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*CO<sub>2</sub> Capture in Solid Form – An Update  
of the SkyMine™ Process*

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# *Outline*

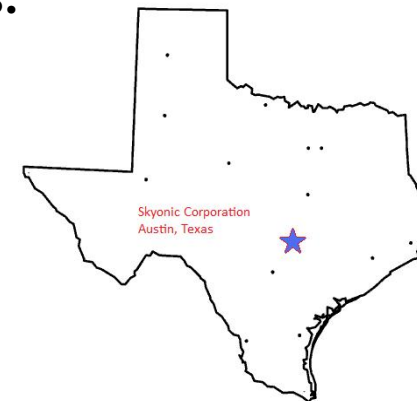
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- **Company Overview?**
- **What does SkyMine™ do?**
- **Process Flow Diagrams**
- **The Value of Hydrogen and Demand Management**
- **Demonstration Plant Update**
- **Company Status**

# Overview of Skyonic

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- **Founded and Incorporated in 2005**
- **Headquartered in Austin, Texas**
- **Developed SkyMine™ to capture & sequester CO<sub>2</sub> in solid form**
- **Development Partner – Southwest Research Institute**
- **Process Development with**
  - **LCRA – Fayette - 2006**
  - **TXU / Luminant – Big Brown Steam Electric Station (BBSES) - 2007**
- **Goal was to develop and deploy a technology that is:**
  - **Retrofittable**
  - **Scalable**
  - **Profitable**

