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Underground Coal Gasification in Abandoned Coal Seam Gas Blocks

Presented by

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Presentation Outline

- Introduction
- UCG in Global Perspective
- UCG in Australia
- Commitment for Sustainable Engineering
- Identified Issues
- Optimization; A new Approach
- Conclusion and Recommendations

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Introduction

- Coal is the major source of Electricity generation.
  - I. Global context- 40%
  - II. Australia- 80%
- Coal extraction methods (conventional method)
  - Underground mining
  - Open cast mining
- Unconventional Coal exploitation (Deeper Position)
  - Coal Seam Gas (95-97% CH_4) extraction
  - Underground Coal Gasification

Coal $\longrightarrow$ **CO_2 , CO, NO_x, SO_x**, Fly ash, Bottom ash etc.

Global trend $\longrightarrow$ **Clean Coal Technology**

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Coal Seam Gas Extraction and GHG Emission

Coal Seam Gas

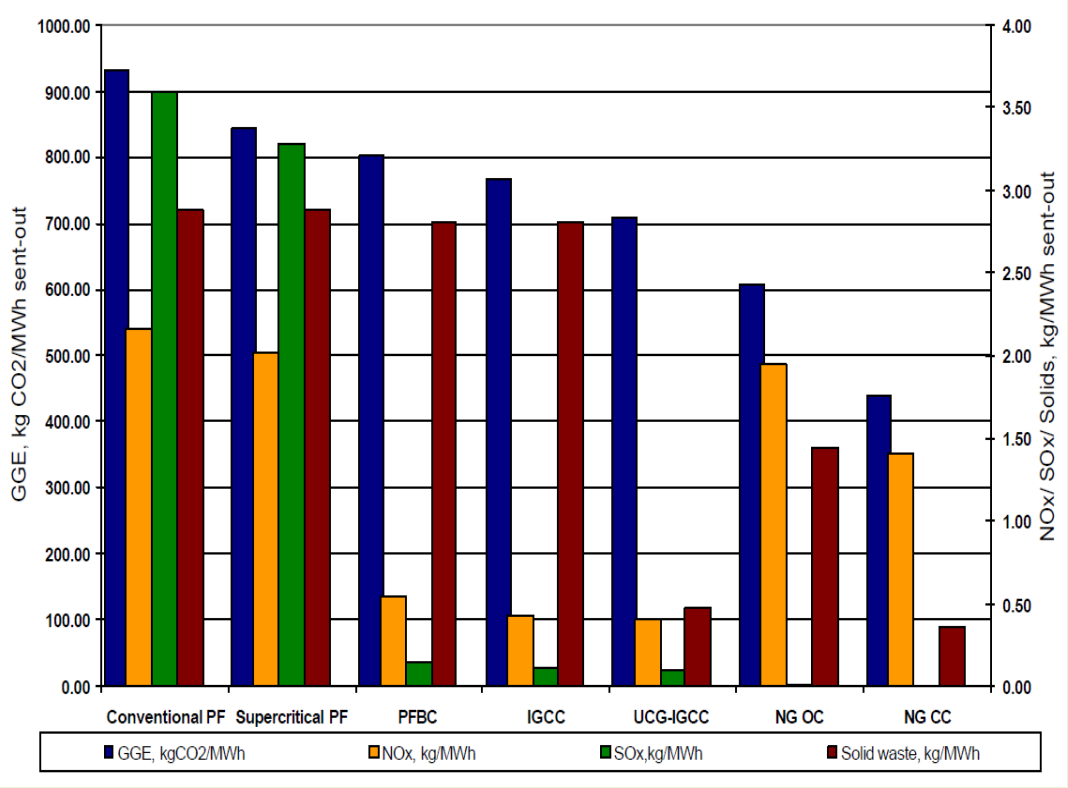
→ Very Low **GHG emission fuel.**

→ Minimum Recovery of coal resource (~5%).

→ Affects ground water .

→ Stimulation activity such as coal body fracturing .

→ Huge capital investment.



"**Work over**" of Production well based on well head gas flow rate.

