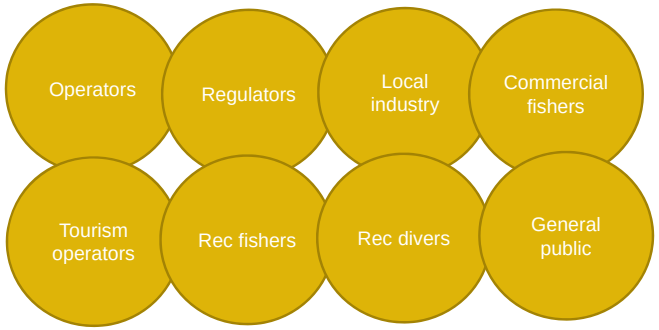
# End of life or afterlife?

## Is it more rational to leave offshore infrastructure in situ after decommissioning?

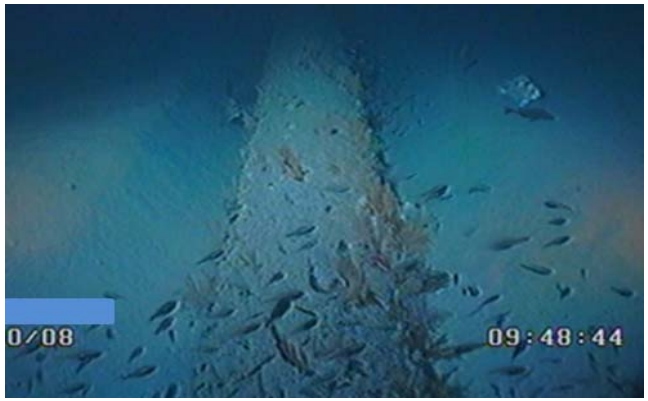
Susan Gourvenec
University of Western Australia
Oceans Institute, Centre for Offshore Foundation Systems, OFFshore Hub

Australasian Oil and Gas Conference 23rd February 2017

## Who cares?

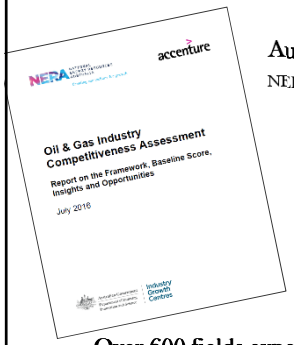



## Who cares?




**Leckie, White, Draper & Cheng** 2016, *ASCE J Pipeline Systems Engineering Practice*

## Why do we care?




Australia has a future liability USD $21bn over next 50 years

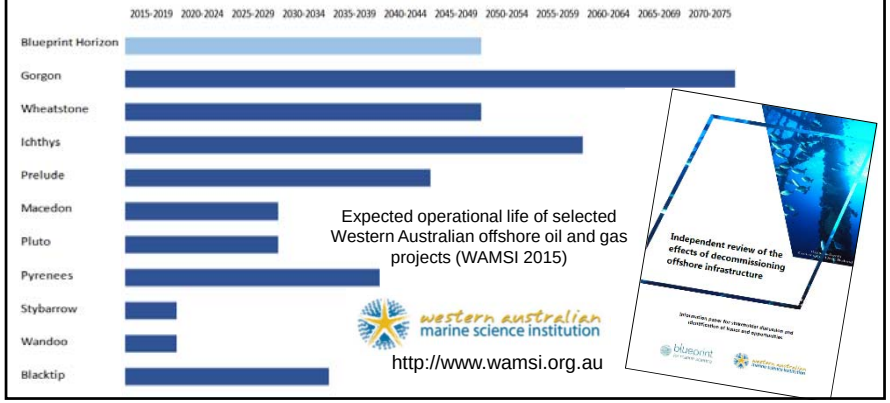
NERA, 2016

NERA *Oil and Gas Industry Competitive Assessment*
"Australia scored poorly in abandonment - below the world median and significantly below the world best, Norway"


Over 600 fields expected to cease production in the next 10 years across the Asia-Pacific

WOOD MACKENZIE, 2016

## Local landscape




Expected operational life of selected Western Australian offshore oil and gas projects (WAMSI 2015)