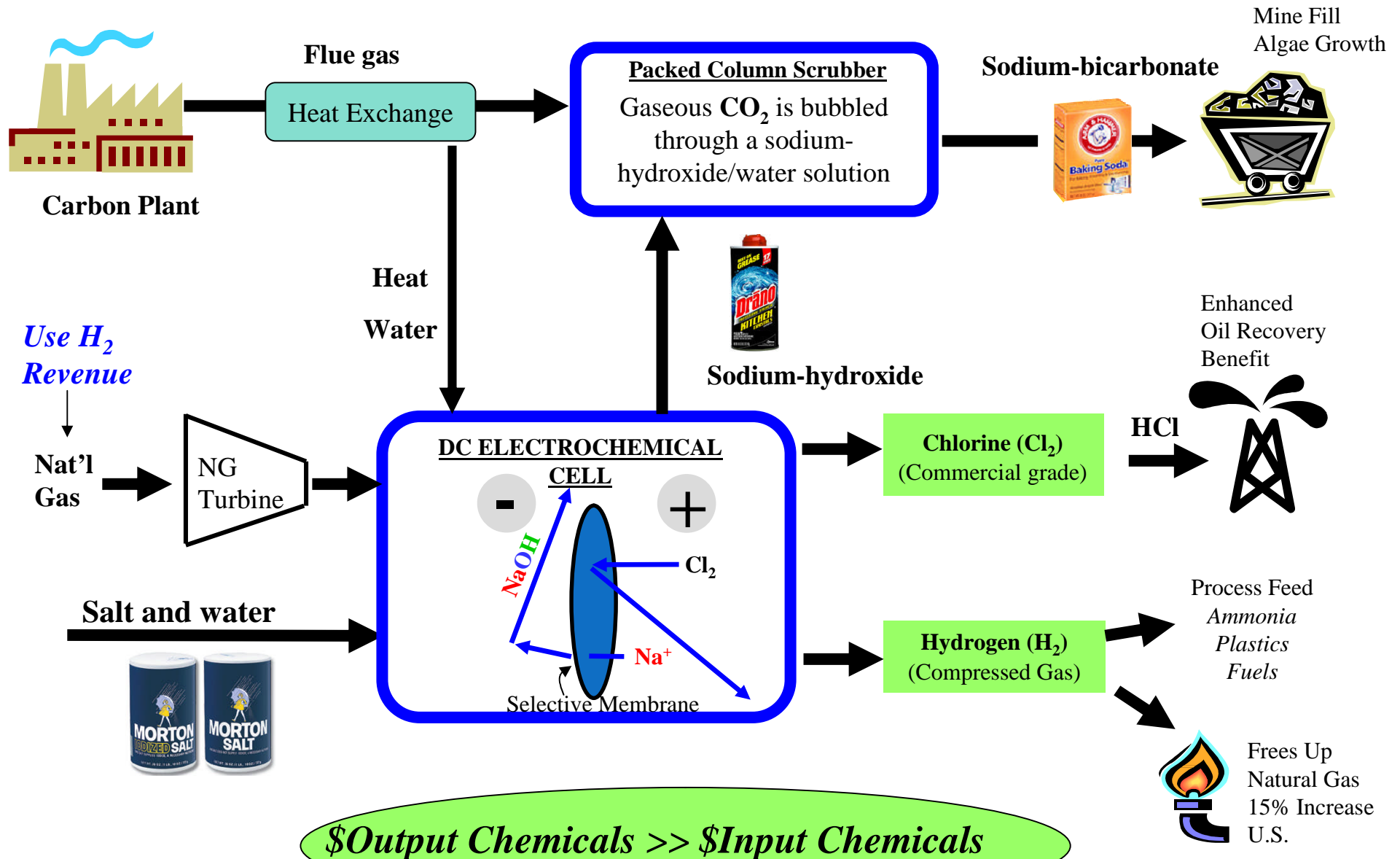


# *What does SkyMine™ do?*

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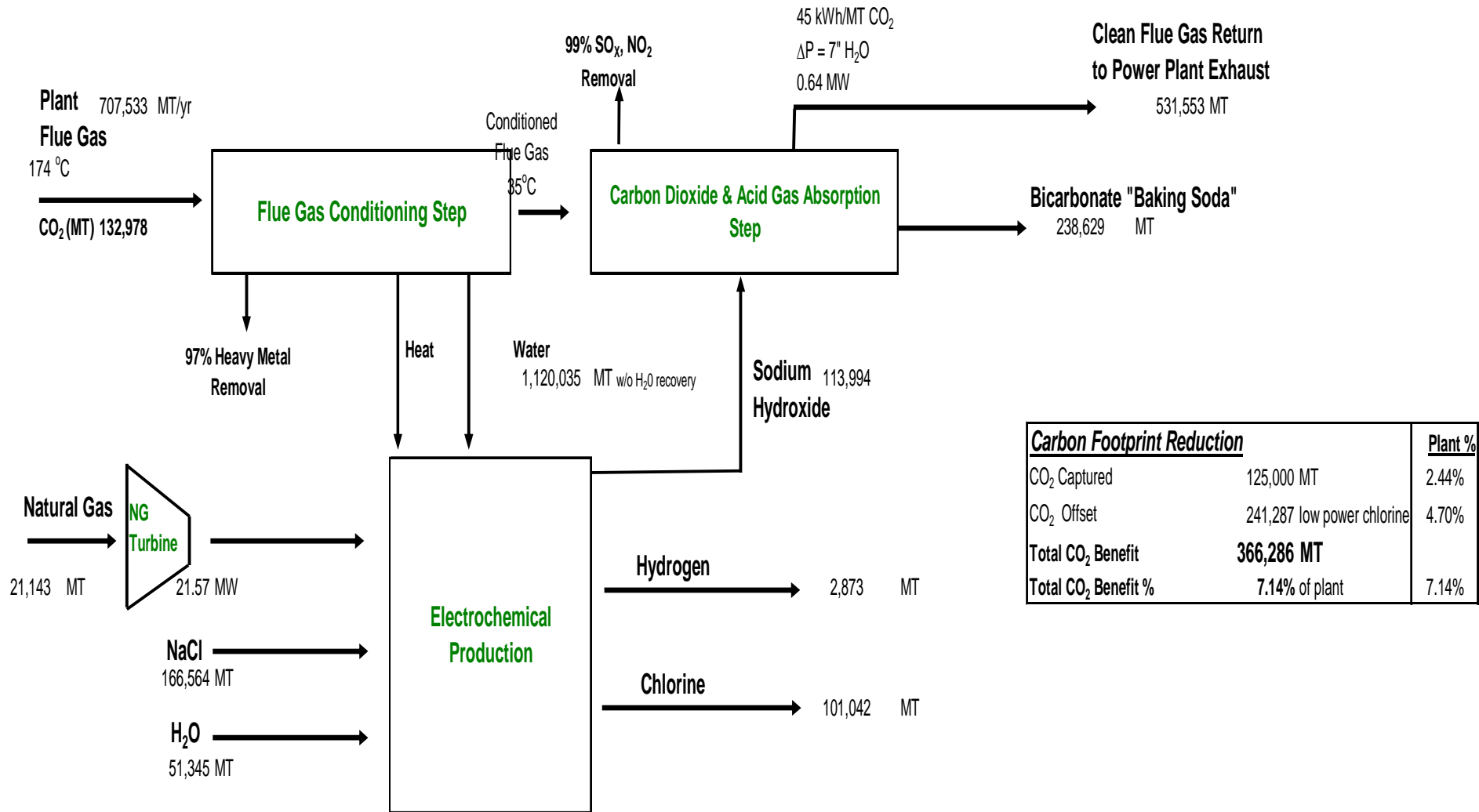
- Captures carbon dioxide (CO<sub>2</sub>) in solid form
- Captures acid gasses (SO<sub>2</sub>, NO<sub>2</sub>)
- Captures heavy metals such as mercury
- Produces electrolytic grade hydrogen
  - Sale
  - Clean energy
- Produces electrolytic grade chlorine
  - Plastics
  - Drinking water
  - HCl
- Eliminates hundreds of millions of dollars in CapEx and ongoing expense for additional scrubber technologies. *“Three-fer”*
- *Recovers and or pays for the process electricity it uses.*
- *Capable of off-peak/on-peak demand management.*