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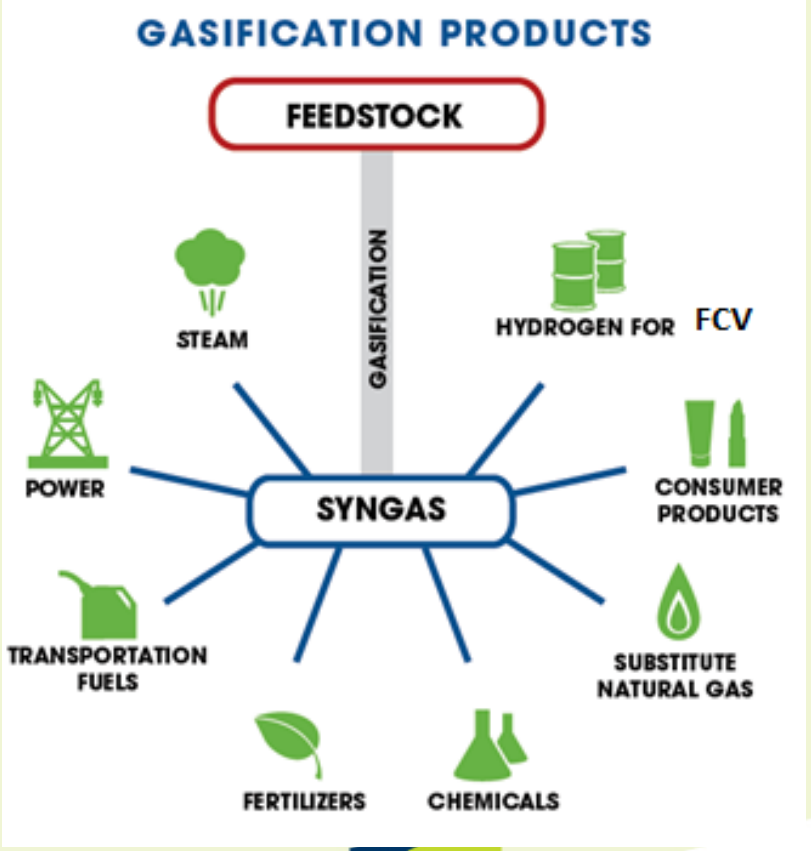
Underground Coal Gasification; An Overview

Underground Coal Gasification (UCG)

- Converted coal in-situ to a "Syngas"
- Energy recovery from coal (~70%)
- Fly ash, Bottom ash left underground
- Demonstrated success in global context.
- Subsidence effect minor (deeper coal)
- Aquifer contamination insignificant for deep seated coal body.

Global trend USA, Canada, Australia, Europe, China, South Africa,
Pakistan and others.



