sCO_2 Cycle Analysis – Preliminary Results

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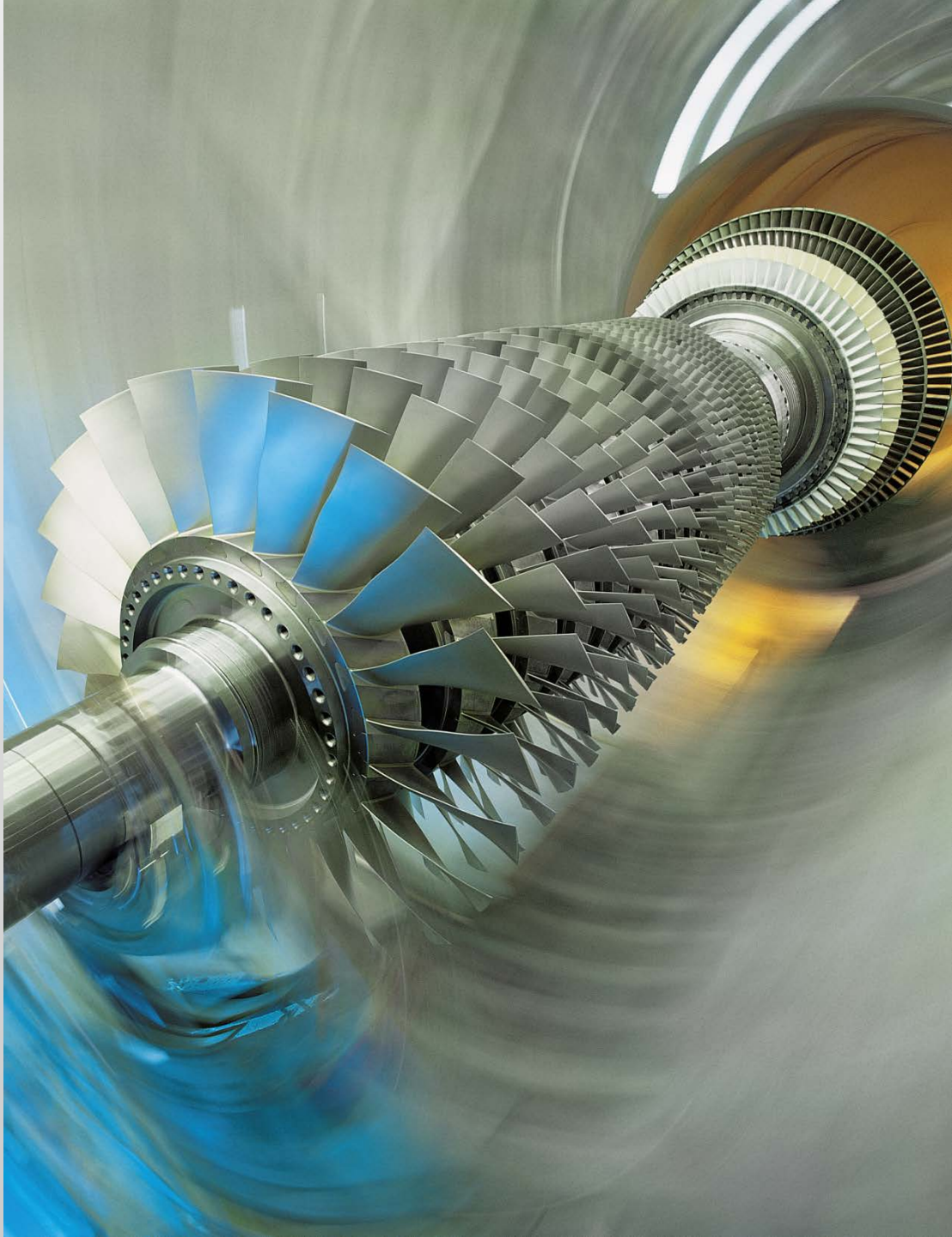

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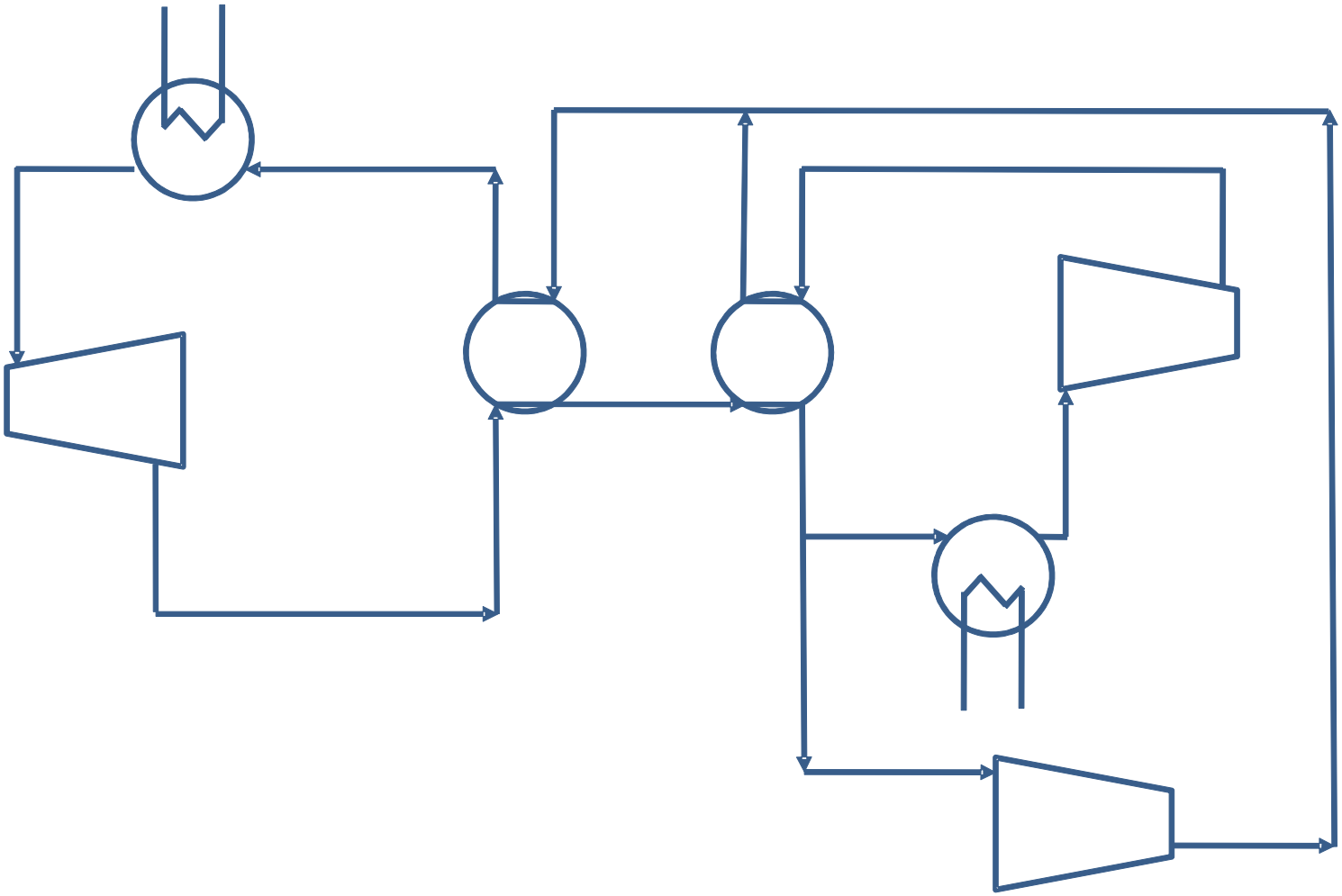
Overview

