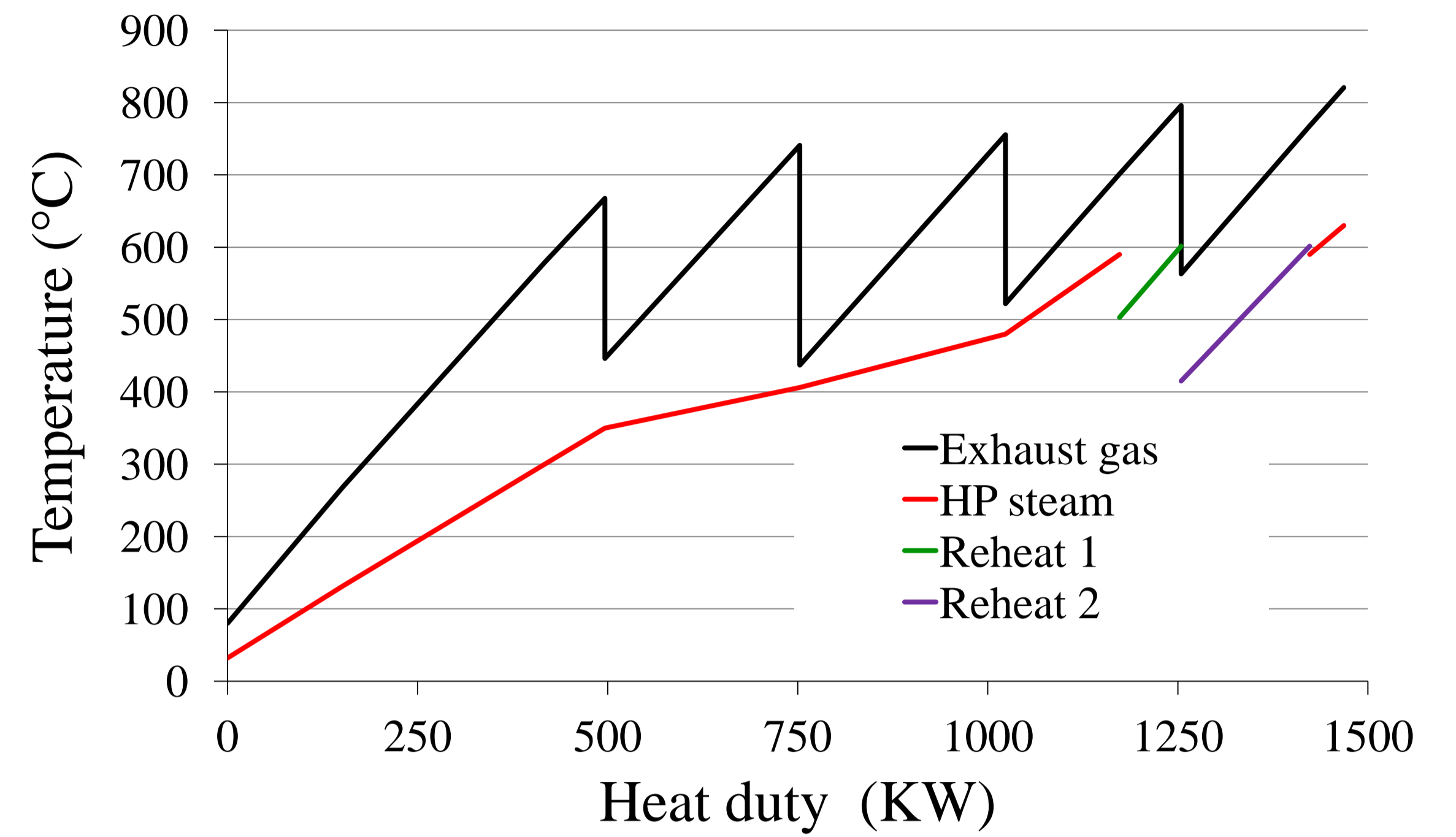