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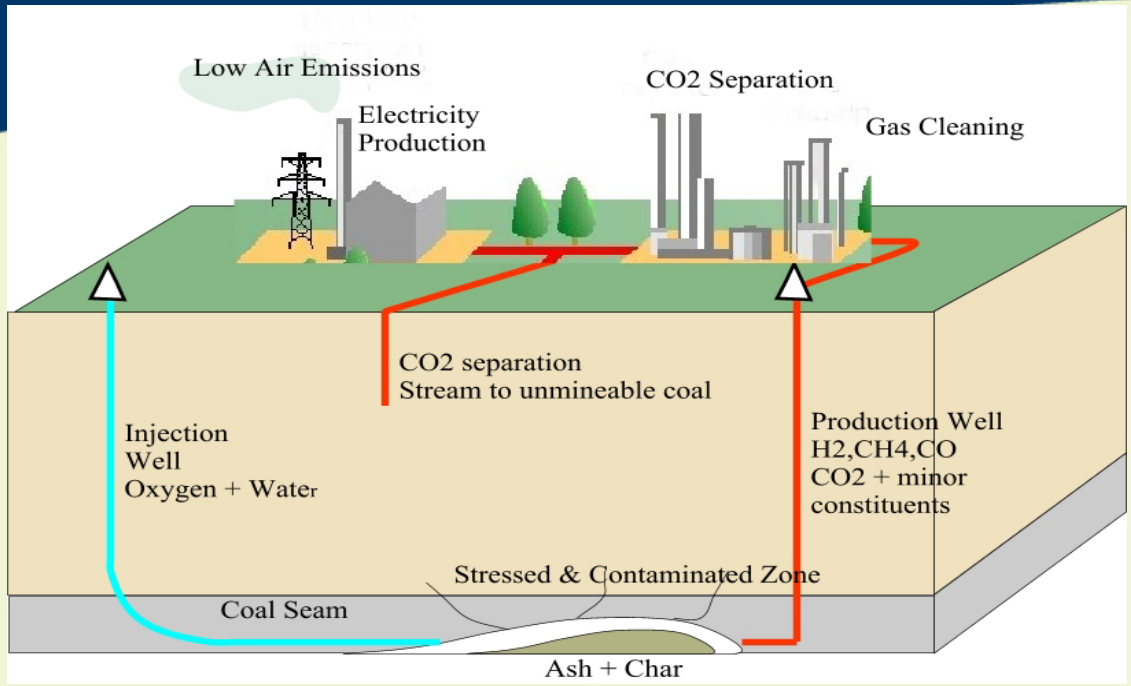
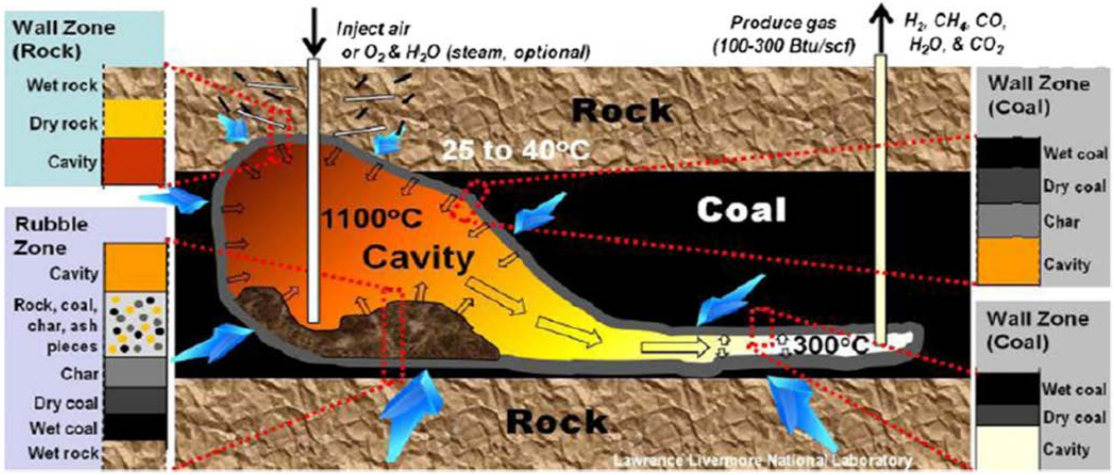
Underground Coal Gasification Process





1. Oxidation/Combustion

$$2C + O_2 \rightarrow 2CO$$
$$C + O_2 \rightarrow CO_2$$

2. Gasification

$$C + H_2O \rightarrow CO + H_2$$
$$C + 2H_2O \rightarrow CO_2 + 2H_2$$
$$CO + H_2O \rightarrow CO_2 + H_2$$
$$C + 2H_2 \rightarrow CH4$$

3. Pyrolysis/devolatization

H_2 , CH_4, N_2, Tar,Solid Char

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UGC in Australia "Western world's leading practice in UCG"

3 pilot projects conducted in Queensland, Australia as :

- Kingaroy Project by Cougar Energy,
- Chinchilla Project by Linc Energy,
- Another project near Dalby run by Carbon Energy (associated with CSIRO).

Chinchilla Project , A Ground Breaking Achievement of UCG

- Coal seam depth at 140 m and thickness 10 m, air injection as oxidant.
- Over than 35,000 tons of coals were gasified (output pressure apx. 10 bar, temperature 300^{o} C 100% availability, 1999-2002).
- 95% recovery of the coal resource. (continued)

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UGC in Australia “Western world’s leading practice in UCG”

- Operated 5 successive UCG activity.
- Run the GTL (gas to liquid) plant.
- Success for controlling process & shut down practices.
- Expertise development & skills for commercialization of UCG technology.
- Scientifically validated numerical results.
- Expands global business, acquired primitive IP share of this technology in Uzbek plant.