# The Skyonic SkyMine™ Process Solution




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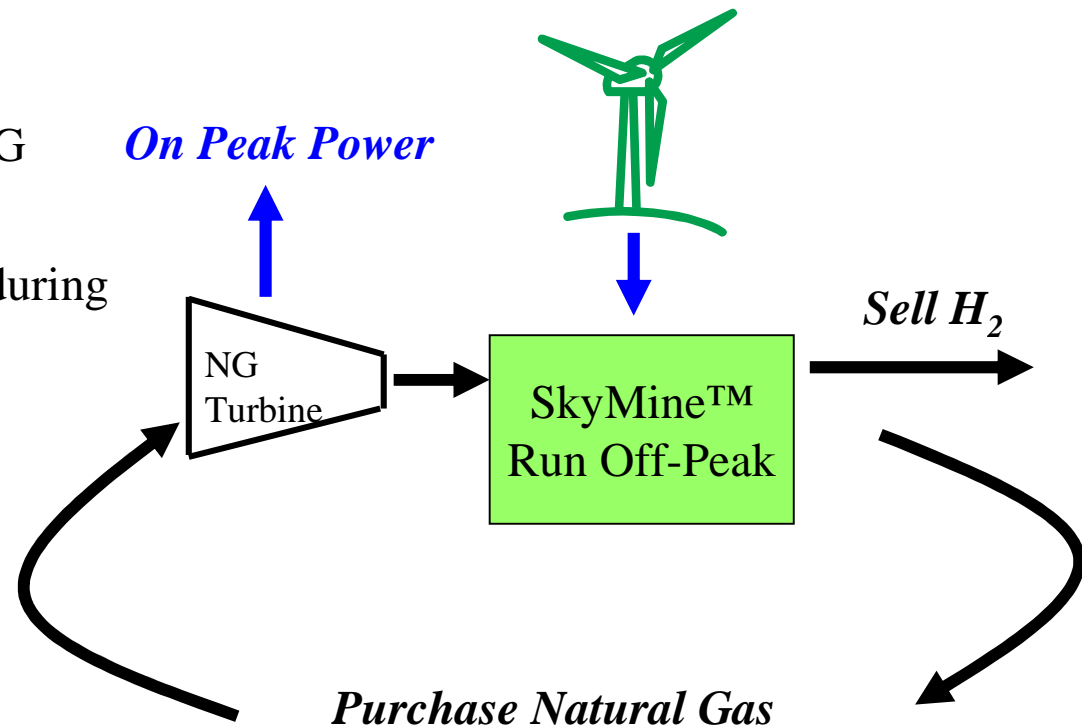
366,000 MT/yr CO<sub>2</sub> Benefit



