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OVERCOMING TECHNICAL AND COMMUNITY BARRIERS TO ADOPTING GASIFICATION TECHNOLOGIES

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PROJECT INFORMATION

PROJECT TITLE: *"Overcoming Technical and Community Barriers to Adopting Gasification Technologies"*

AWARD NO: DE – FE0032237

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Period of Performance:

07/01/2023 – 06/30/2026

Project Amount:

$750,000

UTEP Research Centers:

Aerospace Center UTEP Department of Communication

PROJECT INTRODUCTION

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Student Team

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PROJECT INTRODUCTION

THE SIGNIFICANCE OF HUMANITIES

HDSTEM

Humanities (Directed)

HDSTEM, as a bridge for communication gaps in STEM

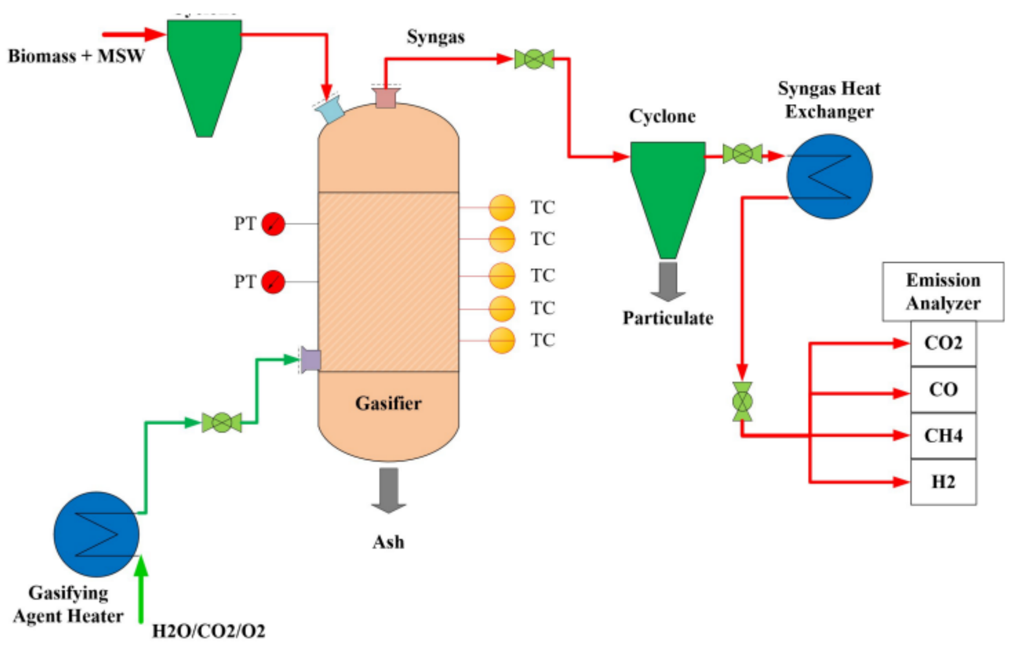
STEM

Courtesy: MusTufa Nullwala

The Significance of Humanities

PROJECT OBJECTIVES

PROJECT OBJECTIVES



Simplified Schematic of the Proposed Gasifier System

Objective 1:
System Configuration Analysis of a 300 KWth Pressurized MSW-Biomass Co-gasifier

Objective 2:
Design, Construction, & Testing of the 300 KWth Pressurized MSW-Biomass Co-gasifier

Objective 3:
Develop Persuasive Messaging and Communication Infrastructure to Educate Policymakers and the Public About the Benefits of Adopting Co-gasification Technologies

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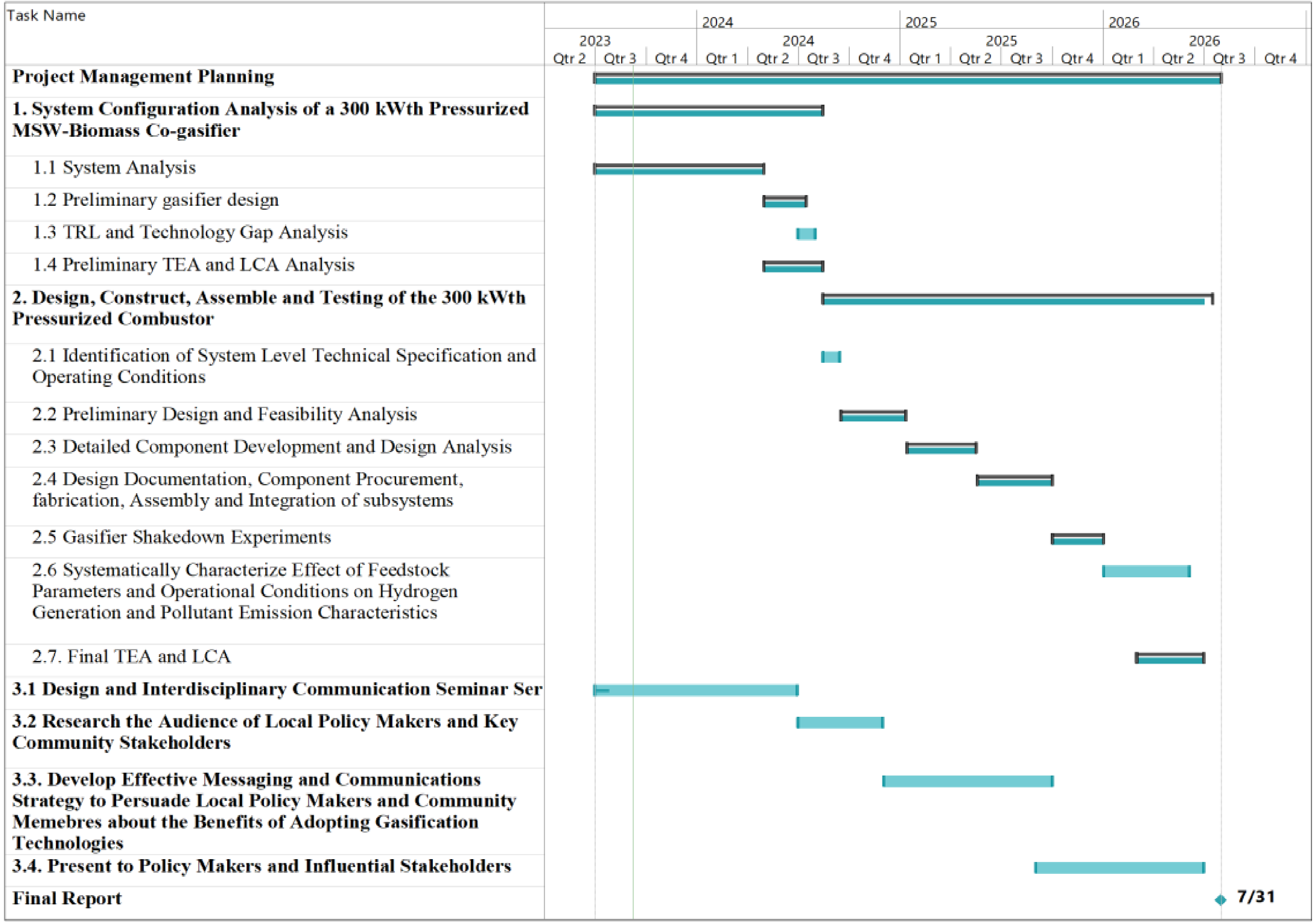
TIMELINE



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PROJECT PROGRESS

TASK 1 SYSTEM CONFIGURATION ANALYSIS

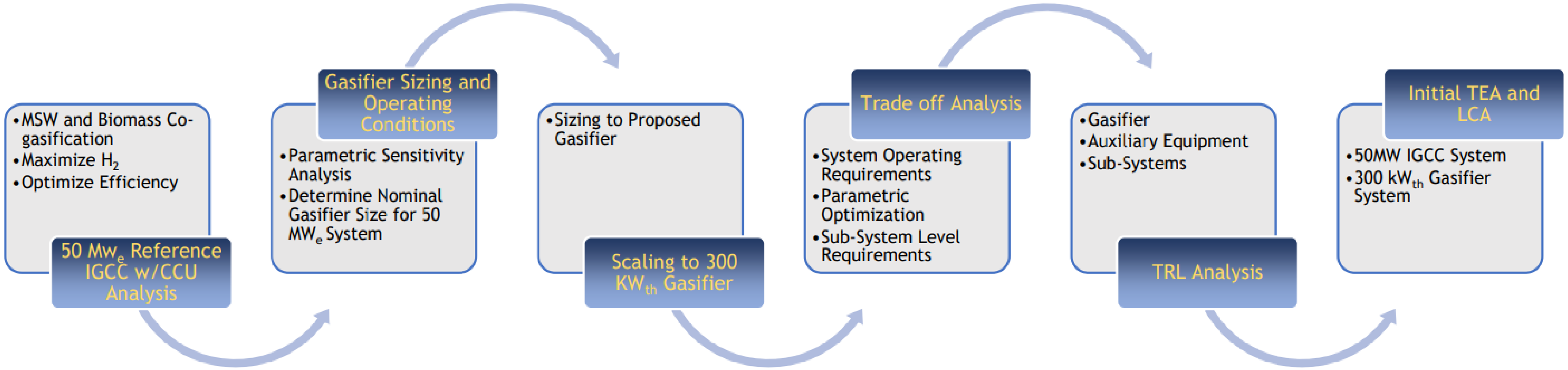


Figure: Approach to Objective 1

PROJECT PROGRESS

TASK 1.1 SYSTEM ANALYSIS

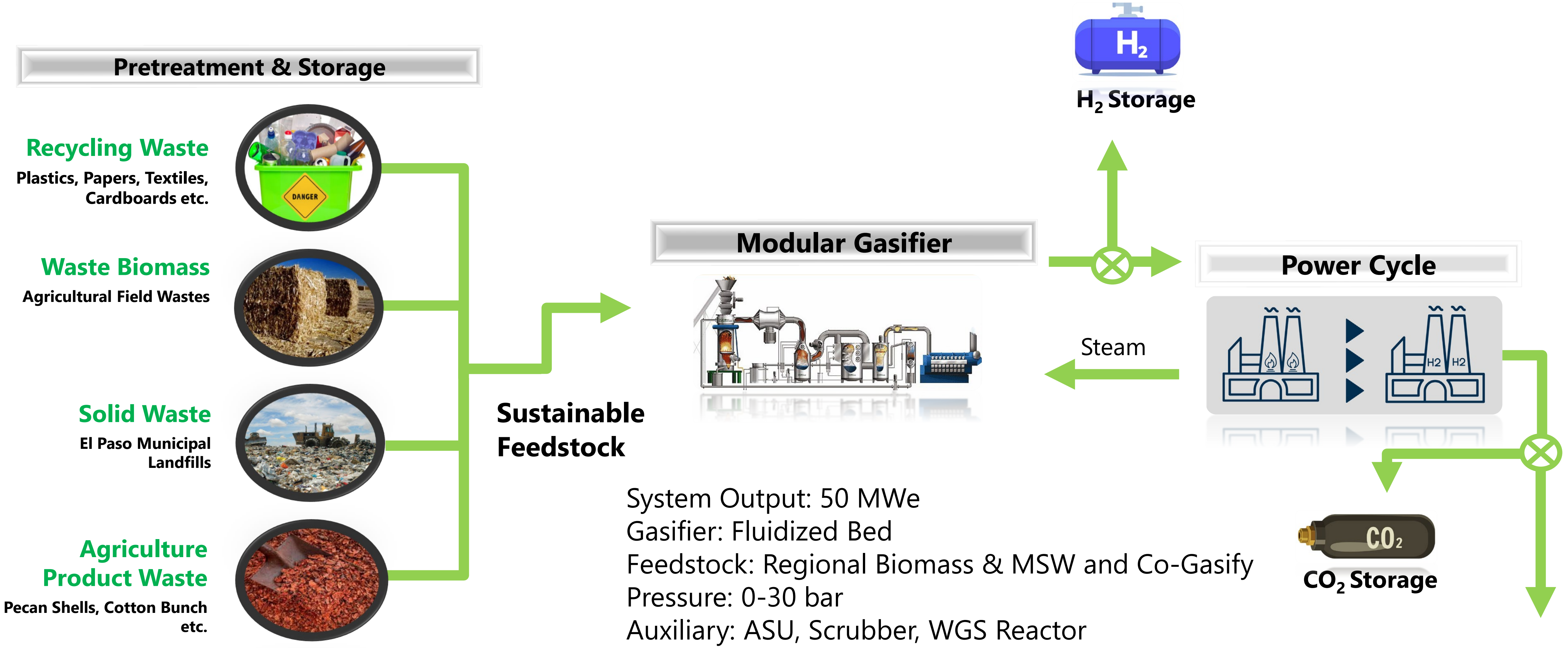


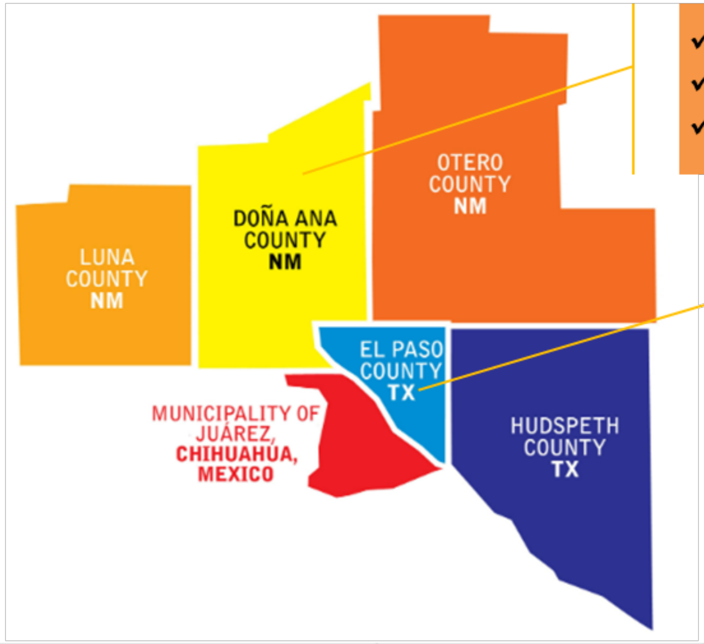
Figure: Initial IGCC Process

System Output: 50 MWe
Gasifier: Fluidized Bed
Feedstock: Regional Biomass & MSW and Co-Gasify
Pressure: 0-30 bar
Auxiliary: ASU, Scrubber, WGS Reactor
Power Cycle: CPC
Pre & Post-combustion CCU

