

SES Gasification Technology from R&D to Commercial – the Journey

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Outline

- The Technology
- Research and Development
- Commercialization
- Next Steps
- What does it take





Synthesis Energy Systems and SGT Technology

Francis Lau





Corporate Highlights

- **U.S. Clean Energy Company** – 2007 Nasdaq: **SES**
- **Unique Proven Technology** – enables low-cost, clean synthesis gas energy production via SES Gasification Technology (SGT)
- **Growing Asset Base** – well-positioned to grow company value
- **Experienced Leadership** – management and Board from Fortune 100 and top energy companies



SES SGT Gasification Technology



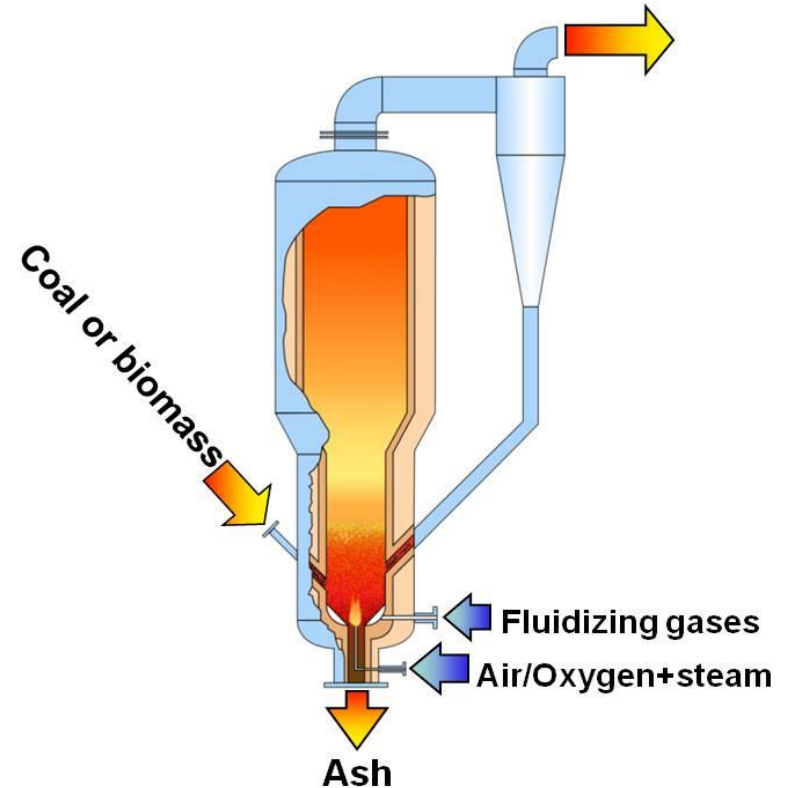
Foundations of SGT Technology



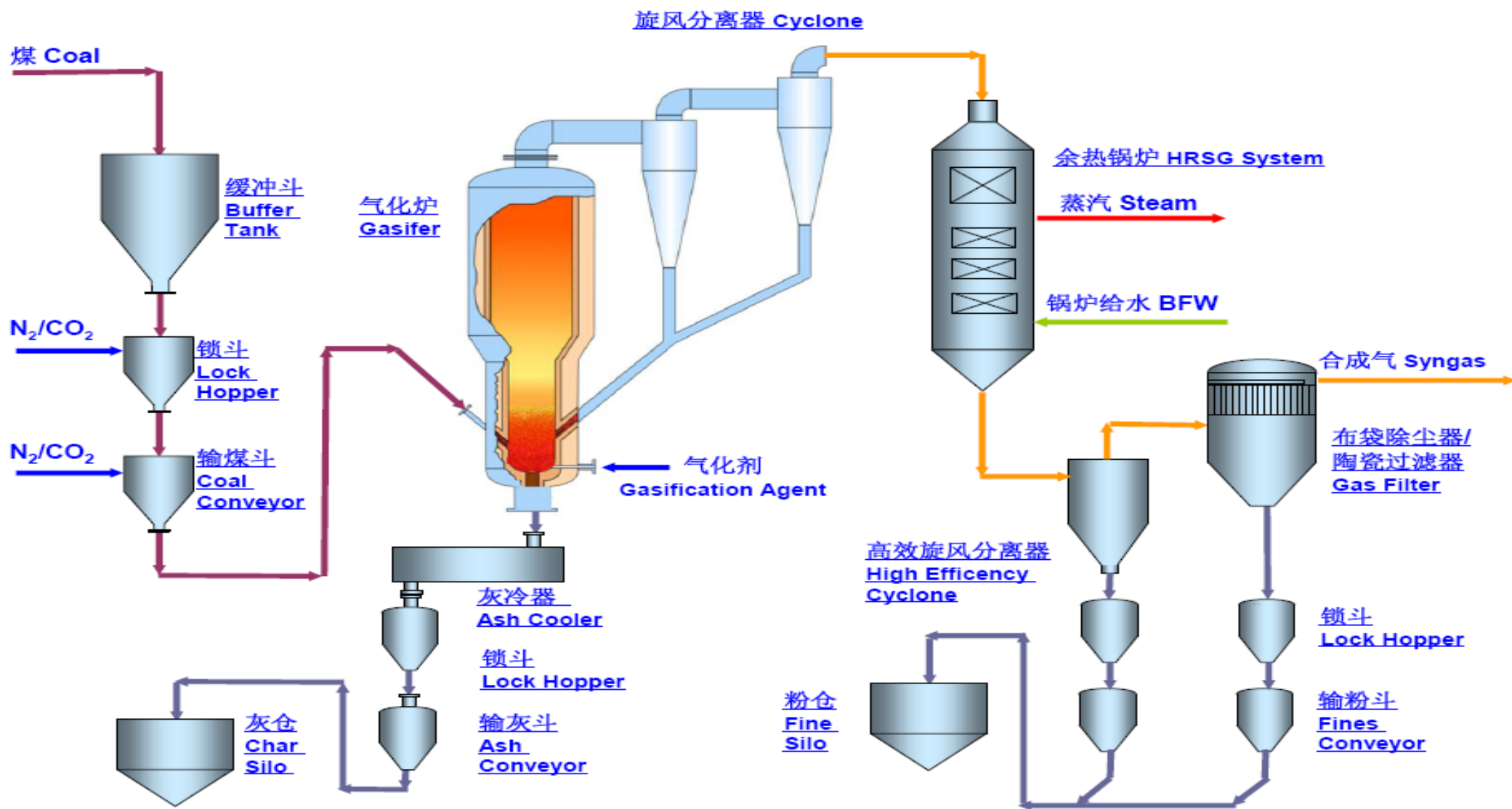
U.S. DEPARTMENT OF
ENERGY

SES SGT Gasification Technology Platform - U-GAS®

- **FUEL FLEXIBLE – ALL RANKS OF COAL, BIOMASS & WASTES**
- **SIMPLE AND LOW-COST DESIGN, SINGLE FLUIDIZED BED GASIFIER WITH RELIABLE OPERATION**
- **HIGH COLD GAS EFFICIENCY WITH HIGH CARBON CONVERSION**
- **LOW WATER USAGE & DISCHARGES, ENVIRONMENTALLY FRIENDLY**



SES SGT Gasification Island



U-GAS Research, Development & Commercialization

GTI Gasification Development History

Development Focus

Supply Security –
Substitute Natural Gas (SNG)