- **Baseline process**
- **Additional sensitivity analysis**
- **Cost surrogate variables**

Recompression Brayton Cycle

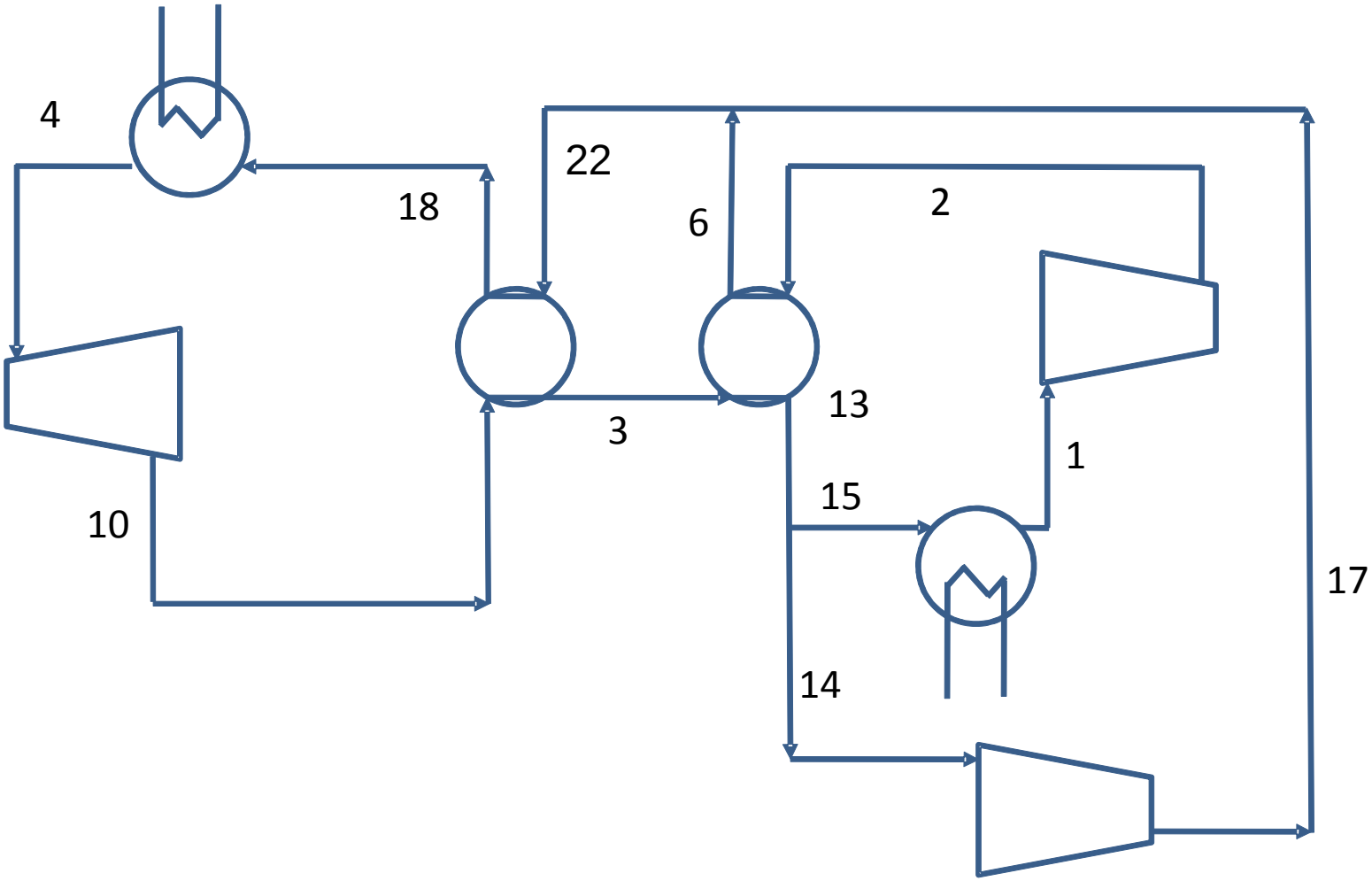


Recompression Brayton Cycle

Parameters for Baseline Cycle

Parameter	Value
Net output	10 MW
Turbine exit pressure	1150 psia
CO_2 cooler temperature	35 °C (95 °F)
Heat source	Agnostic
Turbine isentropic efficiency	0.927
Compressor isentropic efficiency	0.85
Cycle pressure drop	60 psia
Minimum temperature approach	5.6 °C (10 °F)
Turbine inlet temperature	700 °C (1292 °F)
Compressor pressure at maximum efficiency	3250 psia
Pressure ratio at maximum efficiency	2.9