PROJECT PROGRESS

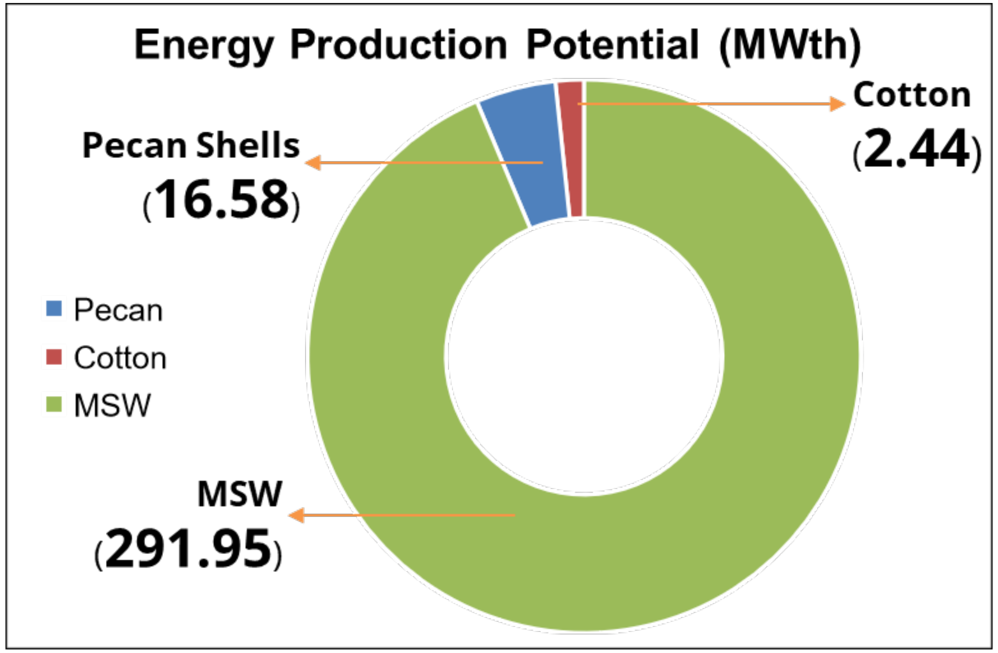
TASK 1.1 SYSTEM ANALYSIS

POTENTIAL ENERGY MATERIALS IN THE PASO DEL NORTE REGION



- ✓ Pecans (38546 acres)
- ✓ Hay & Haylage (11581 acres)
- ✓ Cotton (9866 acres)

- ✓ Cotton (14873 acres)
- ✓ Pecans (10926 acres)



	Pecan Shell	Cotton	MSW
Total Waste (Tons)	~30,000	~4200	~463,000
HHV (MJ/Kg)	17.40	18.33	19.87

	Pecan Shell	Cotton	MSW
Energy (MJ)	522,795,112	77,011,963	9,202,691,150
MWth	16.58	2.44	291.82

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TASK 1.1 SYSTEM ANALYSIS

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Reaction Modeling

- **Shortcut Balance Based**
  - RYield
  - RStoic
- **Equilibrium Based**
  - REquil
  - RGibbs
- **Kinetic Rate Based**
  - RCSTR
  - RPlug
  - Rbatch

MODEL ASSUMPTIONS

- NH_3 or H_2S was ignored.
- Steady-state.
- Inert ash
- No pressure or heat losses.
- Air contains 23 wt% O2- 77 wt% N2.
- Four lumped species for tar modeling.

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TASK 1.1 SYSTEM ANALYSIS

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FEEDSTOCK CHARACTERIZATION

Kinetic Model

Material	Textile Waste	Dried Waste	Pyrolyzed Char
Source	Reference	Excel Calculation	Excel Calculation
VM	87.78	87.78	7
Ash	1.05	1.05	6.25
FC	11.17	11.17	86.74
Moisture	0.82	0	0
C	43.37	43.37	70.20
H	6.18	6.18	5.98
N	1.45	1.45	8.63
O	47.03	47.03	3.43
S	0.92	0.92	5.47

Equilibrium Model

MSW Type	Moisture	Volatile	Fixed Carbon	Ash	C	H	O	N	S
Paper	5.95	78.55	7.57	7.93	41.43	6.87	49.83	1.01	0.86
Textile (cotton)	6.85	82.37	10.61	0.17	41.19	6.97	50.99	0.01	0.84
Wood	9.31	74.96	15.49	0.24	45.69	7.57	43.84	1.89	1.01
Plastic (PET)	-	88.61	11.39	-	64.22	4.65	30.53	0.05	0.55

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TASK 1.1 SYSTEM ANALYSIS

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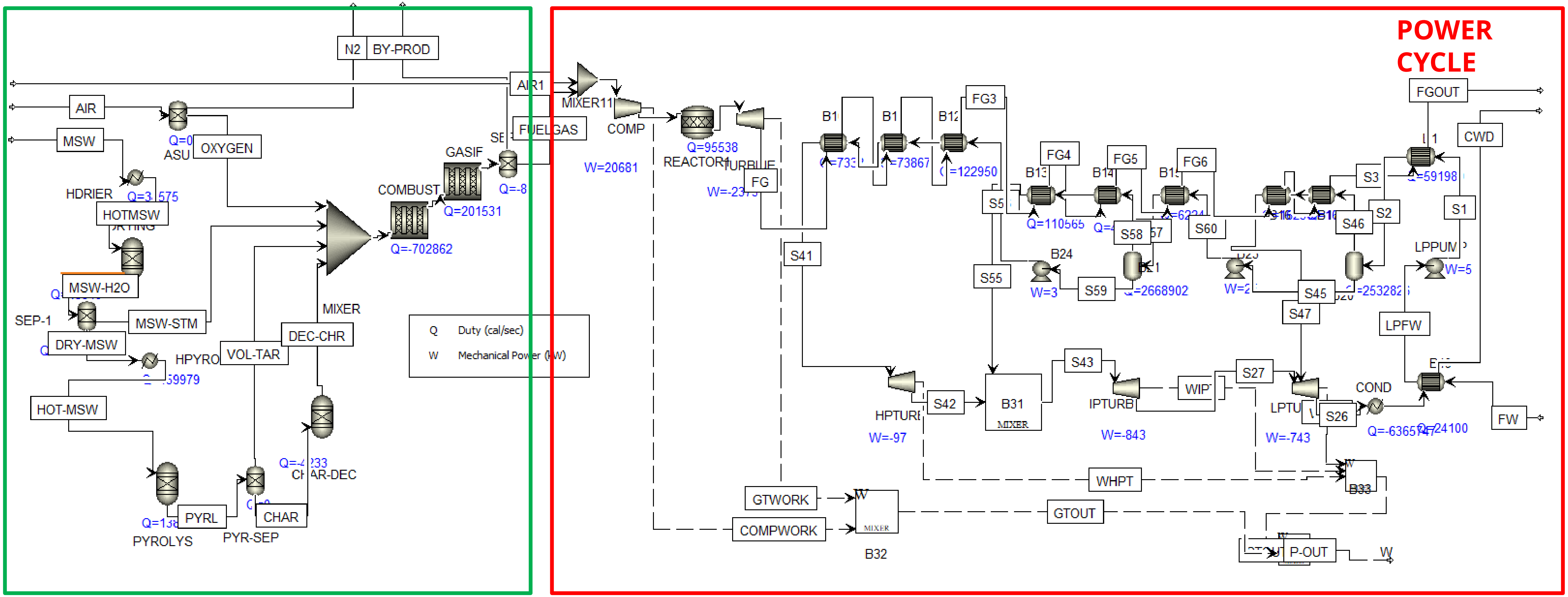

GASIFICATION CYCLE

Figure: Preliminary Process Cycle in Aspen Plus

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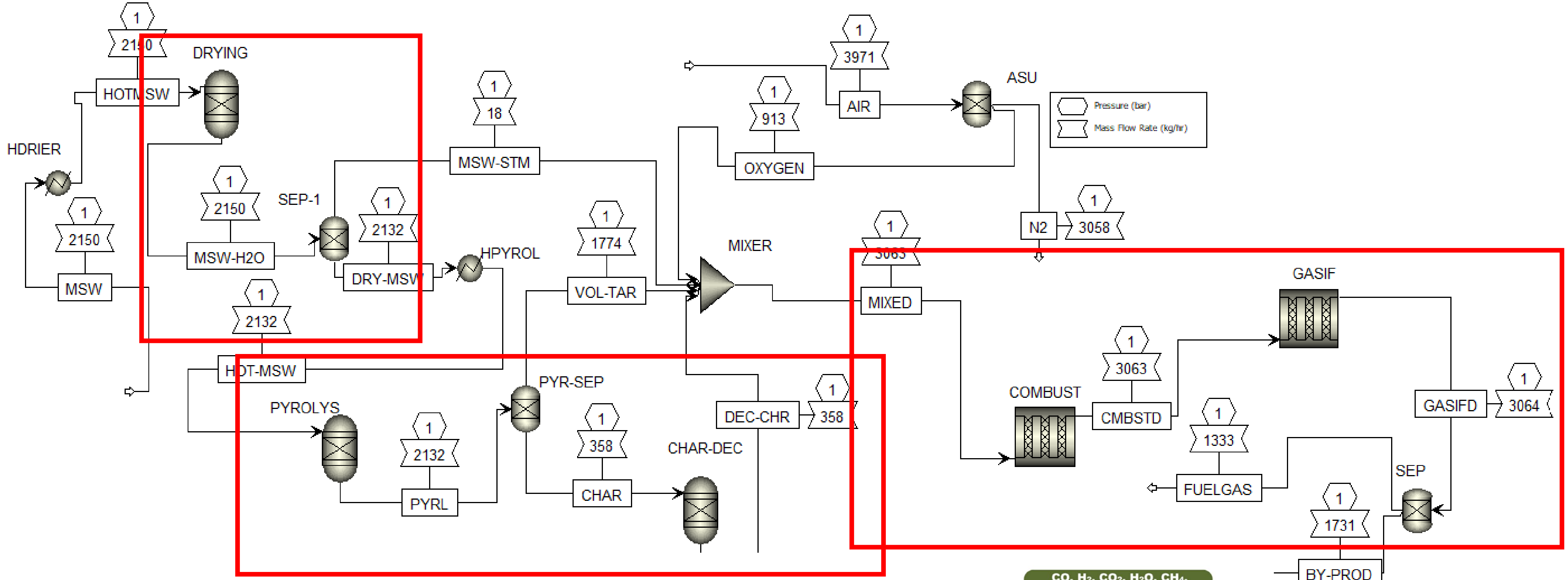
TASK 1.1 SYSTEM ANALYSIS

KINETIC MODEL



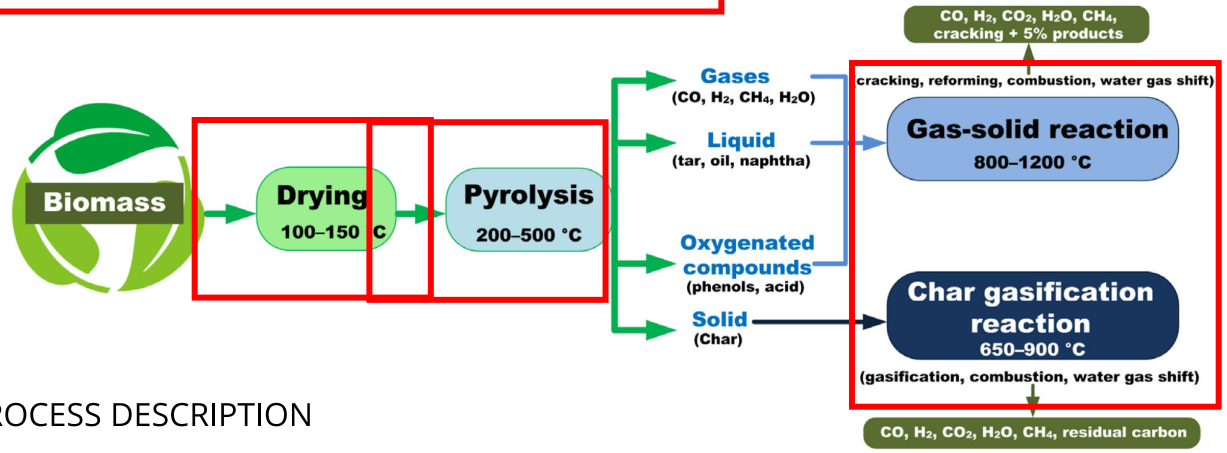


FIGURE: GASIFICATION PROCESS DESCRIPTION

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TASK 1.1 SYSTEM ANALYSIS

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TAR MODELING

Name	Lumped Species
Benzene	Benzene
Phenol	Phenol and Cresols
Toluene	Toluene, Indene, and xylene
Naphthalene	Naphthalene, 1+2 - Methylnaphthalene, Acenaphthylene, and Phenanthrene

PYROLYSIS YIELD FROM EMPIRICAL DATA

Product	a	b	c
CH_4	-4.341×10^{-5}	10.12×10^{-2}	-51.08
H_2	1.362×10^{-5}	-2.517×10^{-2}	12.19
CO	-3.524×10^{-5}	9.770×10^{-2}	-24.93
CO_2	3.958×10^{-5}	-9.126×10^{-2}	64.02
C_2H_4	-6.873×10^{-5}	14.94×10^{-2}	-76.89
C_2H_6	8.265×10^{-6}	-2.105×10^{-2}	13.38
C_6H_6	-3.134×10^{-5}	7.544×10^{-2}	-42.72
C_7H_8	-4.539×10^{-6}	0.687×10^{-2}	1.462
C_6H_6O	1.508×10^{-5}	-3.662×10^{-2}	22.19
$C_{10}H_8$	-8.548×10^{-6}	1.882×10^{-2}	-9.851
H_2O	5.157×10^{-5}	-11.86×10^{-2}	84.91

Mass yields (Y_0) of pyrolysis products are calculated, as $Y_i = aT^2 + bT + c$.

Component	Basis	Basis Yield
CH_4	Mass	0.0582071
H_2	Mass	0.00564559
CO	Mass	0.357021
CO_2	Mass	0.12907
C_2H_4	Mass	0.0297956
C_2H_6	Mass	0.00832825
C_6H_6	Mass	0.00656682
C_7H_8	Mass	0.0385119
C_6H_6O	Mass	0.0100009
$C_{10}H_8$	Mass	0.00310139
H_2O	Mass	0.185847
Char	Mass	0.167905

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TASK 1.1 SYSTEM ANALYSIS

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Reaction	Kinetic Constants	
	K	E_a(KJ/Kmol)
(1)	$8.9 \cdot 10^9$	$1.8 \cdot 10^5$
(2)	$7.9 \cdot 10^{10}$	$2.02 \cdot 10^5$
(3)	$5.4 \cdot 10^7$	$1.25 \cdot 10^4$
(4)	$6.55 \cdot 10^{-1}$	$8.02 \cdot 10^4$
(5)	$1.27 \cdot 10^7$	$1.26 \cdot 10^5$
(6)	3.42	$1.3 \cdot 10^4$
(7)	$2.78 \cdot 10^{-2}$	$1.26 \cdot 10^4$
(8)	$3.00 \cdot 10^5$	$1.25 \cdot 10^5$
(9)	3.42	$1.3 \cdot 10^4$
(10)	$1.00 \cdot 10^7$	$1.00 \cdot 10^5$
(11)	$1.00 \cdot 10^7$	$1.00 \cdot 10^5$
(12)	$1.00 \cdot 10^{14}$	$3.50 \cdot 10^5$

Reaction	Reaction Rate	No
Total oxidation of CO: $CO + 0.5O_2 \rightarrow CO2$	$r = k \cdot e^{\frac{-E_a}{RT}}[CO][O_2]^{0.25}[H_2O]^{0.5}$	(1)
Partial oxidation of CH_4: $CH_4 + \frac{1}{2}O_2 \rightarrow CO + 2H_2$	$r = k \cdot e^{\frac{-E_a}{RT}}[CH_4]^{0.7}[O_2]^{0.8}$	(2)
Hydrogen oxidation: $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$	$r = k \cdot e^{\frac{-E_a}{RT}}[H_2][O_2]$	(3)
Partial oxidation of phenol: $C_6H_6O + 4O_2 \rightarrow 6CO + 3H_2O$	$r = k \cdot T \cdot e^{\frac{-E_a}{RT}}[C_6H_6O]^{0.5}[O_2]$	(4)
Partial oxidation of benzene: $C_6H_6 + \frac{9}{2}O_2 \rightarrow 6CO + 3H_2O$	$r = k \cdot e^{\frac{-E_a}{RT}}[C_6H_6]^{0.5}[O_2]$	(5)

