



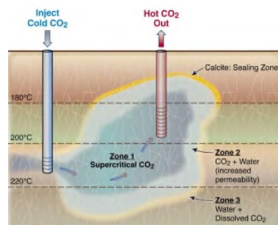
Materials for Supercritical CO₂ Applications

Ganesan Subbaraman, Steven Kung, and Henry Saari

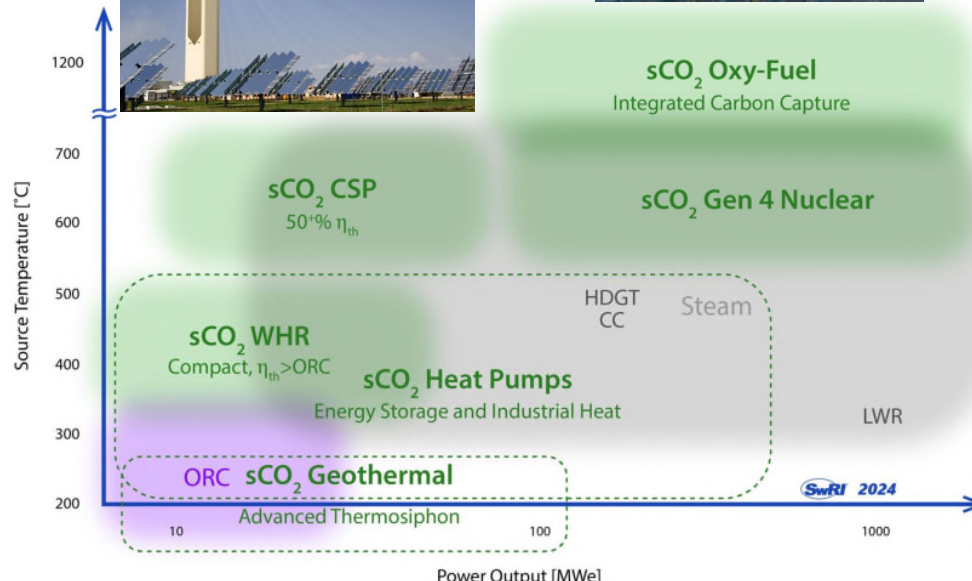


sCO₂ Power Cycles

Heat Sources and Configurations



Many possible heat sources with various temperatures...indirect and direct cycle configurations with many different arrangements

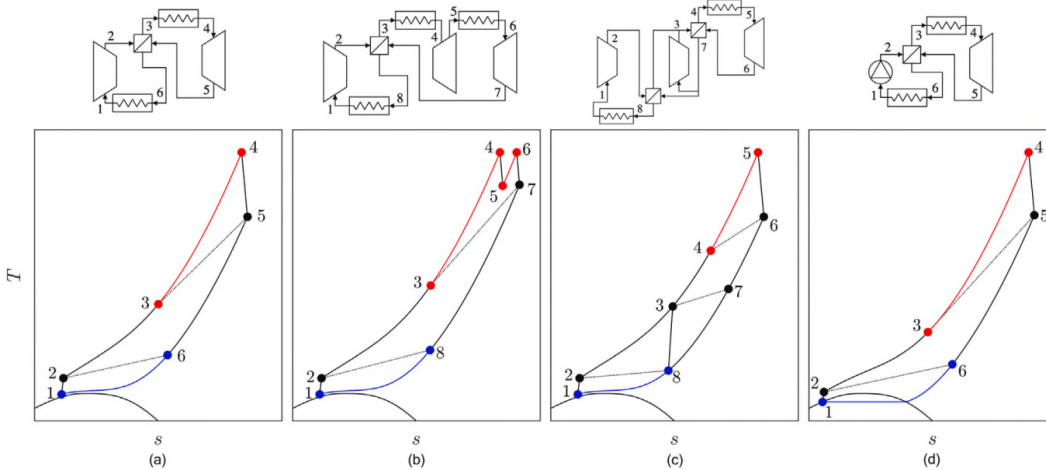


sCO₂ power cycle heat sources [Hofer, 2024; Wilkes, 2024]

The International Supercritical CO₂ Energy Technologies Symposium • March 2 – 5, 2026 • Pittsburgh, PA, USA

sCO₂ Power Cycles

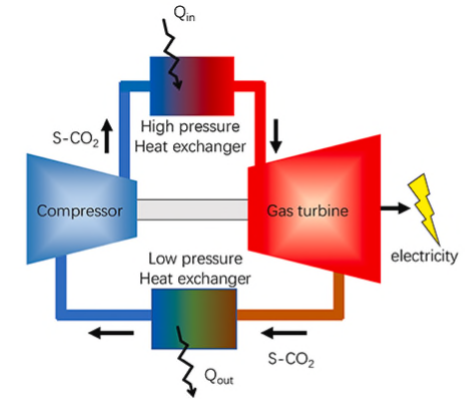
Heat Sources and Configurations



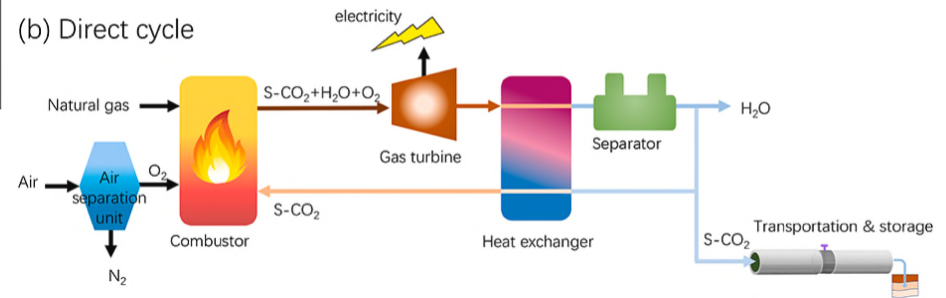
Schematics and T-s diagrams of different sCO₂ power cycle arrangements
 (a) simple recuperated (b) recuperated with reheat (c) recompression (d) transcritical
 [White, 2021]

Many possible heat sources with various temperatures...indirect and direct cycle configurations with many different arrangements

(a) Indirect cycle



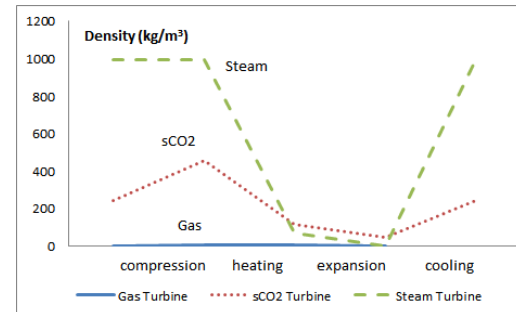
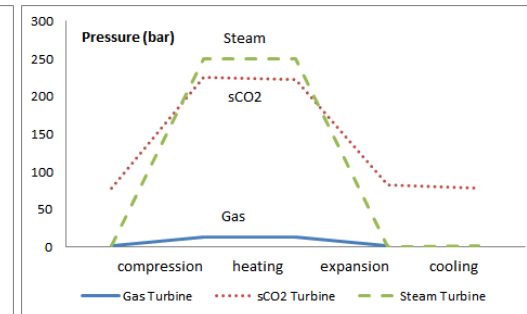
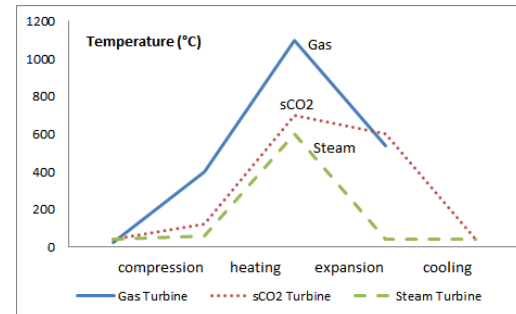
(b) Direct cycle



Schematics of (a) indirect and (b) direct cycles
 [Li, 2023]

Materials for sCO₂ – Challenges

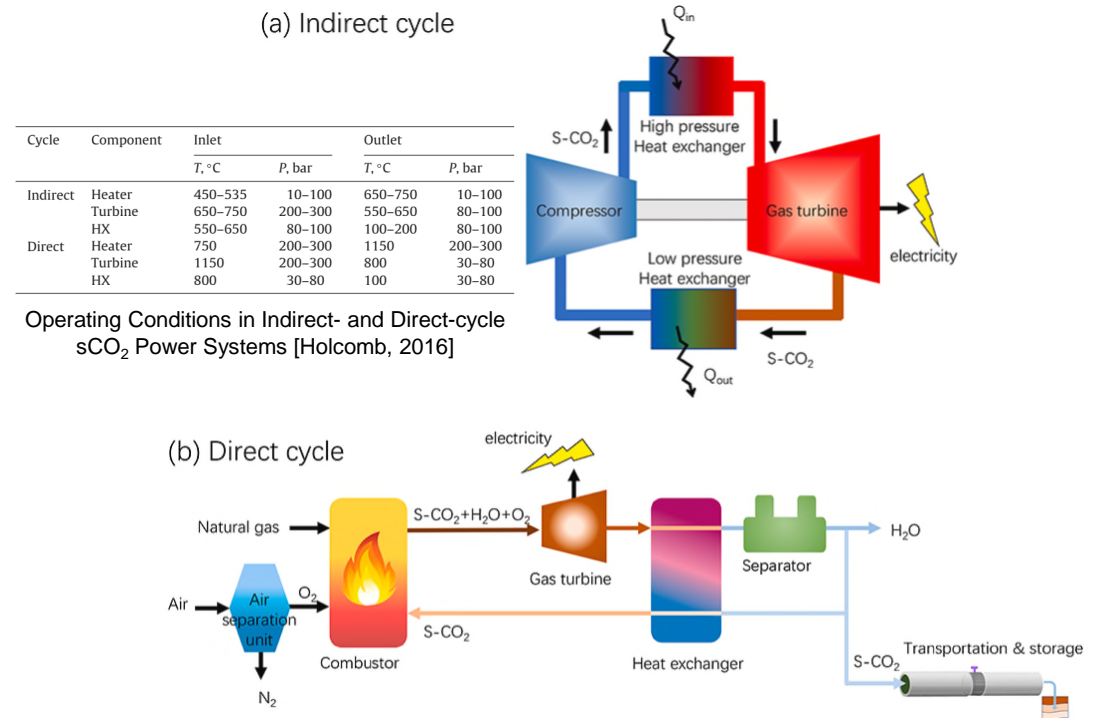
- Materials performance/degradation/availability often cited as technical challenges/barriers to commercialization
 - Materials with adequate mechanical properties available
 - Comply with codes and standards (still evolving)
 - Compatibility and long-term performance in sCO₂?
 - Operating temperature limits lowered due to oxidation/corrosion/carburization
 - Corrosion allowance required
 - Efficiency-economic trade-offs, allowance on early learning
 - Raw materials
 - High costs and long lead times
 - Low supply chain maturity
 - Manufacturing
 - Difficulties with large Ni-base castings and forgings
 - Fabrication
 - Welding, machining, etc.