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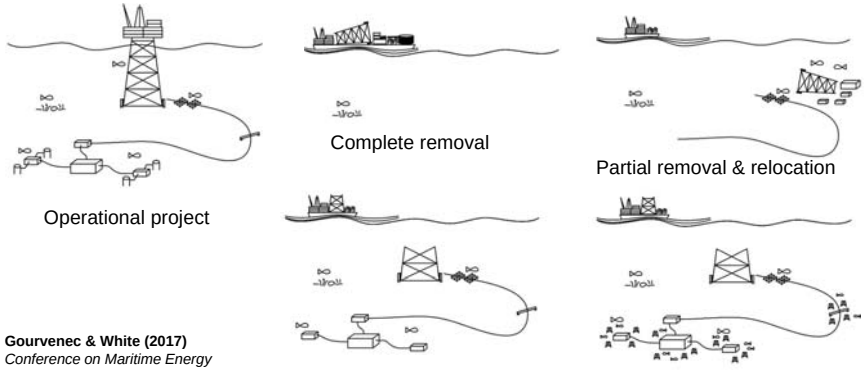
http://www.wamsi.org.au

## Options




**Gourvenec & White (2017)**
*Conference on Maritime Energy Decommissioning of Offshore Geotechnical Structures*

Is it more rational to leave offshore infrastructure in situ after decommissioning?

## Engineering

- A solution can be found to most engineering challenges with sufficient investment.

**Allseas**
**Pioneering Spirit**
www.allseas.com

## Engineering

- A solution can be found to most engineering challenges with sufficient investment.
- *But just because we can - should we?*

- Challenges, risks & costs of removal (even for relocation).
- Challenges, risks & costs of disposal onshore, landfill or recycling.
- Destruction/disruption of established ecosystem around infrastructure.

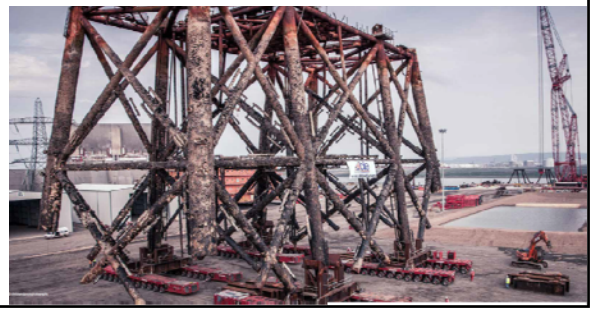


Image from: Decommissioning in the North Sea, Arup

## Engineering

Asgard subsea compression unit
75 m x 45 m
5000t

www.statoil.com
Photo: Elin A/Statoil

## Engineering

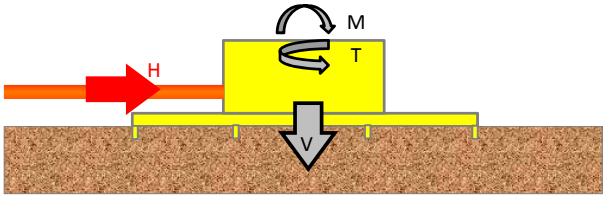
Gorgon project
Subsea mudmat
40 m × 32 m, ~ 1000t
(Epstein & Abelenet 2014, Subsea7)
mcedd.com/wp-content/uploads/Subsea%207%20-%20MCED%20REP%20presentation%20-%20%209%20April%202014%20-%20PvA.pdf

## Engineering

- If cost and risk of engineered removal are to be eliminated – the alternative must be demonstrated to be safe from an engineering and ecological perspective.

## Engineering

- BOD for the afterlife is different to that for the production life
- e.g. subsea structure
  - Less stringent tolerances on differential movements
  - No risk from loss of containment (once cleaned and flushed)
  - Avoid dispersal of structure in large or small parts




## Engineering

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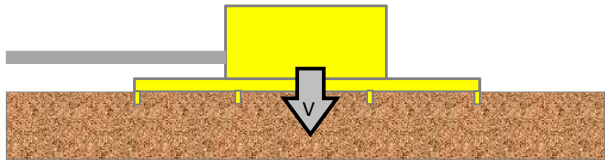
- Loading less onerous in afterlife – absence of operational loads