Reaction	Reaction Rate	No
Water Gas: $C + H_2O \rightleftharpoons CO + H_2$	$r = k \cdot T.e^{\frac{-E_a}{RT}}[C][H_2O]$	(6)
Water-gas shift: $CO + H_2O \leftrightharpoons CO_2 + H_2$	$r = k \cdot e^{\frac{-E_a}{RT}}[CO][H_2O] - \frac{[CO_2][H_2]}{k} k_{eq}$	(7)
Steam reforming: $CH_4 + H_2O \rightleftharpoons CO + 3H_2$	$r = k \cdot T.e^{\frac{-E_a}{RT}}[CH_4][H_2O]$	(8)
Boudouard: $C + CO_2 \rightleftharpoons 2CO$	$r = k \cdot T.e^{\frac{-E_a}{RT}}[C]$	(9)
$C_6H_6O \rightarrow CO + 0.4C_{10}H_8 + 0.15C_6H_6 + 0.1CH_4 + 0.75H_2$	$r = k \cdot T.e^{\frac{-E_a}{RT}}[C_6H_6O]$	(10)
$C_6H_6O + 3H_2O \rightarrow 4CO + 0.5C_2H_4 + CH_4 + 3H_2$	$r = k \cdot T.e^{\frac{-E_a}{RT}}[C_6H_6O]$	(11)
$C_{10}H_8 \rightarrow 6.5C + 0.5C_6H_6 + 0.5CH_4 + 1.5H_2$	$r = k \cdot T.e^{\frac{-E_a}{RT}}[C_{10}H_8]^{1.6}[H_2]^{-0.5}$	(12)

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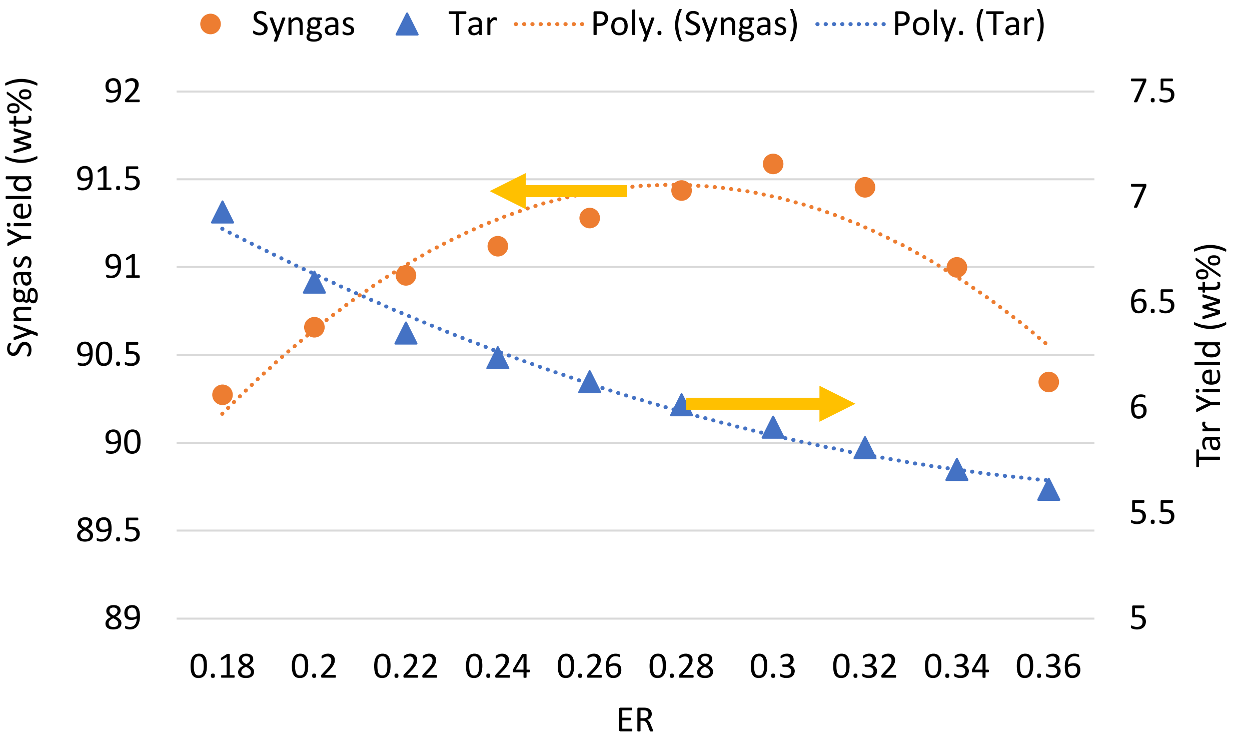
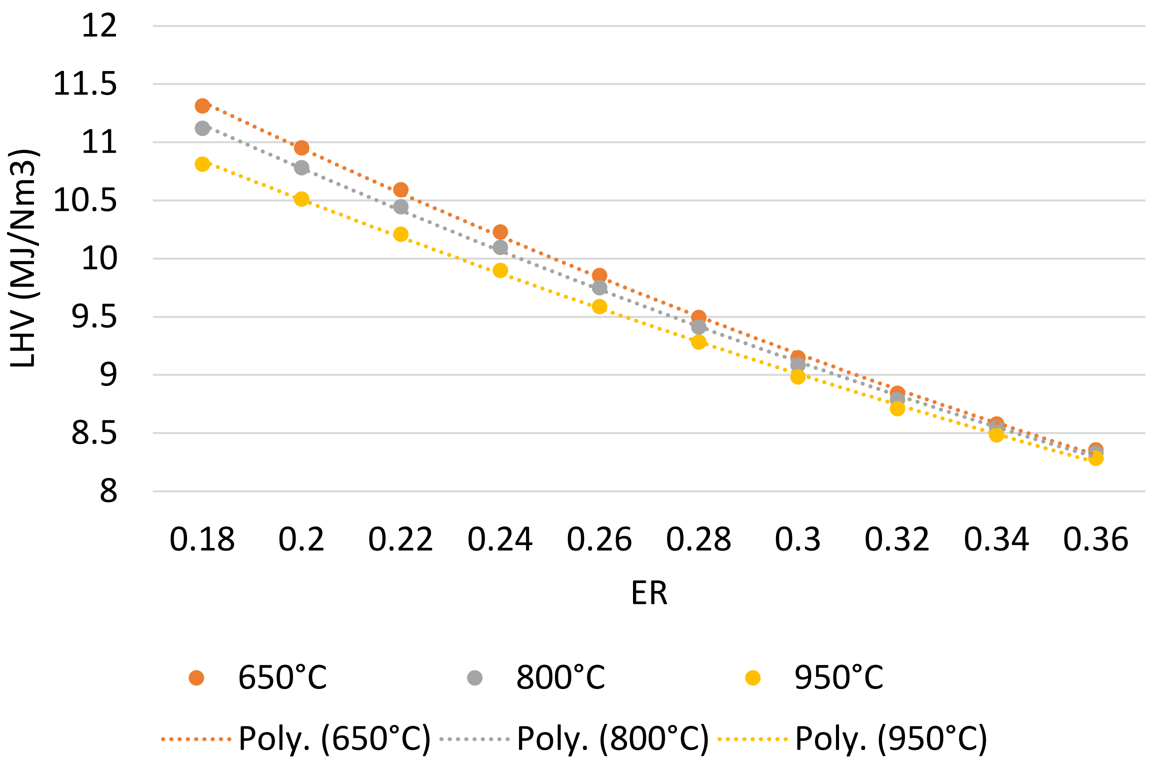
TASK 1.1 SYSTEM ANALYSIS

RESULTS FROM KINETIC MODEL





EFFECT OF ER ON SYNGAS PRODUCTION AT 800C

SENSITIVITY OF HEATING VALUE

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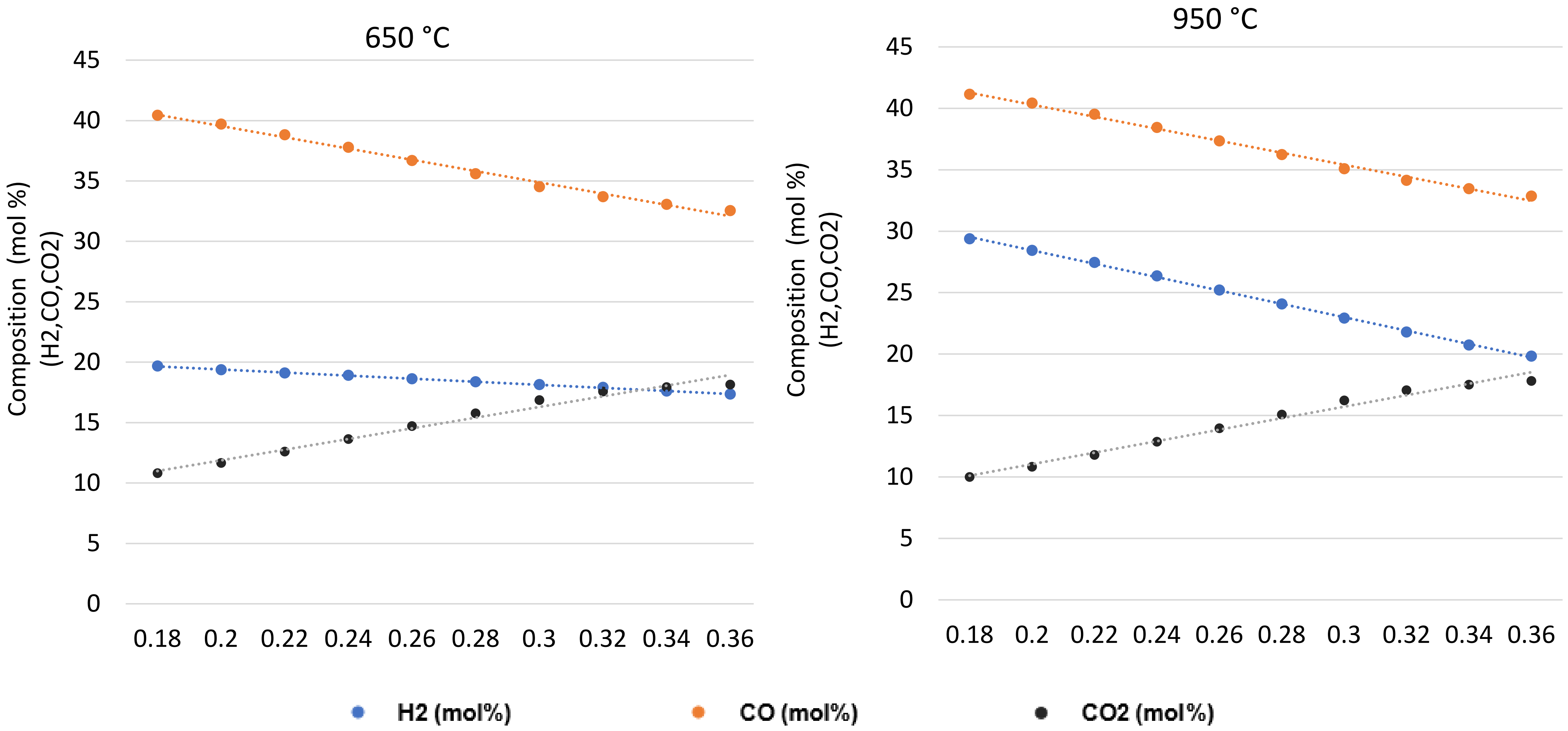
TASK 1.1 SYSTEM ANALYSIS