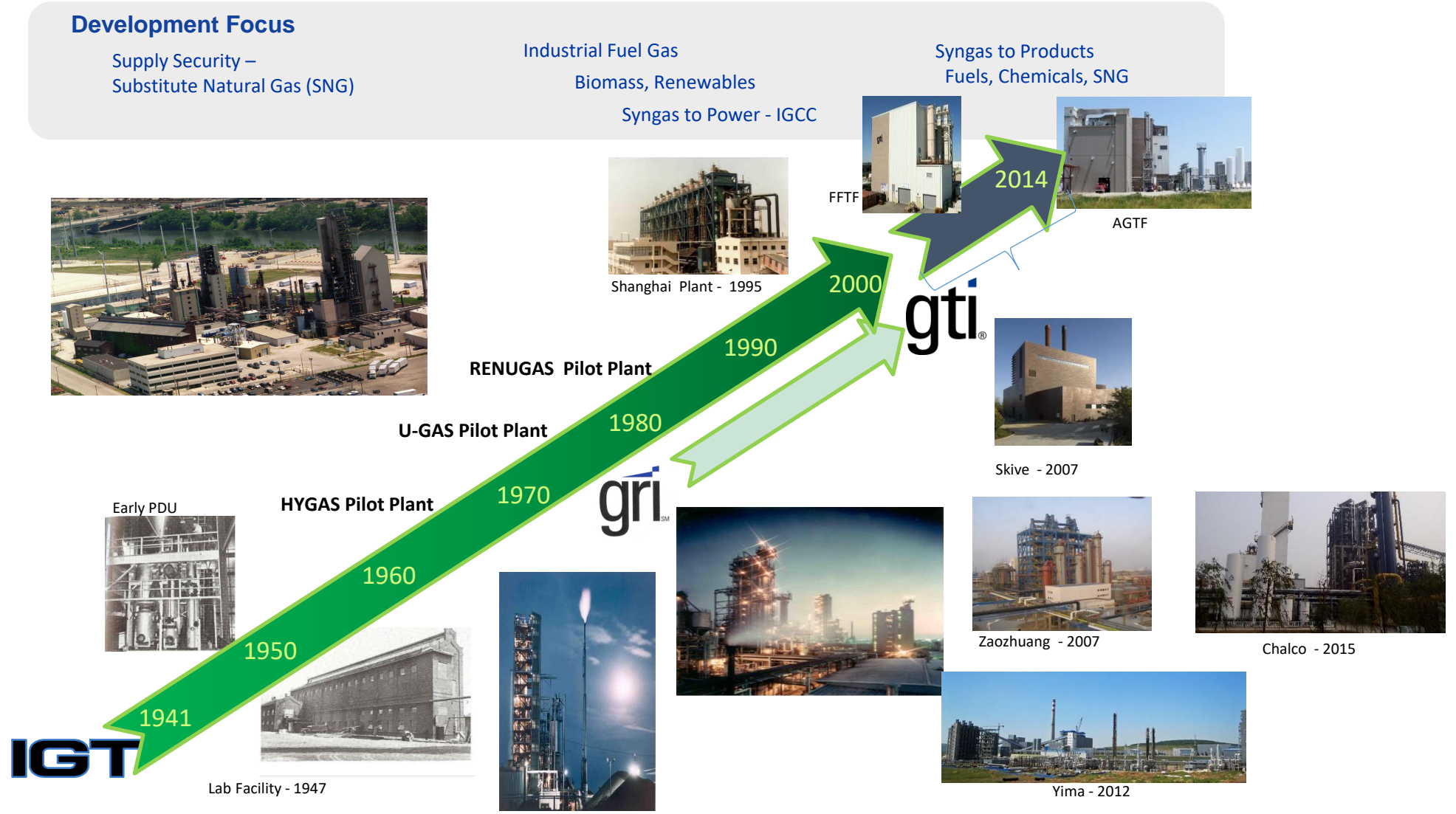
Industrial Fuel Gas

Biomass, Renewables

Syngas to Power - IGCC

Syngas to Products

Fuels, Chemicals, SNG