## Engineering

- BOD for the afterlife
  - Less stringent tolerance requirements on differential movements
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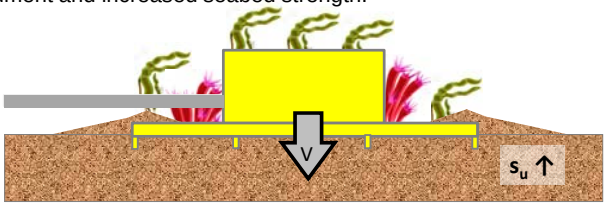
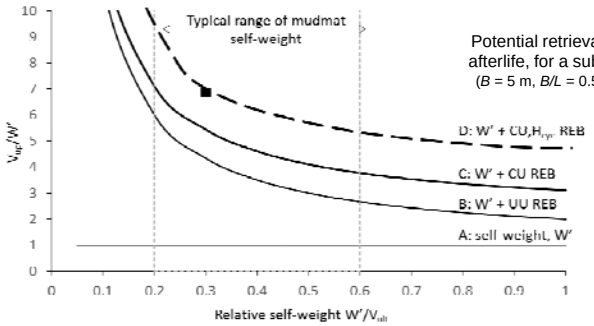
  - Avoid dispersal of structure in large or small parts
- Loading less onerous in afterlife – absence of operational loads
- Resistance may increase relative to design state due to marine growth, burial/ embedment and increased seabed strength.




## Engineering

- Viewed through lens of removal - increased resistance increases the challenge
- Viewed through lens of in situ decommissioning - increased resistance is beneficial.

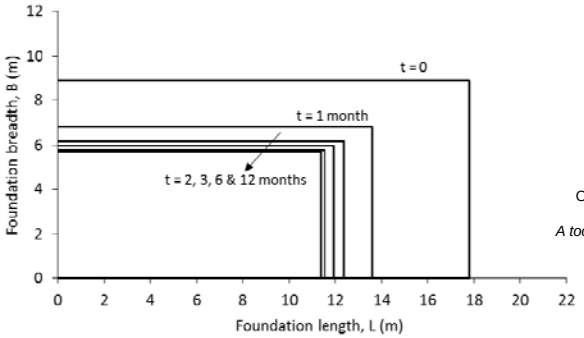



Potential retrieval resistance, or stability for the afterlife, for a subsea mudmat at end of field life ($B$ = 5 m, $B/L$ = 0.5 and $d/B$ = 0.2, $s_u$ (kPa) = 1+ 1.5$z$)

**Gourvenec & White (2017)**
Conference on Maritime Energy, Decommissioning of Offshore Geotechnical Structures
*In situ decommissioning of subsea structures*

## Engineering

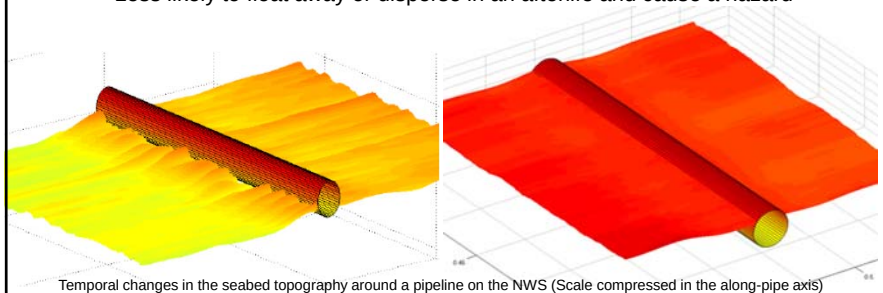
- Same research informs different decommissioning options




**Gourvenec et al. (2017)**
Offshore Technology Conference, Houston
*A toolbox for optimizing geotechnical design of subsea foundations*

## Engineering

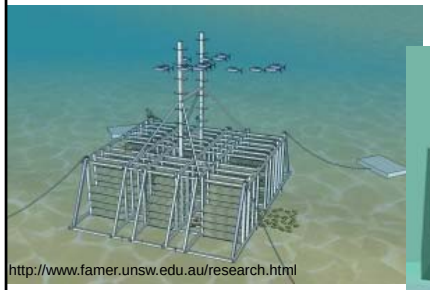
- Pipe self-burial
  - Harder to retrieve from seabed
  - Less likely to float away or disperse in an afterlife and cause a hazard



