

Methanol Industry Overview Equatorial Guinea Experience Prospects For Offshore Methanol

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Solutions For Flaring & Venting – Session A

The Big Scale

Methanol



- **Speaker Biography**

- John Roscoe has worked for Marathon Oil Company since 1986. He has worked on onshore and offshore upstream oil and gas production projects as well as subsea production technology development. Since 2002, he has worked for Marathon's Gas Utilization Team on gas conversion technology development / deployment.
- John Roscoe was previously employed by Davy and Capital Plant International



- Abstract

- The methanol industry is founded on well established technologies available from a number of experienced licensors. World methanol consumption has grown steadily during recent years, and there are prospects of enhanced use in the future. Onshore methanol production has been successfully applied as a gas monetization / flare reduction measure in Equatorial Guinea. There is growing interest in the application of offshore methanol production, with a number of FEED programs expected to commence in 2007.

- Methanol Industry Overview

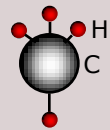
- Methanol is feedstock versatile – can be produced from any carbon source via reforming / gasification:
 - **Natural gas**
 - Hydrocarbon Liquids / Residues
 - Coal
 - Biomass
- Methanol is a versatile product – single molecule - easily aggregated - easily transportable as a liquid - multiple uses in petrochemicals sector – prospects for enhanced use
- Although flammable and toxic, methanol disperses readily, and is rapidly biodegraded in the environment
- Some downsides – conversion energy losses, bulky energy carrier, and high capital intensity, like other gas monetization options

- Methanol Industry Overview

Methane Overall Reaction



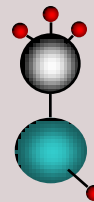
Actual reaction is multi-step



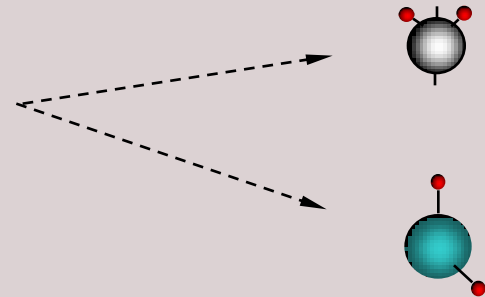
Methane from Natural Gas



Oxygen from Air or Steam



Methanol Product



Methane [Gas]	0.891	GJ / kg-mol HHV
Methanol [Liquid]	0.727	GJ / kg-mol HHV

*Can also think of methanol as:
44 % w hydrocarbon
56 % w water*

Theoretical Maximum Thermal Efficiency = 82 % HHV

Practical thermal efficiency limit ~ 65 % HHV because carbon conversion efficiency < 100%.

