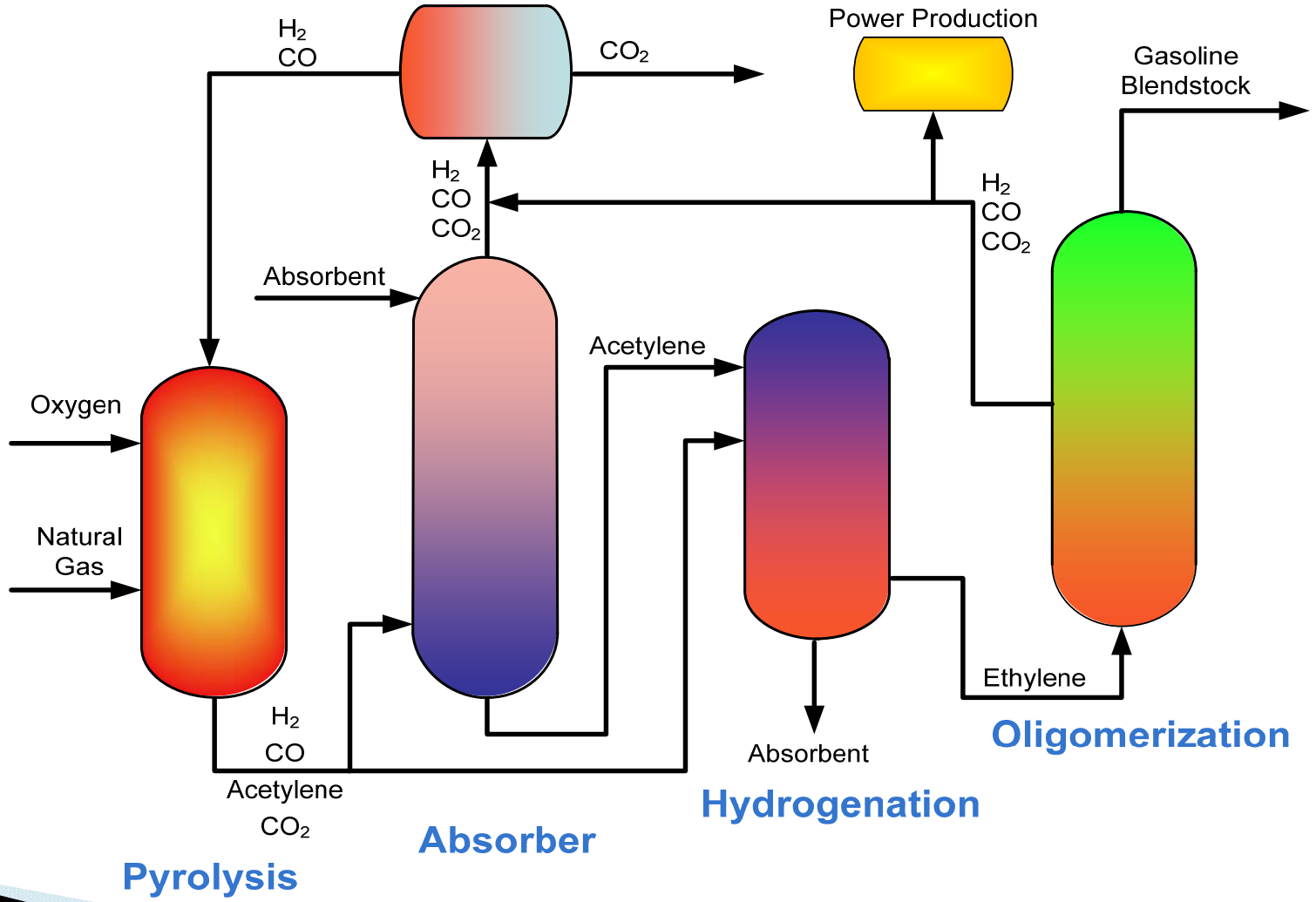
Synfuels GTX

- A 3 Step Process

The Synfuels GTL Process

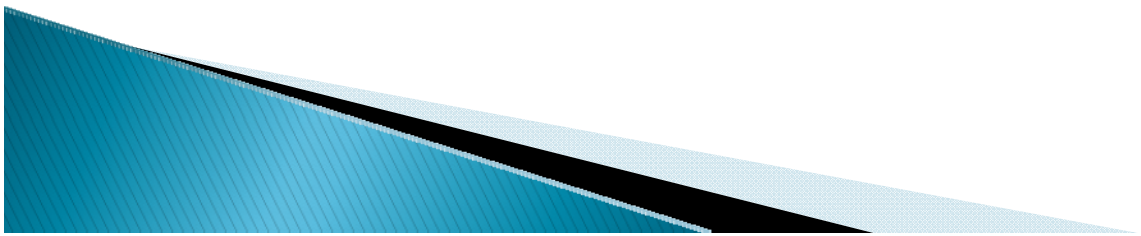


Step 1 - Pyrolysis

- Pyrolysis reactor converts hydrocarbon gas to acetylene and other components

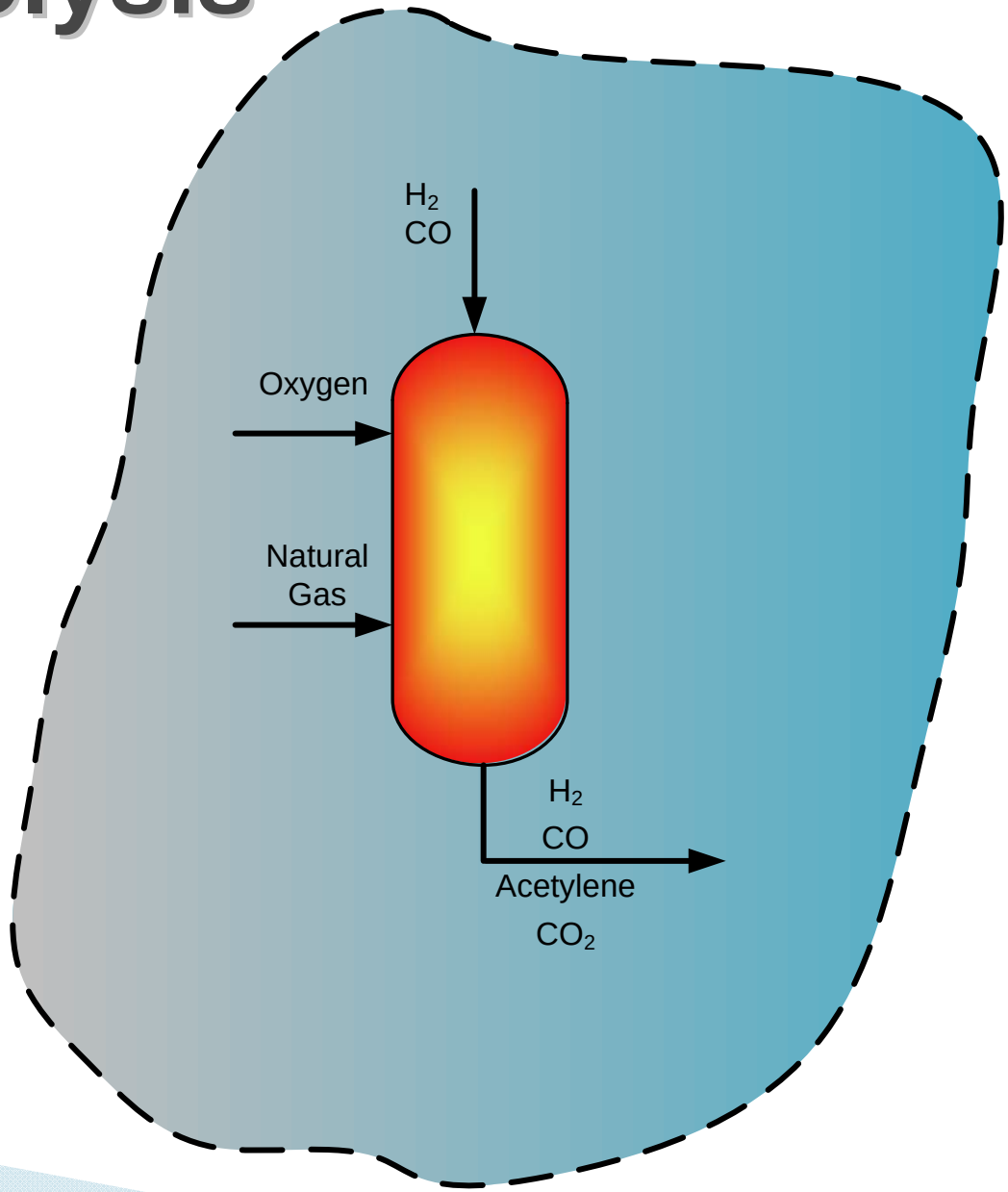
- The Synfuels Pyrolysis Reactor is
  - *Small*
  - Operates at *high temperature*
  - Has *no internal fixtures* or moving parts
  - Constructed from conventional *stainless steel*

- A person can touch the exterior while the interior is at 2500C.



