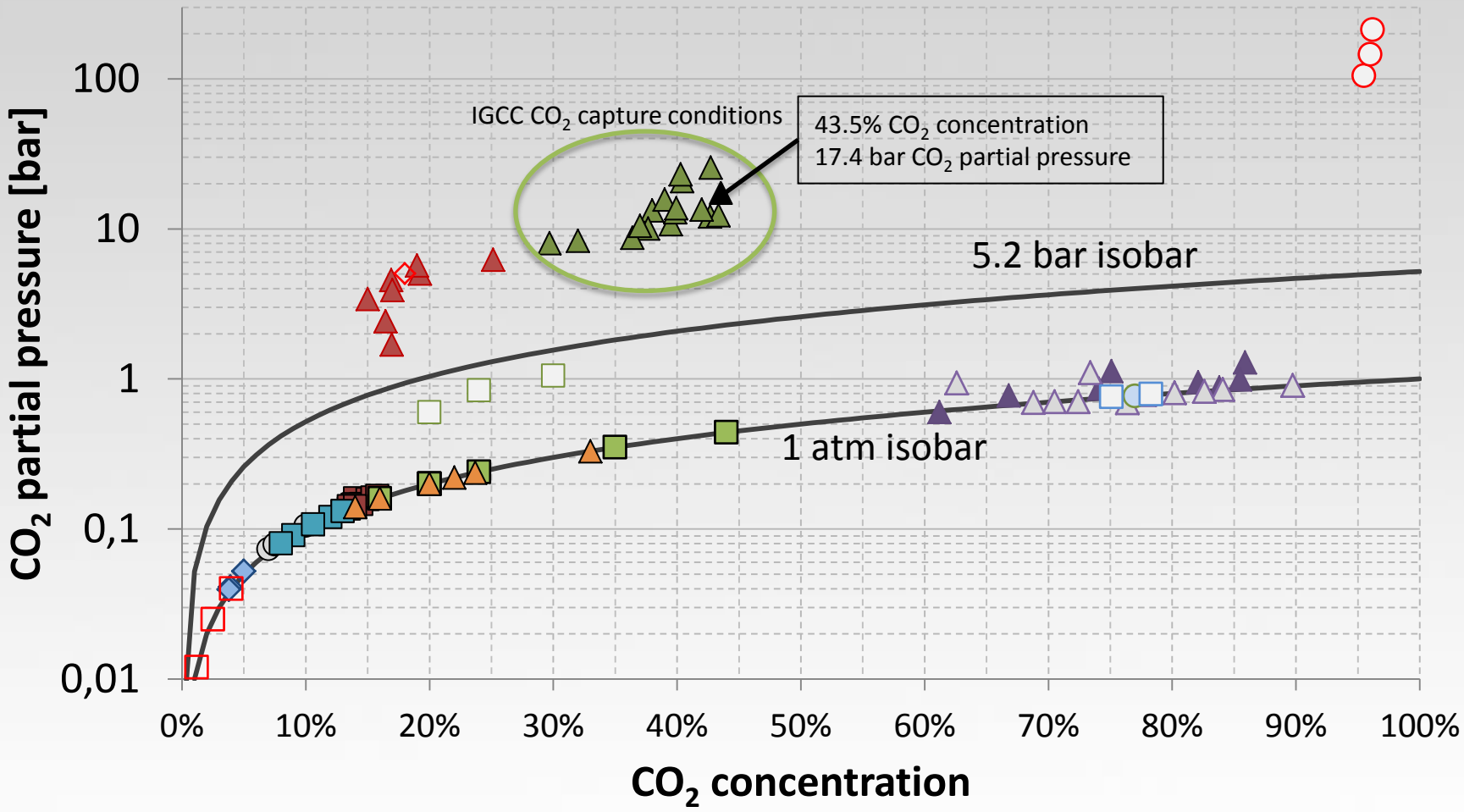
Norway Grants
WP3 – CCS separation process Cryogenic