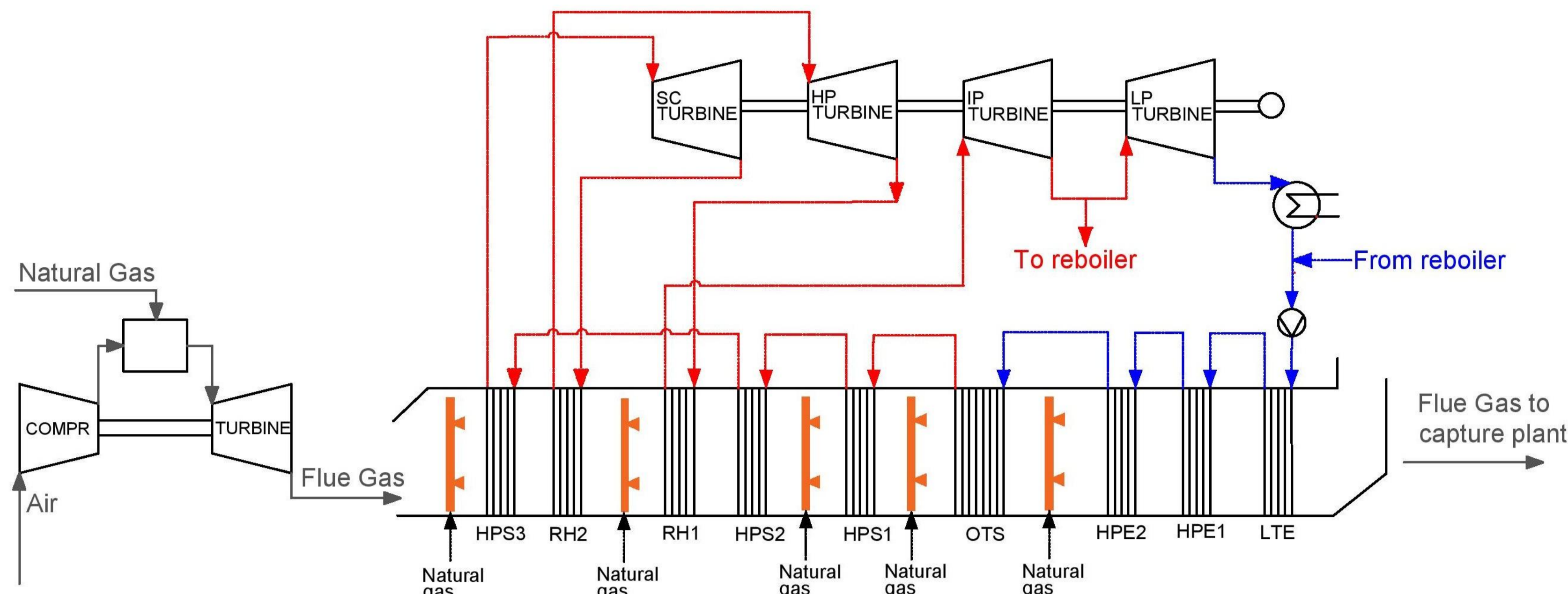