PROCESS SENSITIVITY ANALYSIS

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TASK 1.1 SYSTEM ANALYSIS

EQUILIBRIUM MODEL

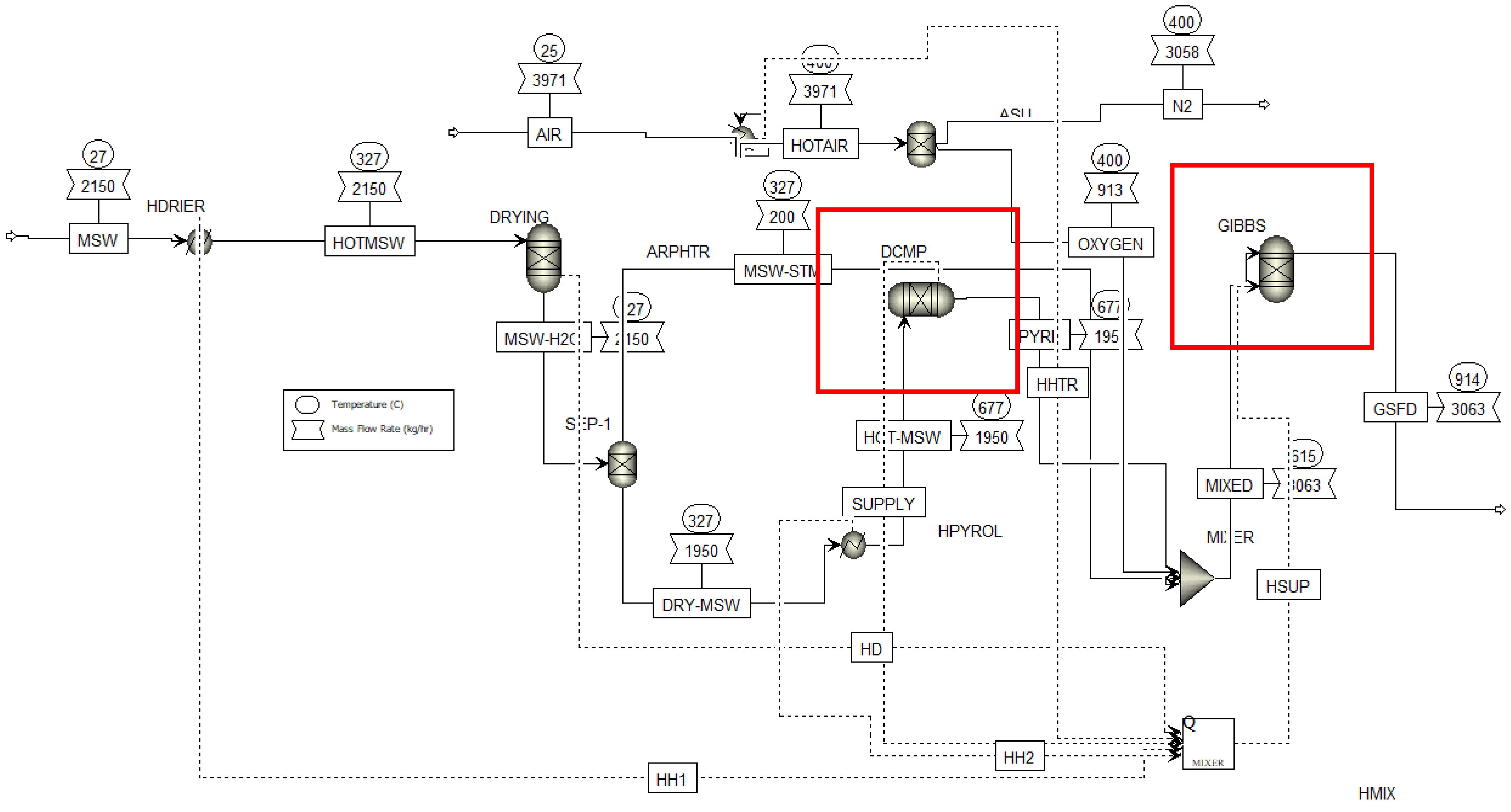

Figure: Cycle Development- Equilibrium Approach

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TASK 1.1 SYSTEM ANALYSIS

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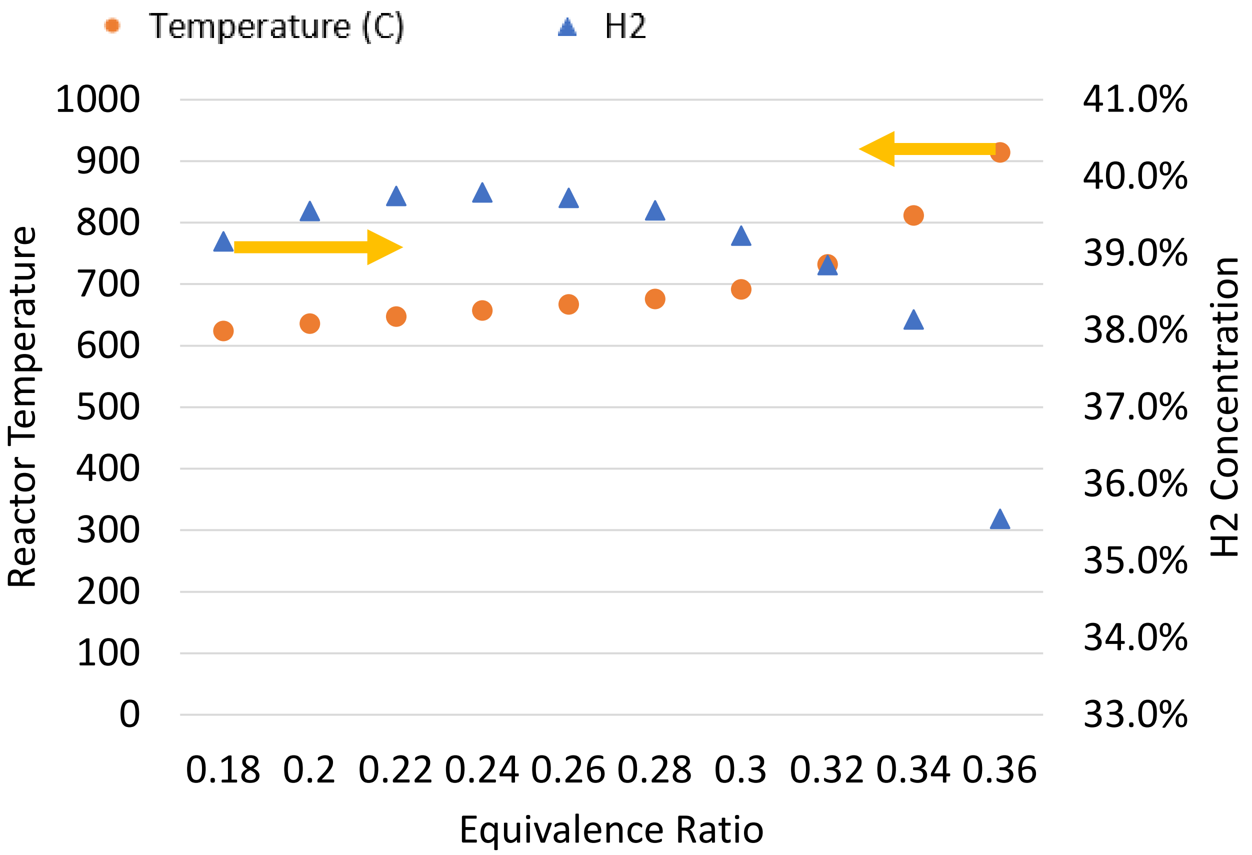
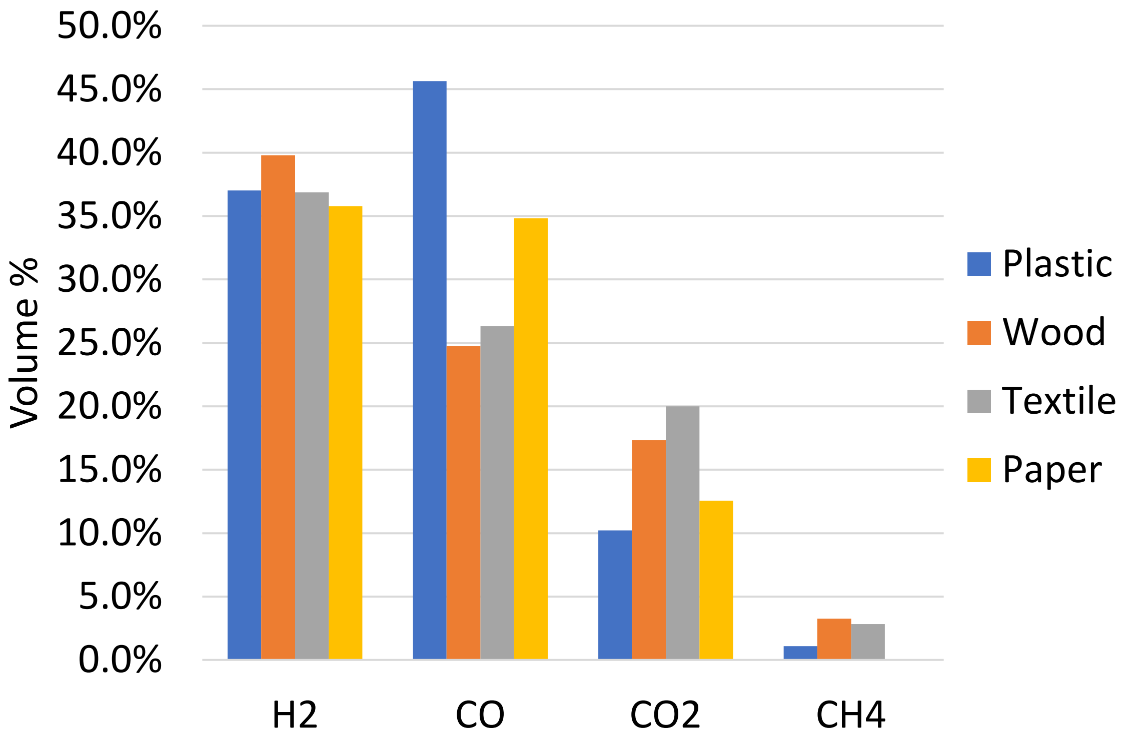
RESULTS FROM EQUILIBRIUM APPROACH





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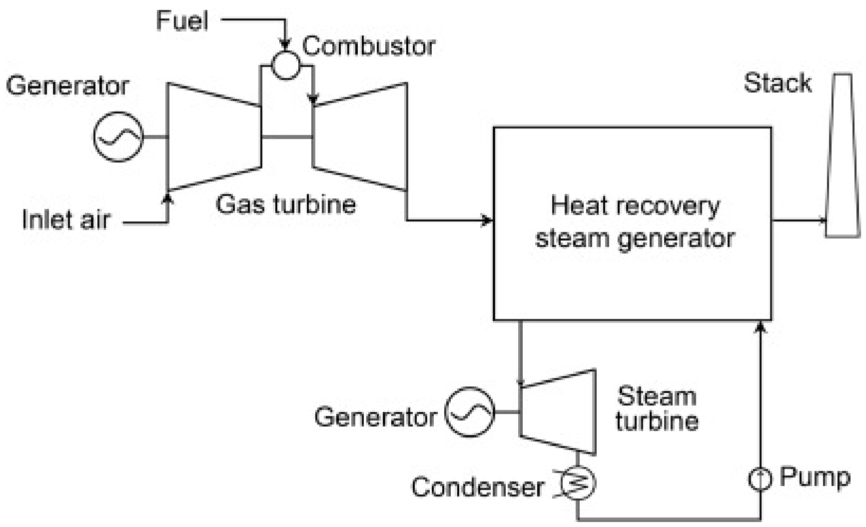
TASK 1.1 SYSTEM ANALYSIS

POWER CYCLE DEVELOPMENT

Assumptions

- The combustion chamber is modeled as a reactor in Aspen Plus.
- Full Combustion achieved in the reactor.
- The compressor and turbine efficiency is considered as isentropic.
- No losses in the energy conversion process.

SCHEMATIC DIAGRAM SHOWING THE ENERGY FLOWS THROUGH COMBINED CYCLE:



ASSUMED TURBINE OPERATING PARAMETERS:

Gas turbine	
GT compressor efficiency	Adiabatic efficiency 80.6%
GT compressor pressure ratio	5/1
GT expander efficiency	Adiabatic efficiency 90.2%
GT expander pressure ratio	1/30
Steam turbine	
HP ST efficiency	Adiabatic efficiency 86.7%
IP ST efficiency	Adiabatic efficiency 91.7%
LP ST efficiency	Adiabatic efficiency 92.4%
HP ST pressure ratio	30/20
IP ST pressure ratio	10/5
LP ST pressure ratio	5/1
Condenser	
Outlet temperature	32°C
Pressure	1 bar

E. P. Foster, P. J. A. Tijm, and D. L. Bennett, "Advanced gas-to-liquids processes for syngas and liquid-phase conversion," Stud Surf Sci Catal, vol. 119, pp. 867–874, 1998, doi: 10.1016/s0167-2991(98)80541-7

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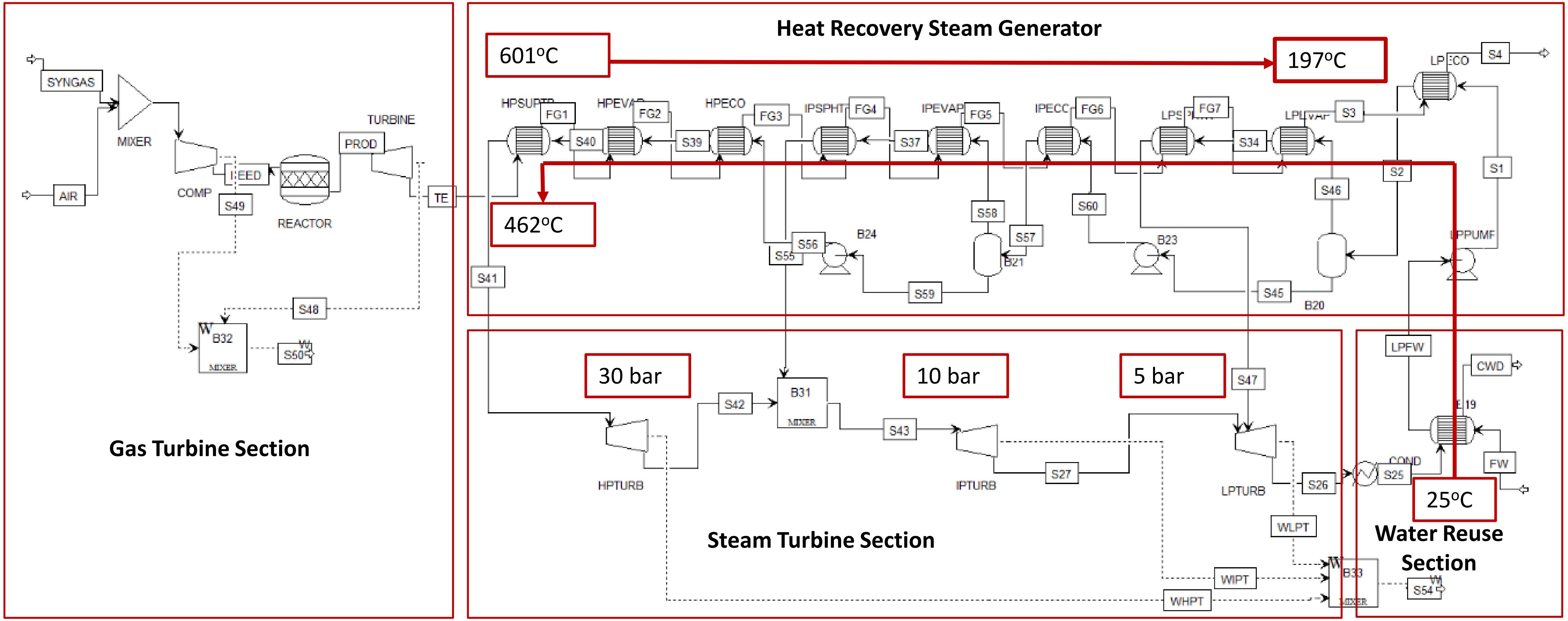
TASK 1.1 SYSTEM ANALYSIS



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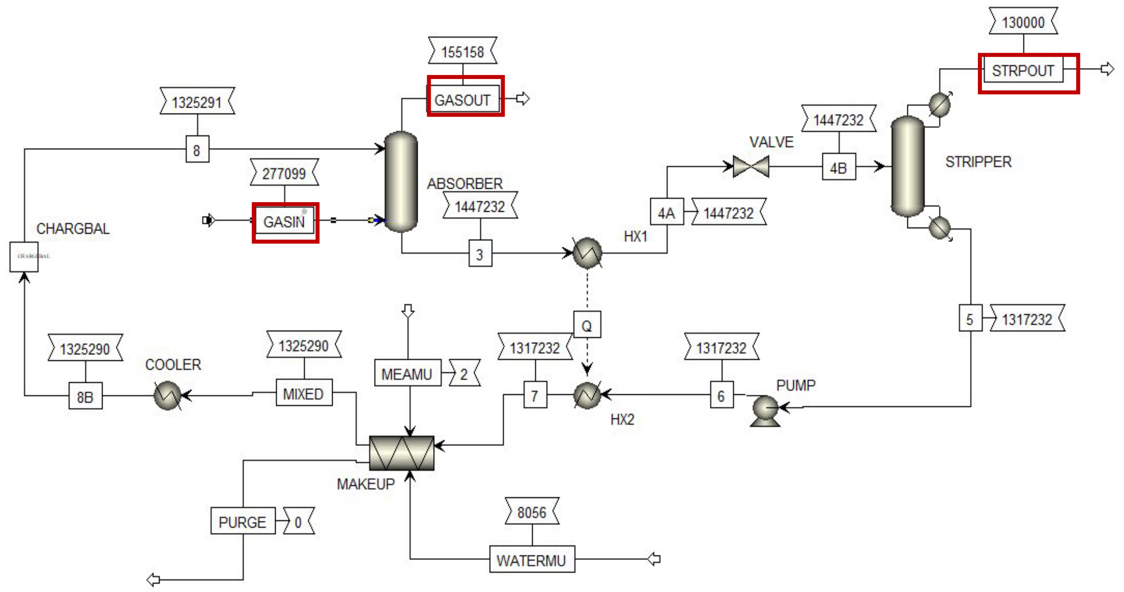
TASK 1.1 SYSTEM ANALYSIS

MEA based CCU Model optimization for the developed decentralized IGCC model



CCU

Comparison table showing the carbon capture amount **(94.58%)**

Species	Flue Gas In (Kg/hr)	Flue Gas Out (Kg/hr)	Stripper Out (Kg/hr)
MEA	0	1.9	0.2
CO_2	128,199	6,939	121,259
H_2S	8.03	0.01	8.1
H_2	7,631	7,573	58
CH_4	1,396	1,394	2
CO	1,354	1,345	8

