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energy for the future

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Stepping Stones to FLNG – The Tassie Shoal Project

Australasian FLNG/FPSO Forum

Perth, 21-22 September 2009

Onshore LNG liquefaction

"Size matters" *

- Why? – because projects include:
  - Separate upstream production facilities
  - Pipelines to shore
  - Land access costs
  - Major environmental footprint
  - Site preparation
  - Rock art relocation
  - Australian fabrication costs
  - Remote locations
  - Site restoration costs

- **Economies of scale are essential to make them attractive**

* D. Voelte - UBS Australian Resources and Energy Conference, 19 June 2009, Sydney

FLNG is a great idea

(that's why we're here)

- Why? – because projects **Exclude**:
  - Separate upstream production facilities
  - Pipelines to shore
  - Land access costs
  - Major environmental footprint
  - Site preparation
  - Rock art relocation
  - Australian fabrication costs
  - Remote locations
  - Site restoration costs

Image courtesy of SMBLinde

Plus:

- Technically achievable
- Economically attractive
- Mitigate resource risk (because they can be moved)

So why aren't any operating yet?

"Intellectuals solve problems....." - A. Einstein

Since the '80s the industry has been overcoming:

- Movement Issues:
  - Processing equipment
  - Storage sloshing
  - Offloading challenges
  - Large gas swivel
- Proximity of staffing
- Infrastructure expandability
  - Leveraging resource growth
  - Capturing economies of scale
- Costs

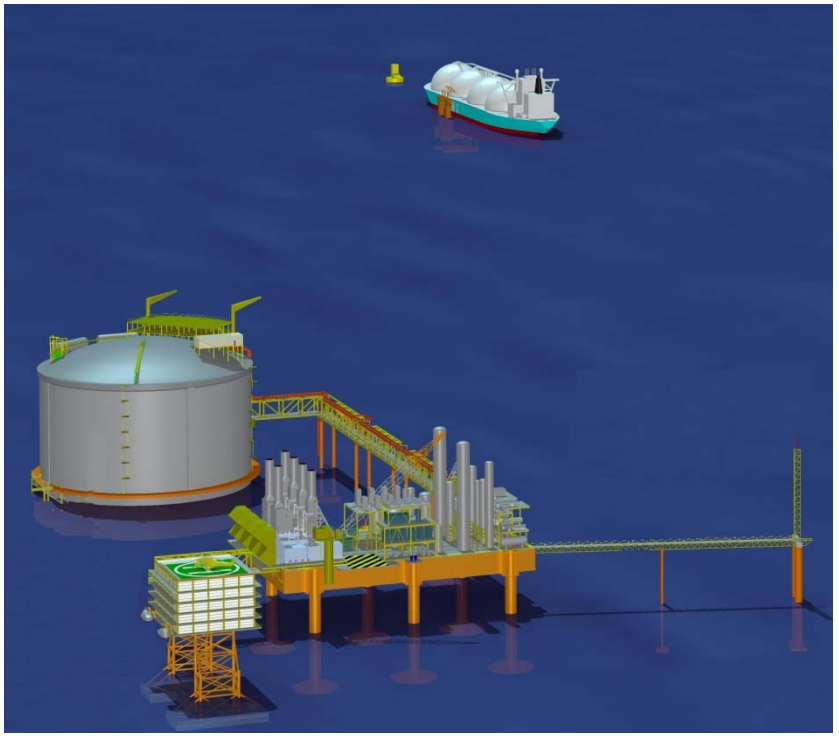
- **BUT** – the industry is poised for breakthrough

FLNG is not the only great idea

"Intellectuals solve problems, geniuses avoid them" - A. Einstein

An alternative niche idea:

- ~~Movement Issues:~~
  - ~~Processing equipment~~ ✓ Avoid
  - ~~Storage sloshing~~ ✓ Avoid
  - ~~Offloading challenges~~ ✓ Solve
  - ~~Large gas swivel~~ ✓ Avoid
- ~~Proximity of staffing~~ ✓ Avoid
- Infrastructure expandability ✓Allow
  - Leverages resource growth ✓Allow
  - Captures economies of scale ✓Allow
- Costs ✓Reduce