sCO₂ Brayton cycle technology overlaps that of steam and gas turbines, but they are unique systems for which material selection is especially critical

Materials for sCO₂ – Selection

- Challenging operating conditions
 - Design to safely operate at high temperatures, pressures, densities
 - Requires specialized materials
- Selection of materials dictated by
 - Mechanical and thermal properties
 - Compatibility with high temperature and pressure environment
 - Raw material and fabrication cost, availability
 - Long-term behaviour



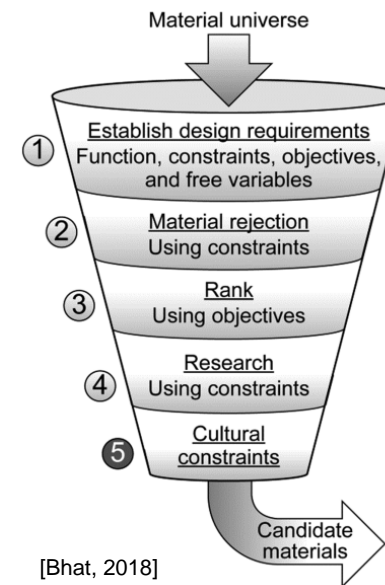
Schematics of (a) indirect and (b) direct cycles [Li, 2023]

Materials for sCO₂ – Selection

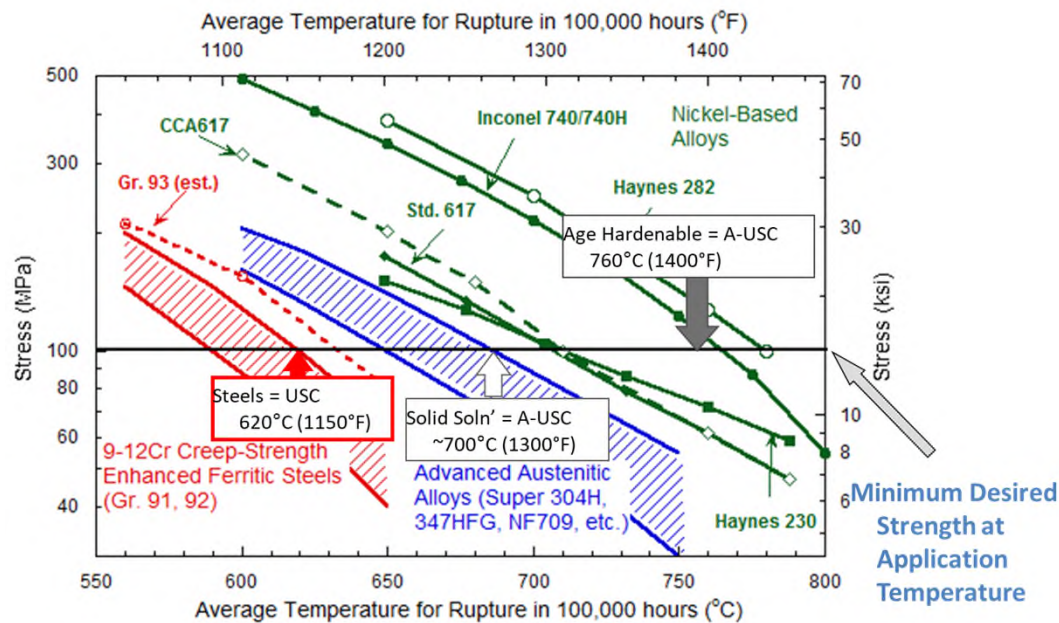
- Key step in design process
- Poor choices?
 - Failures, increased costs
- Best material?
 - Properties to provide service performance
 - Processing into finished components
- Selection process
 - Translate service and environmental conditions into required material properties
 - Screen materials by comparing required properties with databases
 - Rank candidate materials
 - Research candidate materials further
 - Apply cultural constraints
 - Select candidate material(s) by analyzing trade-offs, value analysis, cost-benefit, etc.
 - Develop design data if required (testing, pilots)

Function	What does the component do?
Constraints ^a	What nonnegotiable conditions must be met? What are the negotiable but desirable conditions?
Objective	What is to be maximized or minimized?
Free variables	What parameters of the problem is the designer free to change?

^aIt is sometimes useful to distinguish between hard and soft constraints. Stiffness and strength might be absolute requirements (hard constraints); cost might be negotiable (a soft constraint).



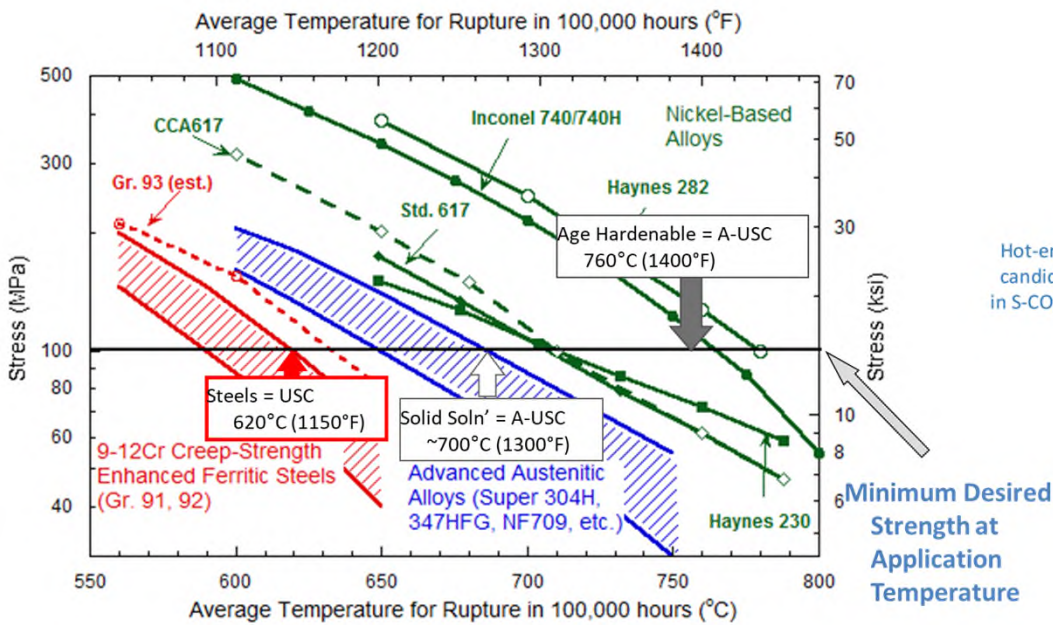
Materials for sCO₂ – Options



	COMPONENT	MATERIAL TYPE	SUPPORTING TECH BASE	RISK / RATIONALE
Heat Exchanger	HEX, <1,000F	Austenitic Stainless Steel	Various	High Technology Readiness Level (TRL) for lower pressures
	HEX, >1,000F	Ni-Cr, solid solution strengthened alloys	USC/A-USC Steam	sCO ₂ oxidation, Weldable, moderate strength
Turbo-Machinery	Compressor Housing	Steel casting	UK Nuclear Magnox / AGR	High TRL for lower pressures
	Compressor Impeller	(trades incomplete)	Cryo Propellant Turbopump	High TRL, Low temp limits oxidation
	Compressor Rotor	Alloy Steel	Various	High TRL, Low temp limits oxidation
	Seals, Dry Gas	Ceramics / Cermet coating	Process Industries	Accelerated wear in sCO ₂
	Turbine Housing	Ni-based casting alloys	A-USC Steam	Low TRL (in development)
	Turbine Disk	Ni-base superalloy	Gas / Power Turbine	Tech Base is shorter life, sCO ₂ Oxidation, Creep
	Turbine Blade	High Cr, Ni-base superalloy Ni-base superalloy + Pt-Al	Gas / Power Turbine	Tech base is shorter life , sCO ₂ Oxidation, Creep, HCF
Balance-of-Plant	Ducts, <1,000F	Austenitic Stainless Steel	Various	High TRL for lower pressures
	Ducts, >1,000F	High Cr, Ni-base superalloy	USC Steam	Low TRL. Oxidation, Creep., Demonstrated weldability.
	High Temp. Valves	Austenitic/Nickel-based	A-USC Steam	Intermediate TRL, not tested in service, supply chain questionable
	High Temp. Piping	Austenitic/Nickel-based	USC/A-USC Steam	High TRL, but supply chain is not established for many needed components

Materials are available...but there are knowledge gaps...and efforts are required to complete the picture

Materials for sCO₂ – Options



Hot-end equipment candidate materials in S-CO₂ Brayton cycle

Materials are available...but there are knowledge gaps...and efforts are required to complete the picture

[Xu, 2023]

