Circular Carbon Economy

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An economic system aimed at eliminating waste and the continual use of resources. It is an alternative economy that takes into consideration the reuse, recovery and recycling of products and materials.
Circular Carbon Economy Framework

Reduce
- Efficiency
- Fuel Switching
- Renewables
- Nuclear
- Blue Hydrogen
- Ammonia
- Carbon Capture

CO₂

Carbon Capture

HC Production

Hydrogen

Combustion

Chemicals
Circular Carbon Economy Framework

**Reduce**
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**Carbon Capture**

**Reuse**
- Food
- CO2 Enhanced Oil Recovery
- Heat & Power (sCO2)

**Combustion**

**HC Production**

**EOR**

**Hydrogen**

**Chemicals**
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**Re-use**
- Food
- CO2 Enhanced Oil Recovery
- Heat & Power (sCO2)

**Re-cycle**
- CO2 Reforming
- Power to X
- Electrolysis/Electrochemistry
- Green Hydrogen
- Methanol/Urea/Ammonia
- E-Fuels/Syn-Fuels
- Syn-Chemicals
- Concrete

Diagram:
- CO2
- Combustion
- Carbon Capture
- Hydrogen
- Chemicals
- Synthetic HC
- Plastic Waste
- HC Production
- EOR
- Food
- CO2 Enhanced Oil Recovery
- Heat & Power (sCO2)
- CO2 Reforming
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**Reduce**
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- Renewables
- Nuclear
- Blue Hydrogen
- Carbon Capture

**CO₂**

**Combustion**

**Carbon Capture**

**Remove**
- Nature Based Solutions
- Direct Air Capture
- CO₂ Sequestration
- Mineralization

**H₂O**

**Re-use**
- Food
- CO₂ Enhanced Oil Recovery
- Heat & Power (sCO₂)

**Re-cycle**
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**Hydrogen**

**Chemicals**

**Synthetic HC**

**EOR**

**Sequestration**

**HC Production**

**Nature Based Solutions**

**Direct Air Capture**

**CO₂ Sequestration**

**Mineralization**

**Plastic Waste**

**Green Hydrogen**

**Methanol/Urea/Ammonia**

**E-Fuels/Syn-Fuels**

**Syn-Chemicals**

**Concrete**

**Coal**

**Natural Gas**

**Oil**

**Concrete**
4Rs definitions for circular carbon economy

**Reduce**
All options that reduce the amount of CO₂ entering the atmosphere

- Energy Efficiency
- Fuel switching
- Renewables
- Nuclear power
- CO₂ capture from (mobile and stationary sources)

**Recycle**
Chemically Transforming CO₂ into new products (with renewable energy)

- Synthetic fuels
- Biofuels
- Fertilizers and urea
- Methanol and chemicals
- Polymers
- Concrete (CO₂ chemically reacted)

**Reuse**
Using CO₂ without changing its molecular form (CO₂ is not chemically reacted)

- CO₂-Enhanced oil recovery
- Super-critical CO₂ applications (power)
- CO₂-Enhanced water recovery

**Remove**
Removal of CO₂ from the atmosphere

- Natural sinks (e.g., afforestation, soil and oceans)
- Bio-energy with CCS (BECCS)
- Direct Air Capture with Storage (DACS)
- Sequestration
Why do we need a circular carbon economy?

- Complex energy system with constraining interdependencies
- Scale of existing system - substitution will take technology, capital, and time
- Challenging sectors - Heat, Industry, Aviation, ...

CCE offers a holistic framework for efficient policymaking with Life Cycle Analysis as the basis

- Allows maximum utilization of existing investments and infrastructure
- Addresses the emissions challenge in hard to decarbonize sectors directly and economically
Thank you