- **Cougar Energy’s** plant shut down due to aquifer contamination with Benzene.
- Queensland State government set goal before commercial operations by **Linc and Carbon Energy** until “demonstrate safe decommissioning by extinguishing the fires, shutting off reactions and preventing groundwater contamination”
- Entrepreneurs are planning to close their business in Australia.

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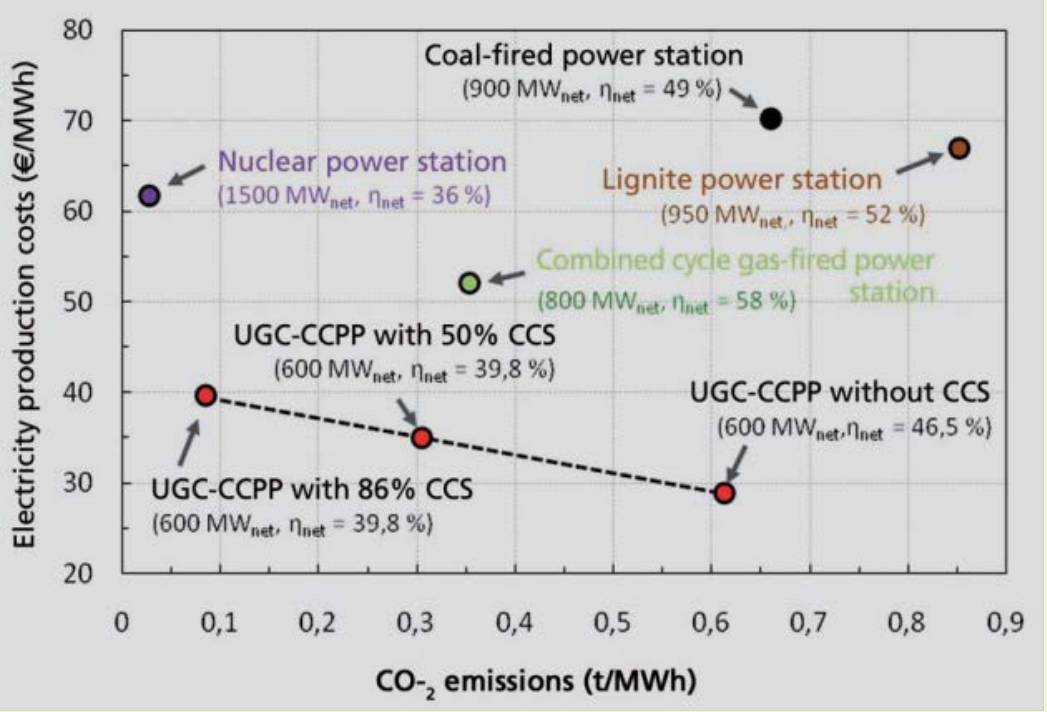
Commitment for Sustainable Engineering

Economic Modelling of UCG ; A Sustainable Technology

- ❑ IRR and Pay Back Period.
- ❑ Environmental issues.
- ❑ Clean coal technology.
- ❑ GHG emission control.
- ❑ Post operation CCS at coal cavity.
- ❑ Best practices of engineering.



