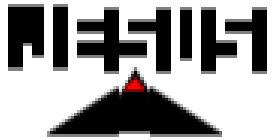
"-then the Lord God formed the man out of the dust of the ground
and blew into his nostrils the breath of life, and the man became a living being."
Genesis 2:7



Black Swan, LLC
K-O2
The Kolodji Corporation

Presents

# Sustainable Energy Carbon Management- DAC/CCS/EOR Versus Crop Carbon Enrichment

at the

American Institute of Chemical Engineers

10th International Congress on Sustainability Science and Engineering

By


Brian Kolodji, PE and President

Email: bkolodji@sbcglobal.net

Cell: (713) 907-8742

Website: K-O2.com

Black Swan, LLC

# Sustainable Energy Carbon Management

- Net Annual Equivalent Carbon Removal Rate Potential over entire Life Cycle (Te/Y)
  - Goal: Positive Net carbon dioxide ($CO_2$) removed= Gross removal minus life-cycle $CO_2$ made in removal

- Low Energy Equivalent Consumption/ High Production Rate (KW-hr per Te/Y)
  - Equivalent annual consumption of electricity, heating, and cooling, preferably non-renewable

- Low Resource (non-Energy) Equivalent Utilization Rate ($ per Te/Y)
  - Soil (real estate, sequestration caverns), air (processed), water (processed), and other materials (MOC)

- Rapid Scalability as percent of 25 Gte/Y CO2 capacity to ultimately reduce carbon inventory in atmosphere
  - 25 GTe/Y (GigatonTons) scale in 25 years (average increase in Carbon Deceleration Rate of 1 GTe/$Y^2$ )

- Renewable (positive)/ Non- Renewable (negative) Fuel Usage/ Production and CO2 Disposition Define Circularity
  - $CO_2$ based renewable fuel production and usage with infrastructure to supplant non-renewable fuels

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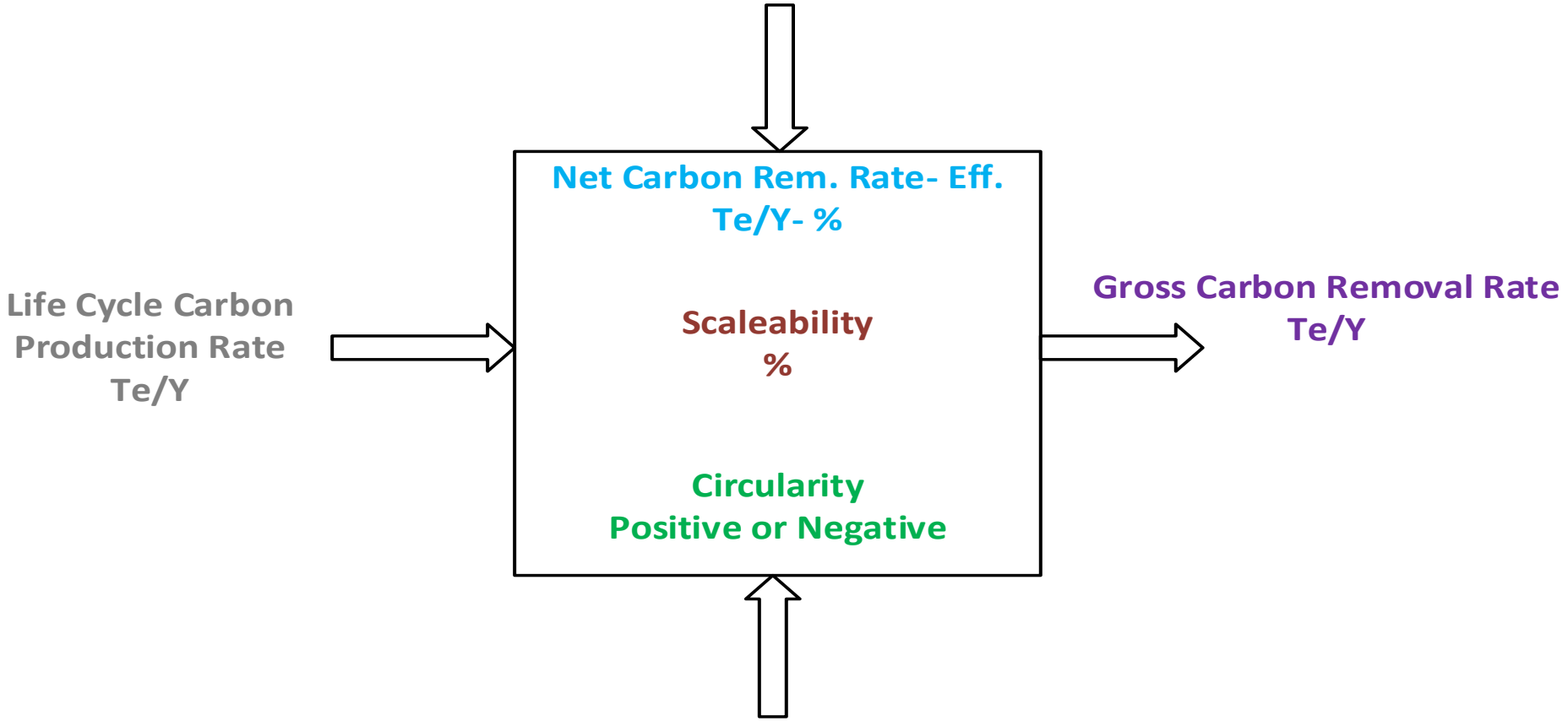
# Sustainable Carbon Management Model