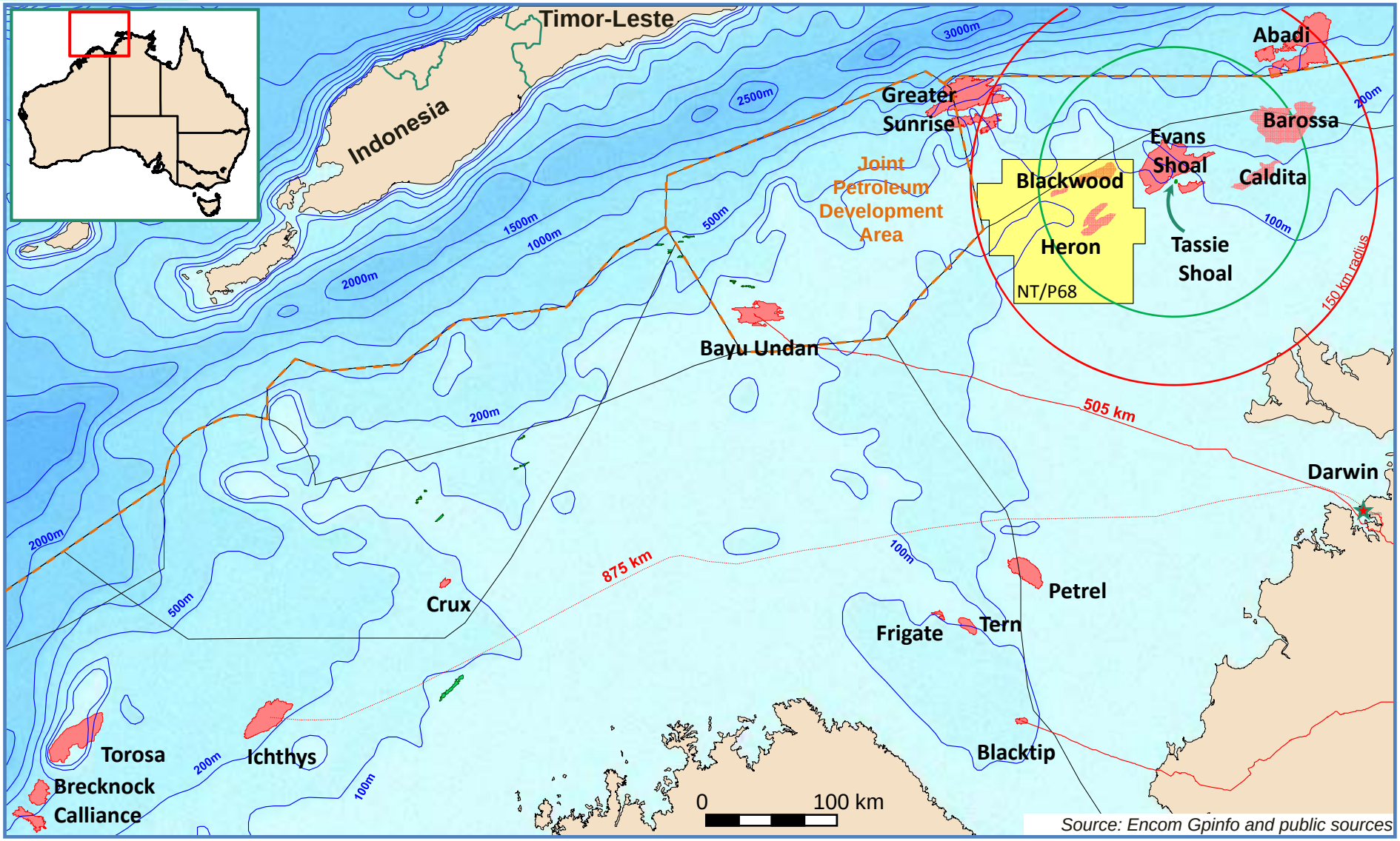


Timor Sea LNG Project

at Tassie Shoal

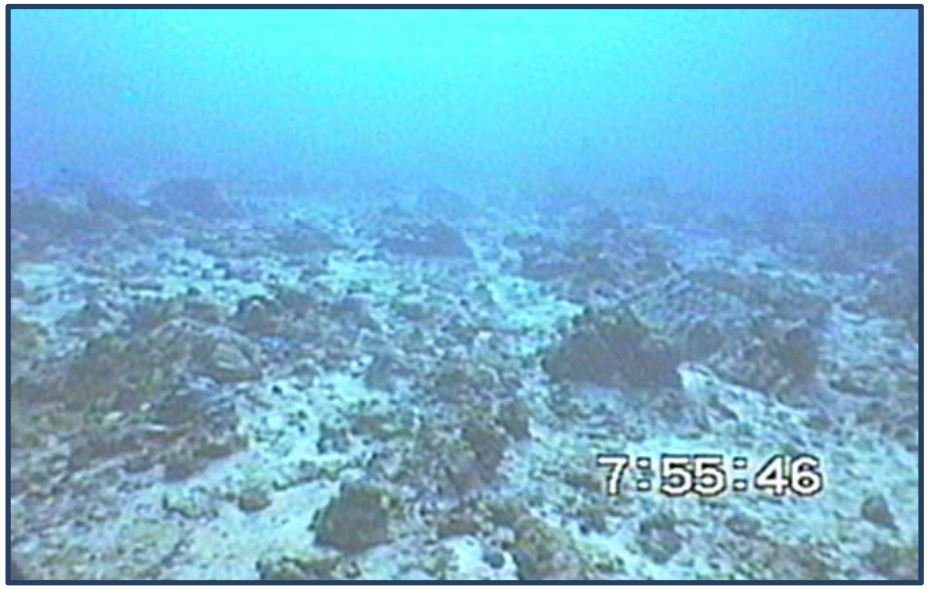
Tassie Shoal Location

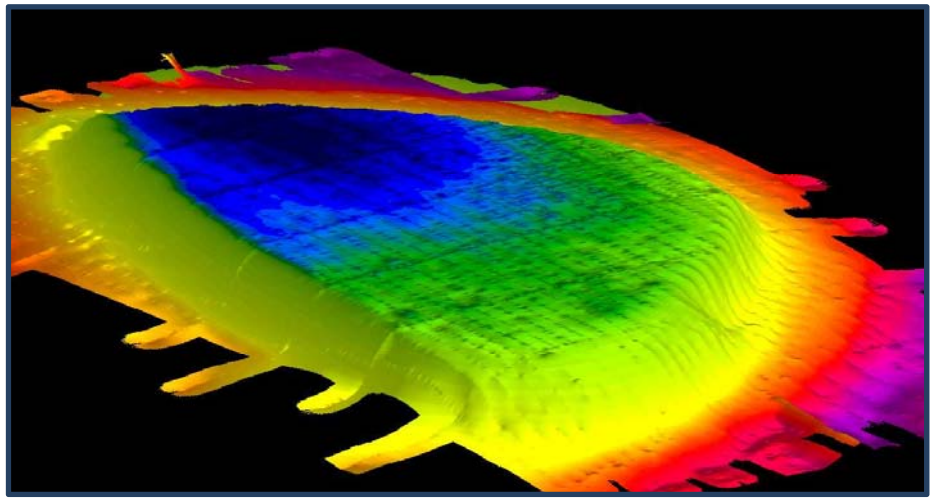
Centrally located amongst several undeveloped gas fields