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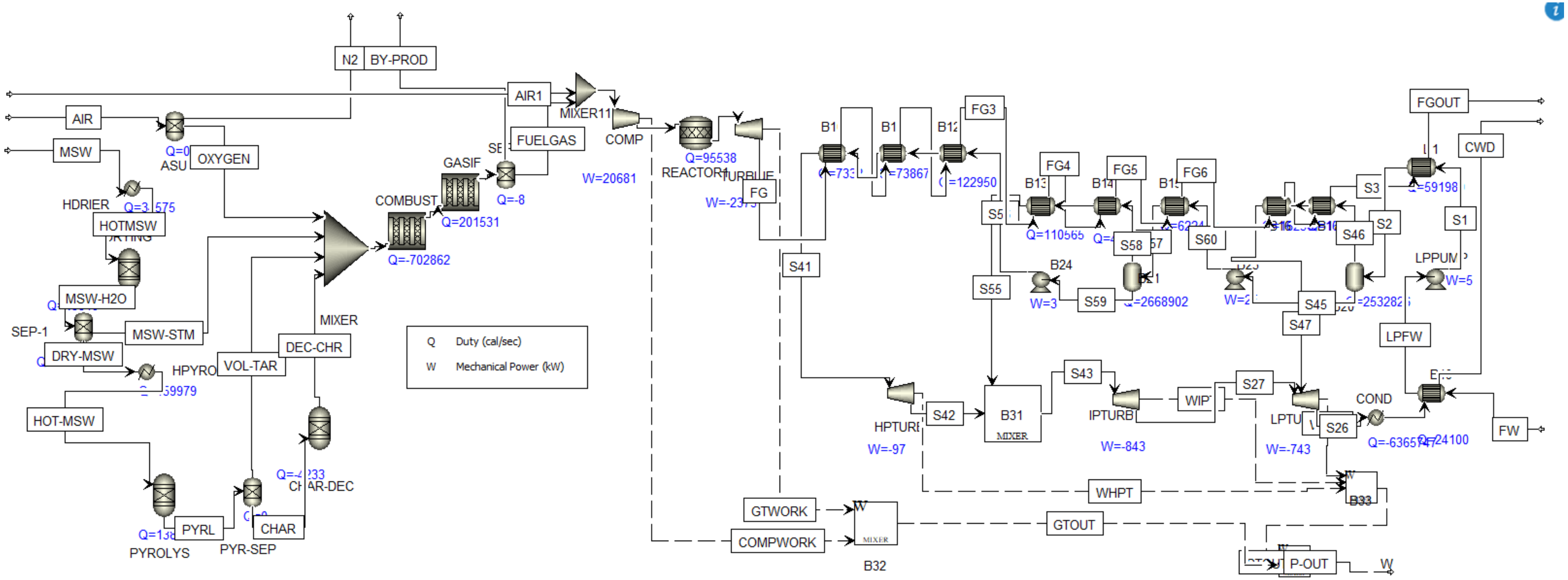
TASK 1.1 SYSTEM ANALYSIS

- Material MSW: 2150 Kg/hr, LHV 18MJ/Kg (Equivalent thermal input: 10,800KW)
- Output from turbines: 4733.44 KW

  Net Efficiency: 43.8%

  Excluded: Energy for the gasification auxiliaries, HeX duties, CCU.



CYCLE EFFICIENCY (INITIAL)

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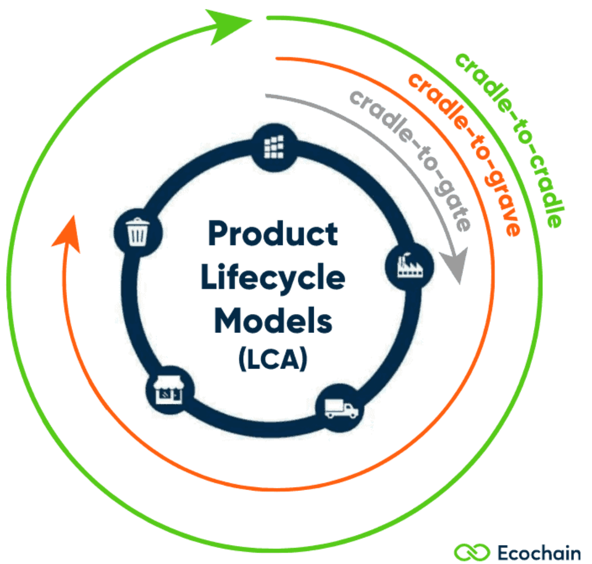
TASK 1.1 SYSTEM ANALYSIS

INVENTORY

CRADLE TO GATE LCA FOR 10.8 MWth GASIFICATION PLANT OPERATING FOR 1 HOUR



LCA MODELS

ASSUMPTIONS:

- The empirical conversion efficiency was considered as 33%.
- The feedstock flowrate was calculated from the total power generated from the plant.

FLOWS:

- Flows were taken from the OpenLCA default library.

IMPACT ASSESSMENT METHODS:

- IPCC 2013 GWP 100a
- Recipe 2016
- Eco Indicator 99

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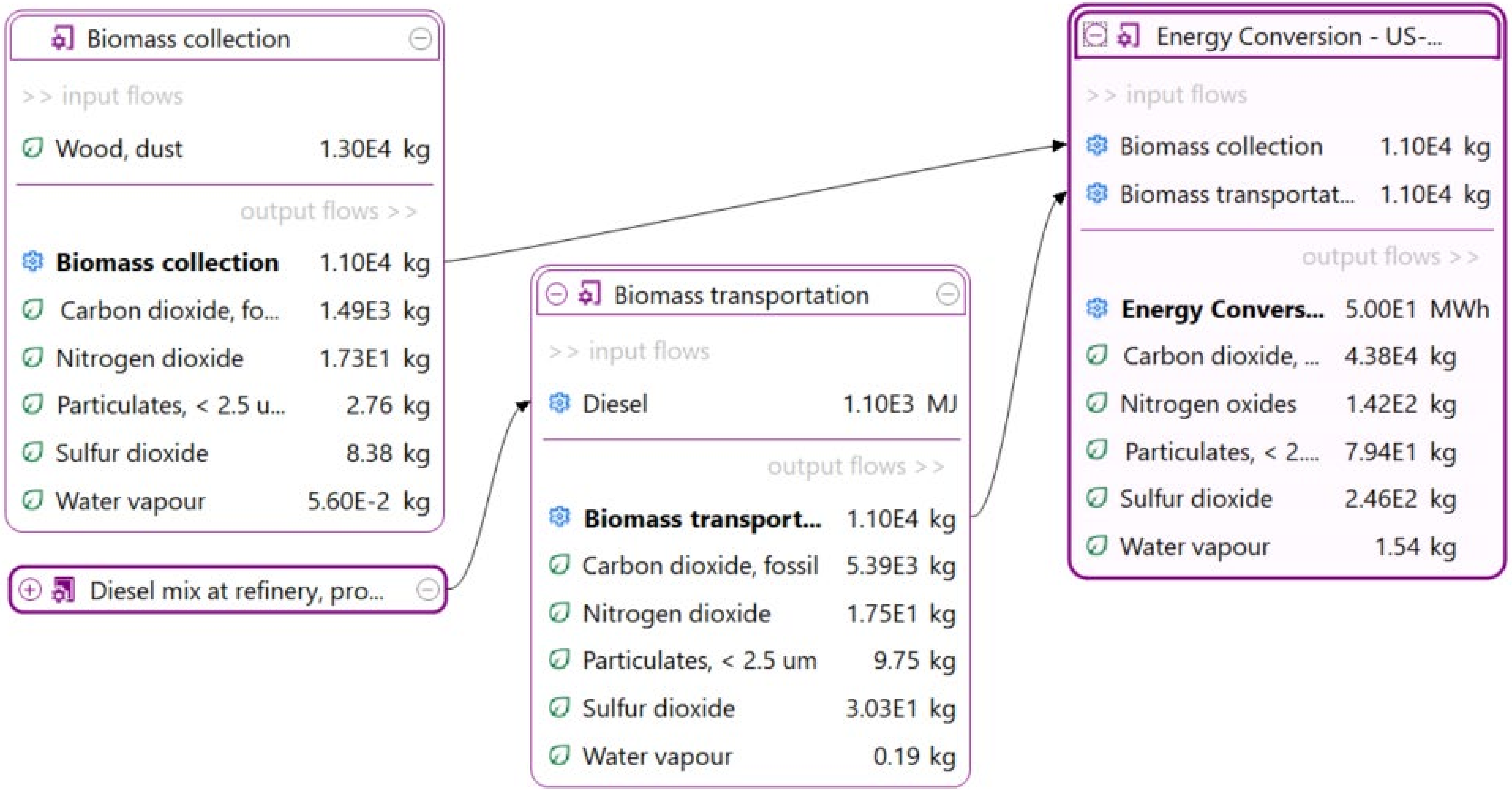
TASK 1.1 SYSTEM ANALYSIS

MODEL GRAPH



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LCA RESULTS

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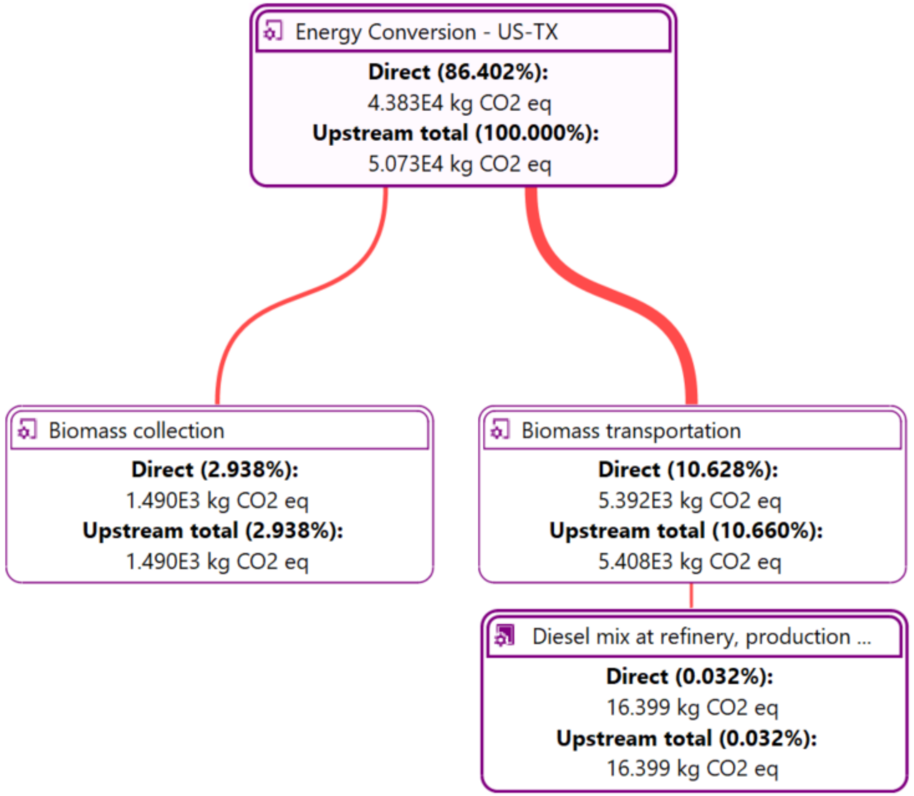
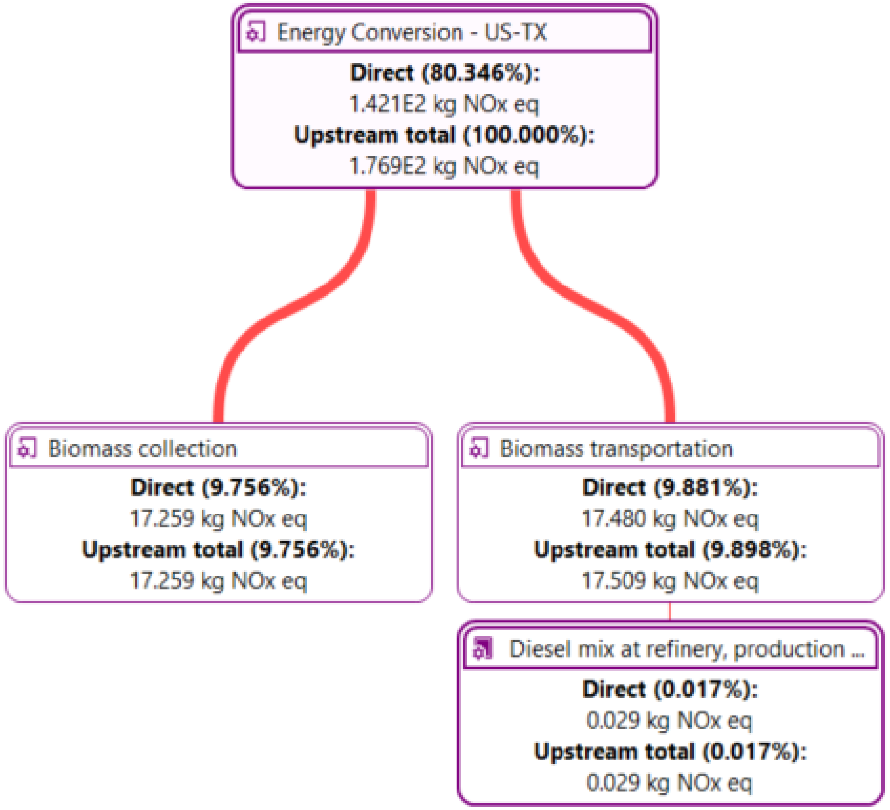
TASK 1.1 SYSTEM ANALYSIS

GWP (CO_2 eq)