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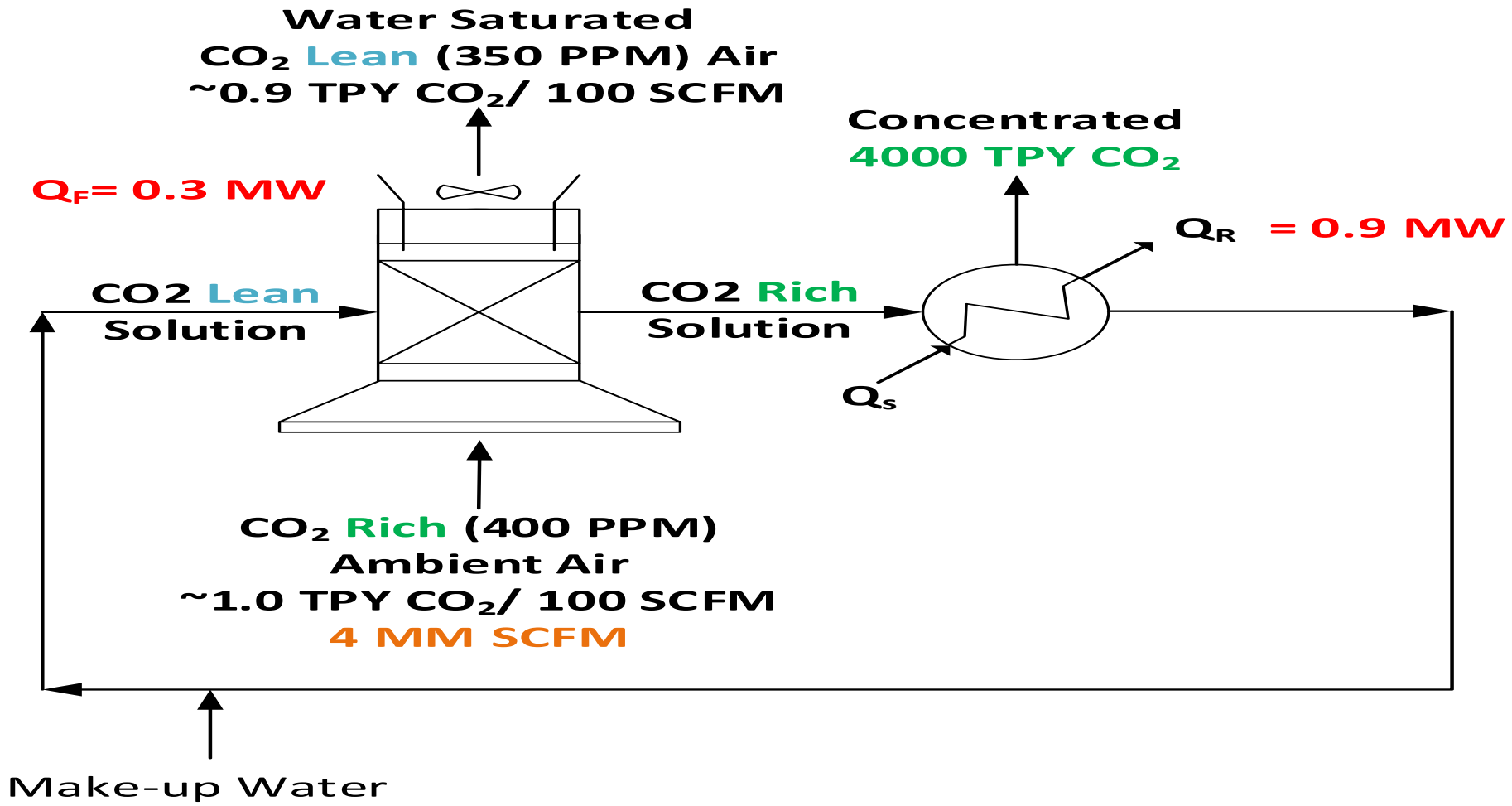
# Simplified Generic Direct Air Capture Process Model- Case 1