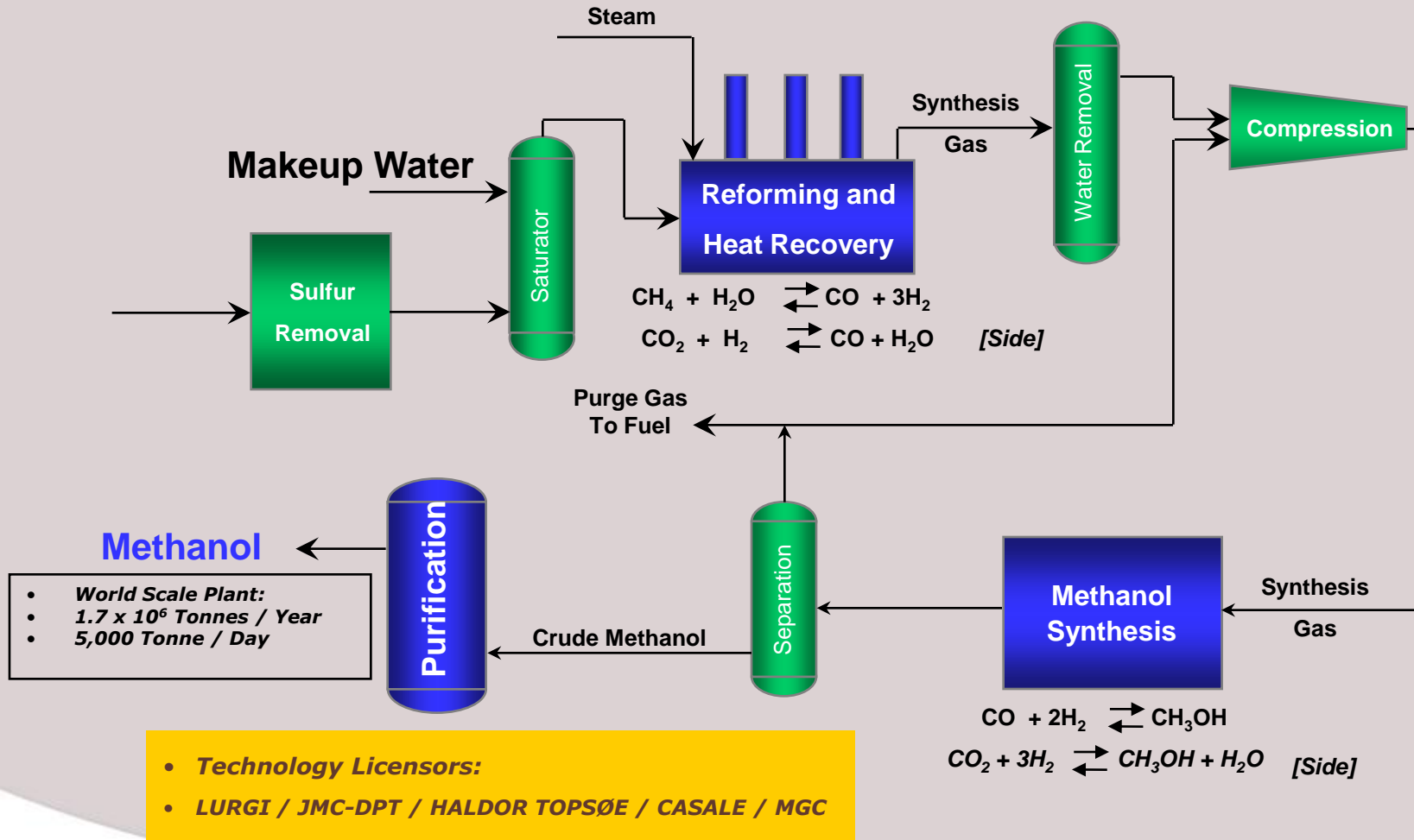
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- Simplified Process Schematic
– Steam Methane Reforming [SMR]



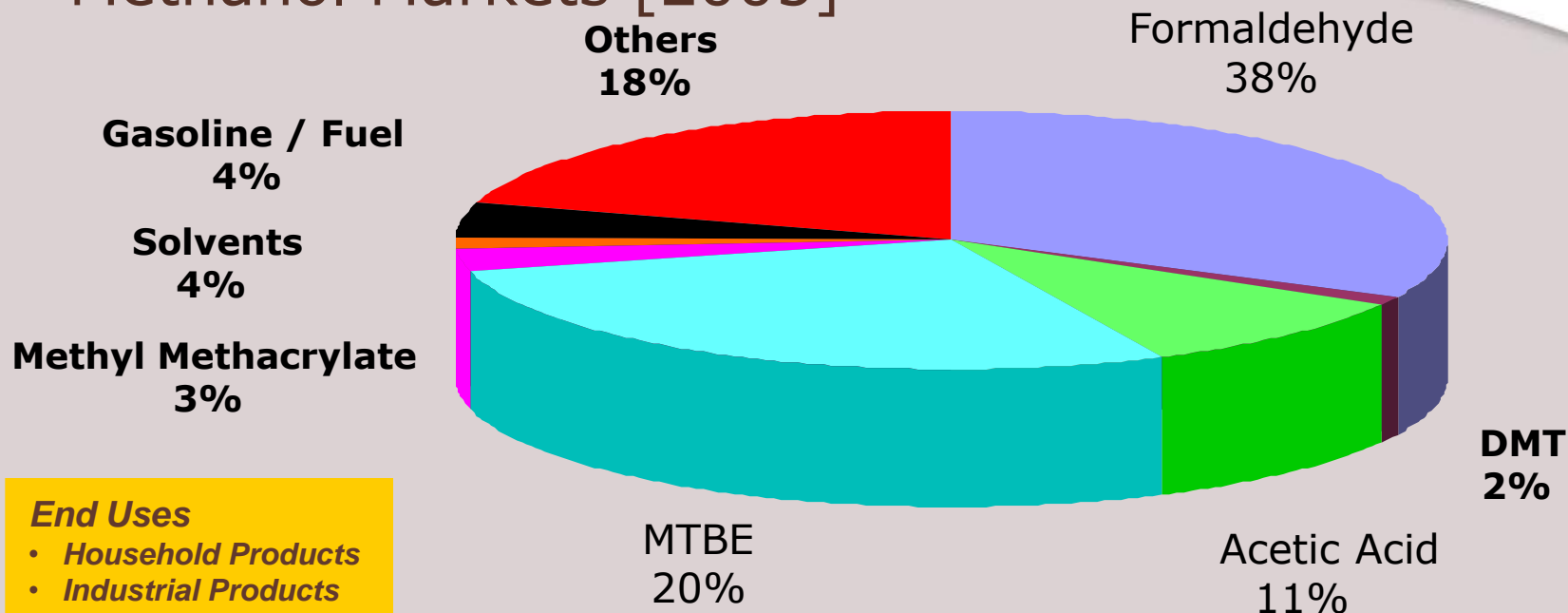
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• Methanol Markets [2005]