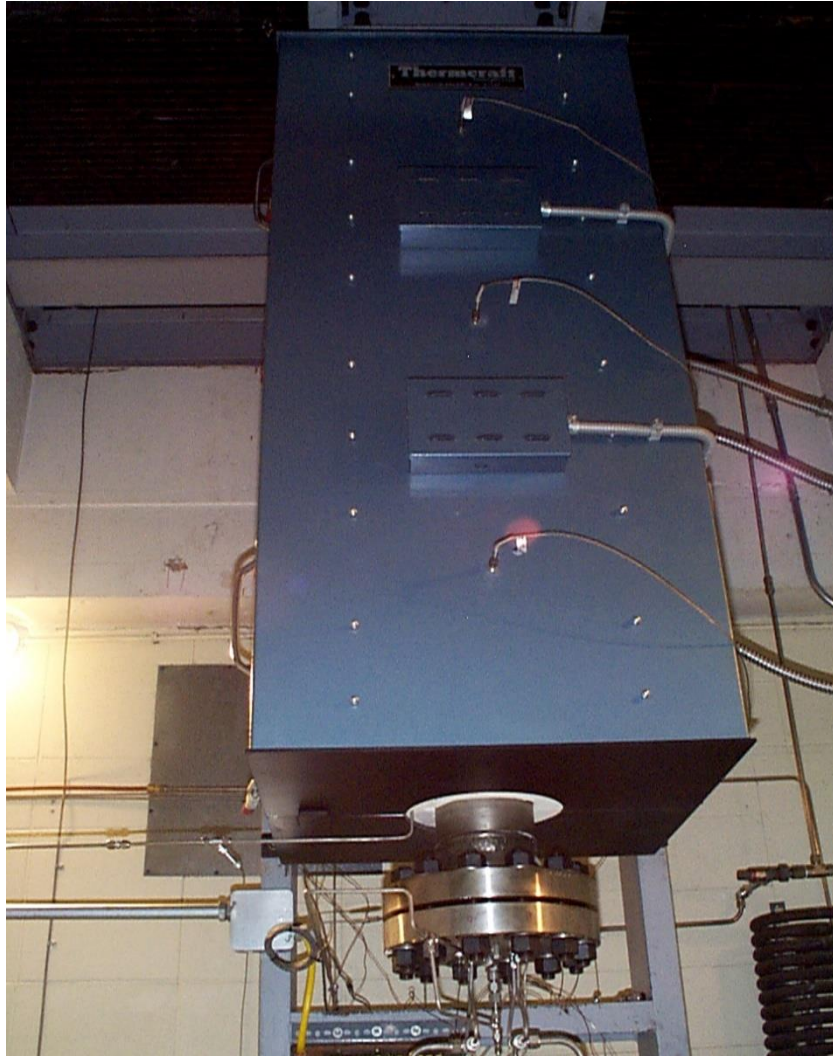
Fundamental Research Laboratory



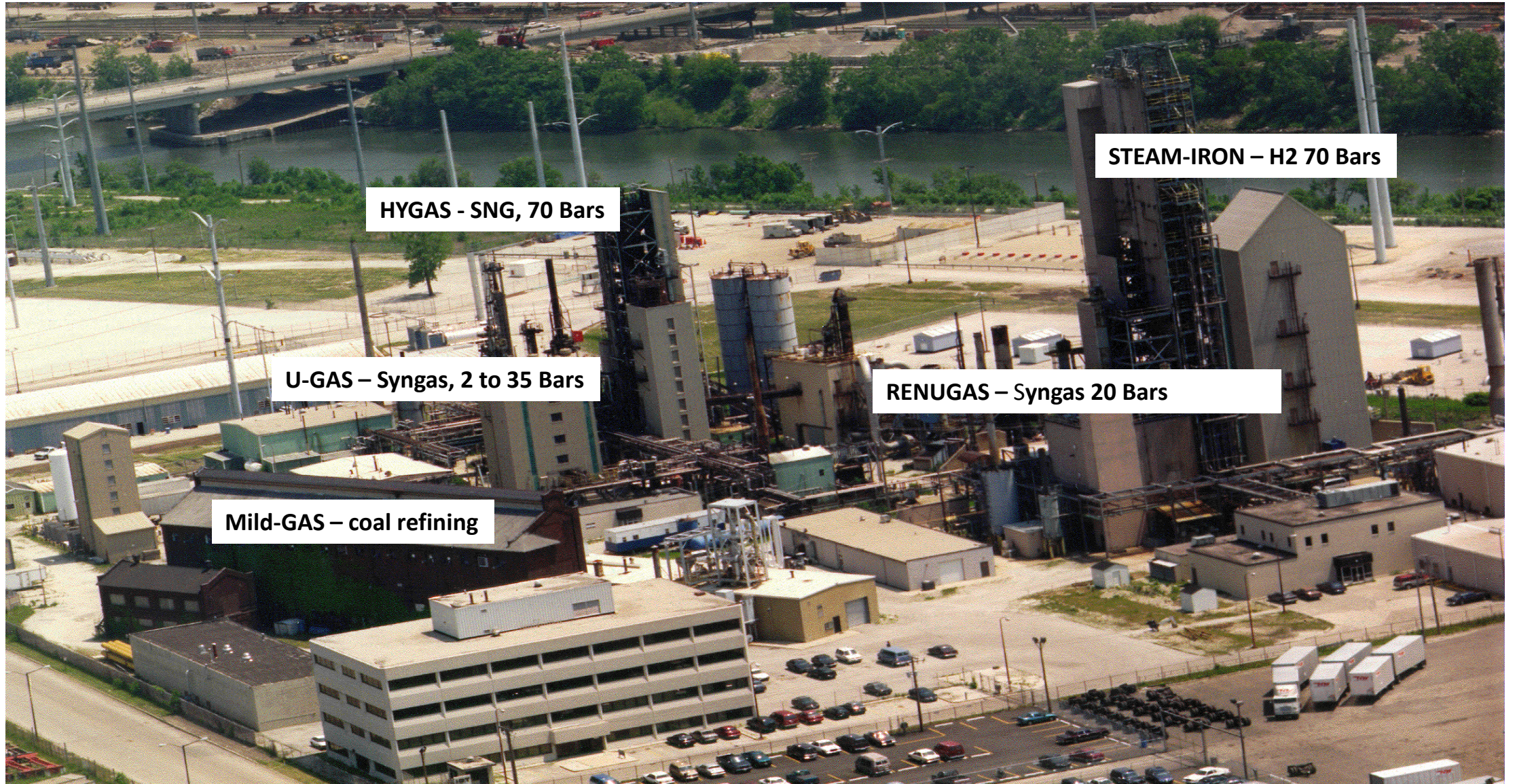
High Pressure TGA



High Pressure Fluidized-Bed Reactor



