

Economic and Policy Considerations for the Commercial Development of New Zealand's Hydrate Resources

J M (Mac) Beggs
George Hooper
Kevin Chong

Background

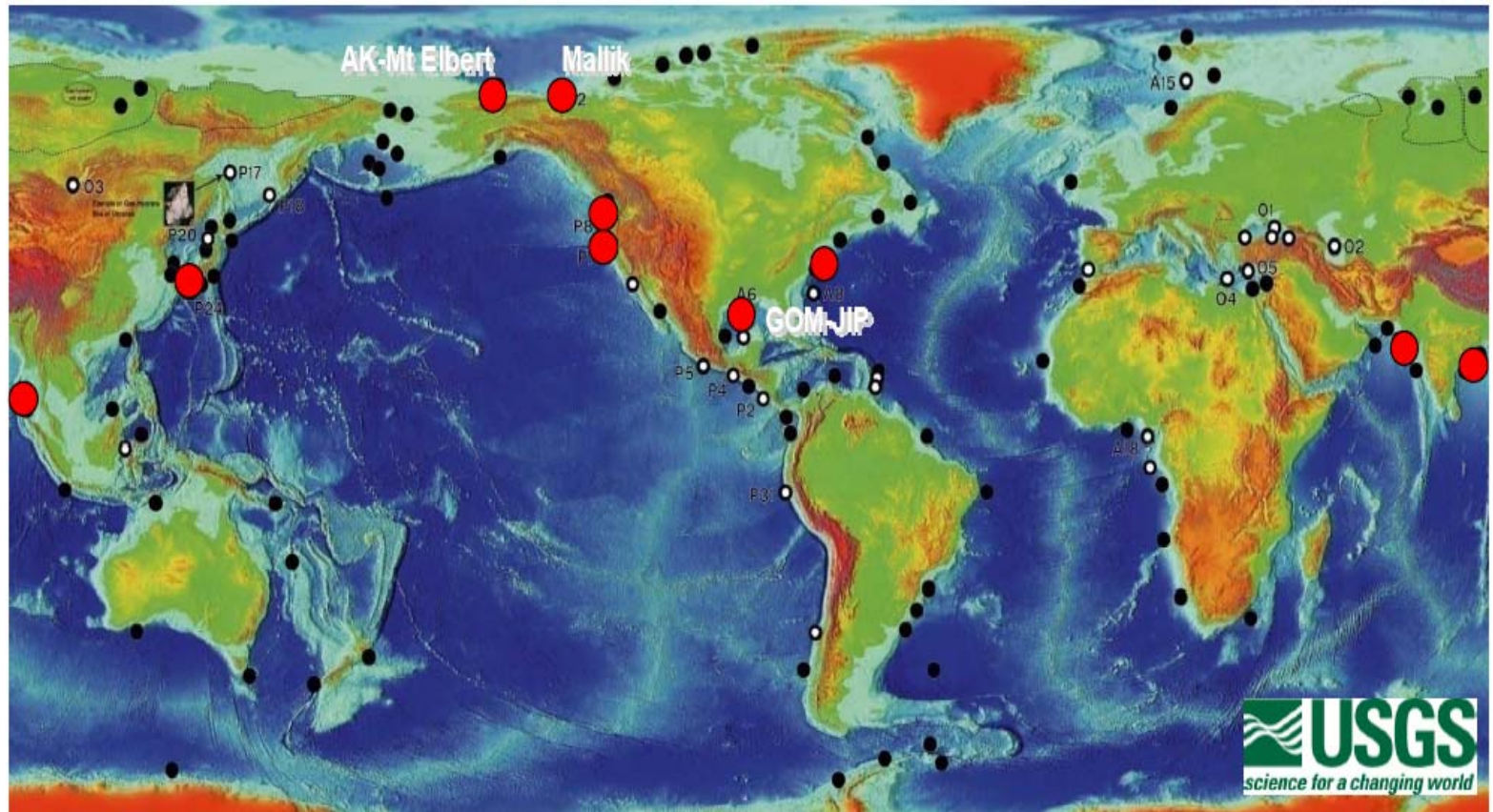
- Centre for Advanced Engineering has maintained a programme on Ocean Resources since 1996
 - Objective is to help enable the realisation of opportunities for sustainable economic development associated with the oceans around New Zealand
- Studies for Ministry for the Environment, 2003 and 2006
- Collaboration with GNS Science in relation to sea bed resources, especially gas hydrate