Vacuum Contactor

Regenerator/ Separator

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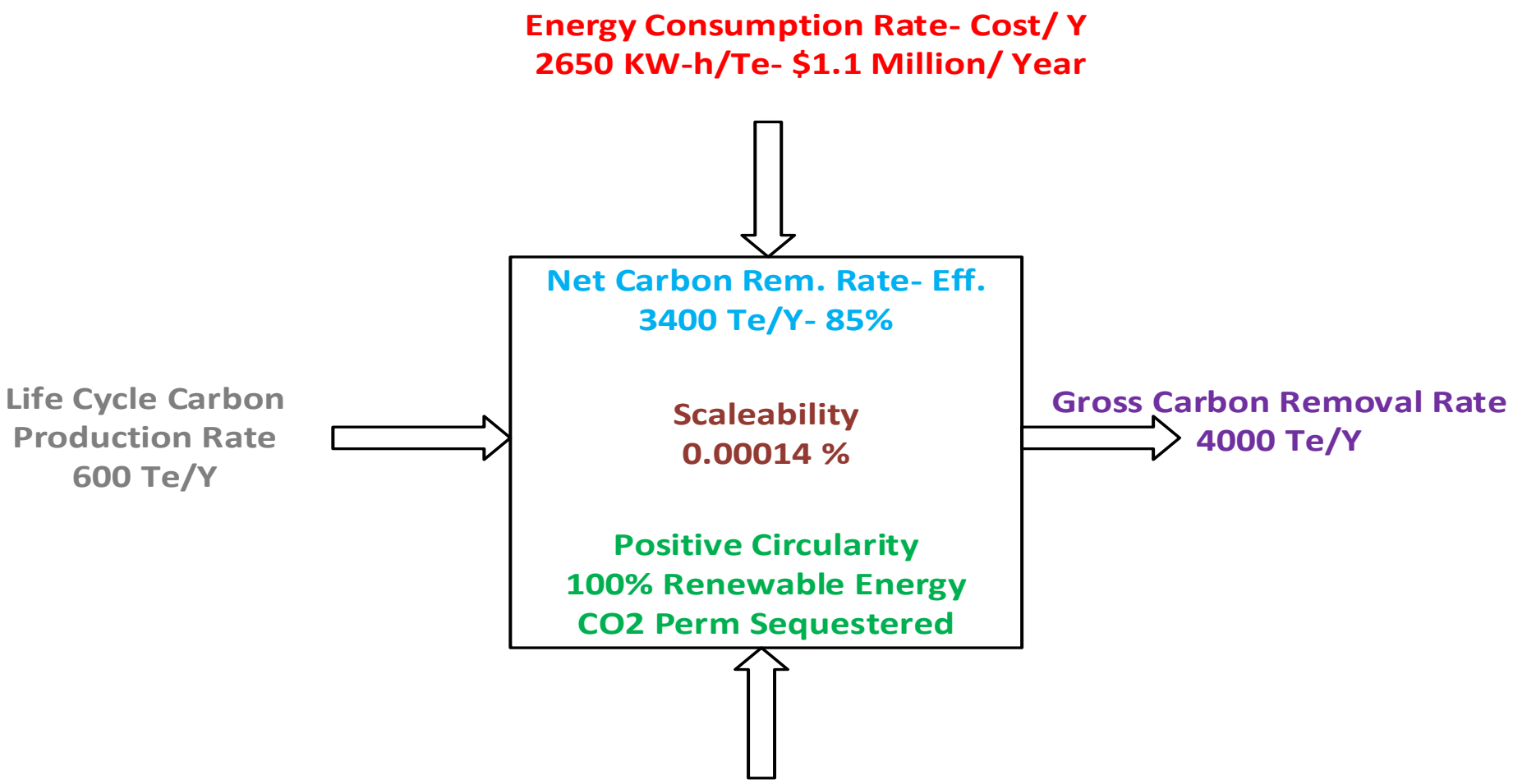
# DIRECT AIR CAPTURE (DAC)- Case 1
# Sustainable Carbon Management Model



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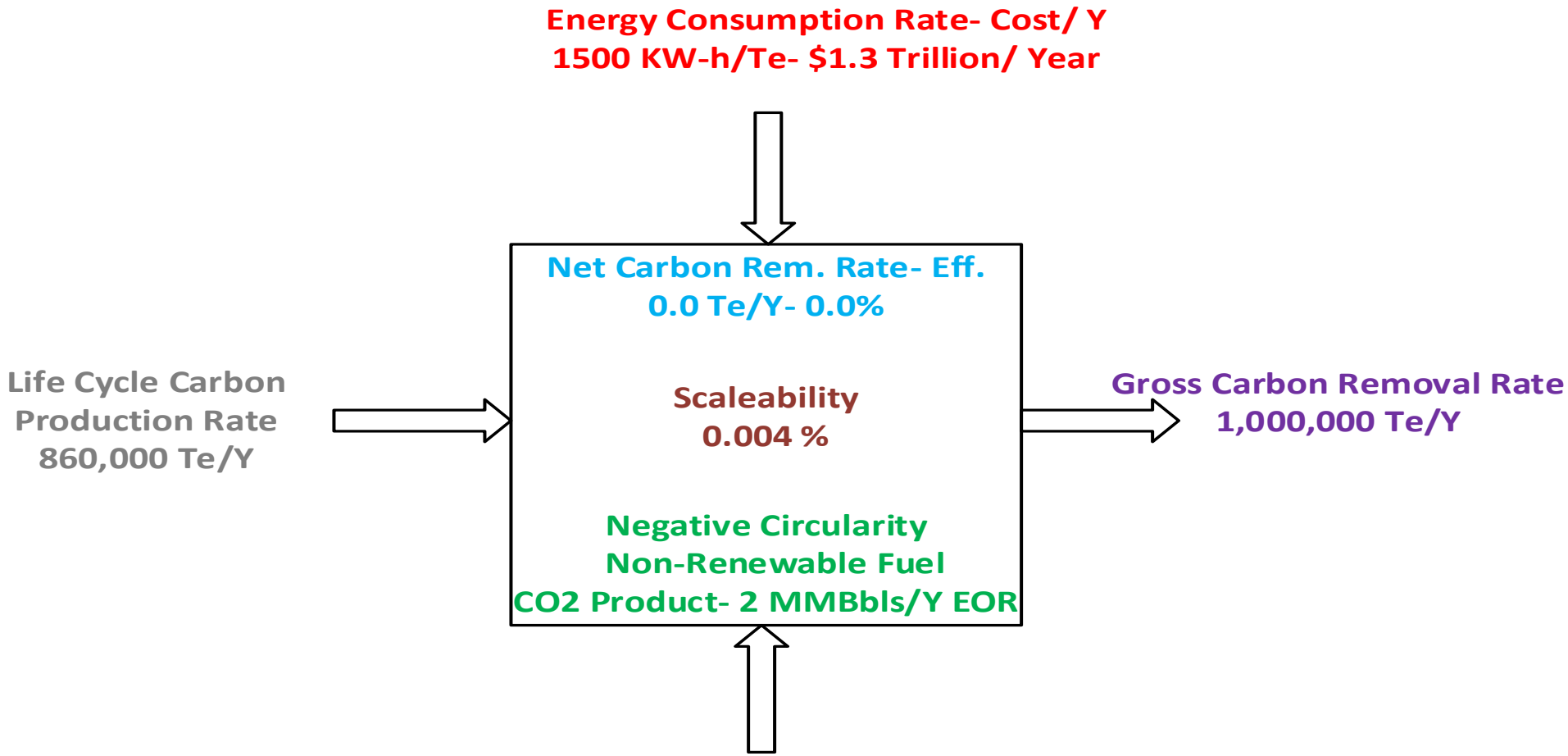
# DIRECT AIR CAPTURE (DAC)- Case 2
# Sustainable Carbon Management Model