The viability of CO₂-EOR projects in the oil fields of Mexico will depend on the availability and supply of CO₂ at a reasonable cost. It is suggested that a CO₂ selling price around 40 (+/- 10) \$/tCO₂ may be an acceptable proposition for CO₂-EOR projects. At a gas price of 3-5 \$/MMBTU in Mexico, SSFCC is an alternative

Sequential supplementary firing with a supercritical steam turbine combined cycle (SSFCC) configuration

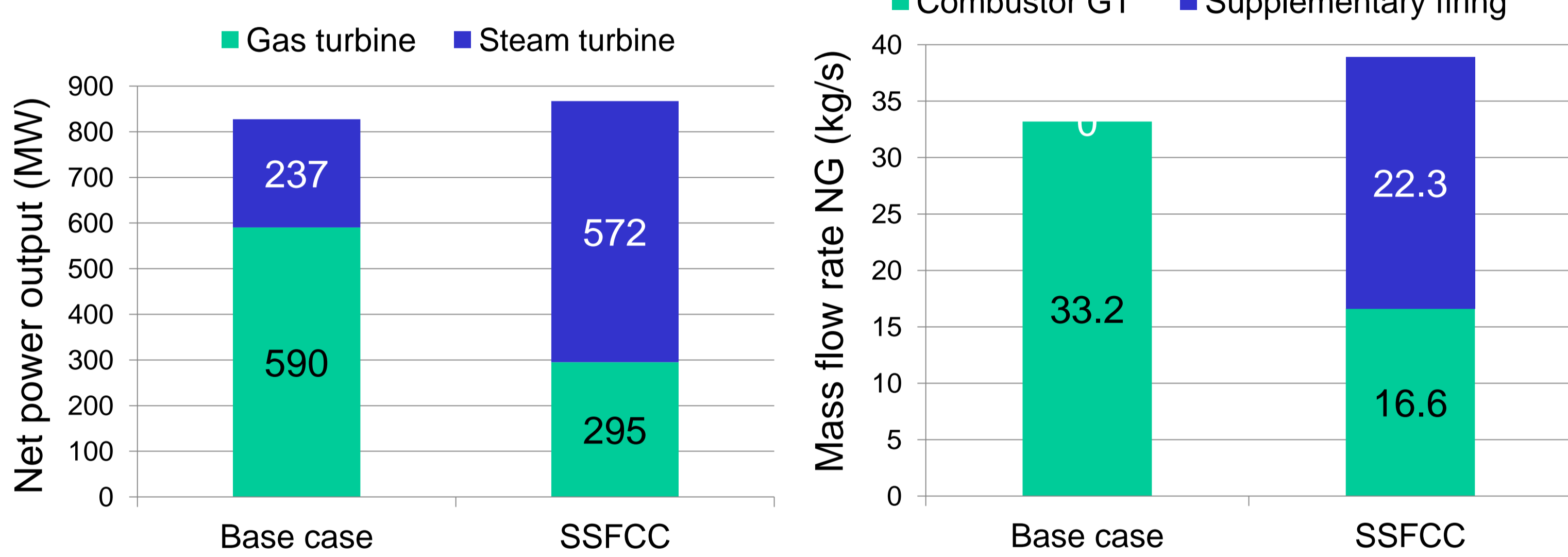


- SSFCC increases CO₂ concentration and reduces O₂ concentration
- Lower solvent degradation
- Reduces exhaust gas volume
- Lower capital cost