End Uses

- Household Products
- Industrial Products
- Fuels

Formaldehyde



MDF
Plywood

Acetic Acid



Paints
Adhesives

Dimethyl
Terephthalate



PET bottles

Methyl
Methacrylate



Clear acrylic
panels

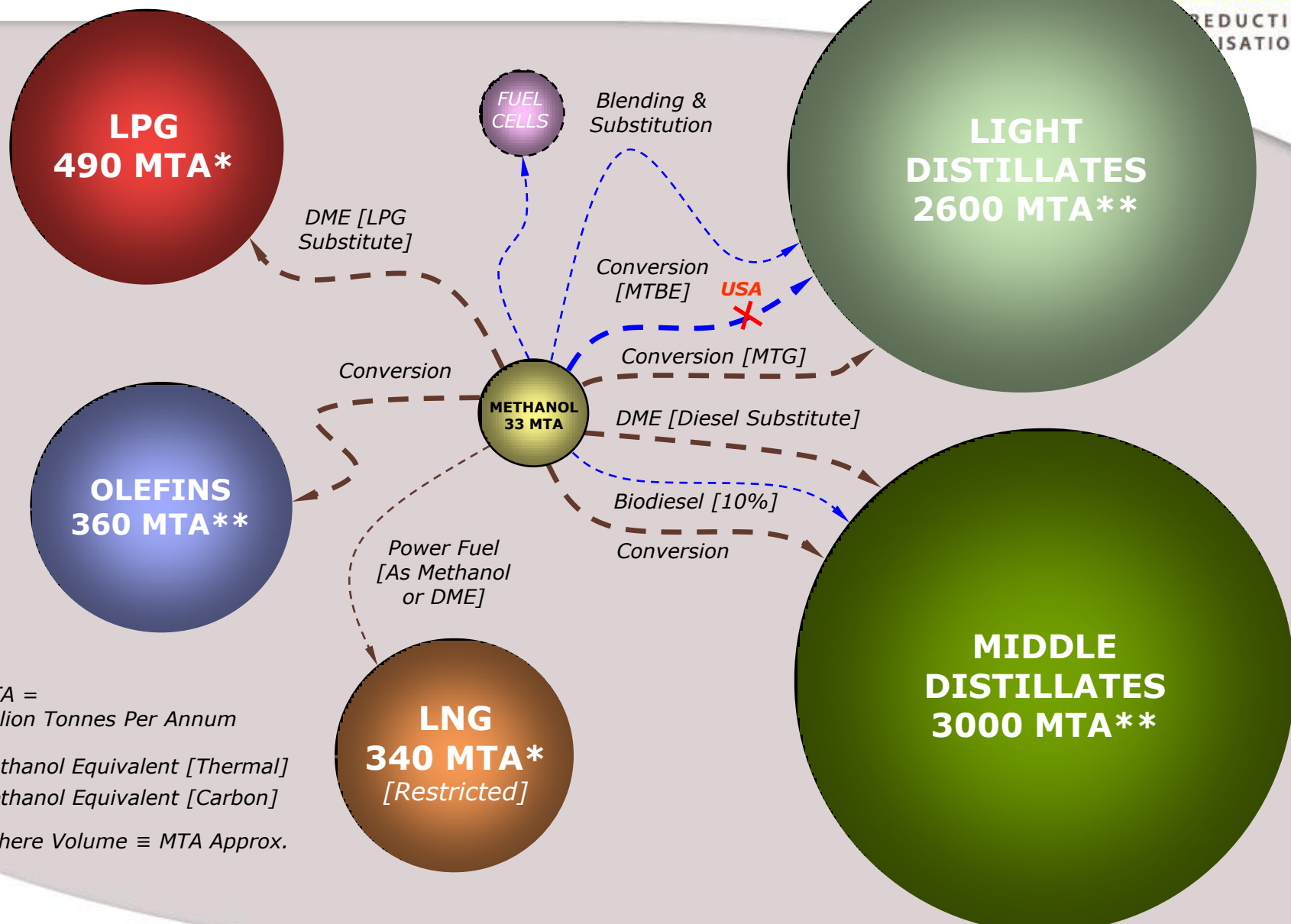
Methyl Chloride



Silicones

- Worldwide Capacity = 39.4 MTY
- Worldwide Demand = 33.1 MTY
- Capacity Utilization = 84%
- Market Growth ~ 2 – 3 % \equiv 1 World Scale Plant Every 2 Years

Methanol Future Prospects



MTA =
Million Tonnes Per Annum

* Methanol Equivalent [Thermal]

** Methanol Equivalent [Carbon]

Sphere Volume \equiv MTA Approx.