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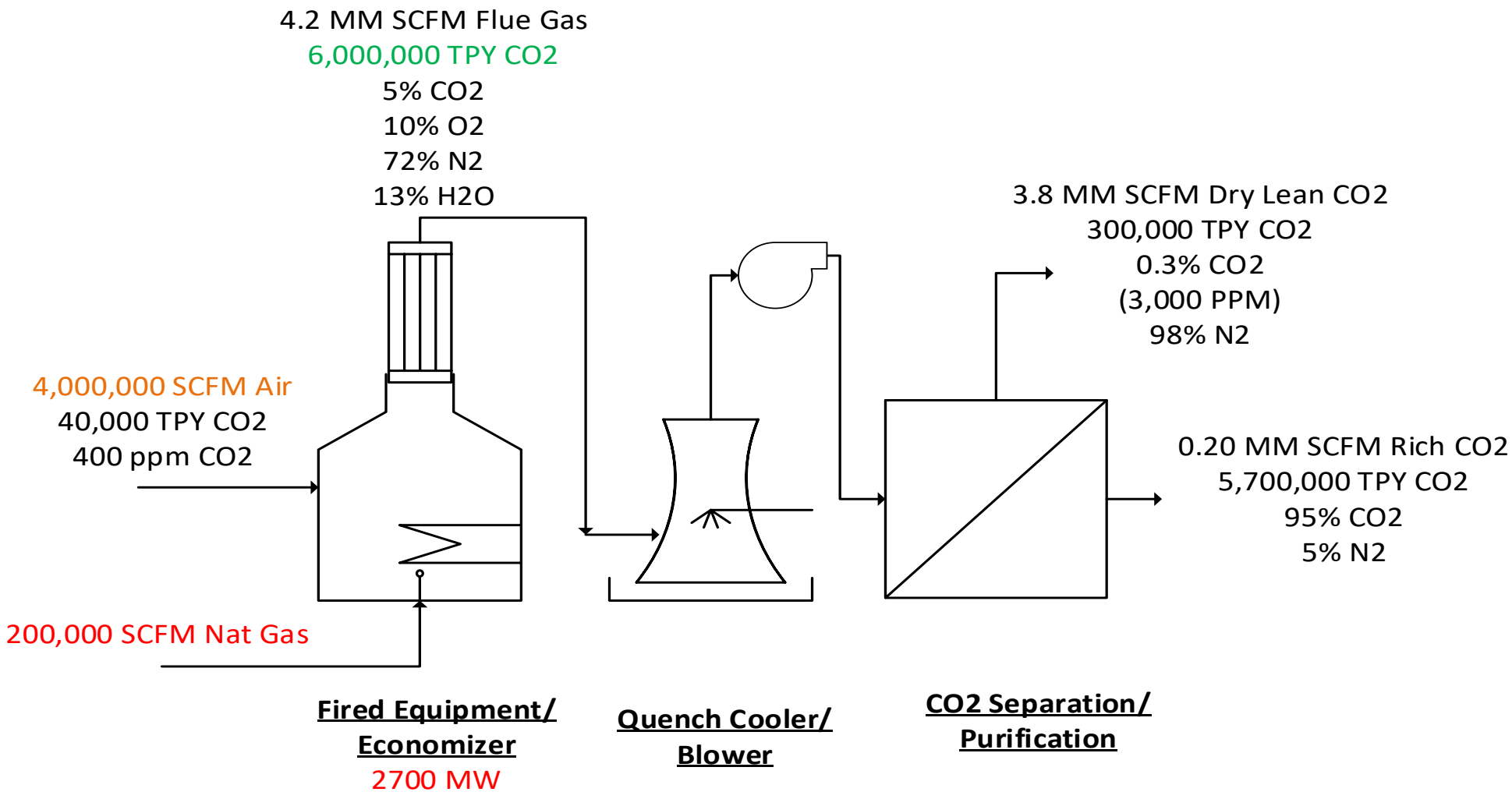
# Simplified Generic Post-Combustion Capture Process Model- Case 3