Step 1 - Pyrolysis

Gas To Acetylene (GTA)

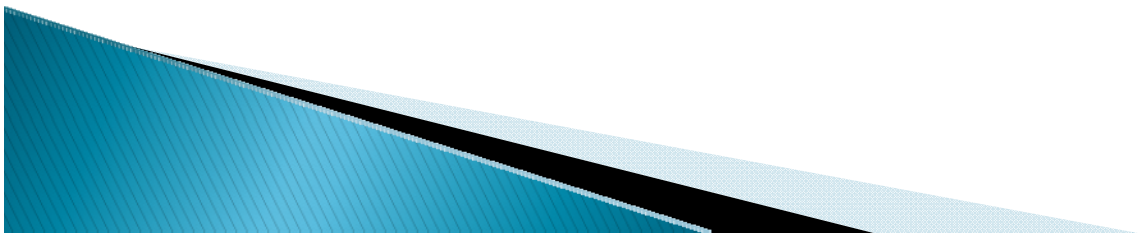


Step 2 - Hydrogenation

- The Hydrogenation reactor converts acetylene to ethylene

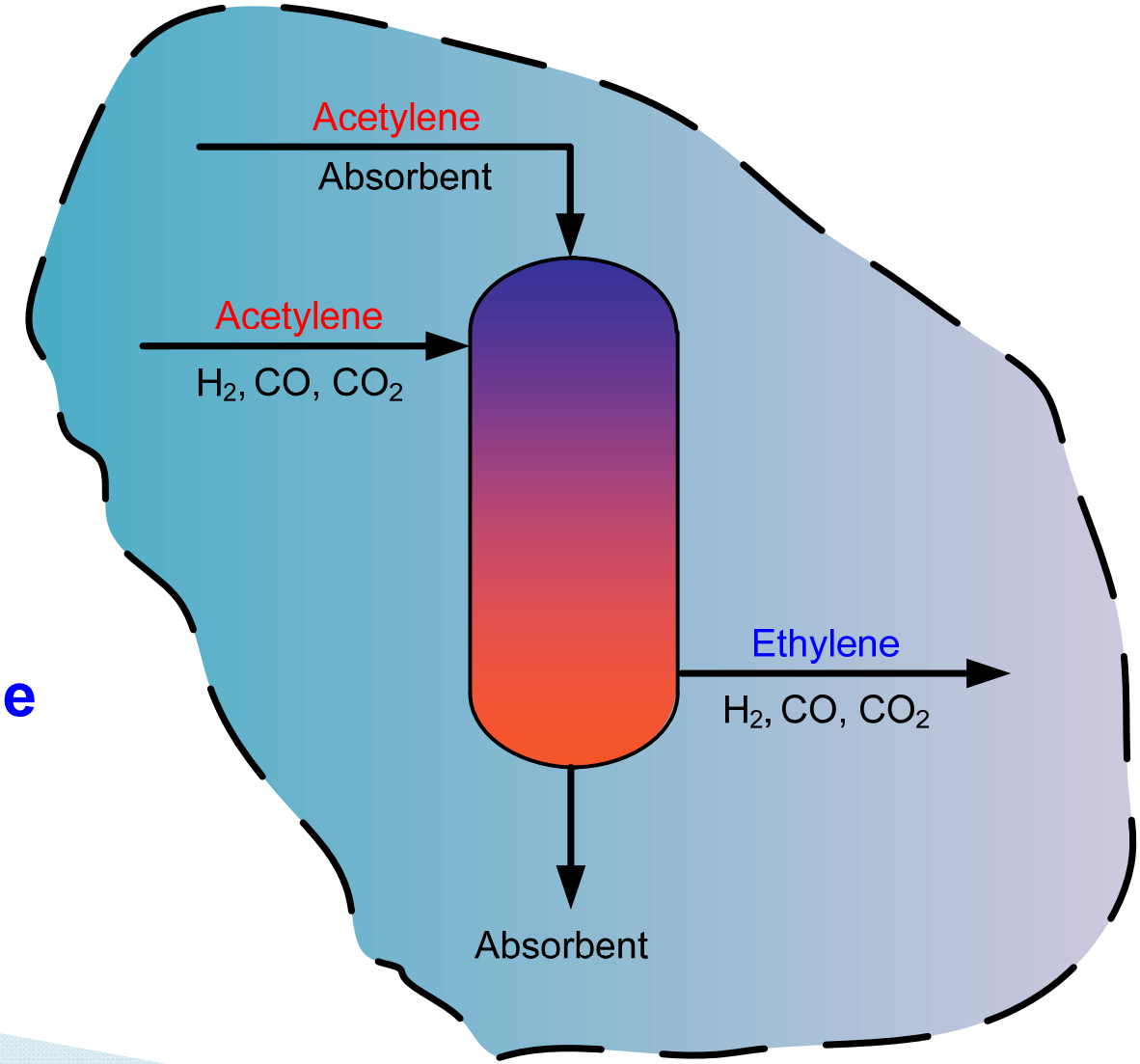
- The Synfuels Hydrogenation Reactor

  - Operates in the *liquid phase*