David Berstad, SINTEF Energy Research
November 4, 2015

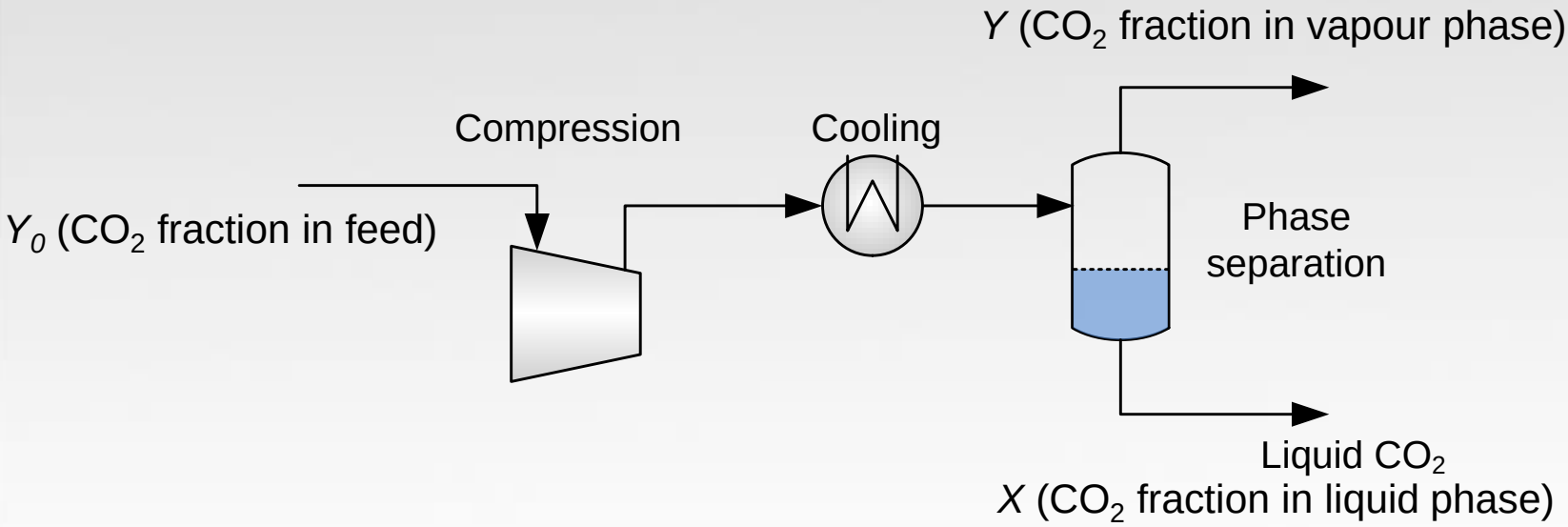
IGCC CO_2 capture conditions



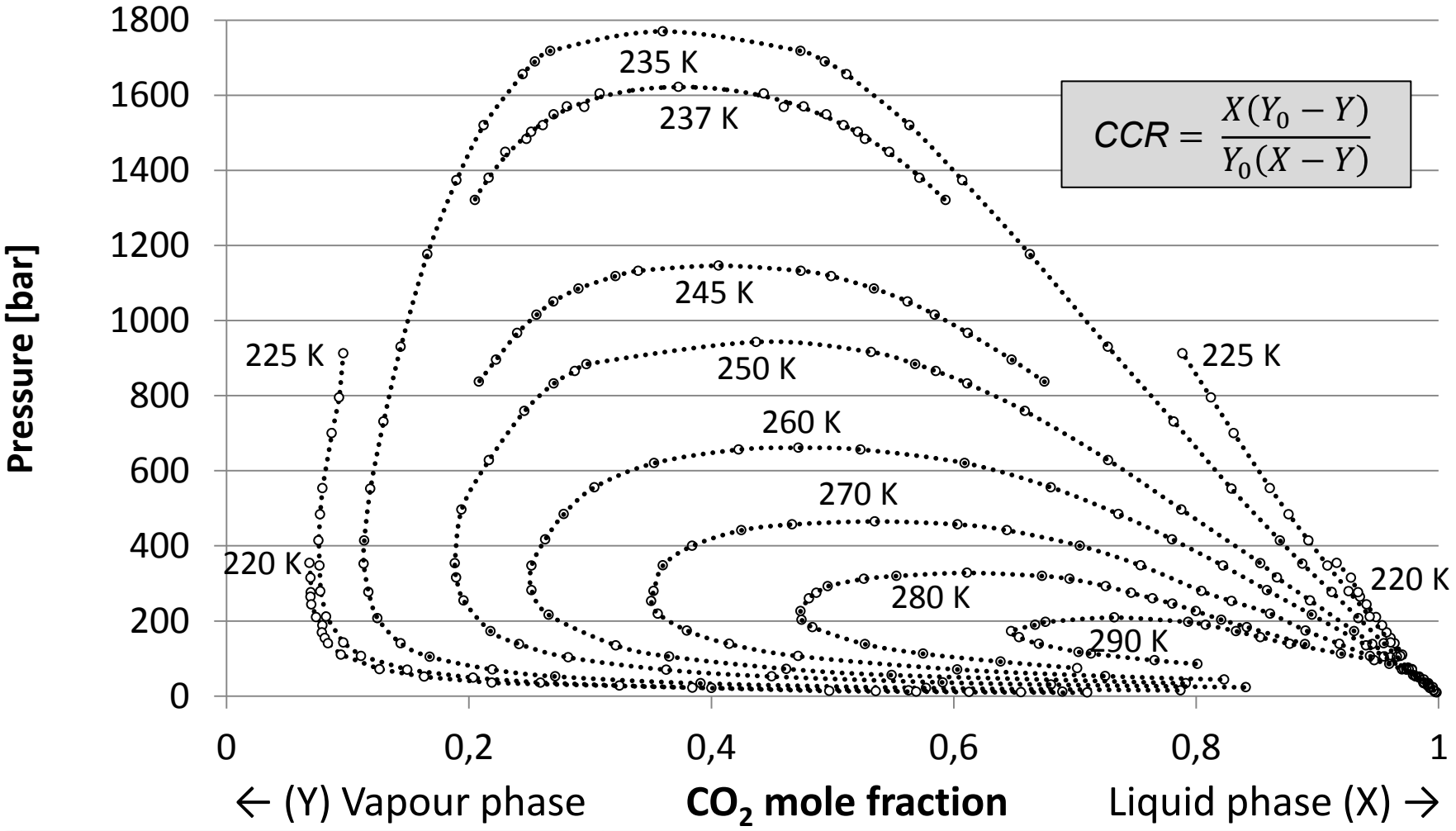
Achievable CO_2 capture ratio by vapour–liquid separation