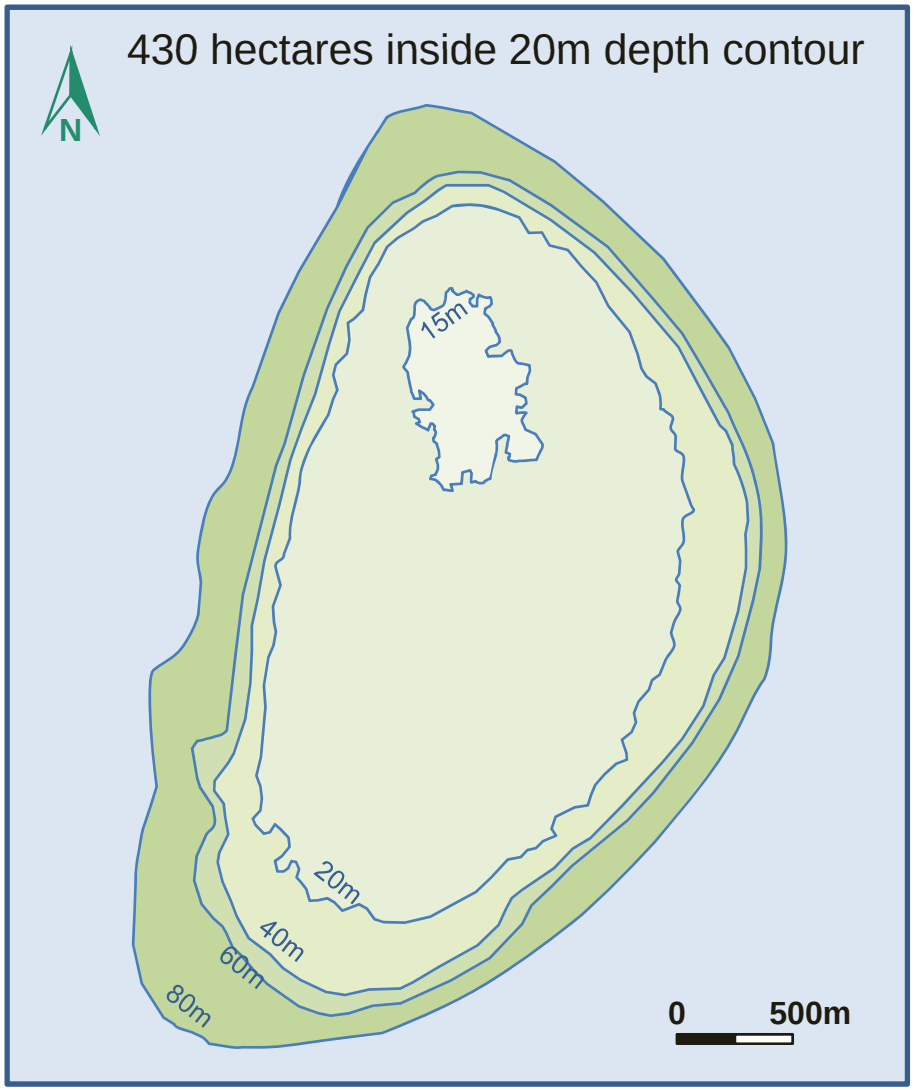


Tassie Shoal

430 hectares of prime real estate

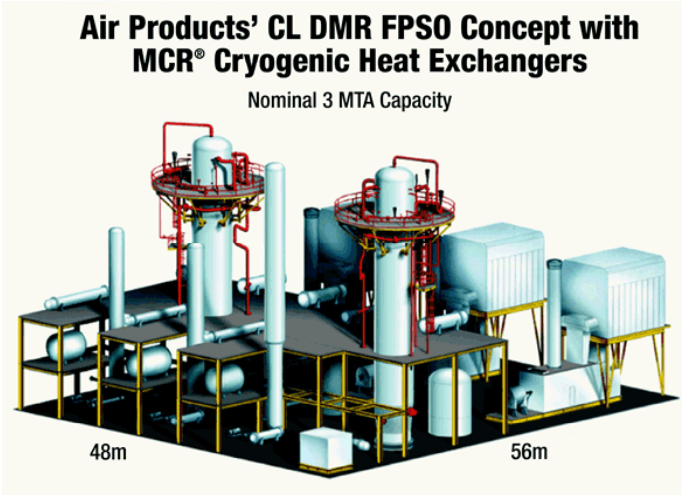






The LNG Plant

Combination of two established designs



Air Products/Aker Kvaerner 1990's Concept

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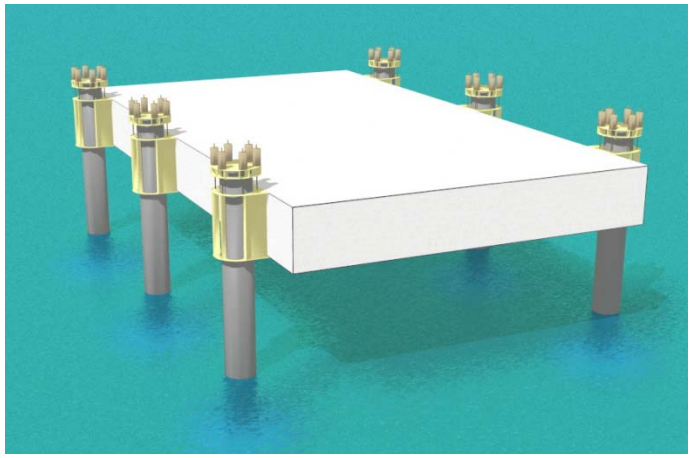

Arup Concept Elevating (ACE) Platform

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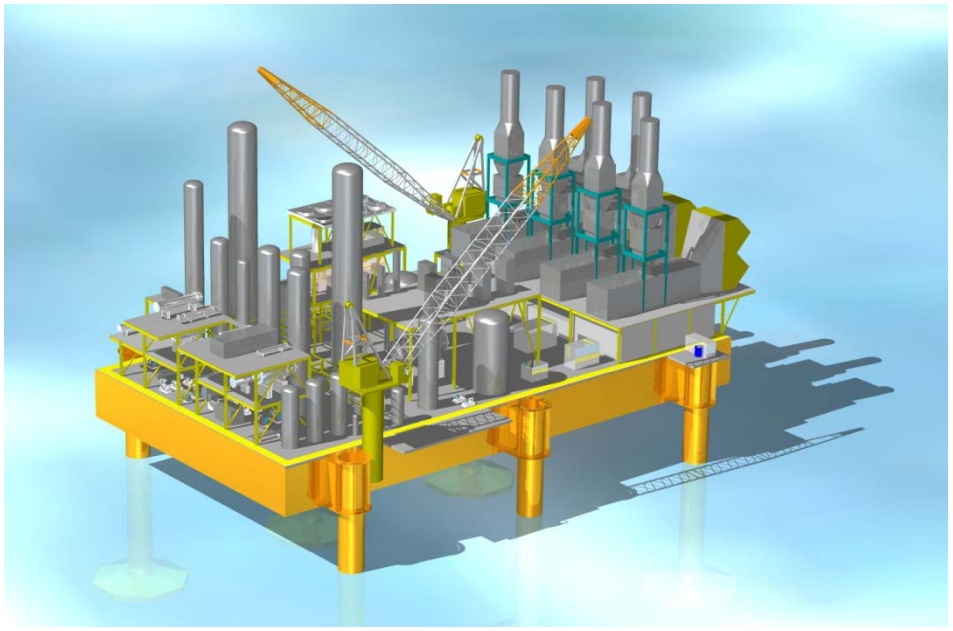

Timor Sea LNG Plant

Timor Sea LNG Project

One module

A NWS Train 5 (4.4 Mtpa) module.
Pluto I (4.3 Mtpa) has **264 modules.**

Darwin LNG Plant (3.7 Mtpa)
Timor Sea LNG Plant (3.0 Mtpa) at same scale – **1 module**

- Plant to be fabricated and pre-commissioned at SE Asian location and delivered as **one entire module**
- Indirect seawater cooling using of compact exchangers
  - up to 1/25th plot area of air coolers