Temporal changes in the seabed topography around a pipeline on the NWS (Scale compressed in the along-pipe axis) (Leckie et al., 2015a)

## Engineering

- Augmentation – artificial reef modules



http://www.famer.unsw.edu.au/research.html

courtesy of Subcon Pty Ltd

## Marine science

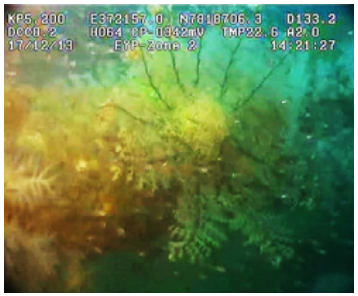
Is it more rational to leave offshore infrastructure in situ after decommissioning?

## Marine science


Dr Diane McLean,
Oceans Institute, UWA

## Marine science

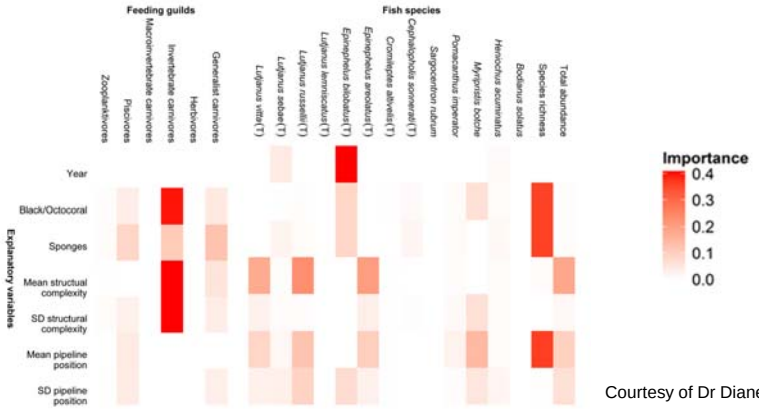
- Fish diversity and abundance on pipelines;
- Variability in fish assemblages on pipelines;
- Pipeline habitats;
- How are fish utilising pipelines; and
- Whether pipelines attract or enhance fish stocks.
- Create scientific data to assist in assessing the value of pipelines to fish and fisheries on the north-west shelf.




Courtesy of Dr Diane McLean

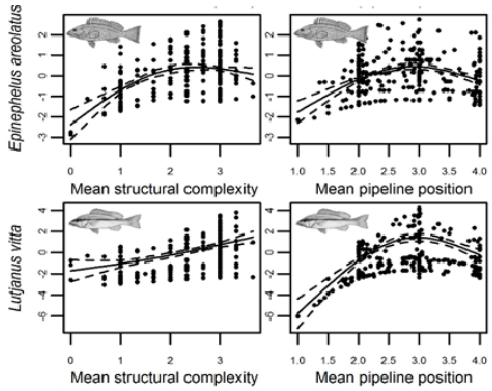
➢ Implications for what to do with the pipelines after decommissioning

## Marine science




Courtesy of Dr Diane McLean

## Marine science




Courtesy of Dr Diane McLean

## Marine science

- Demonstrated benefits of offshore oil and gas infrastructure as part of the marine ecosystem.
- Can it do more harm than good removing infrastructure?
- What are the risks associated with leaving the infrastructure in situ?

Known benefits — Unknown risks

Short term — Long term

➢ Evidence base required to maximize benefits and minimize negative impacts.

## Society

Is it more rational to leave offshore infrastructure in situ after decommissioning?

## Society

- Who might be affected by decision about what to do with offshore infrastructure at the end of production life?
- What are the concerns?
- Can they be addressed?

- A review of stakeholder issues and concerns about decommissioning of offshore oil and gas facilities in WA has been undertaken as part of the WAMSI Blueprint for Marine Science.
  - More than 100 individuals and organizations consulted.
  - Fishers, tourism operators, consultants, oil and gas operators, State and Commonwealth regulators, management agencies.

*Operators consider gains from better policy to be important; other stakeholders and community will not support shift in policy without evidence, and the current state of relevant evidence is vastly insufficient.*

western australian marine science institution

blueprint for marine science

## Society

- Learning from other sectors
  - ➢ Interactions between user groups and policy makers
    - ➢ Coastal communities
  - ➢ Marine archeology
    - ➢ Experience of things left of the seafloor for a long time
    - ➢ Insight into human interaction with oceans

Could offshore oil and gas infrastructure decommissioned in situ form part of our industrial heritage in the future?