- CO_2 capture ratio is governed by the vapour-liquid equilibrium, and depends on:
  - Feed CO_2 concentration
  - Separation pressure
  - Separation temperature

$$\mathrm{CCR} = \frac{X(Y_0 - Y)}{Y_0(X - Y)}$$

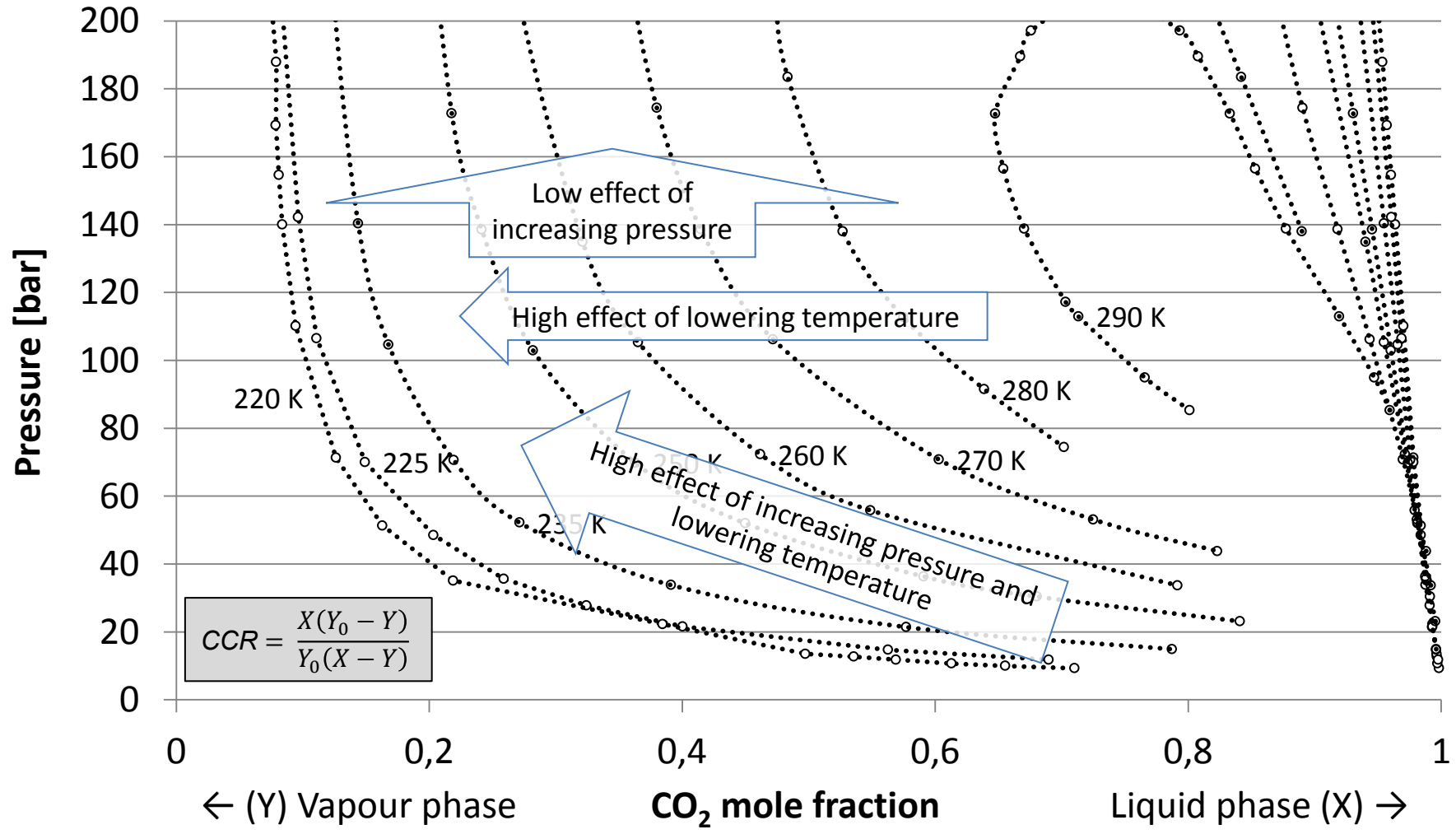


