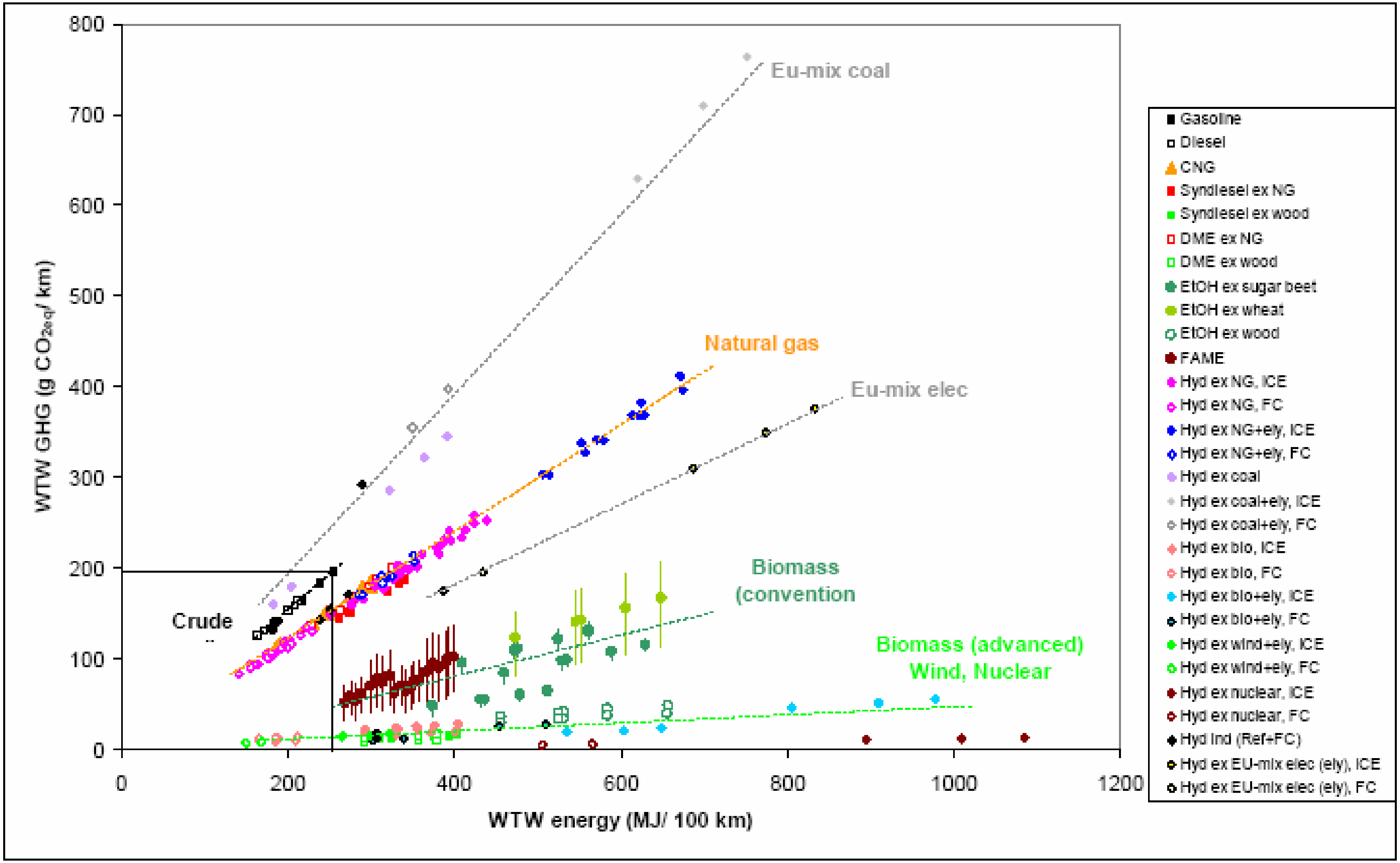


Figure 4.1-1 ***WTW energy and GHG emissions for all pathways and powertrain combinations***



Abbreviations: “Ely”: electrolysis; “ind”: indirect

Questions

- What can make a gaseous mixture burn fast?
- Can H_2 be used successfully in transport ?
- What big city has the best transport policy?
- What big city has the worst?