Hydrates Research in New Zealand

- GNS Science programme since 1996 in collaboration with
 - NIWA
 - NZ universities (Otago, Auckland)
 - Overseas agencies and universities
 - German, US, UK, Australia, France
- Sound geophysical basis for volumetric assessment
- Next step needs to approach development
- CEANZ input to outline a “Roadmap”

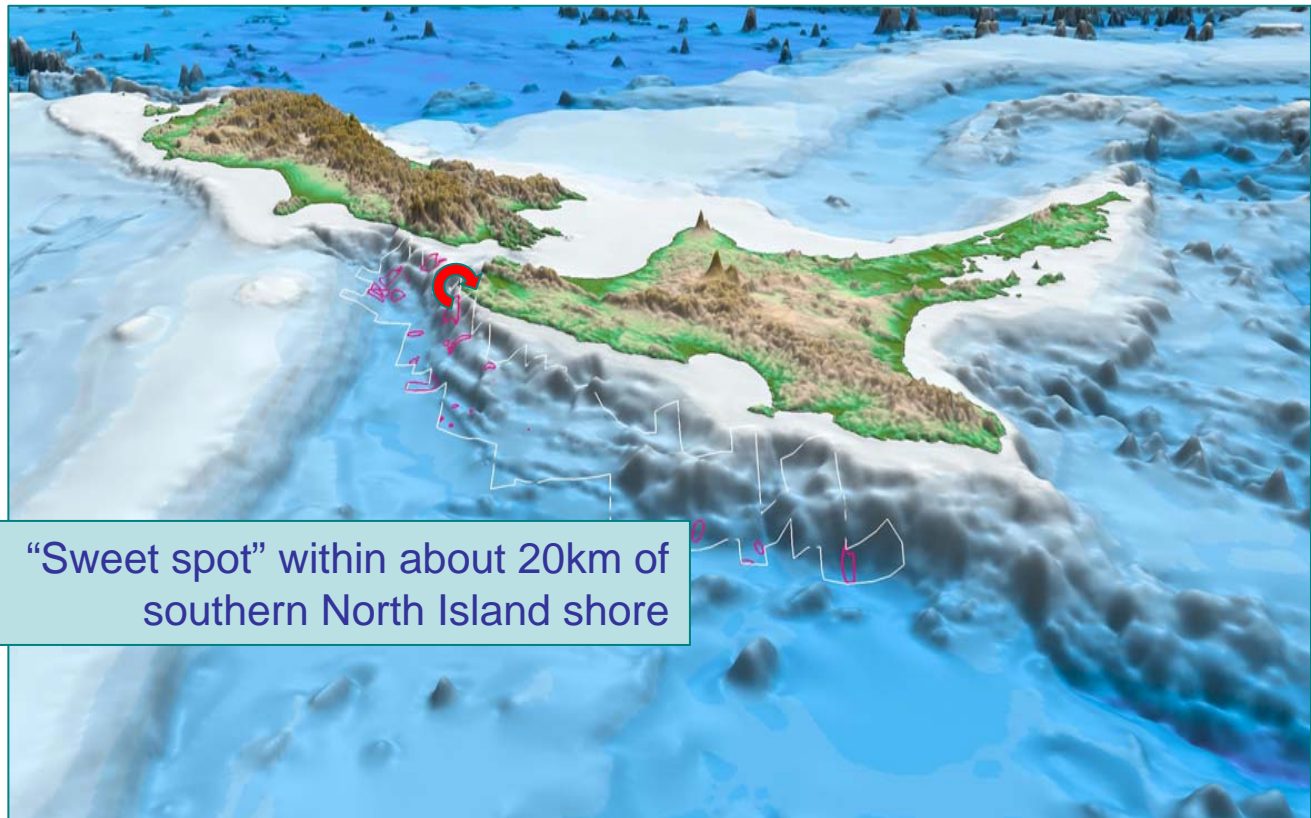
Roadmap

- Next stage of research 2010-2014
 - Should be directed at a basis for an investment decision on a specific development project
 - Characterise the resource
 - Environmental Impact Assessment
 - Technology Selection
- FEED 2014-2016
- Construction 2016-2019
- Commissioning 2020