170,000 m³ LNG Storage

Combination of two proven technologies

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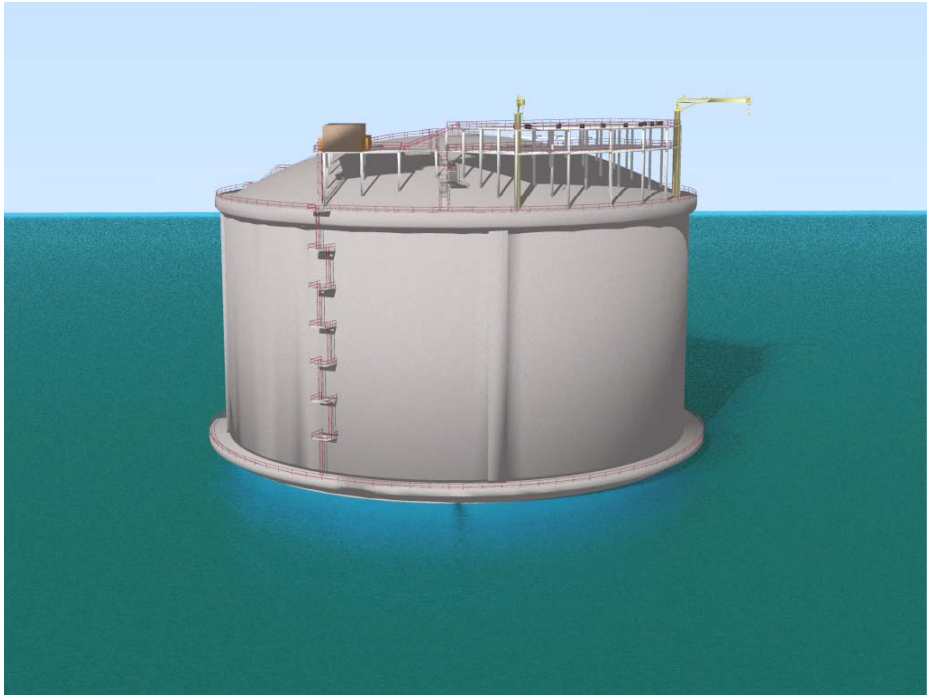
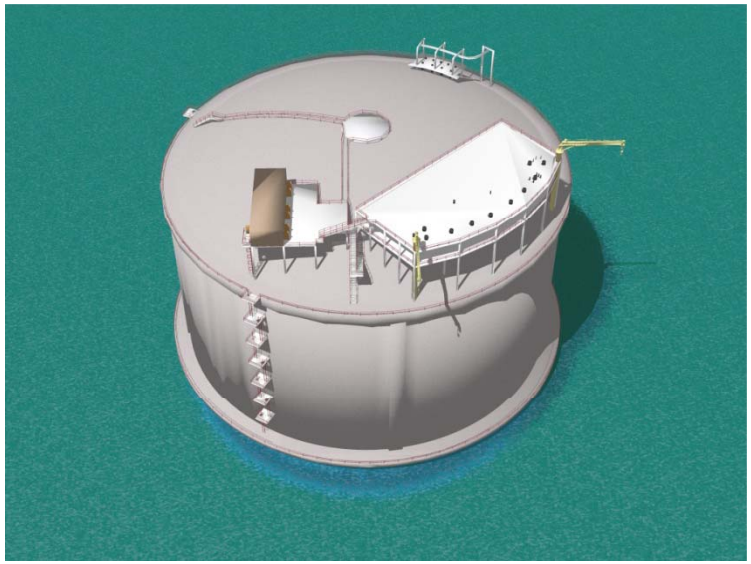
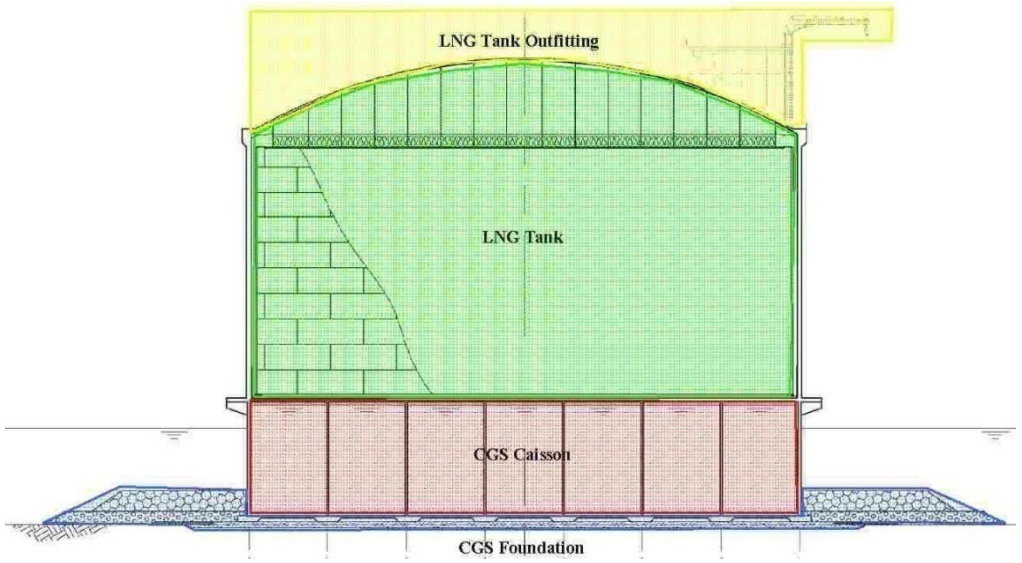


170,000 m³ LNG Storage

Capacity for additional plant at Tassie Shoal





- ArupEnergy Design optimised via secondary follow-up study
- Conventional secondary containment tank on concrete GBS caisson
- Conventional 9% nickel steel LNG tank inside
- Small topside included on tank for LNG handling and export systems
- Water ballast within the CGS caisson for offshore foundation stability

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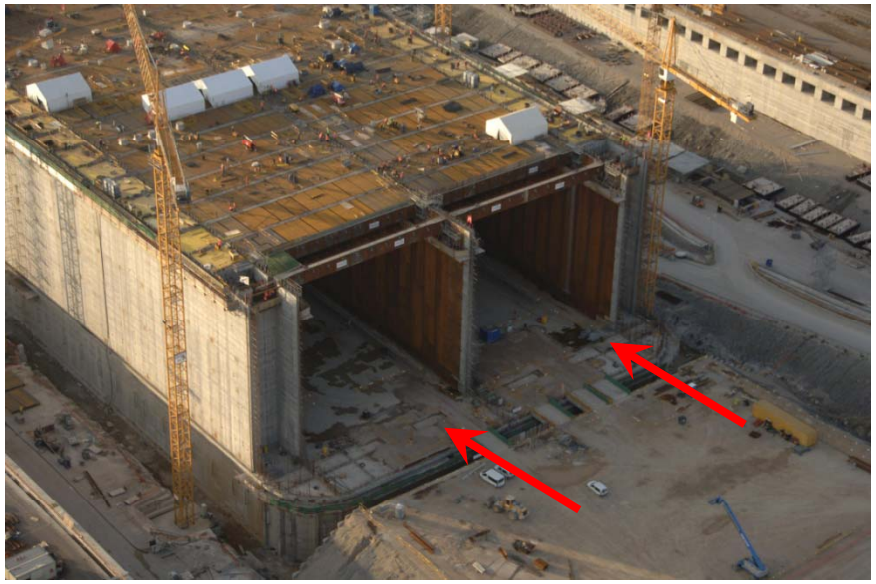
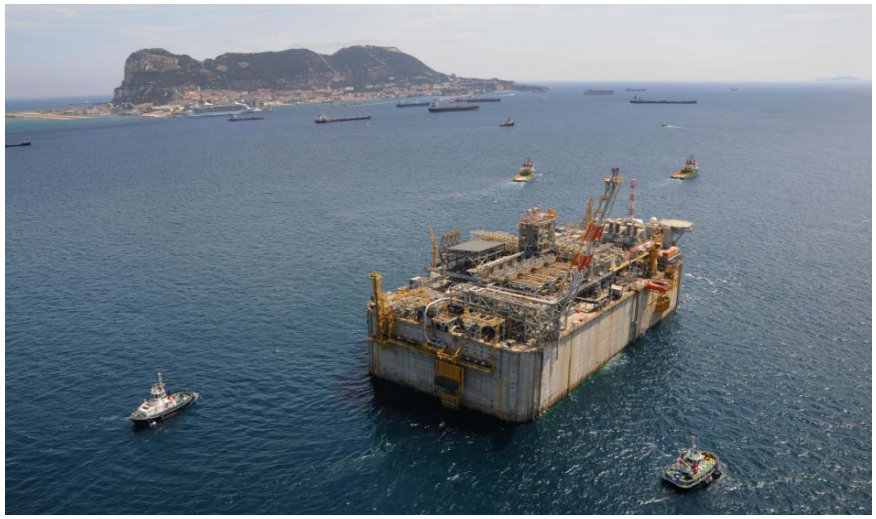
Timor Sea LNG Project