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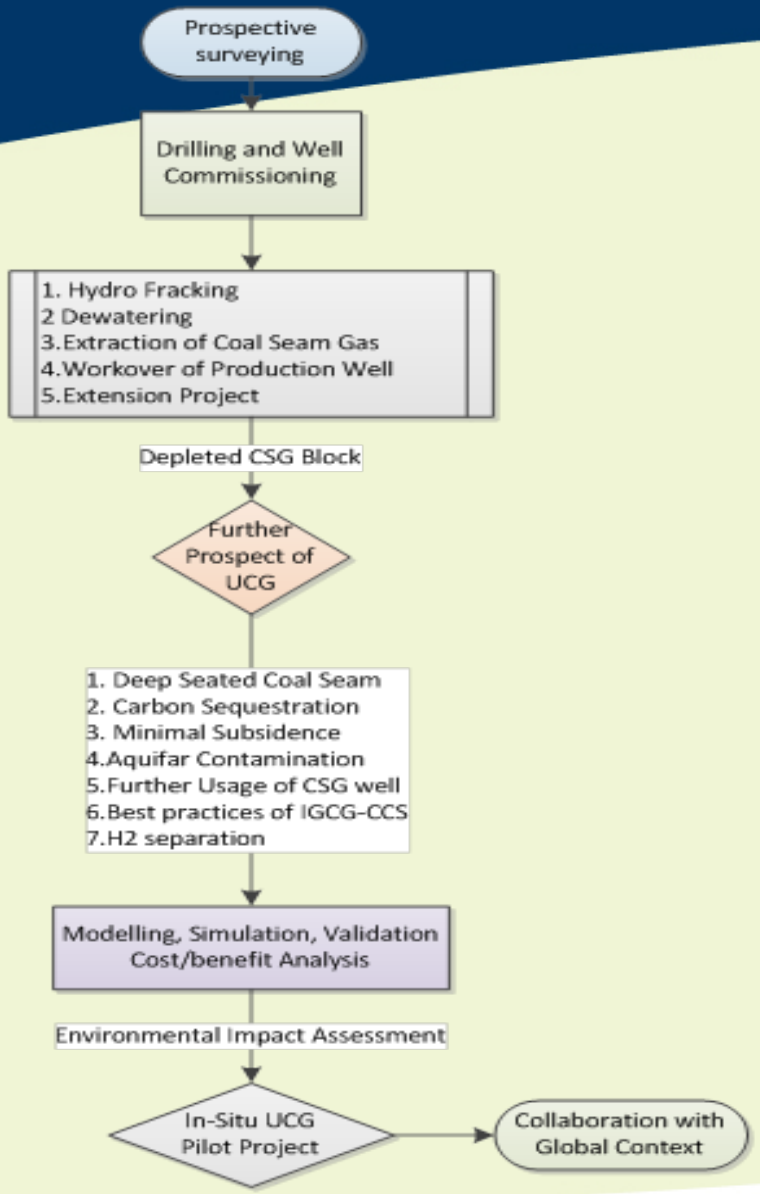
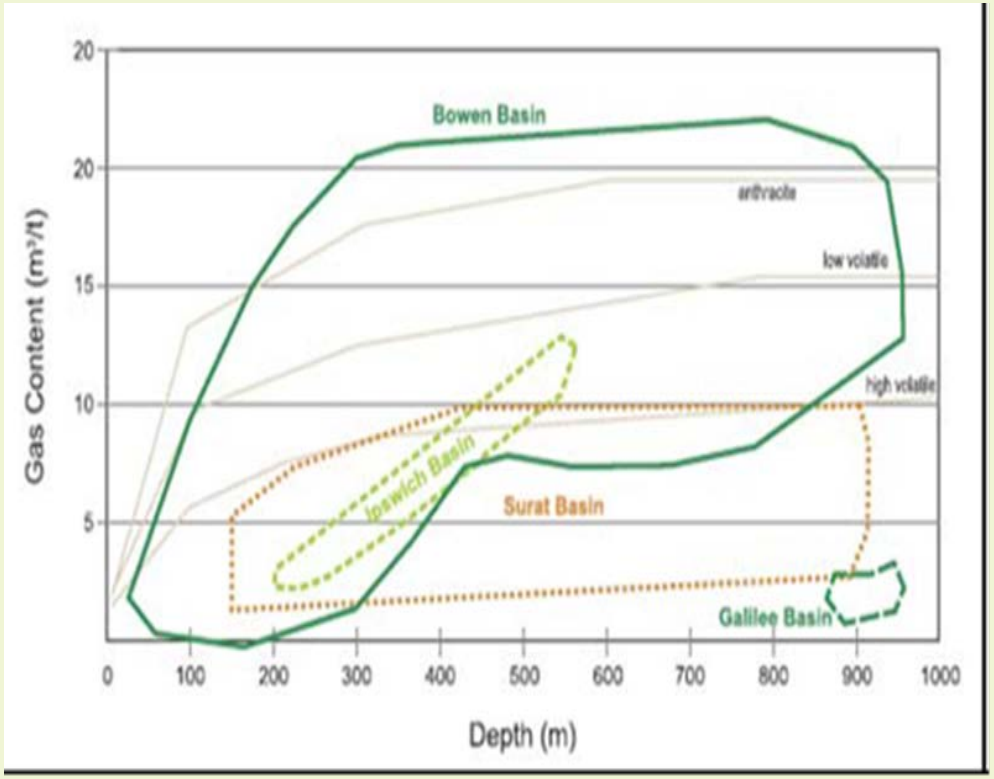
Identified Issues ; UCG Activity in Depleted CSG Blocks





- Coal deposits at **deeper position** in Queensland, are ideal for permanent CO_2 sequestration.