  - *Precludes thermal runaway*
  - Demonstrates *97% conversion* to ethylene
  - Provides for *easy separation of ethylene*
  - Uses pyrolysis byproduct hydrogen



Step 2 - Hydrogenation

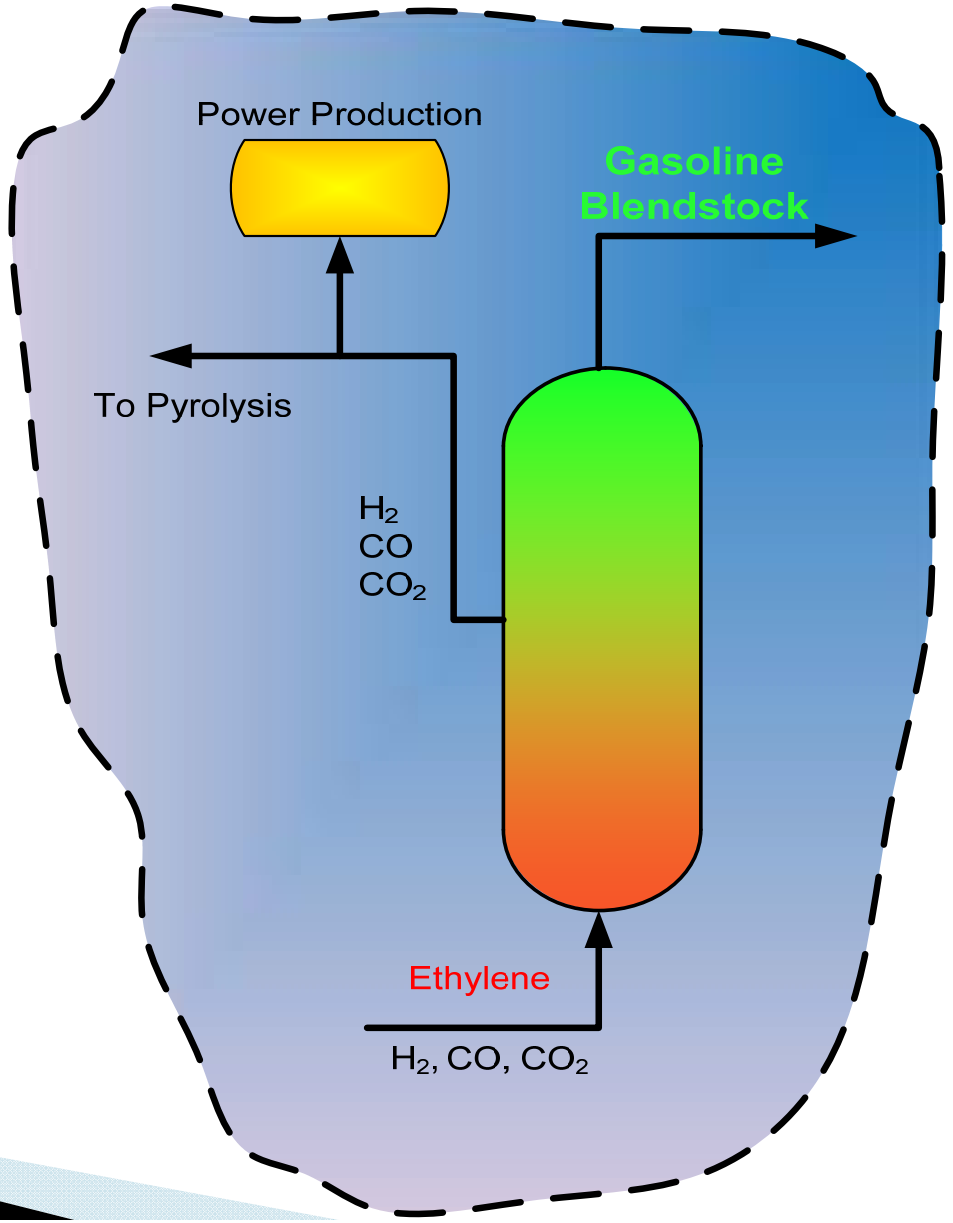
Gas To Ethylene (GTE)