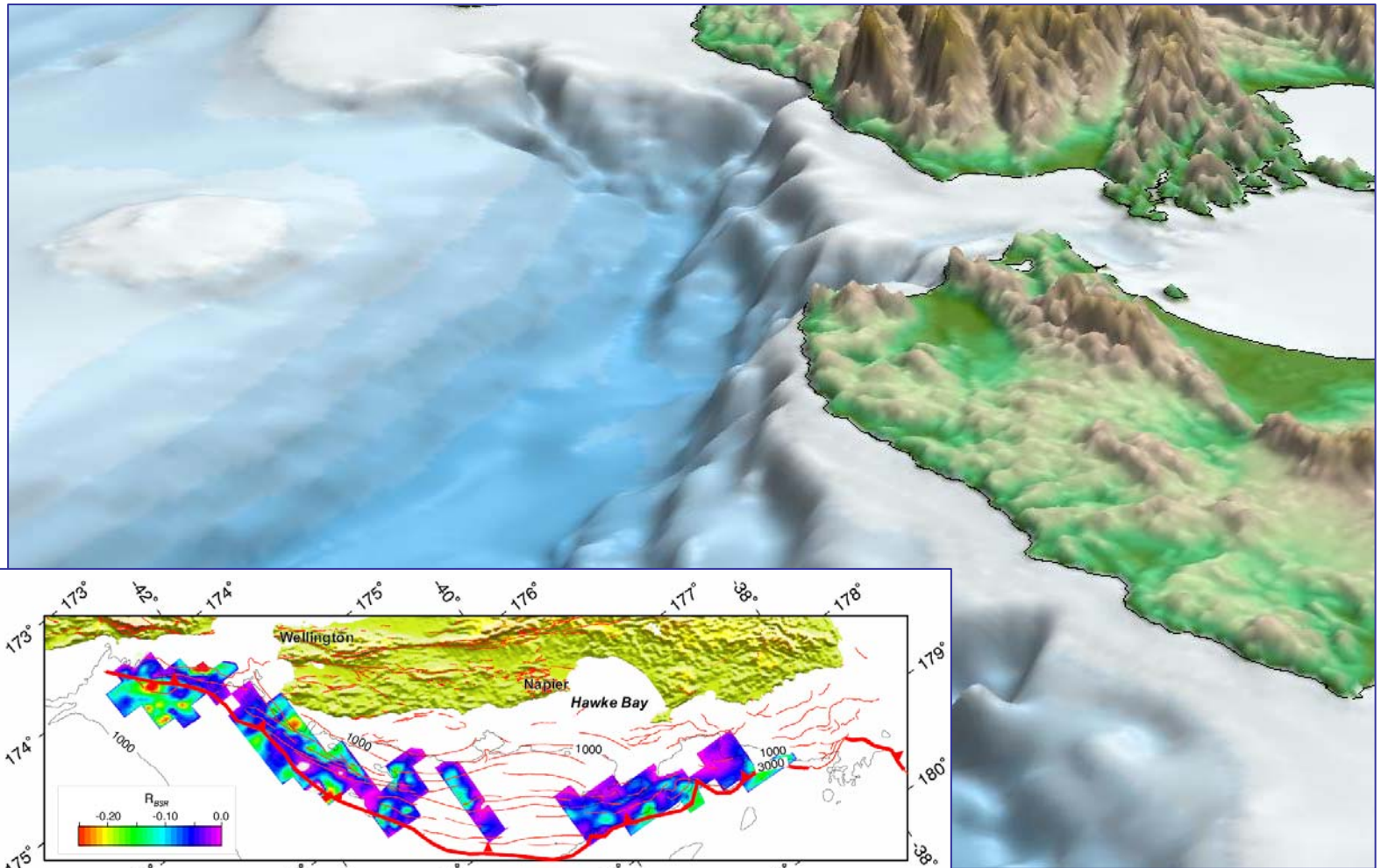


From Hancock, 2008

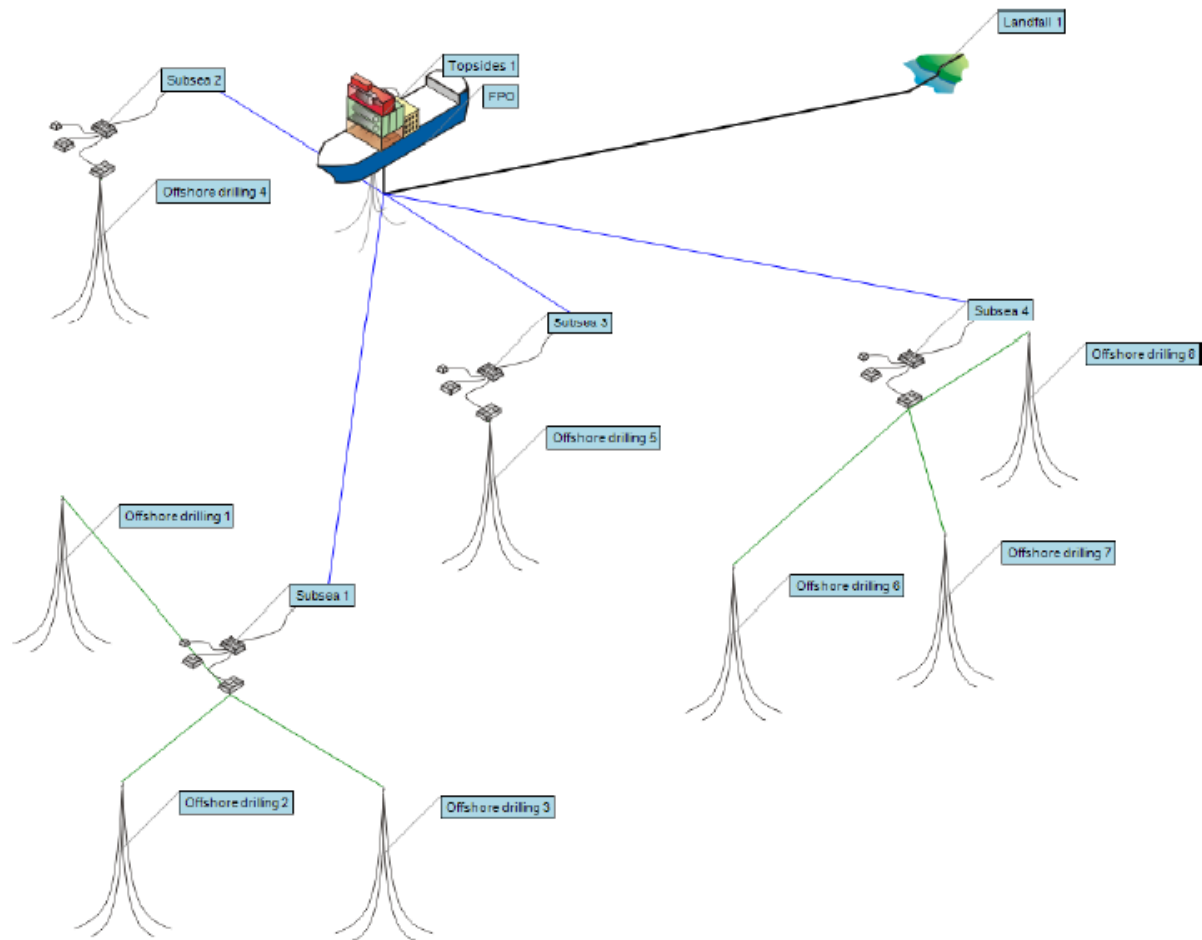
Notional location of a hydrate development off New Zealand



“Sweet spot” within about 20km of southern North Island shore



Gas Hydrate Field Development Plan

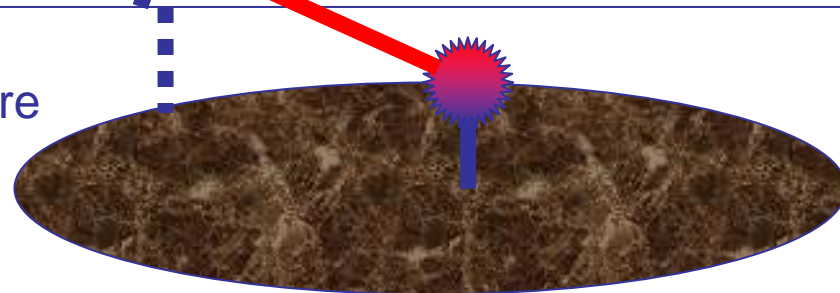


Dissociation: in situ, or transport as “ore”?