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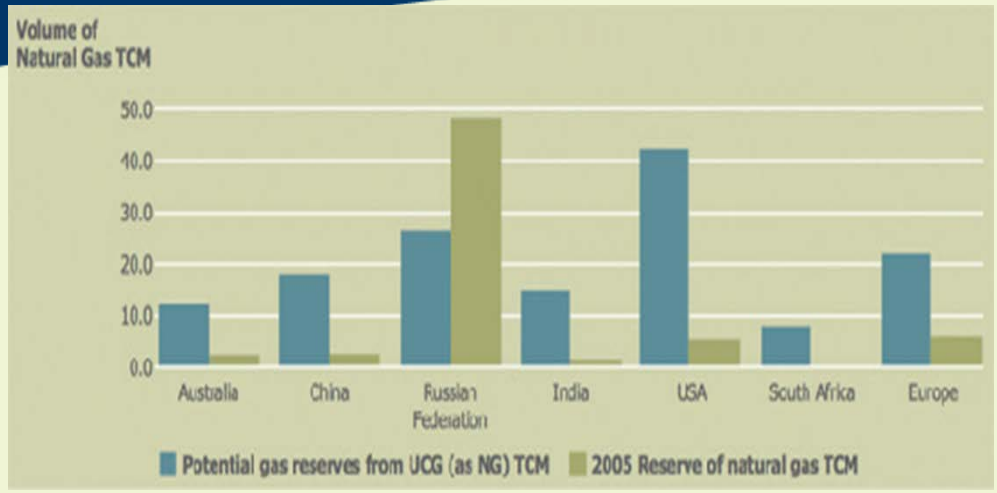
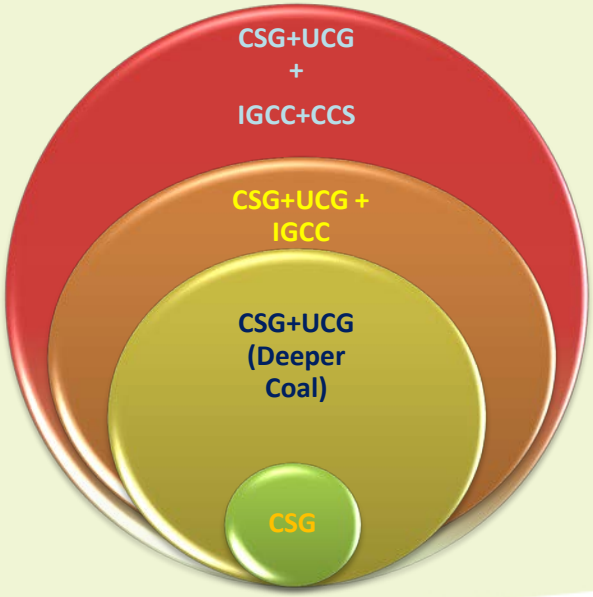
Optimization ; A New Approach for Uneconomic Coal Deposite





Optimization for

- Maximum resource extraction.
- Best practices of UCG technology.
- Cost effective Power Generation.
- Integrated Engineering approach for CSG+UCG+IGCC+CCS within in-situ coal formation.
- "H_2" separation from Syngas for FCV as Zero emission fuel .

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Conclusion and Recommendations

- An engineering approach for Eco-friendly and cost effective exploitation technique for Australian deep seated coal deposits.
- Seeking provision for UCG operation in the depleted CSG blocks
- Carbon sequestration after event exploitation
- H_2 separation for Fuel Cell Vehicle(FCV).
- Joint Collaboration with global partners.

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Thank You

Question?