<p>Heat-resistant steel</p> <p>High temperature strength and resistance to high-temperature oxidation corrosion.</p> <p>Application: boiler manufacturing, steam turbines, power machinery, aviation, and petrochemical.</p>	<p>Martensitic steel</p> <p>Cr content usually 9%-13% high creep resistance, high thermal conductivity, high radiation resistance, low thermal expansion coefficient</p> <p>Application: Steam turbine manufacturing</p>	<p>9Cr High temperature bearing</p> <p>12Cr Steam turbine blades</p> <p>P91 High temperature and high pressure boiler</p> <p>T91 high-temperature superheater</p> <p>F91 High temperature pipelines and valves</p> <p>...</p>
<p>Austenitic steel</p> <p>Excellent corrosion resistance and mechanical properties</p> <p>Application: chemical, petrochemical, marine, nuclear power fields</p>	<p>304 stainless steel High temperature pipelines and valves</p> <p>310 stainless steel Heat exchanger</p> <p>316 stainless steel High temperature pipelines and valves</p> <p>347 stainless steel High temperature boiler</p> <p>...</p>	
<p>High-temperature alloy</p> <p>Based on iron, nickel, cobalt. Capable of long-term operation at high temperatures above 600 °C, with high performance</p> <p>Application: boiler manufacturing, steam turbines, power machinery, aviation, and petrochemical.</p>	<p>Inconel 718 Turbine discs and blade</p> <p>Inconel 713 Turbine blade</p> <p>Inconel 751 High temperature and high pressure valve</p> <p>Haynes 230 Gas turbine of aerospace</p> <p>Incoloy 800 High temperature and pressure vessels</p>	

DOE-funded AUSC Materials Research

- Higher efficiency for new and existing fossil fuel plants
 - +25% HHV efficiency improvement over average U.S. power plants
 - 760°C/1400°F steam conditions drives need for nickel-based superalloys
- Minimizing risk for utilities to build A-USC power plants
 - Close technology gaps leading to commercial scale demonstration
 - Development of fabrication, welding, corrosion/materials database, ...
- Validation of technology applicable to multiple fossil, nuclear, sCO₂, renewable power generation options
 - Focus on development of U.S. supply chain that can produce boiler and turbine components out of AUSC materials
 - Industry partnership under DOE demonstrating supplier readiness for fabricating 760°C/1400°F-capable components
- ASME code case approval for two new alloys:
 - Inconel® 740H, CC-2702 (2012)
 - Haynes® 282, CC-3024 (2021)
- Fabrication demonstrations:
 - Welding: DMWs, thick section, overlay
 - Forming: bending, extruding, swaging
 - Casting: flowability, modeling

Component	Method	Primary Alloy(s)	Key Dimensions
Main Steam Pipe/Header + Bends	Extrusion	Inconel® 740H	25,000 lbs 22 x 3.7 inch
Hot Reheat Pipe/Header + Bends	Extrusion	Inconel® 740H	25,000 lbs 28 x 1.5 inch
Header Assembly	Welding	740H, H282, stainless	About 14' x 16' 16 tube lengths
Membrane Panel	Welding	P92	10' x 4'
Wye (VIM-ESR-VAR)	Forging	Inconel® 740H	25,000 lbs
Nozzle Carrier / Shell	Casting	Haynes® 282	21,000 lbs
Rotor (VIM-ESR-VAR)	Forging	Haynes® 282	22,000 lbs

AUSC Achievements in Materials Research and Fabrication

Tubing
Fabrication
Demonstration



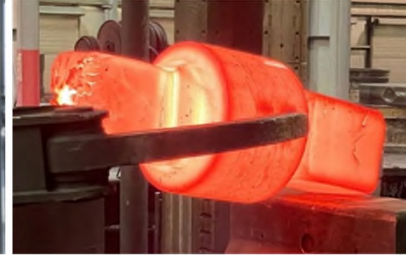
In-Plant
Corrosion
Demonstration



Final
Header
Assembly



H282 Rotor
Forging
(Mid-processing)



Header
Welding
Demonstration



First 740H
Pipe
Extrusion



H282 Valve Body
Casting
(after PT)

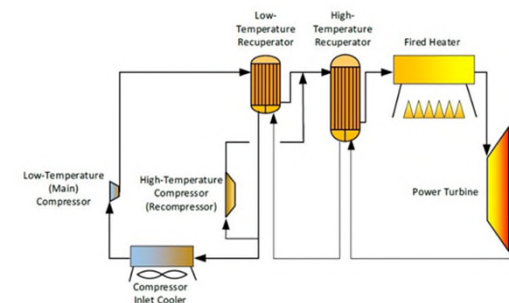
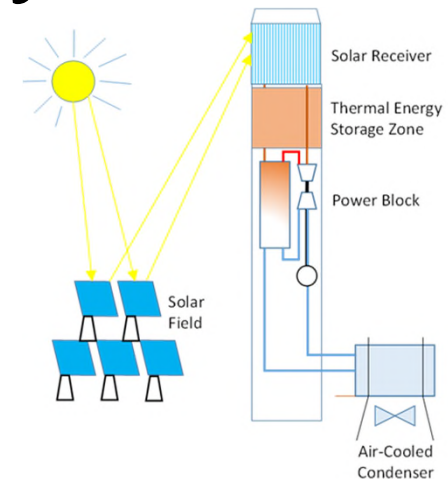


H282 Nozzle
Carrier
Casting



AUSC Developments Enable Advanced Power Cycles

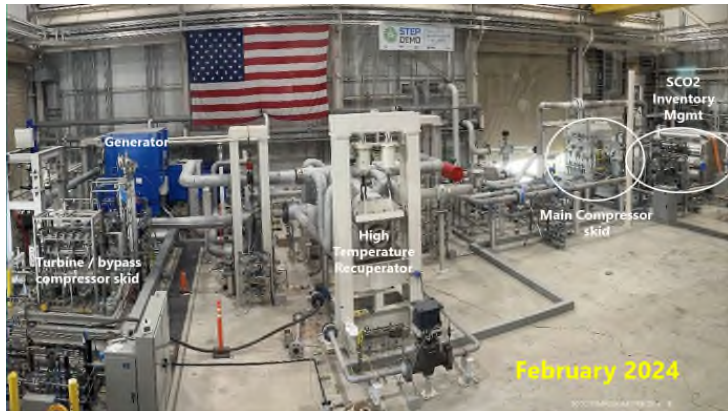
- AUSC materials technology transferrable applications
 - High temperature fossil cycles (+ oxy-combustion)
 - Advanced concentrated solar thermal
 - Gen IV nuclear (VHTR and A-USC steam)
 - sCO₂ power cycles
- AUSC full-scale manufacturing technology and supply chain development lead to crosscutting benefits from advanced materials



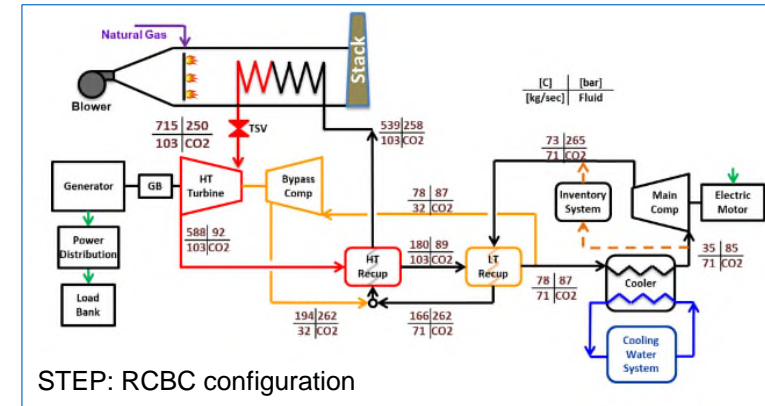
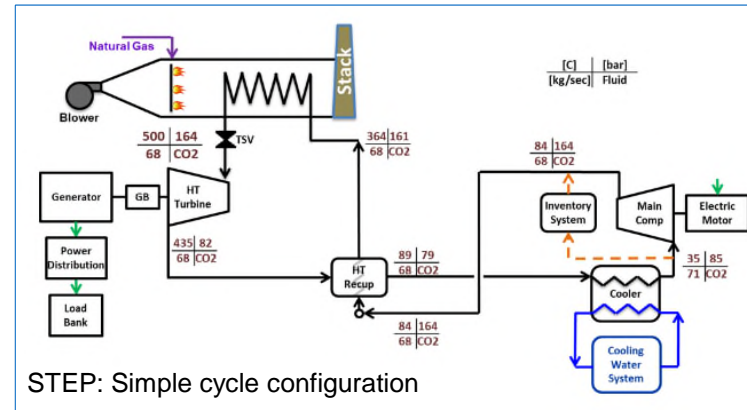
Success achieved from pre-competitive, collaborative nature of AUSC consortium

Reference Case – 10 MW_e STEP Facility

- DOE project to design, construct, commission and operate demo plant
- Objectives
 - Advance sCO₂ power cycle technology
 - Demonstrate pathway to >50% efficiency
 - Demonstrate operability at >700 °C TIT with 10 MW_e power generation
 - Provide adaptable component and cycle development platform

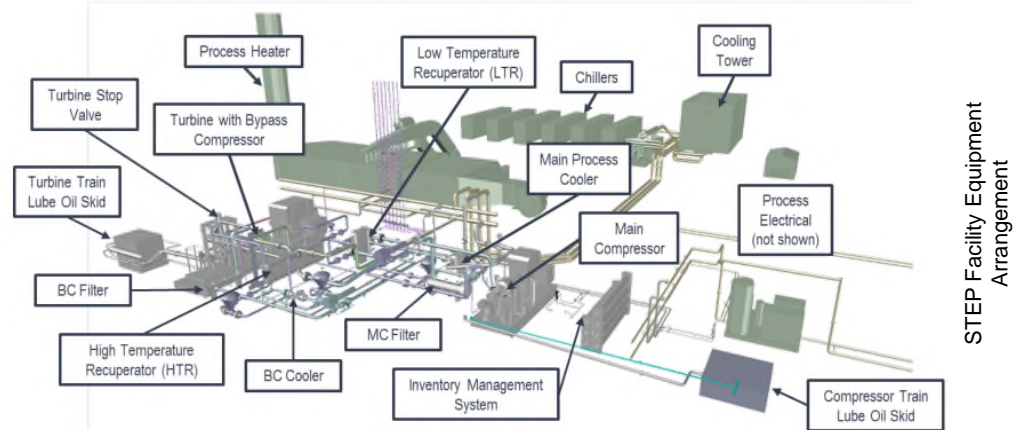


[Stevenson, 2024]