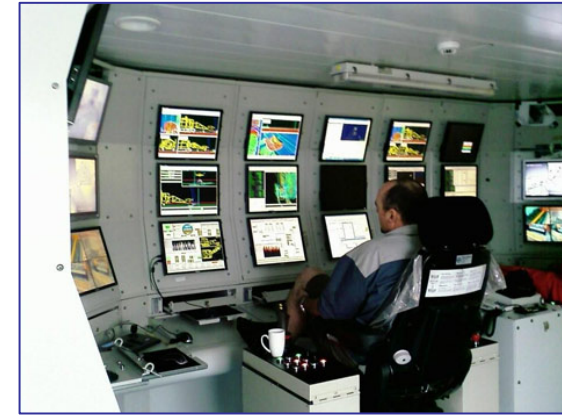
Scenario 1: in situ dissociation; transmission of gas to shore conversion facilities

Scenario 2: transport of hydrate in solid phase; dissociation to gas at shore conversion facilities



Sub-sea crawler and control room

<http://www.mining-technology.com/contractors/dredge/marine-mineral/>



The crawlers weigh 250t and comprise 110t of heavy wall pipe and steel construction and 140t of equipment and machinery.

The pump on the crawler sucks materials from the seabed and draws them to the water's surface. The riser pipe (through which the mined material travels) is 650mm in internal diameter and can handle spheres of up to 300mm. The material's journey from seabed to surface takes just 25 seconds.

Back-of-Envelope Economics

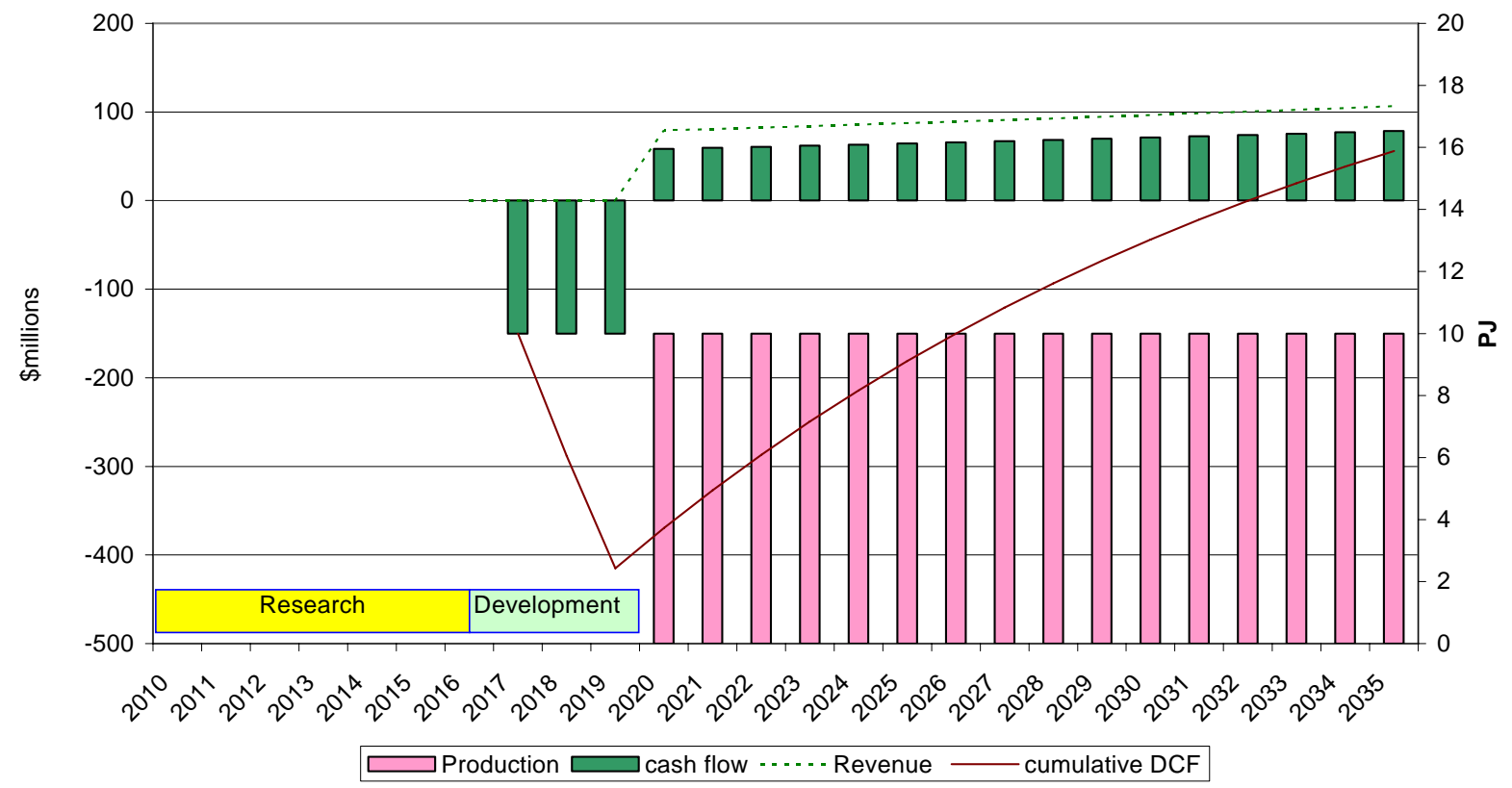
180 m³ (6,360 cu ft, 6.5 GJ) gas per m³ solid hydrate