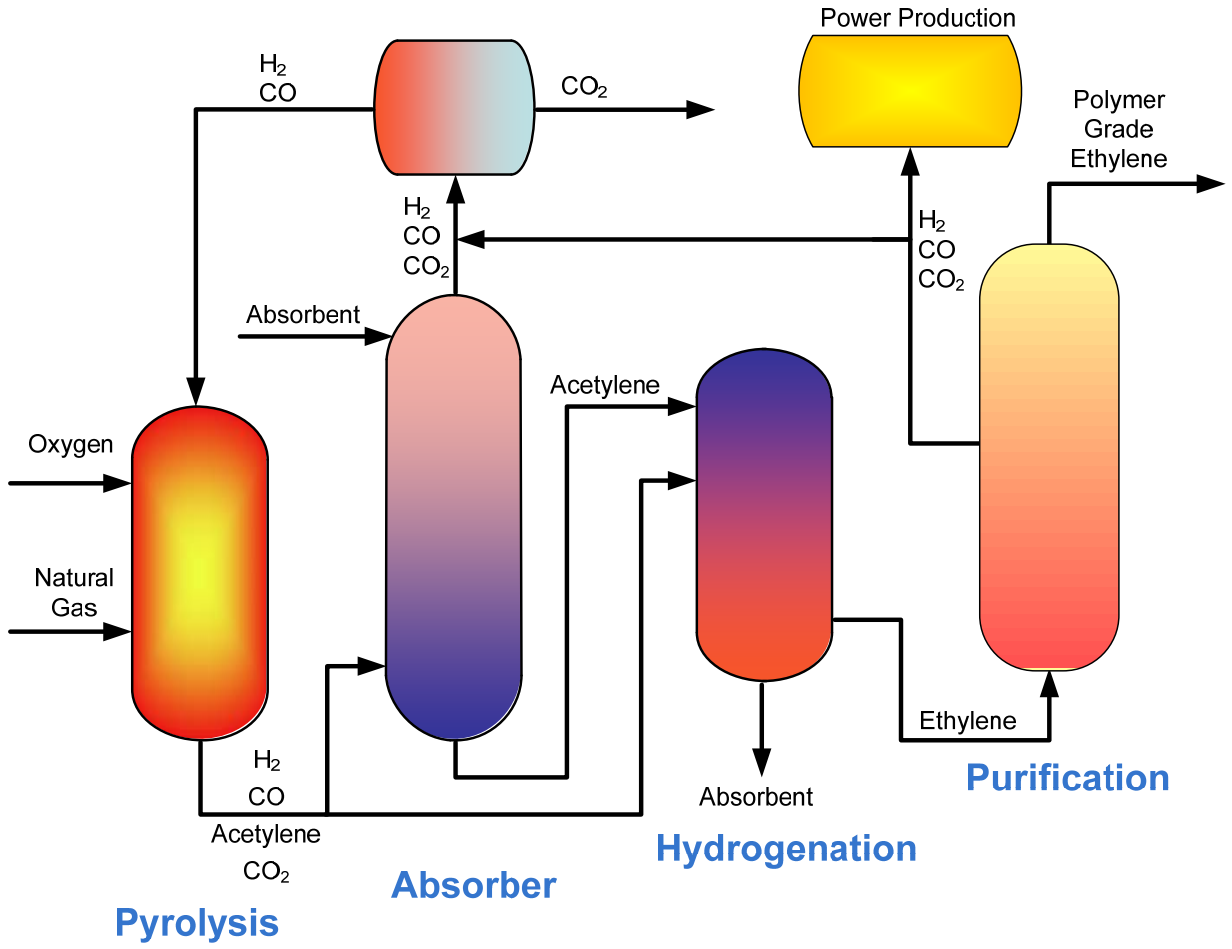
Step 3A - Oligomerization

- The Oligomerization Reactor converts ethylene to gasoline blendstock
- Synfuels Oligomerization Reactor
  - Converts ethylene to heavy hydrocarbons in the presence of CO, CO2, H2 and CH4
  - Utilizes a commercial catalyst