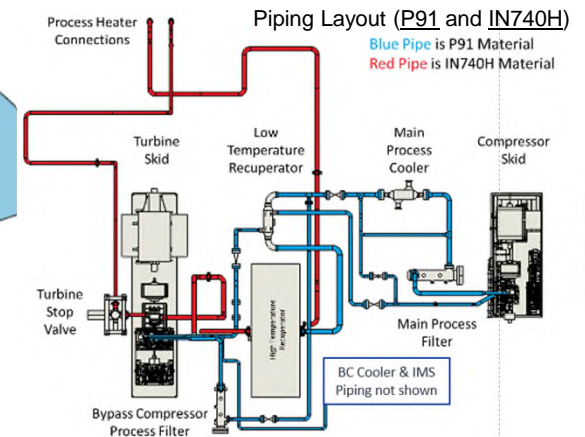
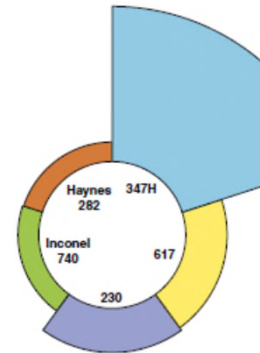


Materials Selection – Components

- Piping/heat exchangers/valves
 - ASME B&PV Code, Piping Codes, Material Standards
 - Code approved materials, allowable stresses
 - Compatibility – corrosion allowance
- Turbines/compressors/shafts
 - More flexibility, many materials
 - OEM designs
 - Compatibility
- Other components
 - Seals
 - Bearings
 - Electrical components
 - Etc.



Turbine stop valve [Stevenson, 2024]

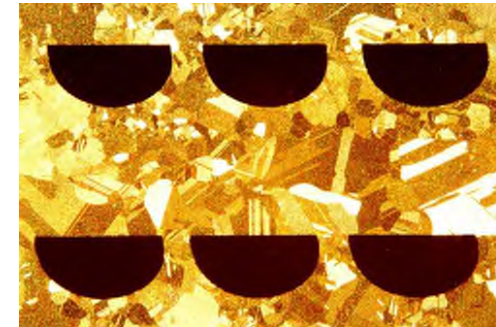


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PCHE high temperature recuperator [Stevenson, 2024]



Micrograph of PCHE section [Southall, 2008]



IN740H heater [Stevenson, 2024]

Materials Selection – Components

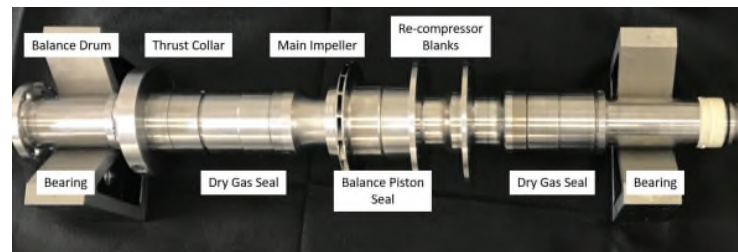
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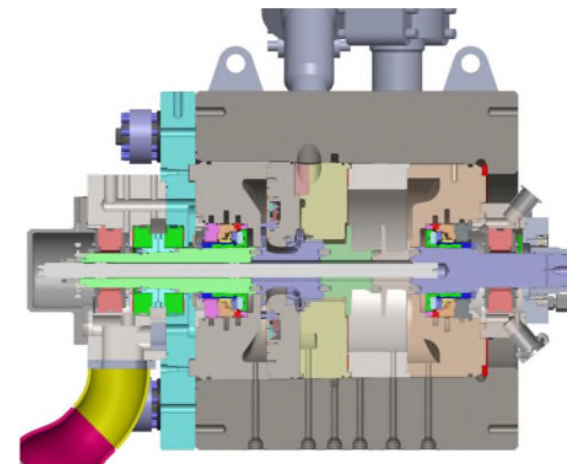
sCO₂ compressor skid [Stevenson, 2024]



STEP Bypass Compressor Rotor (Monolithic)



sCO₂ compressor rotor and assembly [Cich, 2020]

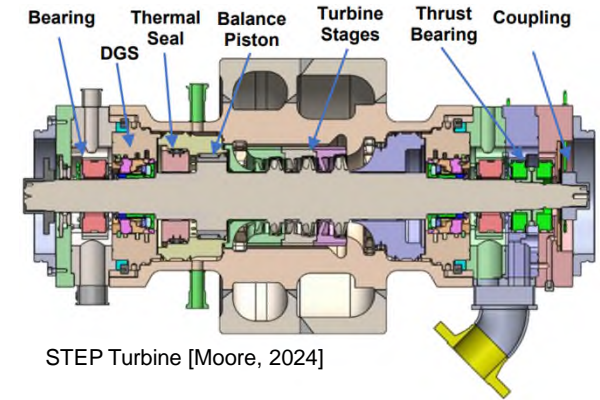


Materials Selection – Components

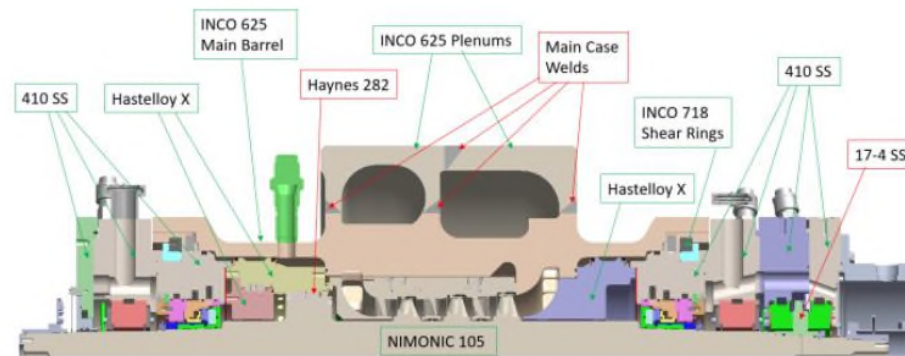
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STEP turbine [Stevenson, 2024]



STEP Turbine [Moore, 2024]



STEP Turbine with Materials [Klaerner, 2023]



STEP Turbine Rotor (Monolithic Nimonic_105_rotor, EDMed)

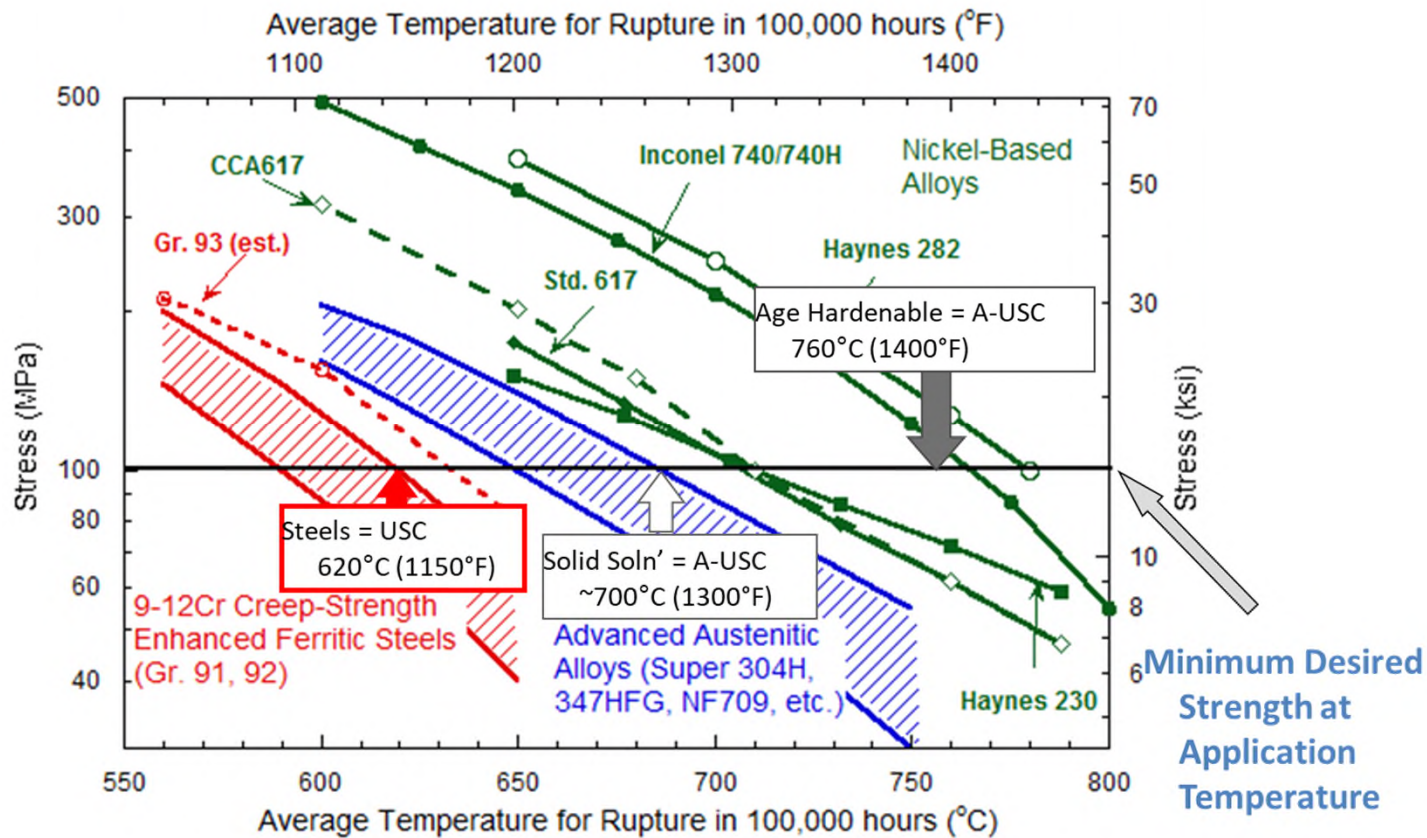
STEP Materials – Summary (Lessons Learned)