Recompression Brayton Cycle



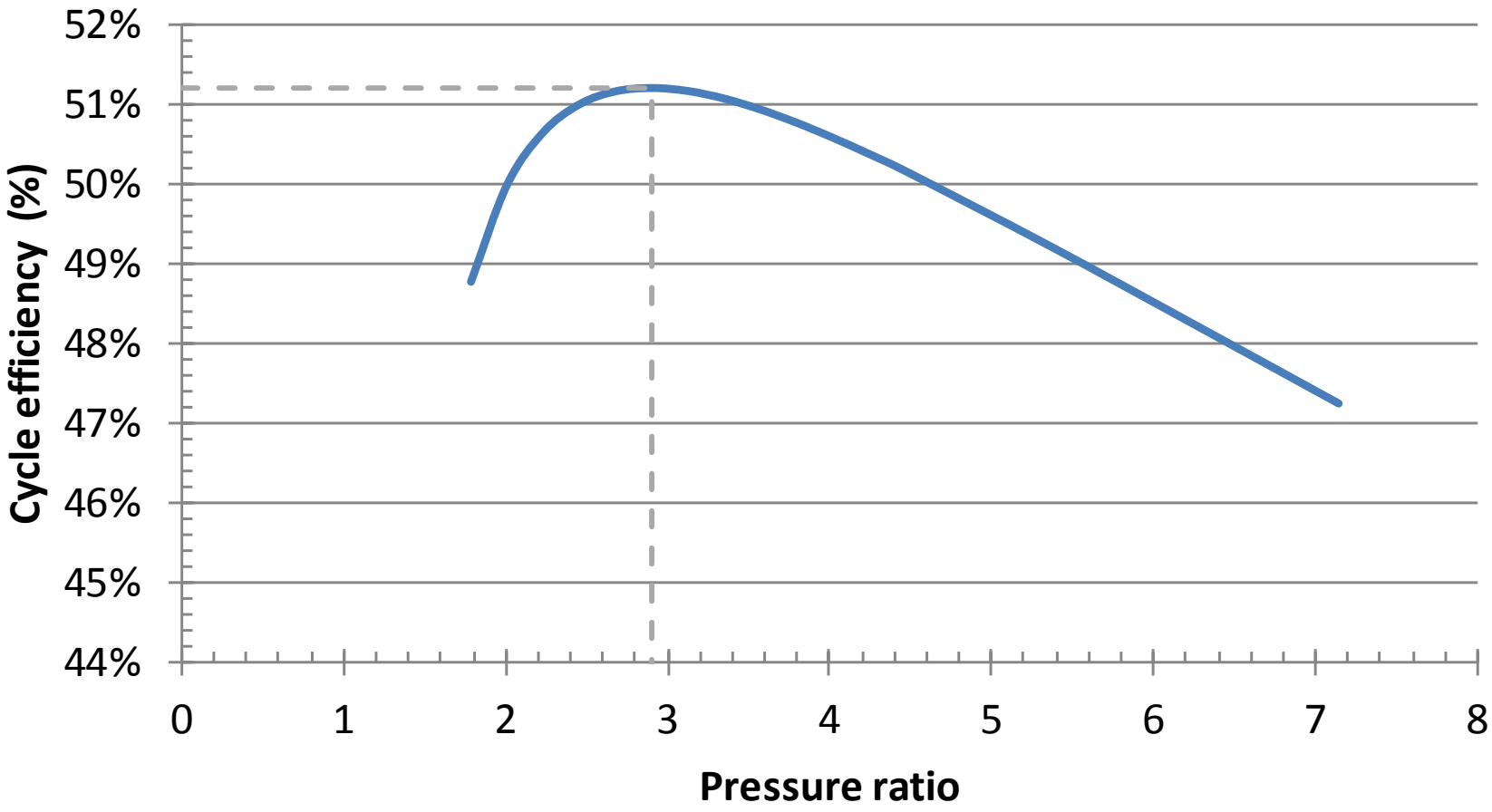
Recompression Brayton Cycle

Stream table at compressor pressure 3250 psia

	1	2	3	4	6	10	13	14	15	17	18	22
Temperature (°F)	95	227.2	452.1	1292	442.1	1045.2	237.2	237.2	237.2	442.1	981.5	442.1
Pressure (psia)	1120	3250	1120	3220	3250	1150	1120	1120	1120	3250	3220	3250
Vapor Frac	1	1	1	1	1	1	1	1	1	1	1	1
Mole Flow (lbmol/hr)	11,634	11,634	16,076	16,076	11,634	16,076	16,076	4,442	11,634	4,442	16,076	16,076
Mass Flow (lb/hr)	511,991	511,991	707,496	707,496	511,991	707,496	707,496	195,505	511,991	195,505	707,496	707,496
Volume Flow (cuft/hr)	25,819	17,281	134,286	99,381	31,984	229,742	89,100	24,621	64,479	12,213	81,277	44,198
Enthalpy (MMBtu/hr)	-1994.53	-1985.19	-2668.36	-2499.89	-1942.33	-2550.86	-2711.22	-749.202	-1962.02	-741.686	-2566.52	-2684.02
Mole Flow (lbmol/hr)												
CO_2	11,634	11,634	16,076	16,076	11,634	16,076	16,076	4,442	11,634	4,442	16,076	16,076