STRATOSPHERIC OZONE LAYER DEPLETION (CFC11 eq)



https://www.rit.edu/sustainabilityinstitute/blog/what-life-cycle-assessment-lca

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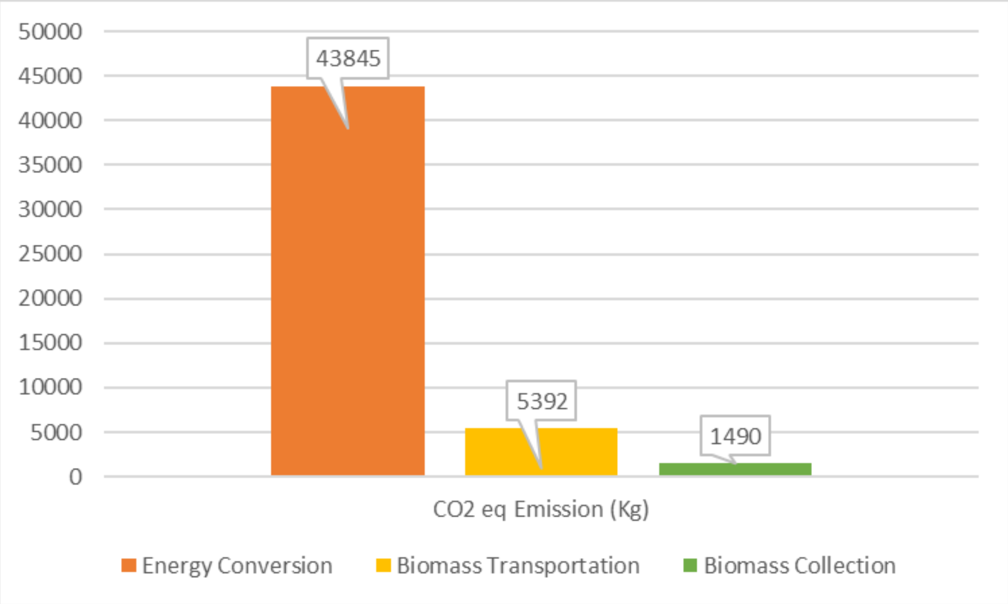
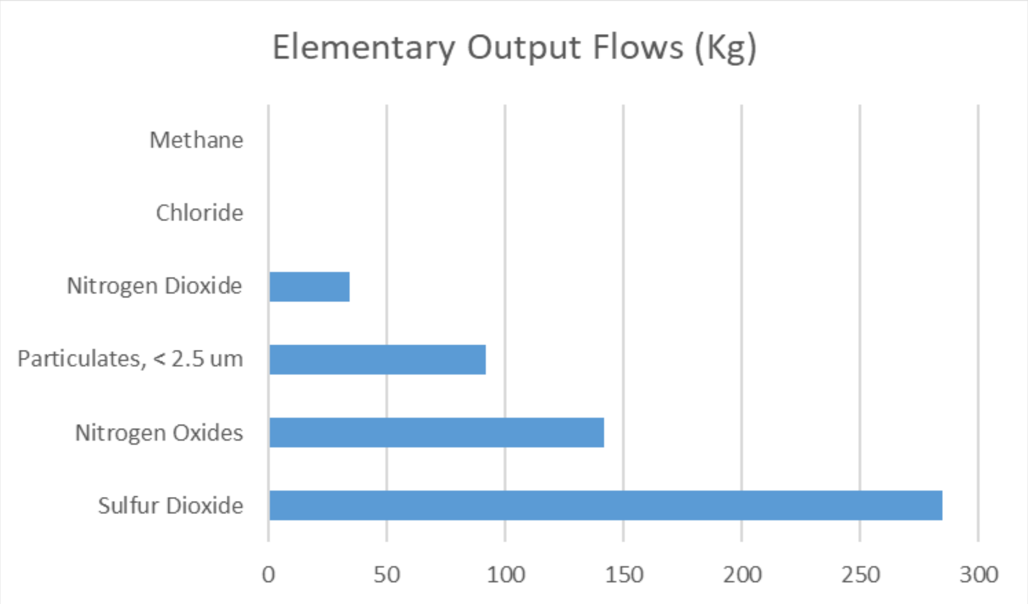
TASK 1.4 PRELIMINARY TEA & LCA

LCA Results





OTHER NOTABLE EMISSIONS FROM THE ENERGY CONVERSION PROCESS

https://www.rit.edu/sustainabilityinstitute/blog/what-life-cycle-assessment-lca

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TASK 1.4 PRELIMINARY TEA & LCA

LCA Results

FINE PARTICULATE MATTER FORMATION

Contribution	Process	Required amount	Unit	Total result [Kg PM2.5 eq]	Direct contribution [Kg PM2.5 eq]
100.00%	Energy Conversion - US-TX	180000	MJ	285	154
30.30%	Biomass transportation	11000	Kg	85.5	46.2
23.40%	Biomass collection	11000	Kg	65.5	36.03

*Kg PM2.5 = 4.2 deaths per Kg inhaled

TERRESTRIAL ACIDIFICATION

Contribution	Process	Required amount	Unit	Total result [Kg SO_2 eq]	Direct contribution [Kg SO_2 eq]
100.00%	Energy Conversion - US-TX	180000	MJ	91.94	39.6
14.50%	Biomass transportation	11000	Kg	12.8	7.2
6.99%	Biomass collection	11000	Kg	6.42	3.5

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TASK 1.4 PRELIMINARY TEA & LCA

PRELIMINARY TEA

CAPEX

Equipment	Cost (million $)
Gasifier	15-20
Air Separation Unit (ASU)	10-15
Gas Cleanup Systems	5-10
Shift Reactors	2-5
Gas Turbine	25-30
Steam Turbine	10-15
Heat Recovery Steam Generator (HRSG)	5-10
CO2 Capture System	15-25
Cooling Systems	1-3
Control and Instrumentation	5-7
Scrubber	0.5 - 1

OPEX

Equipment	Cost (million $)
Gasifier	0.4-0.6
Air Separation Unit (ASU)	0.3-0.4
Gas Cleanup Systems	0.1-0.2
Shift Reactors	0.04-0.1
Gas Turbine	0.5-0.8
Steam Turbine	0.2-0.3
Heat Recovery Steam Generator (HRSG)	0.1-0.2
CO2 Capture System	0.3-0.5
Cooling Systems	0.02-0.06
Control and Instrumentation	0.1-0.14
Emission control system	0.01-0.02

PROJECT PROGRESS

TASK 2 TECHNICAL METHOD

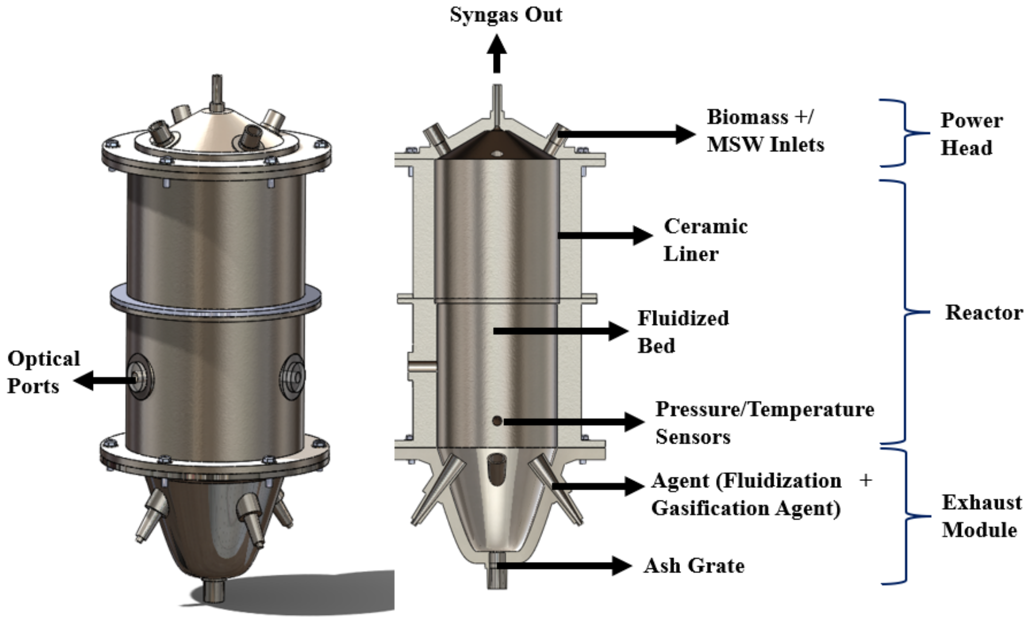


Figure: Concept CAD of the Proposed Gasifier

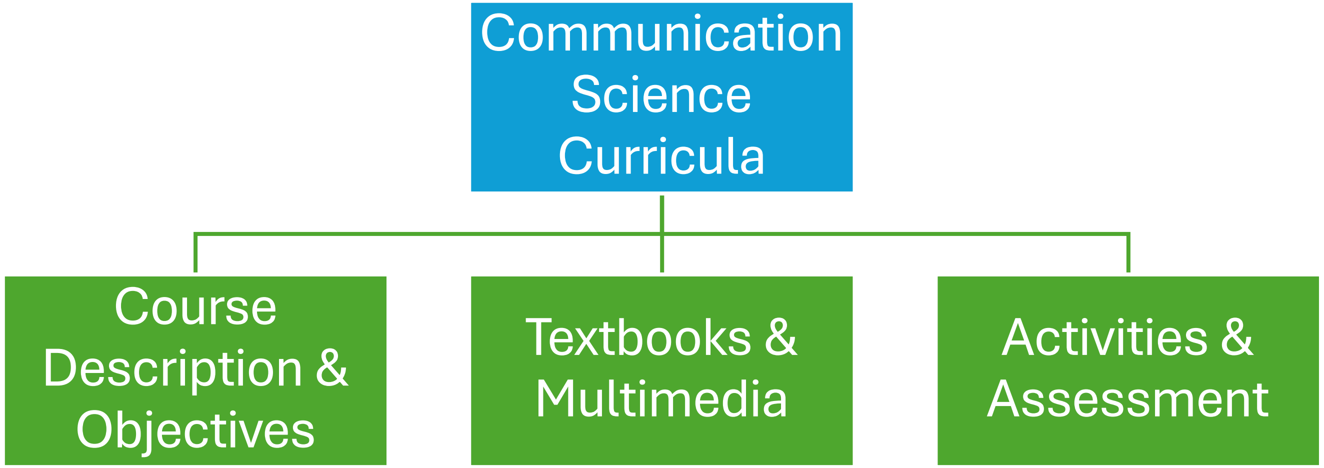
Objective 2: Design, Construction & Testing of the 300 kWth Pressurized MSW-Biomass Co-gasifier

- *Task 2.1: Identification of System Level Technical Specification and Operating Condition*
- *Task 2.2: Preliminary Design and Feasibility Analysis*
- *Task 2.3: Detailed Component Development and Design Analysis*
- *Task 2.4: Design Documentation, Component Procurement, Fabrication, Assembly and Integration of Sub-systems*
- *Task 2.5: Gasifier Shake-Down Experimentations*
- *Task 2.6: Systematically Characterize the Effect of Feedstock Parameters and Operational Conditions on Hydrogen Generation and Pollutant Emission Characteristics*
- *Task 2.7: Improved TEA and LCA:*

COMMUNICATION SCIENCE CURRICULA

PROJECT PROGRESS

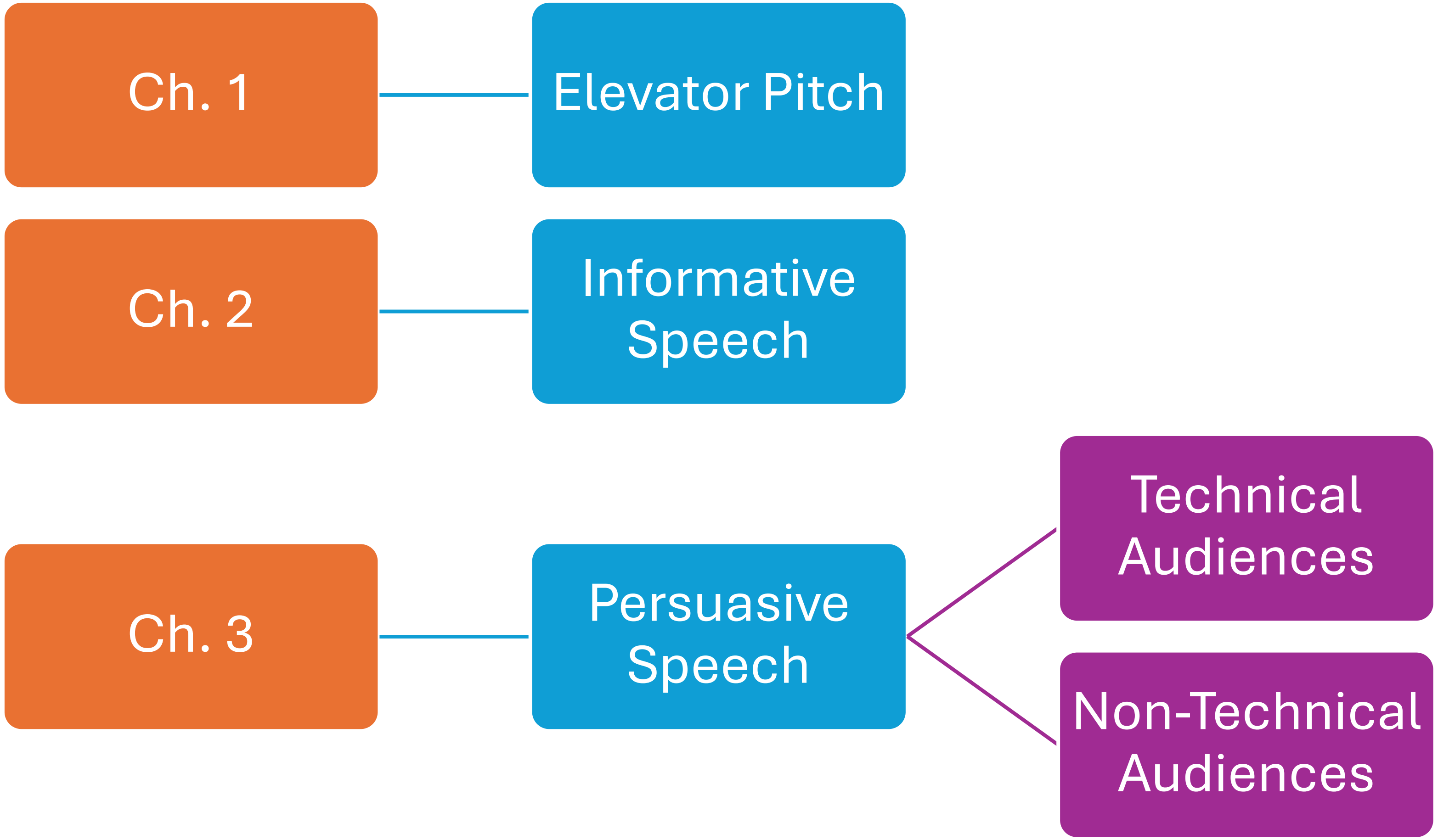
TASK 3.1 INTERDISCIPLINARY COMMUNICATION SEMINAR SERIES



ID No.	Course Description	Course Objectives
A1	‘This class develops the abilities of students to communicate science effectively in a variety of real-world contexts…and addresses challenges in communicating about topics such as climate change and evolution.”	• ‘…To provide intellectual resources for constructive critical analysis of popular science communication in a variety of real-world settings…”