LNG Storage

LNG Storage on a GBS

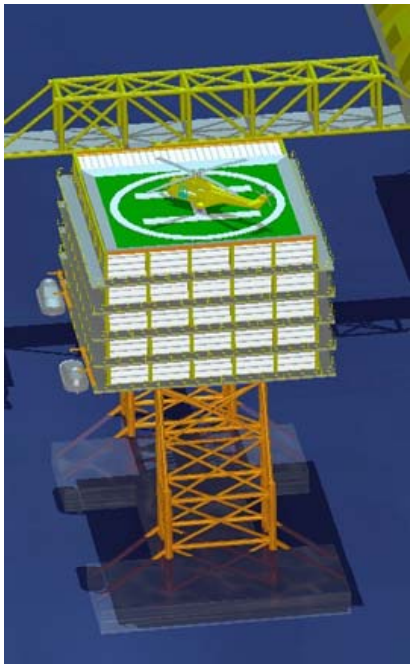
ExxonMobil Adriatic re-gas terminal





Accommodation and Control Platform

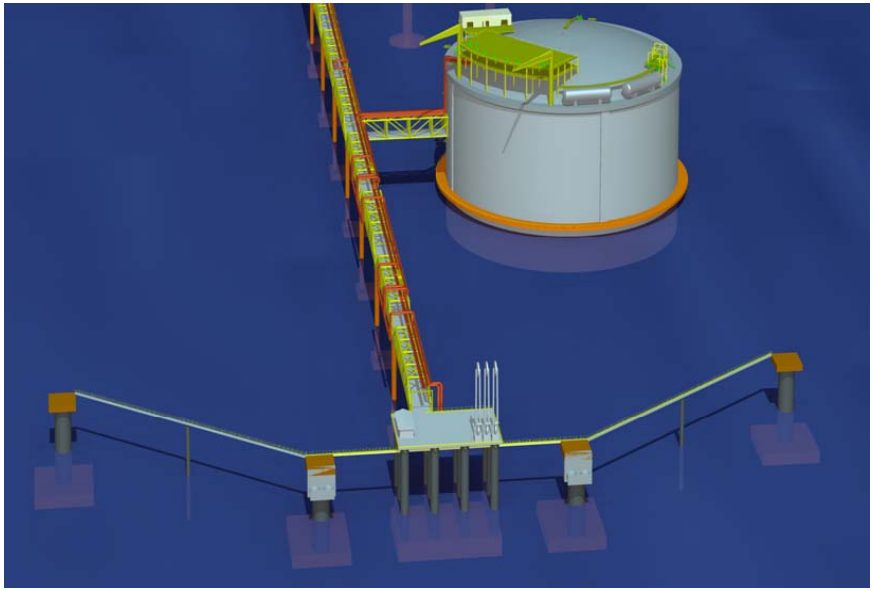
Separate from plant and storage

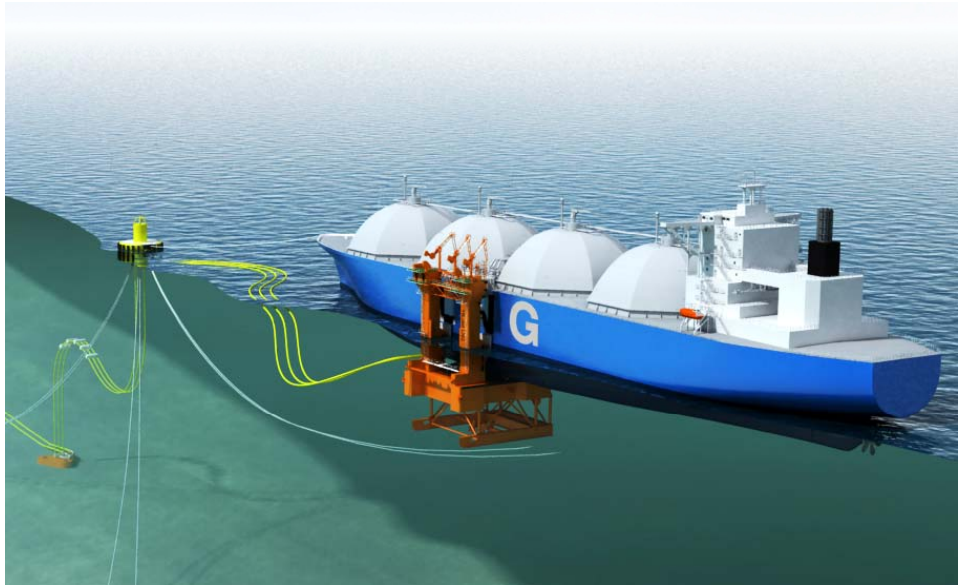


- Bridge connected to production/processing plant
- Float over or ACE platform selection to be made during FEED

Load-out Options

Conventional or TORP HiLoad





- Initial studies based on conventional loading jetty
- TORP HiLoad is preferred option:
  - Avoids close proximity of vessels to plant and storage
  - Can connect to any standard carrier without modification
  - Avoids requirement for tugs on location
  - Is independent of tides, currents or weather
  - Net cost saving over project life

>US$1bn capex saving vs onshore plant

Study compared like for like

Estimated costs (US$M)	Darwin LNG	Tassie Shoal LNG	Potential Savings
Plant Costs	1,549 (WorleyParsons est)	1,090 (WorleyParsons est)	459
Pipeline *	943 (WorleyParsons data)	288 (WorleyParsons data)	655
LNG Tank	300 (MEO est)	330 (Arup est)	(30)
Loadout/Jetty	200 (MEO est)	277 (TORP est)	(77)
Project Development & Owners Costs (6.25%)	188 (same % as TSLNGP)	106 (Fluor/APCI/MEO est)	82
Total Project Cost	$3,180m	$2,091m	$1,089m