- Compressors
 - “Commercial” technology
- Turbines
 - Several generations of learning
 - Materials and fabrication OK, scalable
 - As-built from IN625 case with limited life
 - Production model from IN740H/H282 with 100,000-hour life
- Heater
 - Issues, learning
 - IN740H
- High temperature recuperator
 - Accommodation of differential expansion
 - SS316
- Piping
 - Low temperature – P91 – high TRL
 - High temperature – IN740H – lower TRL
 - Welding, general handling, inspection challenging, but OK
 - Material supply chain less than mature
- Valves and fittings
 - Low temperature – high TRL
 - High temperature – IN740H and H282 – lower TRL
 - H282 TSV body casing challenging (alternate from SS316 for initial operations)
 - IN740H elbows – challenging wrought processing
 - IN740/H282 Grayloc hubs/clamps required

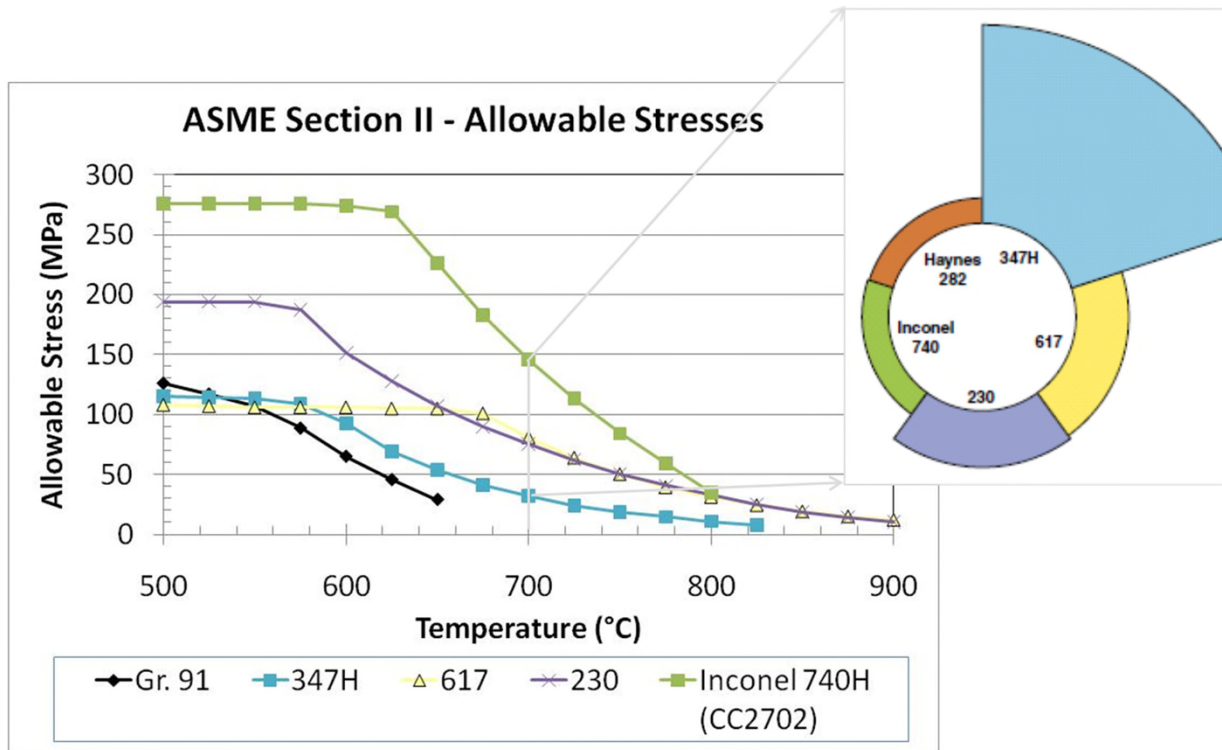
Materials for sCO₂ – Selection

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 - Raw material and fabrication cost, availability
 - Long-term behaviour

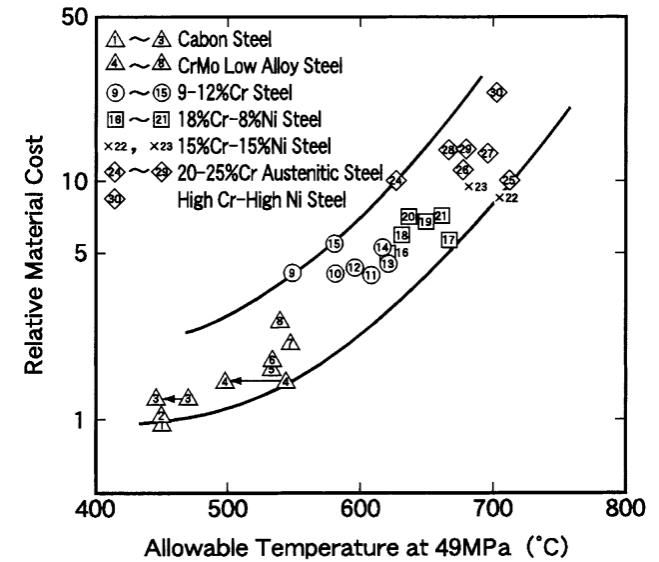
Strength/Creep/Cost



Strength/Creep/Cost



Higher Allowable Stress for 740H and H282 = Thinner Pipe Walls = Less Material

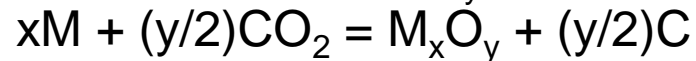
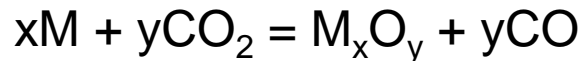


Relative material cost as a function of temperature for an allowable stress of 49 MPa [Masuyama, 2001]

sCO₂ Corrosion – Fundamentals

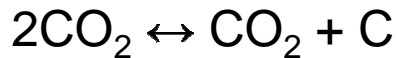
CO₂ Corrosion at Elevated Temperatures

– Oxidation

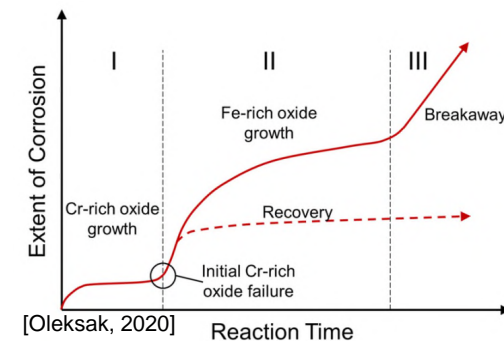
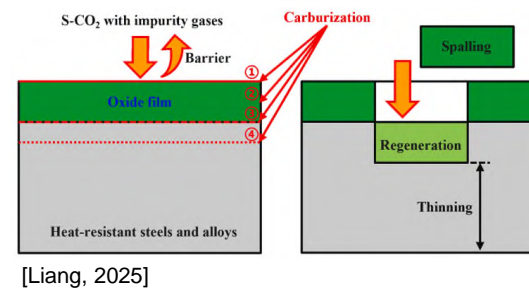
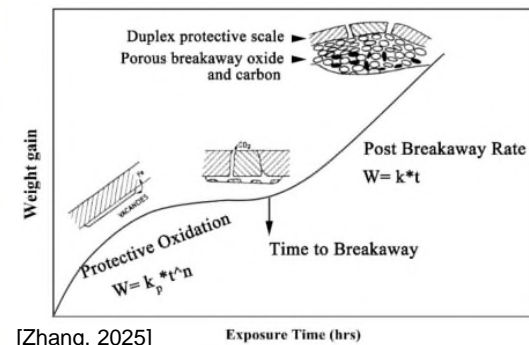
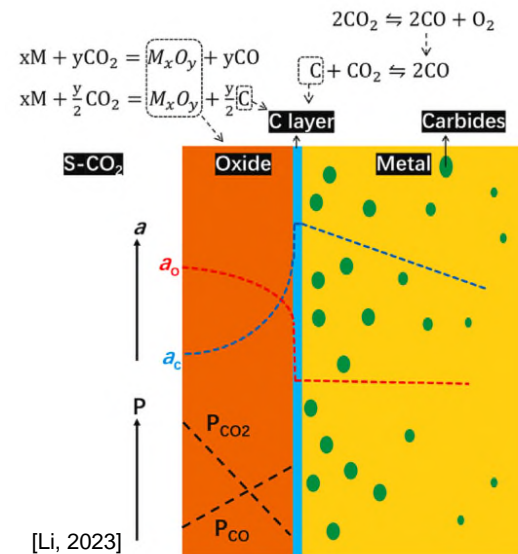


- Oxygen partial pressure high enough to induce oxidation
- Formation of oxide layer

– Carburization

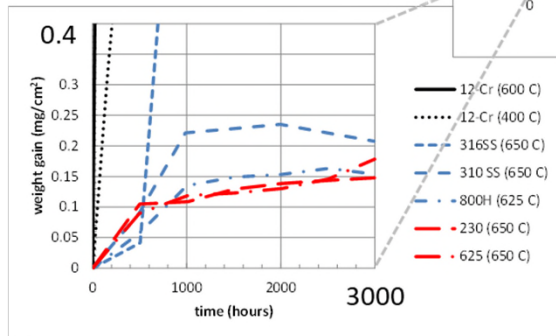
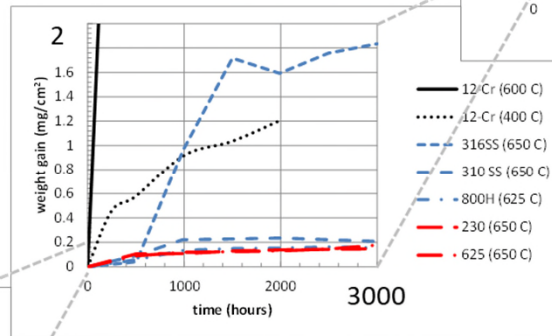
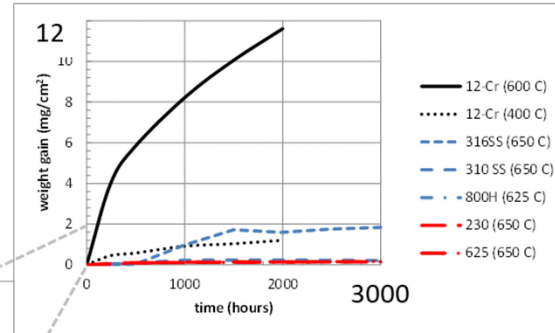