## *A Better Use for Natural Gas, Wind Power Load Mgt.*

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- Hydrogen is normally produced by steam reformation of NG
-  Hydrogen has a higher economic value than NG
- Sell SkyMine™ hydrogen to market and purchase NG
- Burn NG in a turbine to produce electricity to power SkyMine™ and produce electricity on peak.
- This is the best use of our nation's NG
- Run plant harder during off-peak or during renewable energy surge.



## *Hydrogen/Natural Gas Arbitrage (366,000 MT/yr CO2 benefit)*

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- **Option 1 – Self-power (Pre-Tax Income \$29.2MM)**
  - Sell Hydrogen
  - Purchase Natural Gas (Hydrogen has a higher economic value than natural gas)
  - Burn Natural Gas in a turbine to recover process energy
- **Option 2 – Peak-power Producer (Pre-Tax Income \$35.3 MM)**
  - Sell Hydrogen
  - Purchase Natural Gas
  - Size SkyMine™ plant for 18 hour chemical production
  - Burn Natural Gas in turbine, recover process energy and at 6 hour peak demand.



# *Impact*

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- Minimally invasive – requires access to flue gas
- Chemical production can be operated off-peak to “bank” chemicals for use during peak times.
  - Compatible with PV (powered electrochemical plant with PV at demo plant)
  - Variable load for excess generation (wind, increase chem. production, avoid turning down coal plant)
- Sell hydrogen and increase natural gas availability
- Sodium bicarbonate disposal in mine fill, landfill or algae growth.
- Chemicals (H<sub>2</sub>, Cl<sub>2</sub>) sold through a chemical partner.

# Benefits

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- Sequesters as a solid.
  - Simplifies disposal
  - No long term liability from gaseous injection
- Retrofittable to existing plants
  - Not dependent on new plants or designs. No pre-scrub necessary.
- Profitable
  - On-peak hydrogen return has greater value, off-peak power used
  - Chemical sales generate cash flow to pay for investment and operation
  - Is a profit center!
  - Enables fly-ash sales (avoids use of activated carbon injection)
  - Captures CO<sub>2</sub>, acid gases and heavy metals. “*Three fer*”
- Uses established unit operations and chemistry “*Edisonian*”