Achievable CO_2 capture ratio by vapour–liquid separation



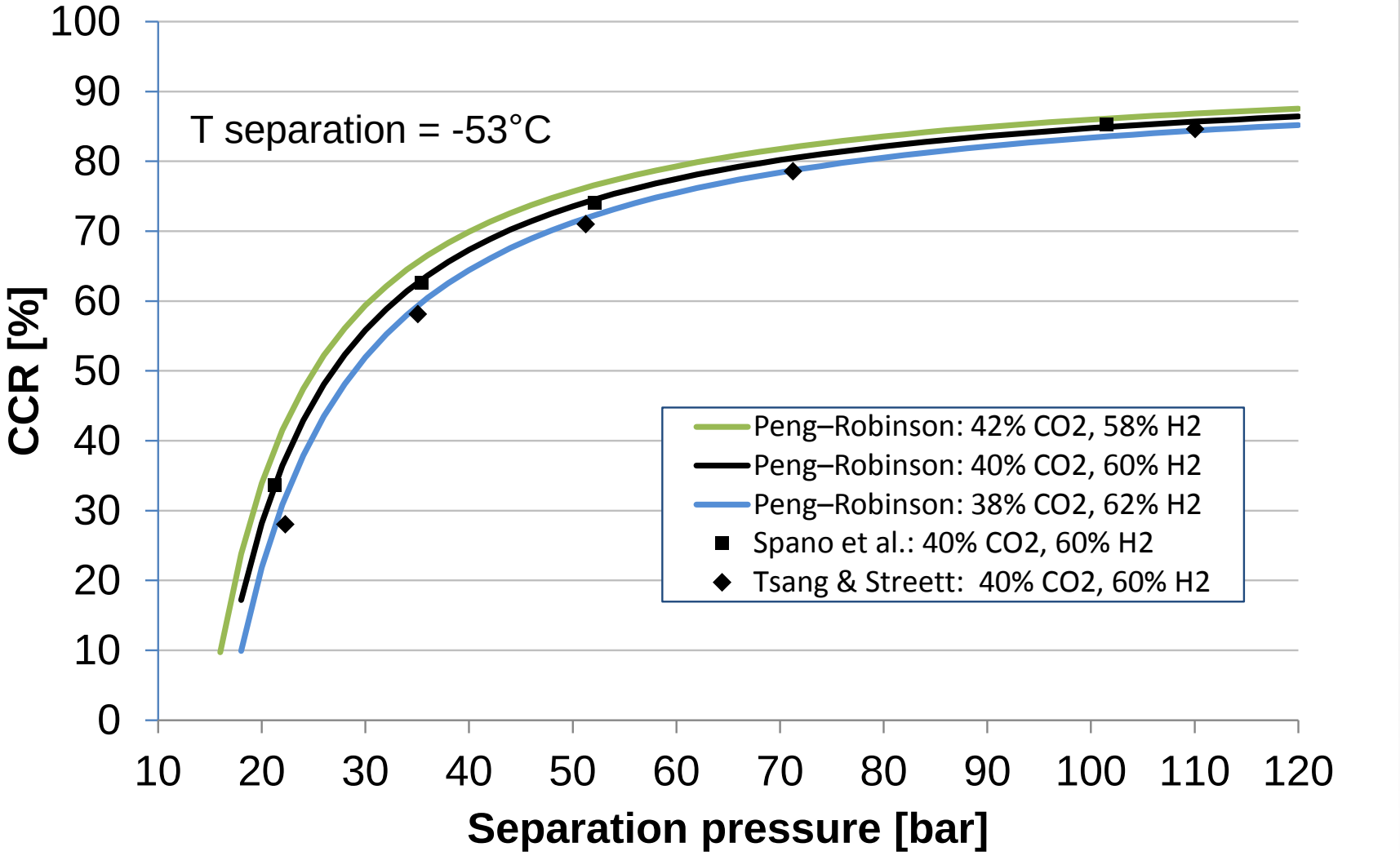
Based on data from:
Tsang, C.Y., Streett, W.B., 1981. Phase equilibria in the H_2/CO_2 system at temperatures from 220 to 290 K and pressures to 172 MPa. Chem. Eng. Sci. 36, 993–1000.