GTI Energy Development Center

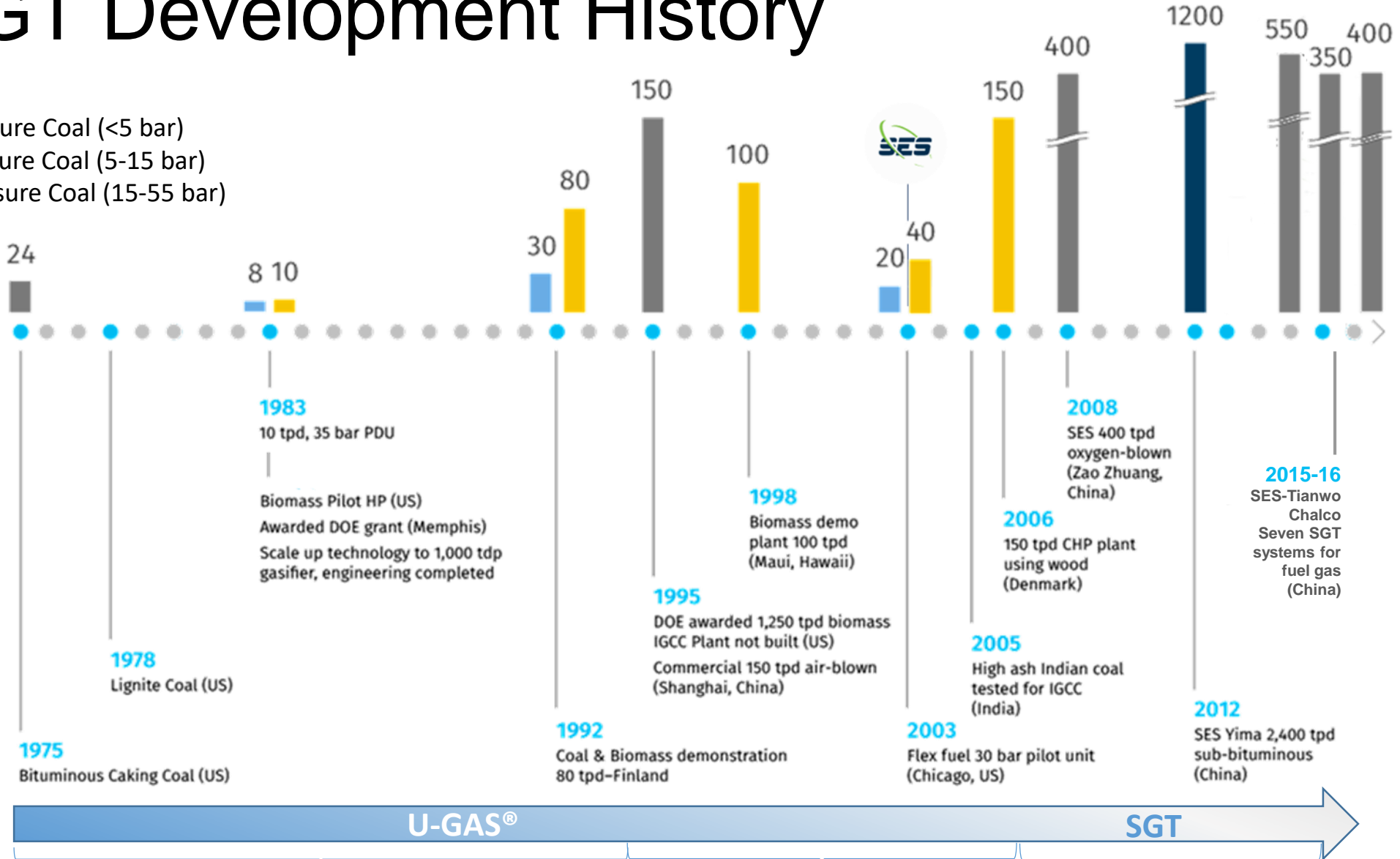


Gas Technology Institute ("GTI") Energy Development Center
(1965 - 1996)