# *Luminant Big Brown SES*

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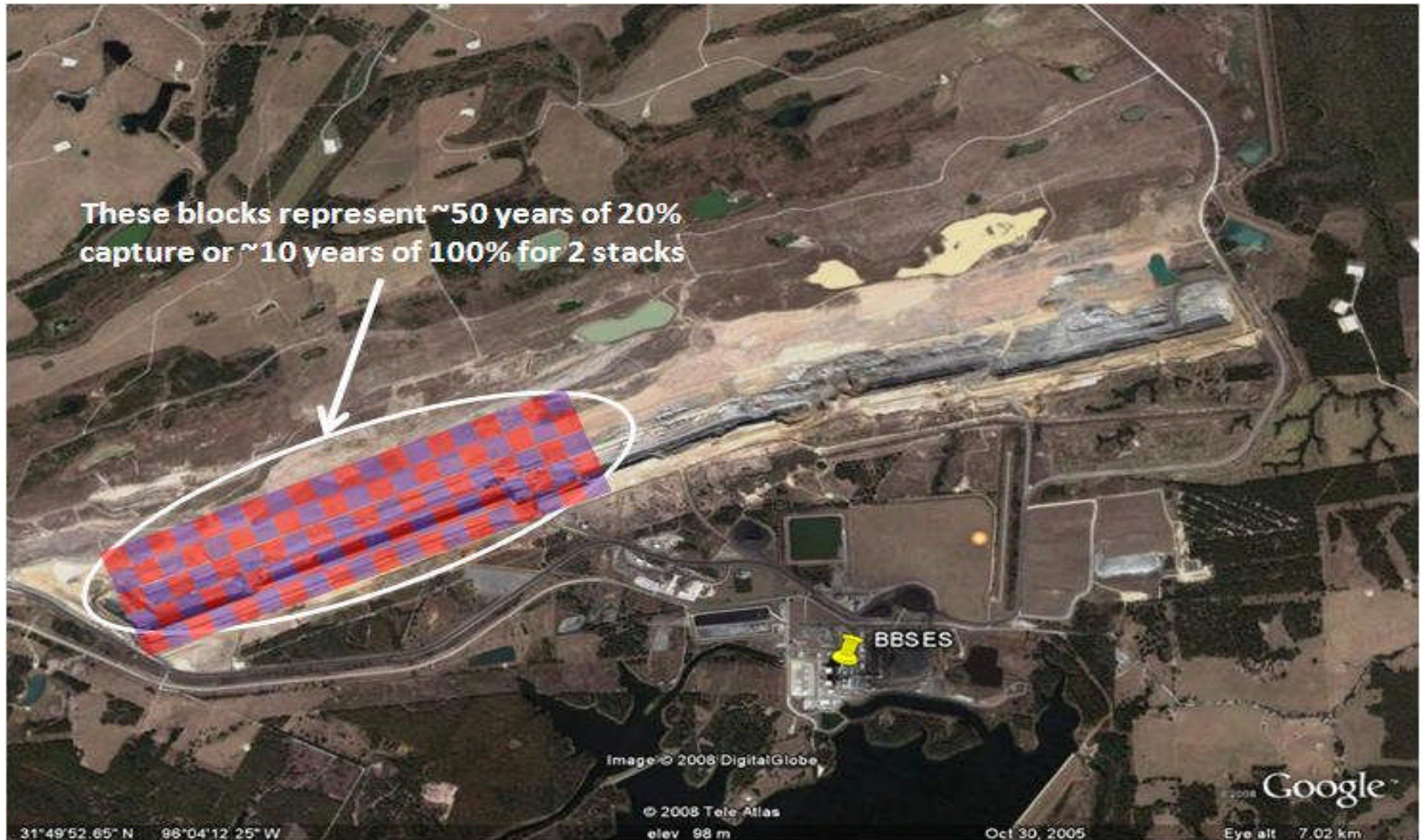
# Results

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- Operating a 100 MT/yr SkyMine™ for 2 years at BBSES
  - Unscrubbed lignite/PRB plant
- Achieved > 80%-92% CO<sub>2</sub> solid conversion
- SO<sub>x</sub> removal “100%” & NO<sub>2</sub> 99.x%
- Mercury capture > 90%
- Produced electrolytic grade H<sub>2</sub> and Cl<sub>2</sub>
- Unified Process Demonstration (GE Intellution)
- Confirmed mass and energy balances
- Waste heat used for anolyte and catholyte heating
- Powered electrochemical plant with PV, battery system

# Bicarbonate Storage

*The density of bicarbonate is ~ 2 - 3X the density of coal!*



# *Status and Invitation*

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- ✓ *Private investment available for our first facility*
- ✓ *Looking for host power and or chemical plants*
- ✓ *First LOI for site host in place*
- ✓ *Layouts for three-four host sites being developed by EPC*
  
- ✓ *Visit the Demonstration Plant at Big Brown*