Achievable CO_2 capture ratio by vapour–liquid separation

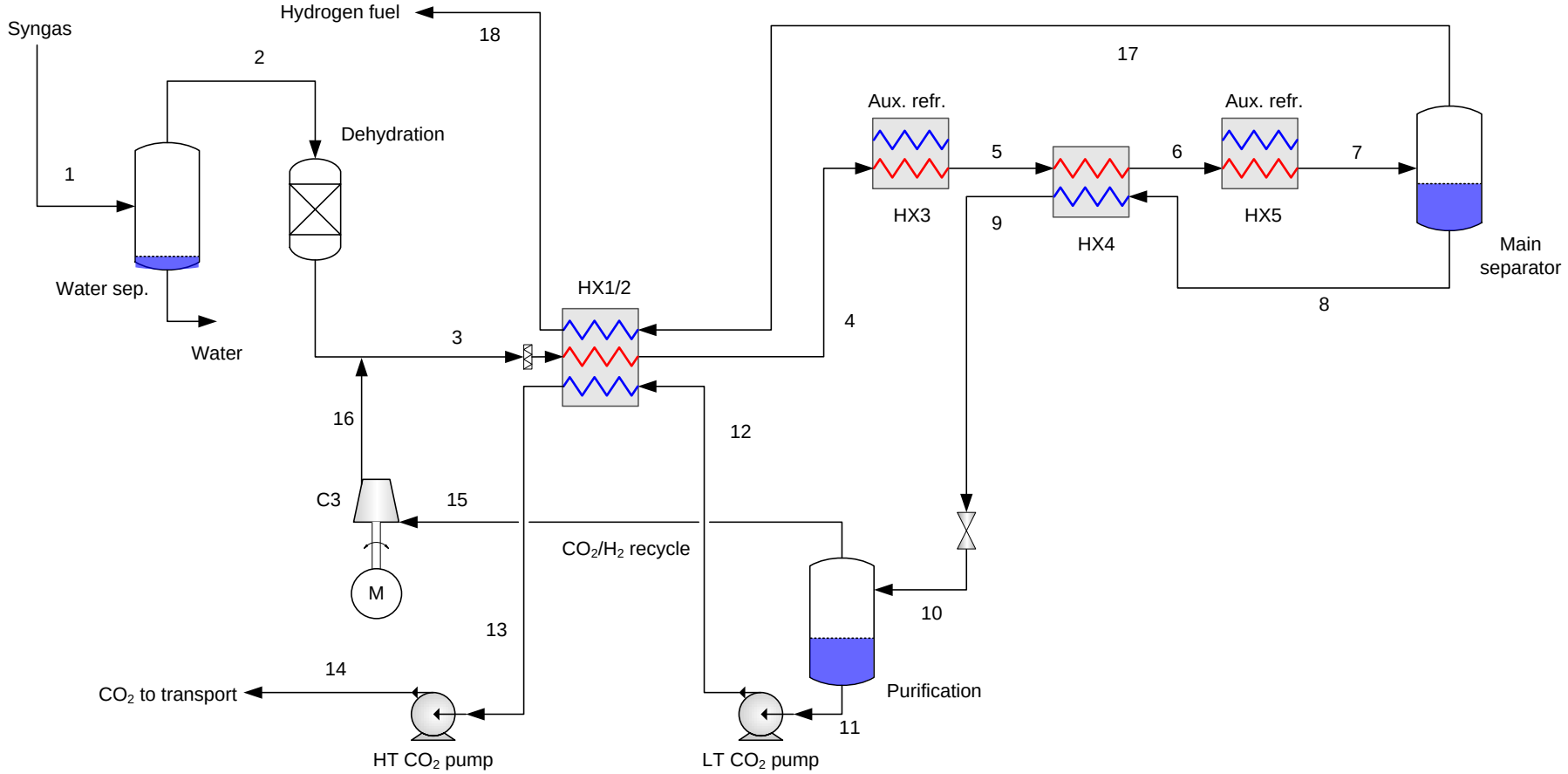


Based on data from:
Tsang, C.Y., Streett, W.B., 1981. Phase equilibria in the H_2/CO_2 system