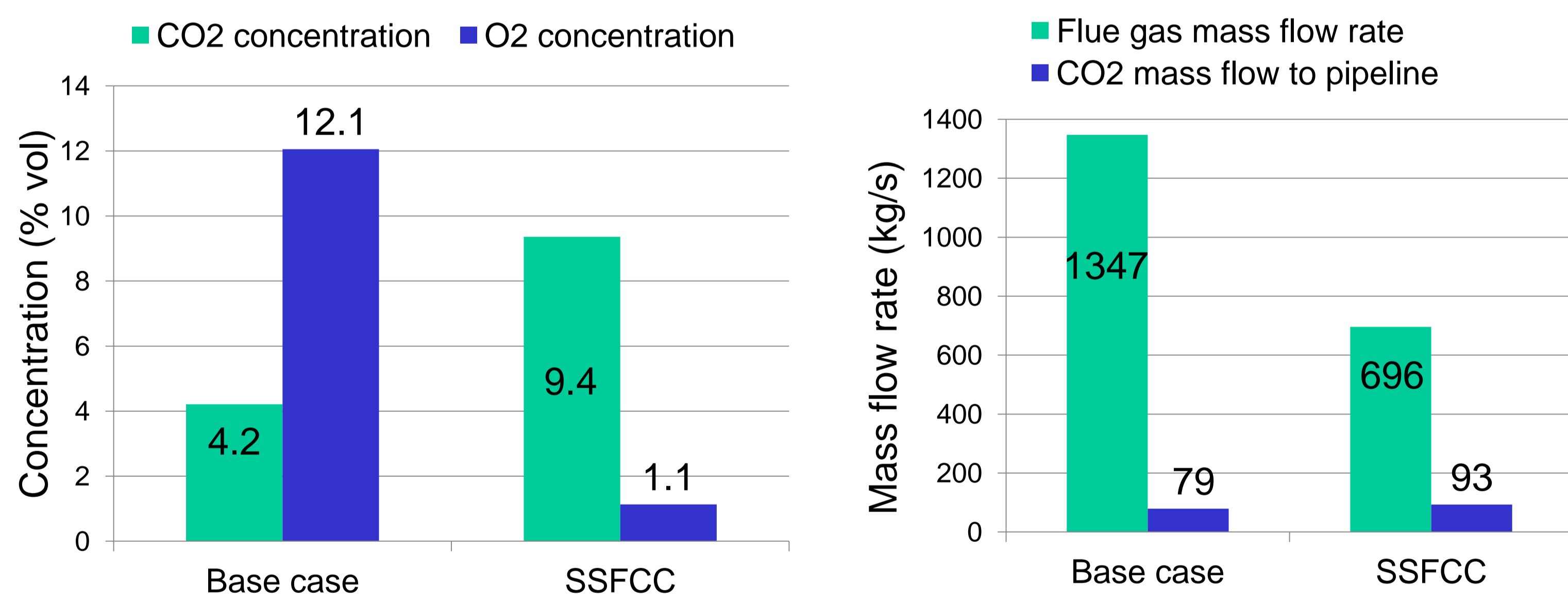
Peak temperature reaches 820°C in the first 2 stages and 800°C, 790°C, 700°C in last 3 stages respectively

Summary of simulation results

Net efficiency with capture and compression (LHV) is reduced from **49%** natural gas combined cycle (NGCC) to **45.4%** SSFCC



The SSFCC configuration requires a single gas turbine/HRSG train compared to two gas turbine/HRSG trains for a standard NGCC.