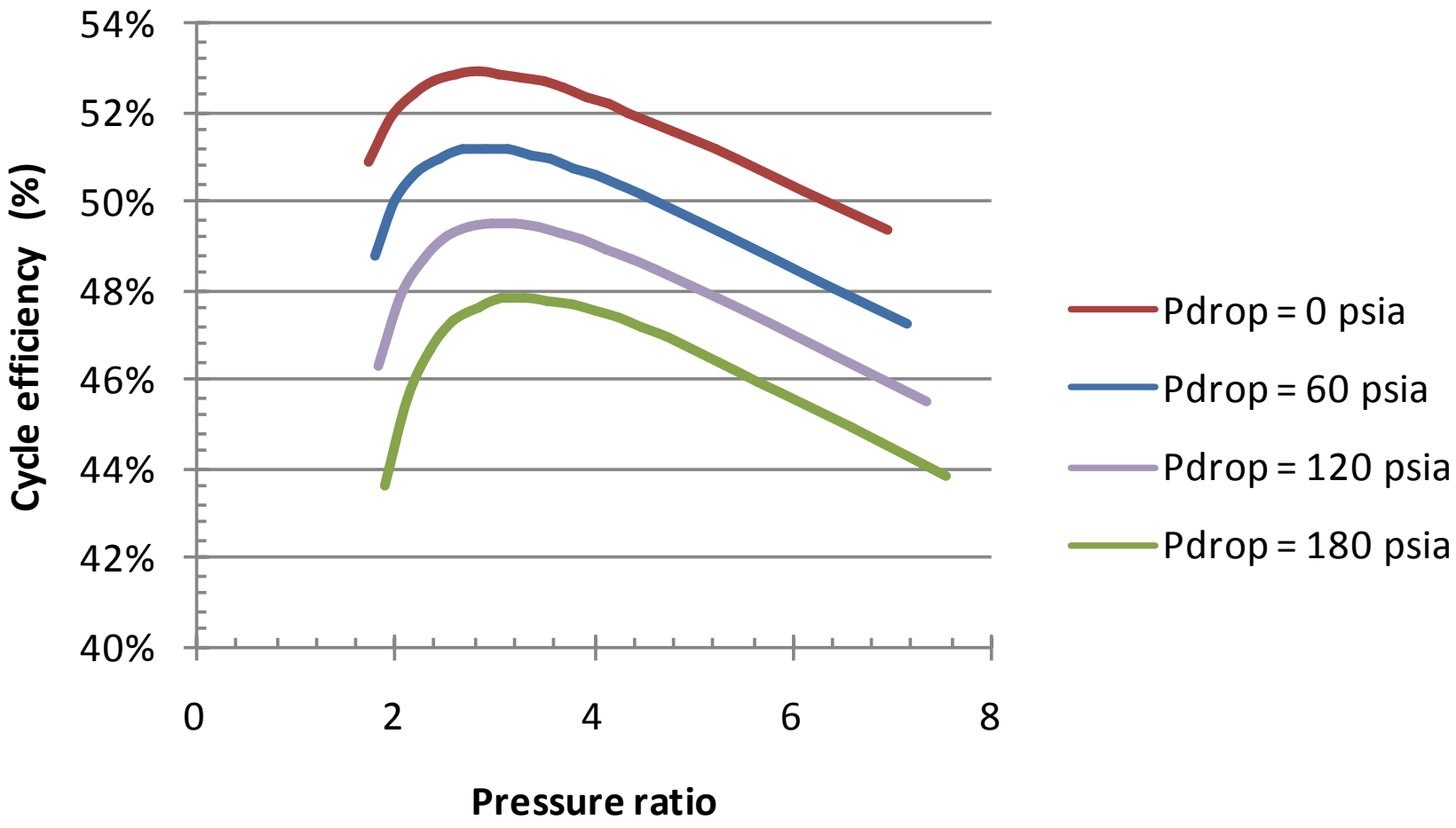
Recompression Brayton Cycle

Sensitivity to pressure ratio



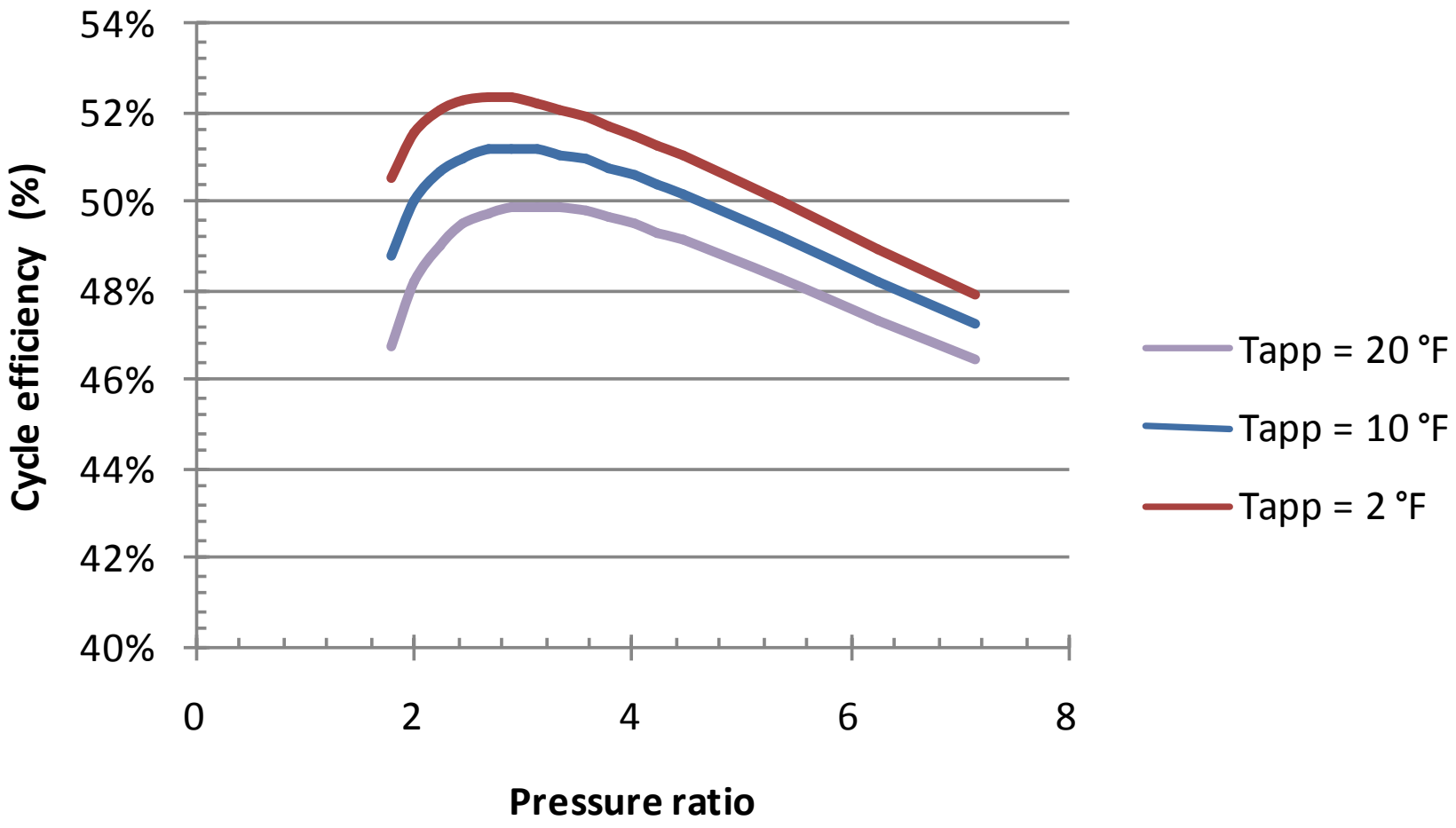
Recompression Brayton Cycle

Sensitivity to pressure drop



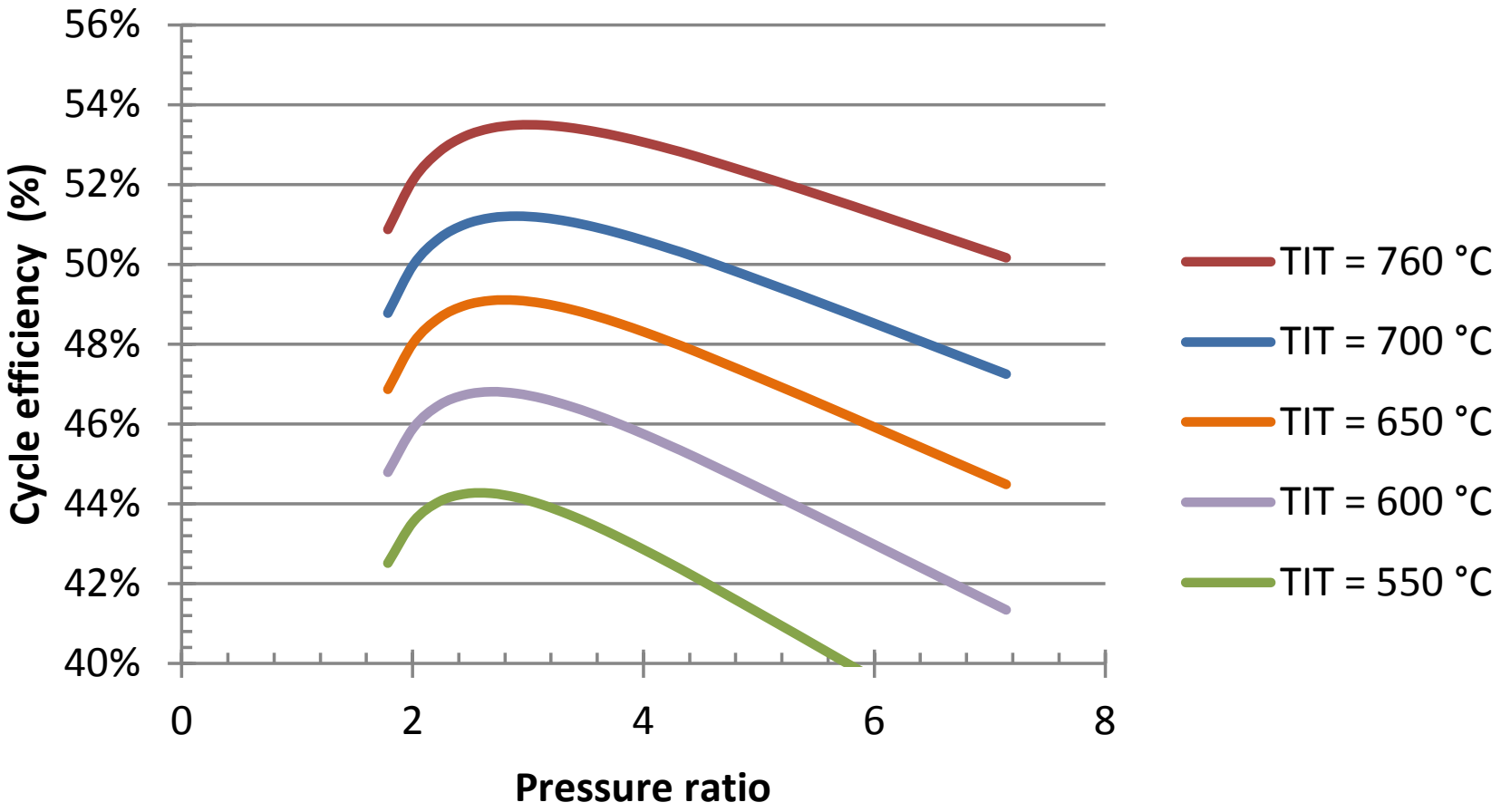
Recompression Brayton Cycle

Sensitivity to minimum temperature approach



Recompression Brayton Cycle

Sensitivity to turbine inlet temperature



Cost surrogate variables

- **Compressor & Turbine**
  - Power
  - Pressure ratio
  - Mass flow
  - Volumetric flow
  - Inlet Temperature