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- Methanol Economic Prospects

$$\text{Net Margin} = \text{Product Slate Value} - \text{Supply Chain Costs} - \text{Feedstock Costs} \pm \text{Incentives Burdens}$$

Per unit of feedstock – applies to all conversion steps

EPC + Owner CAPEX: ~ \$ 450 - 500 / annual tonne methanol [West Africa 2006]

OPEX + Transportation: ~ \$ 50 - 70 / tonne – excluding natural gas feedstock

Alternative refinery feedstock: ~ \$ 50 - 60 / bbl crude oil → \$ 167 - 200 / tonne methanol

Given high methanol prices - may as well stop conversion process at methanol

Given high natural gas prices - LNG yields better returns for large reserve bases

However – there are methanol opportunities for smaller / incremental / developing reserve bases, or higher value product slates [i.e. including olefins], or in gas rich / liquids poor regions ... and the future will depend on the crude oil / gas price ratio

Equatorial Guinea Experience

LNG Jetty

Methanol Tank Farm

Tanker Mooring Area

Methanol Plant

Balance of Facilities

- Pipelines
- Liquids Recovery
- Gas Processing
- Liquids Storage

Construction Dock [New]

Construction Dock [Original]

LNG Plant 3.7×10^6 Tonnes / Year
[Under Construction]



- AMPCO Methanol Plant Punta Europa
 - Gas Utilization / Flaring Reduction Project
 - Start-up - May 2001
 - Joint Ownership: SONAGAS / MARATHON / NOBLE
 - Production $\sim 1 \times 10^6$ tonnes / year
 - Approx. 3% world market
 - Primary markets – Europe and USA
 - Three vessels under long term charter
 - Cumulative avoided CO₂ emissions > 10×10^6 Tonnes [2006]



- AMPCO – Future Plans
 - Capacity Expansions
 - Phase 1 - 2006
 - 10% increase
 - Add pre-reformer
 - Modify methanol loop / distillation section
 - Phase 2 – Under Evaluation - 2008
 - 5% increase
 - CO2 recovery from LNG plant for use as co-feedstock
- Continued National Workforce Development
 - Established Technical Training Center in Malabo
 - OJT / safety / specialized training / progressive integration
 - Successful templates for future use

- Prospects for offshore Methanol

Reference: "Offshore Methanol Production Nearing Reality", Peter Roberts, Johnson Matthey Catalysts

- Drivers

- Avoidance of flaring / gas injection
- Offshore = source of low priced feedstock
- Process tolerant of CO₂ in feed natural gas
- Potential for asset reuse

- Enablers

- Marinization of production technology
- Compact reforming / methanol synthesis technology

- Offshore Considerations

- Field life / profile / compositional variations
- Process design versus space & weight versus gas consumption
- Fixed or floating platform
- Product specification / transportation / aggregation
- HES / RAM

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- Prospects For Offshore Methanol
 - Compact Reforming - SMR