- WorleyParsons prepared detailed cost estimates for LNG Plant at Tassie Shoal
- Commissioned to compare costs for functionally similar LNG liquefaction plant at Darwin
- Plant costs savings driven by higher Australian construction costs vs SE Asian construction and commissioning
- Pipeline savings are distance based

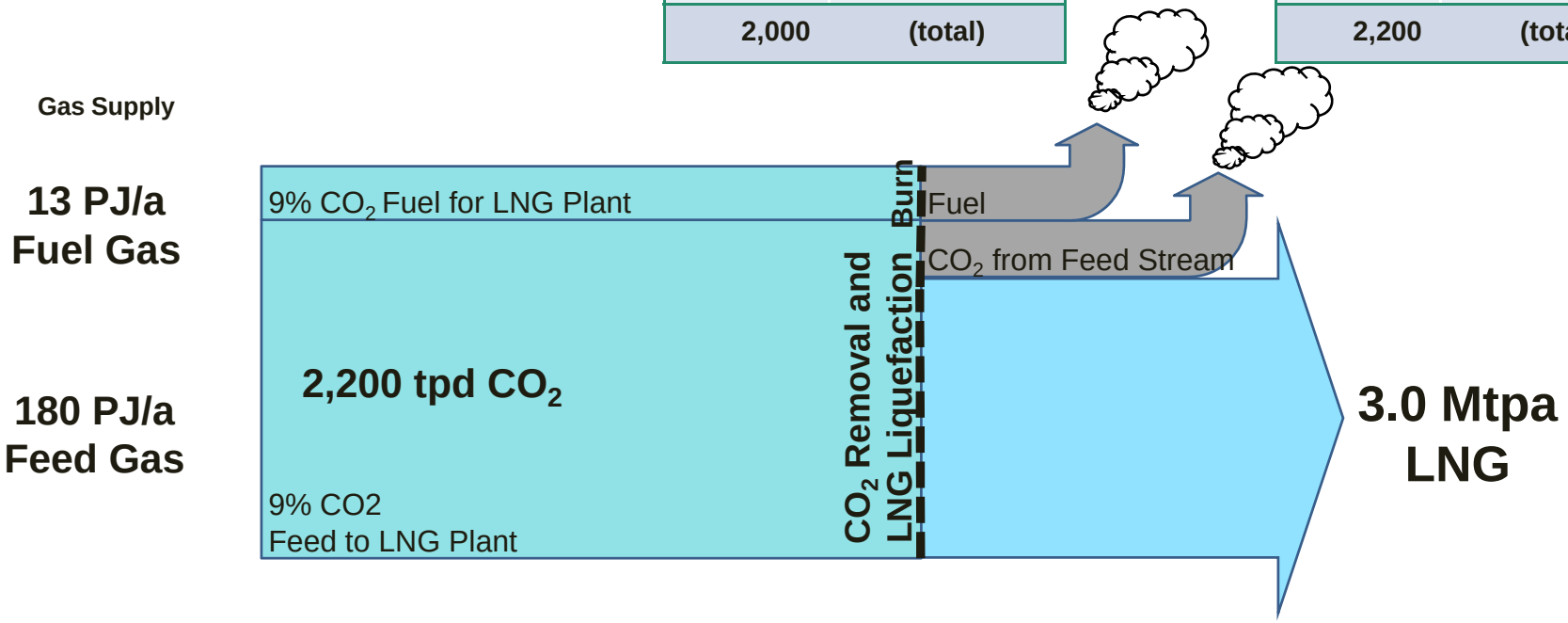
* Based on pipeline from Greater Sunrise to Darwin vs Greater Sunrise to Tassie Shoal

What about CO_2?

"The forgotten challenge" *

tpd CO_2	Source
170	(carried)
1,830	(combustion)
2,000	(total)

tpd CO_2	Source
2,200	(carried)
0	(combustion)
2,200	(total)