- **Recuperator**
  - Duty
  - LMTD (UA)

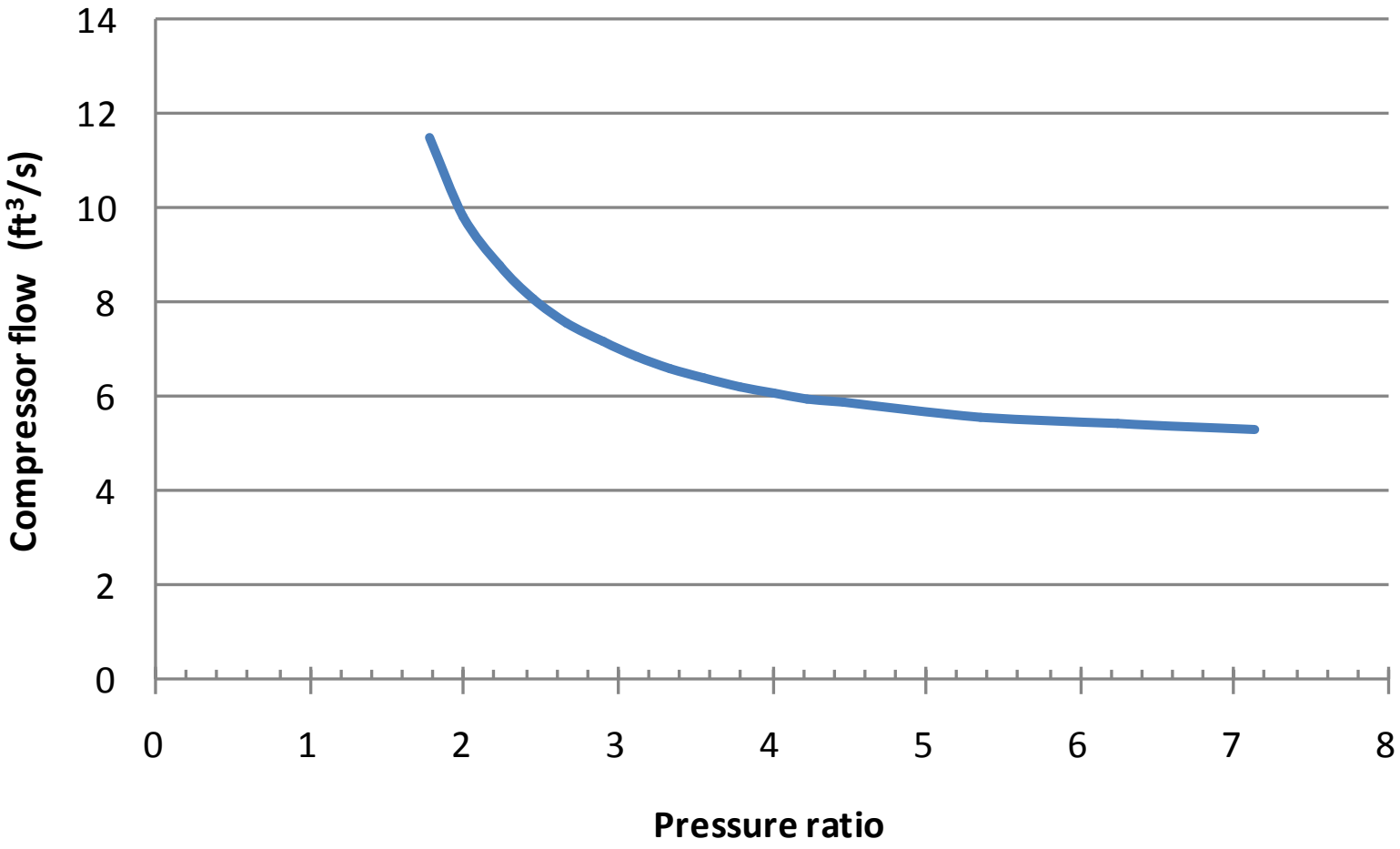
Cost surrogate variables

- **General**
  - Cycle efficiency
  - Mass flow
  - Specific power

- **Heat source**
  - Duty
  - CO_2 thermal capacitance
  - LMTD (UA)