- Penetration of C through the oxide layer
- Reaction with metallic elements



sCO₂ Corrosion Testing – Weight Gain

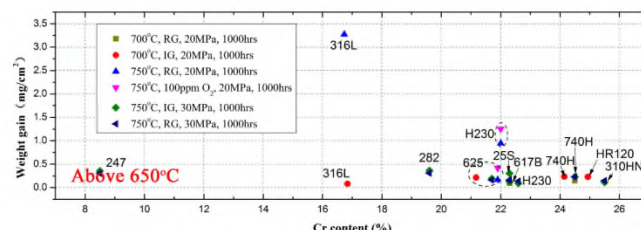
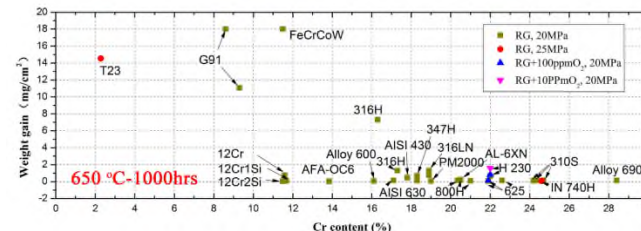
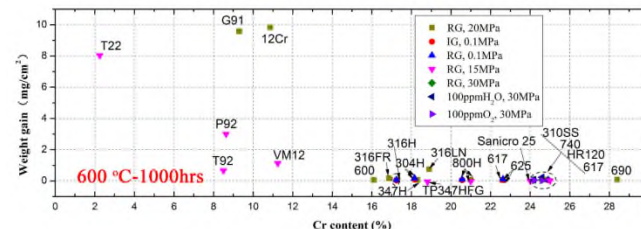
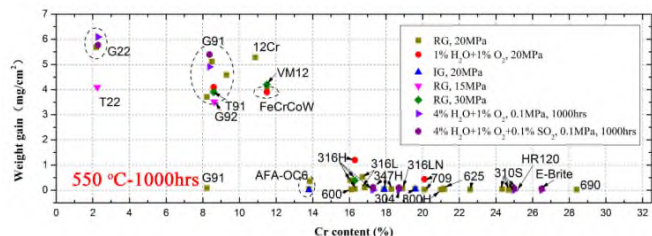
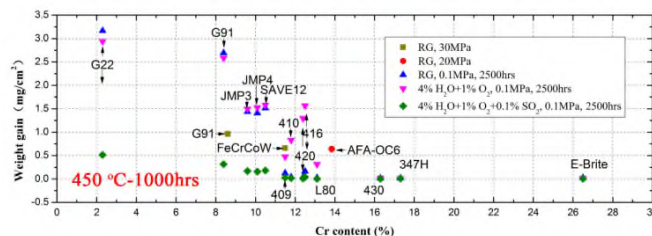
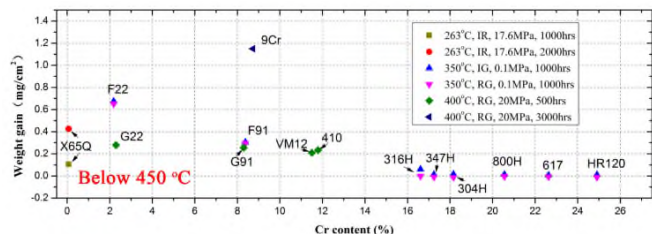
General Weight Gain Trends
 FM > austenitic > nickel-base
 Fe-Cr (<12% Cr) > Fe-Cr-Ni
 (>16% Cr) > Ni-Cr-X (>16% Cr)



Mass gains for sCO₂ and steam are approx. similar...the scale morphologies in sCO₂ would be like those in steam

sCO₂ Corrosion Testing – Weight Gain

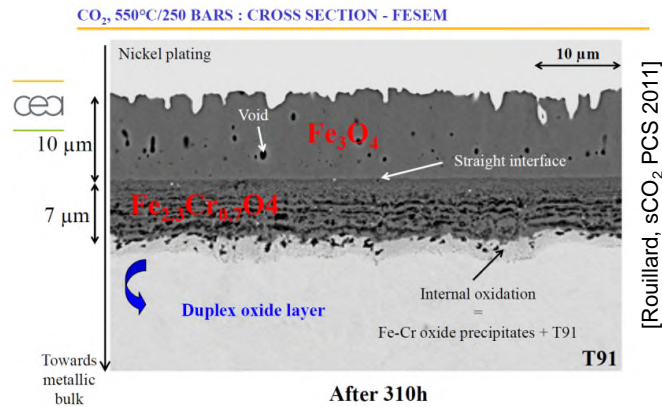
Weight gain versus Cr content of alloys under various testing conditions [Zhang, 2025]



General Weight Gain Trends
 FM > austenitic > nickel-base
 Fe-Cr (<12% Cr) > Fe-Cr-Ni (>16% Cr) > Ni-Cr-X (>16% Cr)

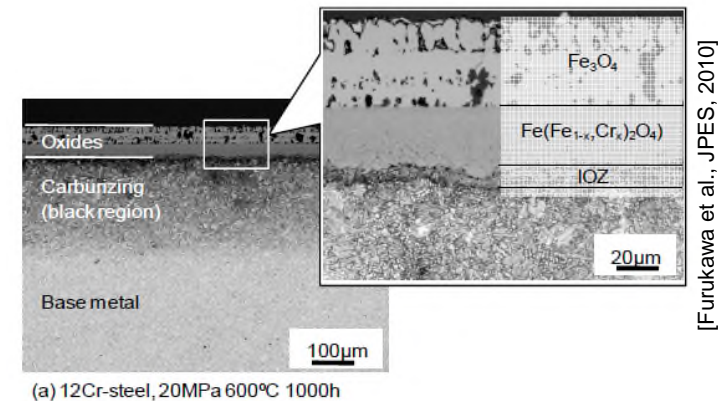
Mass gains for sCO₂ and steam are approx. similar...the scale morphologies in sCO₂ would be like those in steam

sCO₂ Corrosion Testing – Scales



T91 9Cr F-M steel

- Duplex oxide layer
 - Outer: magnetite, Fe_3O_4
 - Inner: spinel, $Fe_{3-x}Cr_xO_4$
- Internal oxidation also
- Extrapolation to 20 years
 - Corrosion layer thickness = 500 μm

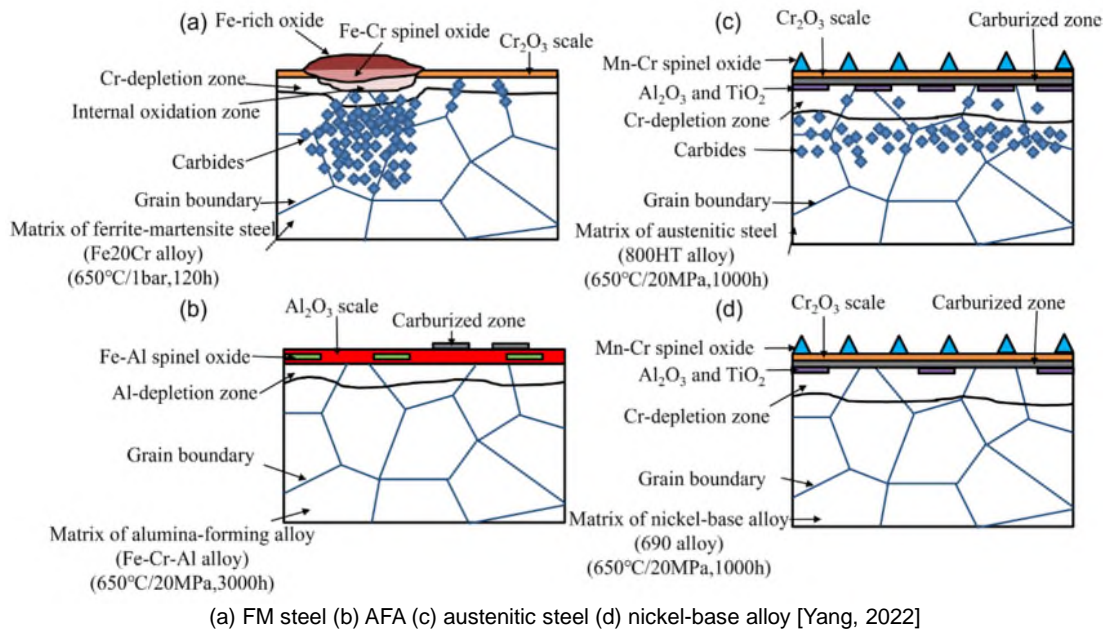


12Cr Martensitic steel

- Two successive layers, no breakaway corrosion
 - Outer: Fe oxide, Fe_3O_4
 - Inner: Fe+Cr oxide, $Fe(Fe_{1-x},Cr_x)_2O_4$
- Thin internal oxide zone (IOZ) between base metal and inner layer
- Carburing observed near surface in base metal
 - Factor in breakaway corrosion, degradation of ductility

sCO₂ Corrosion Testing – Scales

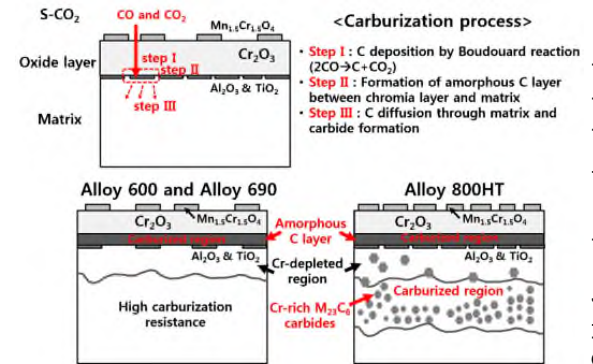
Corrosion Scales – Schematics for Various Alloy Systems