## Basis: Same Air Flow as Case 1



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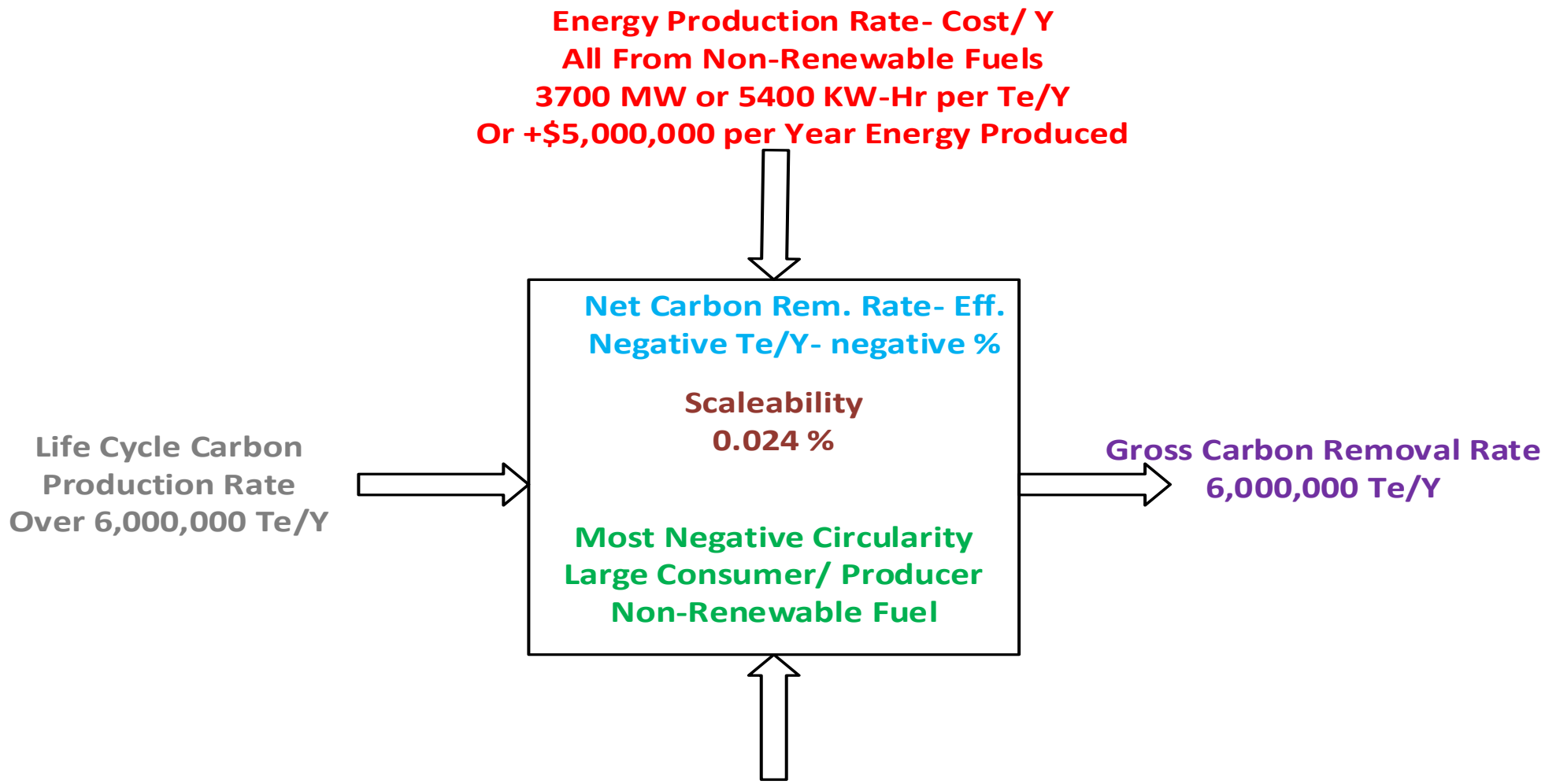
# Post Combustion (PoC) Capture- Case 3
# Sustainable Carbon Management Model