Step 3A - Oligomerization



The Synfuels GTE Process

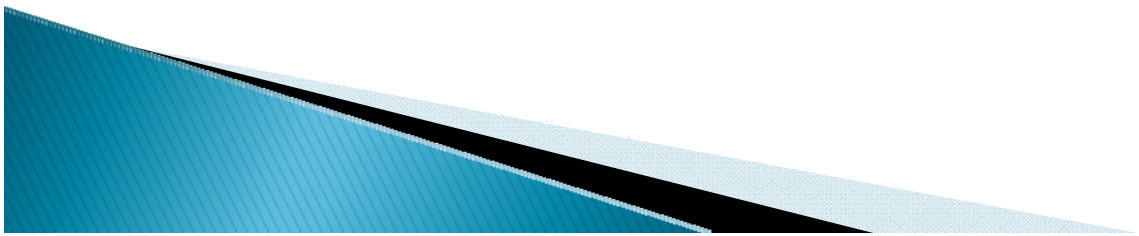


Step 3B - Purification

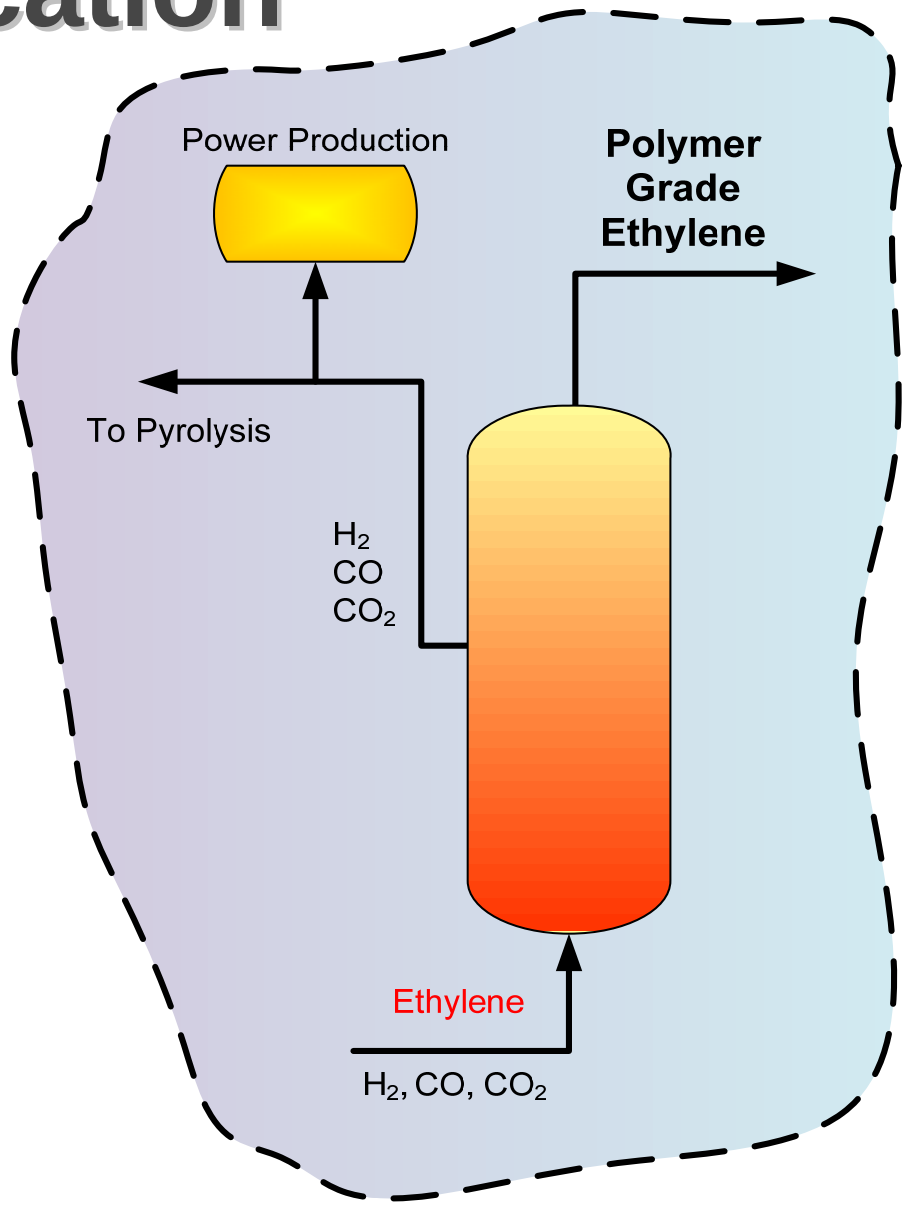
- Ethylene is separated from the other gases and purified to chemical or polymer grade