- Scale A: 10PJ/year of feedstock for thermal power (about 200 MW) and/or petrochemicals would require dissociation of 1.5 million tonnes of hydrate
- Scale B: 200PJ/year (Maui plateau) would require dissociation of 30 million tonnes of hydrate
 - Annual extraction of aggregate from UK waters is about 22 million tonnes
- @\$5/GJ to the miner:
 - Scale A gross annual revenue of \$50 million, Crown royalty of \$2.5 million
 - Scale B gross annual revenue of \$1 billion, Crown royalty of \$50 million
- What opex and capex can be supported?

Scale A: deriving 10PJ CH₄/year

- Dissociate 1.5 million tonnes of pure hydrate
 - 15 million tonnes of 10% grade host sediment
 - @ density of 2.0, = 7.5 m³
- 25m “open-cast mine”
 - Area = 0.3km²/year
- Assume capital cost of \$450 million
- Operating costs \$20 million/year
 - *these are pure guesses*

Scale A: 10PJ/year



Summary of Economic Model

- A revenue stream that corresponds to a suitable scale for the New Zealand energy market appears sufficient to justify major capital investment in development, subject to technology
- Can appropriate technology be “discovered”?
- How should the research into that question be incentivised?

Link to future development right?

Allocation of Development Rights

- Gas hydrate falls within the definition of petroleum in the Crown Minerals Act 1991
- Implicitly, subject to Minerals Programme for Petroleum (2005), which sets out allocation principles and policies
- Government has had to deal with two other “emerging resource classes” in recent years – what lessons?

Crown Minerals Act 1991

Petroleum means—

- (a) Any naturally occurring hydrocarbon (other than coal) whether in a gaseous, liquid, or solid state; or
- (b) Any naturally occurring mixture of hydrocarbons (other than coal) whether in a gaseous, liquid, or solid state; or
- (c) Any naturally occurring mixture of one or more hydrocarbons (other than coal) whether in a gaseous, liquid, or solid state, and one or more of the following, namely hydrogen sulphide, nitrogen, helium, or carbon dioxide—

and, except in sections 10 and 11, includes any petroleum as so defined which has been mined or otherwise recovered from its natural condition, or which has been so mined or otherwise recovered but which has been returned to a natural reservoir for storage purposes in the same or an adjacent area