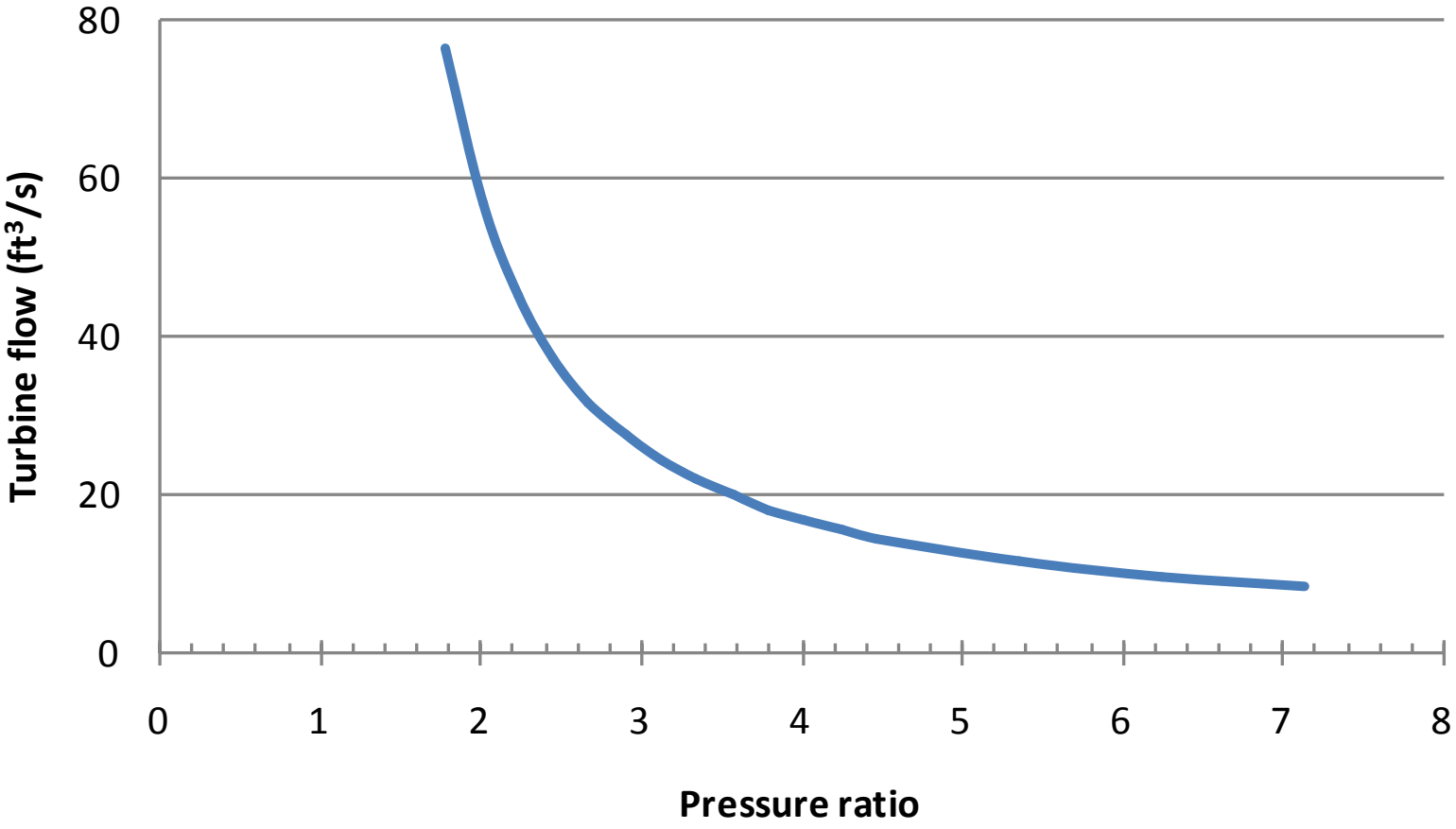
Recompression Brayton Cycle

Main compressor inlet volumetric flow



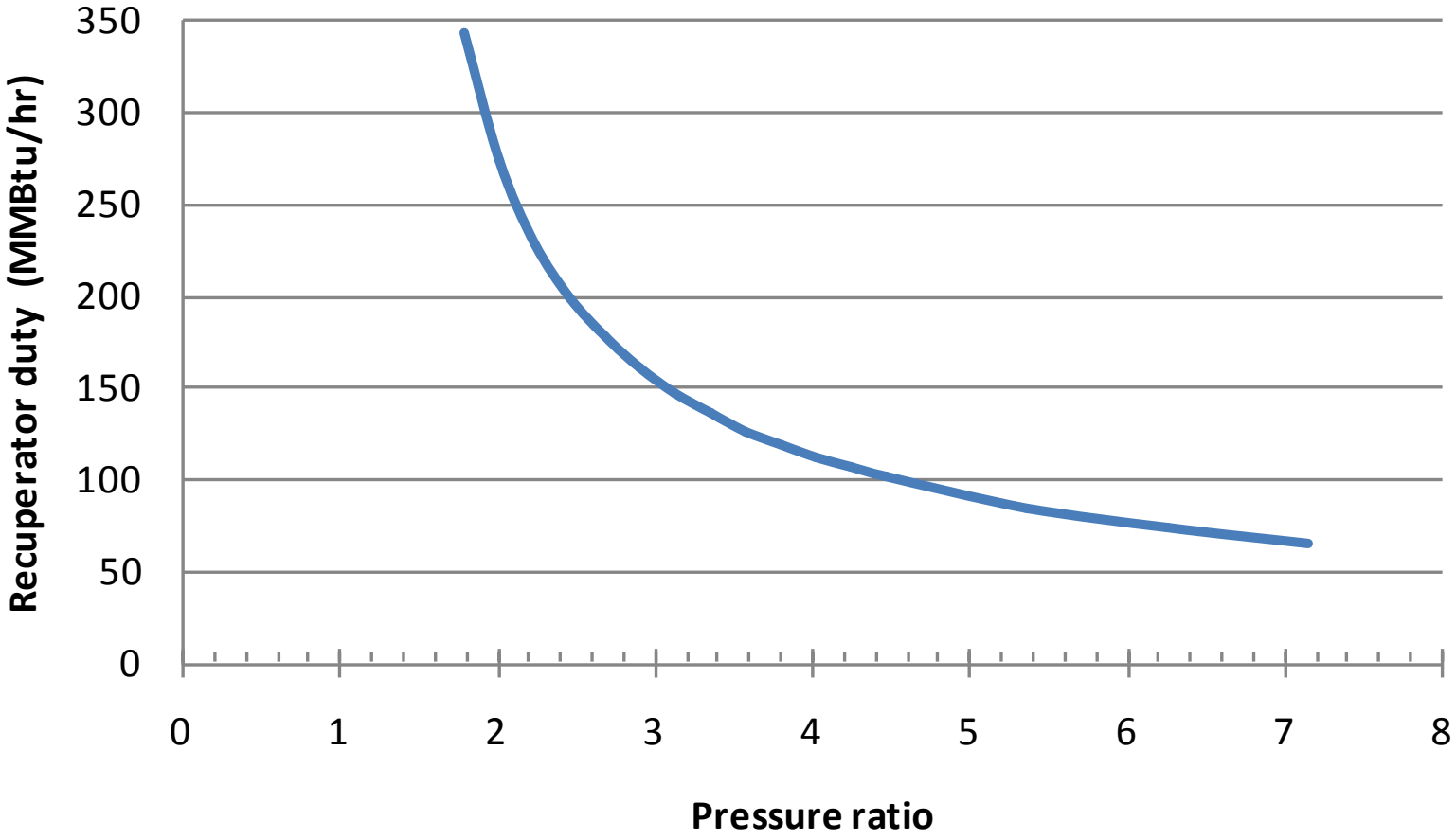
Recompression Brayton Cycle

Turbine inlet volumetric flow