SGT Development History

- Tons/day
- Low Pressure Coal (<5 bar)
 - Mid Pressure Coal (5-15 bar)
 - High Pressure Coal (15-55 bar)
 - Biomass



SES SGT U-GAS Commercial Operational Experiences

SES' ASSETS IN CHINA



SGT Commercialization



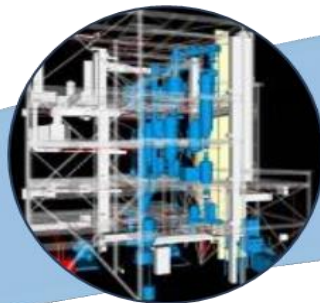
30 Years R&D (GTI)



ZZ Syngas Project 2 Systems



Yima Large Scale Chemical Project 3 Systems (2+1)



Tianwo-SES Equipment Design and Manufacturing



Aluminum Corporation of China 7 Gasification Systems – Industrial Fuel Gas

SES project name	Zao Zhuang	Yima	Chalco Shandong	Chalco Shanxi	Chalco Henan
Year commissioned	2008	2012	2015	2016	2016
# of gasifiers	2	3	2	1	4
Main product	Methanol	Methanol	Fuel Gas	Fuel Gas	Fuel Gas
Annual output	90,000 mtpa	300,000 mtpa	9.33 PJpa	3.27 PJpa	14 PJpa



Commercial Project Summary

Site	No. of Gasifiers	Syngas Capacity (nm ³ /hr)	Startup Year
Zaozhuang	2	20,000	2008
Yima	3	90,000	2012
Shandong	2	80,000	2015
Shanxi	1	26,000	2016
Henan	4	120,000	2016
Totals:	12	338,000	



ZZ 2008



Yima 2012



Chalco 2015-2016



Zao Zhuang Plant has successfully gasified over 20 kinds of coal

including:

- Inner Mongolia lignite (High moisture)
- Australian sub-bituminous coal (High ash content)
- Yan Kuang Yi Shan bituminous coal (local bituminous coal of high ash content and high T2)
- Yima long flame coal (local long flame coal, High Ash Content)
- Ji Yuan Anthracite coal (local anthracite)
- Local washed middle coal (High Ash Content)



Range of Coal Gasified	
Ash, wt % (Aad)	5 – 55
Moisture, wt % (Mad)	4 – 36
Volatile, wt % (Vad)	12 – 40
Fixed Carbon, wt % (FCad)	24 – 70
Sulfur, wt % (St,ad)	0.6 – 4.0
Ash melting– T ₂ , °C	1,112 – 1,450+
Low Heating Value, Kcal/kg, AR	2,900 – 6,100

YIMA PERFORMANCE TEST RESULTS

	SGT Experience	Yima PT Actual
Coal Properties		
Ash Content (wt %)	1 - 55	6
Moisture Content (wt %)	1 - 43	9
Volative Matter (wt %)	3 - 69	36
Fixed Carbon (wt %)	6 - 83	56
Sulfur (wt %)	0.2 - 4.6	0.6
Ash Softening Temp. (°C)	1,040 - 1,490+	~1200
Heat Value (LHV, kcal/kg)	3,050 - 7,700	7,100
Operations		
Gasifier Pressure (barg)	1 - 35 (pilot) 1 - 10 (commercial)	10
Gasifier Temp. (°C)	800 - 1,100	910
Gasifier Capacity (mtpd)	200 - 1,400	1,200
Carbon Conversion (%)	99+	99.5
Cold Gas Efficiency (%)	80+	85



Yima Plant Henan Province, China

- 3 SES gasification trains
- 300K TPY methanol design capacity, Phase I
- Higher pressure and through put