CONVENTIONAL SMR

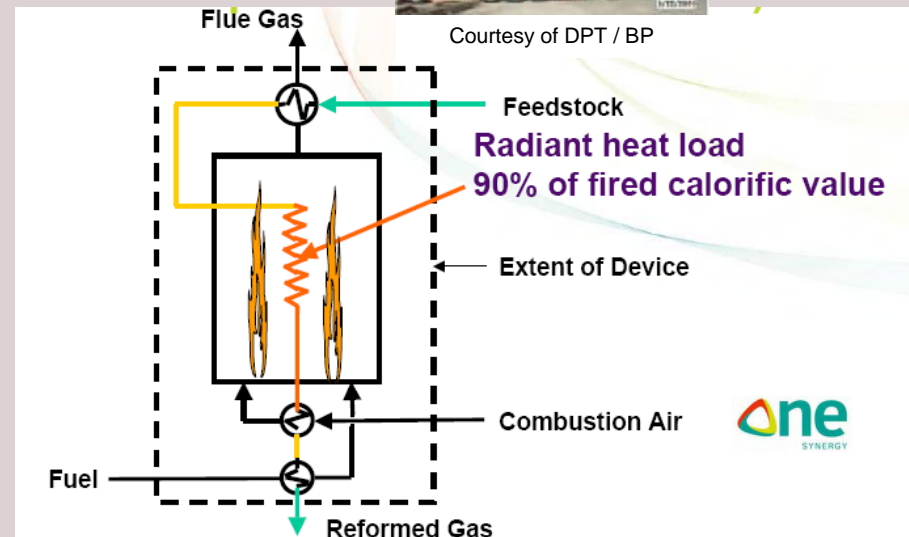


M5000 Steam Reformer - courtesy of MHTL

- **Field fabricated**
- **Heavy / large footprint**
- **Motion sensitive**
- **Associated steam generation**



COMPACT SMR



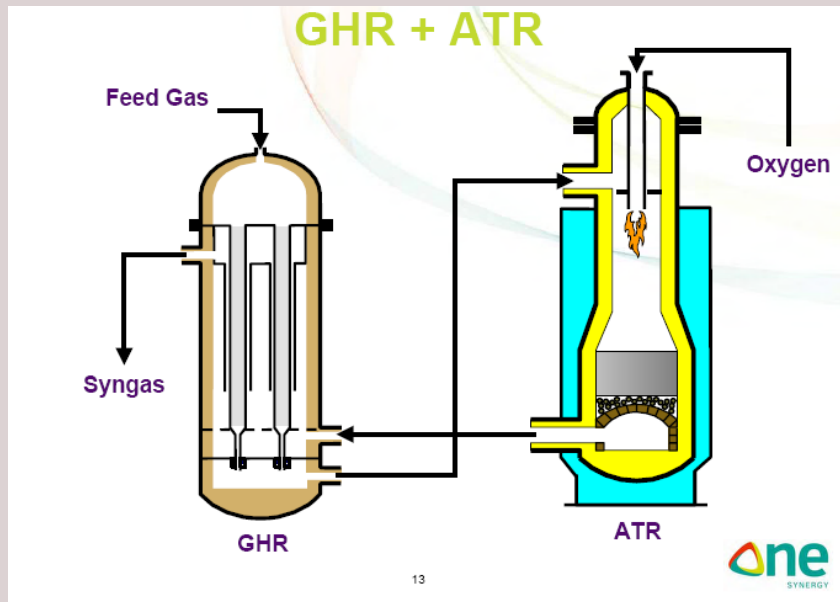
- **Modular, shop fabricated**
- **75% reduction in weight / footprint**
- **Rugged**
- **Elimination of steam generation**
- **Demonstration program in Alaska – ongoing since 2003**

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- Prospects For Offshore Methanol
 - Compact Reforming – Oxygen blown



- High process efficiency
 - Less compact
 - Elimination of steam generation
 - Low water consumption
 - Commercial demonstration unit 230 tonne / day – in operation since 1998
- Offshore ASU
 - Technically viable
 - Risk mitigation required
 - Other key issues = certification, insurance, and financing

- Prospects For Offshore Methanol
 - Methanol Synthesis

Tube/Gas Cooled Reactor

- Commercially proven
- Cheaper loop with heat transfer and reaction combined
- Simple internals are non pressure bearing
- Near Isothermal catalyst temperature profile => low catalyst volume
- Single reactor for 2,500 T/D
- Easy catalyst loading and discharge
- Easy control by inlet temperature
- DPT new loop concept intensification



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- Prospects For Offshore Methanol
 - Australia



Courtesy of Methanol Australia



Courtesy of Coogee Resources

- Methanol Australia
 - Location = Tassie Shoal
 - Fixed platform
 - Capacity 5,000 tonne / day
 - CO₂ co-feedstock from adjacent LNG project
 - Reserve definition ongoing
 - Total investment ~ \$ 1.0 billion
 - FEED expected to commence 2007
- Coogee Resources
 - Location = Timor Sea
 - FPSO
 - Capacity 4,000 tonne / day
 - Coogee Resources is operator of GHR / ATR
 - Total investment ~ \$ 0.9 billion
 - FEED expected to commence 2007

- Methanol - Summary

- Established technology / experienced licensors
- Versatile - feedstocks / product / derivatives
- Prospects for enhanced product utilization
- Successful technology deployment for gas monetization / flaring reduction onshore Equatorial Guinea
- Offshore methanol production in view – with an initial focus on gas monetization

***THANK YOU FOR YOUR KIND
ATTENTION***