- Synfuels Purification Process
  - A cryogenic process to make polymer grade ethylene using well known technology

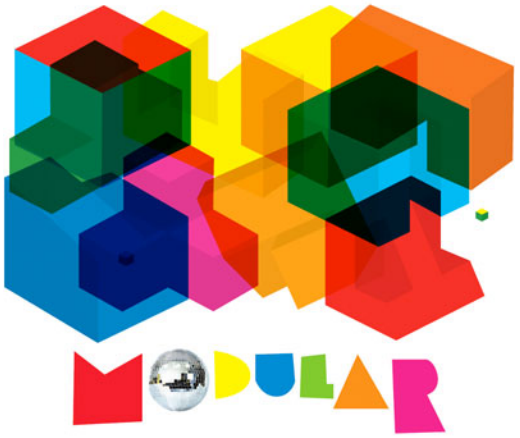
  - Individually separated gases can be used for energy generation or for other chemical processing



Step 3B - Purification



Benefits of Modularization



- Fabrication where skilled craftsmen, complex tools & construction supplies are more available
- Less impact on final project site
- Fewer fitting errors
- Reduced Field work and Elevated Construction
- Faster Construction Problem Correction

Benefits of Modularization

- Easier, more direct procurement
- Reduced site preparation
- Preloading of reactor catalysts
- Easier verification of instrumentation and control viability
- Reduced laydown area and time in field

Mission

- Convert Low Value natural gas to High Value Gasoline Blendstock
  - Nigeria (<$1), US Shale (<$2), CBM ($2 - $4)
- Convert abundant natural gas to High Value Ethylene (>$1000/tonne)
- Reduce gas flaring worldwide
- Add value by effective energy utilization
- Bring unused gas resources to market