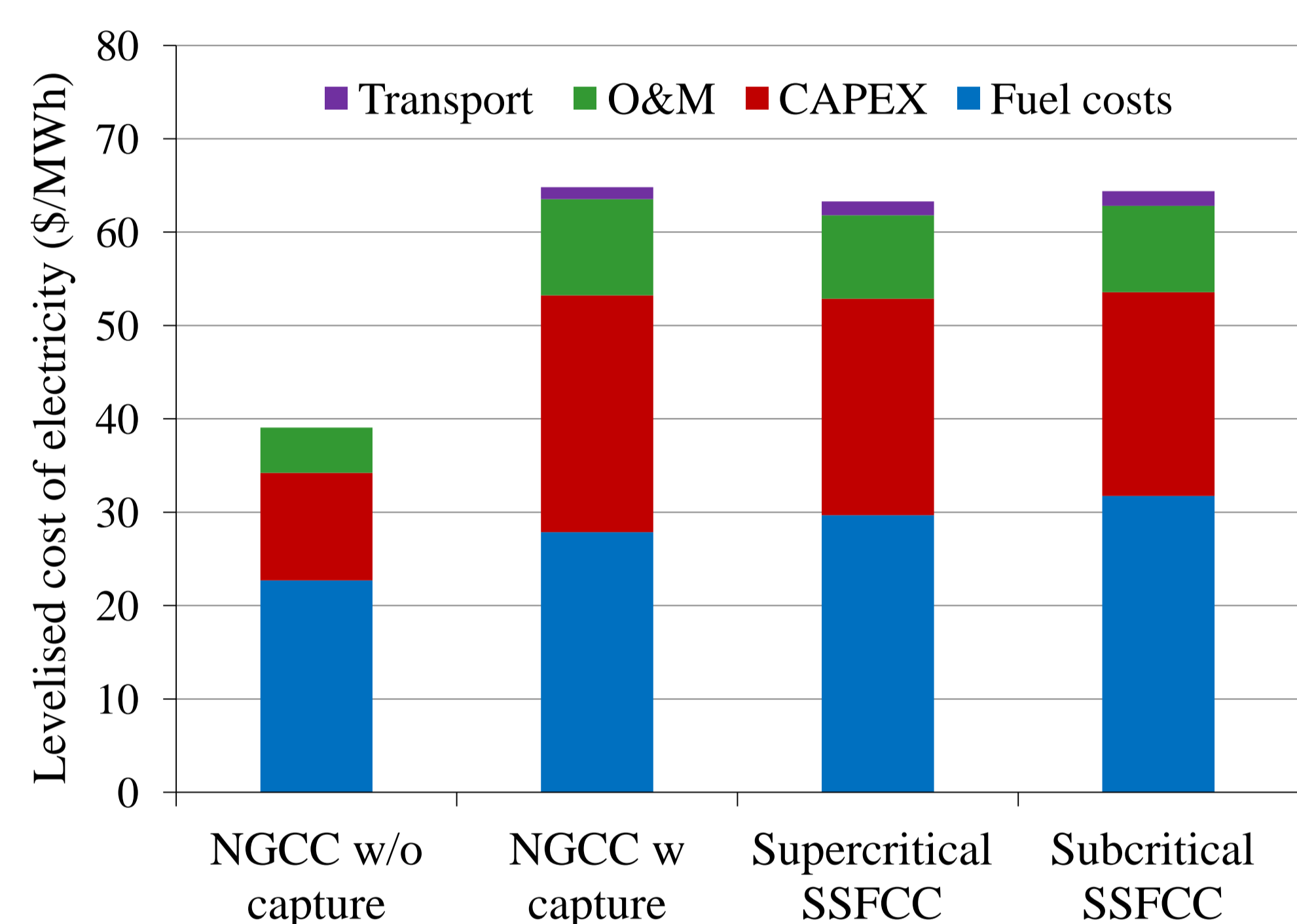


- The number of absorber trains is reduced from **four to two**
- Rigorous simulation shows that size of the stripper and compression train remain the same in both cases