PROJECT PROGRESS

TASK 3.1 INTERDISCIPLINARY COMMUNICATION SEMINAR SERIES



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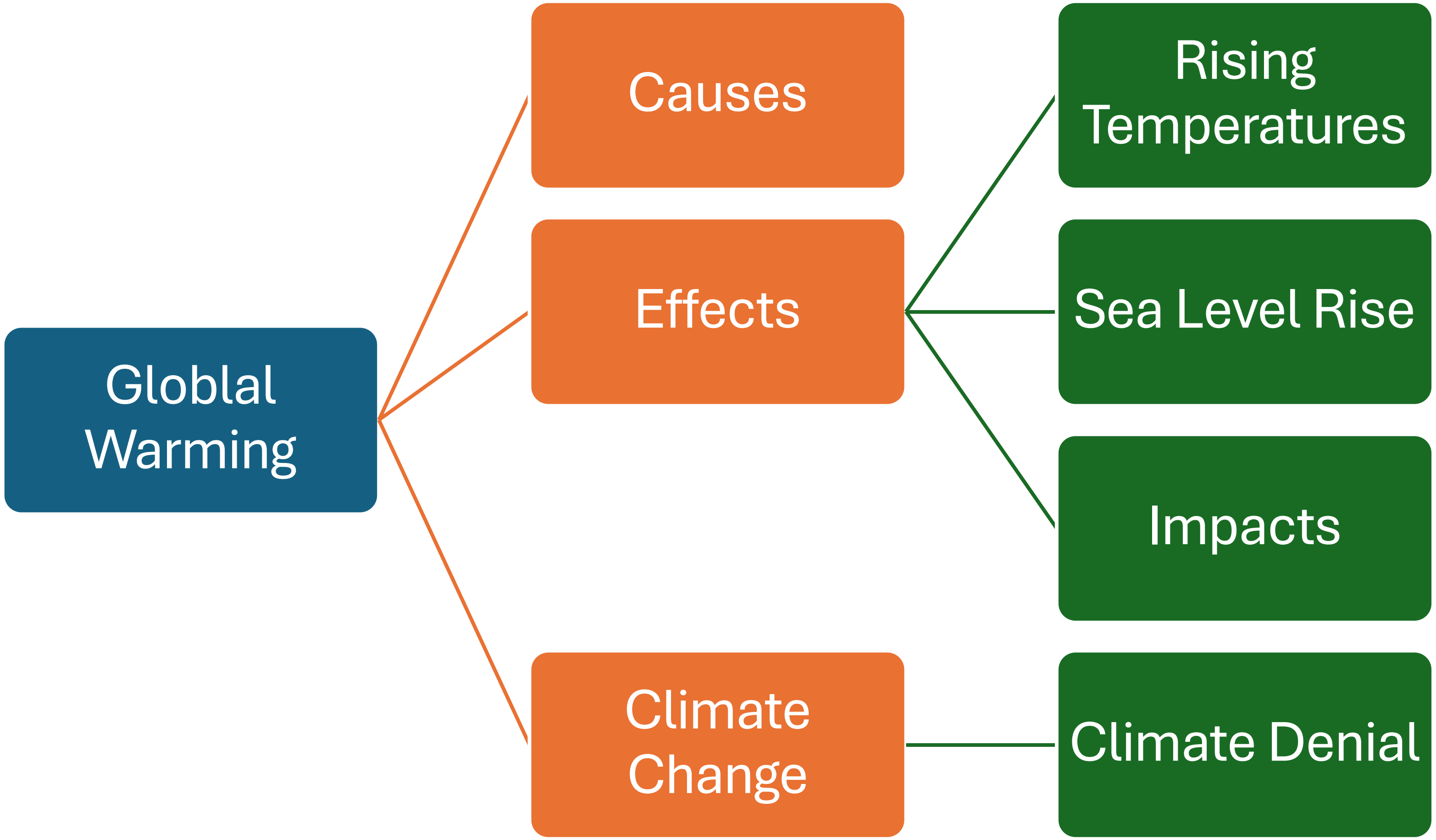
GLOBAL WARMING

PROJECT PROGRESS

TASK 3.1 INTERDISCIPLINARY COMMUNICATION SEMINAR SERIES



PROJECT PROGRESS

TASK 3.1 INTERDISCIPLINARY COMMUNICATION SEMINAR SERIES

CLIMATE DENIAL

Climate Denial

- Why should I worry?
- Skepticism
  - Emerging Denial & Shift in Narrative
- Political Agenda & Insight
- Statistics & Misinformation
- Nature's Will
- Anxiety Due to to Climate Denial

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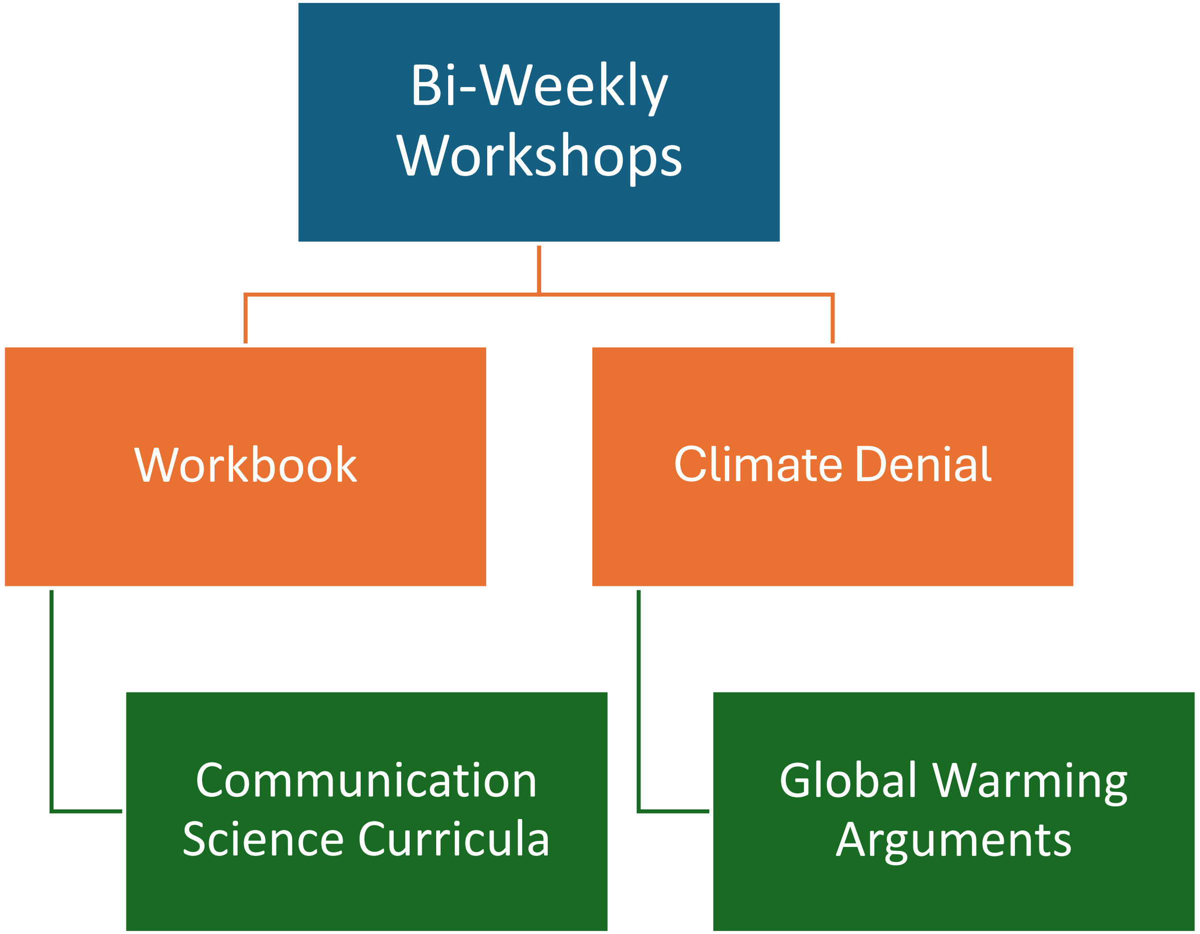
PROJECT PROGRESS

TASK 3.1 INTERDISCIPLINARY COMMUNICATION SEMINAR SERIES



COMMUNICATION WORKSHOPS

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PROJECT PROGRESS

TASK 3.3 DEVELOP STRATEGY FOR COMMUNITY OUTREACH

COMMUNITY OUTREACH

COMPLETITION OF **HDSTEM TRAINING**

COMMUNITY OUTREACH

MILESTONE LOG

Budget Period	Task/ Subtask No.	Milestone Description	Planned Completion	Actual Completion
Y1	1	Updated Project Management Plan	07/30/2023	07/30/2023
Y1	1	Kickoff Meeting	09/08/2023	09/08/2023
Y1	1.1	Determine Net Cycle Efficiency	04/30/2024	
Y1	1.1	Determine Operating Conditions	04/30/2024	
Y1	1.2	Gasifier Preliminary Design	07/15/2024	
Y1	1.3	Technology Gap Analysis	07/31/2024	
Y2	2.2	PDR	01/10/2025	
Y2	2.3	CDR	05/16/2025	
Y3	2.4	System Assembly	09/30/2025	
Y3	2.5	Shake-down Test Results	12/31/2025	
Y3	2.6	Operational Results	05/01/2026	
Y3	2.7	TEA and LCA	06/30/2026	
Y3	3.3	Communication to policy makers and public report	06/30/2026	

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U.S. DEPARTMENT OF ENERGY

NATIONAL ENERGY TECHNOLOGY LABORATORY

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ANY QUESTIONS OR SUGGESTIONS?

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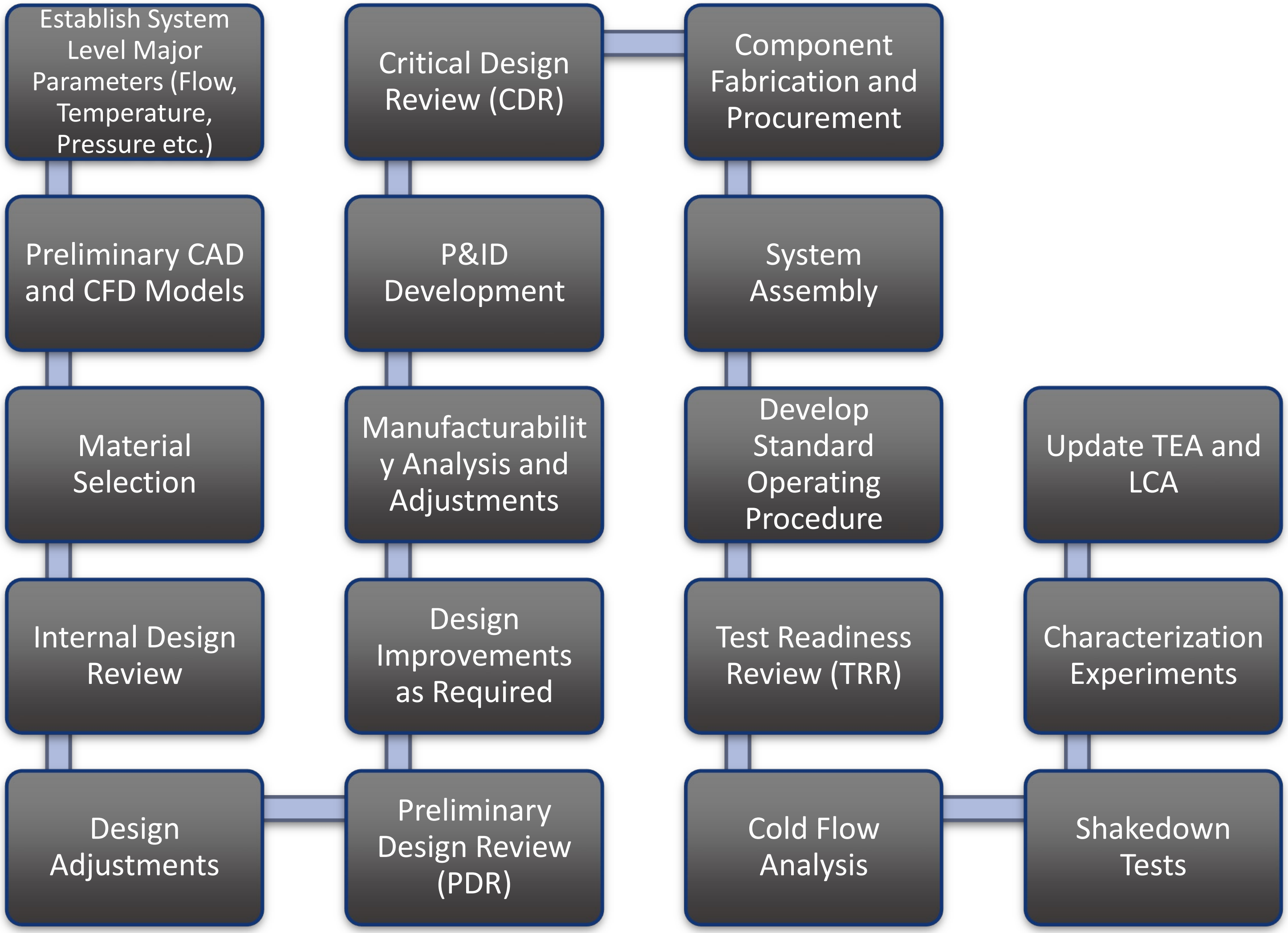
RESEARCH QUESTION

- Regional **pressurized** waste and biomass **co-gasification (0-30 bar).**
- **Digital twin** of a 300 KWth fluidized bed gasifier (Pilot Scale)
- Little information on **Pecan shell gasification**.
- IGCC based on **modular gasifiers**.
- **Decentralized** hydrogen resilience model (Including economic feasibility, LCA).
- **Community informed approach** for project implementation.
- Unlike most gasification research, cycle level optimization focusing on overall **end use and lifecycle**.

SUMMARY

FLOWSHEET



Establish System Level Major Parameters (Flow, Temperature, Pressure etc.)
Preliminary CAD and CFD Models
Material Selection
Internal Design Review
Design Adjustments
Preliminary Design Review (PDR)
Design Improvements as Required
Manufacturability Analysis and Adjustments
P&ID Development
Critical Design Review (CDR)
Component Fabrication and Procurement
System Assembly
Develop Standard Operating Procedure
Test Readiness Review (TRR)
Cold Flow Analysis
Shakedown Tests
Characterization Experiments
Update TEA and LCA

DELIVERABLES

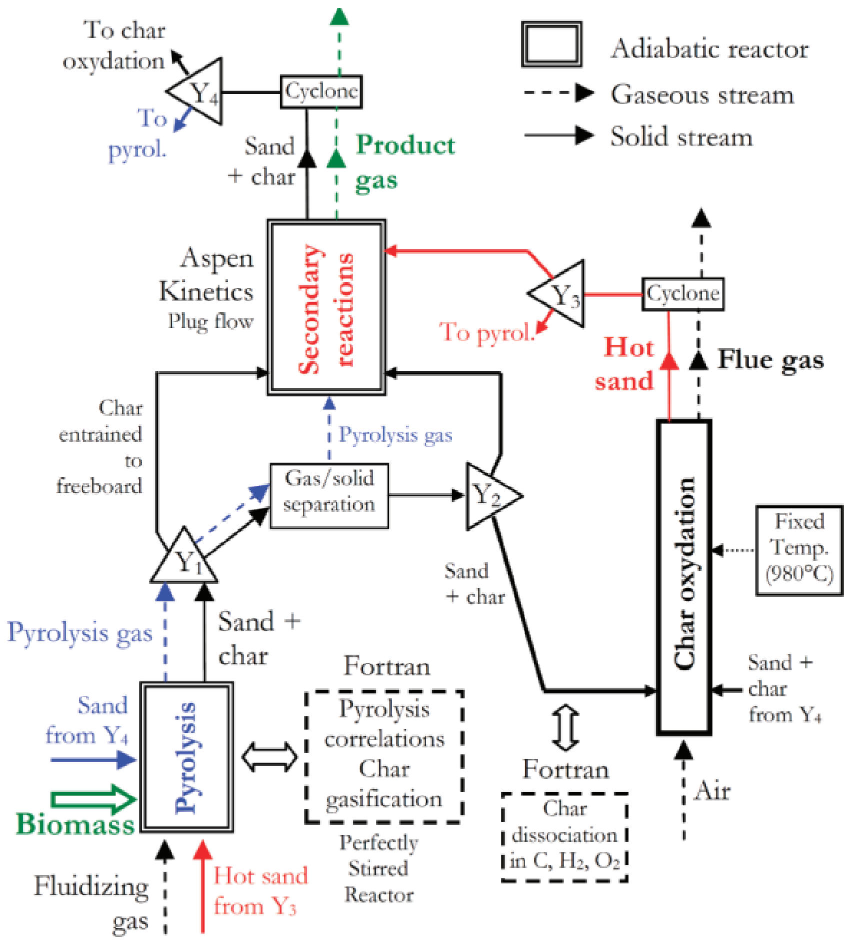
Decision Point	Success Criteria
Determination of gasifier operating conditions (1.1.)	Determine efficiency and H_2 yield as a function of gasifier pressure, temperature, feed blend ratio, and feed rate.
Scaling analysis for the requirements for the 300 kW_{th} gasifier (1.2)	System requirements defined for the scaled system.
Technology Gap Analysis Review (1.3)	Identification of operating conditions, performance characteristics and application issues
PDR (2.2)	Approval of design approach
CDR (2.3)	Approval of designs of system details
System assembly (2.4)	Delivery of the gasifier
Test readiness review (2.5)	Approval of test plan for shake-down testing
Gasifier performance data (2.6)	Successful operation
Test data analysis, TEA and LCA (2.7)	Test data review, TEA, LCA outcomes and final report
Communication Seminar Series and strategy development (3.1, 3.4)	Successful holding of the seminar series and public and policymaker engagements

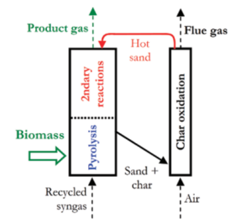
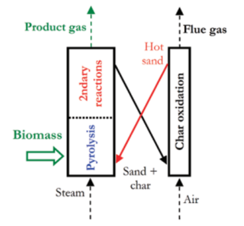
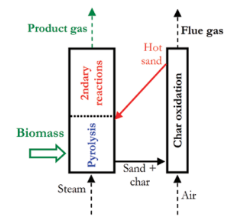
CHALLENGES

- Current high-yield H_2 technologies for Biomass and MSW gasification are-
  - Supercritical Water Gasifier
  - Plasma Gasifier
- Supercritical Gasifiers are prone to high tar formation
- Both gasifiers involve high capital and operation cost
- Emission control and syngas clean-up due to feedstock variability
- Limited understanding of co-gasification of complex feedstocks
- Design and operability issues in modular scale ($<50\ MW_e$)
- Gasification models
- Component level modifications

Indrawan, N., Kumar, A., Moliere, M., Sallam, K.A. and Huhnke, R.L., 2020. Distributed power generation via gasification of biomass and municipal solid waste: A review. *Journal of the Energy Institute*, *93*(6), pp.2293-2313.