A/Professor Julian Clifton
School of Agriculture and Environment, and Oceans Institute, UWA

Professor Alistair Paterson
School of Archaeology and Oceans Institute, UWA

## Economics

Is it more rational to leave offshore infrastructure in situ after decommissioning?

## Economics

- How much does each decommissioning option cost?
- Cost who?
  - operator
  - tax-payer
  - local industry
  - general public
  - environment
- Financial and non-financial consequences need to be assessed
- Multi-variate life-cycle modelling
- What are the opportunities in decommissioning?
  - What is the value of the industry – domestically and to export expertise?
  - What is the effect of decommissioning policy and capability on future investment?

## Economics

- Learning from other sectors
  - e.g. Mine site reclamation

What are the costs and benefits to the nation of offshore decommissioning?

A/Professor Ben White
School of Agriculture and Environment, UWA

A/Professor Michael Burton
School of Agriculture and Environment, UWA

## Law, policy and governance

Is it more rational to leave offshore infrastructure in situ after decommissioning?

## Law, policy and governance

- Geneva convention on the Continental Shelf (1958) requires complete removal of disused marine infrastructure.
- United Nations Convention on the Law of the Sea states that decisions should take into account *generally accepted international standards established … by the competent international organization*.
- International Maritime Organisation (1989) allows structures to be left in place on a case-by-case basis and refers to *new use or other reasonable justification* for in situ disposal.
- Due consideration must have been given to
  - safety of navigation
  - rate of deterioration
  - risk of structural movement
  - environmental effects
  - costs
  - technical feasibility and
  - risks of injury associated with removal.

## Law, policy and governance

- Who owns liability if oil and gas infrastructure is left in situ?
- Work being done in this area …

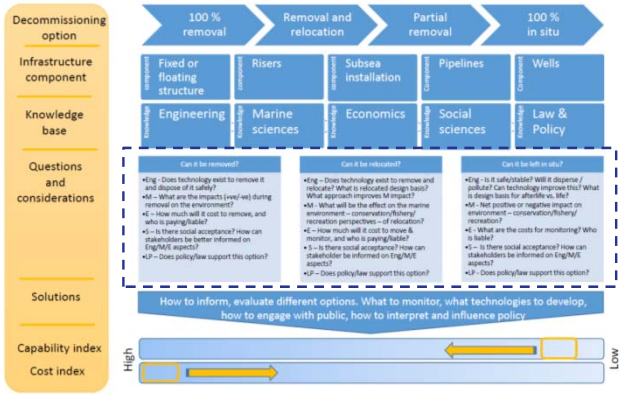
Prof. Erika Techera, UWA
Lawyer & Director of
Oceans Institute

Prof. John Chandler
Co-Director of Centre for
Mining, Energy and Natural
Resources Law, UWA

## Back to the question …

Is it more rational to leave offshore infrastructure in situ after decommissioning?

## Decision framework



## Decision framework

**Can it be removed?**

- Eng - Does technology exist to and dispose of it safely?
- M – What are the impacts (+ve removal on the environment?
- E – How much will it cost to re who is paying/liable?
- S – Is there social acceptance? stakeholders be better informe Eng/M/E aspects?
- LP – Does policy/law support t

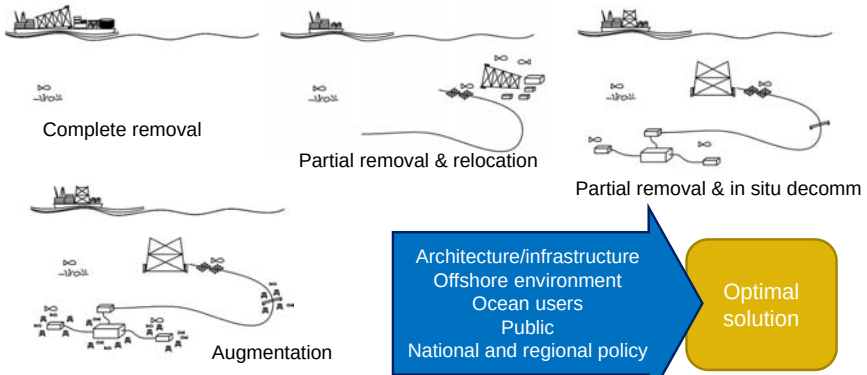
**Can it be relocated?**

- Eng – Does technology exist to relocate? What is relocated de What approach improves M in
- M - What will be the effect on environment – conservation/fi recreation perspectives – of re
- E – How much will it cost to m monitor, and who is paying/lia
- S – Is there social acceptance? stakeholder be informed on Er aspects?
- LP – Does policy/law support t