Licensed SGT Projects

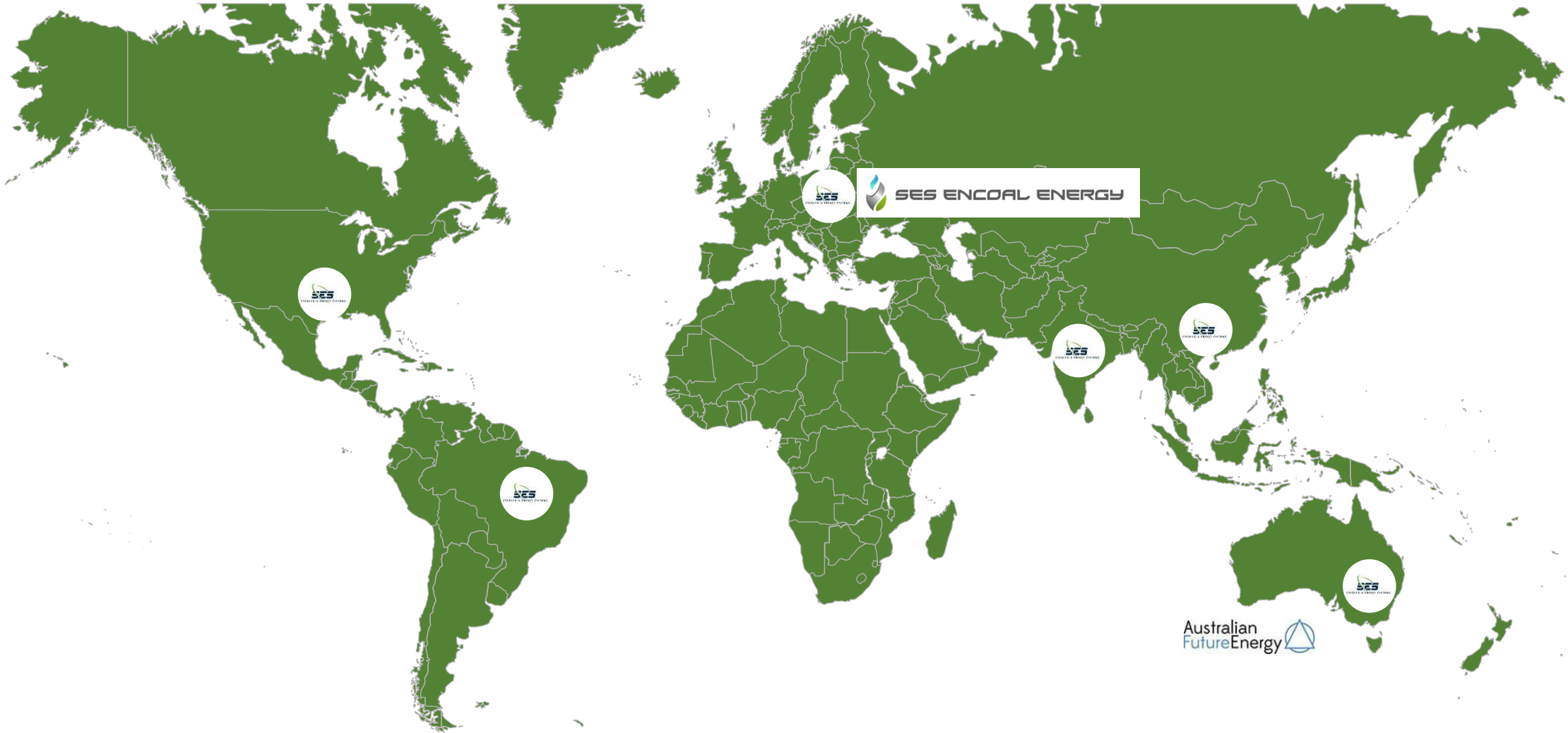
- Aluminum Corporation of China (CHALCO):
 - China's largest alumina and primary aluminum producer and the world's second largest alumina producer
- SGT economically advantaged clean coal NG replacement projects
 - 3 industrial fuel supply plants
 - Secured by China JV Tianwo-SES partner, Suzhou THVOW Technology Co., Ltd.
- All achieved design performances



Next Steps



Global operations and growth platforms





- 12 Commercial Gasifier Systems
- Outstanding SGT Performance
- Strong Base For Growth



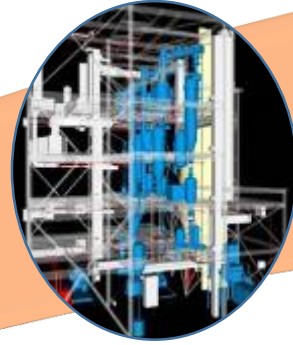
30 Years R&D
(GTI)



ZZ Syngas
Project



Yima Large
Scale Chemical
Project



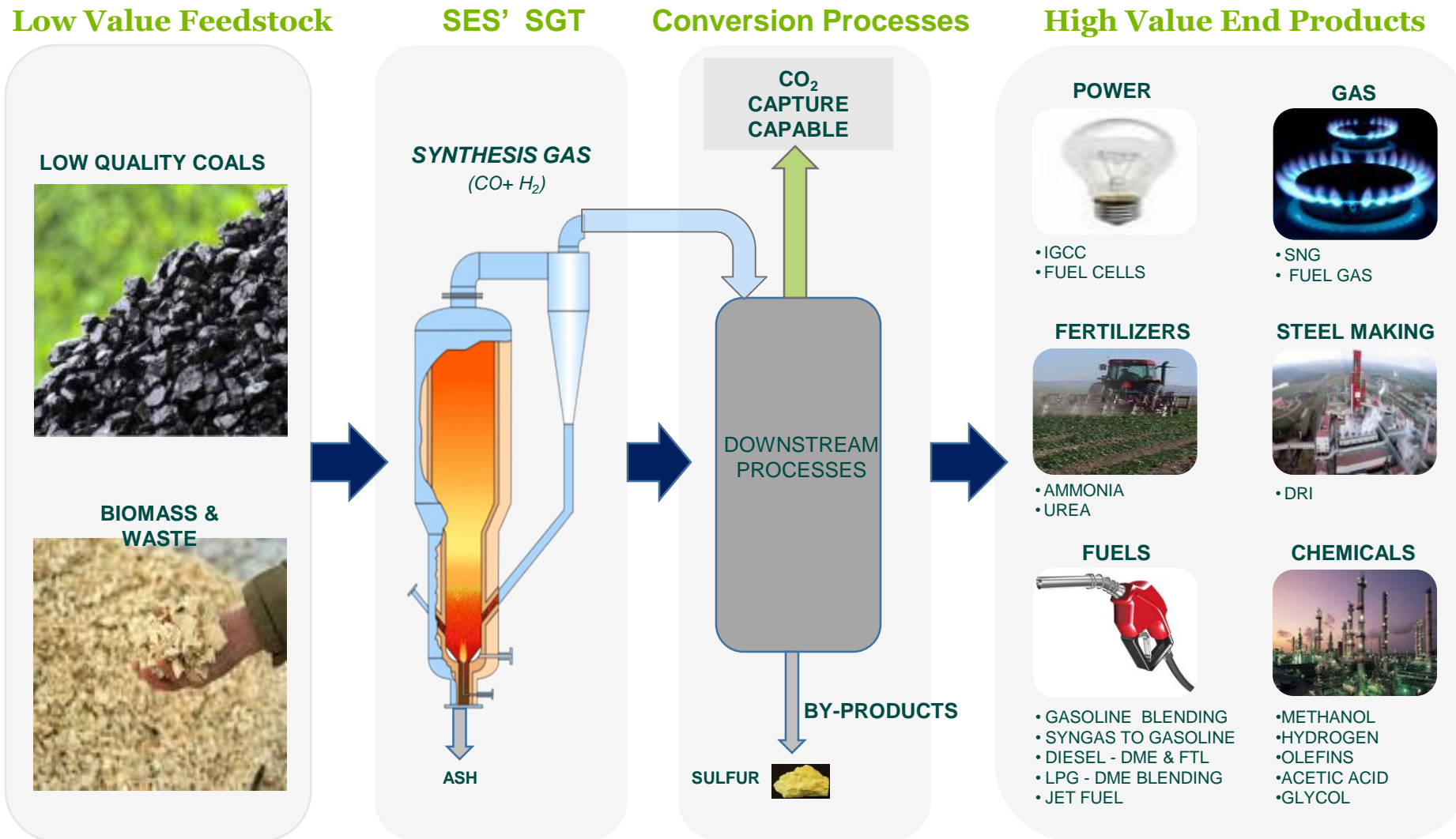
Tianwo-SES
Equipment Design
and Manufacturing