CYCLE COMPARISON

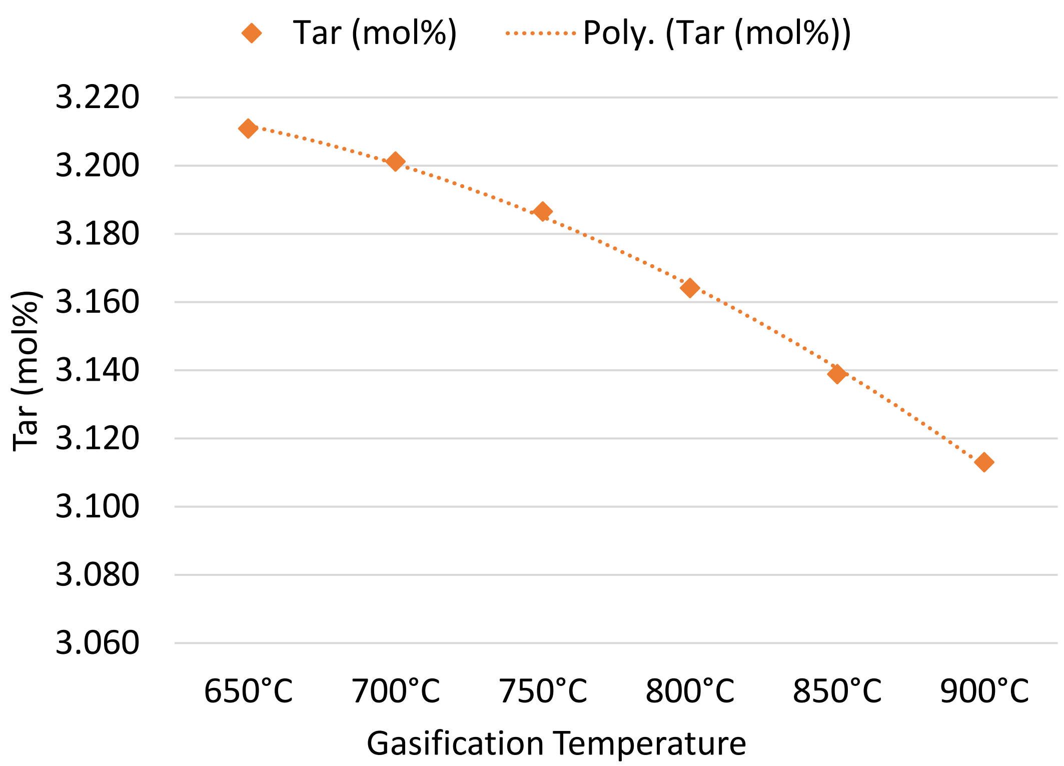


Name of the technology	TNEE [30, 36, 37]	FERCO [3, 31]	Güssing [32, 33]
Development beginning	In the 1980's	In the 1970's	In the 1990's
Simplified scheme			
Technology definition (see text for the definition of the Yi)	$Y_1=0.05$, $Y_2=0$, $Y_3=1$, $Y_4=1$	$Y_1=0$, $Y_2=1$, $Y_3=0$, $Y_4=0$	$Y_1=0.05$, $Y_2=0$, $Y_3=0$, $Y_4=0$

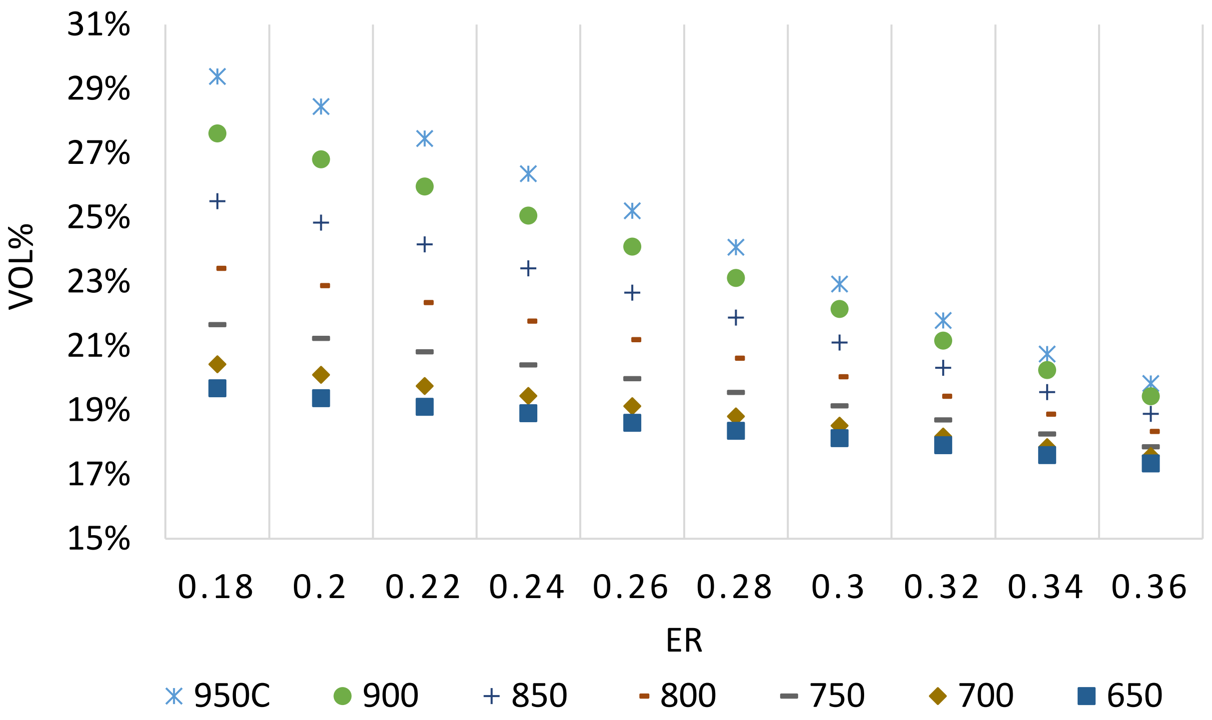
PROJECT PROGRESS

TASK 1.1 SYSTEM ANALYSIS

RESULTS FROM KINETIC MODEL



EFFECT OF TEMPERATURE ON TAR EVOLUTION AT ER 0.3



SENSITIVITY OF HYDROGEN PRODUCTION

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HDSTEM

PROJECT INTRODUCTION

HDSTEM Implementation

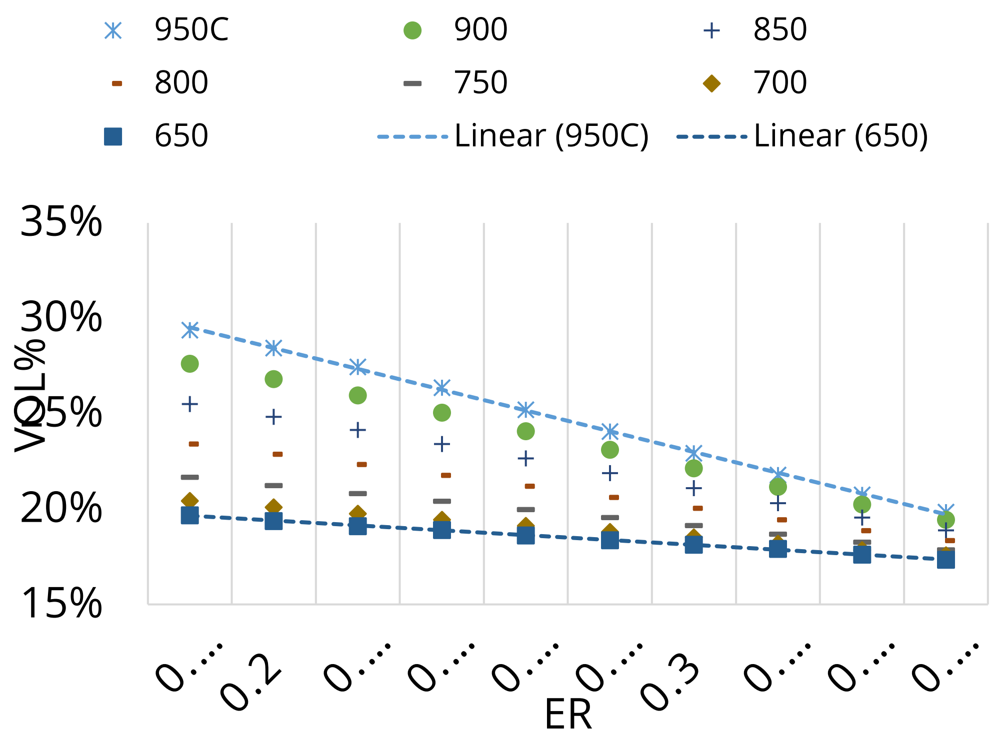
Humanities Directed STEM Objectives

- Overcome communication barriers among general audiences outside of the field.
- Overcome skepticism due to misinformation.
- Overcome the lack of frameworks to communicate STEM research to distinct audiences.

PROJECT PROGRESS

TASK 1.1 SYSTEM ANALYSIS

RESULTS FROM KINETIC MODEL



EFFECT OF TEMPERATURE ON TAR EVOLUTION AT ER 0.3

SENSITIVITY OF HYDROGEN PRODUCTION

PROJECT PROGRESS

TASK 1.1 SYSTEM ANALYSIS

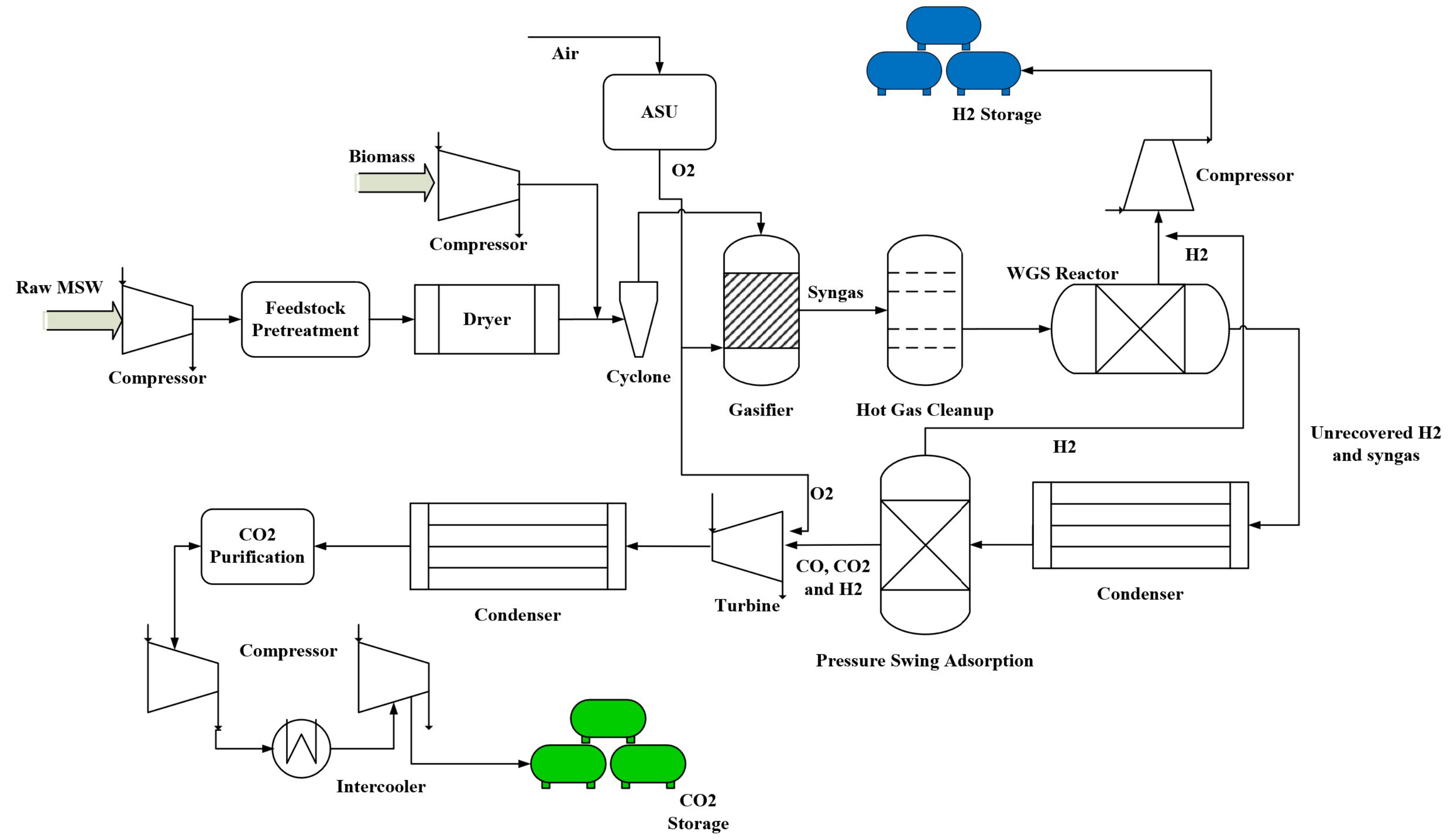


Figure: Initial IGCC Configuration with Post CCS

- System Output: 50 Mwe
- Gasifier: Fluidized Bed
- Feedstock: Regional Biomass & MSW and Co-Gasify
- Pressure: 0-30 bar
- Auxiliary: ASU, Scrubber, WGS Reactor
- Power Cycle: CPC
- Pre & Post-combustion CCU