at temperatures from 220 to 290 K and pressures to 172 MPa. Chem. Eng. Sci. 36, 993–1000.

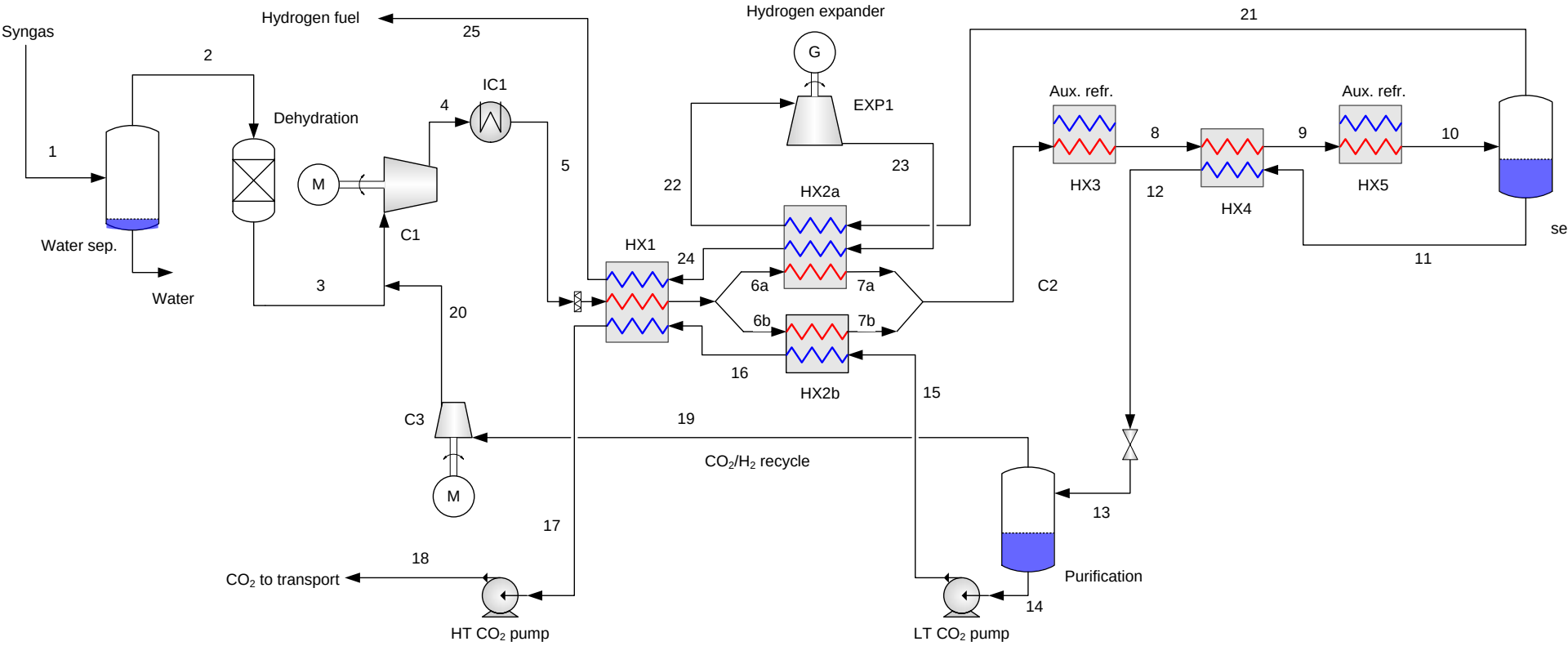
Achievable CO_2 capture ratio by vapour–liquid separation