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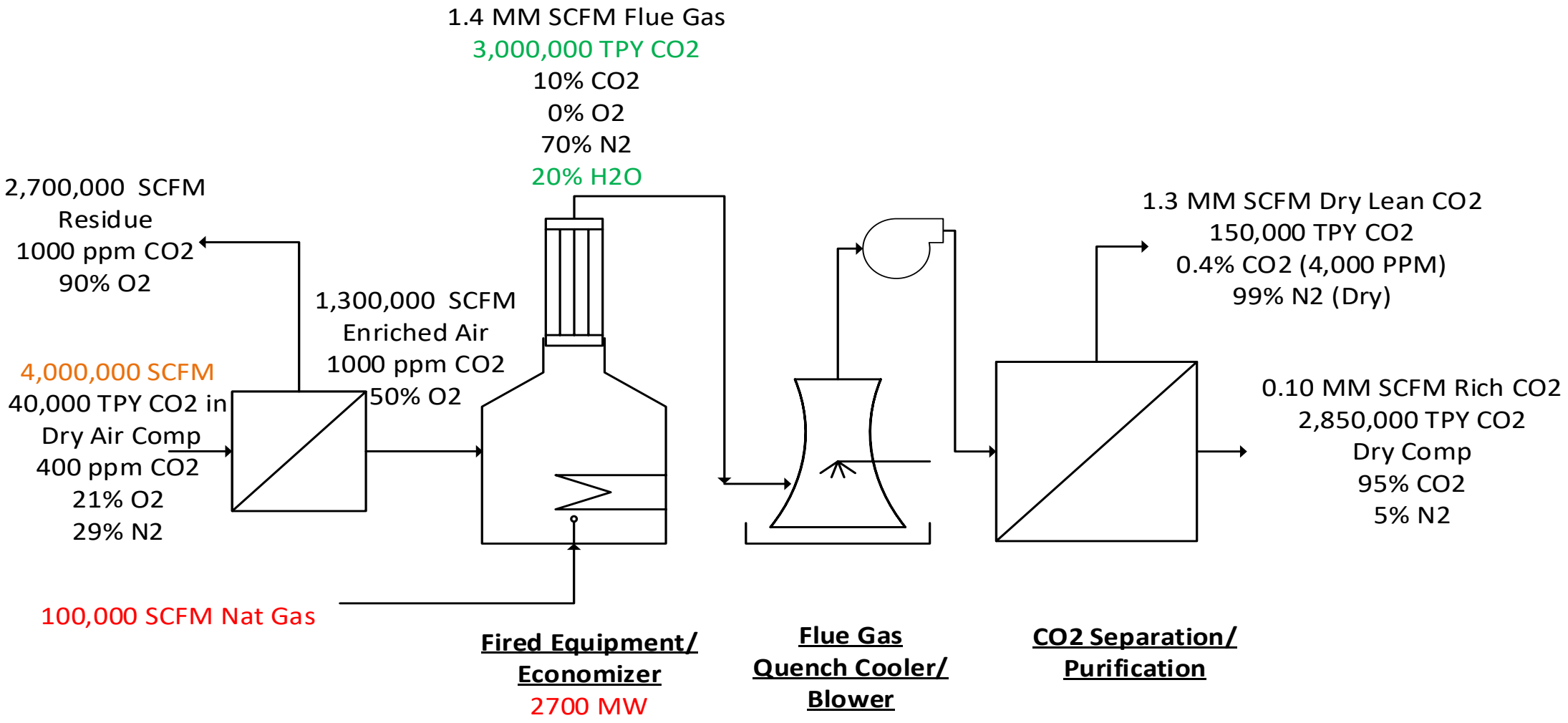
# Simplified Generic Pre-Combustion Capture Process Model- Case 4

## Basis: Same Air Flow as Case 1, Same Duty, with ½ the Fuel Gas, Furnace and Separation System ½ Size as Case 3, Makes Water



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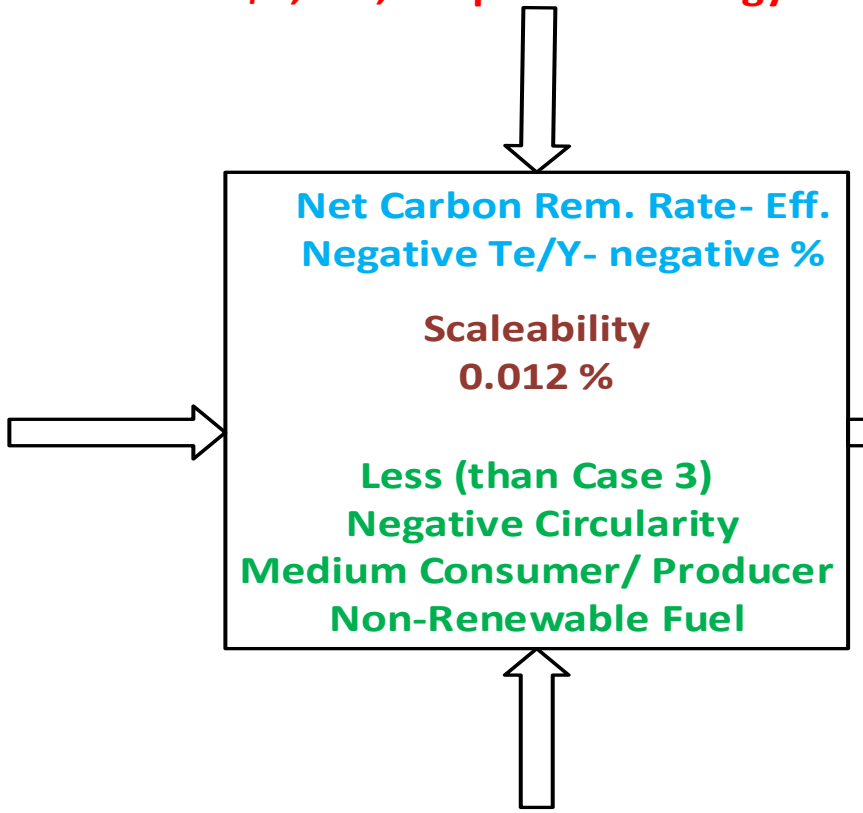
# Pre- Combustion (PrC) Capture- Case 4
# Sustainable Carbon Management Model

**Energy Production Rate- Cost/ Y**
**All From Non-Renewable Fuels**
**3700 MW or 5400 KW-Hr per Te/Y**
**Or +$5,000,000 per Year Energy Produced**