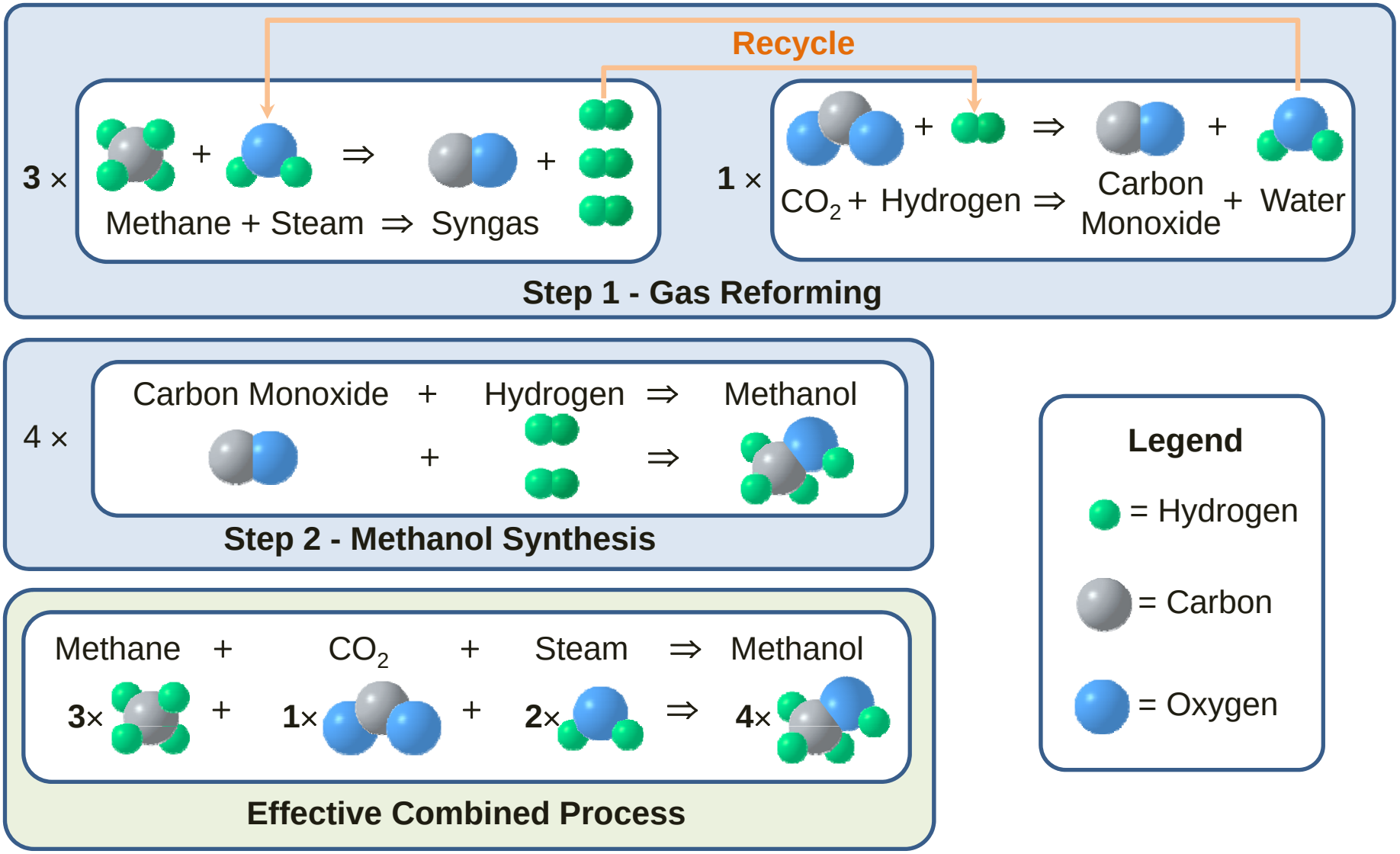


- FLNG motion impacts effectiveness of CO_2 removal processes *
- CO_2 disposal is an issue in light of climate change / CPRS
- Tassie Shoal Project solves both problems

* A.M. Tan, BASF 16 July 2008

Chemical sequestration of CO_2

Alchemy

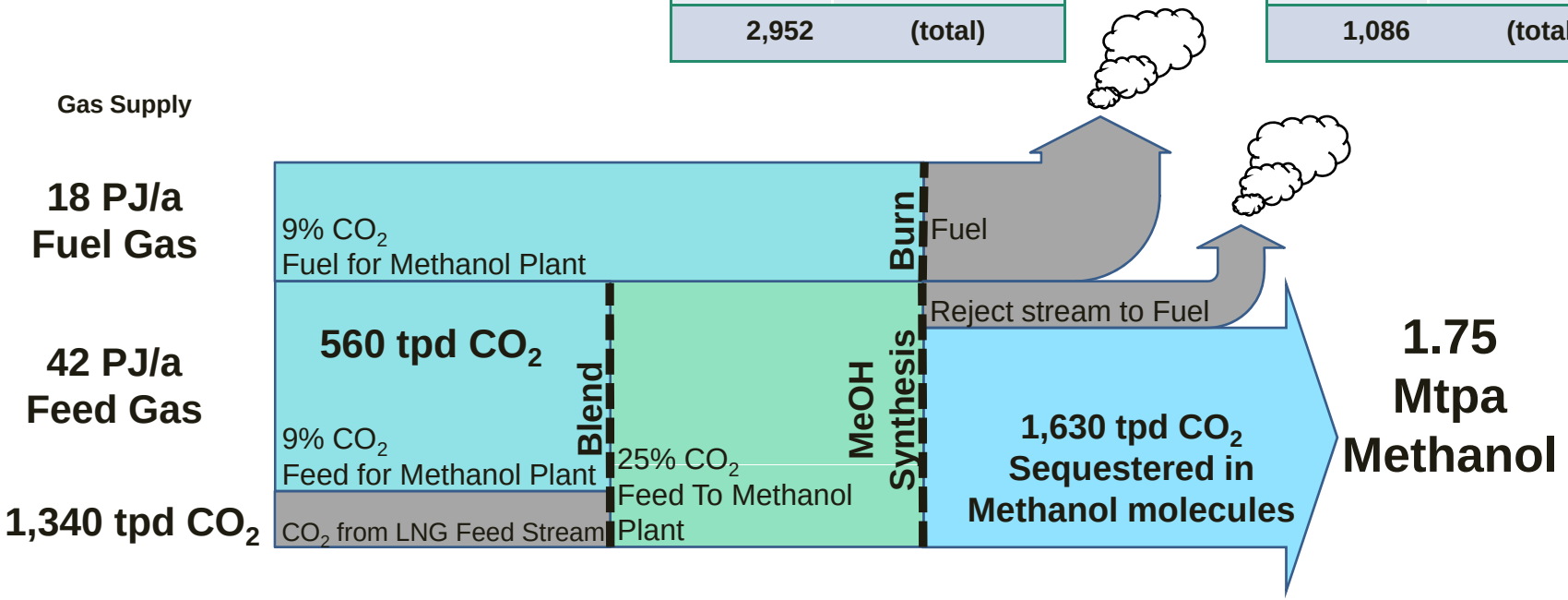


CO_2 sequestration into methanol

Achieves lower CO_2 intensity than geo-sequestration

tpd CO_2	Source
249	(carried)
2,703	(combustion)
2,952	(total)

tpd CO_2	Source
270	(carried)
816	(combustion)
1,086	(total)



- Gorgon LNG based on 9% CO_2 gas with geo-sequestration = **0.35 tCO_2/tLNG ***
- Single Methanol Plant = **0.33 tCO_2/tLNG**
- Chinese coal based methanol production is swing producer and emits >1.7 times CO_2 per tonne of methanol compared with MEO proposed process
- Up to 80% of methanol ends up in chemically inert products (resins, MDF, glues, plastics etc)

* (Source: Gorgon EIS)

Methanol plant on concrete GBS

Combination of two proven technologies

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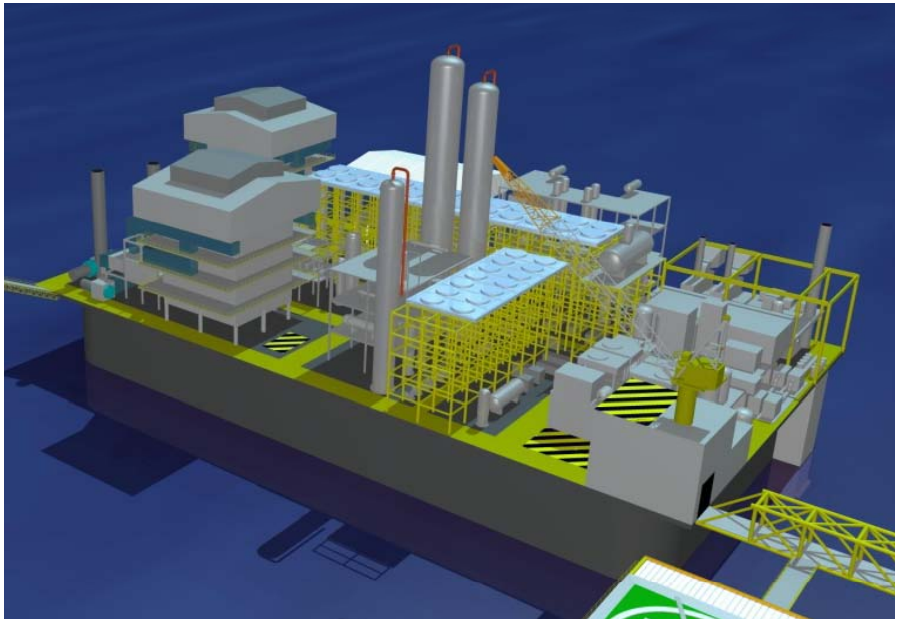
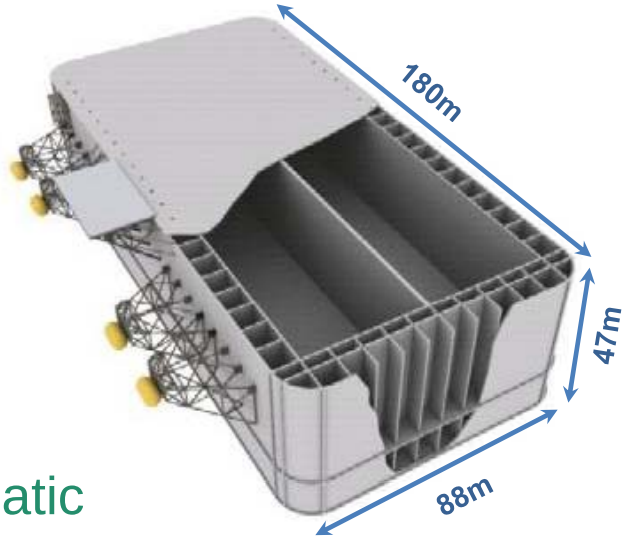