Alloy	Oxide layer structure
Low Cr	substrate Fe-Cr-O spinel Fe-O
Fe-Cr alloys	
High Cr (>17%)	substrate Cr ₂ O ₃
Ni-Cr alloys	
Low Cr	substrate Cr ₂ O ₃ and/or NiO
High Cr (>14%)	substrate Cr ₂ O ₃

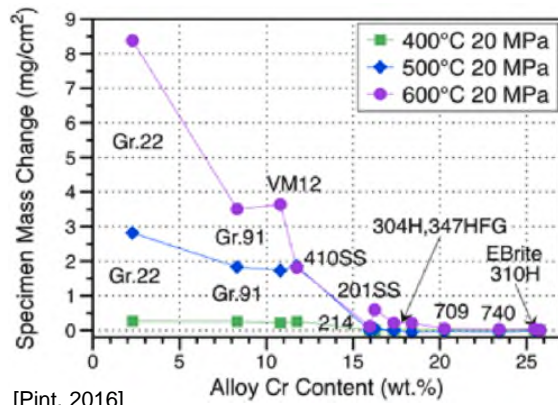
[Li, 2023]

● Fe-Cr-O spinel
● Ni-Cr-O spinel



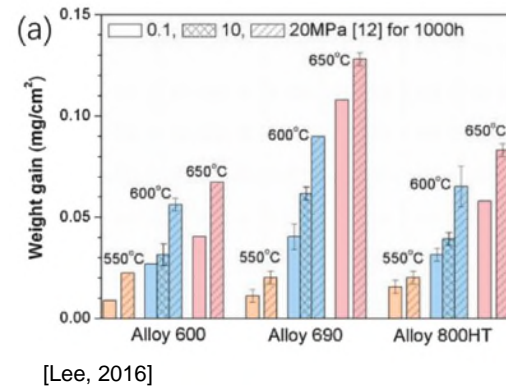
Oxide formation and carburization process for nickel-base alloys and 800 HT [Lee, 2015]

sCO₂ Corrosion Testing – Factors



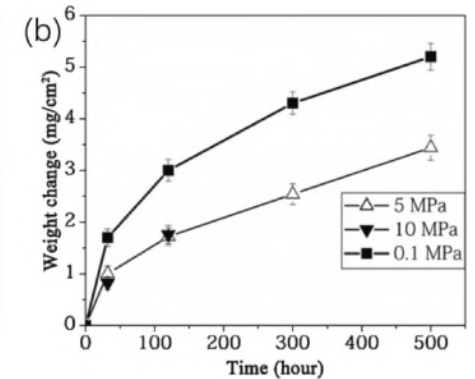
Temperature

- Most important factor – increasing temperature leads to increasing corrosion
- Parabolic growth breaks down, scale becomes non-protective, breakaway corrosion
- However, are there any “surprises” at low temperatures?
- Very high temperatures?
 - Coatings, very high temperature materials, cooling schemes

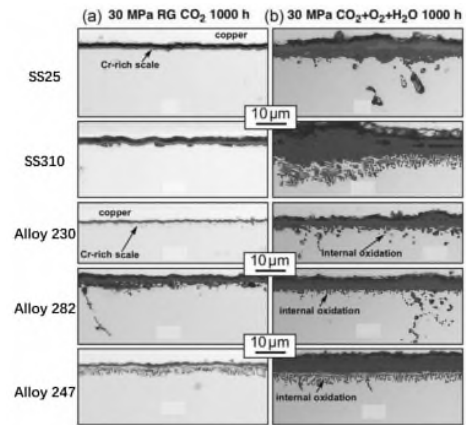


Pressure

- No “real” consensus
- As pressure increases, oxidation and carburization increase?
 - Some results show increased weight gain
 - Going from 0.1 to 20 MPa has minimal effect
 - Some results show more protective scale
 - Infiltration of C becomes easier – more carburization?



sCO₂ Corrosion Testing – Factors



[Pint, 2019]

Impurities

- Indirect cycles: ppm levels
- Direct cycles: % levels
- Corrosion behaviour expected to change as thermodynamics and kinetics change
- Various results

decreasing corrosion resistance →

Nickel Ni-Cr-X Cr>16%	Austenitic Fe-Cr-Ni Cr>16%	FM Fe-Cr Cr<12%
IN625	800H	12Cr
IN617	AL6-XN	HCM12A
Haynes 230	316SS	NF616
IN718	310SS	T91
IN738		

Alloying

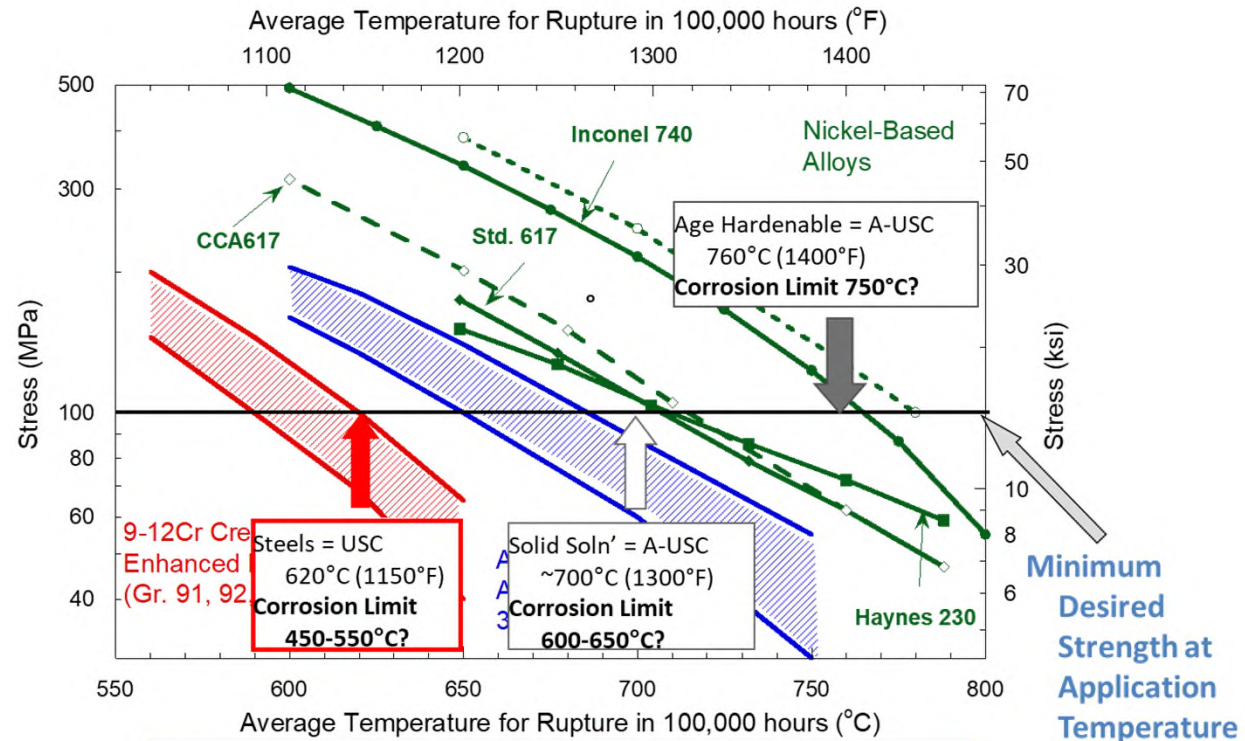
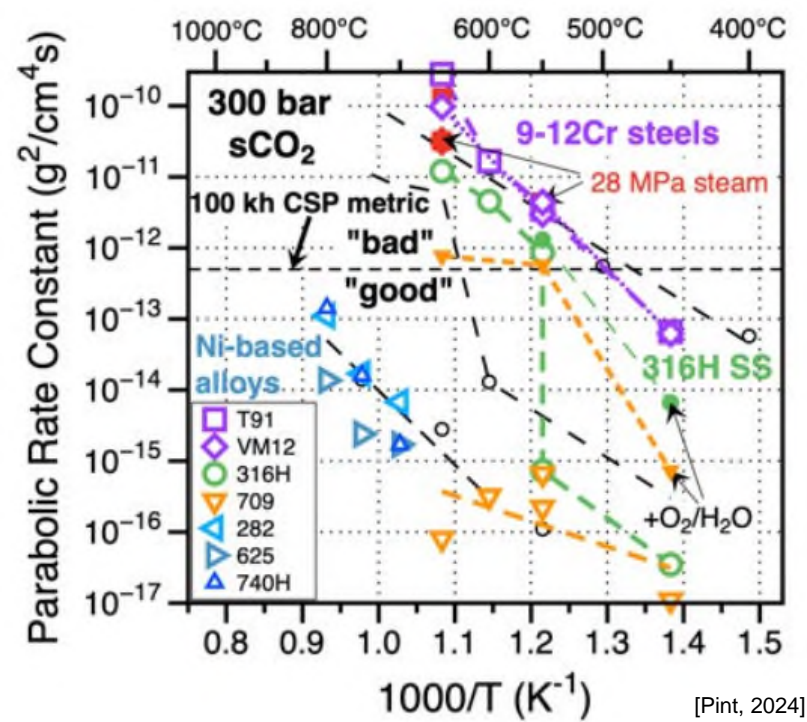
- Cr – determines corrosion resistance of alloys – chromia stable oxide, good protection
 - High Cr favours Cr₂O₃
 - Low Cr fails to form continuous scale – less protective, prone to internal corrosion
- Ni – Ni-base alloys show better carburization resistance than steels
 - Facilitates stable chromia layer
 - Higher solubility of carbides – higher tolerance to C
- Al – improves corrosion resistance by forming protective alumina layer
 - Higher stability, lower oxidation kinetics, higher resistance to C

sCO₂ Corrosion Testing – Factors

Other Factors...