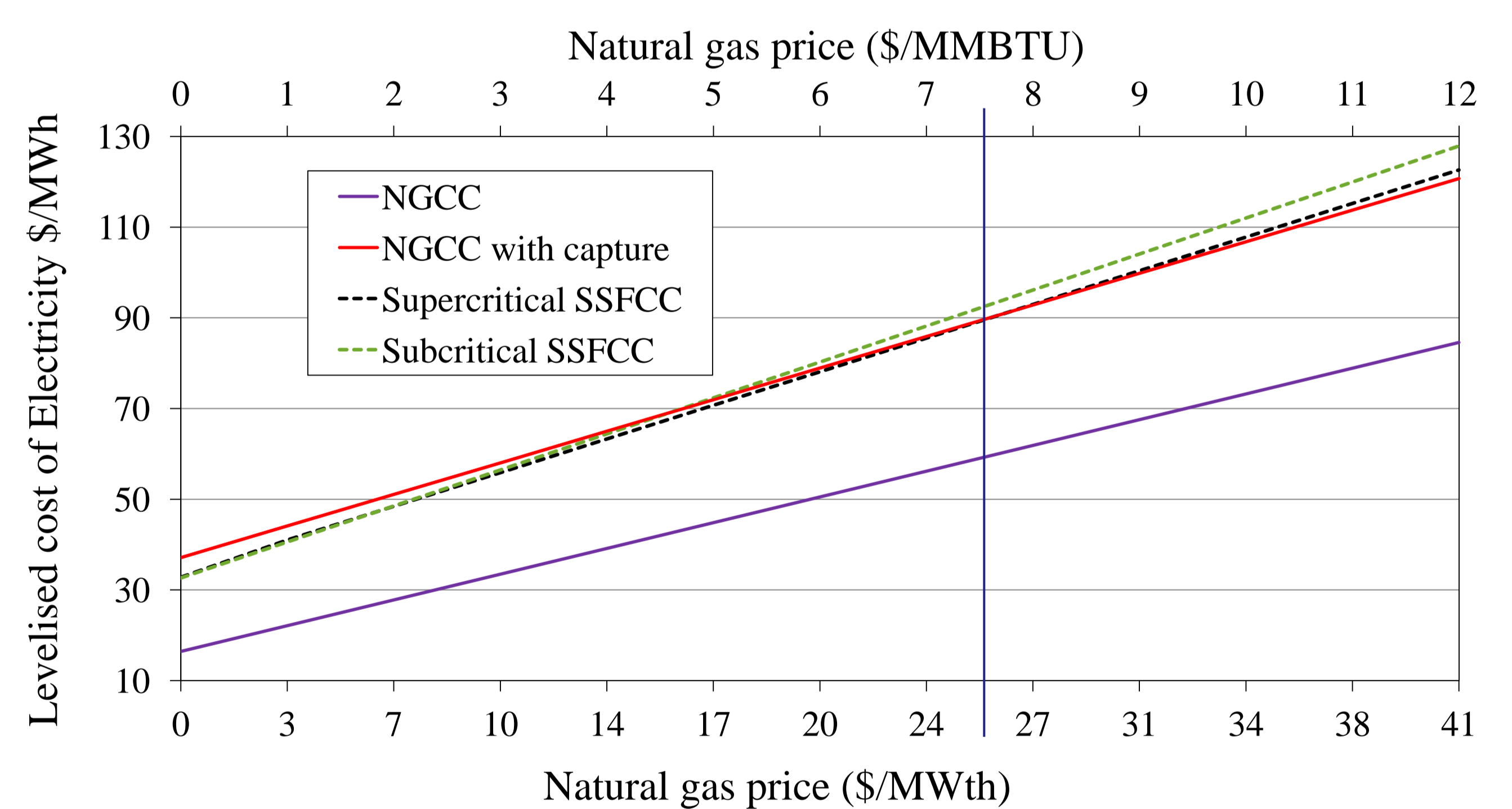
Conclusion

- An HRSG is proposed to use additional fuel to increase CO₂ concentration by reducing excess oxygen levels (1% vol)
- The thermal efficiency is reduced by 5.5% compared to a NGCC plant with capture
- The increase in output of the steam cycle leads to the use of a single gas turbine/HRSG train, compared to a standard CCGT with two gas turbine trains
- At gas prices ranging from 4 to 7.5 \$/MMBTU, supercritical SSFCC represents the lowest LCOE.
- Full capital cost implications of the upgrade of the HRSG and combined cycle have been developed in order to confirm that supercritical SSFCC can be justified in the context of current expectations of CO₂ prices for EOR and natural gas prices.