- Plant based on Davy Process Technology M5000 plant operating in Trinidad

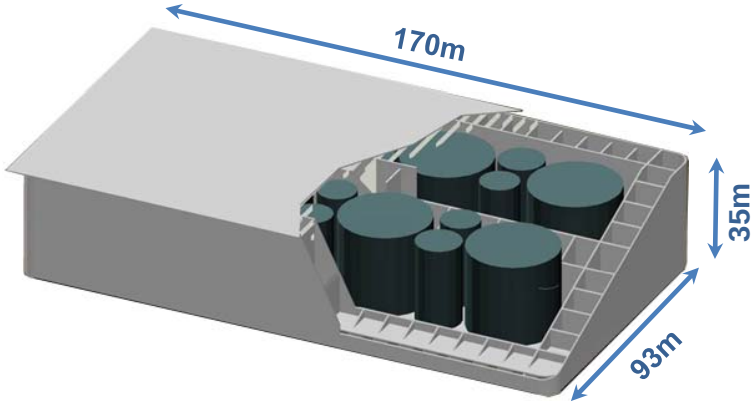
- GBS builds on the lessons of ExxonMobil's Adriatic Re-gas terminal

Concrete GBS with internal storage

ExxonMobil Adriatic re-gas terminal



Adriatic



Tassie Shoal Methanol Plant GBS

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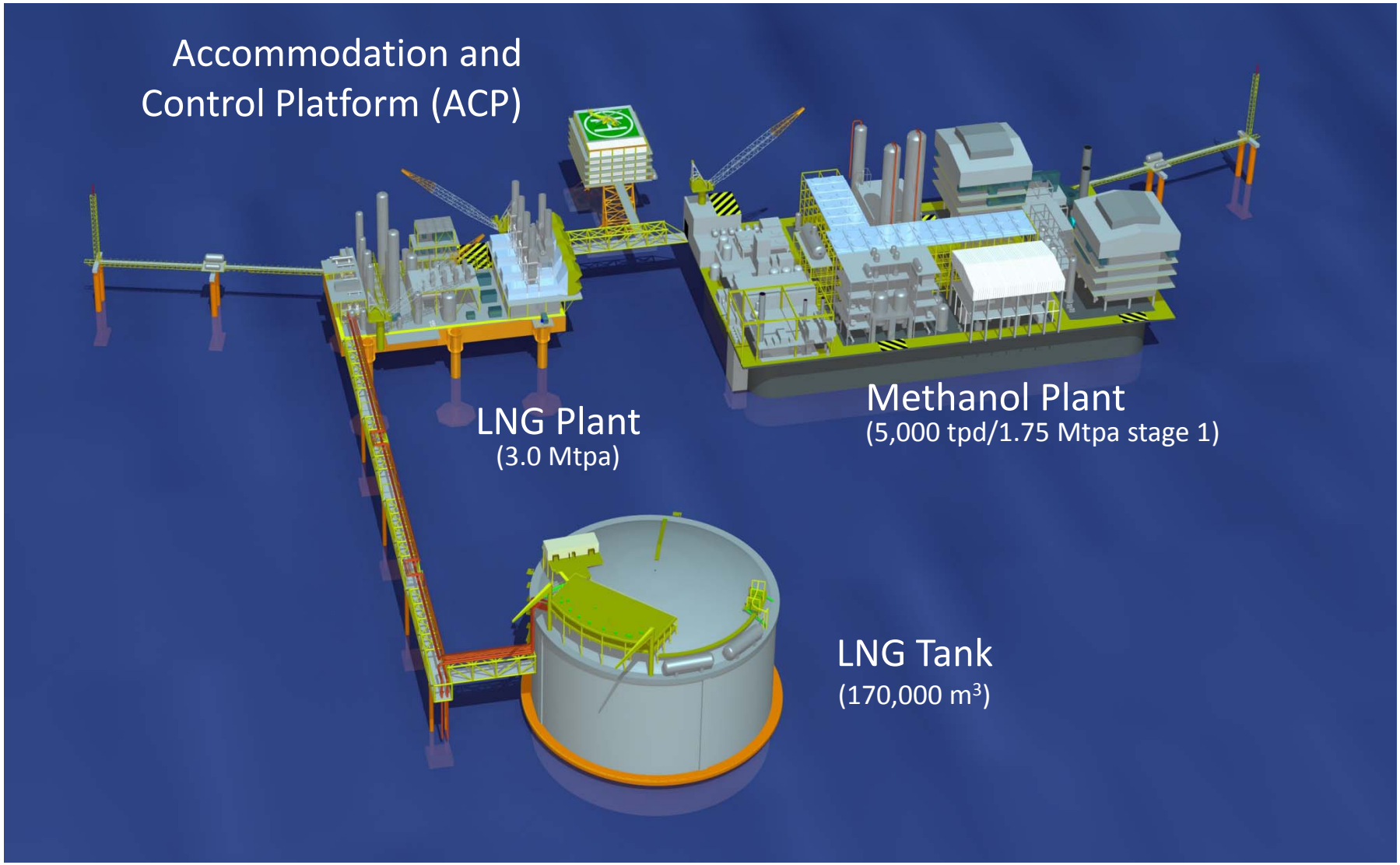
Timor Sea Projects

At Tassie Shoal



The Tassie Shoal Project

Stepping stones to FLNG

Recap:

- Uses liquefaction technology originally developed for FLNG
- Will prove FLNG technology in offshore environment
- Movement issues avoided
- Substantial cost savings
- Environmental approvals in place
- Complementary CO_2 sequestration plant generates additional revenue
- Storage, ACP and load-out can be shared with future developments
- Provides the nucleus for regional development

Won’t work everywhere – but it will work on Tassie Shoal