Emerging classes of Crown Minerals resources: Recent cases

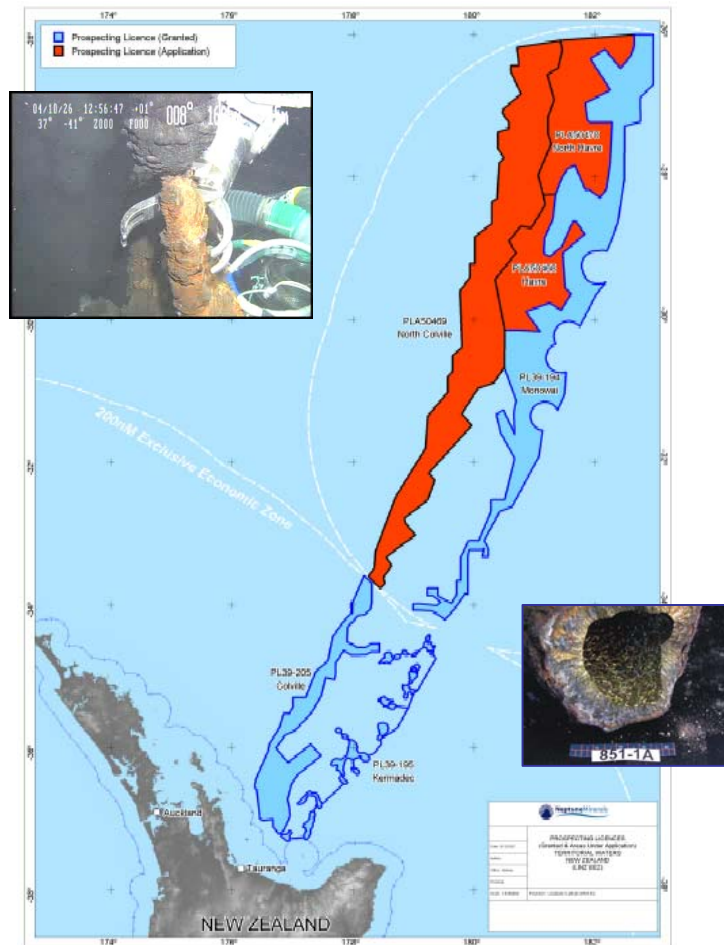
Hydrothermal vent minerals

- Neptune applied for permit over the whole resource area, 1999
- Granted 2002
- Platform for company growth
- Investigations continuing

Coal seam gas

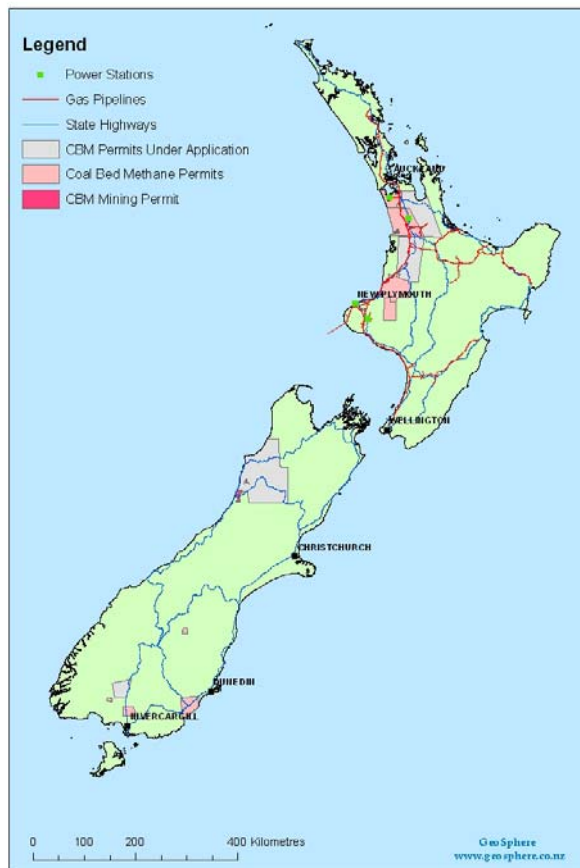
- Several exploration ventures since breakthroughs in eg Queensland
- Diverse strategies
- 1st mining permit granted 2007 but no production to date

Hydrothermal polymetallic sulphides



- Potential demonstrated by CRI research, 1990's
- Application for 1st prospecting permit 1999 by Neptune Minerals (Australian new venture)
- Granted 2002
- Neptune listed (London) 2005, with backing from Newmont, is establishing global leadership in this class of resource
- Market capitalisation about £20 million

Coal seam gas in New Zealand



- Virtually no public-good research
- Commercial interest blossomed due to new paradigms and expansion of development overseas
- Several separate ventures have pursued diverse strategies in different parts of New Zealand
- 1st mining permit granted in 2007

Proposed strategy for gas hydrate

- Controlled allocation process
- Exclude hydrate from conventional petroleum permits (“strata title”)
- Blocks offer concurrent with next research milestone (2014/15)
- Encourage registration of company interest during the research stage
 - Consortium?
 - Subscription as prerequisite for subsequent permit?

Environmental policy aspects

- Subject to proposed new effects-based regulatory regime
- What effect of proposed Marine Protected Areas?