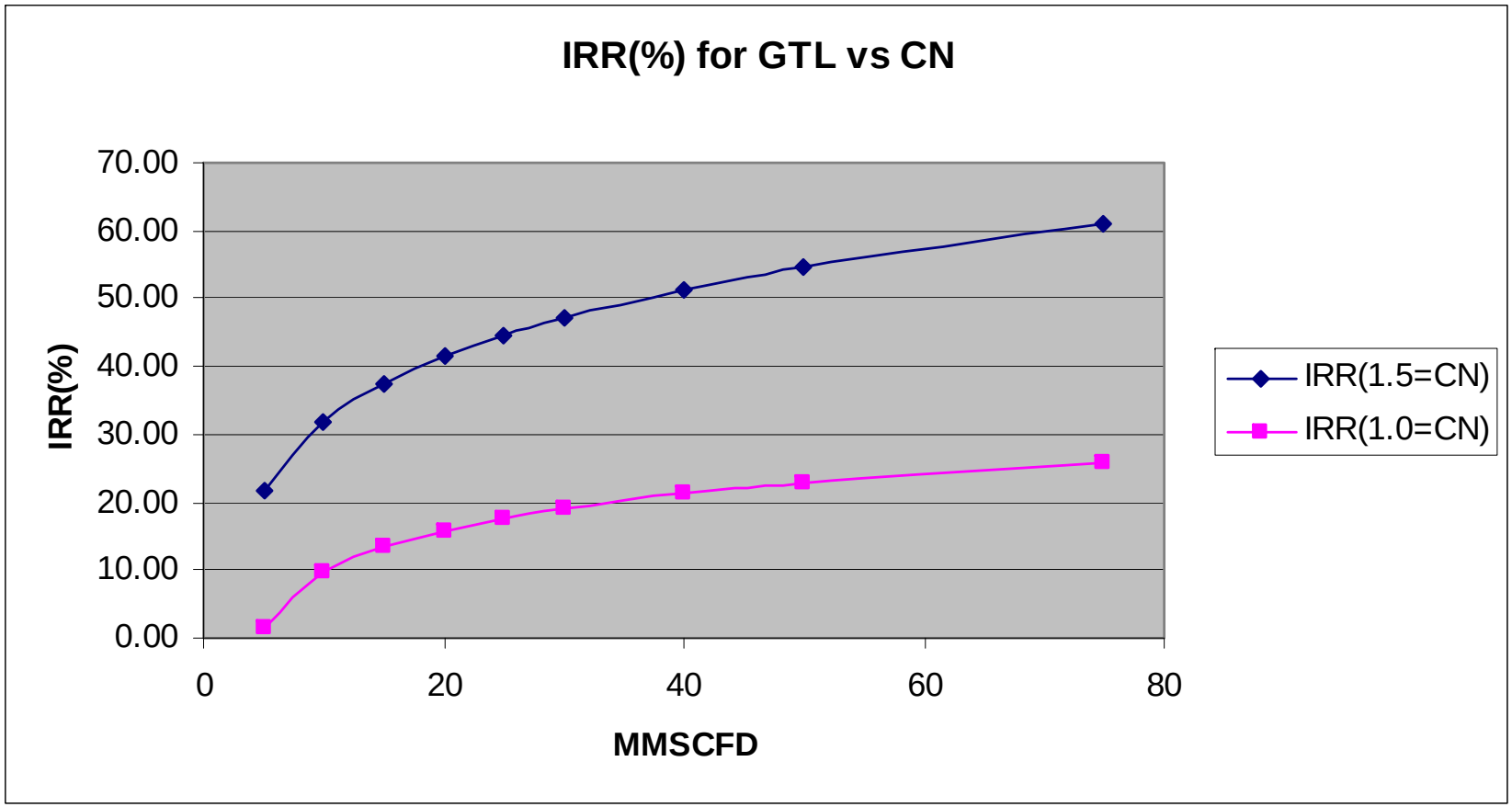
Implementation

- West Africa – Small (10-25 MMSCFD) prefabricated modular plants for fields that have 2-5 years of gas resources
- Offshore Worldwide – Medium (20 – 50 MMSCFD) Ship/Platform based plants processing C1+C2 gas linked to petroleum production
- Large gas fields in remote areas – (50 to 250 MSMCFD) throughout Asia, Africa and South America

Technology

- Small Pyrolysis reactors that are easy to install
- Fixed bed catalyst reactors that operate at moderate pressure and temperature
- Stable, self moderating liquid phase hydrogenation
- Broad range of feedstock gas
- Diverse pure products
- Single pass design

Attractive Economics



Attractive Economics cont.

Gas Cost is $2/MSCF

	GAS FEED RATE (mmscfd)			product value
CN	10	50	200	$/bbl
1	9.23	22.18	32.23	**120**
1.3	24.54	43.79	61.46	
1.6	41.1	69.06	96.06	

	GAS FEED RATE (mmscfd)			
CN	10	50	200	
1		11.17	18.11	**90**
1.3	13.92	28.43	40.57	
1.6	27.02	47.53	66.56	

	GAS FEED RATE (mmscfd)			
CN	10	50	200	
1		4.59	10.32	**75**
1.3	7.92	20.52	30.04	
1.6	19.75	36.72	51.81	

	GAS FEED RATE (mmscfd)			
CN	10	50	200	
1			0.41	**60**
1.3	0.4	12.04	19.18	
1.6	11.97	25.77	37.01	

Gas Cost is $5/MSCF

	GAS FEED RATE (mmscfd)				ethylene value	
CN	10	50	100	200	$/tonne	$/pound
1	12.99	28.04	34.11	40.34	**1500**	0.68
1.3	35.31	60.83	72.61	85.14		
1.6	60.54	99.58	118.27	138.33		

	GAS FEED RATE (mmscfd)					
CN	10	50	100	200		
1	2.37	15.12	19.3	23.35	**1200**	0.54
1.3	22.89	42.13	50.6	59.5		
1.6	43.36	73.16	87.13	102.06		

	GAS FEED RATE (mmscfd)					
CN	10	50	100	200		
1		4.34	7.57	10.35	**990**	0.45
1.3	13.63	28.91	35.13	41.53		
1.6	31.25	54.66	65.34	76.67		

	GAS FEED RATE (mmscfd)					
CN	10	50	100	200		
1					**770**	0.35
1.3	1.62	14.35	18.43	22.37		
1.6	18.13	35.21	42.48	50.06		

*Values in Chart are %IRR

Partnerships

- TAMU - gave Synfuels access to novel process and patents
- AREF - provides marketing access to MENA countries for production
- Byogy – uses Synfuels oligomerization technology to biofuels production
- Major E&C Firms – brings excellent world wide reputation in engineering, construction, marketing and project management