**Life Cycle Carbon Production Rate Over 3,000,000 Te/Y**

**Gross Carbon Removal Rate 3,000,000 Te/Y**

**Resource Consumption Rate- Cost**
**$100/Te- $0.6 Billion/Y**

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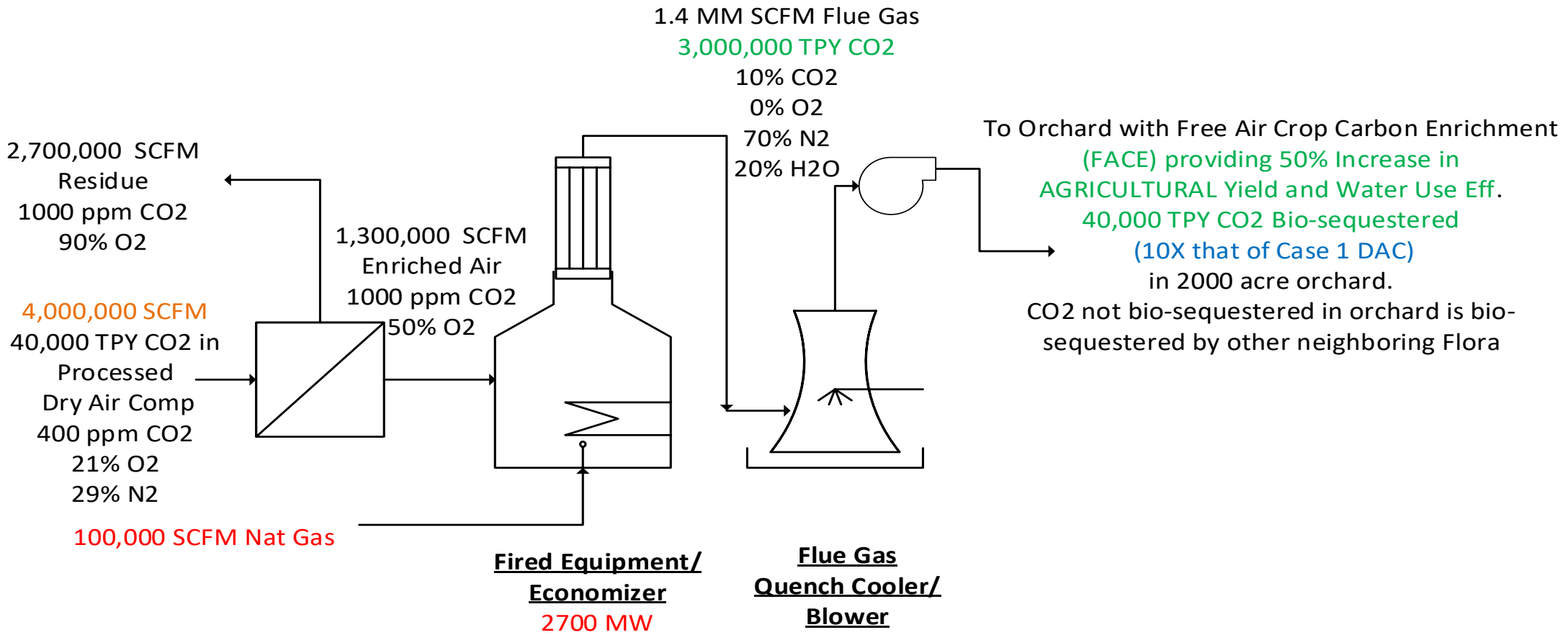
# Simplified Generic Pre-Combustion with Free Air Carbon Enrichment (FACE) Process Model- Case 5

## Basis: Same Air Flow as Case 1, Same Duty, with ½ the Fuel Gas, ½ the Furnace/Quench/Blower Size as Case 3, No Separation System, Makes Water, Renewable Fuel, and FOOD!