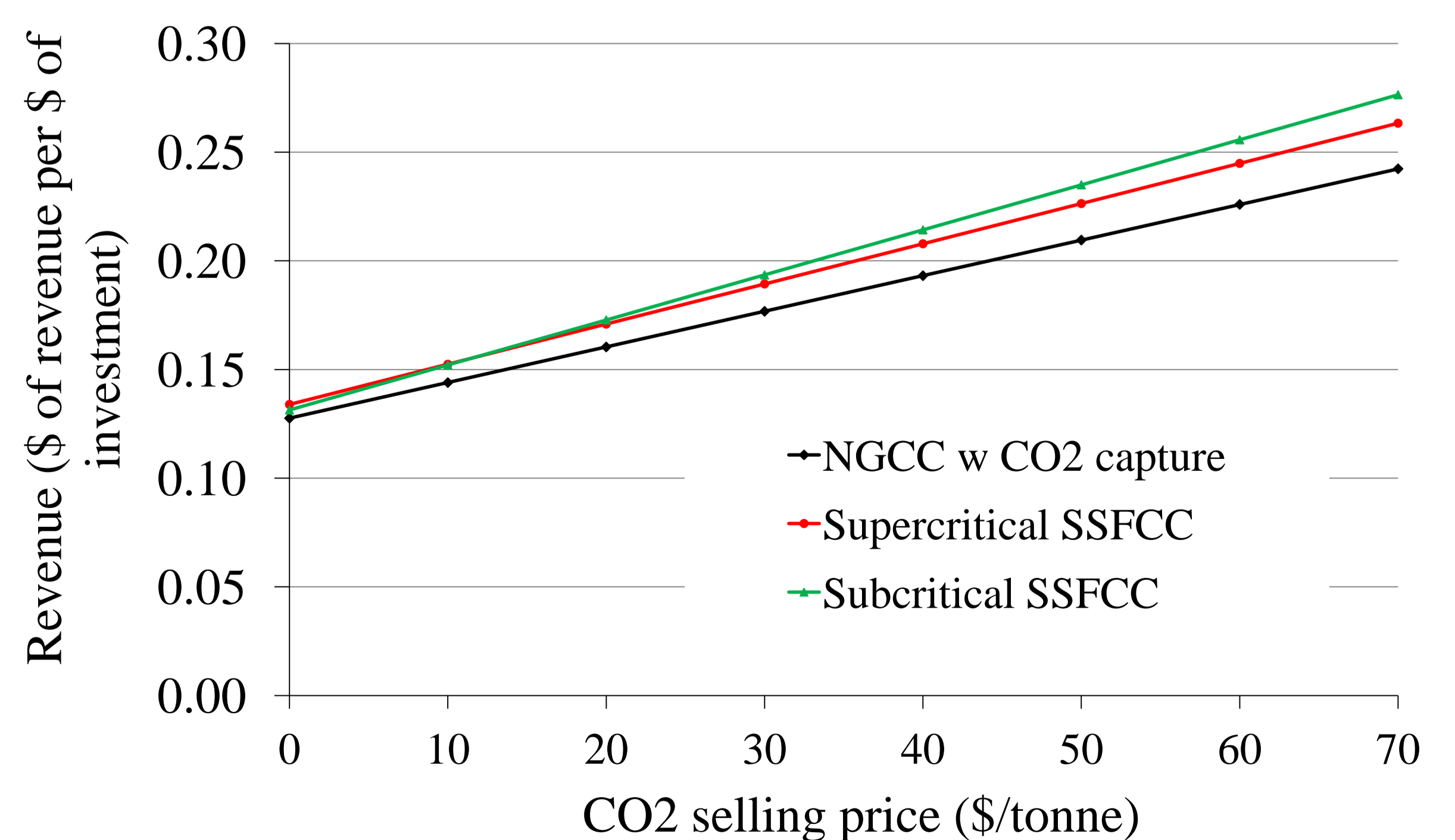
Techno-economic analysis for EOR scenarios



Levelised cost of electricity at 2013, natural gas price of 4 \$/MMBTU (13.65 \$/MWh) including compression and transport costs. CO₂ emission prices and selling CO₂ are not considered.



Sensitivity analysis of levelised cost of electricity for all case studies with capture plant at different natural gas prices, at 2013.



Variations of \$ of revenue per \$ of investment for a natural gas sequential supplementary firing combined cycle plant with CO₂ capture for a range of CO₂ prices and gas price of 4 \$/MMBTU (13.6 \$/MW_{th}) and LCOE of 65 \$/MWh