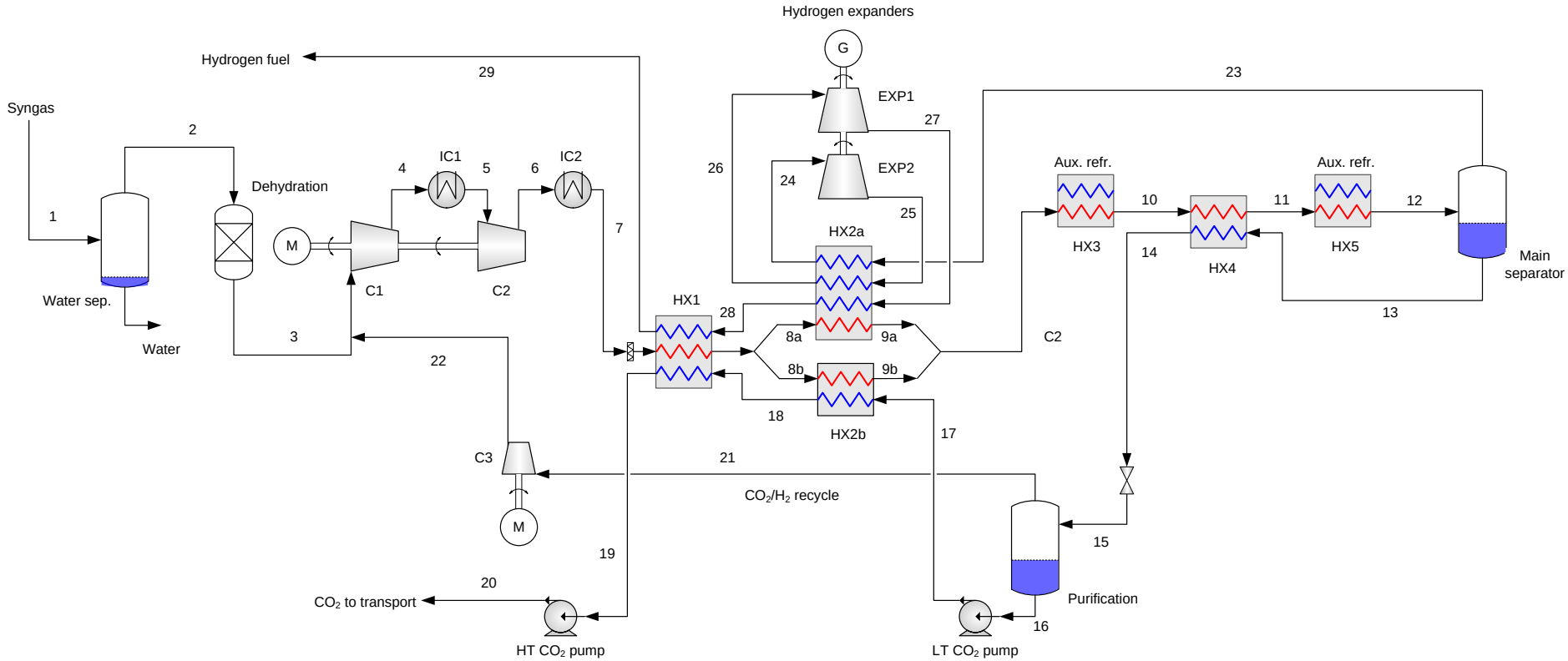
Process flow diagram
No compression (~72% CCR)



Process flow diagram
Compression to ~80 bar (~85% CCR)



Process flow diagram
Compression to ~115 bar (~87% CCR)



Preliminary results

Separation pressure [bar]	37.5	79	88	98	114
CO_2 capture ratio	72 %	85 %	86 %	87 %	88 %
Specific work [kJ/kg_{CO2}]	248	273	279	282	283

Further work

- Final optimisation of process designs for different CCR
- Final techno-economic optimisation of capture processes
- Cost optimum
  - Capex-Opex trade-off
  - Complexity vs. efficiency
- Determine cost-optimal CCR