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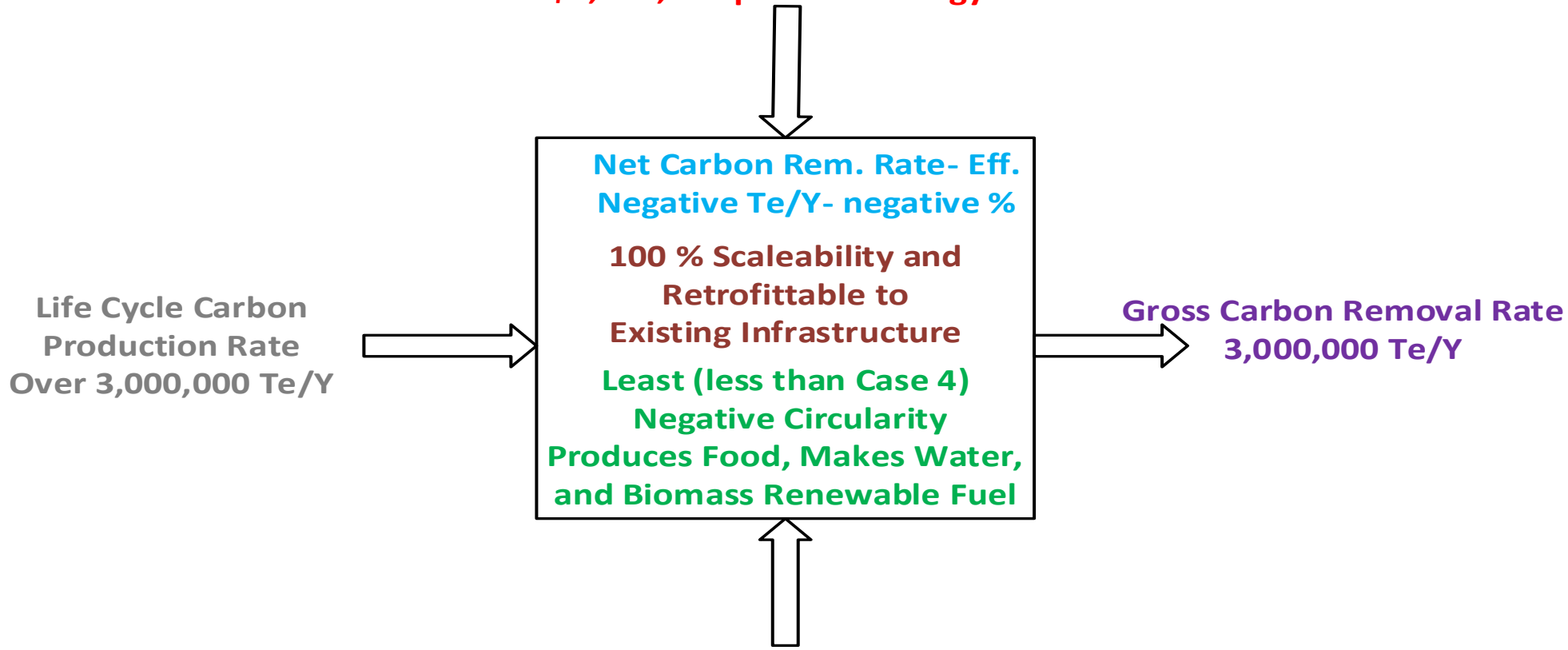
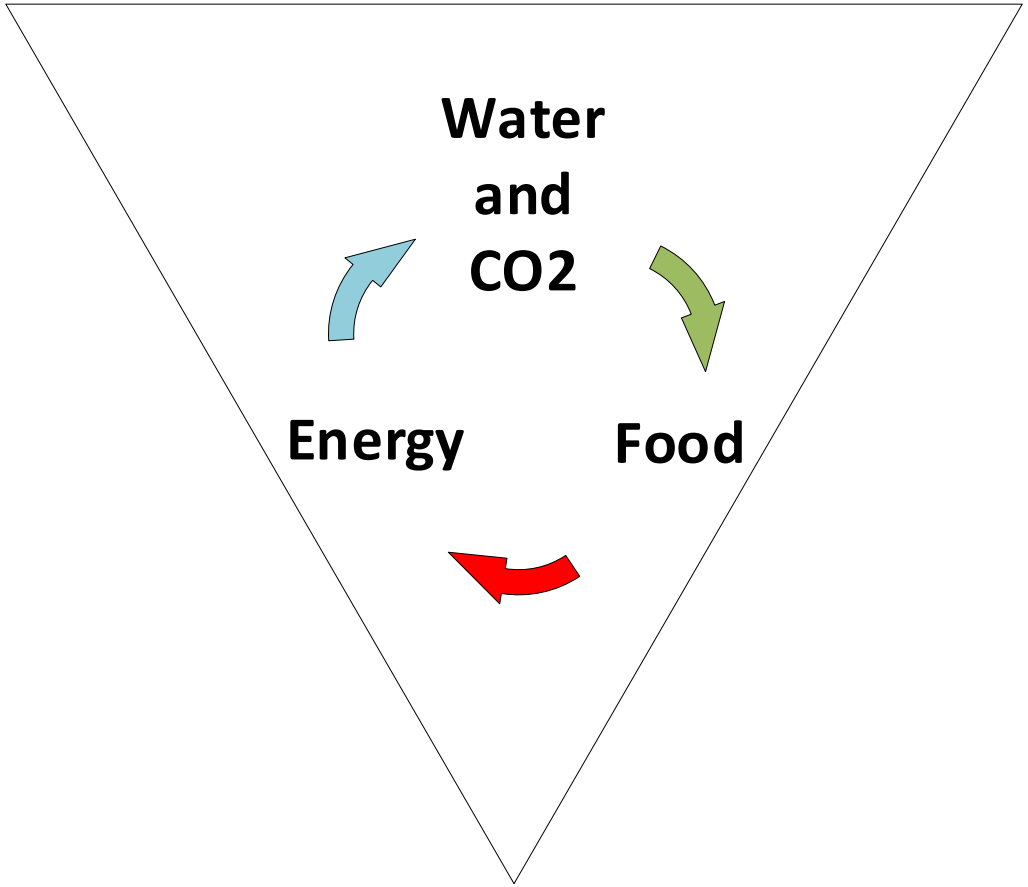
# Pre- Combustion (PrC) Capture with FACE- Case 5
# Sustainable Carbon Management Model

**Energy Production Rate- Cost/ Y**
**All From Non-Renewable Fuels**
**3700 MW or 5400 KW-Hr per Te/Y**
**Or +$5,000,000 per Year Energy Produced**




**Resource Consumption Rate- Cost**
**$40/Te- $0.01 Billion/Y**

# Black · Swan Cycle



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Jesus said to them again, “Peace be with you. As the Father has sent me, so I send you.”
When he had said this, he breathed on them and said to them, “Receive the Holy Spirit…”

John; 20: 21,22