**Can it be left in situ?**

- Eng - Is it safe/stable? Will it disperse / pollute? Can technology improve this? What is design basis for afterlife vs. life?
- M - Net positive or negative impact on environment – conservation/fishery/ recreation?
- E - What are the costs for monitoring? Who is liable?
- S – Is there social acceptance? How can stakeholders be informed on Eng/M/E aspects?
- LP - Does policy/law support this option?

## The answer?



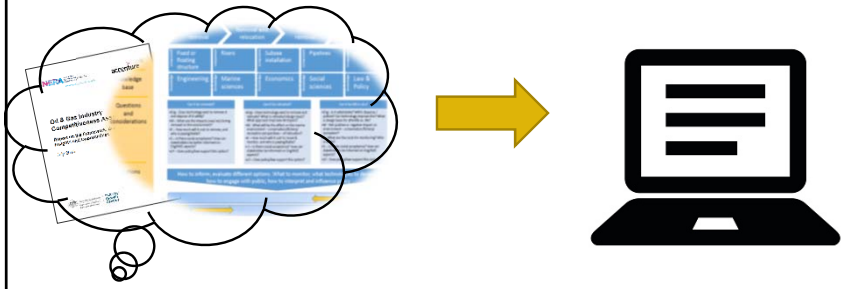

## Moving forward

Forum theme *How the Australian subsea industry can adjust to the evolving market*


- Ensure robust and effective regulations that support the industry;
- Collaborate and invest in industry-led research – develop next generation of equipment and technology;
- Collaborate with other countries – learn from best practice;
- Innovate solutions to reduce risk, time and cost of decommissioning;
- Grow local workforce capability.

*The opportunity and business rational is clear for Australia to invest and build the relevant capability before the wave of decommissioning activities commences.*

## Moving forward



Create the scientific evidence base, develop technology and develop and deliver a decision tool across all stakeholders and relevant disciplines.

## Moving forward

- Call to action!
- What are your challenges facing the upcoming wave of offshore decommissioning?
- What are your ideas & products to contribute towards making Australia more competitive in offshore decommissioning?


Get in touch!

## Acknowledgements

- UWA Oceans Institute
- Centre for Offshore Foundation Systems
- OFFshore Hub

- NERA
- WAMSI

- Australian Research Council

- Australian Oil and Gas Exhibition and Conference
- Society for Underwater Technology, Subsea Energy Australia and Subsea UK

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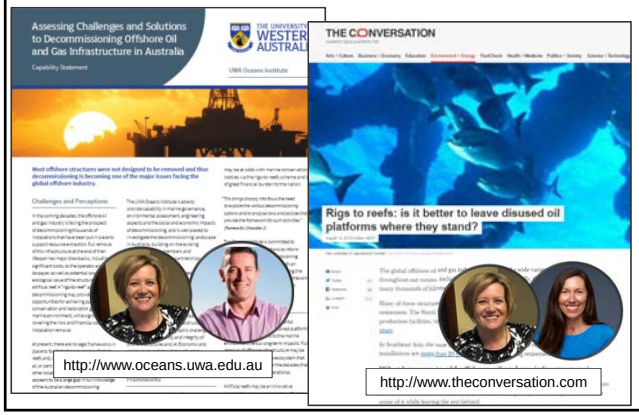
**Australasian Oil and Gas Conference** **23rd February 2017**

## Further info




appea
Conference & Exhibition
Perth, 14-17 May 2017

Bernadette Cullinane,
Partner and National Oil and Gas Leader
Deloitte Australia

**"Decommissioning – the next Australian oil and gas boom?**

blueprint for marine science