CHALCO
7 SGT Gasifier
Systems –
Industrial Fuel
Gas

Building on achievements

SGT Gasification Technology Highlights: Focus on High Value Products from Low Cost Fuels



SES Activities Summary

- Joint Venture Operations in China
 - **Tianwo-SES JV** – First projects(3) producing Fuel Gas to replace NG
 - **Yima JV** – Syngas to Methanol
 - **ZZ New Gas Company JV** – Relocate
- Markets and Global Partnerships:
 - **AFE** – Fuel Gas, Fertilizers, Power, Chemicals, SNG
 - **Encoal** – Fuel Gas for Power, Chemicals
 - **GE Packaged Power** – Distributed Power
 - **Midrex Technologies**, a subsidiary of Kobe Steel – DRI Steel
 - **Brazil, Vamtek** – SNG

- **SES has successfully demonstrated its SGT gasification technology in China, its advantages in clean and efficient utilization of resources, its flexibility in feedstock choices, and its low cost and reliable operations.**
- **SES is expanding its market applications globally with our partnerships in Australia, Poland, India, Brazil....**
- **Global energy demand will continue to grow and cleaner and more efficient technologies are needed to meet the demands in a sustainer manner.**



What Does It Take!



GROWTH WITH BLUE SKIES

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What Does It Take to Commercialize

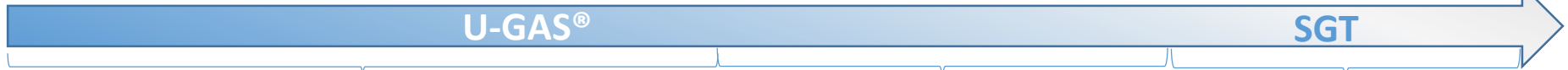
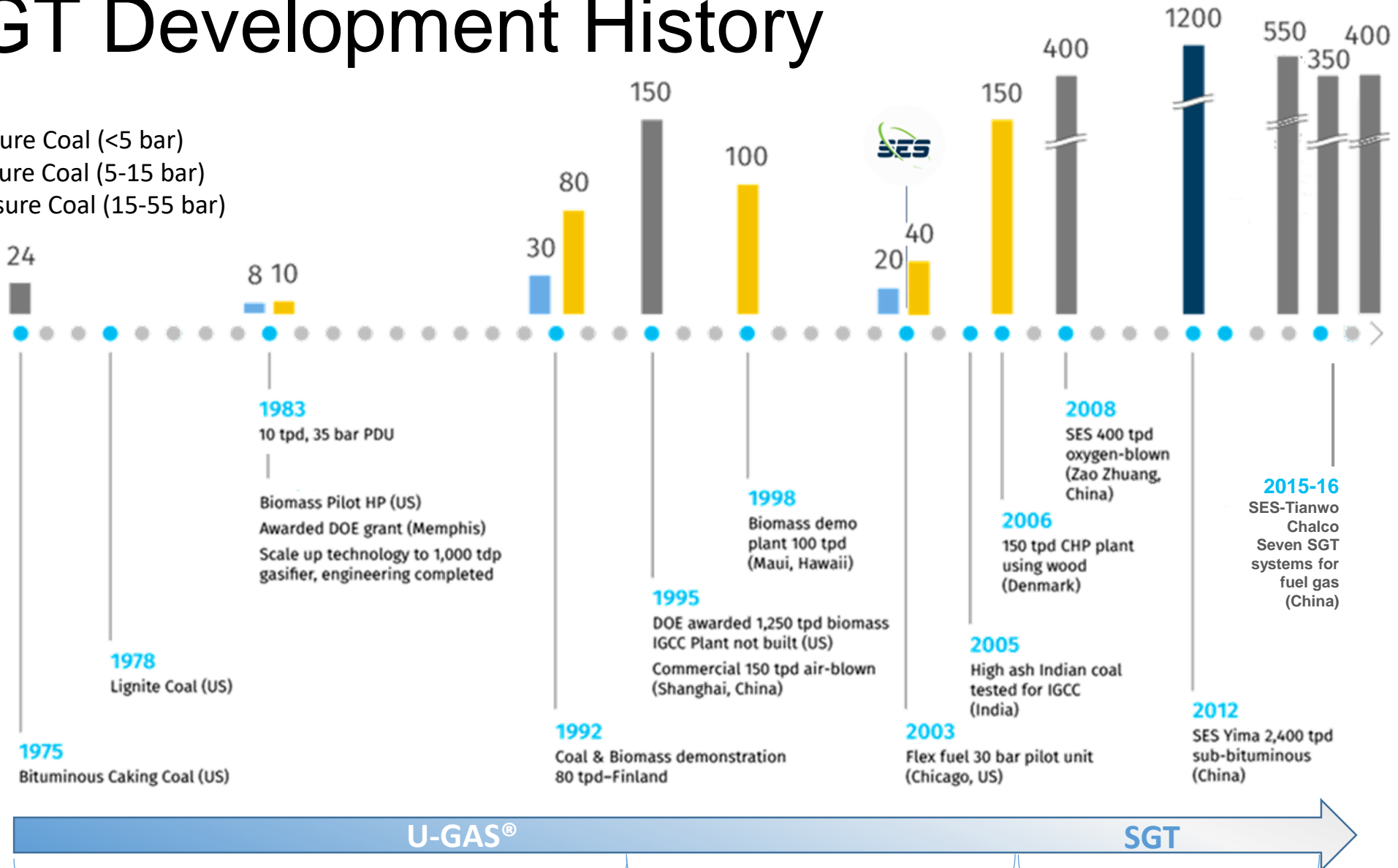
- **Lots of Dedication, Hard Work, and Commitment**
- **Strong Team**
- **Perseverance**
- **Money**
- **Partnerships**
- **Timing**