- Availability/manufacturability/fabricability
- Actual components and material forms
- Operational conditions
 - Temperature, stress, flow
- Long-term testing
 - Corrosion life
 - Mechanical property degradation
 - Combined effects of thermal fatigue, creep-fatigue, corrosion interactions
- Coatings
- Non-metallics

Materials Selection – Strength and Corrosion



Where are the temperature cut-off for different materials when corrosion is considered? [Pint, 2022]

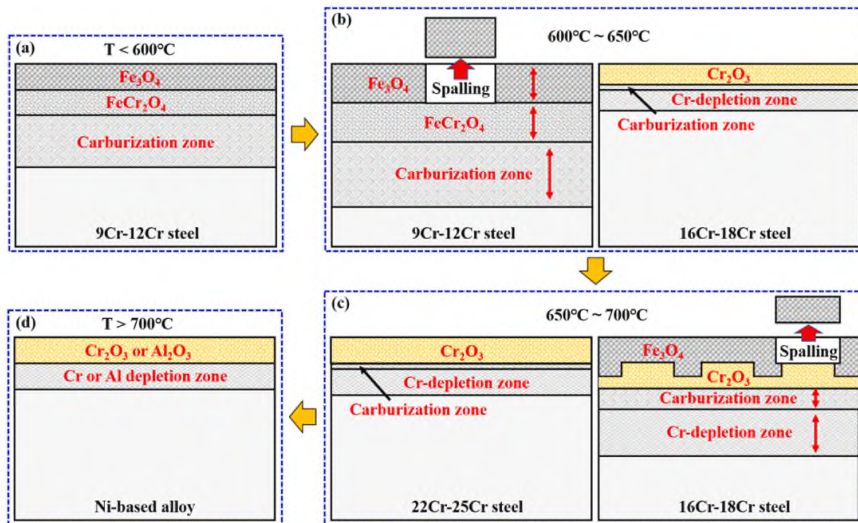
Materials Selection – Strength and Corrosion

Recommended maximum working temperature of Fe- and Ni-based alloys as candidate materials for different components in S-CO₂ environments.

Alloy type	Typical alloys	Recommended temp. (°C)	Notes	
Fe-based	Low Cr ferritic steels	T22	<450	
	High Cr ferritic steels	T/P91, T/P92, T/P122, HCM12A	<550	
	AFA	OC6, OC7, OC10, MA957	<550	Up to 650 °C for some AFAs with Cr > 20%.
	Austenitic stainless steels (Cr < 20%)	TP347HFG, Super SS304H, SS316,	<620	
	Austenitic stainless steels (Cr > 20%)	Alloy 800, SS310	<650	
Ni-based	Cr > 14%	Alloys 230, C-276, 282, 740, 617, 600, 690, 625	<750 °C or other severe environments (high contents of impurities)	For crucial parts like turbine, recommending Cr > 22%; Alloy 625 could be welding fillers.

Recommended temperature ranges	Alloy type	Typical alloys	Max Temperature Limit (°C)	Allowable Stress (MPa)
<350 °C	Low Cr Ferritic steels	T22	580	/
<450 °C	Martensitic Steels (9Cr)	T/P/F91	649	482 °C: 131.7 510 °C: 122.7
		T/P92	649	482 °C: 138.6 510 °C: 132.4
		T/P911	621	482 °C: 138.6 510 °C: 131.0
<500 °C	Martensitic Steels (12Cr)	T/P122	649	482 °C: 140.0 510 °C: 134.4
<600 °C	Austenitic steels (low Cr)	316	700	600 °C: 65 650 °C: 50
		347H	816	500 °C: 125
<650 °C	Austenitic steels (high Cr)	800H	816	500 °C: 138
		310	816	500 °C: 116
		HR120	899	500 °C: 113
		NF709	/	/
<700 °C	Solid solution strengthened nickel-based alloys	625	649	500 °C: 192
		617	982	750 °C: 50.4
		230	982	750 °C: 50.8
<750 °C	Precipitation strengthened nickel-based alloy	282	800	750 °C: 105
		740H	800	750 °C: 84.1

[Li, 2023]?



Recommended maximum use temperatures of different alloys for sCO₂ power cycles [Liang, 2025]

[Liang, 2025]

Materials for sCO₂ – Results (Summary)

Mechanical Properties

- Existing ASME code (and other) alloys OK
- Strength increases:
 - Ferritic – austenitic – Ni-base
- Temperature capability may be limited/reduced by compatibility (corrosion/carburization)

Compatibility

- Extensive data are useful (more required?)
- Materials for AUSC, gas turbines +/- OK for sCO₂ applications
- Corrosion resistance increases:
 - Ferritic – austenitic – Ni-base

Long-term Behaviour

- Many factors affect materials degradation and mechanical property changes
- Longer-term testing, results, and experience required under
 - Real operating conditions
 - Actual component shapes and forms

Lessons Learned/to be Learned

- Previous loops
 - Sandia National Laboratories
 - Piping, erosion
 - Naval Nuclear Laboratory
 - Erosion
 - Others?
- NET Power La Porte Test Facility
 - Open-cycle process demonstrator
- STEP
 - Materials availability, processing, fabrication
 - Compatibility with service environment
 - Operation under “real” conditions – flow, stress, etc.
 - Failures – failures modes, analysis

Pathways to Commercialization

- Significant running hours required
 - Confirm component designs, generate operational experience and data
- Materials and manufacturing (high temperature)
 - Material and component manufacturing supply chain development required
 - Reliable, better availability, lower cost, faster delivery required
 - May come with more demand/market “pull”
- Long-term properties
 - Any surprises with corrosion/carburization, possibly even at lower temperatures?
 - Degradation of material properties?

Overall Summary

Component	Component	Conditions (Indirect)		Codes/Tech Base	Materials	Temperature Limits	Tech Level
		T (°C)	P (bar)				
Low temperature	Piping	40-200	80-275	ASME B31.1 Power Piping, ASME B16.34 Valves, ASME BPVC Various supporting, USC	Low Cr ferritic (T22)	<350-400 °C	High TRL
	Valves				Higher Cr ferritic (T/P91, T/P92)	<400-500 °C	Long-term compatibility under operating conditions?
	Heat exchangers				High Cr ferritic (T/P122)	<500-550 °C	
High temperature	Piping	200-750	80-275	ASME B31.1 Power Piping, ASME B16.34 Valves, ASME BPVC Various supporting, A-USC	Austenitic SS (<20% Cr)	<600 °C	High TRL for SS
	Valves				Austenitic SS (>20% Cr)	<650 °C	Long-term compatibility under operating conditions?
	Heat exchangers				Ni-base	<750 °C	Low-medium TRL for Ni-base Long-term compatibility under operating conditions?
Compressor	Casing	40-200	80-275	OEMs	Steel casting	Low	High TRL
	Impeller + shaft			Industrial Process Compressors	Alloy steel forgings	Low	Degradation of soft seal materials?
Turbine	Casing	600-750	80-275	OEMs Gas and Steam Turbines, A-USC	Ni-base casting	<750 °C	Low-medium TRL
	Disks				Ni-base forging		Long-term compatibility?
	Blades				Ni-base casting, integral forge + machine		High TRL Long-term compatibility?

sCO₂ Materials Review Papers

R. P. Oleksak and F. Rouillard, 4.14 – Materials Performance in CO₂ and Supercritical CO₂, in Comprehensive Nuclear Materials 2nd edition, Volume 4, pp. 422-451, 2020. (<https://doi.org/10.1016/B978-0-12-803581-8.11622-4>)

M. T. White, G. Bianchi, L. Chai, S. A. Tassou, A. I. Sayma, Review of supercritical CO₂ technologies and systems for power generation, Applied Thermal Engineering, Volume 185, 2021, 116447. (<https://doi.org/10.1016/j.applthermaleng.2020.116447>)

Kaiyang Li, Zhongliang Zhu, Bo Xiao, Jing-Li Luo, Naiqiang Zhang, State of the art overview material degradation in high-temperature supercritical CO₂ environments, Progress in Materials Science, Volume 136, 2023, 101107. (<https://doi.org/10.1016/j.pmatsci.2023.101107>)

Z. Xu, Y. Yang, S. Mao, W. Wu, Q. Yang, Review on corrosion of alloys for application in supercritical carbon dioxide brayton cycle, Heliyon, Volume 9, Issue 11, 2023, e22169. (<https://doi.org/10.1016/j.heliyon.2023.e22169>)

B. A. Pint, R. Pillai, J. R. Keiser, Summary of structural alloy compatibility in supercritical CO₂ at 450°-800°C, Advances in Materials, Manufacturing, and Repair for Power Plants: Proceedings from the Tenth International Conference, October 15-18, 2024, Bonita Springs Florida, USA. (<https://doi.org/10.31399/asm.cp.am-epri-2024p0885>)

M. C. Galetz, E. M. H. White, M. Kerbstadt, C. Schlereth, X. Montero, D. Benitez, Material Challenges and Alloy Selection for Particle/s-CO₂ Heat Exchangers in Concentrated Solar Power Systems, Advanced Engineering Materials, Volume 27, Issue 10, 2025, 2402060. (<https://doi.org/10.1002/adem.202402060>)

Z. Liang, T. Guo, Q. Zhao, A review of corrosion and protection of alloys in supercritical carbon dioxide power cycles: From the perspectives of corrosion simulation, dynamic simulation to experimental research, The Journal of Supercritical Fluids, Volume 224, 2025, 106647 (<https://doi.org/10.1016/j.supflu.2025.106647>)

Zhang G, Huang Y-P, Zhao Y-F, et al. High-temperature oxidation and carburization, corrosion protection, materials selection and coolant chemistry for supercritical carbon dioxide power cycles: A review. International Materials Reviews. 2025;0(0). (<https://doi.org/10.1177/09506608251369099>)

Questions?



Carleton
University

Department of Mechanical
and Aerospace Engineering



Thank you for your attention!

Henry Saari

henry.saari@carleton.ca