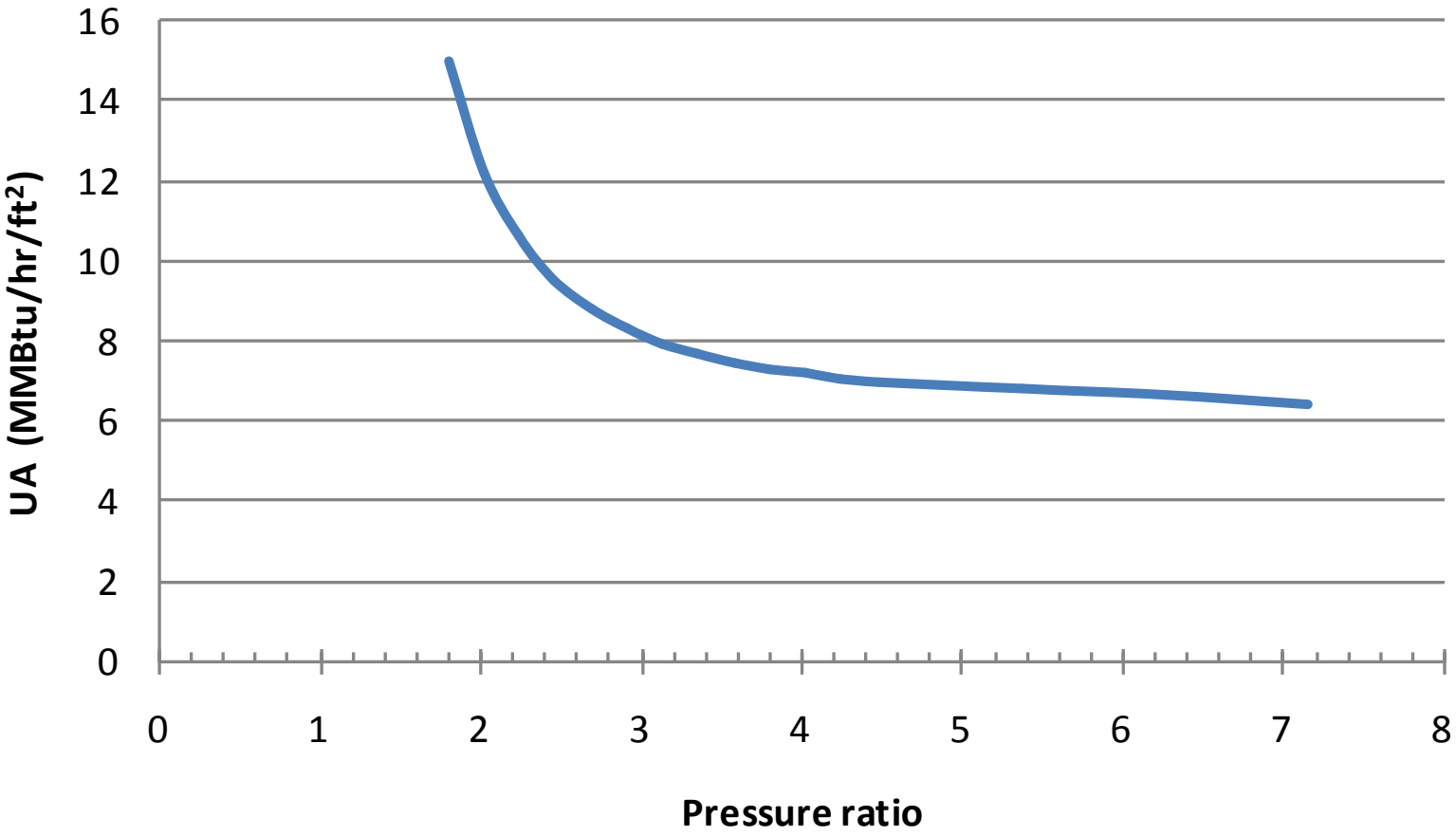
Recompression Brayton Cycle

Total recuperator duty



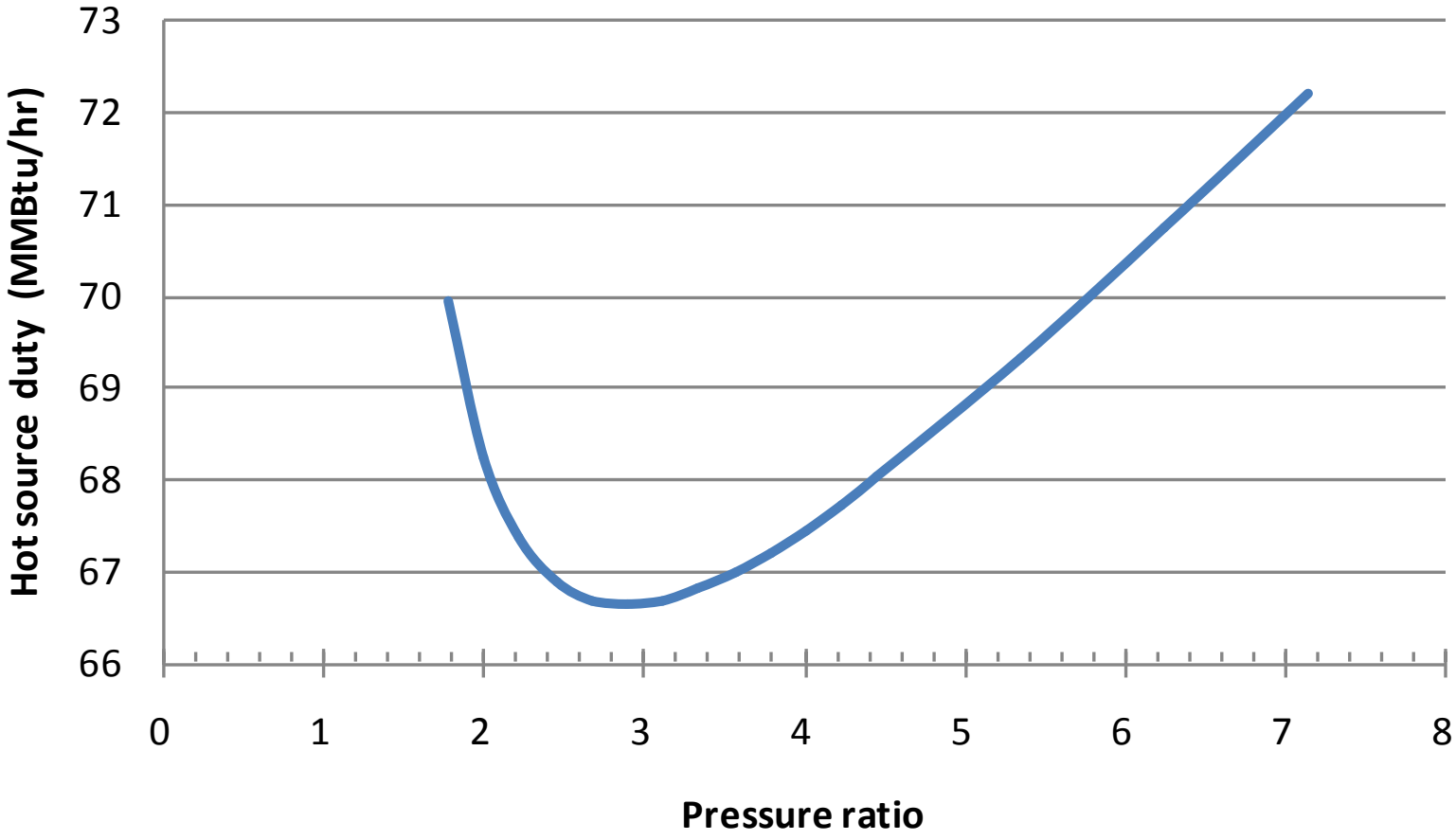
Recompression Brayton Cycle

Total recuperator UA