U-GAS /SGT's path to Success!!



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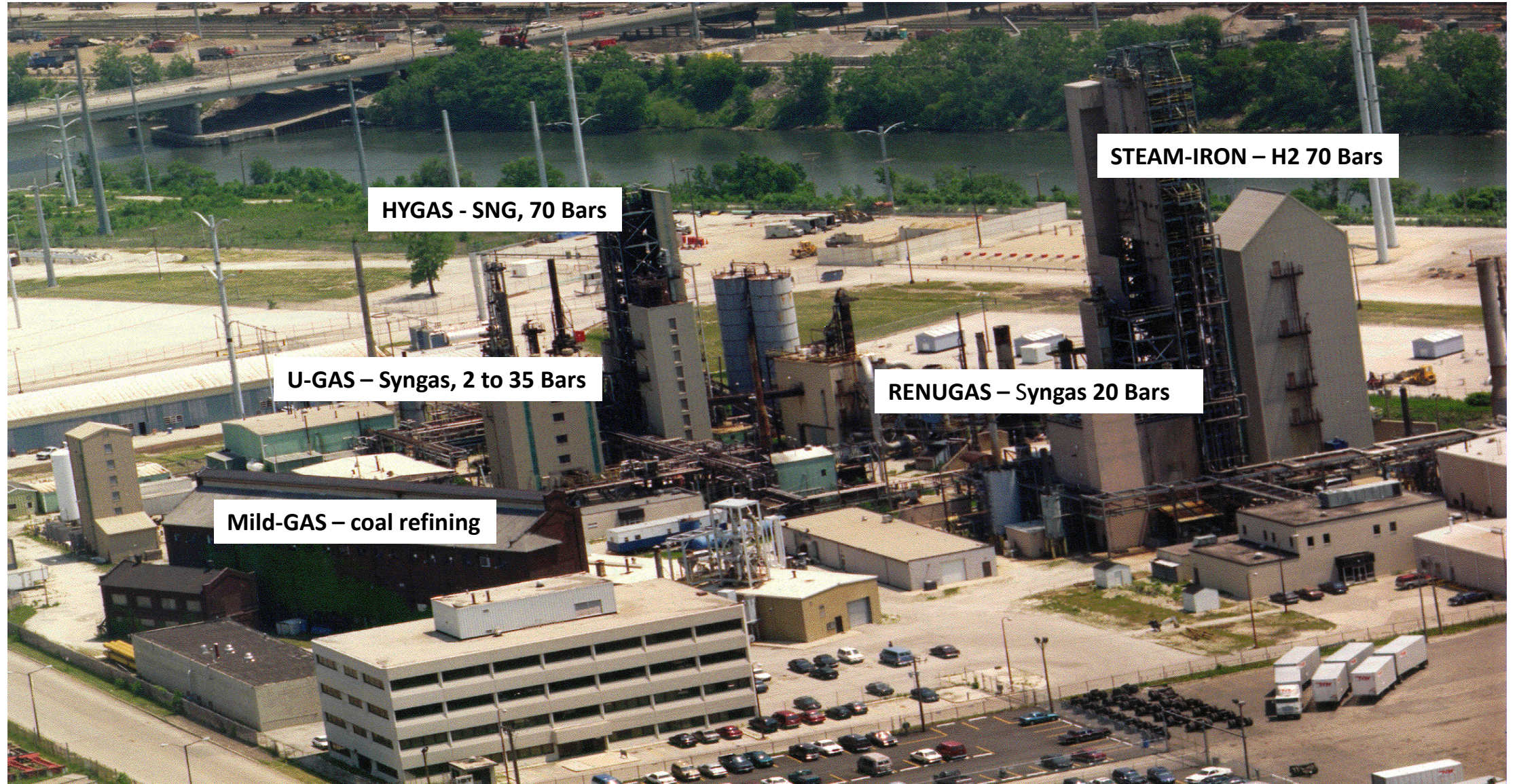


R&D

Early Commercialization

Final Commercialization

GTI Energy Development Center



Gas Technology Institute ("GTI") Energy Development Center
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Thank you!