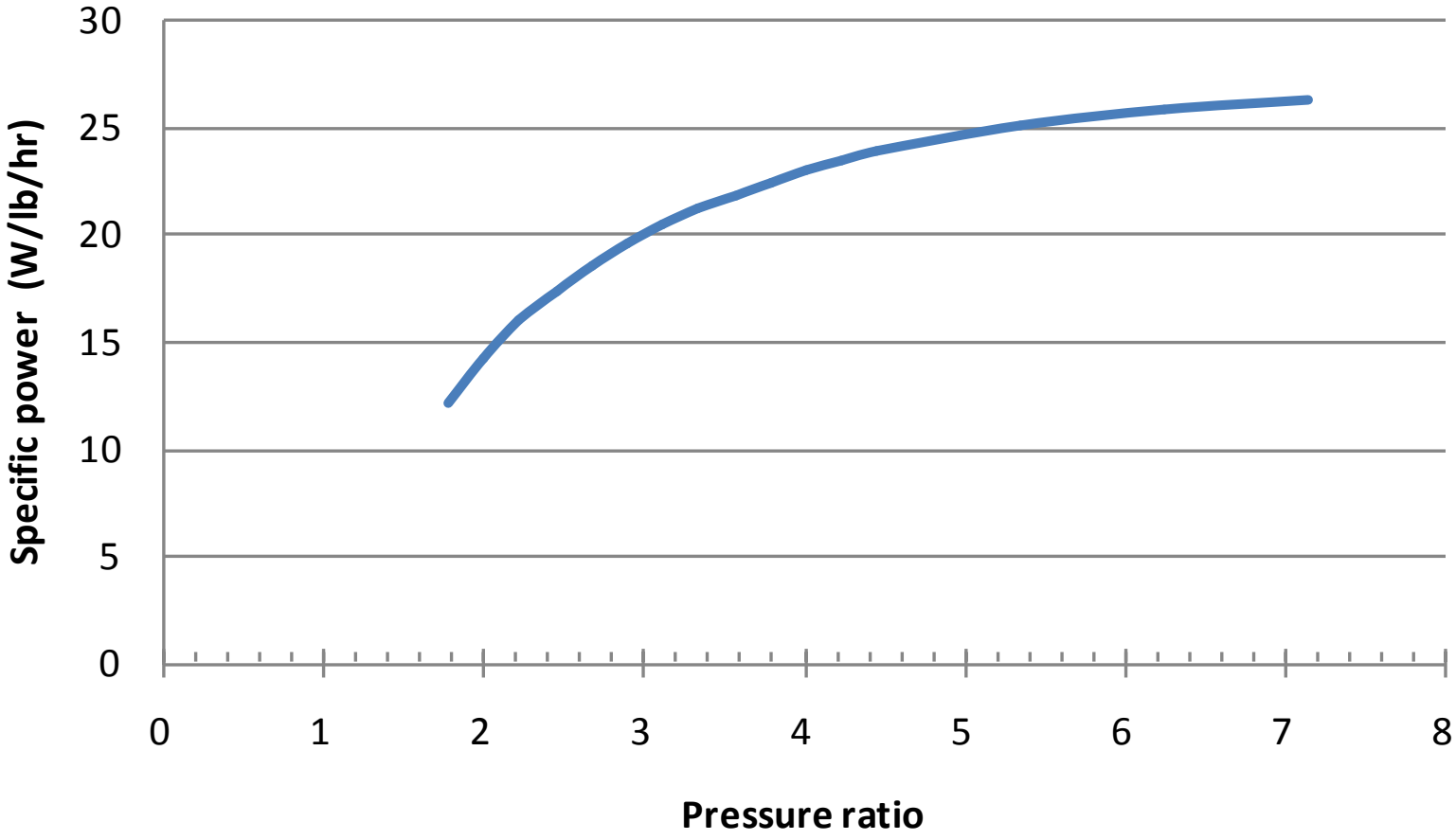
Recompression Brayton Cycle

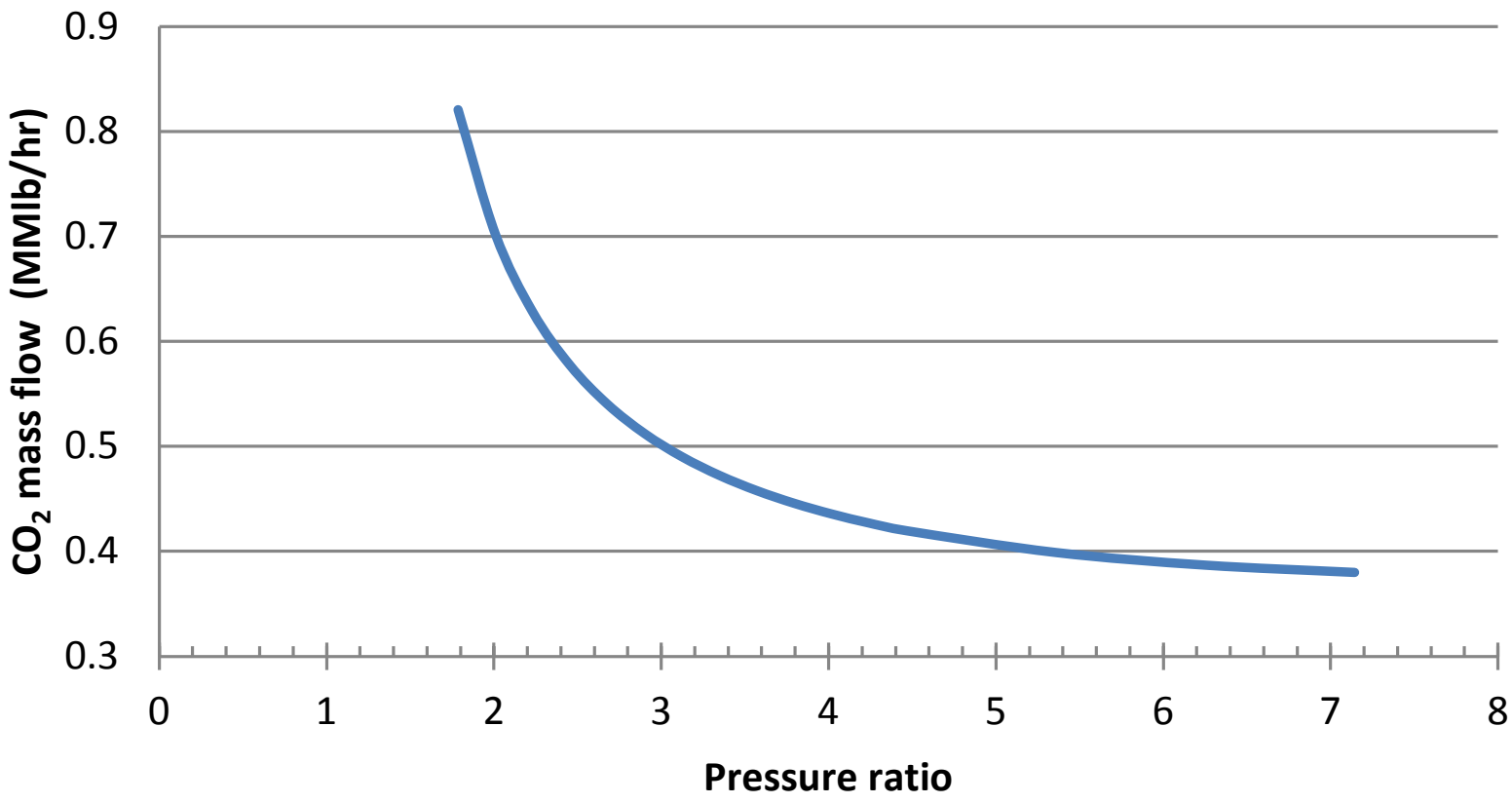
Hot source duty



Recompression Brayton Cycle

Specific power



Recompression Brayton Cycle

CO_2 flow